“Where will our knowledge take you?”

Integrated Climate Change Risk and Adaptation Assessment to Inform Settlement Planning in Choiseul Bay, Solomon Islands

Final Report June, 2014

Integrated Climate Change Risk and Adaptation Assessment to Inform Settlement Planning in Choiseul Bay, Solomon Islands

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Synopsis: **This Risk and Adaptation Assessment has been carried out to provide the Choiseul Provincial Government (CPG) with direct guidance on how to proceed with proposed future development, as well as management of existing development on Taro Island, in order to address natural hazards both now and in the future (i.e. including climate change, and especially sea level rise). The outcome of the assessment is an Adaptation Action Plan and Masterplan for future development on the mainland, including a draft local planning scheme detailing planning provisions and development controls / codes.**

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Executive Summary

There are a number of major natural coastal hazards that prevail in and around Choiseul Bay, in particular Taro Island and the mainland lots 9 and 277, including tsunami, severe coastal storm and shoreline erosion.

Present day hazard and future horizon hazards in 2030, 2055 and 2090 have been considered and quantified. Projections of the future climate are based upon IPCC AR5 (2013) with reference to regional advice where available. The assessment for each of the identified major natural hazards is summarised in Table 6-10 of this report. Consideration has also been given to the joint occurrence of natural hazard (for example a flood event coinciding with a storm surge event).

The hazard assessment indicates that the greatest existing hazard to local populations, especially those located on the low lying fringing islands (Taro and Supizae), is tsunami. All infrastructure, housing and services on Taro Island and Supizae Island are at risk of tsunami. Future conditions, with mean sea level rise, will increase the likelihood of this hazard occurring.

Typically accepted design and planning of infrastructure adopts the 1 in 100 year average recurrent interval (ARI) condition as the level of service. This is an extreme event that is likely to be experienced only once in a lifetime, on average. Inundation level for a 1 in 100 year ARI tsunami event at 2090 on the Taro Island is approximately 3.9m MSL and on the mainland is approximately 3.7m MSL.

For future climate conditions, shoreline retreat is a significant hazard. Considering future mean sea level rise and projections of associated shoreline retreat, coastlines of the inhabited islands of Taro and Supizae may retreat by up to 40m by 2090. Taro Island is around 500m in width; this represents a 15% reduction in island width and a 30% reduction in land area. Similar rates of mangrove habitat retreat are predicted on the mainland site.

Community values associated with land, assets and infrastructure, along with the services and facilities that they provide, were identified through community and stakeholder engagement. Risks to these values were established based on their exposure to major natural coastal hazards and their vulnerability to impact. A risk assessment process was undertaken wherein the likelihood and consequence of risks were evaluated to give overall levels of risk, from low to extreme. Intolerable risks are considered to be those rated as extreme in any timeframe, as well as those rated as high for present day and 2030. The key assets associated with these intolerable risks include:

CPG headquarters	Market	Wharf	Mid island fuel depot
telecommunications	Retail shops	Western edge of Taro Is	Residences
Hospital	Bank & Post office	Medical incinerator	Guesthouses
Airstrip	Fisheries building	Septics	Water supply
Powerhouse	Light industrial area	Mangrove ecosystem	Road

A number of these high risks become extreme with time as the likelihood of occurrence increases.

A wide selection of options for mitigating the intolerable risks have been considered. These options have been generated from a “toolkit” of options derived from various Australian and international coastal management sources, as well as suggestions sourced through community and stakeholder engagement.

Assessment of the options included consideration of costs, community acceptance, reversibility, longevity, viability and effectiveness.

Tsunami remains the major hazard affecting Choiseul Bay, and risks associated with tsunami increase with future sea level rise. As well as a specific emergency and evacuation response plan, options have targeted management of existing assets and infrastructure (notably the high risk assets as noted above), as well as future development, both on the mainland and on the islands (Taro and Supizae). 'No regrets' options of shoreline revegetation and monitoring have also been recommended.

A formal Adaptation Action Plan has been prepared and comprises five (5) components:

(1) Emergency response plan to address the threat and possible need for evacuation due to tsunamis or severe coastal storms that potentially inundate Taro Island and Supizae Island;

(2) Asset and infrastructure management to minimise risk and damage or disruption to the community (covering both existing and future assets);

(3) Future development planning controls, to minimise the risks associated with future assets and infrastructure;

(4) Shoreline revegetation, to restore natural environments and to reduce the impacts of wave and surge inundation; and

(5) Monitoring to ensure effective decision making in the future.

The purpose of the Adaptation Action Plan is largely to manage climate change and other coastal-related hazards and risks associated with existing development until such time that proposed new development on the mainland replaces existing assets and infrastructure on Taro Island and Supizae Island.

To help the CPG with future development in Choiseul Bay, a Masterplan has been prepared covering Lots 9 and 277. It is important that new development on the mainland avoids future climate change risks, and this has been a major consideration for the Masterplan of the proposed development. The Masterplan outlines approximate landuse zones and development layout for a new township that will assume the on-going role of the provincial capital. The layout for the Masterplan has involved extensive input from the community and stakeholders. It has also given consideration to land tenure constraints and the limitations associated with servicing the new town.

A new local planning scheme has been prepared (Appendix H of this report). Once this instrument is adopted and gazetted by the CPG, it is to be used as a framework for guiding and regulating development on the new mainland site as well as for continuing development on Taro Island and the northern part of Supizae Island that is under CPG ownership and control.

It is expected that the new development on the mainland will be largely underway within the next 20 years, subject to funding and property matters. Therefore, the Adaptation Action Plan primarily targets risks within the immediate to short-term. If progress towards new development on the mainland is delayed significantly, then actions within the Adaptation Action Plan should be reconsidered, and priorities adjusted as appropriate.

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1 Introduction

On behalf of the Australian Department of the Environment, a Climate Change Risk and Adaptation Plan for the future settlement of the Choiseul Township, Choiseul Province, Solomon Islands, has been prepared, with the grateful assistance of the Choiseul Provincial Government (CPG) and the Solomon Islands Government (SIG).

The overall Adaptation Plan seeks to:

- Acquire necessary data to establish a hazard and vulnerability assessment of Taro Island and the mainland, incorporating future climate change aspects, with an aim to informing and complementing the planning and development process and the timing and manner of future settlement and urban growth of the provincial capital;
- Provide specific adaptation measures that contribute to the overall process of future settlement; and
- Prepare an Action Plan that combines climate change vulnerability with natural resource management techniques into a program of future works that can be used to guide future investment and planning for settlement and associated development. A key aspect is to identify and categorise risks so that informed decisions can be made on when those risks become unacceptable and to plan an appropriate and timely strategic responses.

2. Description of the Site

2 Description of the Site

2.1 Solomon Islands and Region

The Solomon Islands is a sovereign state in Oceania, consisting of a double chain of six large islands that make up to 997 islands (see Figure 2-1). It covers a land mass of 29,000 km^2. The capital, Honiara, is located on the island of Guadalcanal.

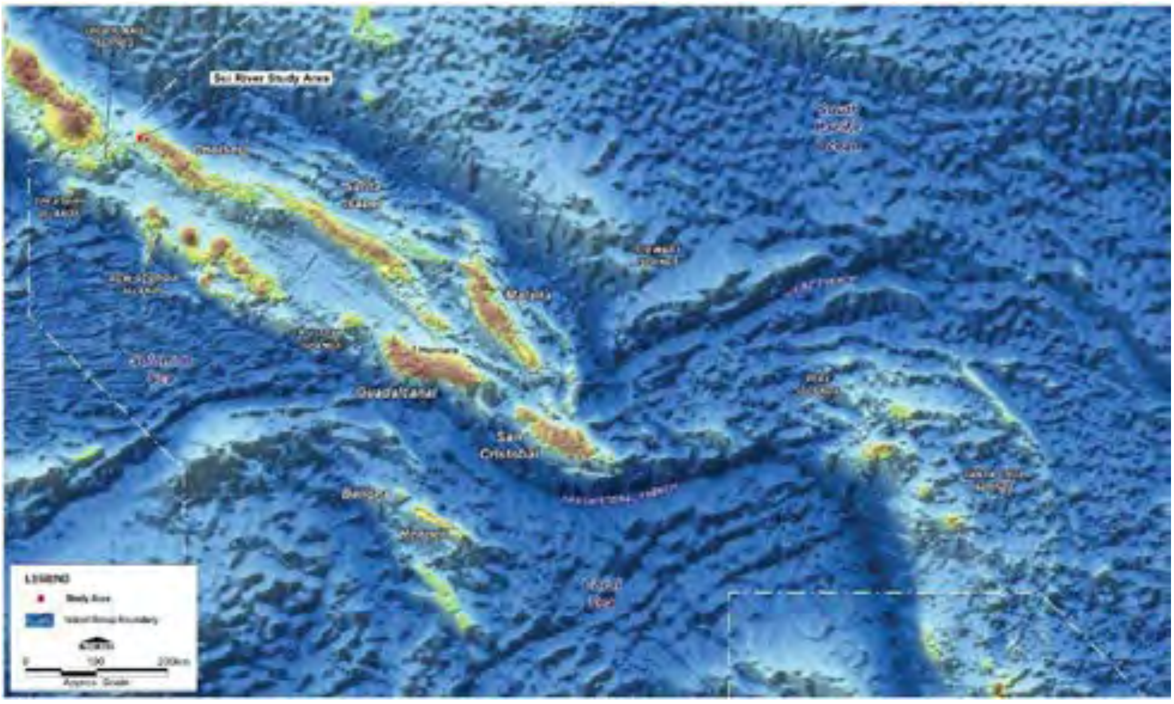


Figure 2-1 Solomon Islands locality

2.2 Choiseul Island

Choiseul Island (and Province) is situated in the north-west of the Solomon Islands. Taro Island and the proposed new settlement site are located at the north-western tip of Choiseul Island.

The 2009 census (described in Choiseul Province Medium Term Development Plan (MTDP) 2012 – 2014) records the population of Choiseul Province as 26,372, up from 20,008 people in 1999. This represents an increase of 2.8% per annum and is the second highest provincial population growth rate behind Guadalcanal Province.

There are 27 major rural communities in Choiseul Province (Figure 2-3). The main cultural groups are indigenous Melanesians, thought to have settled in the area 3,000 years ago, and Micronesians, relocated to Vaghena from current day Kiribati by the colonial government in the early 1960s. Eight languages and dialects are used in Choiseul with the most common language being Babatana. Pidgin and English are typically used in formal settings.

Figure 2-2 Satellite image of Choiseul Island showing area of interest

Figure 2-3 Choiseul Island Communities (Mataki, M. et al: 2013)

2.3 Taro Island and Mainland

Taro Island is a low lying coral atoll fringing the coastal lagoon of Choiseul Bay, at the northern tip of Choiseul Island. It is approximately 1.5 km from the mainland. Based upon recent topographic survey conducted for this study, the island is typically between 0.5 m and 2 m above the typical high tide elevation (an isolated area on the northern end is around 4 to 5 m above high tide level).

The township on the island is the Choiseul Provincial capital, and has a population of around 800-900 (2009 census data). Being the largest population centre in the province, surrounding communities trade and purchase provisions at Taro Island. It is also a key access location for transport, with the airstrip providing transport to the capital and other provinces. The hospital, while still relatively small, represents the most significant medical centre in the province.

The mainland settlement site consists of two identified lots on each side of the Mulambull River (also known as the Sui River):

(6) To the north, Lot 9 (43.2 ha) is a rocky headland at the northern extent of the river entrance. A road runs along a ridge extending inland from the coastline at an elevation of approximately 15m above Mean Sea Level (MSL). There are a number of existing developments on Lot 9, including a jetty, school, light industry and isolated residential homes. Water supply from an upstream reservoir is piped to the school.

(7) To the south, Lot 277 (488.9 ha) is significantly larger but includes an extensive mangrove fringe along the riverbank and foreshore, and other sections are low lying (swamp). An

abandoned logging road runs along a low-lying ridge line on the lot (the road has significant secondary growth).

Locations of these lots are shown in Figure 2-4. Beyond the existing developments on Lot 9, the elevated areas of the mainland site are secondary forest (unsuitable for any vehicles). Access from the river is restricted by the extensive mangrove fringes. Figure 2-4 to Figure 2-9 provide an overview of the island, the geographical location, the coastline and new settlement site.

Figure 2-4 Taro Island and new settlement sites on mainland (lots 9 and 277)

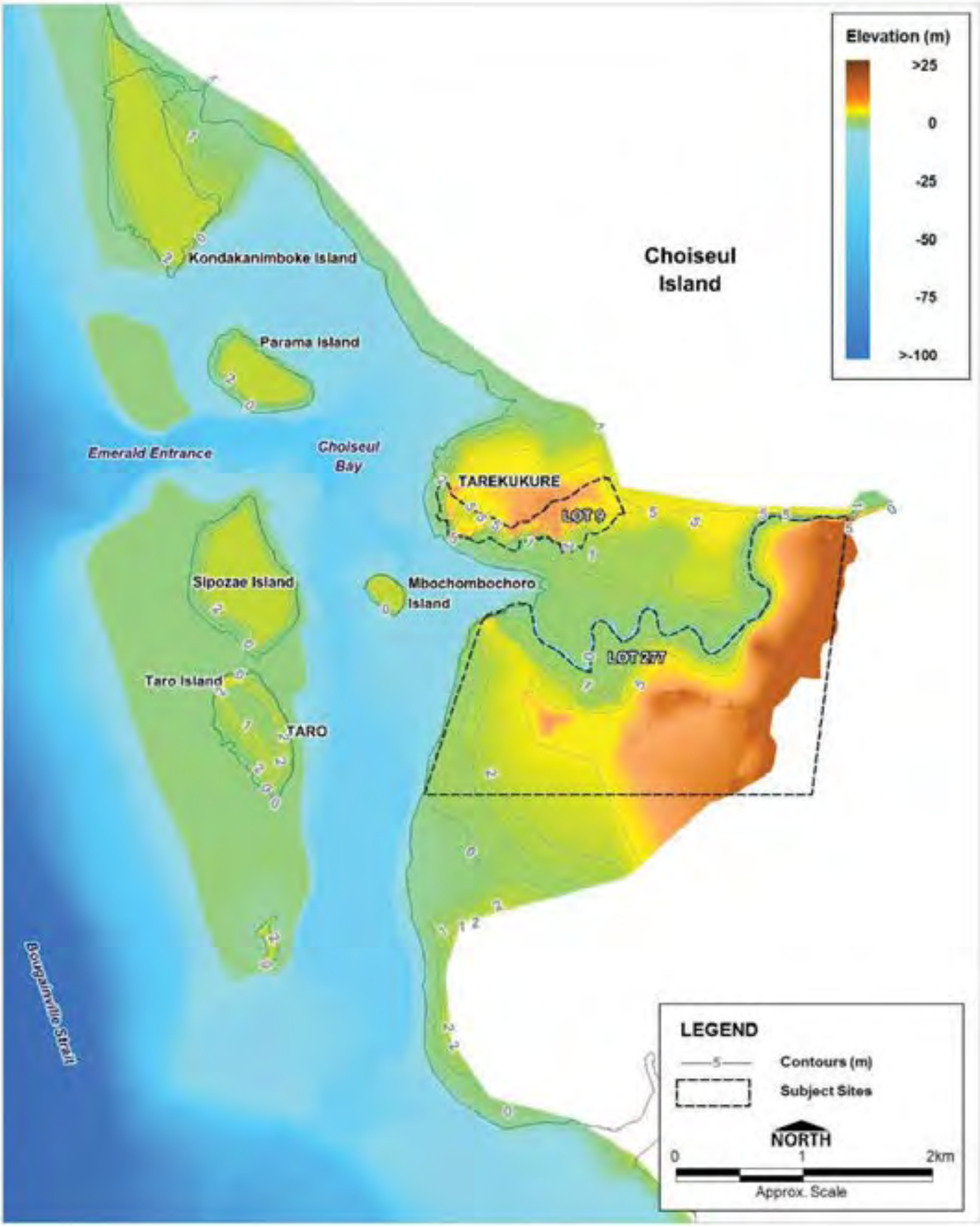


Figure 2-5 Terrain elevation and nearshore bathymetry

Figure 2-6 Image of Taro Island approaching from the air from the south. Source: Choiseul Bay Development Project. Economic and Financial Study report 2011. Date of photograph unknown

Figure 2-7 Sand bag wall preventing erosion on eastern side of Taro Island. Taro hospital is blue building in the background. Tide condition estimated to be mid-tide

Figure 2-8 Coral gabions protecting and underpinning houses on the south-east corner of the island, adjacent E-S beach lodge. View to north. Low-mid-tide conditions

Figure 2-9 Proposed Choiseul Bay township site (upper left of image), Sui catchment. (Source: Simon Albert, School of Civil Engineering, UQ)

2.4 Climate

The climate of Choiseul is equatorial and influenced by the El Nino Southern Oscillation (ENSO), the South Pacific Convergence Zone and the West Pacific Monsoon.

Mean annual rainfall (MAR) at Taro Island is 3300mm and is reasonably consistent throughout the year. The driest month is December and the wettest month is July (see Figure 2-10). There are notable variations in MAR over the available data record; rainfall in excess of 5000mm occurred in 1993 and 2000 and in 1997 and 1999 rainfall was less than 2,500mm (Figure 2-11). Note that 1997 was regarded as a significant drought event regionally. Evaporation rates are of the order of 5mm/day (Source: www.fao.org/ag/AGP/AGPC/doc/Counprof/southpacific/Solomon.htm).

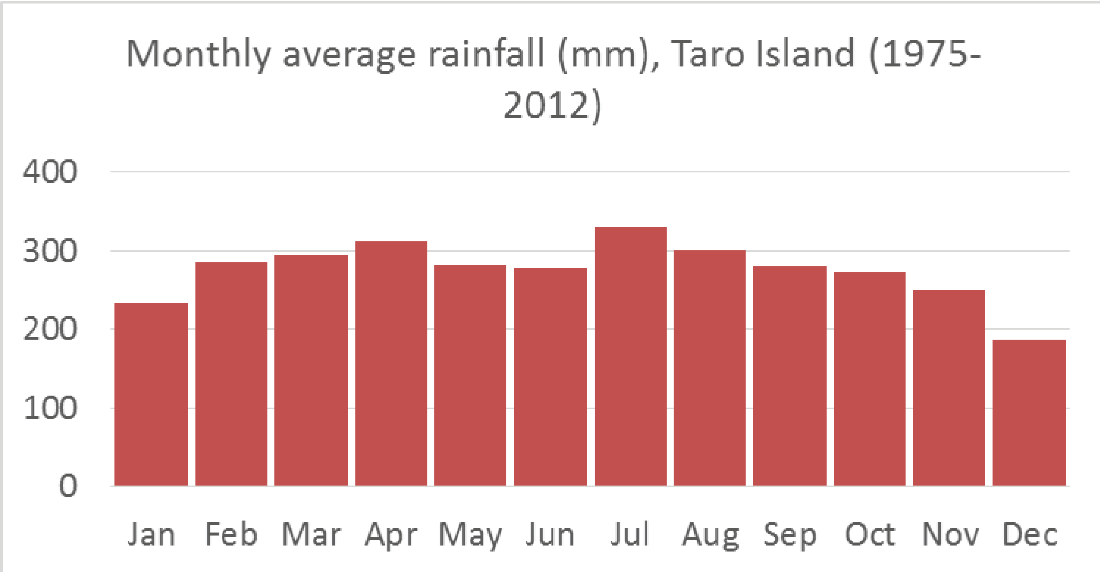


Figure 2-10 Monthly average rainfall, Taro Island

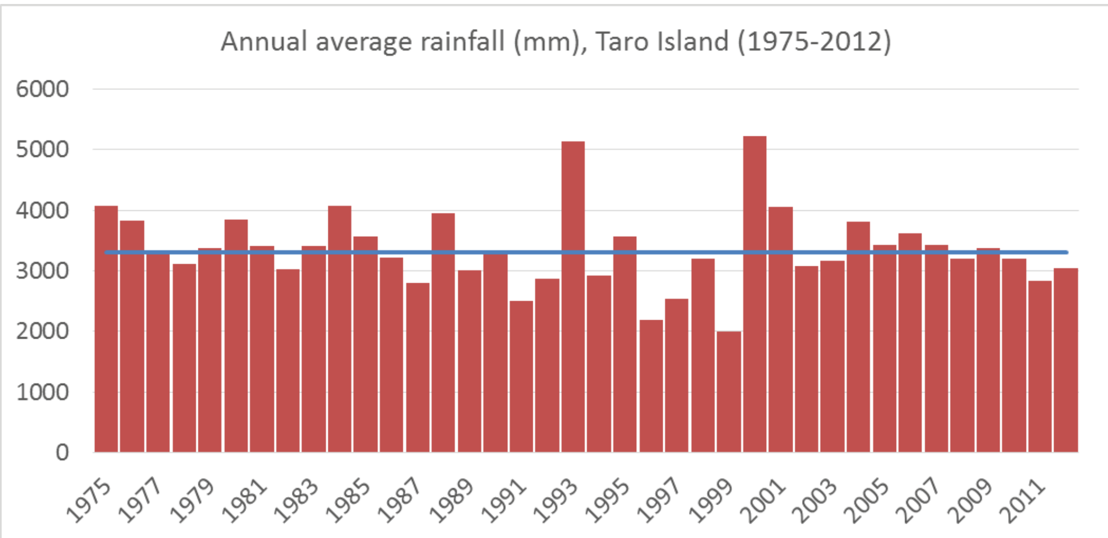


Figure 2-11 Annual average rainfall, Taro Island. Blue line shows average over all years

2.5 Tides

Water levels are available at Tarekukure Wharf, located on the mainland adjacent to Taro Island (sourced from IOC's Sea Level Station Monitoring website, see example in Figure 2-12). Tidal analysis of this dataset was performed to establish tidal planes (Table 2-1) and to investigate residuals.

As shown, typical tide range is 0.5m to 1.0m with HAT (Highest Astronomical Tide) equal to 0.95m MSL.

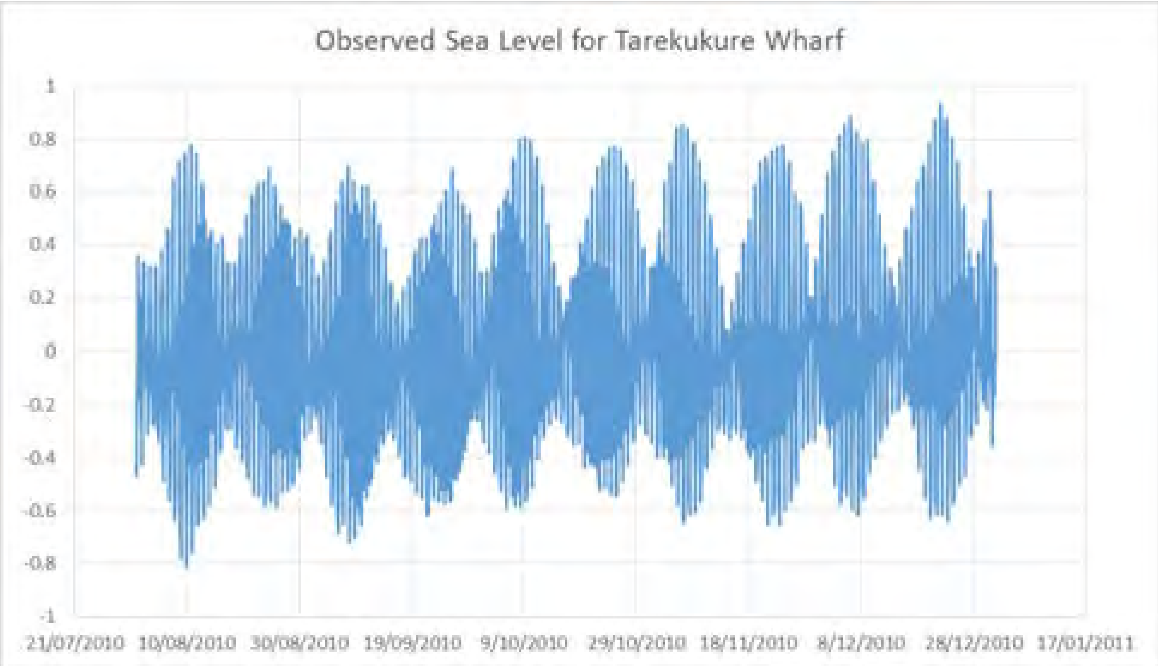


Figure 2-12 Water level record at Tarekukure Wharf, October to December 2010 (http://www.ioc-sealevelmonitoring.org/station.php?code=tare)

Table 2-1 Tidal planes for Tarekukure Wharf, from tidal analysis from August 2010 to December 2013

Tidal planes	Level (mMSL)	Level (mCD)
Highest Astronomical Tide (HAT)	0.95	1.69
Mean High High Water (MHHW)	0.54	1.29
Mean Low High Water (MLHW)	0.20	0.94
Mean Sea Level (MSL)	0.00	0.74
Mean High Low Water (MHLW)	-0.27	0.48
Mean Low Water (MLLW)	-0.47	0.27
Lowest Astronomical Tide (LAT)	-0.84	-0.09

MSL = Mean Sea Level CD = Chart Datum

2.6 Ecology and Environment

There are a number of key ecological zones within the project area and its immediate surrounds (Figure 2-13):

- Fringing mangroves in the sheltered areas along the coastline (Figure 2-14);
- Mangrove forest along the Sui River and adjacent low lying areas (up to the highest tidal extent);
- Secondary forest cover in the more elevated areas of the mainland site (Figure 2-15);
- Coral reefs fringing Taro Island and the lagoon between island and mainland. Reef quality is variable, with local damage in exposed areas and areas close to local populations. It is likely that fish stocks in the waters around Taro Island are depleted.

All the habitats in the area have been subject to degradation of a varying degree. It is expected that logging activities, which ceased around a decade ago, would have caused significant environmental harm. Also, ongoing demands from local subsistence fisheries have had a detrimental impact on local marine habitats.

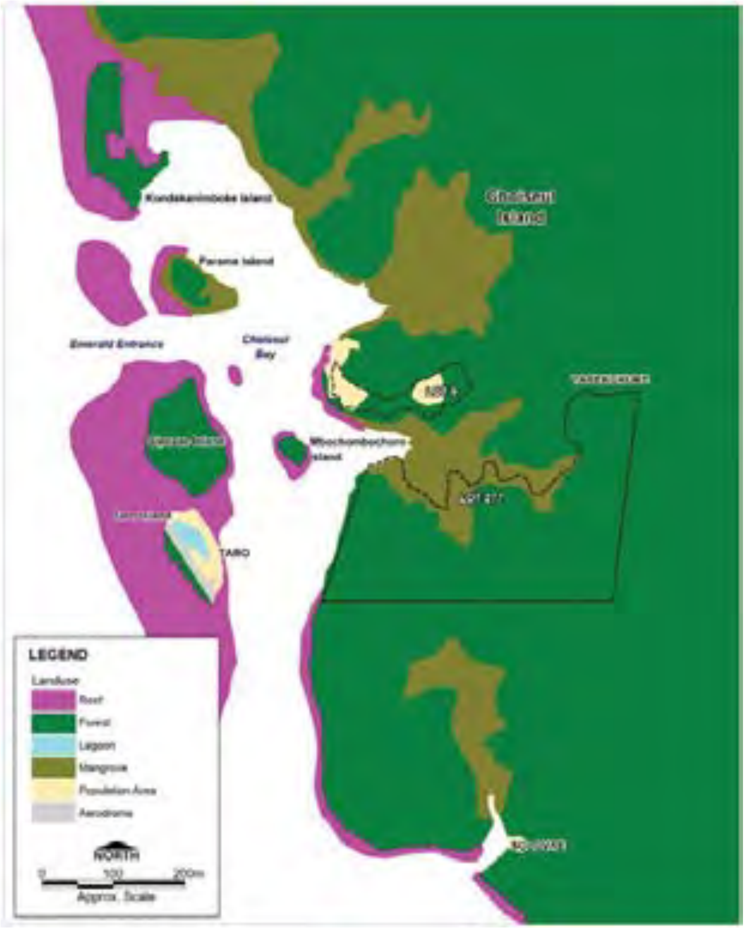


Figure 2-13 Approximate habitat distribution, showing mangroves, forest, coral reefs and population centres (digitised from 1:50,000 topographic maps, 2007)

Figure 2-14 Mangroves bordering Lot 277

Figure 2-15 Typical vegetation along margins of log road at the north-east corner of Lot 277

2.6.1 Rapid Ecology Survey

In conjunction with the topographic survey, a rapid ecology survey of wildlife was performed (visual observations and abundance estimates for vertebrates) on the mainland of Choiseul, in the designated area for the new township on Lot 277. Most invertebrates were identified but no abundance records were made.

In the north-eastern part of the lot, the habitat is mostly old overgrown *Eucalyptus deglupta* plantations, covered by thick undergrowth. Secondary forests in some parts of the ridge have reached a canopy height of almost 20m. The flat areas along the river and ocean margin are dominated by swamp, possibly affected by tidal influences. The logging road was dominated by *Alpinia oceanica*, *Pandanus spiralis*, *Lygodium circinatum*, and *Premna corymbosa*.

A high abundance of certain vertebrates, such as Solomon's Cockatoo's, bush minor, cardinal lories, and Eclectus parrots was found. Frogs of the genus Platymantis frogs and Batrachylodes dominated the forest understory. A total of 52 vertebrates were identified (Table 2-2).

The swamp forests are ideal habitats for Odonata, which is a poorly known insect order. Two species were identified and many other species were seen but not identified. Three snail species were recorded but not identified.

Table 2-2 List of vertebrates identified during the rapid ecology survey, conducted in November 2013

Common name	Scientific name	Ridge	River	Swamp
Birds				
• Beach kingfisher	*Todirhamphus saurophaga*	X	X	
• Cardinal lorry	*Chalcophaps cardinalis*	X	X	
• Eclectus parrot	*Eclectus roratus*	X	X	
• Heron	*Egretta sacra*		X	
• Island imperial pigeon	*Ducula pistrinaria*	X	X	X
• Little kingfisher	*Alcedo pusilla*	X	X	
• Melanesian shrubfowl	*Megapodius eremita*	X		X
• Metallic starling	*Aplornis metallica*	X	X	X
• Midget flowerpecker	*Dicaem aenum*	X		
• Osprey	*Pandion cristatus*		X	
• Pacific golden plover	*Pluvialis fulva*		X	
• Papuan hornbill	*Aceros plicatus*	X		X
• Red-knobbed pigeon	*Ducula rubricera*	X	X	X
• Rufous Night-heron	*Nycticorax caledonicus*		X	
• Solomons cockatoo	*Cocatua ducorpsi*	X	X	X
• Song parrot	*Geoffroys heteroclitus*	X		
• Stephens ground dove	*Chalcophaps stephani*	X	X	

Common name	Scientific name	Ridge	River	Swamp
• Willy wagtail	*Rhipidura leucophrys*	X	X	
• Yellow-faced myna	*Mino dumontii*	X	X	
• Yellow-bellied sunbird	*Nectarinia jugularis*	X	X	
Frogs				
	Batrachylodes elegans	X		
	Batrachylodes vertebralis	X		
	Ceratobatrachus guentheri	X		
	Platymantis solomonis	X	X	
	Platymantis weberi	X	X	
	Rana kreffti		X	X
Mammals				
• Northern common cuscus	*Phalanger orientalis*	X		
Reptiles				
• Saltwater crocodile	*Crocodylus porosus*		X	
	Emoia nigra	X		
	Emoia cyanura	X		
Invertebrates				
	Protorthemis woodfordi	X	X	X
	Neurothemis stigmatizans	X	X	X
Snails				
	Spp1	X		
	Spp2	X		
	Spp3	X		

3. Strategic Context and Problem Definition

3 Strategic Context and Problem Definition

3.1 Background and Context

The Choiseul Provincial Government (CPG) has been actively pursuing access to additional land around Taro Island since 1992.

The Choiseul Province Medium Term Development Plan (MTDP) has, as a priority goal, the expansion of the existing provincial capital of Taro Island Township to the adjacent mainland on Choiseul Island. The MTDP sets out a clear framework for this expansion, including a budget for the next phase of the project. The rationale summarised in the MTDP identifies the key issue as the limited capacity of Taro Island for further and economic and social development, which is hampered due to non-availability of land, vulnerability to sea level rise, scarcity of water and electricity.

The current state of the expansion is that land has been purchased from the original landowners (Choiseul Bay Association Trust Board) and MOUs have been signed for lease agreements for the water supply and possible hydropower catchment area. The intent is to treat the new site as the administrative capital of the province, as well as the economic and industrial growth centre of Choiseul, with development consistent with the government's Rural Policy Framework to promote and develop economic growth centres throughout the country. Taro Island will be retained for specific landuse purposes, including the airport and associated services. A number of preliminary environmental, social and economic assessments have been performed to date that provide a solid basis for future planning.

The Australian Government's Pacific – Australia Climate Change Science and Adaptation Planning (PACCSAP) Program is supporting the Solomon Islands Government (SIG) to better understand and respond to climate change impacts, particularly in relation to infrastructure, coastal zone management and cross-sectoral planning. Choiseul province has been identified by the SIG as a demonstration province where donor activity shall be concentrated to deliver 'whole of province' adaptation support.

To this end, the Department of the Environment is assisting the Choiseul Province and SIG with the Choiseul Bay Township Climate Change Project by providing a hazard and vulnerability assessment, together with advice and capacity building on climate change adaptation options and the planning process. This assistance, which is described in this report, is intended to provide meaningful and relevant inputs to the relocation process, ensuring that climate change related risks are addressed in strategic planning and implementation.

3.2 Governance for Climate Change

A National Climate Change Policy for the Solomon Islands has been issued by the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM). The policy, launched on June 2012, was developed by a number of SIG ministries and supporting organisations including the Global Environment Facility (GEF), the Australian Government through the PACCSAP Project, the UN Development Programme (UNDP), the Secretariat of the Pacific Regional Environment Programme (SPREP), the Adaptation Fund (AF), the World Bank and the

Asian Development Bank (ADB). The Policy provides a framework for a national approach to addressing climate change impacts and adaptation and achieving sustainable development.

This project aims to use the National Climate Change Policy and its associated framework for delivering an adaptation plan for the future expansion of Choiseul Township.

3.3 The Need for Expansion

Choiseul Province has slow economic growth partly attributed to:

- Weak infrastructure of the province;
- Extreme remoteness;
- The limited size and services (water and electricity) of Taro, the provincial capital, which is also threatened by sea level rise (Solomon Islands Government, 2009).

The Choiseul Province Medium Term Development Plan (MTDP) recognises the limited long term capacity of Taro Island to function as the provincial capital. A new provincial capital is proposed on the adjacent mainland; the “Choiseul Bay Township Project”. The MTDP notes that it is expected that some development currently on Taro will be relocated to the new site when considered from redevelopment. The mainland expansion are will become the new administrative capital and a focus for economic and industrial growth.

Presently, Taro Island is vulnerable to a number of physical and economic processes:

- The land area of Taro Island is limited, and there is pressure for land space for the increasing population and associated infrastructure. Into the long term the physical size will become a significant constraint to development. Taro Island population has grown from 440 in 1999 to 810 in 2009; as development continues in the province it is anticipated that the population will increase and demand for associated facilities and infrastructure will also increase (source: Choiseul Township Project 2011 Socio-Economic Study);
- Currently, the primary source of water supply for Taro Island is rainwater, which is captured using individual rainwater tanks attached to residential properties and some commercial and administrative properties. Periodically (once or twice a year) this supply is insufficient to meet demand; during these periods residents rely on groundwater extraction (brackish water, which is used for secondary purposes (not drinking)) and resupply from mainland water sources (transported back to the island via boat). While this situation ensures a continuous water supply, the occasional need to seek mainland sources is an inconvenience;
- The islands and particularly Choiseul province are exposed to a wide range of natural hazards including storm surge, tsunami and tropical cyclones (Table 3-1). Coastal flooding is a hazard that has reportedly been experienced regularly; local residents mention that king tides occur annually in December / January which inundate low lying areas on the island (also mentioned in Ministry of Provincial Government and Rural Development Report, 2001);
- Tsunami is a recognised risk among residents of Taro Island, recent tsunami events (the Japanese tsunami event in 2011 and the Gizo event in 2007) caused significant abnormal increases in mean sea level but did not cause any significant widespread damage on Taro

(mainly because the events occurred at low tide; see Figure 3-1). Local residents highlight a fear of tsunami as a driver for resettlement onto the mainland. Expected sea level rise due to climate change would worsen the existing tsunami hazard;

- Minor coastal erosion is occurring on Taro Island, notably along the eastern shore that fronts the Choiseul Bay lagoon. Protection works (sand bags, gabions, walls constructed of coral pieces, etc.) are evident along the coastline; and
- All of the above vulnerabilities (with the exception of tsunami occurrence) are interlinked with future climate change impacts. Future projections, while uncertain, predict rising sea levels and changes in the dominant El Nino / La Nina climatic cycles. Such changes will exacerbate the existing vulnerability and may ultimately render various infrastructure assets, homes, etc. unusable.

In recognition of these vulnerabilities there has been an intent to expand the Taro Island Township onto the mainland since 1992. The Choiseul Provincial Government (CPG) has acquired Lot 9 and Lot 277 and limited infrastructure has been constructed.

Table 3-1 Disaster Events for Choiseul Province (Sources: Natural Disasters Database Vol 1-4, Meteorology Services and Seismology Section, supplemented with the inclusion of recent tsunami events in 2007 and 2010)

Type of natural hazard	1950-1960	1961-1971	1972-1982	1983-1993	1994-2000	2001-2014	Total
Cyclone	0	3	1	0	0		4
Earthquake	0	1	3	0	0		4
Tsunami	1	1	3	0	0	2	7
Landslide	0	0	0	0	0		0
Flood	0	0	0	0	0		0
Drought	0	0	0	0	1		1
Volcano	0	0	0	0	0		0
Total	**1**	**5**	**7**	**0**	**1**	**2**	**16**

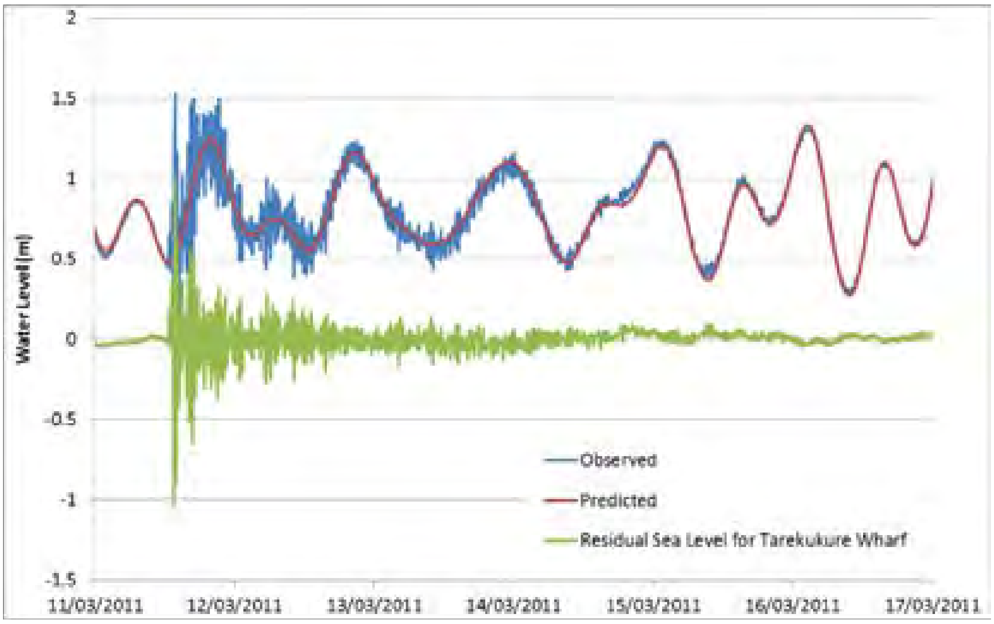


Figure 3-1 Water levels (observed, tidal prediction and residual) at Tarekukure Wharf during the March 2011 tsunami event

3.4 Previous Studies

There have been a number of initiatives undertaken in Choiseul Province specifically relating to the task of expanding Taro onto the mainland. These include a number of studies conducted by (or on behalf of) the Choiseul Provincial Government, under the broad description of the "Choiseul Bay Township Project". These include:

- Terms of Reference for physical development of Choiseul township (2005);
- Choiseul Province Township Road Centreline Survey Report (2008);
- Initial Environmental Examination (2009);
- Choiseul Bay Bathymetric Survey Technical Report (2010);
- Socio-economic study (2011);
- Economic and financial study (2011);
- Final Report by Focal Point Contact Person (2012); and
- Choiseul Bay New township Lot 9 of LR3 (2013).

4. Community and Stakeholder Engagement

4 Community and Stakeholder Engagement

4.1 Introduction

Community and stakeholder engagement activities undertaken for this project were guided by a community and stakeholder engagement plan prepared at the commencement of the project. The plan incorporated feedback from the Australian Department of the Environment (DoE), Choiseul Provincial Government and Solomon Islands Government (MECDM) provided at an inception meeting held on 12 November 2013.

This chapter summarises the key elements of the engagement plan including the overall engagement approach, mapping of community and stakeholder groups; and details of engagement activities.

Community and stakeholder engagement has been a fundamental input into the preparation of this Adaptation Plan (including town planning for the future expansion site) and ongoing engagement will be critical to its future implementation.

4.2 Community and Stakeholder Groups

A representation of key community and stakeholder groups with an interest in the project is provided in the diagram at Figure 4-1. For ease of interpretation, communities of interest and stakeholders have been grouped into the following categories:

- Project management / funding partners;
- Solomon Island Government (SIG);
- Choiseul Provincial Government (CPG);
- Community members / organisations; and
- NGOs / potential donor partners.

The segments of the diagram in Figure 4-1 correlate to the above groupings. Distance from the centre of the diagram represents the relative degree of interest in the project.

Specific engagement initiatives were implemented to engage each of the stakeholders and community groups identified in the diagram at varying stages in the project methodology.

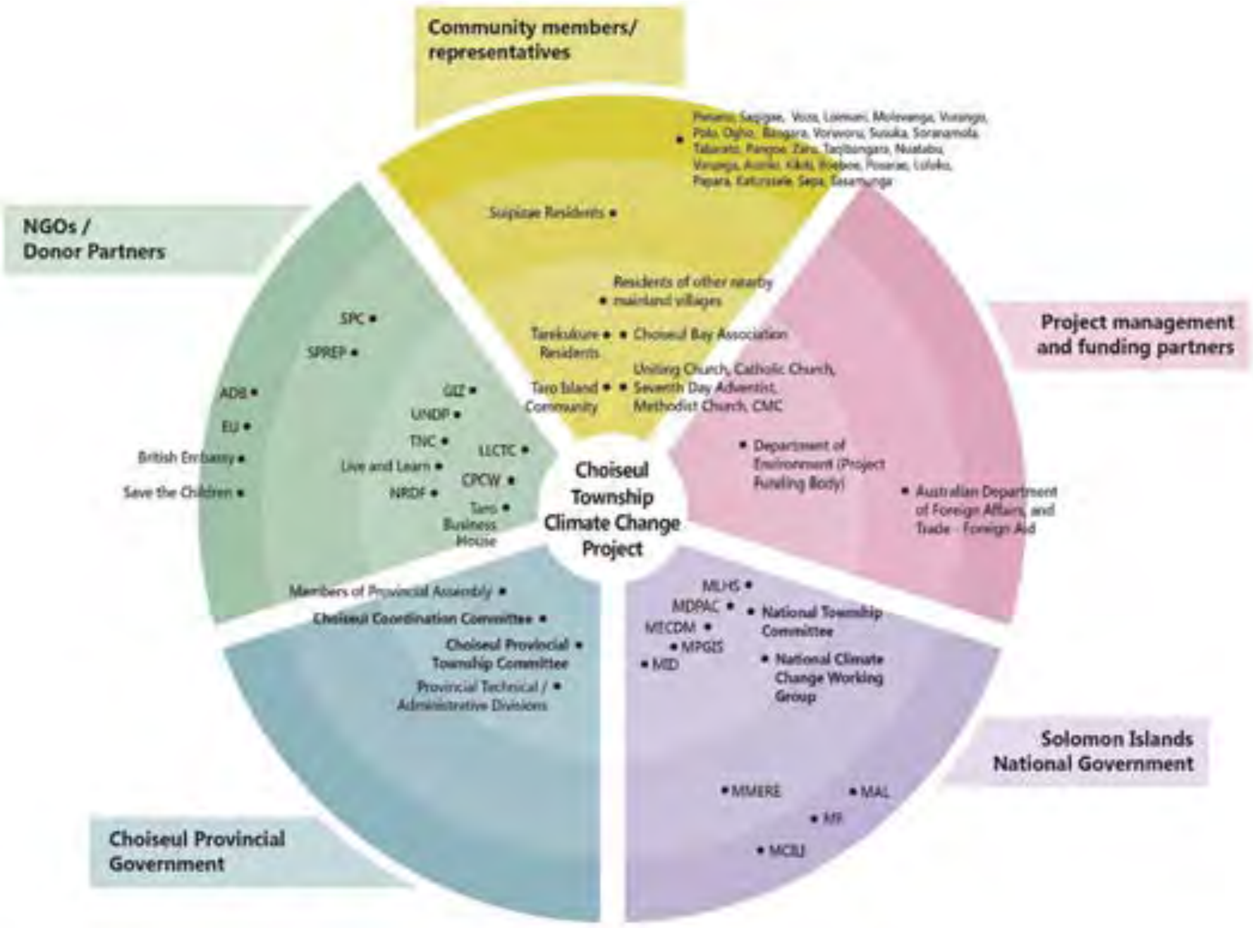


Figure 4-1 Community and stakeholder mapping

4.3 Engagement Approach

4.3.1 Engagement Values

Through all engagement activities, the project team conducted themselves in a manner consistent with the values described in Figure 4-2. The application of these values ensured that:

- Opportunities were provided for all stakeholders and community members to participate in the engagement process (including segments of the community such as women and young people);
- Local knowledge of key stakeholders and community representatives was valued and used to shape and refine the engagement activities throughout the project;
- The project team adhered to community norms and traditions and were respectful of these values;
- Communication was undertaken in a language and with visual aids familiar to the community (e.g. a project team member fluent in Pidgin attended all community engagement events); and
- The project team viewed themselves as guests in the community and behaved accordingly.

Figure 4-2 Engagement values of the project team

4.3.2 Engagement Objectives

Based on the project team's preliminary review of background materials, project team member's previous experience working in the Solomon Islands and initial discussions with the Australian Government Department of the Environment and CPG, the preferred outcomes sought for the community and stakeholder engagement activities were:

- The CPG has a high degree of buy-in and ownership in the project;
- A wide variety of community members (including children, youth, women, men and church representatives) and stakeholders (including the Solomon Islands National Government, business owners, the CPG, NGOs / donor partners) are involved in the community engagement process;
- Stakeholders and community members have an in-depth understanding of the purpose and benefits of the project and feel their views have been incorporated into the project outputs;
- A sense of trust and rapport is built between the stakeholders / the community and the project team;

- Stakeholders and community members gain a better understanding of climate-related hazards; and
- A practical and implementable Adaption Plan (including town planning for future expansion area) is delivered at the end of the project that has the support of the Solomon Islands Government, the CPG, NGOs / donor partners and most importantly, the community.

4.4 Engagement Methodology

4.4.1 Phases of In-Country Engagement

The methodology developed for the project set out four key phases of in-country engagement. The focus of each of the in-country engagement phases is described below:

Engagement Visit 1 – Inception

- Introduce project team; and
- Undertake project inception and seek input into the project work plan and community and stakeholder engagement plan.

Engagement Visit 2 – Values Identification

- Understand environmental, economic, social and cultural values on Taro Island and the future expansion area; and
- Provide an overview of preliminary hazard mapping.

Engagement Visit 3 – Hazard Mapping, Risk Assessment and Town Planning

- Provide an overview and seek input into draft risk assessment and adaptation options; and
- Provide an overview and seek input into town planning for the future expansion area and Taro Island, including draft vision, site analysis and concept plan options.

Engagement Visit 4 – Capacity Building

- Ensure there is a detailed knowledge among CPG and SIG representatives of the hazard mapping, risk assessment and adaptation plan, including how the plan will need to be implemented; and
- Ensure there is a good understanding of the draft local planning scheme so that CPG planners can take ownership of the township development and continue to move it forward following completion of the project.

4.4.2 Engagement Techniques and Materials

Engagement activities were undertaken using a range of engagement techniques and tools selected to support the communication of key messages and encourage community and stakeholder buy-in and awareness of the project. The engagement techniques included one way engagement (such as posters and fact sheets) and two way engagement (such as meetings and workshops).

Communication materials were prepared to support the engagement techniques, which were designed to include project branding and facilitate easy identification of the project by stakeholders and the community.

Table 4-1 provides a summary of the engagement techniques and materials used during the four in-country engagement phases.

Table 4-1 Engagement techniques and materials

Phase of In-Country Engagement	Engagement Technique	Engagement Materials
Engagement Visit 1 *November 2013*	Face to face meetings Small group and one-on-one meetings with CPG and SIG to discuss the work plan and engagement plan.	Presentation Hand-out of powerpoint presentation to participants.
Engagement Visit 2 *January 2014*	Face to face meetings Small group and one-on-one meetings with CPG and SIG representatives, NGOs, infrastructure managers / operators and community members, as was required. CPG and Community Workshops A series of workshops organised according to stakeholder and community group included: Taro Island community workshop CPG workshop on Taro Island Public meetings with mainland village communities (Moli, Nukiki, Supizae, Poroporo) Market Stall A stall was set up at the Taro market on three occasions to provide the broader community with an opportunity to hear about the project, ask questions and learn of other opportunities to be involved. Thank You Movie Night The project team hosted a thank you movie night at the Allan Qurusu hall.	Fact Sheet A four page A4 fact sheet describing the project was handed out to community members and stakeholders. This was produced in English and Pidgin. Mapping for Workshops Large scale (AO) maps were used to elicit feedback from stakeholders and community members. Participants recorded feedback by drawing onto a transparency overlaid on the mapping. Feedback Register A procedure was used to capture feedback from people who were not able to attend the workshops and/or people who did not want to be identified. This was done using a comments register, which was available to be completed during workshops and at other times, was available at the CPG offices. Community Booklet Following the in-country engagement visit, a concise A5 booklet was prepared for distribution among stakeholders and the community which:

Phase of In-Country Engagement	Engagement Technique	Engagement Materials
		provided a project update; described the project and engagement activities; and summarised the feedback received and how it was to be used. Community Poster Posters were prepared to display at the Taro market and other community notice boards to advise of upcoming engagement activities. These were produced in Pidgin and English.
Engagement Visit 3 *March 2014*	Engagement techniques were similar to those undertaken for engagement visit 2.	Engagement materials prepared were similar to those undertaken for engagement visit 2.
Engagement Visit 4 *May 2014*	Training session A 2 day capacity building session was delivered to CPG and SIG officials. Additional training was provided to CPG officials for subsequent delivery of presentation material to the community.	Presentation Delivered by experts in coastal climate change management and town planning Training notes Notes / handouts of training slides were provided to participants Community Booklet As per above, covering activities carried out during engagement visit 3 Community Poster As per above, advising of upcoming community engagement to be facilitated by CPG.
June/July 2014	CPG to conduct community engagement	Resources as provided above.

Documentation that supported the community and stakeholder engagement activities is included in the following appendices:

- A summary of attendees (Appendix E);
- Records of feedback provided during small group exercises and recorded onto maps and butcher's paper (Appendix E);

- Records of discussion from one-on-one and small group meetings (Appendix E);
- Summary of the comments register feedback (Appendix E); and
- Copies of the community booklets produced following in-country engagement trips 2, 3 and 4 (Appendix F).

The outcomes of the engagement activities are summarised in subsequent sections of this Adaptation Report (see Sections 7.3.3, 7.5.4, 8.6 and 10.5).

The following pages show photographs taken during the engagement activities described in the preceding table (Figure 4-3 to Figure 4-13).

Figure 4-3 Participants of CPG workshop, January 2014

Figure 4-4 Reviewing Risk Areas, CPG workshop, January 2014

Figure 4-5 Taro community workshop, March 2014

Figure 4-6 Public meeting at Poroporo, January 2014

Figure 4-7 Public meeting at Nukiki, January 2014

Figure 4-8 Public meeting at Supizae, January 2014

Figure 4-9 Stall at Taro Market, January 2014

Figure 4-10 Presentation at Taro Market Stall, January 2014

Figure 4-11 Engagement with SIG representatives, March 2014

Figure 4-12 Town Planning Training of CPG and SIG officials, May 2014

Figure 4-13 Engineering Training of CPG and SIG officials, May 2014

5. Climate Change Parameters and Projections

5 Climate Change Parameters and Projections

5.1 Introduction

When considering climate change it is necessary to define a project lifespan and, based upon the most current theories and analytical approaches, establish design parameters for the project that consider both existing and future hazards incorporating climate change impacts. With regard to prediction of future climate change conditions, there is a heavy reliance on the global and regional data and analyses available in scientific literature, which continues to be updated as our understanding of climate change improves with time.

5.2 Design Lifespan and Future Horizon

All infrastructure design should consider a level of service; a minimum standard that will protect the asset for a majority of extreme events. Design must also consider the life of service; the duration in years which the infrastructure will be useful and safe.

In most countries a generally accepted level of service for habitable properties, major roads and infrastructure (but not more critical infrastructure such as hospitals and evacuation routes) is the 1% AEP (Annual Exceedence Probability), or sometimes known as the 100 year ARI (Average Recurrence Interval) event. That is, infrastructure should be located and designed such that they withstand extreme natural hazards that have a 1% chance of occurrence in any year.

Life of service is dependent upon the nature and purpose of the infrastructure being designed. Given the potential impacts of climate change in the future, the probability of occurrence of extreme natural hazards may change. Thus, the life of service needs to consider the predictions of future climate change in order to maintain a minimum level of service.

For the current study it is proposed to consider a 1% AEP level of service and a life extending to two horizon years of 2055 and 2090 (2055 and 2090 are horizon years adopted by the Australian Government Pacific Climate Change Futures; see http://www.pacificclimatefutures.net/).

5.3 Future Climate Change

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (AR5, 2013) provide projections of future changes in the climate system. These projections use a hierarchy of climate models based on a set of four greenhouse gas concentration trajectories, called Representative Concentration Pathways (RCPs). In combination, the RCPs represent a range of 21st century climate policies.

The RCPs are labelled according to the range of radiative forcing values in the year 2100 relative to pre-industrial values:

- RCP2.6 applies a radiative forcing value of +2.6 W/m^2 and represents a low forcing level.
- RCP4.5 and RCP6 apply radiative forcing values of +4.5 and +6.0 W/m^2 and represent stabilisation scenarios.
- RCP8.5 applies a radiative forcing value +8.5 W/m^2 and represents a high forcing level.

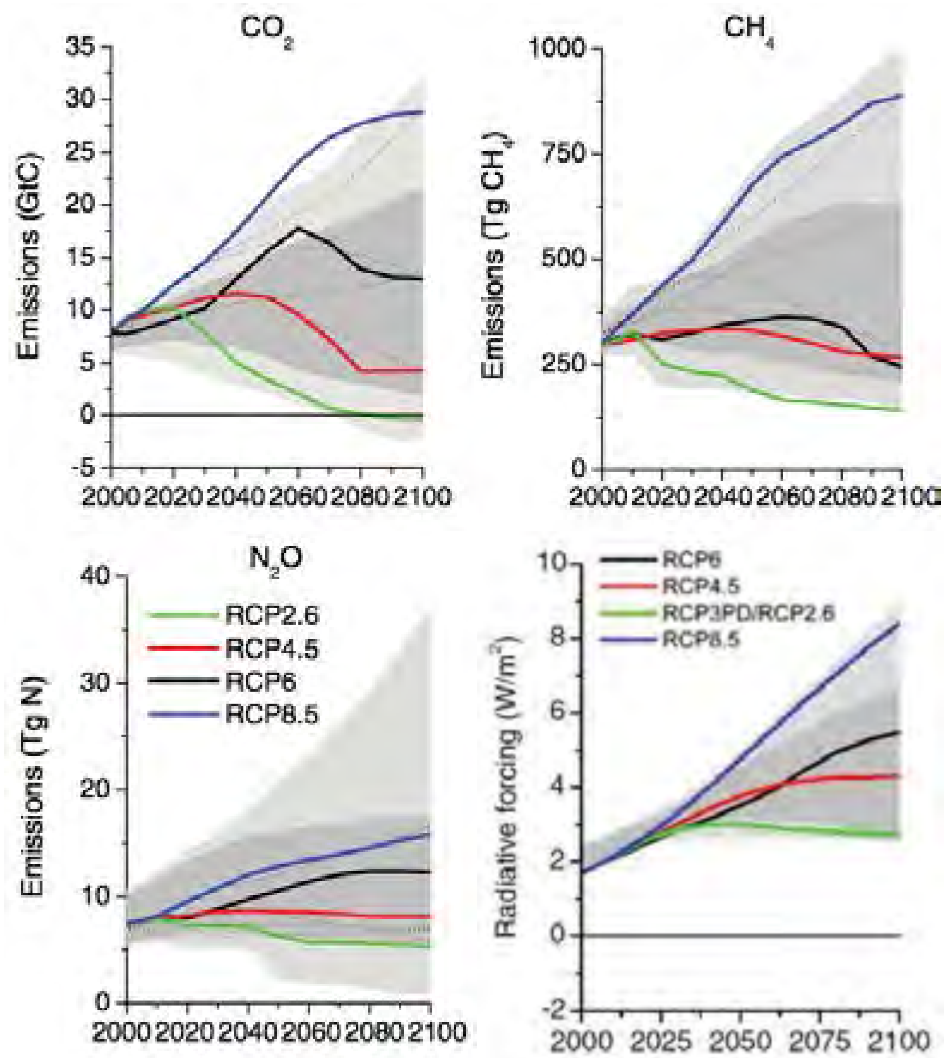


Figure 5-1 Projected emissions of greenhouse gases for the range of RCP trajectories. Radiative forcings for each trajectory shown (bottom right). (van Vuuren et.al., 2011).

5.4 Adopted Climate Change Projections

5.4.1 Sea Level Rise

AR5 provides projections of global sea level rise for each RCP (Figure 5-2). Projections for 2081-2100 (relative to 1986-2005 levels) are in the ranges of 0.26 to 0.55 m for RCP2.6, 0.32 to 0.63 m for RCP4.5, 0.33 to 0.63 m for RCP6.0, and 0.45 to 0.82 m for RCP8.5.

Regional information is available with which to compare the global projections of AR5:

- Hoegh-Guldberg and Bruno (2010, Figure 5-3) present analyses that show a hotspot in sea level rise in the west Pacific of 8 to 10mm/year.

- AusAid (2010), with analyses based upon a long term water level gauge, reports a sea level trend of +7.7mm/year (however the report notes that a nearby gauge, with longer records but less precision and datum control, shows a trend of –5.7mm/year).
- Church et al. (2006) provides a slightly lower estimate of 4mm/year in this region.
- A long term trend of 2mm/year has been recorded in American Samoa over the period 1945-2005 (Gilman et al., 2007).
- The Solomon Islands National Climate Change Policy (2012) adopts a value of 7.7mm/year.

Considering the above information and taking into account the planning focus of the investigation, a conservative future projection is proposed that takes into account the latest scientific literature. Therefore, the adopted future mean sea level rise are based upon the RCP8.5 scenario from AR5:

- In 2055 (42 years): 0.38m.
- In 2090 (77 years): 0.82m.

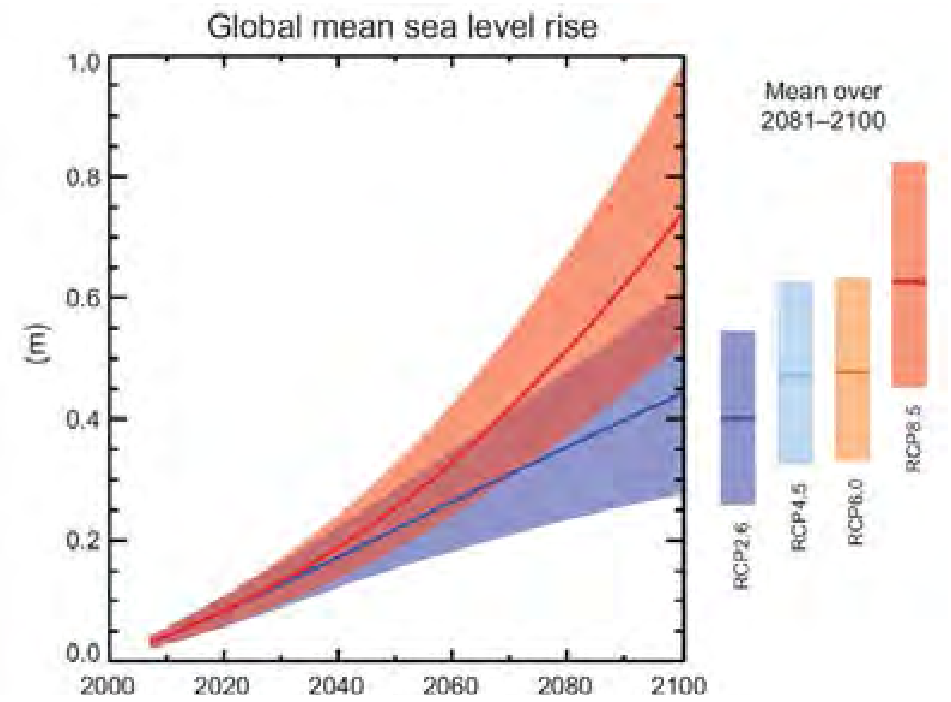


Figure 5-2 Projections of global mean sea level rise over the 21st century relative to 1986–2005 (source: http://www.climatechange2013.org/images/uploads/WGI_AR5_SPM_brochure.pdf)

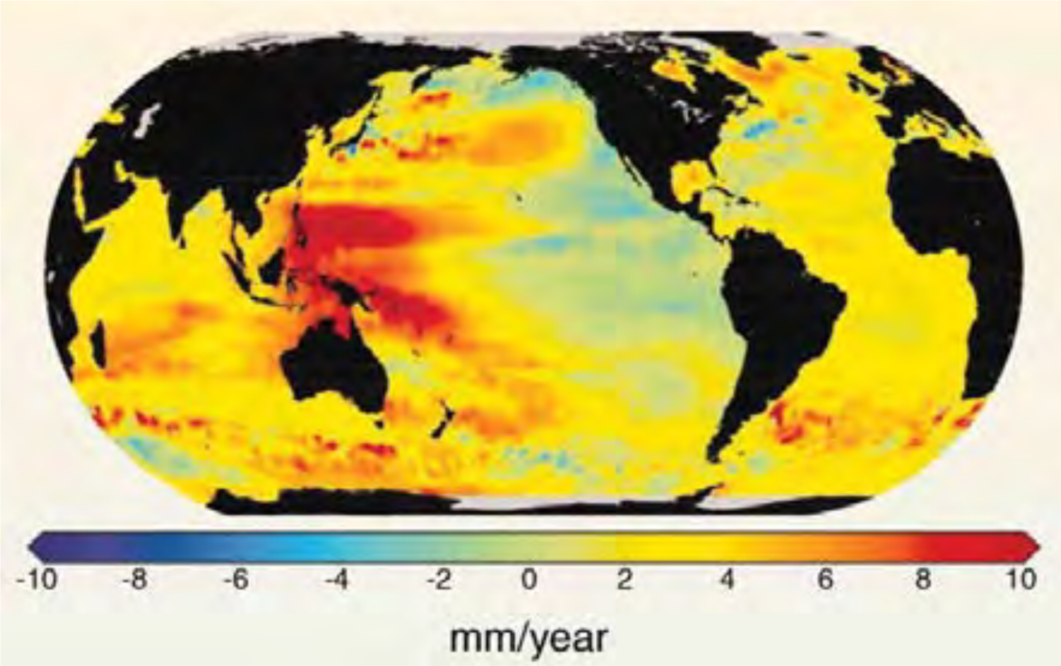


Figure 5-3 Global estimates of sea level rise indicating a hot spot in the Solomon Island region (Source: Hoegh-Guldberg, O., and J. F. Bruno, 2010)

5.4.2 Rainfall

AR5 provides projections of change in hydrological parameters for the RCP8.5 trajectory (Figure 5-4). Further projections of seasonal precipitation changes are shown in Figure 5-5. Also of relevance are projections of tropical cyclone activity, which are likely to cause significant rainfall events (see Figure 5-7). For the Solomon Islands, these projections (considering the RCP8.5 trajectory) can be summarised as follows:

- Seasonal increase in precipitation in 2046-2065 of 10% (Dec-Feb), 30% (Mar-May), 30% (Jun-Aug) and 20% (Sep-Nov).
- Seasonal increase in precipitation in 20081-2100 of 20% (Dec-Feb), 40% (Mar-May), 40% (Jun-Aug) and 30% (Sep-Nov).
- Catchment runoff increase of 40% in 2081-2100.
- Future drought hazard projections are uncertain (AR5 discussion) and projected changes to evaporation rates and soil moisture are small. There is a projected increased risk in drought in presently dry regions (ie not Solomon Islands).
- A projected reduction in overall tropical cyclone frequency, but with a possible increase in high category events and a 10% increase in associated precipitation.

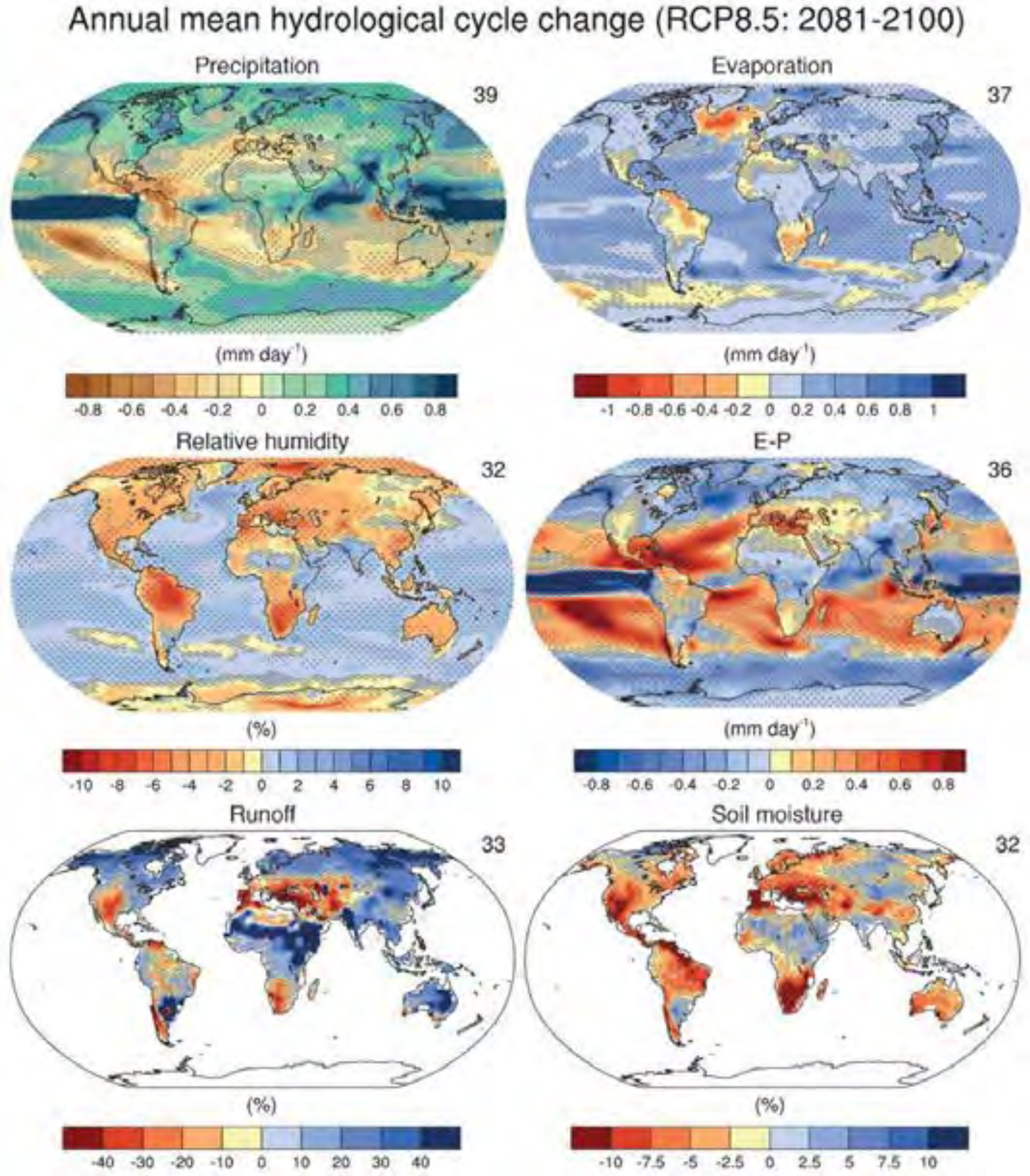


Figure 5-4 Seasonal mean hydrological cycle change for RCP8.5. Source AR5 (http://www.ipcc.ch/report/ar5/wg1)

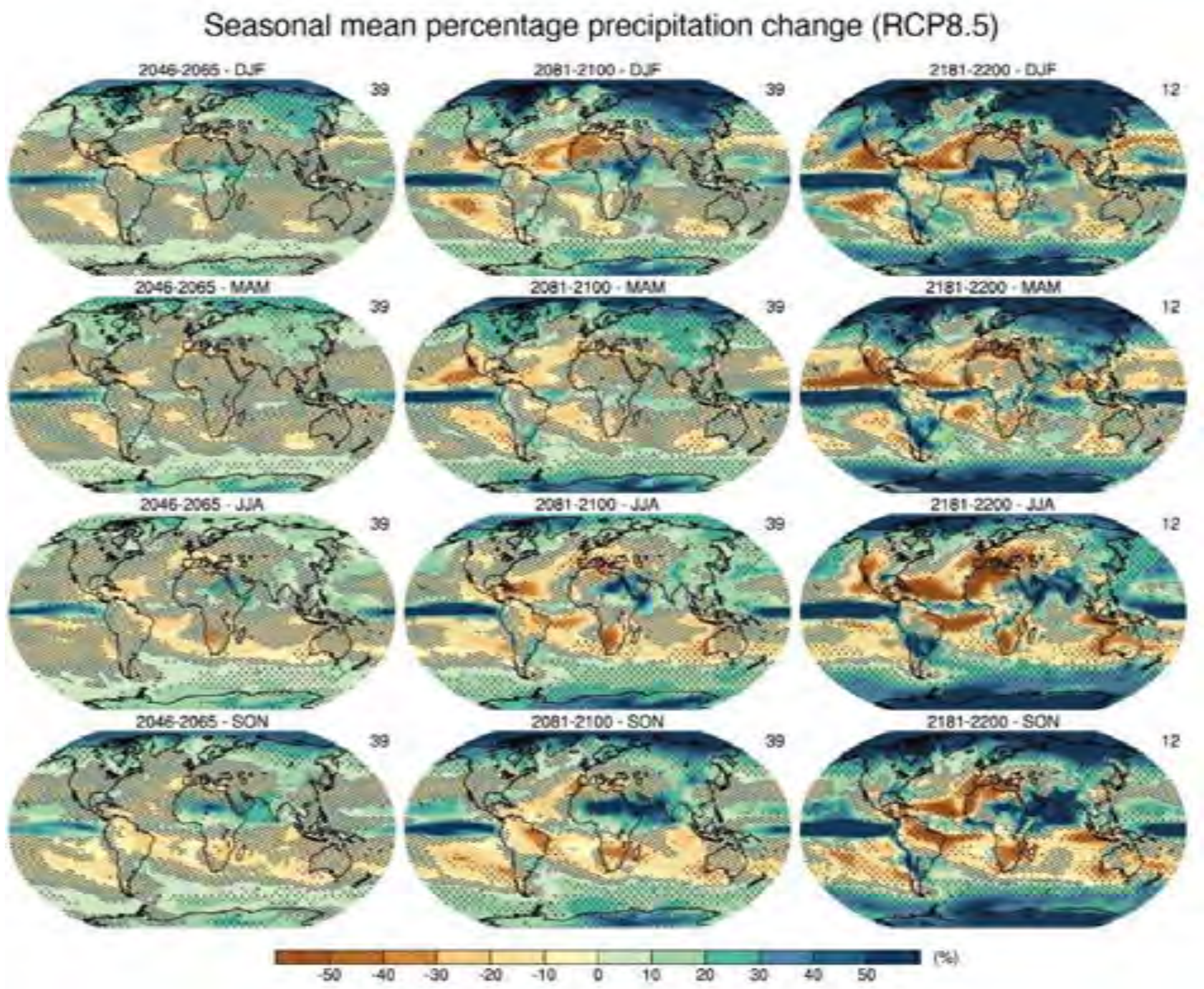


Figure 5-5 Seasonal mean percentage precipitation change for RCP8.5. Source AR5 (http://www.ipcc.ch/report/ar5/wg1)

Considering the above information, the adopted future rainfall climate are as follows:

- In 2055 (42 years):
    - For drought related events: no change from existing situation; and
    - For flood related events: a 30% increase in rainfall intensity.
- In 2090 (77 years):
    - For drought related events: a 10% increase in drought duration over existing situation; and
    - For flood related events: a 40% increase in rainfall intensity.

5.4.3 Waves

Predictions from IPCC (see Figure 5-6) suggest a possible decrease in wave activity in the Solomon Islands, however the confidence of these predictions are low.

Adopted future wave conditions are therefore the same as existing wave conditions.

5.4.4 Cyclonic Activity

Taro Island is situated close to the equator, which means it is not regularly exposed to destructive cyclonic events. Figure 5-7 shows AR5 predictions of changes in tropical cyclone statistics between 2000-2019 and 2081-2100. The 4 metrics shown are percentage changes to:

(1) The total annual frequency of tropical storms, which for the South Pacific is projected to vary between 0 and -60% (best guess is -30%).

(2) The annual frequency of Category 4 and 5 storms, which globally is projected to increase between 0 and +30% (best guess 10%, note there is insufficient data for prediction specific to the South Pacific).

(3) The mean Lifetime Maximum Intensity (LMI, maximum intensity achieved during a storm's lifetime), which for the South Pacific is projected to vary between -5% to +5% (best guess is no variation).

(4) The precipitation rate within 200km of the storm centre at the time of LMI, which for the South Pacific is projected to vary between +5% to +10% (best guess is 7%).

Based upon these predictions and taking a conservative approach, the adopted future tropical cyclone climatology is a 10% increase in cyclone induced vortex winds. This is representative of the projected increase in Category 4 or higher storm events and, to a lesser extent, an increase in LMI.

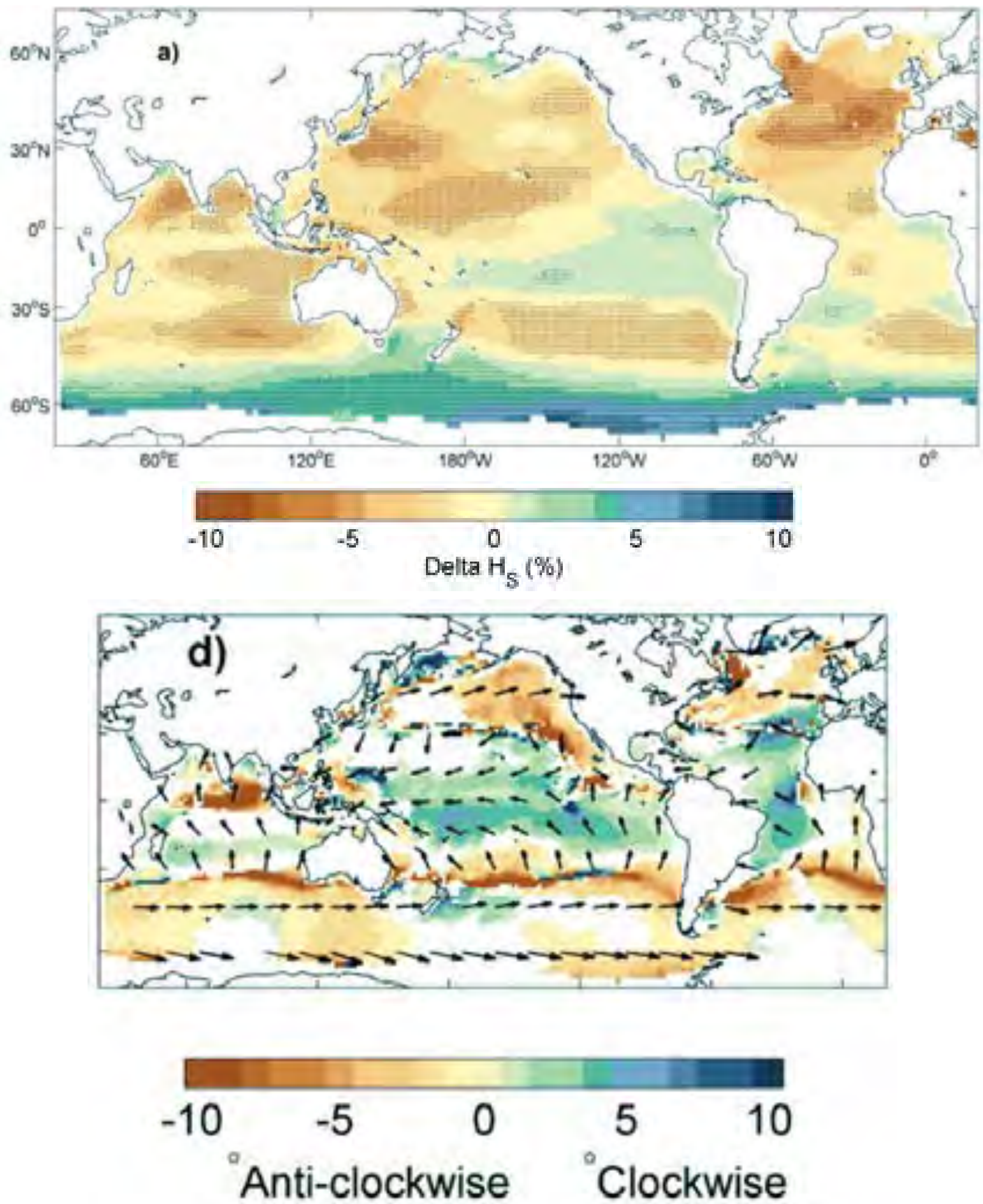


Figure 5-6 Projected changes in wind-wave conditions, mean wave height (top) and mean wave direction (bottom) (source: http://www.climatechange2013.org/images/uploads/WGIAR5_WGI-12Doc2b_FinalDraft_Chapter13.pdf)

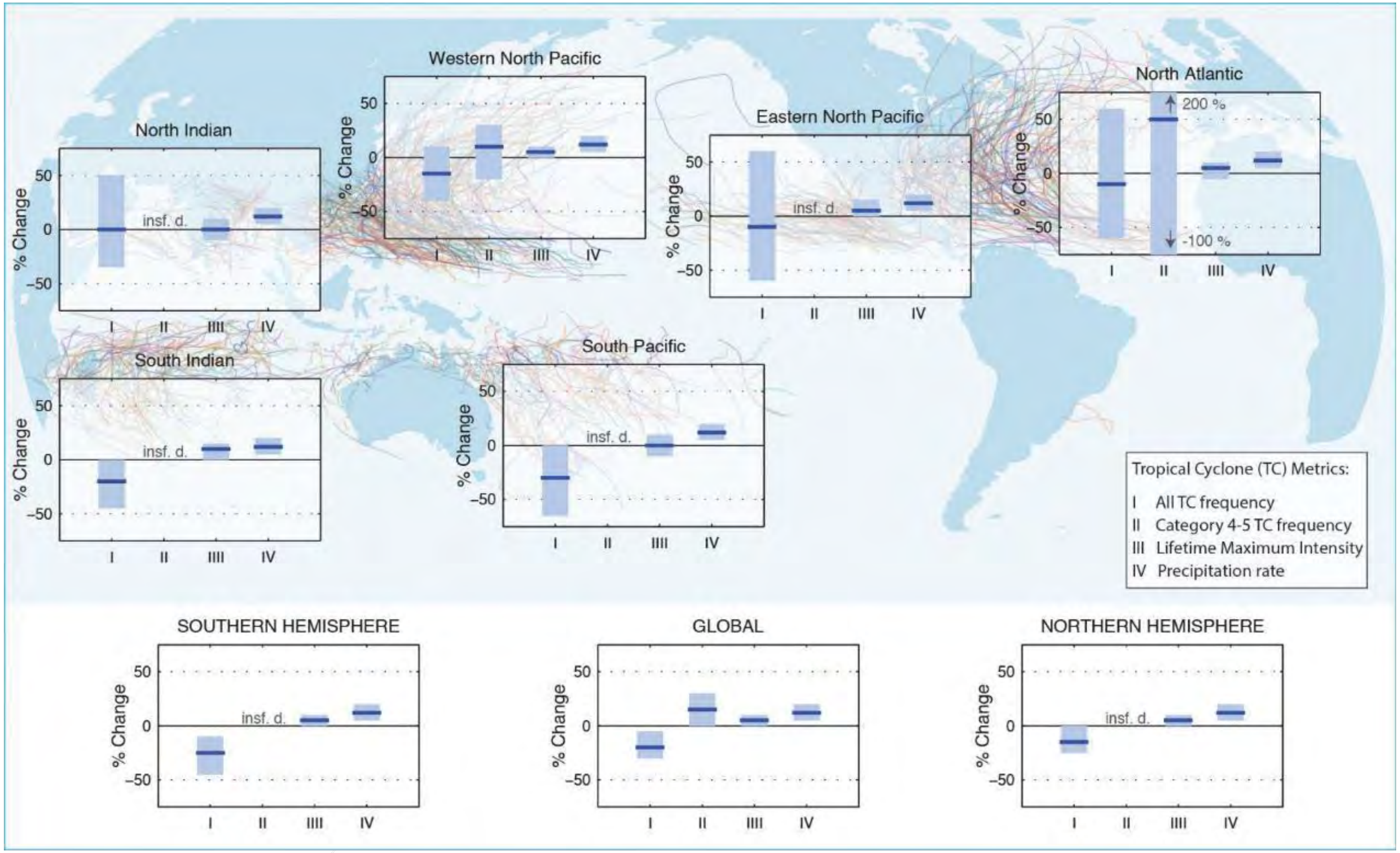


Figure 5-7 Projected changes in tropical cyclone statistics, 2081–2100 relative to 2000–2019. Source AR5 (http://www.ipcc.ch/report/ar5/wg1)

6. Hazard Assessment

6 Hazard Assessment

6.1 Summary of Hazards

The natural hazards defined and described herein are the outcome of a preliminary hazards identification and scoping exercise based on existing information, feedback from local communities and background literature. In turn, the quantifications of hazard are applied to assess likelihood and consequence (i.e. risk).

The outcomes of the hazard assessment are provided as:

- Tables of predicted maximum intensities of hazard and, for hazards relating to sea level variations, vertical water levels.
- Maps, showing maximum spatial extents of each hazard in the study area.
- An overall map, collating all hazards, intended as a basis for subsequent planning and design.

Significant natural hazards identified are:

- Droughts and low flow conditions;
- Floods;
- Tides;
- Cyclones;
- Storm Surge;
- Tsunami; and
- Coastal Processes.

6.2 Droughts

Being equatorial, rainfall is generally consistent in Taro. However, there are periods when there is relatively little rainfall. In a typical year there are 15 consecutive days without rain falling; it is expected that during such periods water availability on Taro Island would become limited, requiring emergency water supply to be sourced from groundwater and the mainland.

Figure 6-1 shows that in 1982, 1986, 1995 and 1997 there were at least 25 consecutive days without rainfall. Based on extreme analyses (Figure 6-2), the 1% AEP dry day duration is about 35 days.

Such extensive dry periods may indeed cause inconvenience to local residents on Taro Island, however it appears that the receiving catchment of the mainland water supply is sufficient to provide continuous emergency supply during these periods.

A reasonable estimate of domestic water use on Taro Island is 100 l/person/day. Based on a typical year with 15 consecutive days without rain, a rainwater storage requirement of 1500 l/person (1.5 m^3/person) is required. This equates to a total rainwater tank volume of 1.2ML, assuming tanks are full at the start of the drought period. This volume is achieved by each building (assuming approximately 200 on Taro Island) having a 6,000litre rainwater tank (or equivalent thereof).

In order to provide a higher level of protection against drought events, a larger water storage capacity would be required.

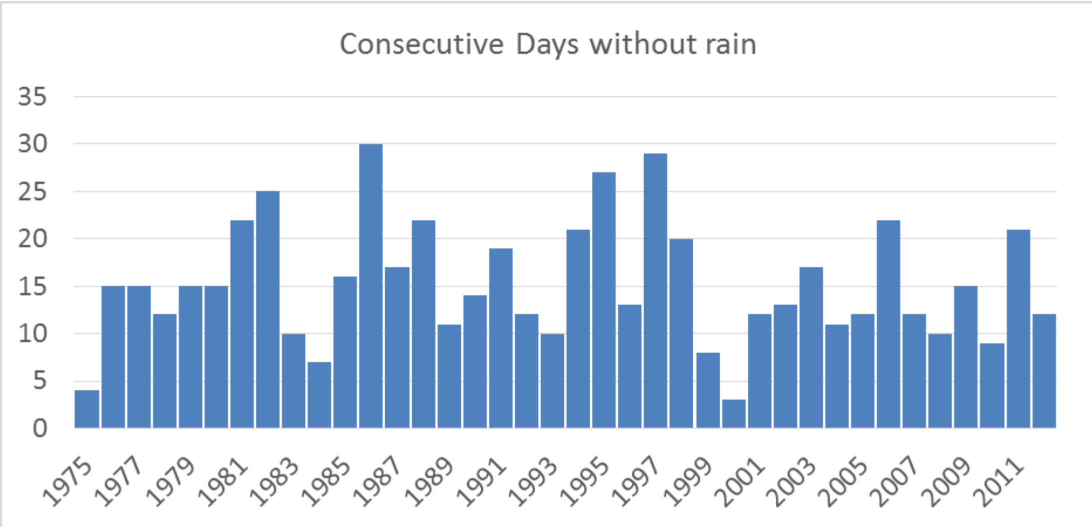


Figure 6-1 Highest consecutive days without rain per year, Taro Island. Note that a day without rain is defined as being a rainfall intensity less than the evaporation rate

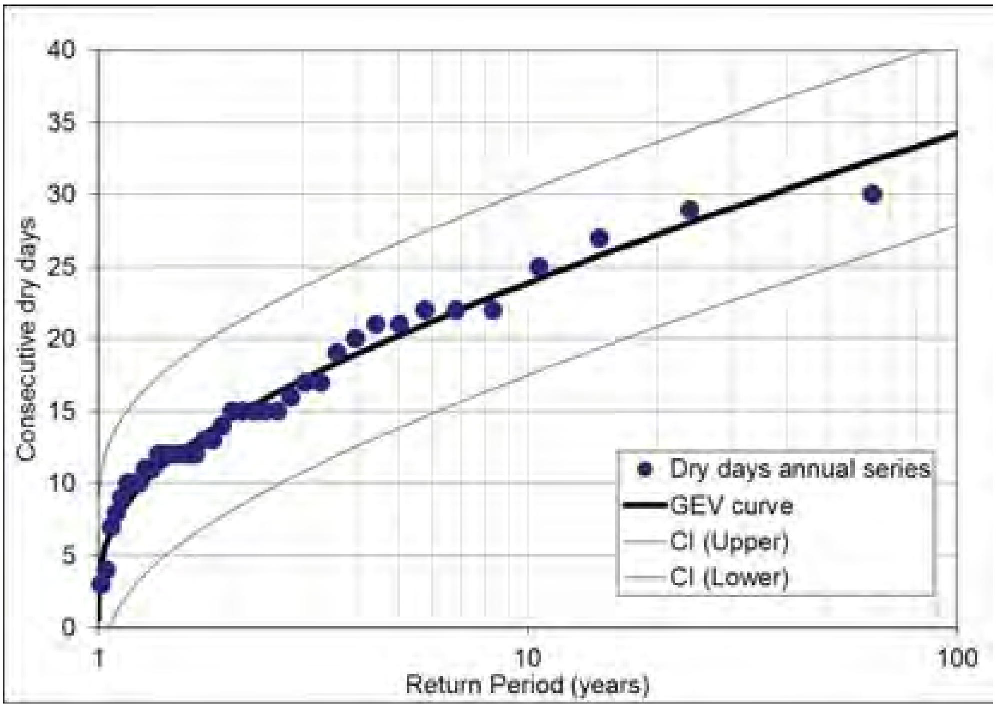


Figure 6-2 Extreme analysis (GEV) of consecutive days without rain, Taro Island. Note that a day without rain is defined as being a rainfall intensity less than the evaporation rate

6.3 Floods

6.3.1 Catchment Runoff

The annual maximum daily rainfall for Taro Island is shown in Figure 6-3. An extreme analysis (GEV) of this series is shown in Figure 6-4. The highest daily total of 257mm occurred in 1979, which is approximately equal to a 1% AEP or 100 year ARI event.

Given its catchment area and slope, a flood event in the Sui River is likely to be caused by a flood event of critical duration of 1 day or less. Sub daily rainfall data is less available and less reliable, however there is a 3 to 6 hourly record of the 1979 event (see Figure 6-5). This sub-daily record was adopted as the temporal pattern for the design 100 year ARI daily rainfall event.

To estimate flooding in the Sui River, a WBNM hydrologic model was developed (Figure 6-6). It consisted of 8 subcatchments, delineated using iFSAR terrain data, with a combined catchment area of 46km^2. Initial losses of 15mm and continuing losses of 2.5mm/hr were applied. The results, shown in Figure 6-7, show a significant flood event with a peak flow of 330m^3/s. No data is available to correlate or confirm this value, however the results appears consistent with other data records (e.g. Sorave River).

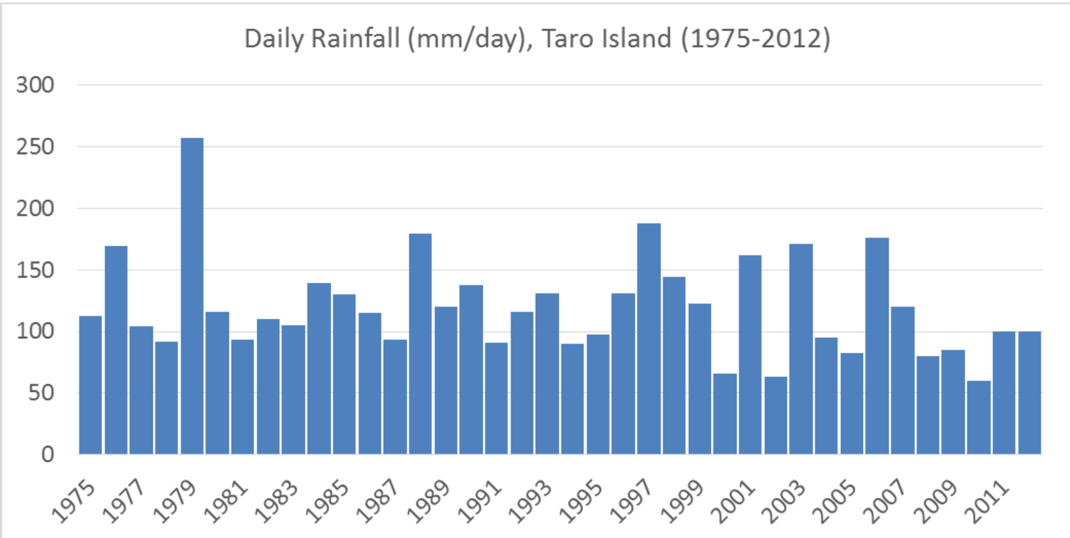


Figure 6-3 Highest daily rainfall per year, Taro Island

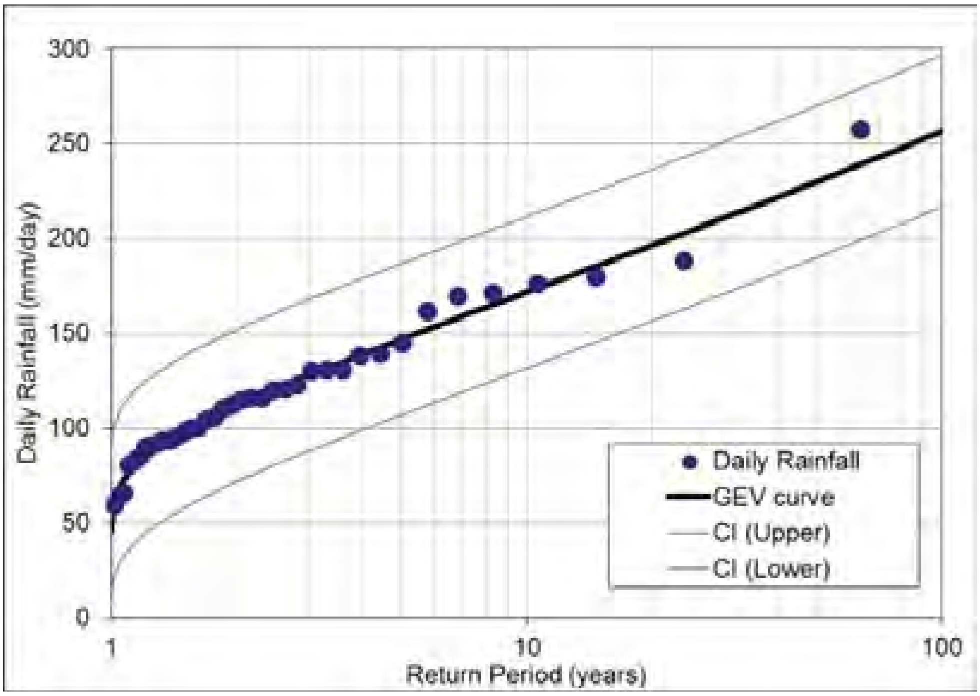


Figure 6-4 Extreme analysis (GEV) of daily rainfall, Taro Island

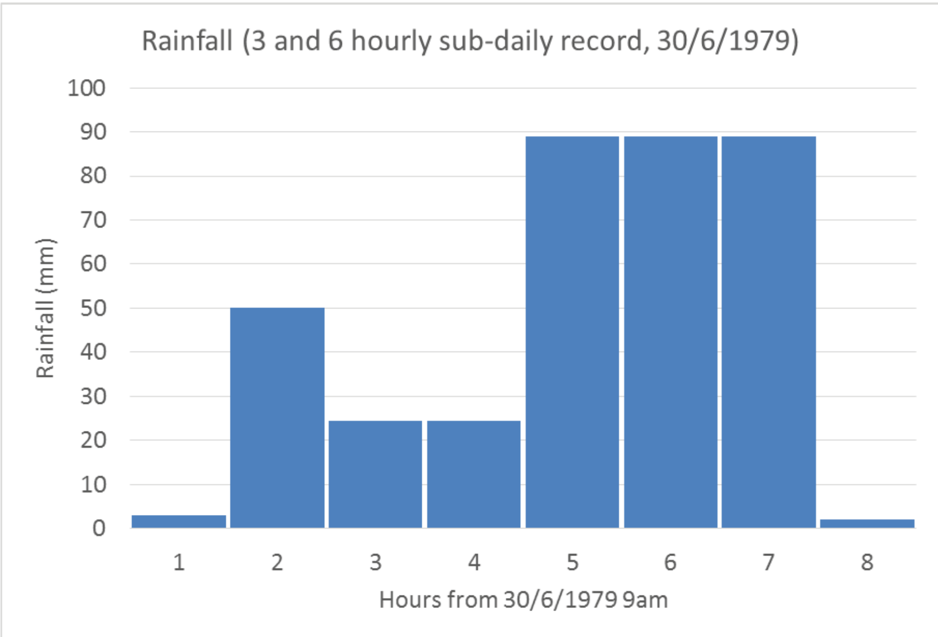


Figure 6-5 Temporal pattern of the 1979 rainfall event, based on 3 and 6 hourly interval data, Taro Island

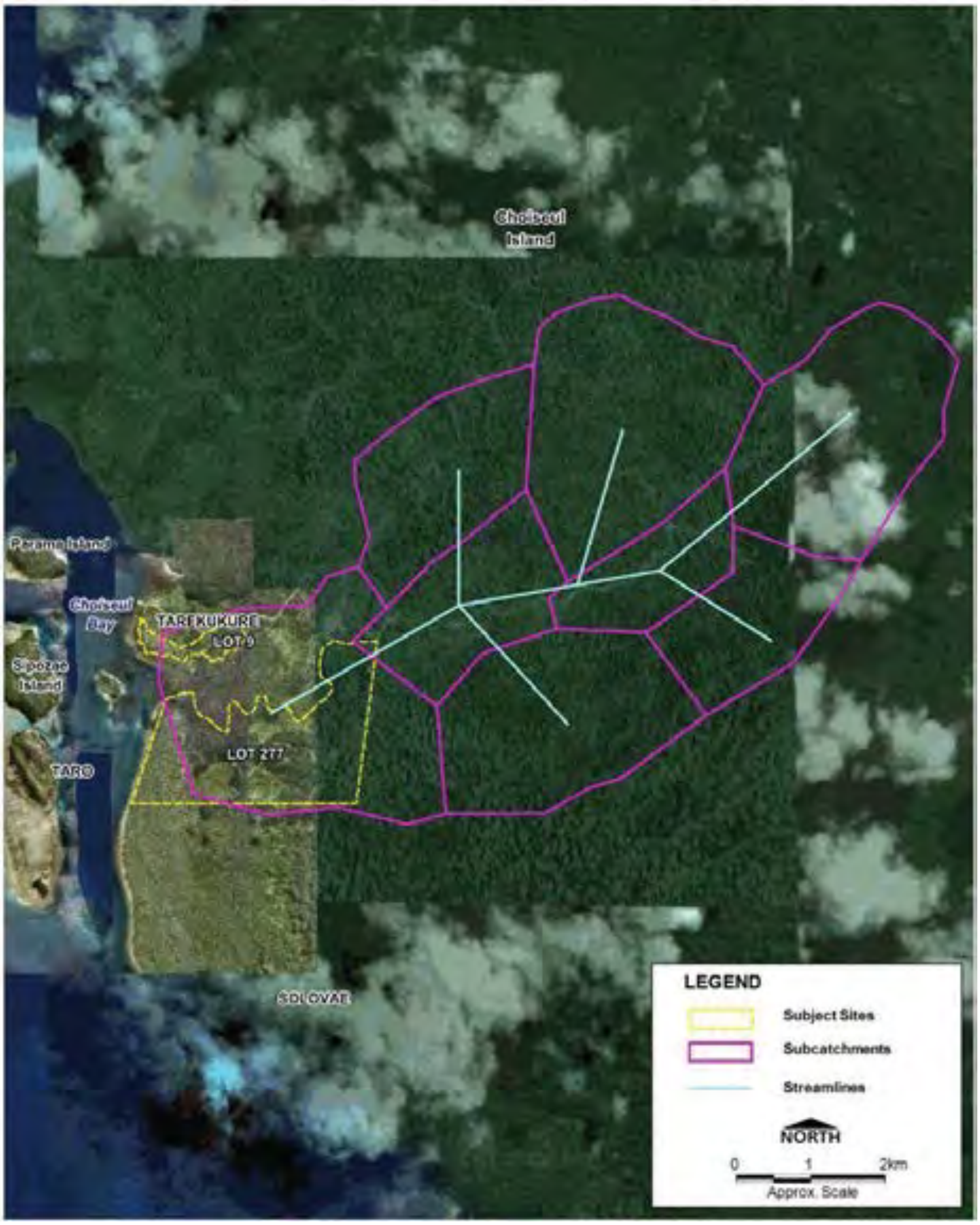


Figure 6-6 Hydrologic model subcatchments applied to predict high flow runoff in Sui River

6.3.2 Coincidence with Tides and Storm Surge

The duration of the flood event (with elevated discharges persisting for 6 hours or more) means that there is a reasonable chance that tidal water levels may be higher than MSL at some time during the event. Conservatively, a MHHW tide level has been applied to the flood scenario.

Heavy rainfall events are often associated with significant climatic events. It is assumed that the design rainfall event coincides with a tropical cyclone which, as is likely, would propagate from offshore and cause widespread heavy rainfall on the catchment shortly after passing the coastline. The flood scenario assumes a joint occurrence of major upstream discharge with a storm surge event, generated by the strong winds, low atmospheric pressure and wave action of the cyclone (parameterisation of storm surge is described in Section 6.5; the combined flood / storm surge timings are shown in Figure 6-7).

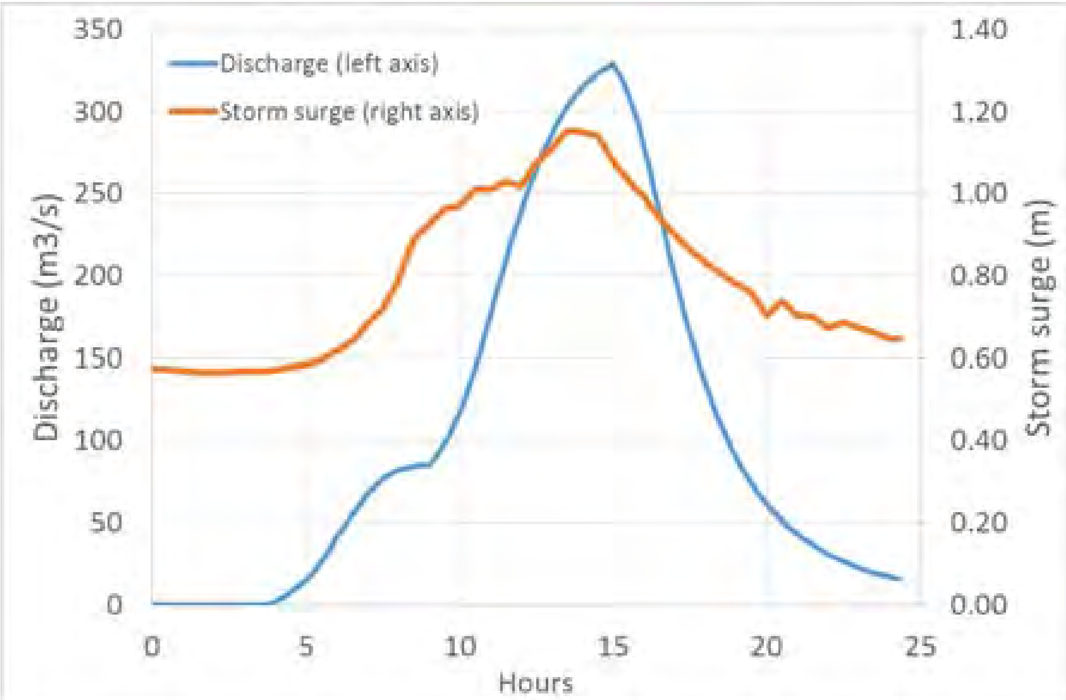


Figure 6-7 100 year ARI flood event for Sui River. Discharge time series based on design rainfall analysis and hydrologic modelling, water level time series based on storm surge analysis from cyclonic activity. Timing assumes storm surge peak occurs close to peak of rainfall.

6.3.3 Flood Mapping

To assess flooding a hydrodynamic numerical model was applied (TUFLOW FV, see Appendix A). The model simulates the propagation of the flood event, from its commencement, through to peak discharge and tailing off, from the upper end of the floodplain and into the lagoon. Downstream water level conditions are a combination of MHHW and the storm event.

Model simulations performed, and the subsequent maximum flood inundation maps, are summarised in Table 6-1.

Table 6-1 List of flood scenarios

Simulation	Condition	Flood inflow	Storm Tide	Water level
1	Existing	100 year ARI	100 year ARI	MHHW
2	2055	100 year ARI, 30% intensification	100 year ARI, 10% intensification	MHHW + 0.38m
3	2090	100 year ARI, 40% intensification	100 year ARI, 10% intensification	MHHW + 0.82m

6.4 Tides

The occurrence of king tides are a hazard, particularly for Taro Island. Local residents describe king tides occurring annually in December / January that inundate low lying areas (this is also mentioned in Ministry of Provincial Government and Rural Development 2001).

Highest Astronomical Tide (HAT) is the highest tidally driven water level that can occur based on tidal prediction analysis. It is the perigean spring tide when the sun and moon are closest to the earth and, in the absence of any other non-tidal influence, will only occur once in 18 years. Conservatively, this value is assigned as the design tide level. From Table 2-1, HAT in the study area is 0.95m MSL.

Other non-tidal influences can contribute to water levels (floods, cyclones, etc, discussed and assessed separately), however the joint occurrence of such non-tidal anomalies with HAT is unlikely.

6.5 Tropical Cyclones

6.5.1 Historical Events

A number of tropical low pressure systems occur each year in the Solomon Islands and some develop into tropical cyclones. Taro Island and the north of Choiseul province is subject to cyclonic activity, but due to its northern location (at the northern edge of the tropical cyclone region) intensities are relatively low. Nevertheless, cyclones can cause damage to structures due to destructive winds and coastal inundation. Tropical cyclones can also cause heavy and widespread rainfall that can cause flooding.

The Australian Bureau of Meteorology's (BoM's) Southern Hemisphere Tropical Cyclone Data Portal provides "best-track" information of historical cyclones, including estimates of storm position, central pressure and maximum winds. This database identifies 30 cyclonic events that passed within a 500km radius of Taro Island since 1947 (see Figure 6-8). The decadal distribution of the events is shown in Figure 6-9.

Historical cyclone track data have been analysed to characterise tropical cyclone climatology in the Choiseul Bay region. For each tropical cyclone the following characteristics have been evaluated:

- Minimum central pressure;
- Average forward travelling velocity; and

- Typical track direction.

The empirical statistical characteristics of the first two of these cyclone parameters are shown in Figure 6-10 and Figure 6-11. The analysis indicates that the 1% AEP (or 100 year ARI) central pressure is around 965hPa, and forward speeds are typically between 1m/s and 3m/s and rarely more than 5m/s.

The analysis of the track direction suggests that both coast-parallel (i.e. moving along Choiseul Island) and coast-crossing cyclones have been recorded in the past. Notwithstanding this, most cyclones tend to track in an overall southerly direction.

The primary parameter governing the 'severity' of a cyclone is the central pressure. Consequently, providing an estimate of the statistical behaviour of the minimum central pressure of a storm is an important part of long-term cyclone-generated coastal hazards prediction. Estimates of statistical minimum central pressures are provided in Table 6-2.

Table 6-2 Minimum central pressures statistics

Annual Exceedence Probability	Return Period (ARI)	Minimum Central Pressure
5%	20 years	982 hPa
1%	100 years	965 hPa
0.2%	500 years	950 hPa

Figure 6-8 Cyclone tracks that passed within 500km of Taro Island since 1947

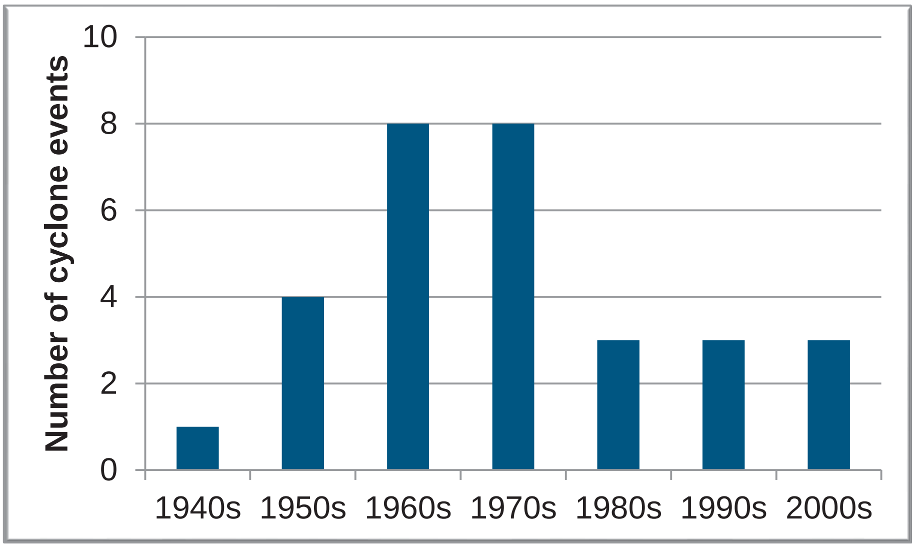


Figure 6-9 Decadal distribution of cyclone events that passed within 500km of Taro Island since 1947

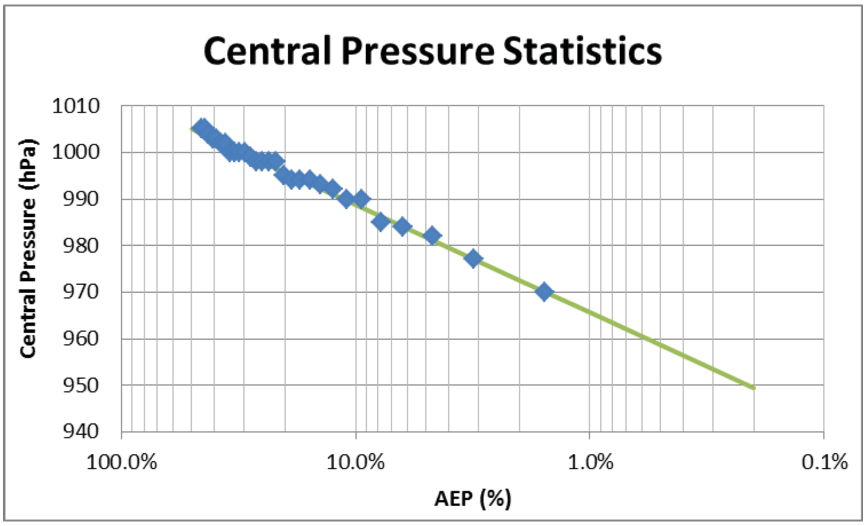


Figure 6-10 Extreme analysis of cyclone central pressures

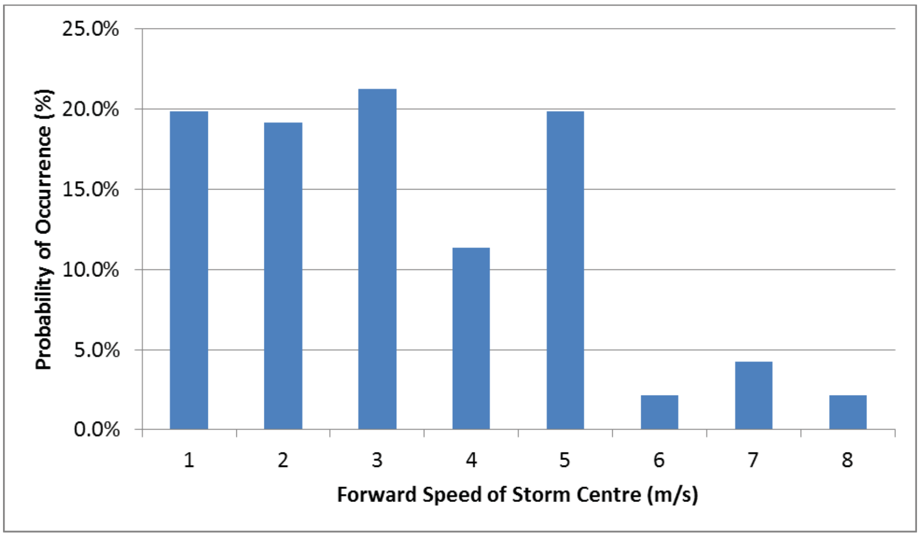


Figure 6-11 Frequency occurrence of cyclone forward speeds

6.5.2 Numerical Modelling

A numerical modelling system was developed to simulate tropical cyclone generated storm surge and inundation along Taro Island and the Choiseul Bay Township site. The modelling system is comprised of the following components:

- Parametric wind and pressure field model (Holland model);
- 2D spectral wave model for simulating storm generated waves (SWAN); and
- 2D hydrodynamic model for simulating storm surge and inundation (TUFLOW FV).

6.5.2.1 Wind and Pressure Field Model

A parametric model of the cyclone wind and pressure fields provides the necessary forcing to the hydrodynamic and spectral wave models. The Holland (1980) model, as described and recommended in the Ocean Hazard Assessment (DNRM, 2001), has been used in this study. The Holland model provides an analytical representation of the cyclone wind and pressure field based on the specification of the following time varying parameters:

- Cyclone position (available from the BOM database);
- Central pressure (available from the BOM database);
- Ambient pressure (available from the BOM database, adopted as 1010hPa);
- Radius to Maximum winds (adopted as 35km);
- Cyclone forward motion vector (available from the BOM database, adopted as 5m/s);
- Line of maximum winds (available from the BOM database);
- Angle of peak winds (adopted as 115 degrees true); and

- Wind profile “peakedness” parameter (based on storm central pressure and determined following Harper and Holland, 1999).

An example of Holland wind field model output, being the time of maximum wind at Choiseul Bay during the 1% AEP design storm “N03”, is shown in Figure 6-12.

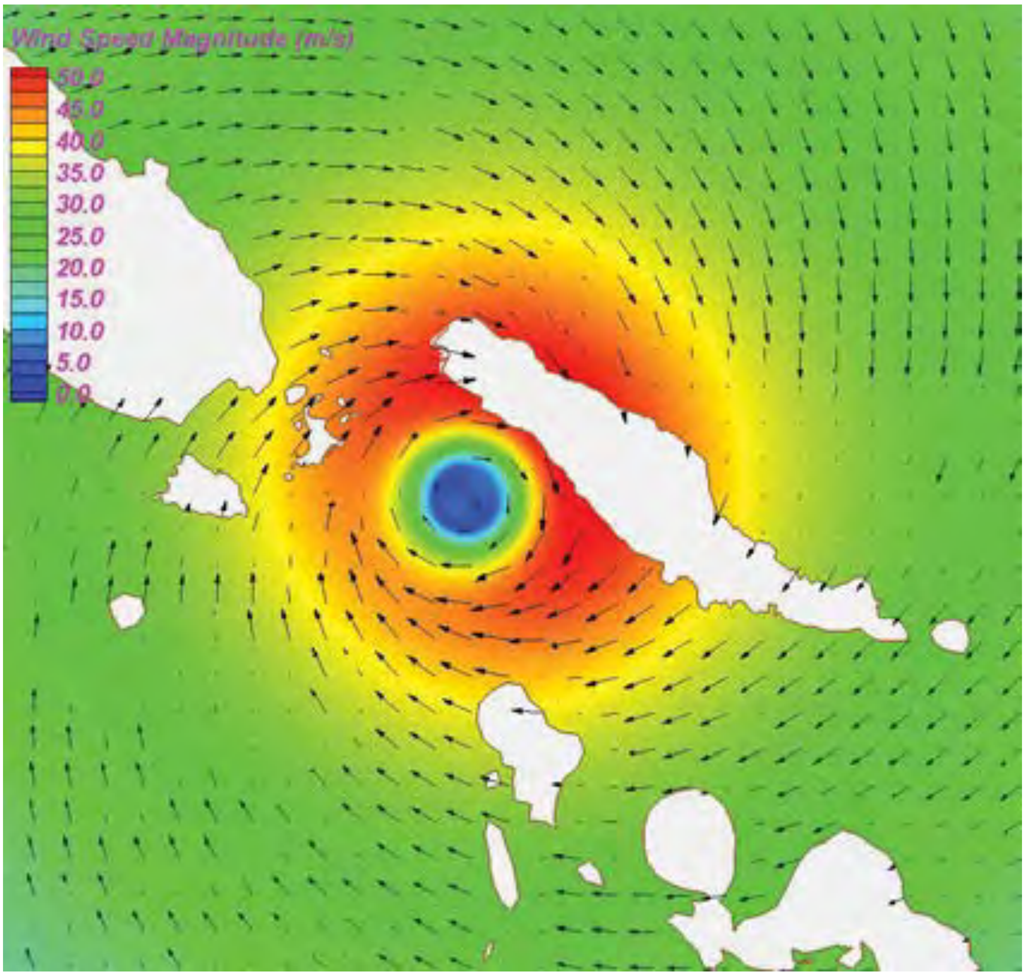


Figure 6-12 Modelled Wind Field during 1% AEP Design Storm Event “N03”

6.5.2.2 Wave Model

Wind wave generation has been predicted using SWAN, a third-generation spectral wave model developed by Delft University of Technology (Booij, 1999). SWAN has been used in non-stationary mode, forced by the moving wind field (varying in space and time) predicted by the Holland wind field model (previous section).

A nested grid system was used to maximise wave model efficiency whilst minimising inaccuracies associated with model boundary definitions. Boundary conditions for each nested grid is obtained from the encompassing coarser grid. The bathymetric input to the SWAN wave models are identical to data sources used for the TUFLOW FV storm surge model. Three model domains were used (Figure 6-13):

- A 2500m grid resolution regional model covering large areas of the Pacific Ocean and the Solomon Sea;
- A 500m grid resolution medium scale model of the coastal waters of Choiseul Island, covering an area of approximately 100km by 100km; and
- A 50m grid resolution fine scale model representing the nearshore regions around Choiseul Bay.

Predicted wave heights and periods have been used to assess the exposure of the site to cyclone-induced wind waves and estimate the wave setup contribution to the mean shoreline water level during such events. The wave setup contribution was estimated using a wave setup method for coral reefs developed by Gourlay (1992, 1994, 1996, 1997) and published in Ocean Hazard Assessment (DNRM, 2001).

Figure 6-13 SWAN model domains for simulation of cyclone induced wave generation

6.5.2.3 Hydrodynamic Model

The hydrodynamic modelling engine TUFLOW FV has been used to simulate cyclone-generated ocean surge and the resulting coastal inundation in the study area.

A flexible mesh approach has been used whereby the storm surge model has a high resolution in the areas of interest, then a relatively lower resolution elsewhere and/or in locations where more gradually varying hydrodynamics are expected. The model domain covers an area of about 800km by 800km and has a mesh resolution of approximately 20m around Taro Island (see Figure 6-14).

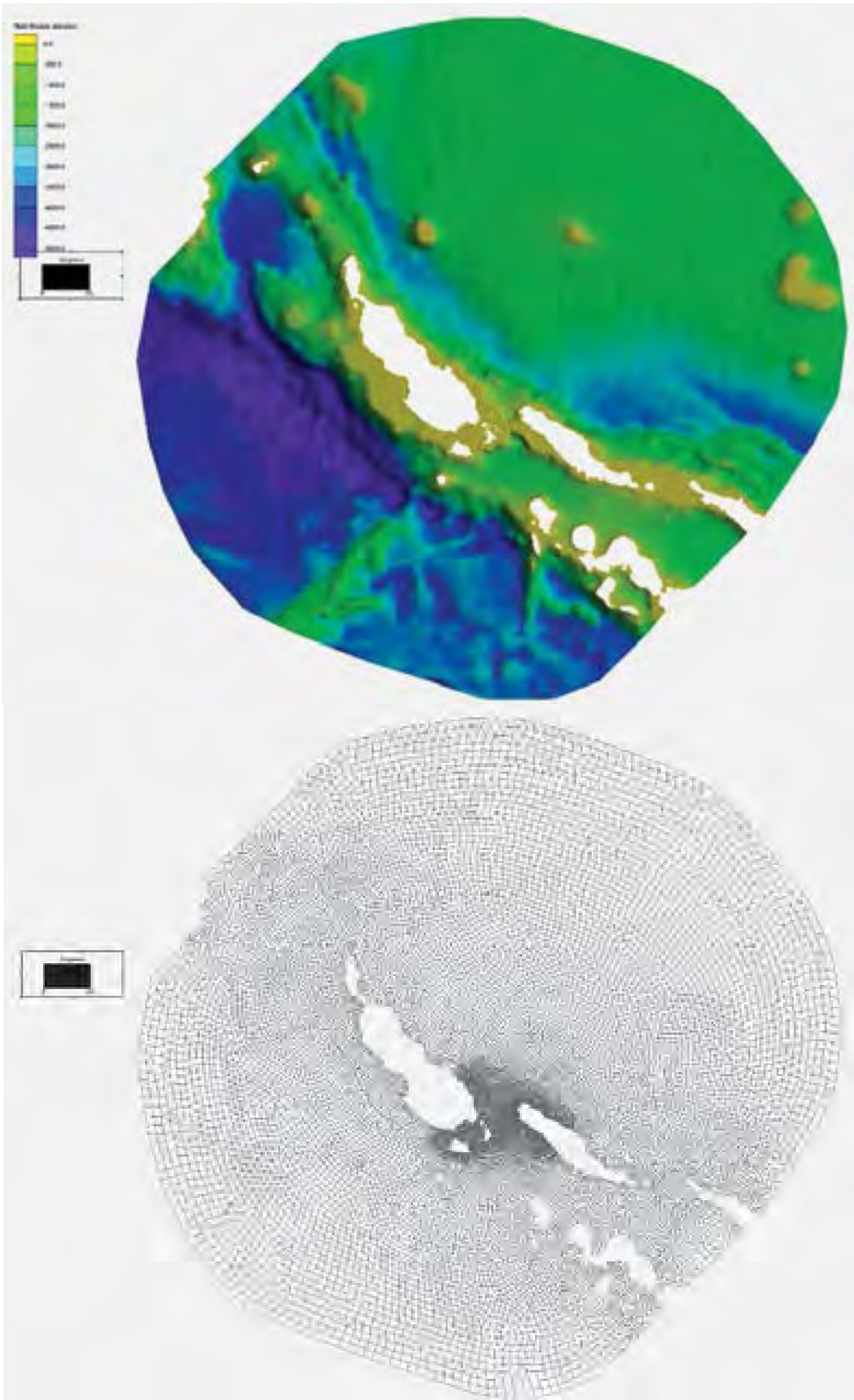


Figure 6-14 Hydrodynamic model domain for simulation of cyclone induced storm surge (bathymetry shown top, mesh design bottom)

The regional bathymetry of the storm surge model was based on the GEBCO_08 gridded bathymetric data set, provided by the British Oceanographic Data Centre (BODC). GEBCO_08 has a grid resolution of 30 arcseconds. Within the Choiseul Bay region the model bathymetry is based on a Digital Elevation Model (DEM) derived from a variety of data sources including a bathymetrical survey of Choiseul Bay, topographical survey of Taro Island and the Choiseul Bay Township site and hydrographic charts (Section 2).

No suitable data could be made available to verify the performance of the storm surge model with regard to simulation of cyclone events.

6.5.3 Design Events

A total of 15 possible tracks of storms with a 100 year ARI storm intensity were considered (Figure 6-15). The design event was then the highest simulated storm surge at Taro Island and Choiseul Bay from these simulations.

The design storm event for Choiseul Bay is where the cyclone track passes directly over Taro Island in a northwest-southeast direction (scenario N03). The design storm event at the offshore coastline of Taro Island is where the cyclone track passes parallel to Choiseul Island approximately 35km offshore (scenario P04). These scenarios were adopted in subsequent design model investigations.

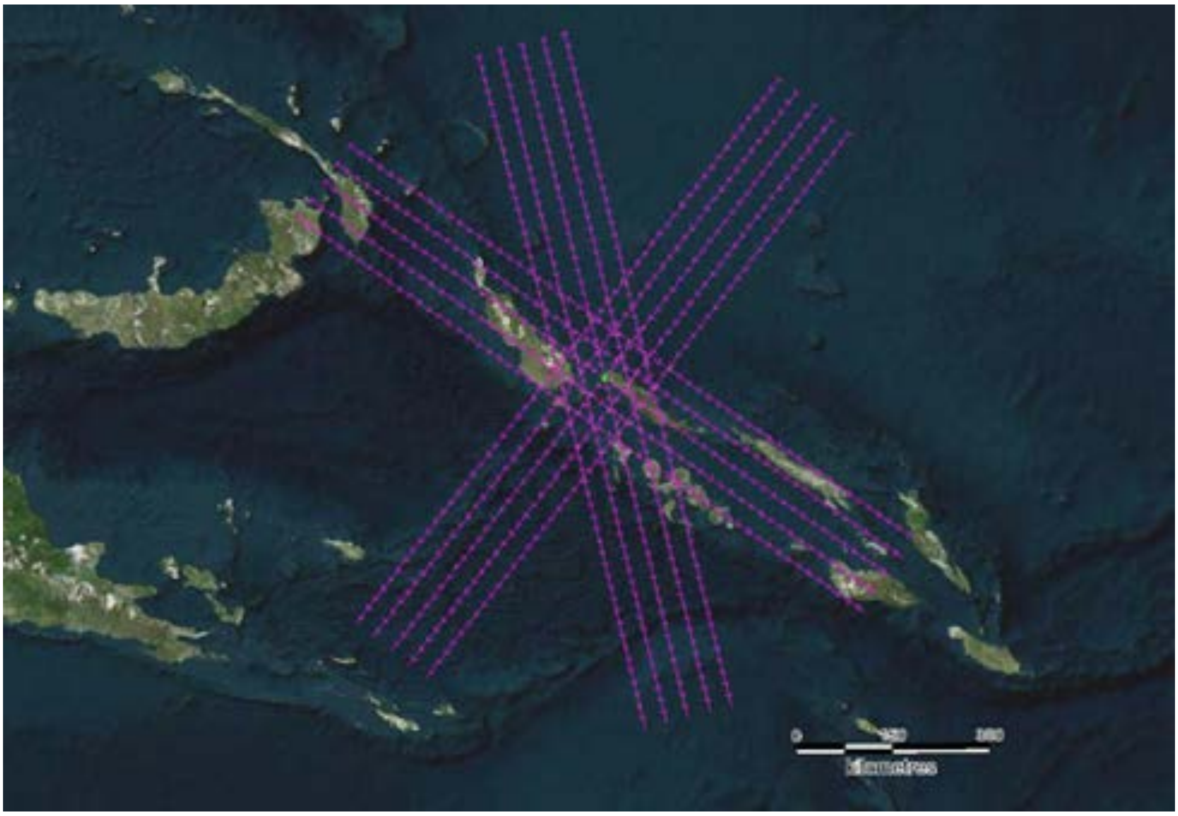


Figure 6-15 Tracks of Modelled Tropical Cyclones

As for the flood simulations, the duration of the cyclone event means that there is a reasonable chance that tidal water levels may be higher than MSL at some time during the cyclone event. Consequently, in the design event modelling it is assumed that the storm event would coincide with a MHHW tidal condition.

The storm tide levels therefore consist of the components of tide (MHHW) and atmospheric pressure and winds (from the TUFLOW FV modelling) and waves (from the SWAN modelling).

Table 6-3 List of storm surge scenarios

Simulation	Condition	Water level	Storm Tide
1	Existing	MHHW	100 year ARI
2	2055	MHHW + 0.38m	100 year ARI, 10% intensification
3	2090	MHHW + 0.82m	100 year ARI, 10% intensification

6.5.4 Elevated Ocean Water Levels

Elevated water levels in the ocean occur as a consequence of the following components:

- Tidal variations;
- Seasonal and decadal variations in mean ocean water levels due to regional climatic and oceanic influences;
- Storm surge, caused by atmospheric pressure, winds and waves; and
- Tsunami (discussed separately).

To establish a maximum water level suitable for design, the following analyses can be considered:

(1) Application of total water level analysis, where the recorded water levels are analysed using extreme value analysis. While this method will inherently incorporate the joint probabilities of high tide levels coincident with elevated seasonal events and storm surge events, it cannot distinguish the relative influences of each physical process.

   – The highest water level recorded at Tarekukure Wharf during 2011 and 2012 was 0.94mMSL. This is close to tidal HAT (see Table 2-1).

(2) Extraction and analysis of residual water levels; tidal variations can be extracted from the water level record using tidal analysis, leaving the residual non-tidal signal. Then, analysis on each component can be performed and the resulting design values recombined.

   – Figure 6-16 shows observed water levels, tidal predictions and the residual water level at Tarekukure Wharf. As shown, the dominant signal in the residual is the 2011 Japanese tsunami event (discussed separately). The remainder of the residual signal is low (typically between -10 and 10cm) and is likely to be a relic from the tidal analysis.

(3) Validation of physical processes using numerical modelling; assessment of the underlying physical processes that cause storm surge provide further validation of the design levels.

– Section 6.5 describes the application of numerical modelling to simulate the effect of wind, wave and atmospheric pressure forcings.

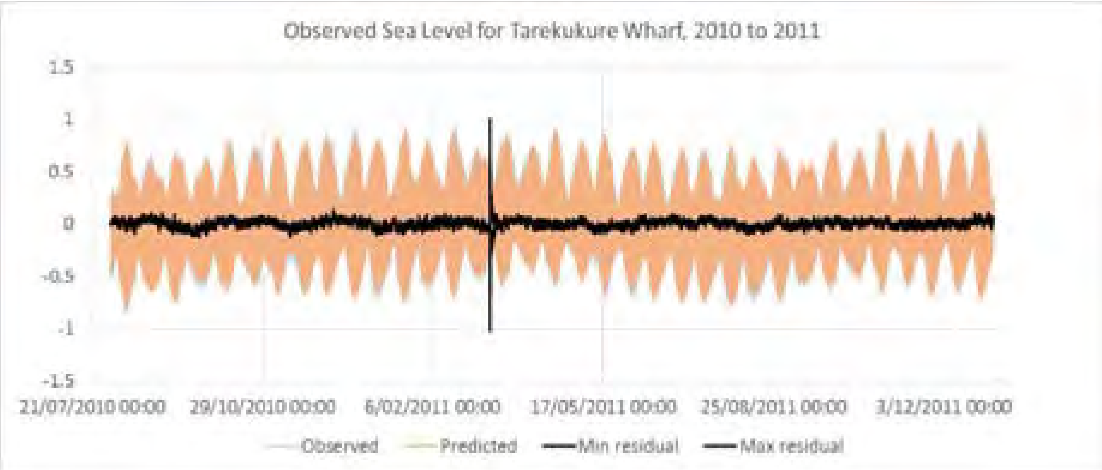


Figure 6-16 Residual analysis of Tarekukure Wharf water level data, 2011 and 2012

The total elevated water level, summarised in Table 6-4, is derived as follows:

- $H_{total} = H_{tide} + H_{seasonal} + H_{storm\ surge} + H_{SLR}$
  – H_{tide} is the water level component due to tidal variations only. Considering the duration of storm surge events (of the order of several hours) it is reasonable to assume a peak coinciding with high tide. A value of 0.54m MSL (MHHW) is proposed.
  – $H_{seasonal}$ is the component due to seasonal variability. Residual analysis does not indicate any significant seasonality in mean sea levels, nor any significant oceanic influences.
  – $H_{storm\ surge}$ is determined from numerical modelling, incorporating wind, wave and atmospheric pressure setup. The 1% AEP / 100 year ARI storm surge estimates are applied.
  – H_{SLR} is mean sea level rise due to future climate change (Section 5).

Table 6-4 List of total elevated ocean water level projections

ID	Condition	Tide + Seasonal + SLR	Storm Surge	Total elevated ocean water level
1	Existing	MHHW + 0.00m	100 year ARI	3.1m MSL
2	2055	MHHW + 0.38m	100 year ARI, 10% intensification	3.6m MSL
3	2090	MHHW + 0.82m	100 year ARI, 10% intensification	4.1m MSL

These values are subject to interpretation and may differ according to specific requirements or opinions. When there is a significant risk to life or major property damage, a more conservative approach is recommended.

6.6 Tsunami

6.6.1 Description of Tsunami Events

The word tsunami is derived from two Japanese words: tsu meaning harbour, and nami meaning wave. Tsunamis are waves with long periods that can travel quickly over long distances. They have fundamental physical differences to normal ocean waves. In particular their energy is not easily dispersed, which can result in significant coastal inundation and damaging current velocities. Tsunamis are generally associated with two types of damage: (1) the effects of still water inundation over land area or buildings, and (2) the destructive force exerted by an impacting wave. For these reasons tsunamis are a threat to human life and property in many coastal locations around the world.

The majority of tsunamis are caused by large earthquakes under the sea floor, when two or more plates suddenly move past each other. Vertical movement of the sea floor causes the overlying water to move upwards and spread outwards from the earthquake centre as a tsunami. Other tsunami generating mechanisms, including submarine landslides and volcanic eruptions, are less well understood and less likely to create a large scale tsunami. Meteorite impacts are capable of cause large tsunami, but are very unlikely to occur. Each source type will generate a unique tsunami source wave size, shape and period.

From the initial disturbance, the long wave periods of a tsunami wave train typically behave like shallow-water waves and propagate at a speed dependent upon water depth. In deep oceans, energy losses are limited.

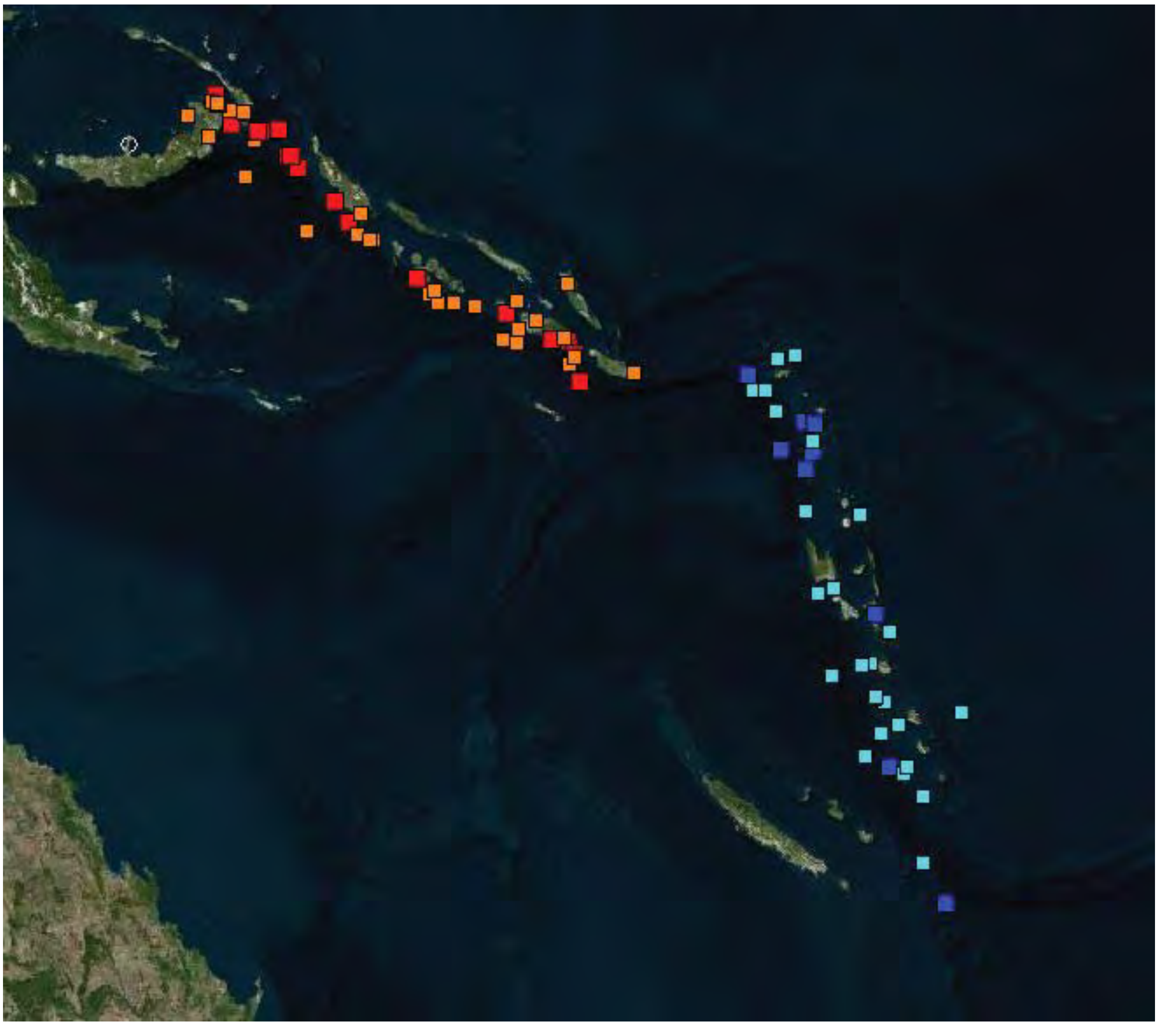
At landfall, the tsunami wave (or series of waves) will shoal up to larger height, deform and possibly break before running up onto the land to a height and distance that depends upon the source wave characteristics, local bathymetry and other factors.

6.6.2 Tsunami Sources

The Solomon Islands region is characterised by a high frequency of earthquake activity, making it vulnerable to tsunami. Primary sources of tsunami for the country are from the South Solomons and New Hebrides trenches. Figure 6-17 summarises large earthquake events that have occurred along these trenches since 1910.

In the vicinity of Choiseul Island, there is a major earthquake focal area where the Pacific, Woodlark and Australian plates meet. This earthquake focal area runs approximately 100km to the south of Choiseul Island (Figure 6-18).

Other sources of tsunami are regional plate boundaries that lie in and around the Pacific Ocean; the Japanese tsunami in 2011 is an example. The Solomon Islands is surrounded by the “Ring of Fire” (Figure 6-19), a region of intense tectonic activity. Numerous volcanoes ring the Pacific Ocean and it is the location of some of the largest and most seismically active faults in the world.



Historical tsunamis: South Solomons Trench (red)	Historical tsunamis: New Hebrides trench (blue)
49 events since 1910 of which 16 events >7.5 Mw (in red) Largest recorded earthquake: magnitude 8.1 (April 2007 and April 1977)	35 events since 1910 of which 9 events >7.5 Mw (in blue) Largest recorded earthquake: magnitude 7.9 (July 1980)

Figure 6-17 Historical seismic events in Solomon Islands since 1910, originating from the Solomons trench (red) and the New Hebrides trench (blue) (source: NOAA database)

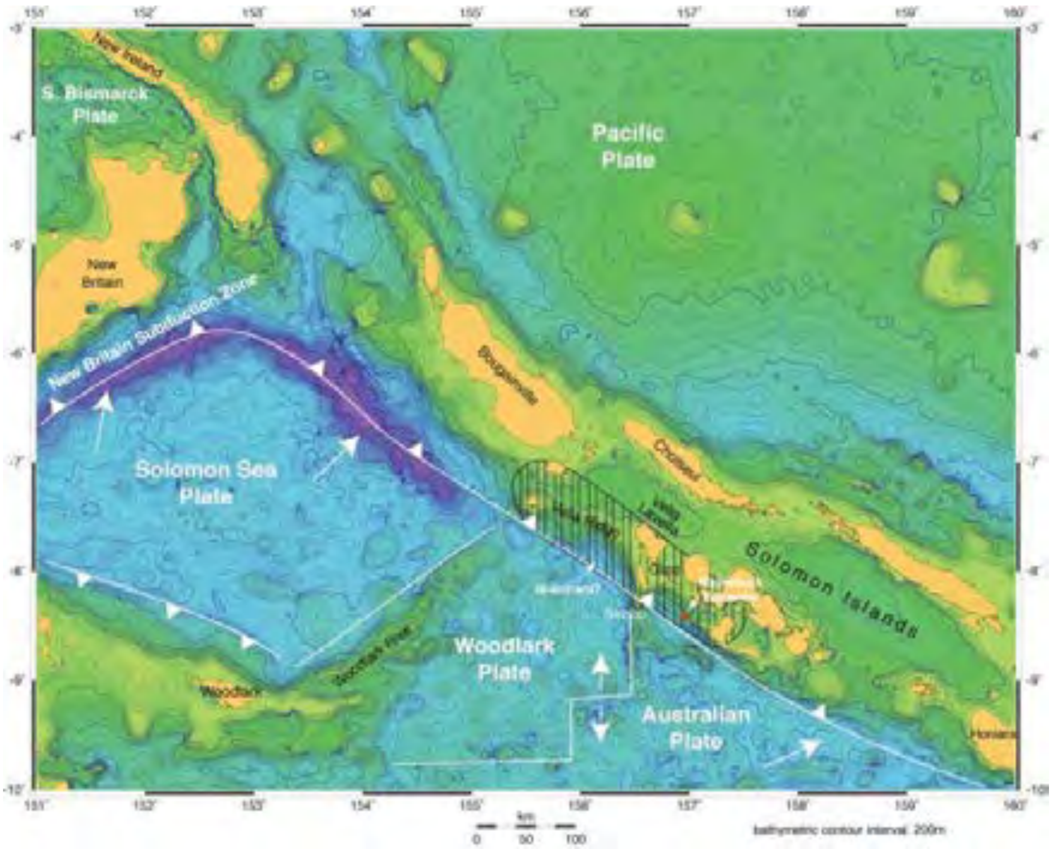


Figure 6-18 Tectonic setting of Choiseul Bay region

Figure 6-19 The Pacific "ring of fire"; locations of tectonic activity that influence tsunami hazard (http://www.ngdc.noaa.gov/hazard/stratoguide/intro.html)

6.6.2.1 NOAA Forecast Propagation Database

To examine the relative exposure of the Choiseul Bay region to earthquake sources around the Pacific Ocean, NOAA's Forecast Propagation Database was used.

NOAA, the National Oceanic and Atmospheric Administration, has a primary responsibility for tsunami warning in the US and takes a leading role in global tsunami research and observation. As part of NOAA's warning system, a computer model capable of forecasting tsunami generation and propagation and a Forecast Propagation Database has been developed.

The Forecast Propagation Database is a collection of tsunami propagation model runs that have been pre-computed for tsunami source functions at 1691 selected locations along known and potential earthquake zones. Each pre-defined source in the Propagation Database is referred to as a "unit source" and is equivalent to a moment magnitude of 7.5. Output in terms of water level timeseries can be obtained at either near-field or far-field offshore locations.

The database can be used to provide an indication of the relative exposure to earthquake sources around the world by examining the maximum tsunami amplitude for each pre-defined source location. Figure 6-20 presents the resulting map for an offshore location near Choiseul Island.

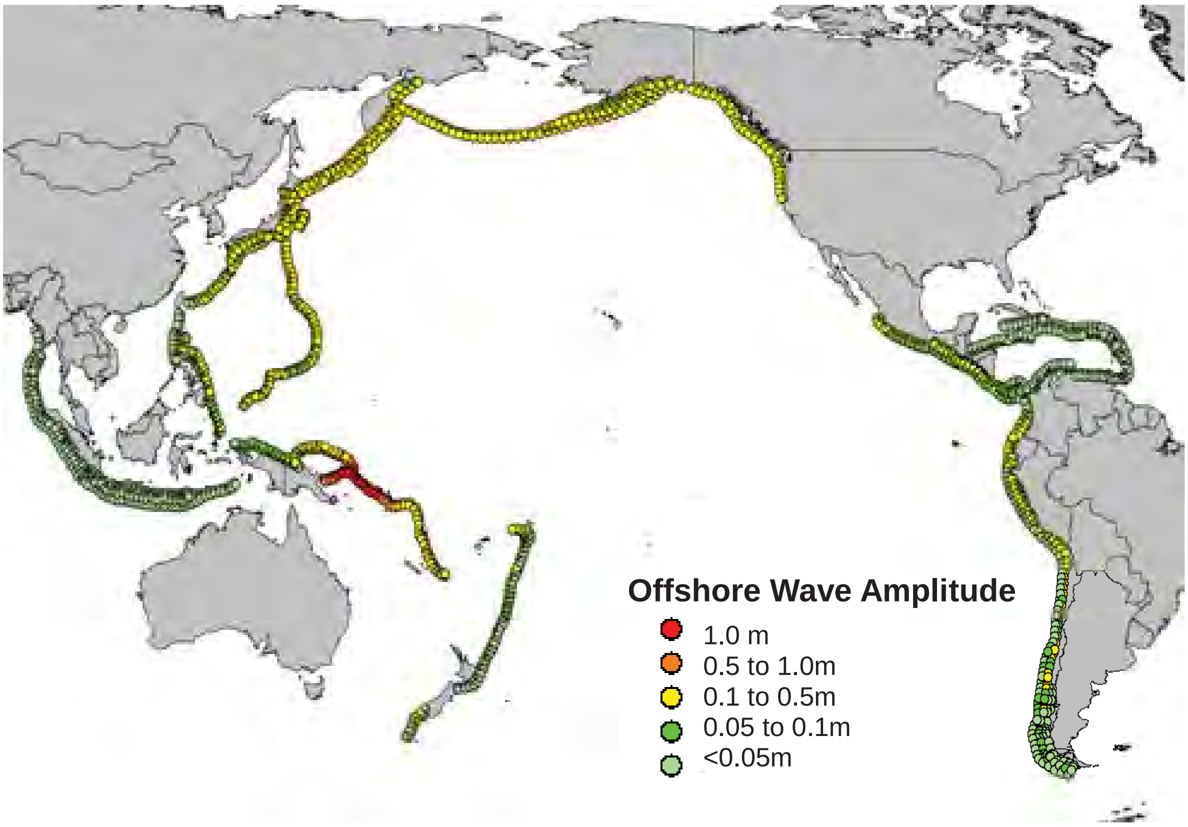


Figure 6-20 Database of tsunami generated maximum wave height offshore of Choiseul Island based on a 7.5 magnitude earthquake (NOAA Forecast Propagation Database)

It should be recognised that each pre-defined source is based on the same earthquake magnitude and such an earthquake magnitude does not have the same probability of exceedence at each source location.

Notwithstanding this, it is clear from Figure 6-20 that large earthquakes along the South Solomons Trench will generally result in the largest offshore tsunami wave amplitudes around Choiseul Island. This is confirmed by a recent tsunami hazard assessment of the Pacific Nations by Geoscience Australia (Thomas and Burbidge, 2009), which concluded that for the Solomon Islands "*the South Solomon and New Hebrides trenches are the only significant sources of hazard for the region*".

Consequently, tsunamis from nearfield sources have been the primary focus in the tsunami inundation modelling assessment.

Using the NOAA Forecast Propagation Database, time to impact at Choiseul for tsunamis generated by earthquake sources from around the world was determined (Figure 6-21). This figure shows that tsunamis generated from earthquakes located within the South Solomons Trench would take less than 1 hour to reach Taro Island, while tsunamis generated from the north of Papua New Guinea and within the New Herbrides trench (Vanuatu) may take between 1 and 4 hours to reach Taro.

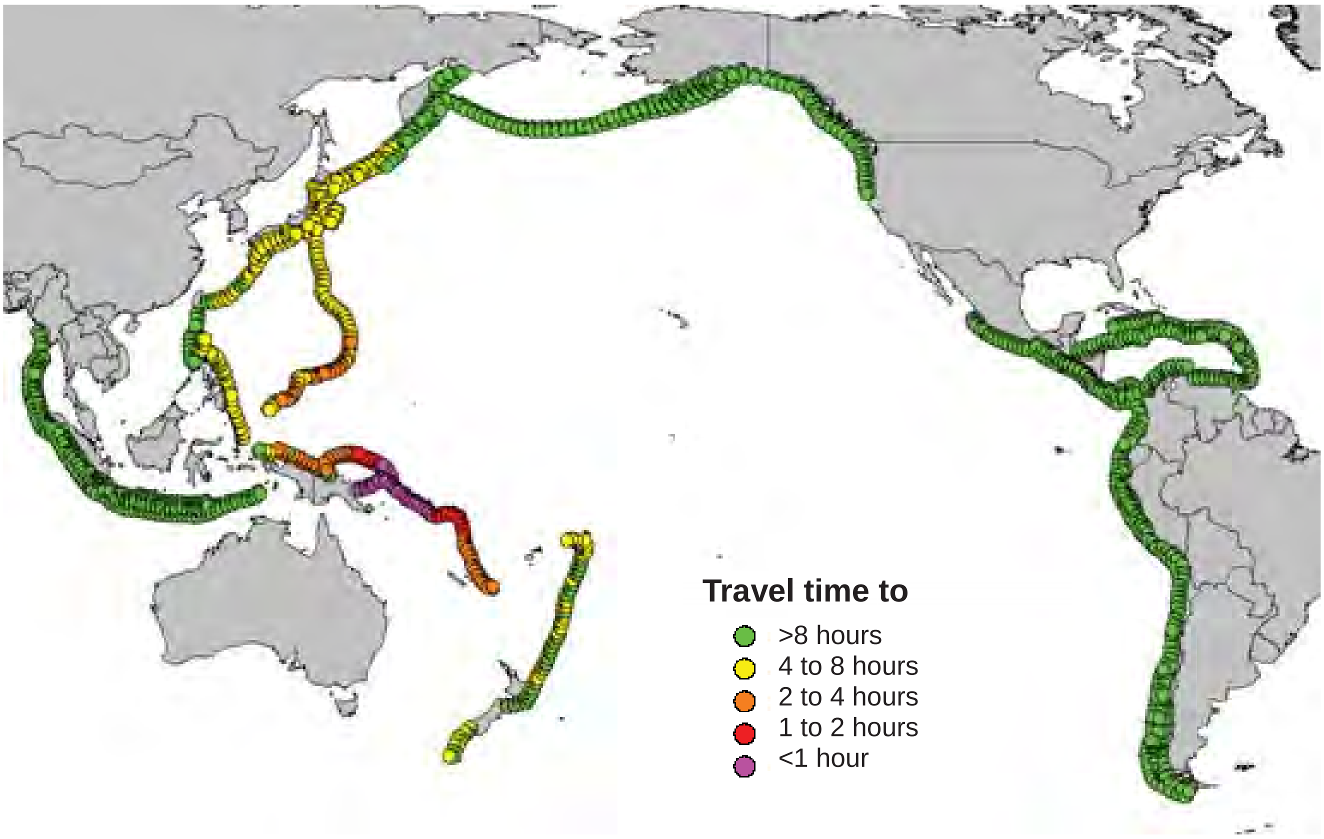


Figure 6-21 Database of tsunami travel time to reach Choiseul Island based on a 7.5 magnitude earthquake (NOAA Forecast Propagation Database)

6.6.3 Tsunami Inundation Modelling

A series of hydrodynamic numerical models has been developed and applied to simulate tsunami propagation and runup in the Choiseul Bay region using the 2D hydrodynamic modelling engine TUFLOW FV (Appendix A). As recommended in (Guard et al, 2013), a 2^{nd} order scheme using a Maximum Limited Gradient (MLG) horizontal gradient limiter solver was employed.

Two tsunami inundation models were developed; the first (the "South Pacific model") was used to simulate the 2011 Tohoku tsunami event, the second (the "South Solomons Trench or SST model") to simulate the 2007 Gizo tsunami event. Following calibration to the 2007 event, the second model was used to assess the inundation hazards at Taro Island and the Choiseul Bay township site as a result of near-field tsunamis around the South Solomon Trench.

Both tsunami inundation models use a variable mesh resolution with larger elements in deep water (of the order of 5km face length) and progressively smaller elements approaching Choiseul Bay and Taro Island (of the order of 50m face length). The local mesh layout of the SST model is presented in Figure 6-22.

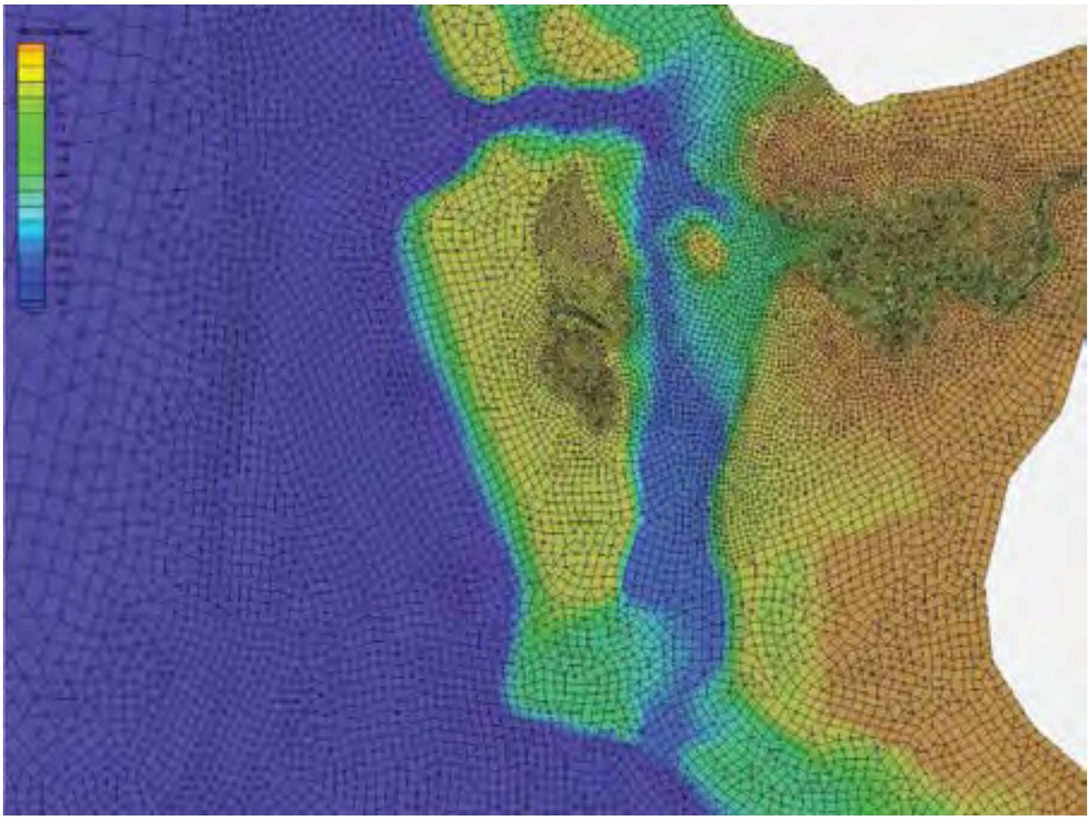


Figure 6-22 Mesh layout of SST tsunami inundation model in study area

6.6.3.1 2011 Japan Tsunami Event

A tsunami inundation model was developed to simulate the 2011 Great East Japan Earthquake Tsunami, to assess model performance and to identify tsunami wave runup patterns in and around Choiseul Bay.

The 2011 Tohoku tsunami was caused by a magnitude 9.0 Mw undersea earthquake, located near the east coast of Japan. The epicentre was approximately 5,500km distant from Choiseul. NGDC Dart buoys illustrate the propagation of the tsunami to the Solomon Islands (Figure 6-23). The tsunami reach Taro Island on 11th of March 2011 at approximately 13:00UTC when the water level recorder at Tarekukure Wharf registered an anomaly of approximately +1 and -1m (Figure 6-24).

Time varying water levels interpolated from DART stations 52406 and 52403 (http://www.ngdc.noaa.gov/hazard/dart/2011honshu_dart.html) were used to generate boundary conditions at the northern boundary of the tsunami runup model. The model boundary alignment was curved to maintain a phase-neutral wave propagation into the model domain.

Figure 6-25 compares water level disturbance predicted by the model with the residual time series at Tarekukure Wharf. The comparison is accurate, especially in capturing the amplitude of the initial wave trough and peak. Timings of subsequent wave troughs and peaks are faster in the model compared to measurements.

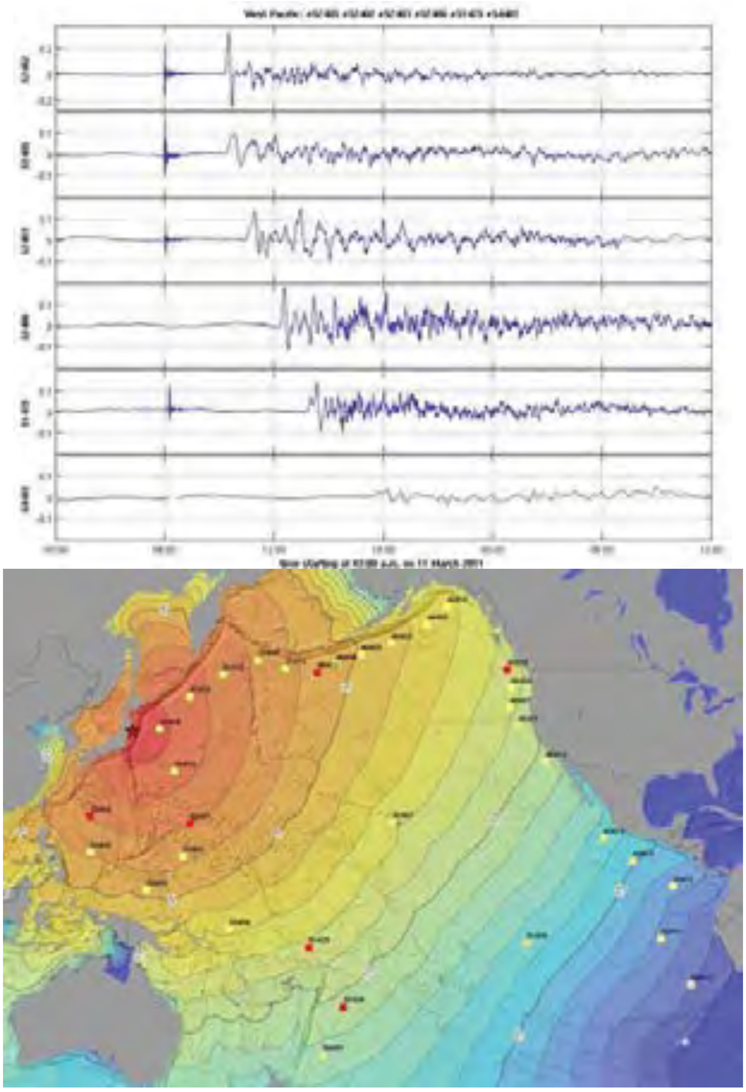


Figure 6-23 NGDC DART buoy data, showing the propagation of the Japanese tsunami across the Pacific Ocean

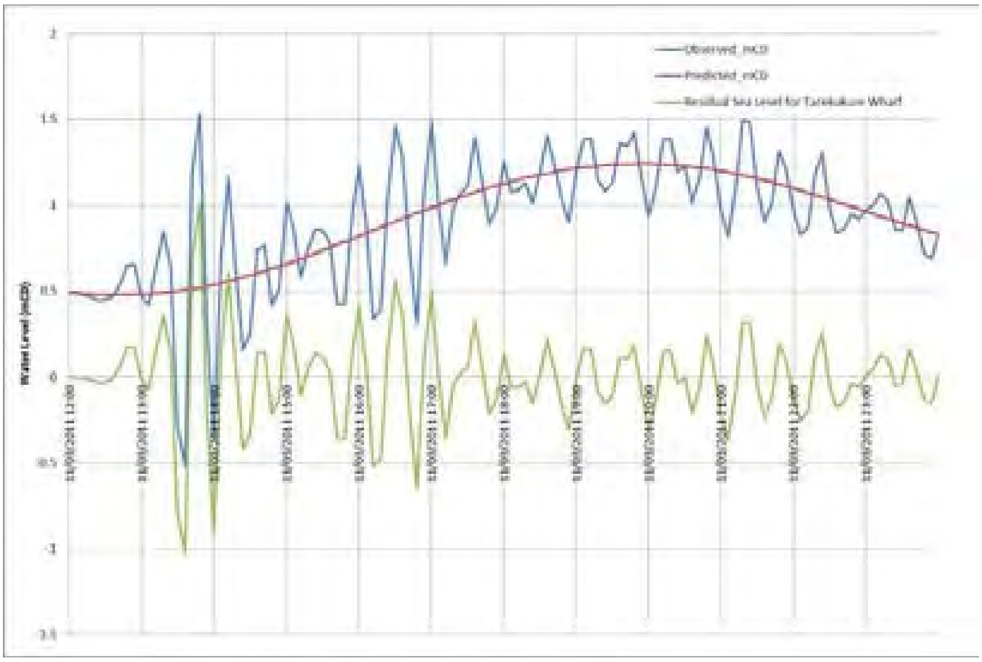


Figure 6-24 Water levels (observed, tidal prediction and residual) at Tarekukure Wharf during the March 2011 tsunami event – zoom view

Figure 6-25 Model calibration to the 2011 Japanese tsunami, comparing time series of residual water levels at Tarekukure Wharf (6 minute sampling interval) with model predictions. DART deep ocean measurement site 52406 time series also shown (http://www.ngdc.noaa.gov/hazard/dart/2011honshu_dart.html, applied as time varying water level boundary condition to the model) and at Tarekukure Wharf.

6.6.4 2007 Solomon Islands Tsunami Event

The 2007 Gizo tsunami event was caused by a magnitude 8.1 Mw undersea earthquake with the epicentre located near Gizo Island, approximately 160km to the southeast of Choiseul Bay (near Ranongga Island). The event caused severe damage and destruction throughout the Solomon Islands (see Figure 6-26, Figure 6-27 and Figure 6-31).

The 2007 Gizo tsunami was analysed to evaluate the tsunami model's capability to simulate tsunami runup at the Choiseul Bay area from near-field tsunami sources and estimate the relationship between earthquake features and the initial water surface disturbance caused by earthquakes.

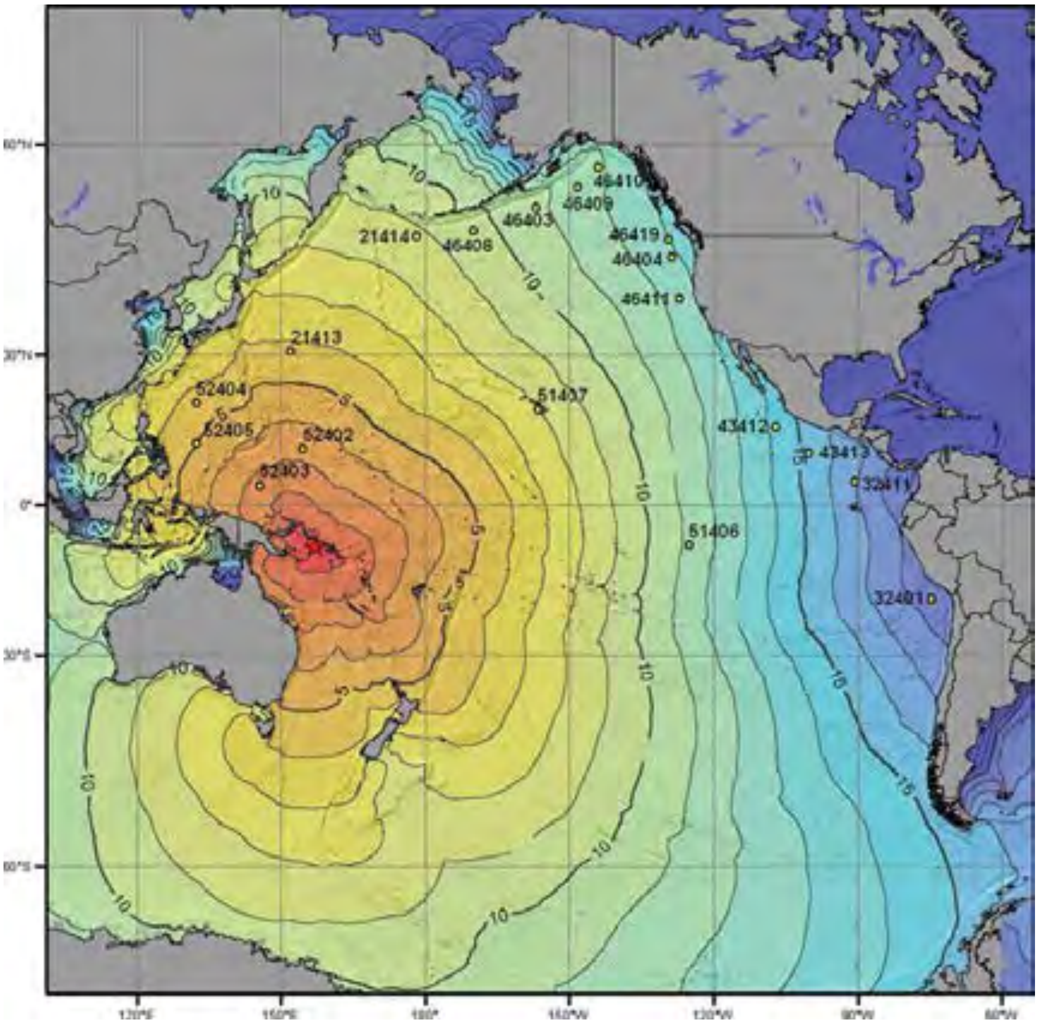


Figure 6-26 Propagation of the 2007 Gizo tsunami across the Pacific Ocean

	Population (% of affected pop.)	Number of Dead (% of village pop.)	Children (under 10) dead (% of dead)
Ghizo			
Gizo	3302 (77.6%)	2 (0.1%)	0
New Manra	*206 (4.8%)*	*8 (3.9%)*	*5 (62.5%)*
Titiana	*366 (8.6%)*	*13 (3.6%)*	*8 (61.5%)*
Pailongge	76 (1.8%)	0	0
Kolombangara	89 (2.1%)	0	0
Nusa Mbaruku	*216 (5.1%)*	*10 (4.6%)*	*8 (80.0%)*
TOTAL	**4255**	33	**21**
Simbo			
Tapurai	234 (85.4%)	7 (3.0%)	1 (14.3%)
Riguru	40 (14.6%)	2 (5.0%)	0
TOTAL	**274**	**9**	**1**
Ranongga			
Mondo	341 (100%)	2 (0.6%)	0
TOTAL	**341**	**2**	**0**
Vella Lavella			
Sambora	319 (76.7%)		0
Lambulambu	97 (23.3%)	2 (2.1%)	2 (100%)
TOTAL	**416**	**2**	**2**
Choisuel			
Luti	101 (24.6%)	1 (1.0%)	0
Lologae	9 (2.2%)	1 (11.1%)	0
Sagiae	21 (5.1%)	1 (4.8%)	0
Sepa	165 (40.2%)	1 (0.6%)	0
Sasamunga	114 (27.8%)	2 (1.7%)	0
TOTAL	**410**	**6**	**0**
GRAND TOTAL	**5696**	**52 (0.9%)**	**24 (46.2%)**
Gilbertese	*788 (13.8%)*	*31 (59.6%)*	*21 (87.5%)*

Figure 6-27 Mortality statistics within Solomon Islands from the 2007 tsunami event

6.6.4.1 Initial Sea Water Level Disturbance

The generation stage of tsunami evolution includes the formation of the initial water surface disturbance due to earthquake-triggered deformation of the seafloor. This initial water surface disturbance evolves into a long wave radiating out from the earthquake source. Modelling of the initial stage of tsunami generation is therefore closely linked to studies of earthquake source mechanics.

The Joint Research Centre of the European Commission conducted a study into the initial stage of the April 2007 Solomon Islands tsunami event (JRC, 2011). The study examined a number of different fault deformation models against ground deformation field measurement data, published in Tomita et al., 2008). The study concluded that none of the “quick” (read un-calibrated) fault models was able to estimate correctly the measure value.

Recognising this, the initial water level disturbance used as input for modelling of the 2007 tsunami event was based on interpretation of measured ground deformation data (Figure 6-28).

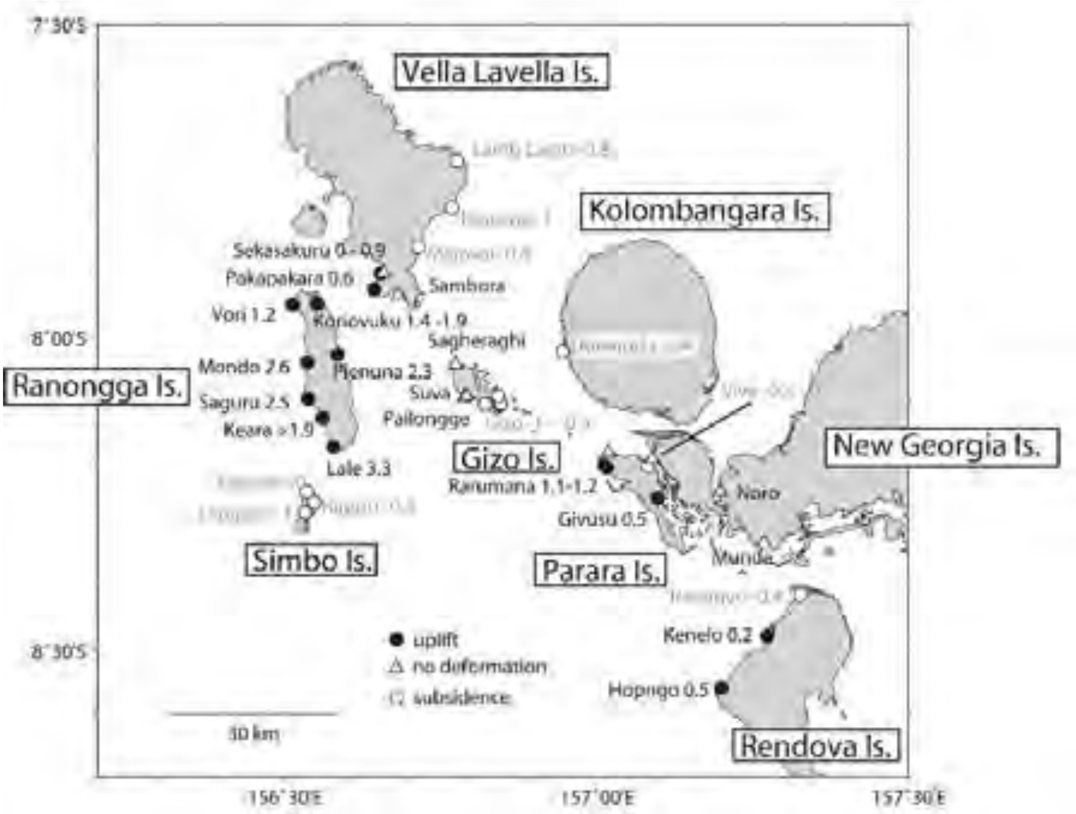


Figure 6-28 Measured ground deformation data around Gizo (from Tomita et al, 2008)

Figure 6-29 Adopted initial water level disturbance - 2007 tsunami event simulation

6.6.4.2 Tsunami Propagation Model

129 recorded observations of tsunami runup, measured around the Solomon Island in the aftermath of the 2007 event and included in the NOAA/WDC Tsunami Runup database, were used to evaluate the model's performance (Figure 6-30). Model parameter calibration considered:

- Bathymetric and mesh definition and resolution, especially in and around the shelf of Choiseul Island; and
- Initial water level disturbance parameters.

Table 6-5 shows the comparison between observations and model predictions. The average difference is 0.23m which is considered to be a suitable demonstration of model performance. Figure 6-31 shows water level contours at a series of snapshots during the model simulation that demonstrate the tsunami wave propagation to the shoreline.

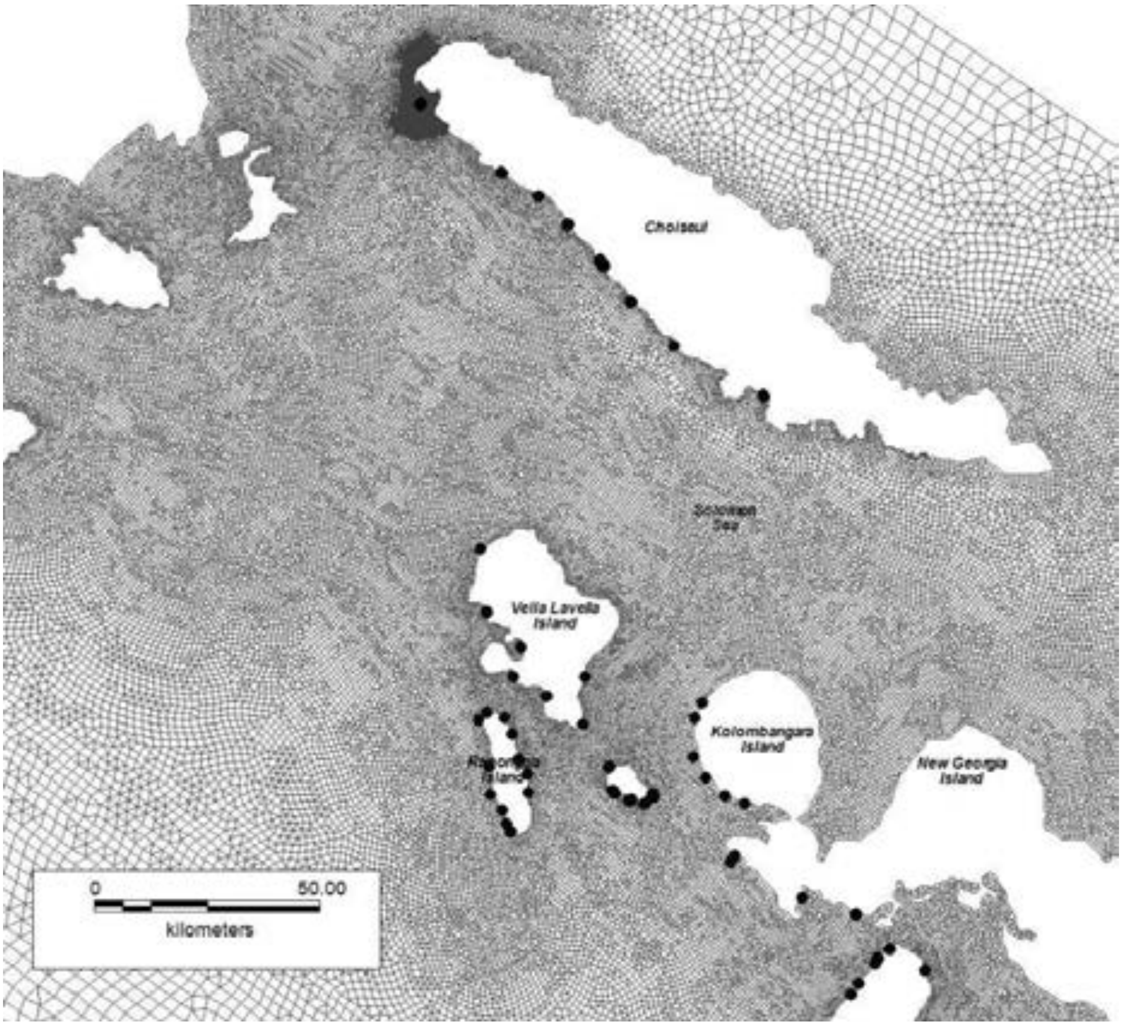


Figure 6-30 Model mesh in study area with locations of runup water level observations from the NOAA/WDC tsunami runup database (http://www.ngdc.noaa.gov/hazard/tsu_db.shtml) for the 2007 event.

Table 6-5 Comparison of model predictions with observations of runup water level from the NOAA/WDC tsunami runup database (http://www.ngdc.noaa.gov/hazard/tsu_db.shtml) for the 2007 event.

Island	Number of observations / island	Average observed runup / island (m)	Average modelled runup / island (m)	Average difference between observations and model prediction (m)
Taro Island	4	1.39	1.45	0.06
Choiseul Island	44	2.59	2.64	0.05
Gizo Island	34	4.04	4.22	0.17
Kolombangara Island	6	1.23	0.67	-0.56
New Georgia Island	3	0.98	1.75	0.77
Ranongga Island	6	3.05	2.75	-0.30
Rendova Island	10	2.08	2.10	0.02
Vella Lavella Island	10	2.51	3.89	1.38
Vonavona Island	3	1.46	1.89	0.43
Lola Island	1	0.62	0.66	0.04
Nusatupe Island	8	1.82	2.90	1.08
Total	129			0.23

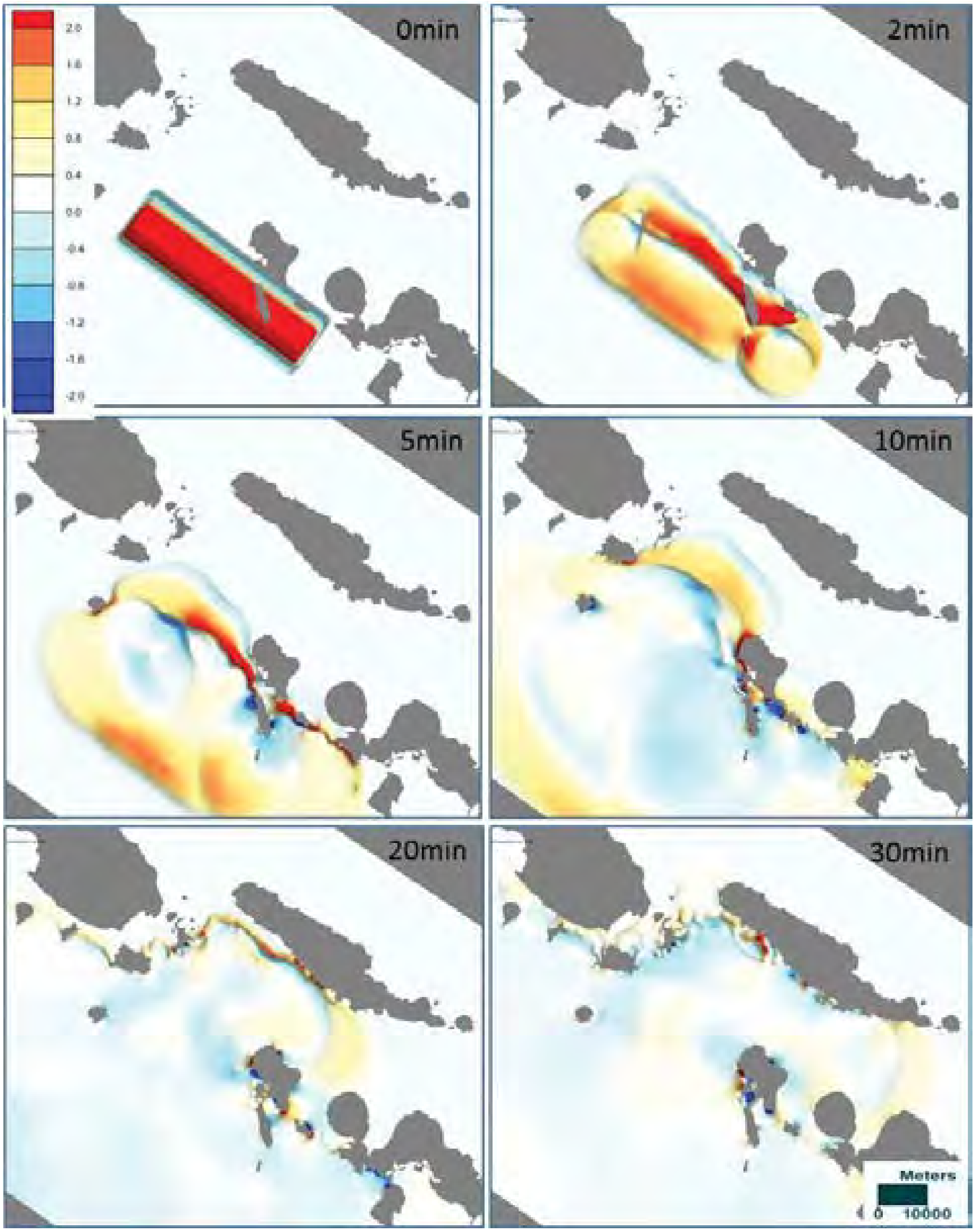


Figure 6-31 Contours of water surface elevation of a sub-area of the model domain, showing tsunami propagation at outputs 0, 2, 5, 10, 20 and 30 minutes from simulation start

6.6.5 Design Events

To provide an estimate of the tsunami hazard profile of Taro Island and the Choiseul Bay township site, a design case tsunami modelling analysis was undertaken in which a range of near-field tsunami scenarios were analysed for likely runup levels. The design case tsunami modelling involved the following steps:

(1) Determine near-field earthquake statistics;

(2) Define initial water level disturbance parameters for each design earthquake event;

(3) Run the tsunami inundation model for a range of design case scenarios and return periods; and

(4) Mapping of the overland tsunami inundation for each return period.

6.6.5.1 Near-field Earthquake Statistics

A statistical earthquake analysis method suggested by Burbidge (Burbidge et al., 2008) was used to provide estimates of regional earthquake magnitude statistics. The historical tsunami events within South Pacific region as contained in NOAA/WDC's Tsunami Events database were used in this analysis (Table 6-6).

Table 6-6 Earthquake Magnitude Statistics for Solomon Islands region

Annual Exceedence Probability	Earthquake Magnitude (M_w)
5% (~20 years ARI)	7.9
1% (~100 years ARI)	8.2
0.2% (~500 years ARI)	8.5

6.6.5.2 Initial Water Level Disturbance Parameters

Wells and Coppersmith (1994) investigated 421 historical earthquakes and proposed empirical relationships between earthquake magnitude and rupture parameters (length, width and displacement). These empirical relationships were used to estimate rupture parameters for the design case modelling scenarios.

Initial water level disturbance parameters for the design case scenarios were derived by scaling the rupture parameters in accordance with the scaling parameters of the 2007 tsunami event (Table 6-7).

Table 6-7 Initial water level disturbance parameters used in Design Case Scenarios

Annual Exceedence Probability	Water Level Disturbance Area	Maximum Water Level Disturbance Height
5% (~20 years ARI)	112 km by 30 km	2.5m
1% (~100 years ARI)	164 km by 38 km	3.8m
0.2% (~500 years ARI)	242 km by 49 km	5.8m

6.6.5.3 Tsunami Inundation Modelling

Design case modelling was undertaken for three return periods, namely 20 years, 100 years and 500 years ARI in which the previously described initial water level disturbance parameters were used as input to the SST tsunami inundation model.

Three potential tsunami source locations between Vella Lavella Island and Mono Island (along the South Solomon Trench) were tested for each return period intensity.

Figure 6-32 presents the propagation of the tsunami wave of a 100 year ARI tsunami event from the tsunami source towards Choiseul Bay. Because of the nature of generation and propagation in four directions away from the source, the deepwater wave amplitude approaching Choiseul Island is significantly smaller (<50%) than at the source. As the tsunami wave approaches the shelf of Choiseul Island (Figure 6-33), shoaling occurs and the wave amplitude increases. After approximately 25 to 35 minutes, tsunami wave impacts on Choiseul Bay.

Table 6-8 provides a summary of the maximum tsunami runup levels for the 20 years, 100 years and 500 year ARI design tsunami events.

Table 6-8 Modelled tsunami runup levels (present-day)

Location	Annual Exceedence Probability (AEP)	Inundation Level
Taro Island	5% (~20 years ARI)	2.0m MSL
	1% (~100 years ARI)	3.1m MSL
	0.2% (~500 years ARI)	4.7m MSL
Choiseul mainland (entrance to Sui River)	5% (~20 years ARI)	1.8m MSL
	1% (~100 years ARI)	2.9m MSL
	0.2% (~500 years ARI)	4.4m MSL

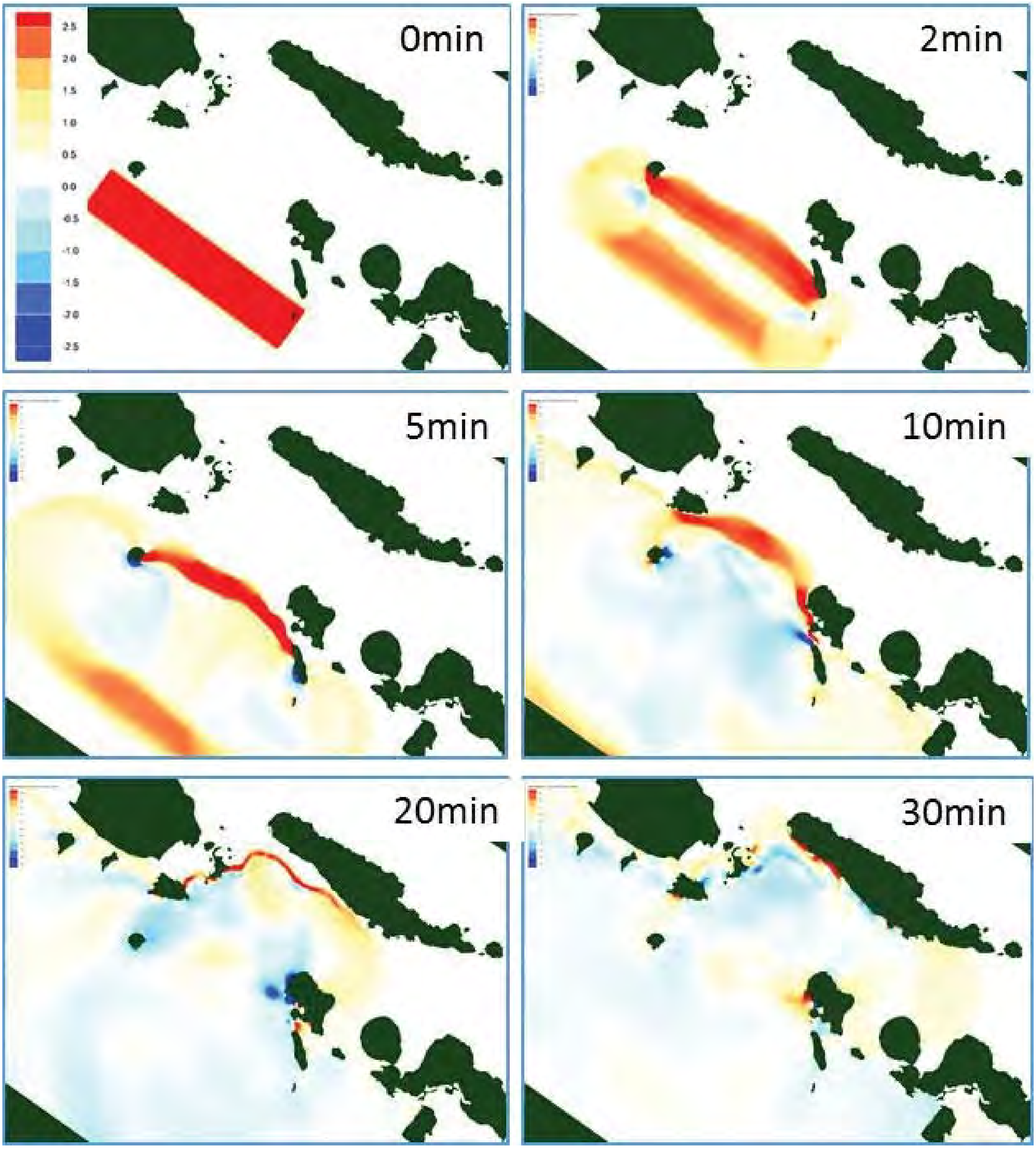


Figure 6-32 Tsunami propagation of 100 years ARI design event, regional

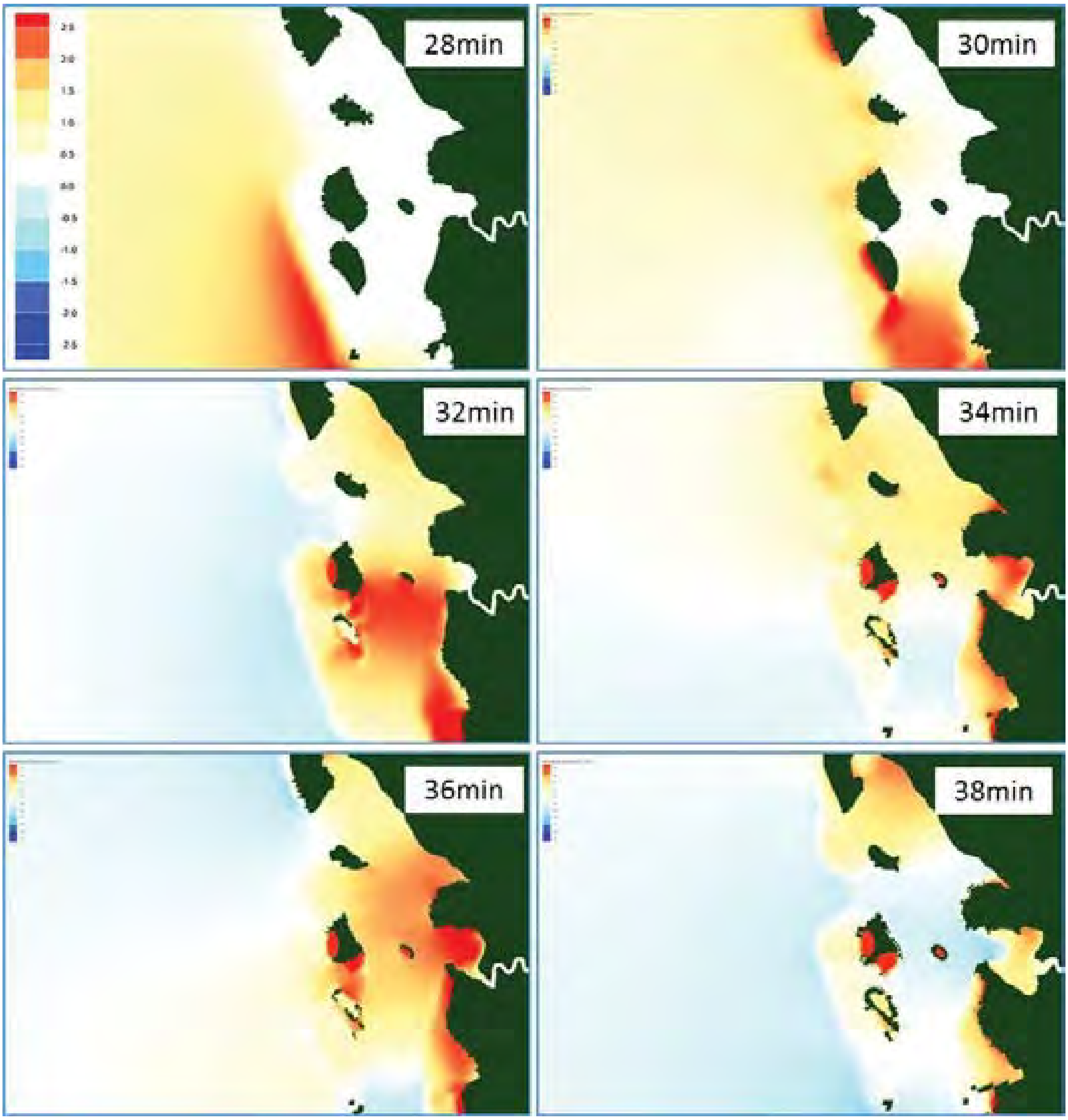


Figure 6-33 Tsunami propagation of 100 years ARI design event, local

6.6.6 Tsunami Scenarios

Tsunami hazard is a significant one that will be worse in a future with mean sea level rise because depths and extents of inundation will be more severe and extensive. Tsunami scenarios applied to the hazard mapping exercise are as follows. The adopted initial water level state for the tsunami scenarios is MSL; considering the duration of tsunami (of the order of < 1 hour) it is unlikely that the event will coincide with high tide over any other stage of the tide.

Table 6-9 List of tsunami scenarios

Simulation	Condition	Water level	Tsunami event
1	Existing	MSL	100 year ARI
2	2030	MSL + 0.15m	100 year ARI
3	2055	MSL + 0.38m	100 year ARI
4	2090	MSL + 0.82m	100 year ARI

6.7 Coastal Processes

6.7.1 Prevailing Coastal Features

Woodroffe (2008) provides a synthesis of selected atolls in the Pacific. Typical features include:

- The islands are not greatly affected by swell, with the exceptions of cyclones, which play a role in building beach ridges.
- A common feature is a beach ridge on the ocean side which may rise 2-3m above MSL.
- Vegetated ridges suggest overtopping is rare.
- Land is typically below 2m above MSL.
- Shores fronting reefs often exhibit a coarse shingle or coral rubble ridge when storms play an important role in the morphology.

While not an atoll, Taro Island has similar features. The airstrip on Taro Island lies between 1.5-2m above MSL, or approximately 0.75m above spring high tides. The lack of such a ridge on Taro Island suggests that storms are infrequent and have not transported significant quantities of coral rubble to the western shore, although it should be noted that material may have been removed for construction purposes.

Woodroffe (2008) argues that long term accretion may outweigh short term erosion due to SLR on ocean facing beaches. The primary reason which may lead to such a process on Taro Island is the shoreward transport of sand from the reef flat. While aerial photography is limited for Taro Island, on many islands such images show shoreline progradation over recent periods. The reef / sand flat to the western side of Taro is primarily composed of sand on the surface, with little live coral in evidence over the bulk of the area. This suggests a viable source of sand for onshore supply, although present productions rates may be limited.

6.7.2 Shoreline Variation

A comparison of historical aerial imagery (circa 1940-1950) and present day (2003) imagery is provided in Figure 6-34. Cyclones and storms may add sediment to ocean shores where a source is available (Woodroffe, 2008, Webb and Kench, 2010), as well as erode individual shorelines. While many reef islands undergo a cyclic behaviour due to seasonal variations in wind and wave direction (Kench et al., 2006), the remarkable lack of variation in the shorelines indicated in Figure 6-34 suggests that Taro Island and the western reef and sand flat are very stable, despite a likely sea level rise of the order of 0.1mm to 0.2mm since 1940. This is consistent with patterns of change on many reef islands. For example Webb and Kench (2010) found that only 14% of surveyed islands showed a net reduction in area over recent decades. While Webb and Kench (2010) observed that 50% of shorelines facing the ocean reef showed erosion over this period, with recession of up to 5m to 10m, clearly half did not.

While changes of this magnitude are difficult to detect in the available imagery of Taro Island (due to vegetation) there is no obvious loss or hotspot of erosion. It should however be noted that SLR will allow larger waves to reach the western shore of Taro Island. Sheppard et al. (2005) argue that this will be a driver for accelerated erosion of shorelines on reef islands, contrary to Woodroffe (2008).

Since erosion on atolls and reef islands is most likely a result of extreme events, the vegetation buffer that exists on Taro Island and the mainland provides a valuable coastal defence and should be retained and protected as a high priority.

6.7.3 Coastal Protection on Taro Island

Rudimentary coastal protection has been installed at a number of locations around the island, except on the western shore, (consisting of sand bags, coral gabions, small coral rock groynes, examples in Figure 6-35 and Figure 6-36), which will prevent erosion locally but may exacerbate any chronic erosion elsewhere.

It is reported that the area south of the jetty on the eastern shoreline of Taro Island has eroded of the order of 2m to 5m and that the township market required relocation to a new part of the island. Based on satellite imagery (Figure 6-37), this shoreline appears to experience a net northward transport which has been disrupted by construction of the local pier, causing a buildup of sand to the south of the pier and erosion to the north. Since this image (2003) additional coastal developments have been constructed which may have exacerbated this situation.

It is also reported that the channel at the northern end of the island (between Taro and Supizae islands) has been widening slowly in recent years. However, there is little evidence from the aerial photography to suggest that this is a long term or significant problem, unless this is a very recent phenomenon.

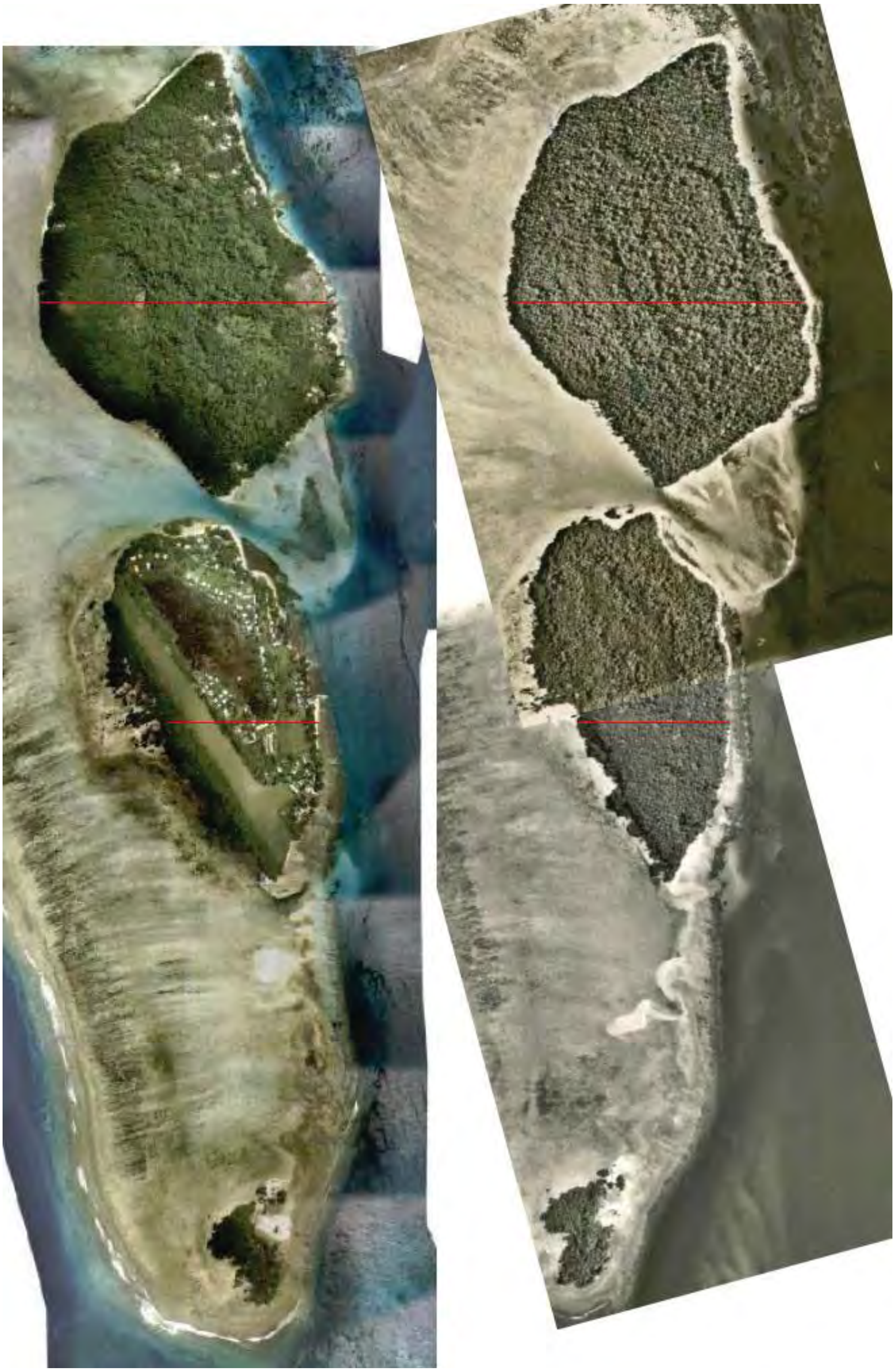


Figure 6-34 Comparison of 2003 shoreline of Taro Island (left) with historical aerial photography (right). Red lines are the same length. Date of historical photograph unknown, but likely circa 1940-1950. Tidal conditions at time of photograph unknown.

Figure 6-35 Coral gabions protecting and underpinning houses on the south-east corner of the island, adjacent E-S beach lodge. View to north. Low-mid-tide conditions.

Figure 6-36 Coral rock breakwaters protecting individual properties on the north-east corner of Taro Island. View from west.

Figure 6-37 Zoomed image of orthophotomap showing evidence of a northward transport and localised erosion as a consequence of pier construction (from 2003 orthophotomap 1-SIOPM-X011)

6.7.4 Estimates of Future Shoreline Recession

A number of authors argue that application of the conventional Bruun rule model (Bruun, 1962) for estimating the impact of sea level rise on sandy beaches is inappropriate for atolls and reef island beaches (Woodroffe, 2008; Webb and Kench, 2010). This is due to the distinct break in topography moving from the reef flat to the land and because the sediment pathway is predominantly from reef to land. In addition, the lower shoreface on Taro Island is comprised of solid reef flat in places (e.g. the north-western shoreline, see Figure 6-38).

The Bruun rule assumes that the lower shoreface is reshaped over the timescale of the sea level rise, and fixing a depth of closure for sediment motion is a key requirement. This issue had led to considerable debate about the use of the Bruun rule, even on open sandy open wave dominated ocean coasts. Further, the western shores of Taro Island and the mainland (Lot 277) are heavily vegetated and the Bruun rule has not been verified for such conditions. It is anticipated that the vegetation and mangroves provide significant resistance to erosion by waves.

Coastal recession rates under conditions of strong onshore sand supply are unknown at the timescales of development in this project. As discussed by Woodroffe (2008) and observed by Webb and Kench (2010), recession may be minimal in some cases, but this is not a conservative estimate. An upper bound is provided by the Bruun rule type of approach, despite obvious differences. However, defining a depth of closure for both the western ocean beach and the Choiseul bay beaches is difficult because of the broad sand flat and coral substrate, and is inconsistent with traditional application of the Bruun rule. Further, the Choiseul Bay beaches are backed by a mangrove swamp at lower elevation than the wave built beach ridge. Thus, to recede, the beach ridge must be eroded away or transgress landward by overtopping and roll-over.

A more realistic expectation is that the western beaches will maintain the present slope around the water line (typically 1:50 but rising to 1:20 in places) and that the lower shoreface maintains the existing gradient and elevation. Recession in step with SLR will then be of order 5m to 20m over 50 years (i.e. the upper beach slope divided by SLR). It should be noted that these estimates do not apply where no beach exists or coastal protection works are in place. Assuming the coastal defence or hard substrate remains, recession will not occur at these locations unless overtopping occurs and erodes sediment on the landward side of the protection.

6.7.5 Consequences of Future Shoreline Recession

On the western beach on Taro Island, recession of this magnitude will be detrimental toward the northern end of the airstrip, but less problematic toward the southern end. It is anticipated that the airstrip will be extended in the near future. The northern end will require full coastal protection as at present. Any extension southward will push the airstrip into the ocean and therefore also require coastal protection. The existing beach at the southern end will be lost in this instance.

Note that the extension of the runway may prevent sand from travelling around the northern and southern ends of the island, leading to down drift coastal erosion of the adjacent beaches.

On the eastern Choiseul Bay side of Taro Island, recession rates of 5m or more will threaten property and infrastructure, notably the hospital and Government buildings. Some limited coastal protection exists on the eastern side of Taro Island, probably to prevent erosion induced by the interruption of longshore sand motion due to construction of the jetty and hotel that extends into the Bay (Figure 6-37).

Figure 6-38 Coral boulders protecting runway on western (ocean) side of the island, northern end of the island. View to south

6.7.6 Future Mangrove Recession

Taro Island has a small but important mangrove habitat on the western shore, and lot 277 has extensive mangrove habitat on the western shore and along the Sui River.

It is anticipated that mangroves will transgress inland with sea level rise, with erosion at the seaward margin, such that the frequency, period, and depth of inundation is maintained. This behaviour assumes the present mix of species remains largely the same with SLR. Such processes are expected to be episodic, rather than a gradual procession in step with SLR (SCOR working group, 1991). Mangrove habitat may expand or contract in this process, depending on the elevation of the terrain and the species present. In order to preserve the existing habitat, accommodation space is required to enable transgression without impacting on areas to be developed. If transgression of the inland margin is prevented, e.g. by structures or housing or agriculture, then the mangrove fringe will narrow and can be potentially lost altogether.

Given the threat from tsunami and storm surge, it is anticipated that infrastructure and community buildings will be located above potential inundations lines and that this is likely to be at least 2m above HAT (highest astronomical tide). Inland transgression of the mangrove margin to this elevation as a result of sea level rise would take of the order of 200 years at current SLR projections. Consequently, it is assumed that landward transgression will not be prevented by anthropogenic activities and will occur at a rate governed by SLR and the slope of the topography at the landward margin.

Gilman et al. (2007) provide an assessment of changes in mangrove position and extent over recent decades in American Samoa. Seaward margins recessed landward horizontally between 3m and 138m over 40 years and were generally well correlated with SLR. These rates are between 12 and 36 times the relative vertical sea level rise, and substantially smaller than the expected landward movement of the shoreline given the topography at the study sites. The latter suggests a recession rate of approximately 140 times the sea level rise (SLR/mean topographic slope), which is also equal to the simplest estimates from the Bruun rule. Consequently, mangrove protected shorelines appear unlikely to recess at rates given by the Bruun rule. It is noted that the occasional fallen mangrove and palm tree on the western shore of Lot 277 are potential signs of erosion (Figure 6-39 and Figure 6-40). However, determining if a long term erosion trend exists or whether this is simply localised erosion as result of storms cannot be determined. No scarps or obvious erosion indicators were evident and the existing beach ridge is well colonised by vegetation, suggesting it is not receding rapidly at present.

For estimates of recession rates it is necessary to consider upper bounds and a more likely rate. An upper bound will be equal to Bruun rule type equilibrium, i.e., SLR/Mean slope of topography. For the western shore of Taro, the slope in the vicinity of the mangroves is 1/100. This implies a recession of 20m over 30 years or 40m over 50 years. However, the beach rises more steeply behind the mangrove fringe, at a slope of 1:60 around the present waterline at locations where the beach ridge is low or absent, giving a recession of 15m to 25m. Based on the data from Gilman et al. (2007) and the lack of change in the aerial imagery over 60 years, the likely recession rates will be smaller than this. Taking 20 times the relative sea level rise suggests a rate of order 5m to 10m over 30 to 50 years. At present, the width of the mangrove and vegetation buffer between the western shoreline and the airstrip ranges from 10m to 40m. Consequently, complete loss of the beach and vegetation buffer seems unlikely.

On the western boundary of Lot 277 and along the Sui River the inland topography is very gently sloping, with extensive standing water in the present mangroves behind the beach ridge and river edge at low tide. Topographic gradients are typically less than 1/500. Therefore, there is the potential for significant landward progression of the seaward margin, up to several hundred metres. However, as discussed above, observations do not support recession at the same rate as sea level encroachment. Given the beach ridge is likely to be maintained under SLR, providing a buffer against wave action, sediment accumulation in the mangroves may enable this margin to keep pace with SLR or recess more slowly.

A more realistic estimate of rate of the mangrove recession is therefore 20 to 40 times SLR, or 10m to 20m. Given the extensive width of the present mangrove margin and swamp, of order 500m or greater, this recession is not significant in terms of overall loss of coastal habitat or coastal protection.

Figure 6-39 Western edge of new settlement site, southern end of Lot 277. View to east. Mid-High tide. Beach ridge fronting mangrove swamp behind.

Figure 6-40 Western edge of new settlement site, Lot 277. View to east. Mid-High tide.

6.8 Summary of Hazard

Table 6-10 summarises the hazards analysed. The table describes:

- nature of the hazard;
- future horizon (and corresponding projected future climate state);
- Summary of the hazard quantification (in particular maximum intensities, vertical water levels, etc); and
- reference to the relevant hazard map showing extents and severity (Section 6.9).

The hazard maps, which show contour plots of peak water levels for the range of hazards, are based upon fit-for-purpose survey data over a relatively limited area. As such, absolute extents of inundation may differ from those shown in the maps, especially beyond the immediate study area of Taro Island and Sui River entrance.

There is more confidence in the projections of peak water levels. In future, if more survey data becomes available, the peak water levels can be used to update the hazard maps.

The peak water levels and hazard maps, especially for storm surge events, do not include the influences of wave runup (the wave uprush onto a beach or structure). It is recommended that a freeboard of 1m above the values provided in Table 6-10 be considered.

Table 6-10 Summary of hazards

Major hazard(s)	Condition	Summary of hazard quantification	Map
Drought	Present day	Existing rainfall and seasonality Consecutive days without rain • Typical year = 15 days • 100 year ARI = 34 days	None
	2055	Existing rainfall and seasonality Consecutive days without rain • Typical year = 15 days • 100 year ARI = 34 days	
	2090	10% reduction in rainfall and increased variability in seasonality Consecutive days without rain • Typical year = 17 days (10% intensification) • 100 year ARI = 38 days (10% intensification)	
Tide	Present day	Highest Astronomical Tide (HAT) = 0.95m MSL	Figure 6-41
	2055	Highest Astronomical Tide (HAT) + 0.38m = 1.33m MSL	Figure 6-42
	2090	Highest Astronomical Tide (HAT) + 0.82m = 1.77m MSL	Figure 6-43
Shoreline retreat	Present day	Current shoreline position, water level = 0m MSL Localised erosion issues	Figure 6-44
	2055	Future shoreline position, the maximum retreat of:	Figure 6-45

Major hazard(s)	Condition	Summary of hazard quantification	Map
		• Water level = 0.38m above existing MSL • Taro Island shoreline recession of 5-20m (20 to 40 times SLR) • Mainland mangrove habitat recession of 10-20m (20 to 40 times SLR)	
	2090	Future shoreline position, the maximum retreat of: • Water level = 0.82m above existing MSL • Taro Island shoreline recession of 20-50m (20 to 40 times SLR) • Mainland mangrove habitat recession of 20-100m (20 to 40 times SLR)	Figure 6-46
Flooding + storm surge	Present day	100 year ARI cyclone event causing storm surge and flooding (including wave setup but not wave runup) • Peak water level (Taro Island) = 2.3m MSL • Peak water level (mainland) = 1.7 m MSL	Figure 6-47
	2055	100 year ARI cyclone event causing storm surge and flooding (including wave setup but not wave runup) • Peak water level (Taro Island) = 2.7 m MSL • Peak water level (mainland) = 2.1 m MSL	Figure 6-48
	2090	100 year ARI cyclone event causing storm surge and flooding (including wave setup but not wave runup) • Peak water level (Taro Island) = 2.9 m MSL • Peak water level (mainland) = 2.4m MSL	Figure 6-49
Tsunami	Present day	100 year ARI tsunami event, source within local tectonically active area • Peak water level (Taro Island) = 3.1 m MSL • Peak water level (mainland) = 2.9 m MSL	Figure 6-50
	2030	100 year ARI tsunami event, source within local tectonically active area • Peak water level (Taro Island) = 3.25 m MSL • Peak water level (mainland) = 3.05 m MSL	Figure 6-51
	2055	100 year ARI tsunami event, source within local tectonically active area • Peak water level (Taro Island) = 3.5 m MSL • Peak water level (mainland) = 3.3 m MSL	Figure 6-52
	2090	100 year ARI tsunami event, source within local tectonically active area • Peak water level (Taro Island) = 3.9 m MSL • Peak water level (mainland) =3.7 m MSL	Figure 6-53

6.9 Hazard Maps

Hazard maps associated with the major hazards, as outlined in Table 6-10, are presented in Figure 6-41 to Figure 6-53 on the following pages.

Figure 6-41 Hazard map, tides, present day

Figure 6-42 Hazard map, tides, 2055

Figure 6-43 Hazard map, tides, 2090

Figure 6-44 Hazard map, shoreline, present day

Figure 6-45 Hazard map, shoreline retreat, 2055

Figure 6-46 Hazard map, shoreline retreat, 2090

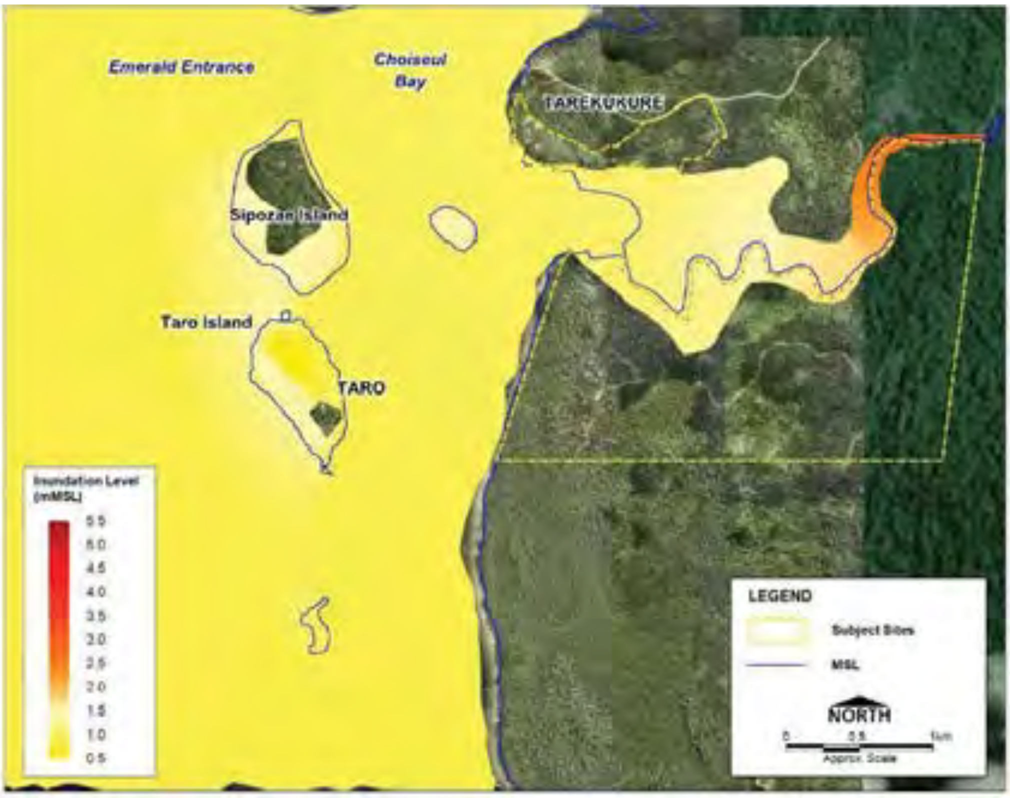


Figure 6-47 Hazard map, floods plus storm surge, present day

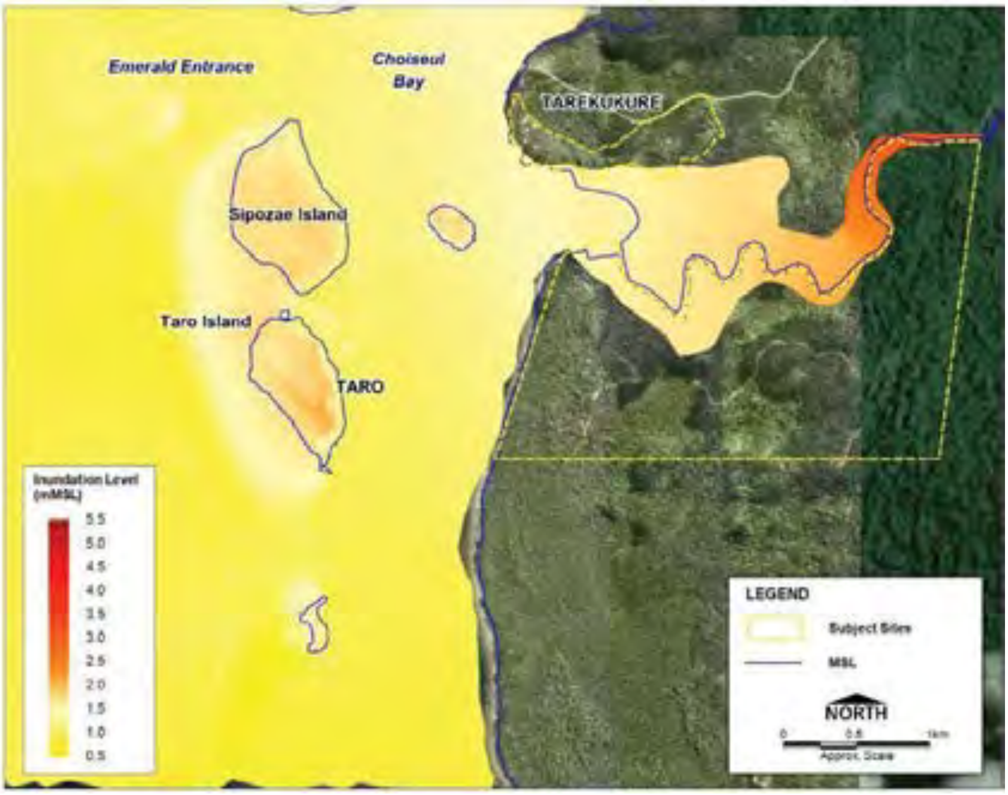


Figure 6-48 Hazard map, floods plus storm surge, 2055

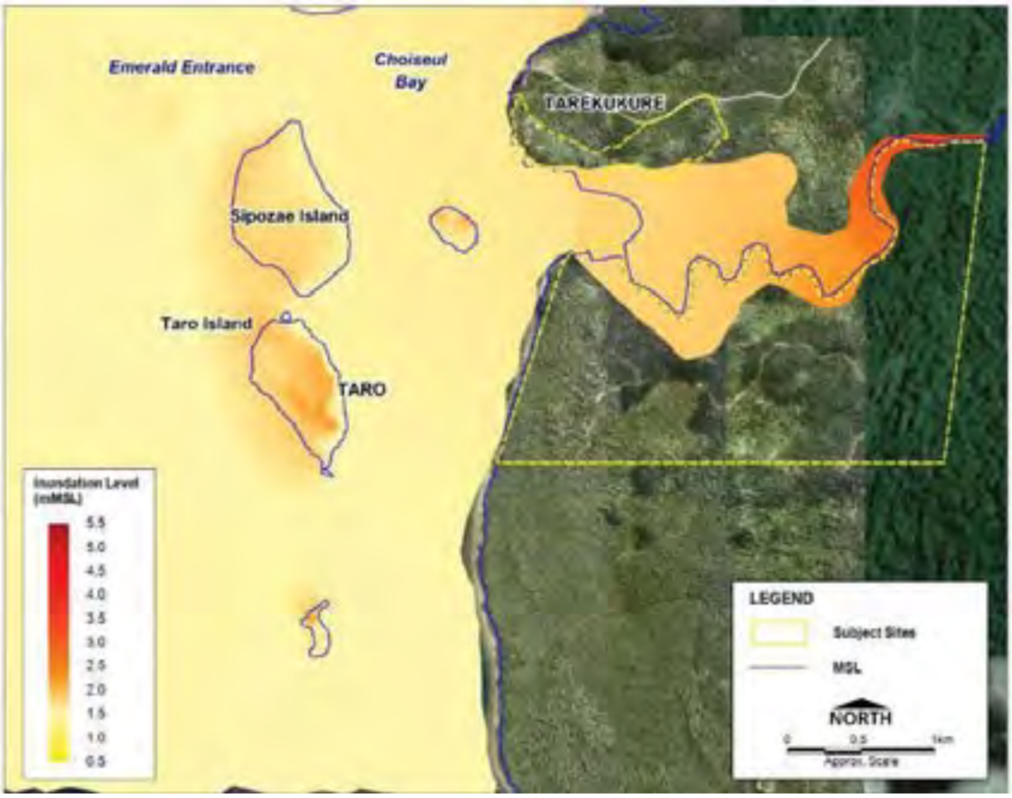


Figure 6-49 Hazard map, floods plus storm surge, 2090

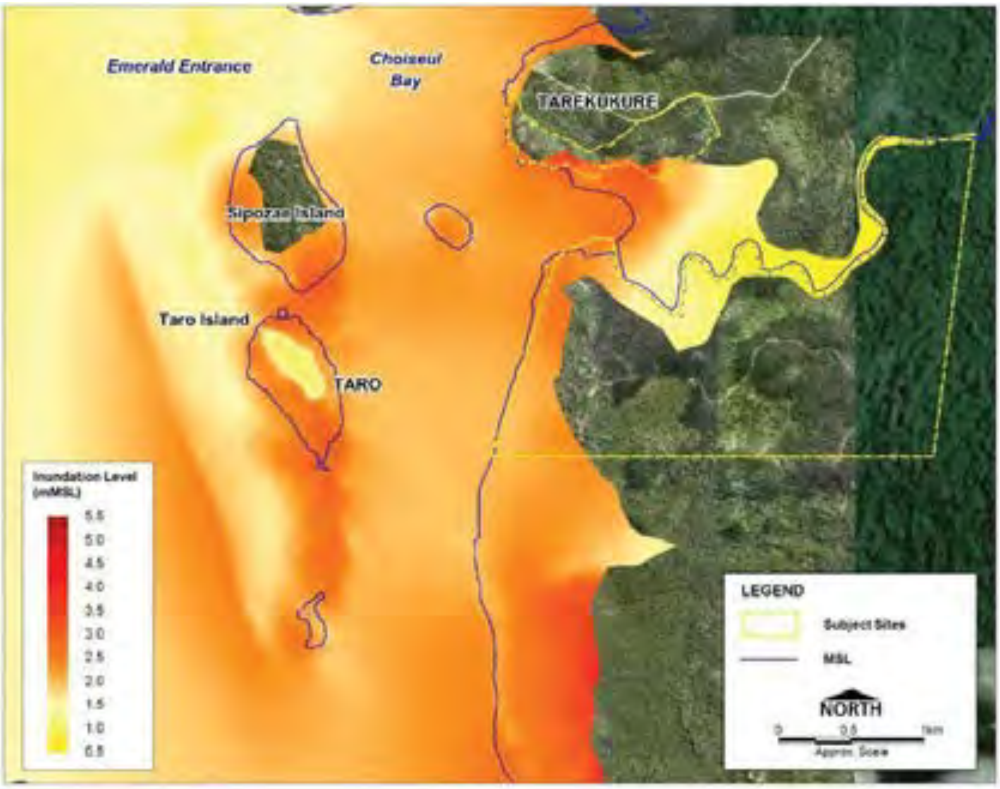


Figure 6-50 Hazard map, tsunami, present day

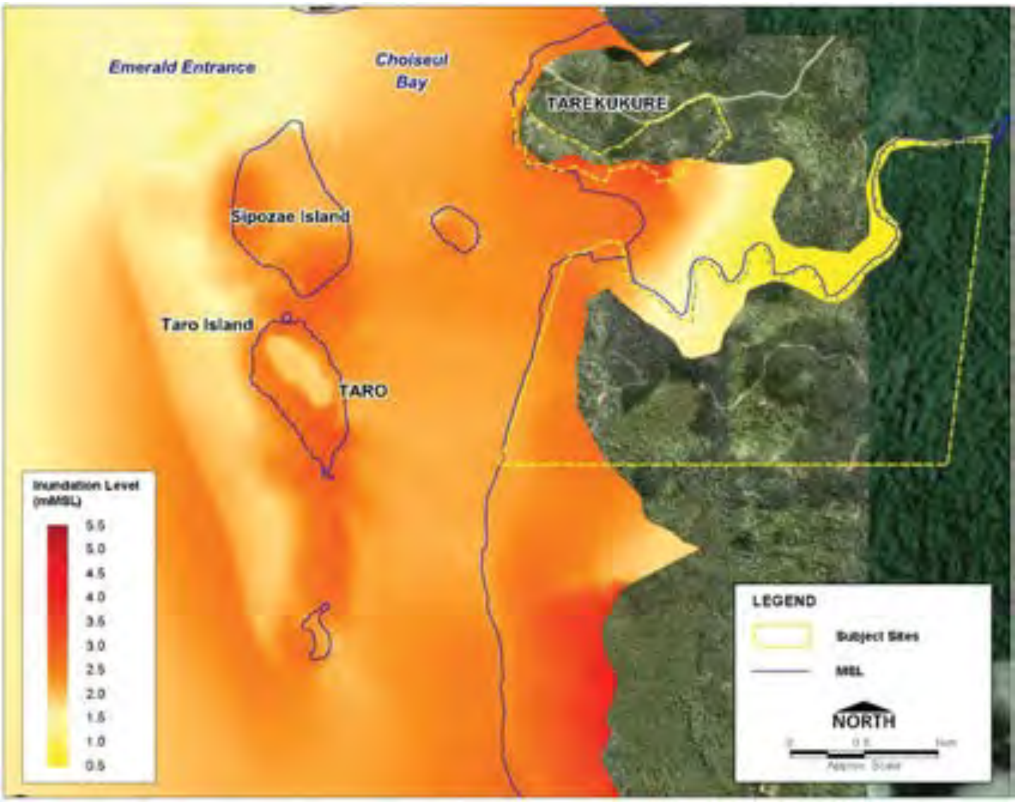


Figure 6-51 Hazard map, tsunami, 2030

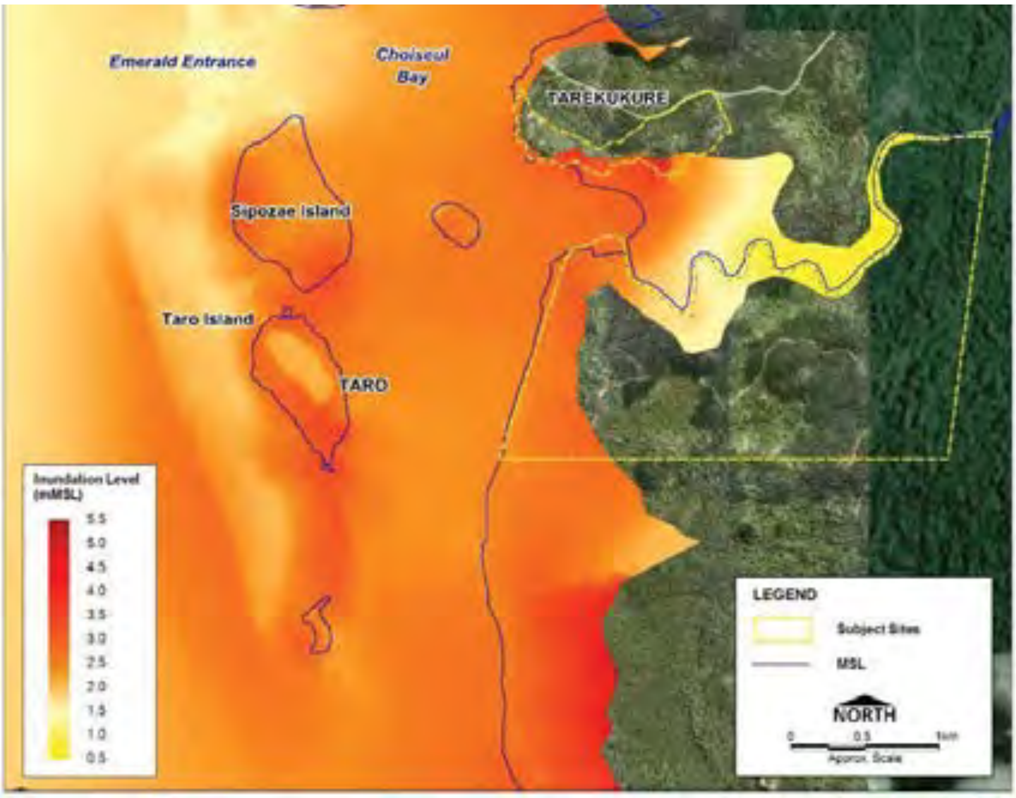


Figure 6-52 Hazard map, tsunami, 2055

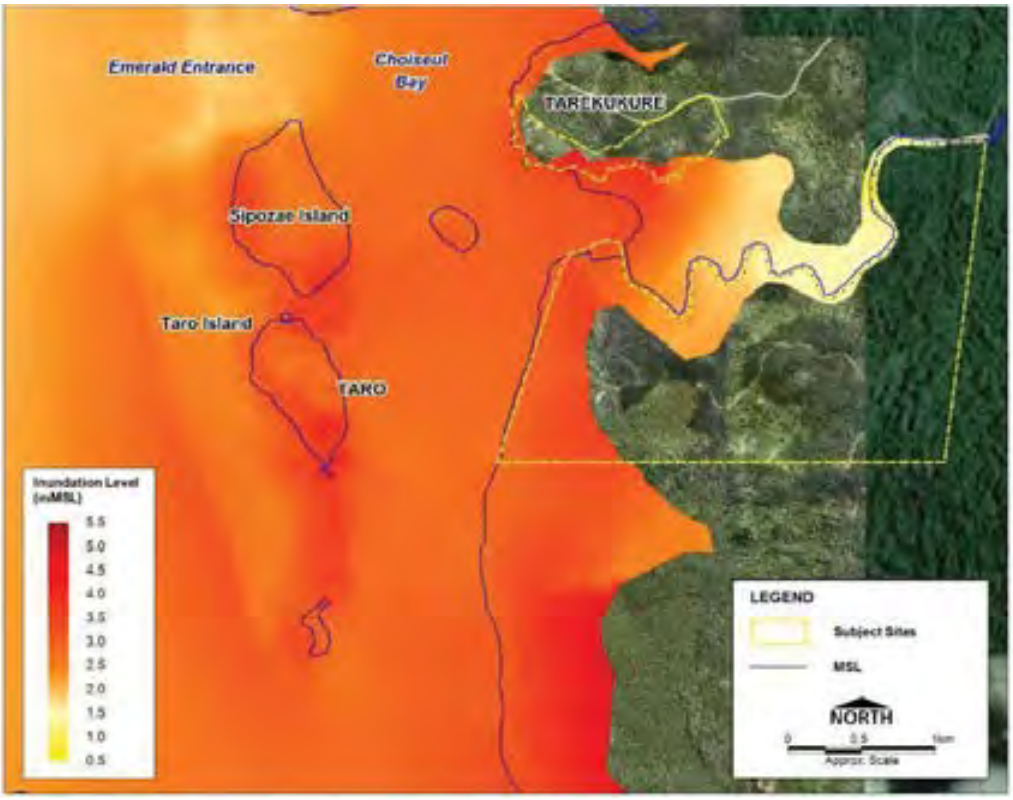


Figure 6-53 Hazard map, tsunami, 2090

7. Vulnerability and Risk Assessment

7 Vulnerability and Risk Assessment

The definition of coastal hazards inherently involves uncertainty relating not only to coastal hazard processes but also to climate change variables. Irrespective of climate change, coastal hazards have always presented a challenge to planners and managers given the infrequent nature but potentially devastating impacts of events. Existing coastal hazards at Choiseul Bay are particularly complex, due to the significant effects of tsunamis, which are inherently difficult to predict.

Given the limited understanding of tsunami processes, along with limited meteorological, oceanographic and topographic data, careful consideration is required in terms of the expected level of uncertainty in hazards identification and prediction. Added to this is the uncertainty regarding expected future climate conditions and the timeframe over which climate variables may change, as well as the uncertainty of response by the coastal environment to these broadscale climate changes.

A risk-based approach is useful when dealing with high degrees of uncertainty in processes and information. Rather than providing a single answer, the risk assessment approach allows managers to consider a range of events, their likelihood, consequence and thus the overall level of risk.

A risk is defined as the likelihood of an event occurring combined with the consequential impact of the event upon an asset or value. Under ISO 31000 (refer Section 7.1), risks are analysed and evaluated in terms of their ‘likelihood’ and their ‘consequence’. For this study, coastal hazards are considered to be the event in question, therefore both ‘likelihood’ and ‘consequence’ of the coastal hazards needs to be analysed.

The hazard assessment (described in Section 6) provided an analysis of the various hazards impacting on the values of Taro Island and the mainland sites (Lot 9 and Lot 277), with a focus on the two main impact types (inundation and erosion) that may occur as a result of climate change. This assessment is suited to defining the ‘likelihood’ or probability of occurrence of coastal hazards, through the analysis of environmental processes, historical response, and likely future response.

7.1 Risk Management Standards

The International Standard *Risk management – Principles and guidelines* (AS/NZS ISO 31000:2009) is a recognised and reliable methodology for systematic application of procedures and practices to establish the context, and identify, analyse, evaluate and treat risks. While this standard has been regularly implemented in various contexts, the more recent Australian Standard *Climate change adaptation for settlements and infrastructure – A risk based approach* (AS 5334-2013) has been developed to provide a systematic approach to planning for adaptation to risks resulting from climate change hazards. Both AS/NZS ISO 31000:2009 and AS 5334-2013 have been referred to and applied in the context of the Choiseul Township Climate Change Project.

7.2 Climate Risk Management Approach

The climate risk management approach adopted for this study follows the process outlined in Figure 7-1. The following sections provide further detail on the steps taken in implementing this approach in the context of the Choiseul Township Climate Change Project, and the findings resulting from the process.

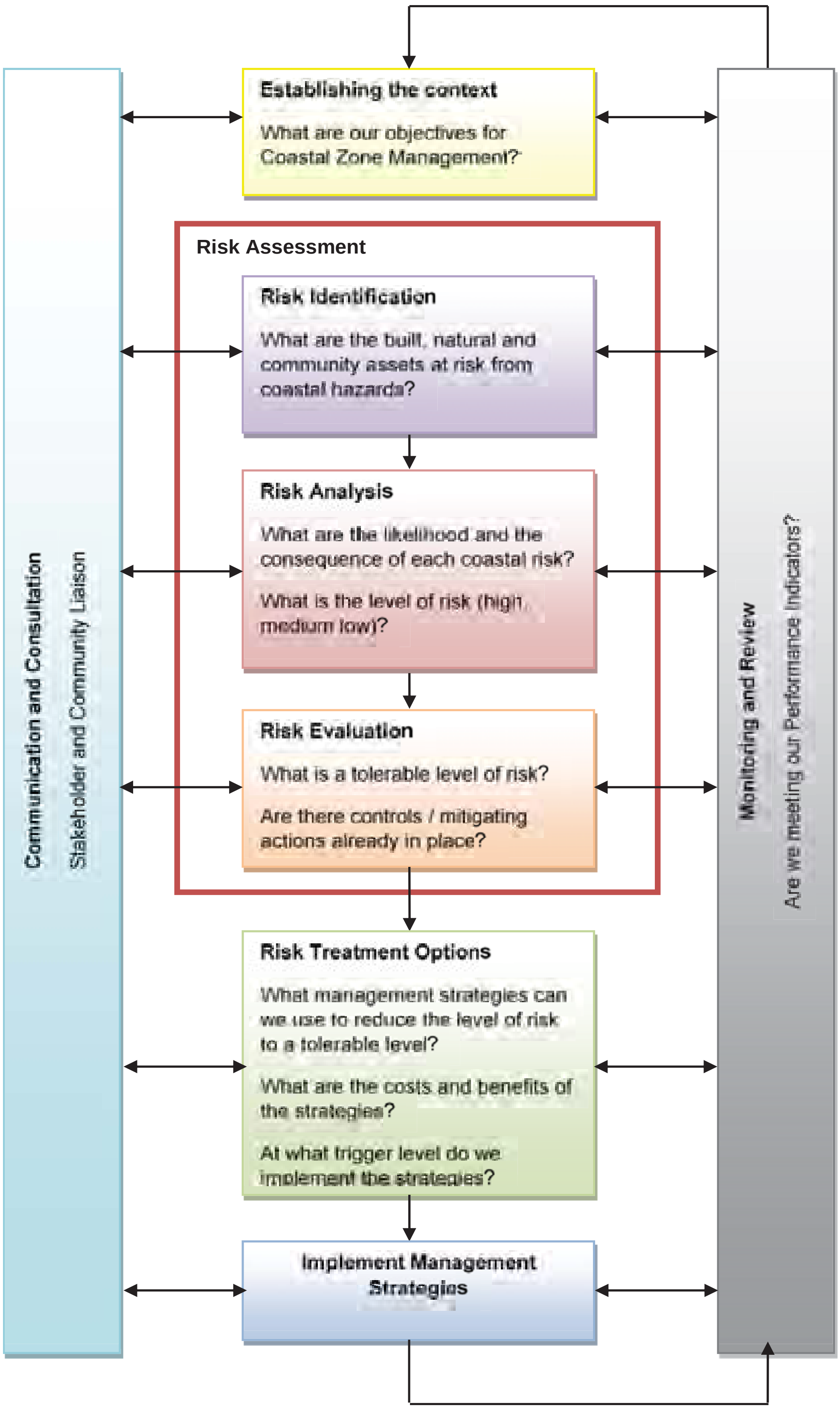


Figure 7-1 Risk Management Process applied to Coastal Zone Management, adapted from AS/NZS ISO31000 (AS 5334-2013)

The risk assessment was initially undertaken by the study team, and then confirmed through discussions with the CPG and key stakeholders during consultation sessions.

7.3 Establishing the Context

A number of factors need to be considered in determining the context of risk management. These include:

- The objectives;
- The climate change context, through identification of the climate change scenarios to be used;
- The relevant stakeholders and their objectives. The results of the stakeholders consultation and the 'values' identified during this process have been considered in this regard; and
- Any external and internal factors that give rise to risks from climate change.

7.3.1 Objectives

The original objective of this project was to ensure the capital of Choiseul Province is climate-resilient. Noting the concern of the community and Government with regard to tsunami hazard, the study team has expanded the objective, for the purposes of this risk management process:

To ensure a climate and tsunami-resilient capital for Choiseul Province that can deliver existing services and has the capacity to expand to meet population growth and needs in the future.

7.3.2 Climate Scenarios and Hazards

Climate scenarios and hazards were identified and assessed through the hazard assessment provided in Section 6.

7.3.3 Outcomes of Community and Stakeholders Engagement

Community and stakeholder input into the identification of environmental, economic, social and cultural values for Taro Island and the future expansion area was provided during in-country engagement visit 2, undertaken in January 2014 (see Section 4 for an overview of engagement activities). A summary of the community and stakeholder input received is as follows:

- Areas that have environmental importance – this includes areas for conservation, mangroves, the reef, the creek on Taro Island and the Sui River;
- Places that provide valuable natural resources – such as fishing areas, mangroves, food gardens, places where stones can be collected and where building materials can be found;
- Buildings and infrastructure providing a critical service to the province – such as the hospital, airstrip, telekom, generator (including a number of back up generators), businesses, fuel storage areas, employment areas, the bank, waste disposal areas and provincial government services; and
- Other buildings and structures important for the health and wellbeing of the community – such as churches, schools, swimming areas, picnic areas, the soccer field, residences and the Taro Island market.

Maps summarising community and stakeholder feedback were prepared to report back to the community. These are provided in Figure 7-2 and Figure 7-3.

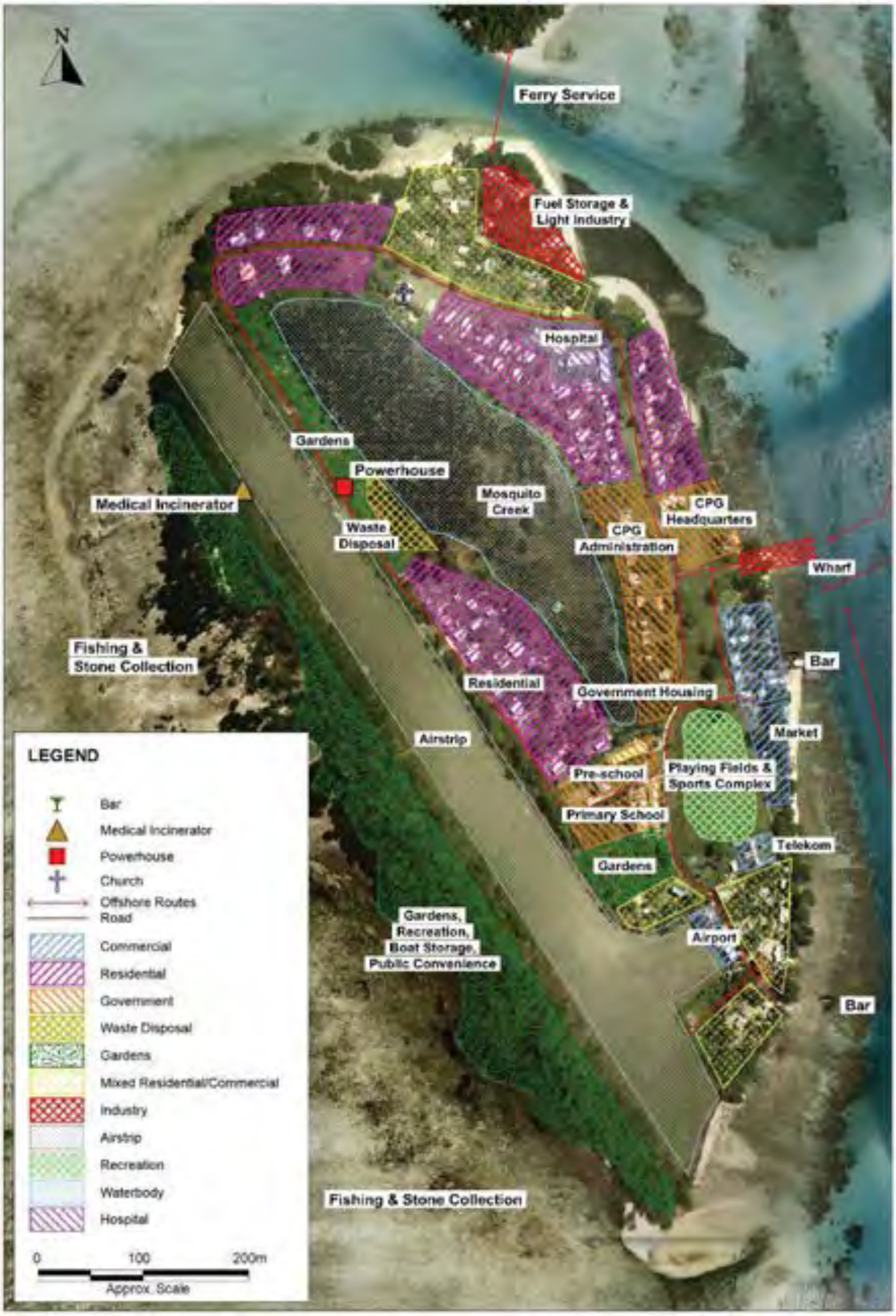


Figure 7-2 Values of Taro Island

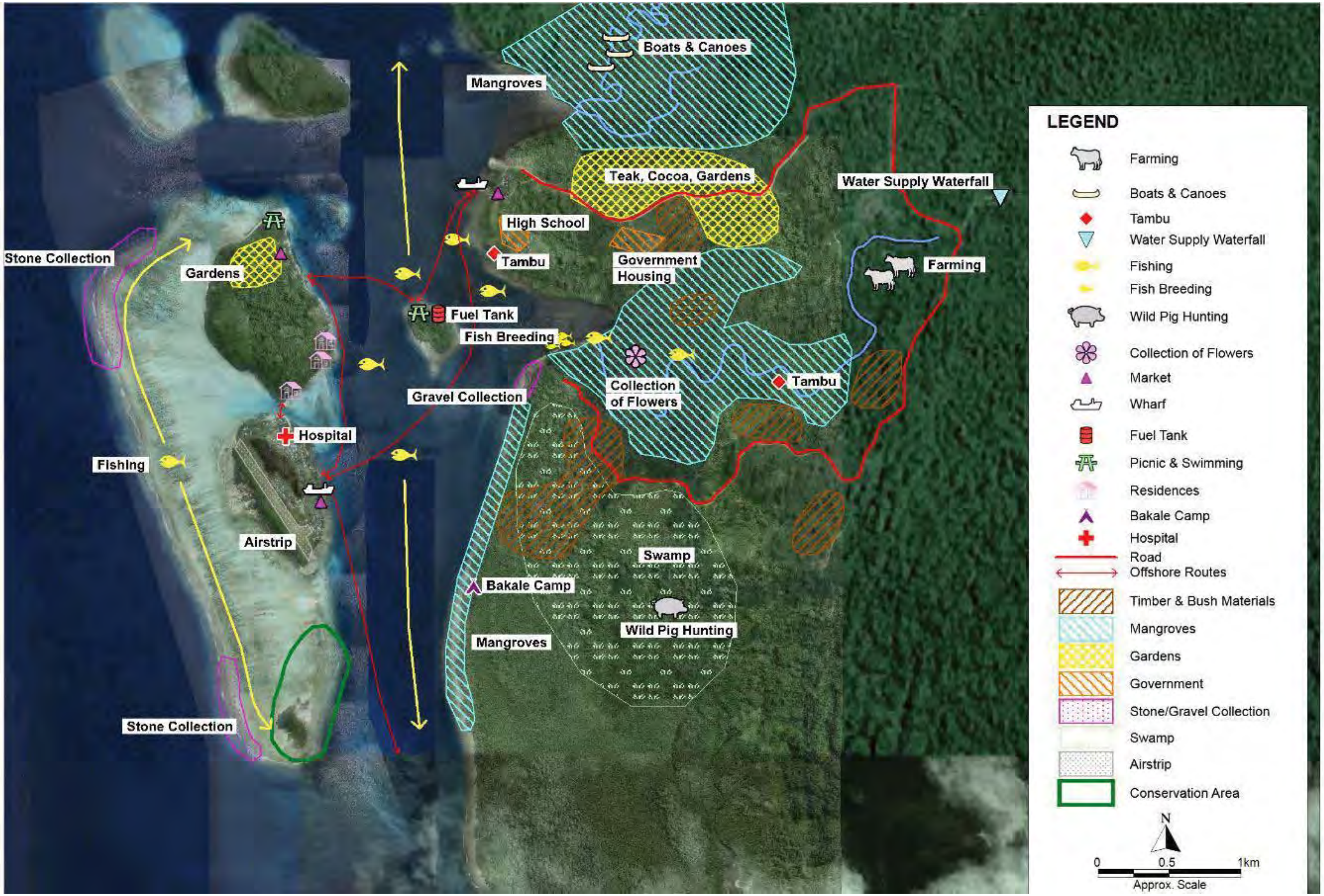


Figure 7-3 Values of the mainland, islands, freshwater and marine areas near Taro Island

BMT WBM

7.4 Risk Identification

The community engagement identified assets and values that could potentially be affected by coastal hazards, as listed in Table 7-1. A comprehensive list of risks has been developed that captures the potential impacts on these community assets and values, covering both Taro Island and the mainland sites (Lots 9 and 277). Risks considered involve the temporary or permanent affectation of the assets/values in terms of their provision of community service, their economic value, their cultural significance and the environmental significance.

The comprehensive list of risks is provided as a Risk Register, in Appendix B. This list was development during the January 2014 consultation sessions, and confirmed during the March 2014 consultation activities.

Table 7-1 Assets/values of study area

Assets / Values on Taro Island	Assets / Values on mainland (Lots 9, 277)
CPG Headquarters and Administration Telecommunications and backup generator Hospital and backup generator Airport Powerhouse Market Retail shops (CBD) Bank and post office Primary school Residences Fisheries building / Rural Water Supply Office Light industrial/fuel storage and supply Wharf Western edge of island Gardens beside airstrip Reef/conservation area Bar(s) Playing fields and sports buildings Picnic/swimming area Guesthouses and rental business Mosquito Creek Water supply Sewerage (septic systems) Community hall Church Road Rainwater tanks	Mangrove ecosystems Freshwater swamp ecosystems Fisheries / fishing grounds / fish breeding grounds Pig hunting grounds Timber / bush materials Gravel source Gardens and crops Farming land Cultural sites Fuel Depot High School

7.5 Risk Analysis

Risk analysis considers both the likelihood and consequence of the identified hazards, to determine the overall level of risk (extreme, high, medium, low). The *likelihood* of risks is largely related to the extent of coastal hazards, now and in the future. Analysis of the likelihood of the key coastal hazards is detailed in Section 6. The *consequence* of the risks relates to the type of coastal hazard impact and the assets, services and values affected.

7.5.1 Likelihood

Assigning 'likelihood' to the hazard extents provides transparency regarding the uncertainties, limitations and assumptions used to assess hazards. The likelihood concept can also educate planners and the wider community that hazard lines are estimates only and not precise predictions of the future.

Based upon the best practice guidelines for risk management (AS/NZS ISO 31000:2009 and AS 5334-2013), a scale of likelihood or probability of occurrence for hazard impact mapping has been developed that covers '*almost certain*', '*possible*' and '*rare*' likelihoods. From a community appreciation perspective, these translate roughly as follows:

- Almost certain = events that occur 'frequently' (i.e. about every year or so),
- Possible = events that occur 'sometimes' (i.e. there is about a 50/50 chance of occurrence with a 10 year period). and
- Rare = events that occur 'very infrequently' (i.e. once in a lifetime event). These events may be beyond the current community knowledge and memory.

While the typical risk assessment would include up to five likelihood descriptors, only three was considered practical for this study given the complexities of the coastal hazards in the study area, the limitations of available data and modelling and the basic level of interpretation by community and stakeholders.

It is important to recognise that the likelihood scale reflects a qualitative interpretation of risk occurrence because there are no suitable methods for defining quantitative probabilities for coastal hazard extents. The timeframes over which coastal hazard probability has been assessed is the present-day climate conditions (2014), 2030, 2055 and 2090, in accordance with IPCC standards.

Hazard mapping has been prepared that depict areas that may be continuously affected by coastal processes (Permanent Coastal Hazards) and areas temporarily affected by natural hazard events (Temporary Coastal Hazards).

7.5.1.1 Permanent Coastal Hazard Zone Mapping

Permanent coastal hazard maps show areas of the study area that may be inundated on a regular basis by tidal waters, or affected by permanent erosion of the shoreline. With projected sea level rise, it is expected that increasing tidal waters will affect the nature a number of low-lying parts of the study area, including foreshores, drains and swamps.

Mapping of the permanent inundation hazard has been compiled by assessing the areas inundated by the Highest Astronomical Tide (HAT) under a range of potential sea level rise scenarios. A 'bath tub' approach has been applied, which means that ocean water levels are applied to all tributaries and creeks without any tidal attenuation or amplification.

Note that the mapping of permanent inundation does not consider potential impacts associated with rising groundwater levels. It is expected that the interaction of groundwater and surface water will be a further constraint on future usability of land and should be investigated further. Inundation resulting from land subsidence (e.g. following an earthquake event) is also not considered as part of this assessment. The adopted permanent inundation estimates are summarised in Table 7-2.

Table 7-2 Likelihood of permanent coastal inundation

Rating	Present-day	2030(3)	2055	2090
Almost certain	HAT (as currently recorded)(1) 0.95m MSL	Present-day HAT plus 0.09m of SLR (Best-estimate of RCP 2.6 in AR5) 1.04m MSL	Present-day HAT plus 0.24m of SLR (Best-estimate of RCP 2.6 in AR5) 1.19m MSL	Present-day HAT plus 0.40m of SLR (Best-estimate of RCP 2.6 in AR5) 1.35m MSL
Possible	n/a(2)	Present-day HAT plus 0.15m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 1.10m MSL	Present-day HAT plus 0.38m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 1.33m MSL	Present-day HAT plus 0.82m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 1.77m MSL
Rare	n/a(2)	Present-day HAT plus 0.18m of SLR (High-end estimate of Netherlands Delta Committee) 1.13m MSL	Present-day HAT plus 0.45m of SLR (High-end estimate of Netherlands Delta Committee) 1.40m MSL	Present-day HAT plus 1.2m of SLR (High-end estimate of Netherlands Delta Committee) 2.15m MSL

(1) HAT does not occur yearly, however, the largest tide of the year has a level that is close to HAT. For simplicity, HAT level has been adopted as the almost certain level of permanent inundation.

(2) Possible and rare scenarios for present day is not applicable

(3) 2030 estimates have been adopted by lineal interpolation between present day and 2055 projections

The coastal hazard assessment derived a range of shoreline recession estimates, based upon assessment of the likely shoreline response to a range of possible sea level rise scenarios. The recession estimates for Taro Island was estimated to range between 5 and 20m by 2055 and between 20 and 50m by 2090. The mangrove-fringed shoreline at the mainland site is estimated to transgress inland by 10 to 20m by 2055 and 20 to 100m by 2090. The adopted shoreline recession estimates are summarised in Table 7-3.

Table 7-3 Likelihood of permanent coastal recession (relative to present day shoreline)

Rating	Present-day	2030(2)	2055	2090
Almost certain	0m (as currently recorded)	Taro Island: 2m Mainland site: 4m	Taro Island: 5m Mainland site: 10m	Taro Island: 20m Mainland site: 20m
Possible	n/a(1)	Taro Island: 4m Mainland site: 6m	Taro Island: 10m Mainland site: 15m	Taro Island: 35m Mainland site: 60m
Rare	n/a(1)	Taro Island: 8m Mainland site: 8m	Taro Island: 20m Mainland site: 20m	Taro Island: 50m Mainland site: 100m

(1) Possible and rare scenarios for present day is not applicable

(2) 2030 estimates have been adopted by lineal interpolation between present day and 2055 projections

Mapping of Permanent Coastal Hazards on Taro Island and the mainland sites, including the identification of key community assets/values, for 2014, 2030, 2055 and 2090 timeframes is provided in Appendix C.

7.5.1.2 Temporary Coastal Hazards Zone Mapping

Mapping of the Temporary Coastal Hazard Zones demonstrates areas of the study area that may be subject to coastal hazards that have an episodic nature (i.e. hazards due to particular events or episode). The following coastal inundation hazards are incorporated in the temporary coastal hazards mapping:

- Inundation due to storm tide events, including tropical cyclones;
- Inundation due to fluvial flood events; and
- Inundation due to tsunami events.

For future timeframes (2030, 2055 and 2090 planning horizons), the hazard estimate includes the following climate changes parameters:

- projected sea level rise;
- projected increases in storm rainfall intensity; and
- projected increases in cyclone intensity.

The adopted temporary coastal inundation levels are summarised in Table 7-4.

Mapping of Temporary Coastal Hazards on Taro Island and the mainland sites, including the identification of key community assets/values, for 2014, 2030, 2055 and 2090 timeframes is provided in Appendix C.

Table 7-4 Temporary coastal inundation likelihood summary

Rating	Present-day	2030	2055	2090
Almost certain	Mean Higher High Water + 0.5m 1.1m MSL	As per present-day, but with 0.09m of SLR (Best-estimate of RCP 2.6 in AR5) 1.2m MSL	As per present-day, but with 0.24m of SLR (Best-estimate of RCP 2.6 in AR5) 1.3m MSL	As per present-day, but with 0.40m of SLR (Best-estimate of RCP 2.6 in AR5) 1.5m MSL
Possible	The highest level of either a 1 in 20 year ARI storm tide, flood or tsunami event 2.0m MSL: Taro 1.8m MSL: mainland	The highest level of either a 1 in 20 year ARI storm tide, flood or tsunami event with 0.15m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 2.2m MSL: Taro 2.0m MSL: mainland	The highest level of either a 1 in 20 year ARI storm tide, flood or tsunami event with 0.38m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 2.4m MSL: Taro 2.2m MSL: mainland	The highest level of either a 1 in 20 year ARI storm tide, flood or tsunami event with 0.82m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 2.8m MSL: Taro 2.6m MSL: mainland
Rare(1)	The highest level of either a 1 in 100 year ARI storm tide, flood or tsunami event 3.1m MSL: Taro 2.9m MSL: mainland	The highest level of either a 1 in 100 year ARI storm tide, flood or tsunami event with 0.15m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 3.3m MSL: Taro 3.1m MSL: mainland	The highest level of either a 1 in 100 year ARI storm tide, flood or tsunami event with 0.38m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 3.5m MSL: Taro 3.3m MSL: mainland	The highest level of either a 1 in 100 year ARI storm tide, flood or tsunami event with 0.82m of SLR (Upper end estimate of likely range of RCP 8.5 in AR5) 3.9m MSL: Taro 3.7m MSL: mainland

(1) 1 in 500 year tsunami conditions have also been assessed as part of the hazard assessment, which would be considered as ‘extremely rare’. These conditions may be considered as part of design criteria when planning very sensitive and vulnerable future development (e.g. emergency services, hospital, evacuation centres etc) – refer Section 6 for details.

(2) 2030 estimates have been adopted by lineal interpolation between present day and 2055 projections

7.5.2 Consequence

A consequence scale was developed and adapted from the standard provided in AS 5334-2013. The consequence scale has given consideration to potential impacts on various ‘values’ to the local and national community, including infrastructure/services, social/cultural values, environmental values/services and finances/economy that may be impacted by coastal hazards over the relevant planning timeframes (i.e. to 2090). The adopted consequence scale is provided in Table 7-5.

The scale was utilised in deriving a consequence value for the various land and assets that provide the values to the communities, which are affected by the different coastal hazards.

The assessment of consequence values utilised the results of community and stakeholder engagement carried out at Taro Island and surrounding villages (during January 2014).

Assignment of consequence levels for the identified risks was undertaken by the study team giving consideration to:

- The nature (e.g. inundation and coastal erosion) and magnitude of the consequence;
- Secondary consequences in terms of health, financial impact and disruption;
- The timing and timeframe of consequences; and
- The persistence and reversibility of consequences.

Table 7-5 Consequence scale

Consequence	Infrastructure / Service	Social / Cultural	Environmental	Financial / Economy
Catastrophic	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service. Loss of infrastructure support and translocation of service to other sites. >90% of infrastructure requiring major repair or replacement.	Severe adverse human health effects, leading to multiple events of total disability or fatalities. Widespread semi-permanent impact (~ 1 yr) to highly utilised community services, wellbeing, or culture of the community with no suitable alternatives. Emergency response at a major level.	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be required.	Widespread major damage or loss of property or infrastructure. Extreme financial loss, >90%. Major effects on the local, regional and provincial economies.
Major	Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. 50-90% of infrastructure requiring major repair or replacement.	Permanent physical illnesses, injuries and fatalities may occur. Major widespread long term (~ 1 month) disruption to well-utilised services, wellbeing, or culture of the community with very few alternatives available.	Significant effect on the environment and local ecosystems. Remedial action likely to be required.	Major damage or loss of property or infrastructure. Major financial loss, 50-90%. Serious effect on the local economy spreading to the wider community.
Moderate	Limited infrastructure damage and loss of service. Damage recoverable by maintenance and minor repair. 10-50% of infrastructure requiring major repair or replacement.	Adverse human health effects (isolated serious injuries/ illnesses and/or multiple minor injuries/ illnesses) Minor medium to long term (~ 1 week) or major short term disruption to moderately utilised services, wellbeing, or culture of the community with limited alternatives.	Some damage to the environment, including local ecosystems. Some remedial action may be required.	Major damage to property or infrastructure. Moderate financial loss, 10-50%. High impact on the local economy, with some effect on the wider community.
Minor	Localised infrastructure / service disruption No permanent damage. Some minor restoration work required. <10% of infrastructure requiring major repair or replacement. Need for new/modified ancillary equipment.	Slight adverse human health effects or general amenity issues; minor and isolated injuries and illnesses. Small to medium short term disruption (~ 1 day) to moderately utilised services, wellbeing, or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Minimal effects on the natural environment.	Substantial damage to properties or infrastructure. Additional operational costs. Financial loss small, <10%. Minor effect on the broader economy due to disruption of service provided by the asset.
Insignificant	No infrastructure damage, little change to service	No human health effects (negligible injuries or illnesses) Very small short term disruption (~1 hr) to services, wellbeing, or culture of the community with numerous alternatives available.	No / negligible adverse effects on natural environment.	Minor damage to properties or infrastructure. Little financial loss or increase in operating expenses. No effects on the broader economy.

Consequences were defined on the basis of risks to the services/provisions provided by the assets/values, and are documented within the Risk Register (see Appendix B). The consequence values assigned to risks specifically considered permanent and temporary aspects of coastal hazards. In essence, permanent affectation (e.g. shoreline erosion) results in total loss of service or asset value, whereas temporary affectation (e.g. tsunami or storm tide) would result in a period of disruption to service (covering both the period of the hazard and a period following for restoration of infrastructure etc) as well as a diminished value of assets.

7.5.3 Risk Assessment

Within a risk assessment approach, risk is defined as *likelihood X consequence*. A risk matrix defining the level of risk from the various combinations of likelihood and consequence was developed for this assessment, as given in Table 7-6, largely adapted from AS 5334-2013.

For all identified risks, both likelihood and consequence have been documented, along with the resulting risk level, as determined from the matrix above (refer Risk Register in Appendix B).

Existing adaptation measures or risk controls were considered in determining the consequence and risk levels. It should be noted that controls considered have not necessarily been developed or implemented to specifically address potential impacts from coastal hazards, however they may still provide some adaptive capacity in the context of treating existing and future coastal risks.

The resulting level for each risk identified for Taro Island and the mainland sites (Lots 9 and 227), (refer Appendix B) were confirmed during consultation with the CPG and key stakeholders in March 2014.

Table 7-6 Risk matrix

		CONSEQUENCE				
		Insignificant	*Minor*	*Moderate*	*Major*	*Catastrophic*
LIKELIHOOD	Almost Certain	Low	Medium	High	Extreme	Extreme
	Possible	Low	Low	Medium	High	Extreme
	Rare	Low	Low	Low	Medium	High

7.5.4 Community Validation of Risk

During in-country engagement visit 3 (March 2014), the project team presented a draft version of the risk assessment for validation by key community members and CPG representatives (Figure 7-4, Figure 7-5). The validation process resulted in minor changes to the consequence rating assigned to some of the identified risks, which have been incorporated into the risk assessment results presented in this chapter.

Figure 7-4 Workshop with CPG on risk assessment and adaptation options

Figure 7-5 Key message: Community risk validation workshop: Supizae

Generally, community members and other stakeholders who attended the workshops agreed that values on Taro Island with the highest risk levels (either now or in the future) include:

- Choiseul Provincial Government buildings;
- Telecommunications infrastructure;
- The hospital;
- The airstrip;
- The power house;
- Residences;
- Guest houses and rental businesses;
- Water supply; and
- Roads.

Specific changes to risk consequence levels were made to adjust the overall risk level (low, medium, high, extreme) for a small number of risks, and primarily for the immediate (2014) timeframe. These changes are noted below:

- Records, data, registry and administration functions of the CPG headquarters/admin building are very important and are at significant risk from tsunami inundation. This function potentially impacts the whole of the Choiseul Province;
- Temporary inundation of telecommunications building can cause complete loss of equipment, not just disruption;
- The hospital is the administrative headquarters for the Provincial Health Service, so its impact has consequences for the whole of the Province in terms of governance, communications with doctors/nurses, records etc.;
- The hospital has a pharmacy that stores and provides medicines for the whole Province;
- The hospital takes referrals for all serious cases from clinics around the whole Province;
- There are multiple locations for fuel supply, so consequence of impact for light industrial area not as significant as originally indicated;
- The wharf has been designed by MID, so deck level and structural integrity is sufficient (although it still may be susceptible to erosion in the future, not at 2014 though);
- Flooding of residential septic systems could cause serious health impacts. If people can't use existing toilets, they will use other areas along the coastline and in nearby bush, causing other flow-on health impacts;
- Loss of the western edge of the island would increase the vulnerability of the airstrip to erosion and inundation;
- Significant impact on guesthouses is reasonable, especially those located along the southern edge of Taro Island; and

- There are multiple bar/recreation areas, so consequence of impact for these is not as significant as originally indicated.

Additionally, it was noted that there are a number of existing assets located within areas that have an 'almost certain' likelihood of permanent tidal inundation or shoreline erosion under existing (2014) conditions. This includes the wharf, the Fisheries building, other buildings within the low-lying light industrial area at the northern end of Taro Island, and the mid-way island fuel depot. It was considered that these assets would be mostly protected from permanent inundation under present day conditions given their current and on-going use, and as such, were removed from the 2014 risk profile. Similarly, permanent inundation of the western shoreline of Taro Island and the mangrove ecosystems on the mainland under 2014 conditions was not considered a specific risk, as it essentially just represents the current tidal inundation scenario. However, risks may develop in the future once inundation patterns change, affecting vegetation and thus environmental buffers and values.

Given all these areas described above are very low-lying, risks at the 2030 timeframe were captured in the risk register. Indeed these areas are likely to be some of the first areas affected by progressive sea level rise (manifesting as more frequent tidal inundation or by shoreline erosion that doesn't recover after storm events) over the next decade or two. As such, they should be monitored carefully for changes and used as triggers for appropriate risk management actions, as outlined in the next Chapter.

7.6 Risk Evaluation

It is impractical to mitigate all risk. Priority should be given, however, to treating risks that are considered to be the most important. Determining which risks to treat as part of future planning is based upon the community's (and the Government's) tolerance for risk. In most cases it would be expected that low risks can simply be monitored, rather than demand valuable management resources, while extreme or high risks require more immediate management attention.

A risk tolerance scale is used to determine which risks/locations/assets must be addressed as a priority. The risk tolerance scale utilised in this project to guide the priority risk areas or assets has been established, as given in Table 7-7. This risk tolerance scale takes into account the timeframe for impact. Relative priority is given to risks that are currently occurring or will emerge within the next 15 years (to 2030), given this would be a reasonable timeframe for implementation of adaptation actions.

Table 7-7 Risk tolerance scale

Tolerance	Risk Level	Action required
Intolerable	Extreme @ 2014 Extreme @ 2030 Extreme @ 2055 Extreme @ 2090 High @ 2014 High @ 2030	Requires risk treatment. Eliminate or Reduce the risk or Accept the risk provided residual risk level is understood
Tolerable	High @ 2055 High @ 2090 Medium @ 2014 Medium @ 2030	Reduce the risk or Accept the risk provided residual risk level is understood
Acceptable	Medium @2055 Medium @ 2090 Low @ 2014 Low @ 2030 Low @ 2055 Low @ 2090	Accept the risk & mange through existing risk management systems

Clearly extreme risks, as determined through the risk evaluation process, are considered to be intolerable. Extreme risks at the present day timeframe are most critical, however, extreme risks at future timeframes are also very important as there is still considerable uncertainty regarding when these risks may manifest. The risk tolerance scale adopted for this study also shows that a high risk level is also intolerable for the present and 2030 timeframe.

The final prioritisation of risks was confirmed through consultation with the CPG and key stakeholder in March 2014. A number of minor adjustments to the consequence ratings was made following the consultation to reflect an agreed prioritised risk register (as shown in Appendix B).

Table 7-8 lists the intolerable risks that need to be managed at 2014, 2030, 2055 and 2090. These intolerable risks form the focus for treatment and adaptation, as discussed in the following chapter.

Table 7-8 Intolerable risks (all timeframes)

Time-frame	Risk Level	Intolerable Risks	Key value / asset affected
2014	HIGH	There is a risk that temporary inundation of the CPG headquarters by tsunami or storms causes loss of Government records	CPG headquarters
	HIGH	There is a risk that temporary inundation of the CPG headquarters by tsunami or storms causes diminished capacity to respond to emergencies	CPG headquarters
	HIGH	There is a risk that temporary inundation of the telecommunications equipment by tsunami or storms causes disruption to telecommunication services	Telecommunications
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the telecommunications back-up generator by tsunami or storms causes disruption to telecommunication services	Telecommunications
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the hospital by tsunami or storms causes disruption of local and provincial medical services / administration	Hospital
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the hospital by tsunami or storms causes diminished capacity to respond to emergencies and provide care for patients	Hospital
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the hospital back-up generator by tsunami or storms causes disruption to local and provincial medical services	Hospital
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the airstrip by tsunami or storms causes damage to the airstrip and other associated facilities that disrupts air transport services	Airstrip
	HIGH Increasing to Extreme by 2090	There is a risk that temporary inundation of the powerhouse by tsunami or storms causes disruption to electricity generation	Powerhouse
	HIGH	There is a risk that temporary inundation of the retail shops on Taro Island by tsunami or storms causes disruption to local income generation	Retail shops
	HIGH	There is a risk that temporary inundation of the light industrial area on Taro Island by tsunami or storms causes damage to equipment and infrastructure	Light industrial area
	HIGH	There is a risk that temporary inundation of the Taro Island medical incinerator by tsunami or storms will cause damage or loss of facility	Medical incinerator

Time-frame	Risk Level	Intolerable Risks	Key value / asset affected
	HIGH Increasing to Extreme by 2055	There is a risk that temporary inundation of septic systems on Taro Island by tsunami or storms causes flooding of septics and water quality issues	Septics
	HIGH	There is a risk that temporary inundation of the mid-island fuel depot by tsunami or storms causes damage to infrastructure and potential petrochemical spill, as well as loss of associated income for operators.	Mid-island fuel depot
2030	In addition to the 2014 intolerable risks,		
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the Taro Island Market causes loss of facility	Market
	HIGH	There is a risk that permanent tidal inundation of the fisheries building and rural water supply office on Taro Island will cause loss of equipment and infrastructure leading to loss of service	Fisheries building
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the light industrial area on Taro Island causes loss of service and damage to equipment and infrastructure	Light industrial area
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the Taro Island wharf causes loss of use	Wharf
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the western edge of Taro Island causes loss of environmental service / buffer	Western edge of island
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the Retail Shops on Taro Island causes loss of facility and provision of food and other goods	Retail shops
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the Bank and post office on Taro Island causes loss of facility, equipment and infrastructure	Bank and Post Office
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the mainland coastline causes a decrease in area of mangroves	Mangrove ecosystems
	HIGH	There is a risk that permanent tidal inundation or shoreline erosion of the mid-island fuel depot causes loss of infrastructure, as well as loss of associated income for operators.	Mid-island fuel depot
2055	In addition to the 2030 intolerable risks,		
	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of the telecommunications back-up generator causes loss of service	Telecommunications
	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of the airstrip causes loss of facility to support air services	Airstrip
	EXTREME	There is a risk that permanent tidal inundation of the powerhouse causes loss of infrastructure and equipment	Powerhouse

Time-frame	Risk Level	Intolerable Risks	Key value / asset affected
		leading to loss of electricity supply	
	EXTREME	There is a risk that permanent tidal inundation and groundwater changes causes loss of effective use of septic systems	Septics
2090	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of telecommunications equipment causes loss of telecommunications service on Taro Island	Telecommunications
	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of residences causes loss of housing on Taro Island	Residences
	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of guesthouses and rental businesses on Taro Island causes loss of accommodation service and associated income generation	Guesthouses
	EXTREME	There is a risk that permanent tidal inundation and groundwater changes diminishes available water supply on Taro Island	Water supply
	EXTREME	There is a risk that permanent tidal inundation or shoreline erosion of the road on Taro Island causes loss of vehicular and pedestrian access	Road

8. Adaptation Options

8 Adaptation Options

8.1 Options Overview

The risks considered in this study are created by different mechanisms and have different levels and likelihoods of occurrence. The outcomes of the risk assessment and evaluation process suggest, however, that the most significant risks relate primarily to temporary inundation from coastal waters (with tsunami being the most significant driver for causing inundation).

The unpredictable nature of tsunami occurrence, along with the potentially limited warning time available (note that the Gizo tsunami in 2007 took approximately 20 minutes before the surge reached Taro Island), mean that adaptation options need to be largely passive and permanently in place. It is considered that mobilisation of resources would only be of notable assistance in the clean-up after an event occurs.

While there is a significant risk of temporary inundation (especially from tsunami) on Taro Island and the mainland under present day conditions, the vulnerability of these sites to inundation increases with time. By 2090, current day high tide levels will become mean sea level, while current day storm surge levels will become the normal (twice daily) high tide levels.

Risk management typically advocates the following risk treatment options:

(1) Avoid the risk;

(2) Reduce the risk (through reducing the likelihood or consequence);

(3) Share the risk (typically through insurance or similar, which would be largely impractical in these circumstances); and

(4) Retain the risk.

These options are generally considered with a continuum of treatment approaches wherein avoiding the risk is the most ideal (but generally most impractical) approach, while retaining the risk, or at least some component of the risk is usually necessary in some form.

From a climate adaptation perspective where risks (or at least exacerbation of risks due to climate change) are not expected to manifest for some time, there are a number of adaptation pathways that can be explored that incorporate a selection of approaches that can be implemented as risks materialise.

Whilst adaptation options focus primarily on the coastal risks, given they are the most significant risks to the existing communities, it is proposed that adaptation pathways for Choiseul Bay will incorporate other climate-related risks wherever possible, such as increased occurrence of drought and catchment flooding.

8.2 Adaptation Options Framework

Within the context of coastal climate change adaptation, there are a number of potential management options to consider, with relevance depending on whether the infrastructure/assets/values are already in place, or are planned for the future (Figure 8-1).

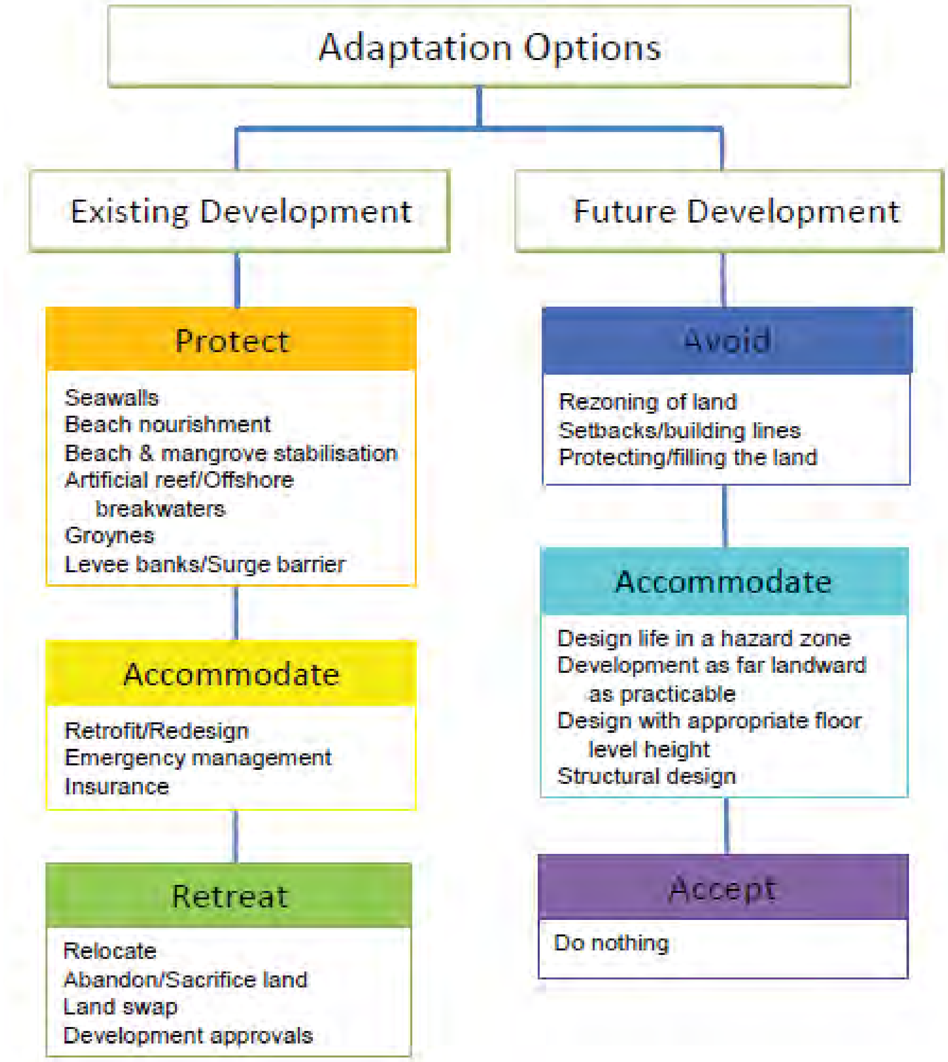


Figure 8-1 Adaptation options framework for existing and future development

For **Future Development**, the management approaches are generally as follows:

Avoid the risk, by not permitting vulnerable developments within high-risk areas (considered over the full design life of the development);

Accommodate the risk by including provisions that reduce the consequence of impacts (e.g. having minimum floor levels to reduce property damage resulting from future coastal inundation); or

Accept the risk where appropriate to the level of risk over the design life of the development.

Existing development is typically much harder to manage as works and infrastructure are already in place that limits the opportunity for both ‘avoiding’ and ‘accommodating’ the risk. Thus, risk management options generally become either ‘protecting/defending’ the land or asset, or ‘accepting’ the potential for damage or loss given the expected timeframe and likelihood of impact.

For assets that are movable, damage or loss can be reduced through education, warning and evacuation. When existing structures and infrastructure reach the end of their functional design life, they should be relocated away from high-risk areas, or redesigned to accommodate the risk, where appropriate. 'Like for like' replacement of infrastructure should only be considered in areas unaffected by existing and potential future hazards. Options for managing existing development include:

Protect existing development (private or public) from erosion and/or flooding/inundation. Protection may be in the form of hard defence structures (e.g. revetments) or soft-engineering measures (e.g. foreshore sand nourishment, vegetation). Some protection works can cause impacts to adjacent areas ('offsite impacts'), and therefore, the decision to implement a 'protect' option must consider all potential impacts;

Accommodate the risk, which aims to re-develop or retrofit existing infrastructure, public assets and private property in a manner that minimises losses from potential impacts (e.g. stronger foundations, flood-proofing etc) through careful re-design; and

Retreat development, which aims to allowing the natural processes to occur largely uninhibited by infrastructure or development. The options for existing development involve relocating or abandoning/sacrificing infrastructure, public assets or private property, if and when impacts occur. The retreat options may include compensation/land swap to private property owners where feasible and appropriate.

For existing development, it may be useful to identify 'trigger points' for future action rather than undertaking potentially costly actions immediately. This approach effectively defers action until an identified point or event in the future (such as a distance from an erosion escarpment, a frequency of inundation or water level etc) whereby the appropriate action (protection, accommodation, or retreat) should then be implemented.

It must be noted that setting a trigger point is not an excuse to "do nothing", i.e. undertake no management action at the present time. Planning controls, "no regrets" actions and preliminary investigations (see discussion below) must still be undertaken to effectively reduce the scale and cost of risk treatment required in the future. That is, setting triggers without taking action in the present timeframe to reduce the intensity of assets and values within known risk areas only enhances the difficult and costly actions required in the future. Setting triggers must be accompanied by actions now to prepare the funding and resources required and to reduce the scale or costs of impacts in the future.

No regrets and Preliminary Actions have been devised to support the implementation of other management options. Such options offer a range of assessments and works to provide further information (including approvals) required prior to implementing larger scale options for specific assets, particularly where a more costly or difficult option may be needed. The 'no regrets' options also include activities that will improve resilience and preparedness for future impact, without limiting the ability to change a management approach if future impacts do not emerge as expected.

8.3 Coastal Adaptation Management Options

Appendix D provides a range of adaptation options that may be applicable to managing the coastal hazards in Choiseul Bay, and in particular the coastal hazards that increase as a result of future climate change (and sea level rise in particular). This management options 'toolkit' has been compiled from various Australian and international sources including:

- First Pass National Assessment of Climate Change Risks to Australia's Coast (2009),
- NSW Coastal Planning Guideline: Adapting to Sea Level Rise (2009),
- NSW Guidelines for Preparing Coastal Zone Management Plans (DECCW, 2010),
- Qld Guideline for Preparing a Coastal Hazard Adaptation Strategy (EHP, 2013),
- Qld Coastal Hazard Adaptation Options – Compendium (GCCM & GHD, 2013), and,
- Other coastal zone adaptation and management studies developed by the study team across Australia and overseas.

Included in the toolkit are a number of links and references for additional information regarding the adaptation options.

8.4 Tsunami Risks Management Options

Tsunami hazards represent the greatest risk to existing development around Choiseul Bay. With future sea level rise this risk will increase as a result of higher surge water levels and higher frequency of impact.

Options for managing risks associated with tsunami can be considered as follows:

- Options to improve warning and response (pre-event);
- Options to improve recovery (post-event); and
- Options to minimise damage and loss of life.

Many of the options associated with managing tsunami risk are similar to the options to address other coastal risks, as presented in the toolkit (refer Appendix D). An overview of the main tsunami risk management options is provided in Table 8-1.

Table 8-1 Tsunami options

Option	Description	Costs	Feasibility for Choiseul Bay
Pre-event options (largely emergency management)			
Warnings	To be provided from a centralised service (Honiara or elsewhere). Requires a 24/7 response at Choiseul Bay. Needs to have a mechanism for disseminating warning to broader population.	MEDIUM COST Includes system set-up, broadcasting of notice to public (e.g. via SMS, PA, bell etc)	Potentially very effective, although warning time would be very small if tsunami is locally generated (15 minute warning time for Gizo tsunami in 2007).
Evacuation	This requires both a suitable evacuation route and a suitable destination (refuge). Refuge can be on higher land (ideal) or an elevated part of a structure (e.g. roof of a building, is appropriate).	MEDIUM COST May involve construction of an elevated area to accommodate people at short notice (e.g. an outdoor grandstand)	Evacuation is essential on Taro Island given its susceptibility. Effective warning will be necessary in order to achieve evacuation.
Education	People will need to know what to do when they receive a warning. This includes where to go and what to take.	LOW COST Will involve periodic campaigns plus signage.	Can be very effective within a small community like Taro Island or Supazie.
Post-event options			
Restoration of access	Water traffic and air traffic to Taro Island will need to be restored quickly after an event to provide essential supplies and services that may have been affected. Can involve preventative measures to minimise loss of access or contingency measures.	VARIABLE If considerable damage, then access will be difficult and lengthy to restore. As a minimum, would involve a ready-assembled labour force to clear debris and make repairs etc.	Access to and from Taro Island will be fundamental for restoration of services.
Restoration of health services	The hospital on Taro Island should be restored with urgency. Also includes restoration of a water supply (could be achieved by having full raintanks on higher land unaffected by the tsunami). Sanitation also needs to be managed by ensuring contact with any standing water is avoided.	MEDIUM COST Includes installation of 6000 litre raintank on high land on Taro Island and pumps to keep it full. Provision of emergency supplies for medicines etc on high land (or kept elevated within hospital)	Following access, health services need to be restored as a priority on Taro Island.

Option	Description	Costs	Feasibility for Choiseul Bay
Restoration of essential services	Would involve workable back-up generators and other equipment to restore essential services (power, telecommunications, CPG headquarters, air traffic control etc)	LOW-MEDIUM COST A portable back-up generator can be stored on high land for multiple purposes, along with necessary supplies of fuel etc.	Communications with the outside world after an event will need to be restored quickly to help with recovery needs.
Damage and loss minimisation options			
Structural modifications to existing buildings and infrastructure	Raised floor levels and allow flow under buildings	HIGH COST Depends on the building	Only some buildings would be able to be raised.
	Floodproofing to prevent inundation (beware hydrostatic loads and structural collapse for dry-floodproofing)	MEDIUM COST Depends on building and scope	Availability of materials may be an issue. Wet-floodproofing better by just ensuring all valuables (equipment etc) are raised as high as practical within building.
	Reinforced foundations and tie-down to foundations	MEDIUM COST Depends on building	Only relevant if flows under building to produce buoyancy loads
	Provision of vertical evacuation facilities within buildings, including access onto roof as appropriate	MEDIUM COST Not appropriate for all buildings.	Vertical evacuation within buildings should be considered a last resort, but given the potential short warning time would be important to minimising loss of live.
	General strengthening of structures to withstand wave and debris loading	MEDIUM COST May prioritise buildings that will be important to post-event recovery, such as hospital, telecom, CPG HQ	Materials and labour may be an issue for major construction works. Retrofitting existing buildings will require careful design.

8.5 Other Climate Risk Management Options

In addition to the primary coastal-related risks, there are other secondary risks to the Choiseul Bay community that will increase in the future as a result of projected climate change. These risks are described briefly below, along with some options for mitigation the risks.

8.5.1 Increase in Drought

Taro Island is particularly susceptible to drought, requiring transportation of freshwater from the mainland on a daily basis. Projections for future rainfall across the Solomon Islands are inconsistent, however, it is possible that longer and more intense periods of drought may be experienced in the future.

Resilience to drought is best achieved by securing more dependable water sources. As a coral atoll, Taro Island has little natural sources of water. Rainwater tanks are the primary current source, while some groundwater extraction is also undertaken (although it tends to be partially saline). Future adaptation options would involve:

- Increasing local reserves of freshwater by improving the efficiency of rainwater capture (e.g. improving guttering and piping) and the storage capacity (e.g. more rainwater tanks of larger capacity connected to roofs);
- Construction of a waterpipe from the mainland (sourced from the Sui River catchment) and associated local infrastructure (tanks, pumps, distribution network etc); and
- Construction of a small desalination plant.

Of these options, increasing local reserves via greater rainwater capture is the most affordable and adaptable, as this infrastructure can be re-used if relocated to the mainland.

8.5.2 Increase in Storm Frequency and Intensity

The Solomon Islands is already vulnerable to intense storms, notably tropical cyclones or ex-tropical cyclones that produce high winds and very high rainfall (e.g. Honiara, early April 2014).

Taro Island has a small local catchment, and thus runoff from local rainfall would be relatively contained. The mainland site, however, is located adjacent to the Sui River. Approximate flood extents of the river in the vicinity of Lot 9 and Lot 277 have been established (refer Section 6.3). Future resilience to flooding risks will be achieved by avoiding future development within Sui River floodplains. Whilst it is impossible to avoid completely future development within flood affected areas (as there will always be a need for access and some infrastructure adjacent to the waterway), such development should be designed and constructed to withstand periodic inundation and flood debris impacts.

The other major infrastructure that requires careful consideration of future storm conditions is the road bridge that connects Lot 9 and Lot 277. As the future mainland development site will be a 'split town', access over the Sui River will be very important, with a high level of flood immunity.

8.5.3 Increase in Temperature (and number of hot days)

Based on higher level projections, temperatures in the Solomon Islands could increase by 1°C by 2030, 2°C by 2055 and 3°C by 2090. It is possible that this increase in extreme heat could cause distress for vulnerable members of the community, notably the young, elderly and infirm.

Adaptation for increasing temperatures relate to a more dependable supply of water, provision of health services (both at centres and within the community), maximising shade through vegetation and cover, and provision of cooling (e.g. fans or air conditioning) within community buildings, churches, retail shops etc.

8.5.4 Increase in Groundwater Levels

As sea level rises groundwater levels will also rise by a similar amount. As Taro Island is a low lying coral atoll, an increase in groundwater levels will make some areas less suitable for use, especially in the lower-lying parts of the island that surround Mosquito Creek. An increase in groundwater levels may also compromise the effectiveness of existing septic systems.

The projected increase in groundwater levels will be virtually impossible to avoid. Therefore, adaptation options associated with this effect will need to increase the community's ability to accommodate the higher levels. This will involve changing landuse behaviour in areas affected, or modifying the foundation requirements for new or existing infrastructure.

For some infrastructure, such as the airstrip, additional filling will most likely be required to maintain functionality, as shallow groundwater levels would cause deterioration of the ground surface (e.g. potholing). An increase in groundwater levels may (as well as an increase in sea level) would also cause diminished drainage capacity on Taro Island. Thus there may be a need to re-establish surface drainage network (using wider and shallower drains).

8.6 Community and Stakeholder Engagement Outcomes

Adaptation options were workshopped with stakeholders and community members during in-country engagement visit 3 held in March 2014. The feedback and suggestions received are summarised in Table 8-2.

The adaptation options identified through community and stakeholder engagement were included in the options assessment (Section 8.7 – see below), however, not all of the adaptation options suggested by the community are included in the final recommendations for adaptation made in this report. Notwithstanding this, the multi-criteria assessment includes consideration of community acceptability as indicated through broad community feedback.

Table 8-2 Adaptation options identified through community and stakeholder engagement

Values	Summary of Workshop Discussions
Taro Island generally	• Plant trees along the coast as a buffer • Build sea walls, groynes or wave breakers • Prepare a tsunami evacuation and recovery plan • Raise buildings • Make sure new buildings are elevated off the ground
Choiseul Provincial Government (CPG) buildings	• Make digital backups of data and store at Honiara • Archive older documents in an elevated room in the CPG offices or on the mainland
Telecommunications infrastructure	• Raise the buildings and the generator platform • Build new or back up services on the mainland • Build sea wall in front of the generator or around the whole facility

Values	Summary of Workshop Discussions
The hospital	• Relocate to the mainland • Build groynes or sea walls • Revise the evacuation plan and develop an education program • Raise or relocate the pharmacy and generator • Build a multi-purpose safe house on high ground • Remove the roof and build another storey • Upgrade CBPSS to cater for evacuations
Airstrip and associated buildings	• Make the airstrip higher and longer • Relocate airstrip to the mainland • Provide a fast ferry service • Use a nearby airport or helicopter in an emergency • Build sea wall at southern end of the airstrip
The Powerhouse	• Raise the powerhouse or relocate to higher ground • Find an alternative power source • Install solar panels for houses
Residences	• Raise houses off the ground • Relocate to mainland • Build new houses to a safe standard (i.e. raised off the ground)
Guest houses and rental businesses	• Raise off the ground • Close business and open new business on mainland
Water supply	• Install guttering and water tanks on existing buildings (private and communal) • Construct a pipeline from the mainland • Build a desalination plant
Road	• Raise all or parts of the road • Build a sea wall or groyne • Consider alternate route

8.7 Adaptation Options Evaluation

8.7.1 Assessment Criteria

The assessment of options carried out for this study has involved a first pass analysis using a multi-criteria assessment approach .This task involved critical feedback from consultation with the CPG and key stakeholders during engagement in March 2014.

The criteria used in the first pass assessment are:

- Cost, with “high” to “low” limit values based upon an order of magnitude difference in expenditure (and includes whole of life costs, not just capital expenditure);

- Community Acceptance, as established through feedback during consultation and a general appreciation for community opinions;
- The ability for the option to be Reversible / Adaptable in the future, which is particularly relevant where there is considerable uncertainty and or long time frames for a future impact.
- Longevity of solution, based on whether option presents a long term solution or a short term solution that would require additional management action or upgrades in the future;
- The technical viability, to highlight where certain options may or may not be technically feasible based on the availability of material, labour etc both for capital works and on-going maintenance;
- Effectiveness in mitigating risks, recognising the full spectrum of risks present and the ability of some options to be beneficial in addressing multiple risks.

As part of the assessment, each criteria has been scored using a ‘traffic light’ framework (refer Table 8-3) to indicate:

- **“GO”** where an option is suitable with minimal trade-offs, and so will be recommended for further consideration with no further cost-benefit analysis required;
- **“SLOW”**, where an option may be suitable at specific sites or under specific circumstances, but should be subject to a more detailed assessment at individual assets / locations (‘fine’ filtering); and
- **“STOP”** where an option is not suitable, and no further consideration of the option should be given (i.e. excluded).

An overall score is also established as part of the first pass analysis, wherein each “go” is worth 2 points, each “slow” is 1 points and each “stop” is -1 point. Given the inability to finance the more expensive options, a “stop” for the cost criteria is given a score of -2. All other criteria are weighted equally.

Table 8-3 Adaptation options first pass assessment criteria

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
STOP	Expensive to build and maintain. Requiring external grants	Not generally acceptable to community	Cannot be reversed or modified once implemented	Address short-term risks only or to infrastructure with limited lifespan	Requires materials and skilled labour to be imported	Limited benefit in addressing identified risks	-1 (-2 for cost only)
SLOW	Moderately costly (possibly through grants), but with lower on-going maintenance costs (CPG funded).	Palatable to some but not others	Can be reversed or modified but at considerable cost	Largely short-medium term, based on longevity of infrastructure	Can utilise some labour and materials, but still requires some imports	Provides some benefits to isolated risks. May address existing risks, but not future risks.	1
GO	Little or minimal costs, and within existing budgetary funding for CPG and/or SIG	Largely acceptable to all affected parties	Can be reversed or modified easily with little impact	Provides a long term solution that will accommodate future risks	Easy to implement using local labour and available materials	Provides considerable benefits to a range of potential existing and future risks	2

8.7.2 Tsunami Response and Recovery Plan

There is no current evacuation plan for Taro Island in the event of a tsunami or similar emergency. The informal assembly point is at the high school on the mainland. That is, if there is a tsunami warning/alert, residents of Taro Island travel by boat to the mainland. If the tsunami is generated locally (e.g. Gizo, 2007), there would not be sufficient time to reach the mainland. Additionally, if the tsunami is preceded by a significant out-rush of water, then boats may become stranded mid-channel.

A tsunami response and recovery plan involves the delivery of essential information to all people on the islands. It also involves establishing an appropriate shelter or assembly point(s) that can accommodate a large number of people temporarily and recovery after the event has passed.

8.7.2.1 Preparedness

Tsunamis may be generated locally (like the Gizo 2007 event) or many thousands of kilometres way (like the Japan 2011 event). For tsunamis generated locally, there will be no formal warning of an approaching devastating wave given the small lead time (may be less than 20 minutes). For these situations, the earthquake that causes the tsunami actually provides the best warning of an impending danger. Thus, the Taro Island community should be prepared to respond on the basis of substantial earthquake tremors.

For tsunamis generated from distant earthquakes, it is expected that warnings would be issued from Honiara through the Pacific Tsunami Warning Centre. Warnings containing the location, depth and magnitude of earthquakes can generally be issued within about 5 minutes of an event occurring. Earthquakes that occur deeper than 20 -50 kilometres generally have a low likelihood of creating tsunamis. Warnings regarding the timing and size of an expected tsunami event, however, require further analysis and may take longer to issue.

When an earthquake is experienced, it is important that the community know how to respond. This includes where to go, and what to take. Recognising that lead time for an event may be less than 20 minutes (if locally generated), it will be important that there is widespread knowledge of the location for evacuation shelters. For facilities that house larger numbers of people, such as administration buildings and the hospital, formal evacuation plans should be prepared, with dedicated wardens to assist with the evacuation of people to safer ground. Special provision needs to be made for the infirm and those lacking mobility.

For larger buildings that have sufficient structural integrity to withstand inundation (e.g. the new recreational building, the CPG headquarters), internal vertical evacuation may be acceptable, with facilities retrofitted to accommodate such access.

8.7.2.2 Warning

Whilst earthquake tremors would generally be sufficient to alert people of a potential tsunami that would occur in short notice, this could be supplemented by a more formal warning system. This system could involve a siren, PA system or a bell, with back-up generator if power is required. Clearly some form of community education would be required so that the community understands what the warning means and how to respond.

8.7.2.3 Evacuation Centre

The church located on the higher land at the northern end of Taro Island would provide a suitable refuge for the community in the event of a tsunami. Once activated as an evacuation centre, this facility could provide shelter (although not enough for the entire Taro Island population). It can also be used to distribute essentials such as water, food and medicines. Minor alternations to the building would be required to improve its suitability as an emergency shelter, including increasing the capacity of the rainwater tanks, improving guttering, and providing storage to hold emergency packs and other essentials. It could also be fitted with a bell or siren to be used to issue warnings.

A second evacuation centre could also be considered at the southern end of the island. Depending on the lead time available, some members of the population may struggle to reach the church on the higher ground before a tsunami hits the island. It is considered that emergency refuge could be provided by (1) retrofitting some existing buildings to allow for people to elevate themselves (e.g. climb onto an elevated platform or stable roof structure, such as within the new recreation building), or (2) ensure any new major facility constructed on the island incorporates provision for vertical evacuation (e.g. an elevated observation platform for a new airport building).

For residents on Supizae Island there may be insufficient time to get to Taro Island. Also, the $1 canoe service would most likely be unavailable as water levels could be drawn down before a tsunami wave exposing the shallow flats adjacent to the channel. For Supizae Island residents, in the short-term it is recommended that they temporarily seek refuge wherever they can and as high as they can. This could include accessing the roofs of their houses or climbing trees. In the longer-term, construction of a new facility that acts as a dedicated evacuation shelter on Supizae Island is recommended.

Co-ordination and activation of evacuation centres, registration of people seeking shelter, and distribution of essentials would need to be the designated responsibility of someone on the island. This role requires further discussion with the CPG.

8.7.2.4 Recovery

Once the tsunami or storm has passed, recovery needs to occur as quickly as possible. Recovery involves firstly an initial assessment of damage to assets and infrastructure. It is important that this be carried out before the general population are allowed to return to their homes in order to avoid harm or loss of life due to collapsing structures, exposed electrical wires or other similar hazards.

Once any dangerous areas have been identified, the clean-up operation can commence. Of most importance is restoring boating access to the island. If there is extensive damage on the island, the mainland will be the only centre that can provide for the needs of the population. Also, provision of supplies from the mainland will be required almost immediately to help with the recovery process.

Restoring air traffic will also be a high priority for Taro Island, so clean-up of the airstrip and air traffic control will be needed. This may require moving heavy logs or sediment deposits from the airstrip, which would involve some form of machinery (assuming it is still operational after the event). The airstrip will provide essential linkage to Honiara and other provincial centres. It is assumed that if Taro Island was devastated by a tsunami or storm, then other areas throughout the

Solomon Islands would also be affected. This may affect air traffic across the whole of the country, and it may be many days before outside assistance and emergency provisions reach Taro Island. Thus, the mainland should be the primary base for recovery. In this regard, storage of emergency supplies on the mainland should be incorporated into an overall evacuation and recovery plan for Taro and Supizae Islands.

8.7.3 Existing Infrastructure and Development

The key assets associated with the intolerable risks at Choiseul Bay are listed in Table 8-4.

Table 8-4 Key existing assets affected by intolerable risks

CPG headquarters	Market	Wharf	Mid island fuel depot
telecommunications	Retail shops	Western edge of Taro Island	Residences on Taro Island and Supizae Island
Hospital	Bank and post office	Medical incinerator	Guesthouses on Taro Island
Airstrip	Fisheries building	Septics	Water supply
Powerhouse	Light industrial area	Mangrove ecosystem (mainland)	Road

These particular assets and the risks associated with them were discussed during the March 2014 consultation campaign. Outlined below are more specific details on some of the adaptation options that are considered to be more appropriate to these assets and the nature of the risks that is affected them. These include the options suggested by the CPG and the community during consultations session in March 2014.

It is recognised that the community were of the strong opinion that further investment in existing infrastructure and development should be minimised / limited to allow for maximum new investment into the development of the new township site on the mainland. Thus, a critical criteria for assessment is cost minimisation for adaptation works associated with existing infrastructure and development.

8.7.3.1 CPG Headquarters, Fisheries Building

Issues are similar for these two administrative buildings. The CPG headquarters (Figure 8-2) houses valuable paper records, while the Fisheries building (Figure 8-3) also contains equipment necessary for on-going functioning of the department. A first pass assessment of options derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-5.

Figure 8-2 CPG headquarters building, Taro Island

Figure 8-3 Fisheries building, Taro Island

Table 8-5 CPG headquarters and Fisheries building options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Digital back-up system	SLOW	GO	GO	GO	GO	GO	11
Relocate sensitive files to building on mainland	GO	SLOW	GO	GO	GO	GO	11
Raised storage facility within existing building	SLOW	GO	SLOW	STOP	GO	SLOW	6
Raise sensitive equipment	SLOW	GO	SLOW	STOP	SLOW	SLOW	5
Flood-proof building	STOP	SLOW	SLOW	STOP	STOP	GO	0

Based on the above, it is recommended that sensitive files are relocated to the mainland and also converted to digital form as funds become available. For the Fisheries building, it is recommended that sensitive equipment and information be raised as high as practical within the existing facility.

8.7.3.2 Telecommunications, Powerhouse, Medical incinerator

Issues are similar for these service-related buildings, shown in Figure 8-4, Figure 8-5 and Figure 8-6. It is understood that the powerhouse is currently being considered for upgrade. Routine maintenance/upgrades would provide an ideal opportunity for retrofitting works to improve adaptive capacity. A first pass assessment of options derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-6.

Figure 8-4 Telecommunications building, Taro Island

Figure 8-5 Powerhouse building, Taro Island

Figure 8-6 Medical incinerator, Taro Island

Table 8-6 Telecom, powerhouse and medical incinerator options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Link to repeater towers	SLOW	GO	GO	GO	SLOW	GO	10
Relocate services to mainland	SLOW	SLOW	GO	GO	SLOW	GO	9
Provide back-up power from batteries or solar panels	SLOW	GO	GO	SLOW	SLOW	GO	9
Relocate to higher ground on Taro Island	SLOW	SLOW	SLOW	SLOW	SLOW	GO	7
Raise sensitive equipment	SLOW	GO	SLOW	STOP	SLOW	SLOW	5
Protect building using a seawall	STOP	SLOW	SLOW	GO	STOP	GO	3
Raise building	STOP	GO	SLOW	STOP	SLOW	SLOW	2
Flood-proof building	STOP	SLOW	SLOW	STOP	STOP	GO	0

Based on this first pass assessment it is recommended that services be relocated to the mainland as the opportunity arises. Until then it is recommended that alternatives be provided via mobile back-up generators and solar panels. Further investigation into the suitability of linking to repeater towers should also be undertaken.

8.7.3.3 Hospital

The hospital (refer Figure 8-7) provides local and provincial level services, taking referrals from local clinics located elsewhere around Choiseul. It is considered that the hospital is one of the critical assets of Taro Island. A first pass assessment of options for the hospital derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-7.

Figure 8-7 Hospital, Taro Island

Table 8-7 Hospital options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Relocate back-up generator to higher ground	SLOW	GO	GO	SLOW	GO	GO	10
Protect building by raising the road	SLOW	GO	SLOW	GO	SLOW	SLOW	8
Relocate temporary services to higher ground on Taro Is, esp pharmacy	SLOW	SLOW	GO	STOP	GO	GO	7
Relocate services to mainland	STOP	GO	GO	GO	SLOW	GO	7
Raised storage facility within existing building, especially pharmacy	SLOW	GO	SLOW	STOP	GO	SLOW	6
Increase capacity of other clinics	SLOW	SLOW	GO	GO	SLOW	STOP	6
Raise sensitive equipment, including back-up generator	SLOW	GO	SLOW	STOP	SLOW	SLOW	5
Protect building using a seawall	STOP	GO	SLOW	GO	STOP	GO	4
Build second storey onto existing building	STOP	GO	SLOW	STOP	SLOW	SLOW	2
Raise building	STOP	SLOW	SLOW	STOP	SLOW	SLOW	1
Flood-proof building	STOP	SLOW	SLOW	STOP	STOP	GO	0

The ideal solution is to relocate the main referral hospital service to the mainland. A local clinic can remain in the present location while ever there is a reasonable population on Taro Island and Supizae Island. Funding would be required to build a new hospital on the mainland, however, it is considered one of the critical items of infrastructure to encourage resettlement to the new development site.

As an interim measure, it is recommended that the back-up generator is relocated to higher ground, or if no alternative site is available, then raise the generator in its current location using a stand or frame. It is assumed that back-up power is necessary for the hospital to enable on-going use of medical equipment and for refrigeration of sensitive medicines and vaccines. Essential medical supplies could continue to be dispensed via a temporary (mobile) pharmacy in the event of a tsunami or similar. This would require planning and appropriate storage so that a sufficient supply of medicines can be collected and moved at very short notice.

8.7.3.4 Airstrip

The airstrip (refer Figure 8-8) provides an essential link for people between Choiseul province and Honiara. It is understood that the airstrip is currently too short to accommodate larger Dash 8 aircraft, although the current condition of the airstrip may also be a factor in its suitability for these larger aircraft. The airstrip already spans the full width of the island, so any lengthening of the runway would require significant investment in major land reclamation (at one or both ends of the existing runway). Future investment in upgrading the airstrip and associated facilities should consider the long-term position of the airstrip and its significant vulnerability to existing and future coastal risks. A first pass assessment of options for the airstrip derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-8.

Figure 8-8 Airstrip, Taro Island

Table 8-8 Airstrip options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Tree planting	GO	SLOW	GO	SLOW	GO	STOP	7
Raise level of airstrip	STOP	GO	SLOW	GO	SLOW	GO	6
Relocate to mainland	STOP	GO	GO	GO	STOP	GO	5
Protect airstrip using a seawall	STOP	GO	SLOW	GO	STOP	GO	4
Extend and raise airstrip	STOP	GO	SLOW	GO	STOP	GO	4
Provide fast ferry service to Honiara, as alternative to slow provincial ship	STOP	GO	GO	GO	STOP	SLOW	4

Once again the ideal scenario would be to relocate the facility to the mainland. However, unlike the hospital, a new airstrip cannot be readily accommodated within existing mainland allotments, meaning that additional land negotiations and acquisition would be required if this option was to be pursued. Significant land filling may also be required if the only practical location for a new airstrip on the mainland is on the low-lying and swampy coastal flats. Thus, there may not be any significant advantage to relocating this facility if the new mainland location is still vulnerable to rising sea levels and other coastal impacts. Having an airstrip that is located offshore from the main community centre is not considered to be a future constraint, as Gizo airstrip is similarly located on an offshore island.

A realistic alternative may be to continue using the existing facility for at least another 50 years or more, but invest in appropriate upgrades to improve its resilience to coastal impacts. Part of this would likely be extension and/or raising and stabilising of the runway to accommodate larger Dash 8 aircraft, which may require reclamation and seawall construction. Clearly significant financial investment would be required to pursue this as an option.

While tree planting may be economic and achievable, it would have little value in protecting the airstrip from future inundation or coastal recession.

8.7.3.5 Market, Retail Shops, Bank and Post Office

The Taro Island markets (refer Figure 8-9) are located close to the edge of the island and as such, are particularly vulnerable to inundation and coastal erosion. Retail shops including the bank and post office are also located in close proximity to the markets and are similarly susceptible to existing and future coastal risks. . A first pass assessment of options for the airstrip derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-9.

Figure 8-9 Market, Taro Island

Table 8-9 Market, shops and retail options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Tree planting	GO	SLOW	GO	SLOW	GO	STOP	7
Raised storage within existing buildings	SLOW	SLOW	GO	STOP	GO	SLOW	7
Relocate services to mainland	SLOW	STOP	GO	GO	SLOW	GO	7
Relocate to alternative site on Taro Island	SLOW	SLOW	SLOW	SLOW	SLOW	SLOW	6
Protect using a seawall	STOP	GO	STOP	GO	STOP	GO	5
Raise sensitive equipment	SLOW	SLOW	SLOW	STOP	SLOW	SLOW	4
Raise buildings	STOP	SLOW	SLOW	STOP	SLOW	SLOW	1
Flood-proof buildings	STOP	SLOW	SLOW	STOP	STOP	GO	0

The preferred solution would be to provide these services from an alternative location on the mainland. While this may be an ideal long-term goal for when there is a sizable and thriving population on the mainland, the short to medium term horizon still presents a reasonable risk of damage to goods and infrastructure. Until such time that alternative services can be provided on the mainland, it is recommended that owners and proprietors try to raise goods and equipment as high as practical to minimise impact in the event of inundation. If the markets or retail shops become threatened by shoreline erosion, relocating the markets to an alternative location on Taro Island should be considered, or using sandbags to slow the rate of erosion.

Again, tree planting may be economic and achievable, but would have little value in protecting the market and retail shops from future inundation or coastal recession.

8.7.3.6 Light Industrial Area

The light industrial area (Figure 8-10) is located at the northern end of Taro Island, and comprises of a number of small sheds that are expected to contain various equipment, largely relating to boats and maritime services. A first pass assessment of options for the light industrial area derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-10.

Figure 8-10 Light industrial area, Taro Island

Table 8-10 Light industrial area options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Relocate services to mainland	SLOW	STOP	GO	GO	SLOW	GO	7
Raise sensitive equipment	SLOW	GO	SLOW	STOP	SLOW	SLOW	5
Raised storage within existing buildings	SLOW	SLOW	SLOW	STOP	GO	SLOW	5
Raise buildings	STOP	STOP	SLOW	STOP	SLOW	SLOW	-1
Flood-proof building	STOP	SLOW	SLOW	STOP	STOP	SLOW	-1

The light industrial area provides important services the local community of Taro Island, and as such, will remain on Taro Island until the broader population resettles to the new mainland site in the future. It is expected that new industrial facilities will be established as the mainland site develops. These facilities may or may not be the same as those provided by the existing light industrial area on Taro Island. To minimise damage it is recommended that owners and proprietors of buildings within the light industrial area take steps to permanently raise valuable assets and equipment as high as practical.

8.7.3.7 Wharves

The Taro Island wharf (Figure 8-11) and the existing mainland wharf (Figure 8-11) provide an essential link between Taro Island and the mainland. Both of these wharves are significant engineering structures, which are likely to have been designed taking into account periodic coastal inundation as well as some wave impact. A first pass assessment of options for the wharves derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-11.

Figure 8-11 Taro Island Wharf

Figure 8-12 Tarekukure Wharf, mainland

Table 8-11 Wharves options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Confirm design standards and estimate functional life	GO	GO	GO	SLOW	GO	STOP	8
Stabilise/protect land connection of wharf	SLOW	GO	SLOW	SLOW	SLOW	SLOW	7
Raise deck level and/or enhance structural integrity	STOP	GO	STOP	SLOW	STOP	GO	1

It is expected that the existing wharf structures are suitable to withstand coastal impacts to the end of their functional life. However, a no-regrets option would be to confirm that this is indeed the case. While the wharf structure itself may be adequately designed and constructed by MID, the land immediately behind the structure may still be subject to erosion. It is recommended that monitoring be carried out regarding possible erosion at the land-end of the wharves, and if erosion potentially compromises the use of the wharf, then appropriate protection works be carried out (e.g. sand bags).

8.7.3.8 Western Edge of Taro Island

The western edge of Taro Island (see Figure 8-13) provides a number of local services to the community. As we being a significant area of dense vegetation on the island (and thus associated ecosystem services), the area is used as informal latrines, and for pedestrian access to the ocean-side reef flat for fishing. A first pass assessment of options for the western edge of Taro Island derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-12.

Figure 8-13 Western edge of Taro Island

Table 8-12 Western edge of Taro Island options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Prevent future development	GO	GO	GO	GO	SLOW	GO	11
Allow natural landward migration of vegetation as sea level rises	GO	SLOW	SLOW	GO	GO	GO	10
Tree planting	GO	SLOW	GO	SLOW	GO	STOP	7

The western edge of Taro Island is not susceptible to present day erosion, however, sea level rise may result in some future recession of the shoreline (which could not be mitigated through coastal structures such as groynes or offshore breakwaters). Also, the land will experience “coastal squeeze”, where the coastal vegetated fringe is diminished because it is confined between rising sea levels and artificially elevated land behind (i.e. the airstrip). Indeed the entire will potentially become an inter-tidal mangrove forest by the end of the century.

It is recommended that this area be preserved from future development given its susceptibility to future inundation, and that it be allowed to change naturally without any intervention. This will result in gradual die-off of existing vegetation and replacement with alternative species (primarily mangroves).

The western edge of the island is the area primarily exposed to direct tsunami wave impacts. The tsunami surge wave is attenuated to some degree by the outer reef edge and the shallow sand shoals in front of the island. Vegetation on the shoreline also helps to attenuate the tsunami impacts. It is recommended that coral and sand mining on the outer edge of the reef is prohibited and shoreline vegetation along the western edge of Taro Island maintained to ensure that impacts of tsunami surge waves are not exacerbated in the future.

8.7.3.9 Septics, Water Supply

There is extensive use of septic tanks on Taro Island for effluent disposal. Septic systems comprise of a holding tank where the effluent undergoes partial treatment, and a soak away, where effluent is discharged into the soil and then infiltrates through to groundwater.

Primary water supply on Taro Island is rainwater tanks, although the capacity of the tanks and the condition of the guttering on buildings significantly limited the reliability of this supply (see Figure 8-14). When diminished, alternative water supply involves collection from the mainland (Sui River), which is then transported to Taro Island by boat, and pumping from groundwater wells, although groundwater can be potentially saline and contaminated by septic discharges.

Future sea level rise will increase groundwater levels on Taro Island. This will affect the efficiency of existing septic systems, potentially increase the salinity of groundwater, and will compromise the use of local groundwater on Taro Island as an alternative water supply.

A first pass assessment of options for septics and water supply derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-13.

Figure 8-14 Existing rainwater tanks on Taro Island

Table 8-13 Septics, water supply options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Improve guttering and rainwater tanks – communal buildings (with a water sharing arrangement)	SLOW	SLOW	GO	STOP	GO	GO	7
Improve guttering and rainwater tanks – private houses	SLOW	GO	GO	STOP	GO	SLOW	7
Pipeline from mainland	STOP	GO	SLOW	GO	SLOW	GO	6
Raise septic tanks and soakaways	SLOW	GO	STOP	STOP	GO	SLOW	4
Desalination plant	STOP	SLOW	STOP	GO	STOP	GO	1
Construct centralised sewage collection and treatment system on Taro Island	STOP	SLOW	STOP	SLOW	STOP	GO	0

The use of septic systems will remain a challenge on Taro Island under higher sea level conditions. If existing development is upgraded/replaced, it is recommended that alternative effluent disposal methods be considered, such as composting/biological toilets. It is expected that the end of design life of existing septic systems would be reached before any increase in groundwater levels would significantly compromise their integrity.

As a short-term measure, increasing the capture of rainwater on Taro Island should be achieved through improving tank storage and guttering on both private and public buildings. Not all private buildings are suitable for capturing rainwater, so a water sharing arrangement would need to be established to ensure an equitable share of water to all residents. Based on estimates provided by the CPG, the cost of piping water from the mainland would be approximately double the cost of installing a new rainwater tank on every dwelling on the island.

8.7.3.10 Mangrove Ecosystem (mainland)

There are extensive mangroves fringing the coastline along the mainland (see Figure 8-15). The mangroves are valued for their ecosystem services and also for providing timber. A first pass assessment of options for the mangrove ecosystem derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-14.

Figure 8-15 Mangroves on the mainland

Table 8-14 Mangrove ecosystem options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Allow natural landward migration of vegetation as sea level rises	GO	GO	SLOW	GO	GO	GO	11
Conserve area and limit felling / access etc	GO	SLOW	GO	GO	GO	GO	11
Tree planting	GO	SLOW	GO	SLOW	GO	STOP	7

Similar to the vegetated western edge of Taro Island, the recommended approach for the mainland mangrove ecosystem is to allow natural processes to occur largely unimpeded. This would result in a gradual transformation and landward migration of the ecosystem as sea level rises. Masterplanning of the proposed new settlement site should include appropriate development setbacks to allow for future migration of mangroves around the waterway fringes.

8.7.3.11 Mid Island Fuel Depot

The island located between Taro Island and the mainland is used as a storage centre for fuel, and contains a number of large tanks, as well as a jetty (see Figure 8-16). A first pass assessment of options for the mid-island fuel depot derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-15.

Figure 8-16 Mid island fuel depot

Table 8-15 Mid island fuel depot options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Future development with appropriate levels and other design criteria	GO	GO	GO	GO	GO	SLOW	11
Relocate services to mainland	SLOW	STOP	GO	GO	SLOW	SLOW	6
Raised storage facility and associated infrastructure	SLOW	GO	SLOW	STOP	GO	SLOW	6
Protect building using a seawall	STOP	SLOW	SLOW	GO	STOP	GO	3

Relocating the fuel depot to the mainland may have some merit, however, its current location is convenient and also addresses potential for risk. Relocating the depot to the mainland and positioning it amongst other industrial infrastructure may prove challenging. The mid island contains higher land, and the existing fuel tanks are positioned well above existing sea level.

It is recommended that the existing facility continue to be used. As assets within the facility reach the end of their design life, consideration should be given to raising infrastructure and modifying designs to accommodate future coastal conditions.

8.7.3.12 Residences, Guesthouses

There are many residences and guesthouses on Taro Island (see Figure 8-17) that are susceptible to inundation and coastal erosion. Some properties are vulnerable under present day conditions, but many more will become vulnerable as sea level rises in the future. Residences are generally constructed from lightweight materials and to a lower standard than other community facilities. Flooding and inundation under the buildings can cause buoyancy, resulting in these structures ‘floating’ off foundations. The lateral forces associated with tsunami surge and debris loading can also dislodge houses from foundations.

A first pass assessment of options for residences and guesthouses in Taro Island derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-16.

Figure 8-17 Typical residence on Taro Island

Table 8-16 Residences and guesthouses options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Relocate services to mainland	SLOW	SLOW	GO	GO	SLOW	SLOW	8
Tie-down structure to foundations	GO	GO	SLOW	STOP	GO	SLOW	7
Raise building	STOP	GO	SLOW	STOP	SLOW	SLOW	2
Protect building using a seawall	STOP	SLOW	SLOW	GO	STOP	SLOW	2

Relocation to the mainland is the most appropriate long-term option to address this risk. However, it is acknowledged that there will be a lead time before this starts to happen, and even then, not all residents will be physically or financially capable of relocating in the future. Therefore, it is recommended that structural assessments be carried out on residences and guesthouses, and if considered appropriate, additional support provided to better withstand future inundation, including tie-down of the structure to the foundations.

8.7.3.13 Road

A central access road traverses Taro Island, from the south to the north. (see Figure 8-18). In the vicinity of the hospital the road is located close to the current shoreline and is relatively low-lying. During periods of high sea levels, this section of the road would be affected for a period of time. Although there are very few vehicles on Taro Island, the road still provides an important pedestrian linkage.

A first pass assessment of options for the Taro Island road derived from the toolkit as well as other options put forward by the CPG and stakeholders as part of the consultation in March 2014 is provided in Table 8-17.

Figure 8-18 Road on Taro Island

Table 8-17 Road options assessment

	Costs	Acceptance	Reversible	Longevity	Viability	Effectiveness	SCORE
Raise the road in low-lying sections	SLOW	GO	SLOW	GO	SLOW	GO	8
Relocate the road along an alternative (higher) route (old road)	STOP	SLOW	SLOW	GO	SLOW	SLOW	4
Protect road using a seawall	STOP	SLOW	SLOW	GO	STOP	GO	3

Any works on the road are likely to require reasonable funding, especially if it involves importation of material and/or earthworks. The current road alignment means it is susceptible to both inundation and coastal erosion. Whilst raising the level of the road may help limit inundation, it would still require protection from erosion (i.e. a sandbag seawall or similar). It is recommended that the current road continue to be used until such time that it is compromised by erosion. At that time, the old road (behind the hospital) should be cleared and used as an alternative for vehicles. Pedestrians could continue to use the front road if still suitable.

If significant erosion occurs in the short-term that potentially compromises hospital building, then protection would should be undertaken. It is recommended that this protection be carried out some distance away from the hospital to provide a safety buffer. As such, protection could be done on the sea-side of the existing road alignment, thus restoring / maintaining road function.

8.7.4 Future Development Controls

Development controls simply apply controls to new developments (including re-developments of existing sites) as appropriate to the type of development and likely hazard over the expected life of the development.

Different development controls can apply to Taro Island and the new mainland site given the different context of hazards at these two locations. While there is a small difference in the hazard profile around Taro Island, it is recommended that for simplicity one set of development controls be applied to all new development across the whole island.

Development controls would typically specify assessment or performance criteria for the Land Use Category / Development Type that need to be satisfied. Applicable development controls to achieve these criteria may include:

- Setbacks for development landward of the open coastline and river channel (e.g. a Foreshore Building Line);
- Use of particular types of structures in high hazard areas;
- Minimum floor levels;
- Alternative/additional criteria that may be applied includes:
    - **Safe design standards** that specifically consider the buoyancy and surge impact of tsunami inundation, and allow for internal vertical evacuation;

  - **Adaptable building design**, for structures to be temporary, sacrificial or relocatable, as considered suitable for the type of development;
  - **Alternative locations** for the structure (particularly for public assets); and
  - **Water supply and wastewater disposal**, to prevent future water shortages and avoid soil/groundwater contamination.

Development controls do not prohibit existing landholders from remaining on their land until such time as an impact occurs. However, the development controls may specify that further expansion of the development footprint (e.g. extensions or renovations, subdivision, change of use) is not permitted, thereby avoiding the intensification of asset values and therefore risk in high hazard areas over time.

As well as general residential buildings, development controls would apply to all future infrastructure to ensure they are better able to withstand the effects of future hazards. The low-lying nature of Taro Island presents a significant challenge for drainage and stormwater in the future as the downstream tailwater levels in the ocean slowly increase due to sea level rise. Also, contemporaneous with sea level rise will be increases in groundwater levels. For some part of Taro Island and the mainland, an increase in the groundwater table will create significant difficulties for continuing landuse well before the more obvious impacts of permanent surface water inundation. Future development needs to consider groundwater conditions and impacts.

8.8 No Regrets Options

8.8.1 Asset Management Planning

An audit of assets located within potential hazard areas should be carried out. In this context it means essentially all infrastructure and development currently on Taro Island. In general, assets should be considered in terms of the remaining functional life. The remaining life of the assets should then be managed in accordance with an asset plan that gives consideration to the most appropriate long term alternative to the asset. These alternatives may include:

- “manage to fail”, where the remaining life of the asset is approximately equivalent to the timeframe before emerging hazards will have an effect on the essential function of the asset. After this time the asset will need to be replaced and/or relocated to manage the risks associated with the hazards;
- “life extension”, where retrofitting and on-going maintenance can extend the function life of the asset to a timeframe equivalent of when the hazards will start to impact on asset function. Life extension can also consider protection works in order to delay the timeframe for impact of assets by future hazards; and
- “replacement”, where the impacts of hazards will not occur for some time, enabling replacement of existing assets with new alternative assets in the same, or similar, locations with only minor changes in design criteria. This would be suitable for assets that have a relatively short functional life and are located in areas that are not subject to immediate hazards.

In the long term, most assets located on Taro Island will require relocation to the mainland, or significant redesign to accommodate the risks associated with the hazards if they are to remain on the island into the distant future. Thus, asset planning essentially involves managing the existing asset portfolio until such time that the assets are eventually relocated away from the island or are rebuild to meet future demands and future hazards.

The audit should result in a detailed asset management plan, wherein all relevant assets should be notated with information regarding hazards, and associated timeframes for impact (2030, 2055, 2090). The risk register in Appendix B provides a starting point for this. For assets that are critical for community function (e.g. hospital, telecommunications, powerhouse, CPG headquarters, pre-school, school, government offices, wharf, airstrip and terminal), effective asset management and planning will be essential for ensuring adequate services are maintained in the future as elements of the relevant systems are progressively replaced and/or relocated.

It is recognised that relocation of the population to the mainland will occur over many years or even decades. As such, residual facilities are still required on Taro Island to service the remaining population (who may also be vulnerable population an unable to afford to move, e.g. elderly, widows, infirm). The retention of community services and infrastructure as part of the transition of the population to the mainland will require significant prior planning and funding preparation.

8.8.2 Shoreline Revegetation

Foreshore and mangrove revegetation programs can be implemented in locations around Taro Island, Supizae Island and the mainland where vegetation is currently degraded, limited or overcome by weeds.

Foreshore vegetation can assist with accretion (or at least slow the rate of erosion) by the sand being 'captured' by the vegetation. Vegetation, especially mangroves, also helps to dissipate waves and storm surges as they run-up the foreshore. Vegetation also provides ecological benefits that promote a functioning beach ecosystem.

Over 37,000 mangrove seedlings were planted on the islands of Aranuka, Butaritari, Maiana, Makin and in North and South Tarawa, Kiribati, to help provide resilience against coastal erosion. The seedlings were planted through an activity funded by the World Bank's KAPII (Kiribati Adaptation Program Phase II) under the supervision of the Government of Kiribati's Environment and Conservation Division. Phase III for the KAP program has now extended the mangrove planting Nonouti, Tabiteuea South, Tabiteuea North and Beru.

8.8.3 Monitoring

The approach generally adopted for management of risks to existing assets and infrastructure is to wait until the risks have materialised to a level that is no longer considered tolerable (i.e. it reaches a 'trigger' level) before acting. Monitoring of key indicators is necessary in order to determine when this ‘trigger’ has been reached. It may be important that this ‘trigger’ is reached before impacts to assets and infrastructure actually occur to enable sufficient prior-planning and the implementation of alternatives, especially in terms of community-dependent infrastructure.

Monitoring of triggers at specific critical assets should be reviewed regularly to determine when a trigger is reached.

Monitoring should cover:

- frequency and depths/extents of tidal inundation,
- erosion and recession of beach profiles, and
- condition of the existing foreshore structures.


9. Adaptation Action Plan

9 Adaptation Action Plan

The climate change risk adaptation action plan for Choiseul Bay comprises five (5) components, each described in detail in this chapter:

(5) Emergency Response Plan to address the threat and possible need for evacuation due to tsunamis or severe coastal storms that potentially inundate Taro Island and Supizae Island;

(6) Asset and infrastructure management to minimise risk and damage or disruption to the community (covering both existing and future assets);

(7) Future development planning controls, to minimise the risks associated with future assets and infrastructure;

(8) Shoreline revegetation, to restore natural environments and to reduce the impacts of wave and surge inundation; and

(9) Monitoring to ensure effective decision making in the future.

The adaptation action plan is to be implemented in concert with the proposed new urban development on Lot 9 and Lot 277, to replace the existing development on Taro Island and become the new provincial capital for Choiseul Province. The Masterplan for the proposed new development on Lot 9 and Lot 277 is outlined in Section 10.

The purpose of the adaptation action plan is largely to manage climate change and other coastal-related risks associated with existing development until such time that proposed new development on the mainland replaces existing assets and infrastructure. It is important that new development on the mainland avoids future climate change risks, and this has been a major consideration for the Masterplan of the proposed development, as described in Section 10.

It is expected that the new development on the mainland will be largely underway within the next 20 years, subject to funding and property matters. Therefore, the adaptation action plan primarily targets risks within the immediate to short-term. If progress towards new development on the mainland is delayed significantly, then actions within this climate change adaptation plan should be reconsidered, and priorities adjusted as appropriate.

9.1 Emergency Response Plan (Taro Island and Supizae Island)

Both Taro Island and the adjacent Supizae Island within Choiseul Bay are very low lying. Less than 2ha of land is higher than 3.0m MSL on Taro Island (~5% of the island area), while it is likely that there is little or no land higher than 3.0m MSL on Supizae Island.

Recent seismic activity in the vicinity of Choiseul (13th and 19th April 2014) triggered two mass evacuations of people from Taro Island and Supizae Island. Evacuations were completed within about an hour, and were co-ordinated by the CPG and the local Police. While evacuation of the island within this short timeframe (including all hospital patients, disabled and elderly community members) is commendable, it is considered that a formal emergency response plan would assist by providing clear directions/instructions on appropriate response to various events, and avoiding unnecessary evacuations that could jeopardise lives and assets.

9.1.1 Tsunami Risk

The approximate present day risk of a local tsunami event affecting Taro Island is described in Table 9-1.

Table 9-1 Approximate present day tsunami risk for Taro Island

Frequency	Magnitude of local seismic event (approx.) – epicentre within about 100km from Taro Island	Approximate tsunami wave height	Approximate inundation level (tide-dependent) on Taro Island
1 in 20 years, on average	7.9	2m	1.5 – 2.5m MSL
1 in 100 years, on average	8.2	3m	2.5 – 3.5m MSL
1 in 200 years, on average	8.3	4m	3.5 – 4.5m MSL
1 in 500 years, on average	8.5	5m	4.5 – 5.5m MSL

There is approximately 2 hectares of land higher than 3.0m MSL, and less than 0.5ha of land higher than 4.0m MSL on Taro Island. It is considered that the elevated land on Taro Island could be used as immediate refuge for a locally generated tsunami event (up to a 1 in 100yr event). With future sea level rise, the suitability of this higher land would reduce to about a 1 in 20yr event by 2090.

The seismic events that are likely to have a significant impact on Taro Island would be locally generated (i.e. within about 100 km). This is significant because:

(1) The seismic event would be felt as major tremors on Taro Island, which would serve as a prompt for emergency action; and

(2) The close proximity of the event would see the tsunami wave reach Taro Island within a timeframe of less than an hour (refer Figure 6-21), which is less than the time needed to evacuate everyone to the mainland.

It is likely that an earthquake of magnitude 8.5 or larger (i.e. 1 in 500yr average occurrence) would result in widespread collapse and damage to buildings and infrastructure on Taro Island. Any co-ordinated emergency response in this situation would be difficult. Nonetheless, survivors of the earthquake should shelter on high ground on Taro Island until at least two hours after the tsunami threat has passed.

9.1.2 Framework and Principles for Emergency Response

A basic decision-path framework for emergency response to tsunamis is outlined in Figure 9-1. The framework is predicated on the basis that temporary shelter is available on Taro Island and Supizae Island, where the community would be able to initially assemble. For Taro Island, this would be the high ground above the hospital, while for Supizae Island, it would require construction of a new elevated structure (refer Section 9.2.3 for details).

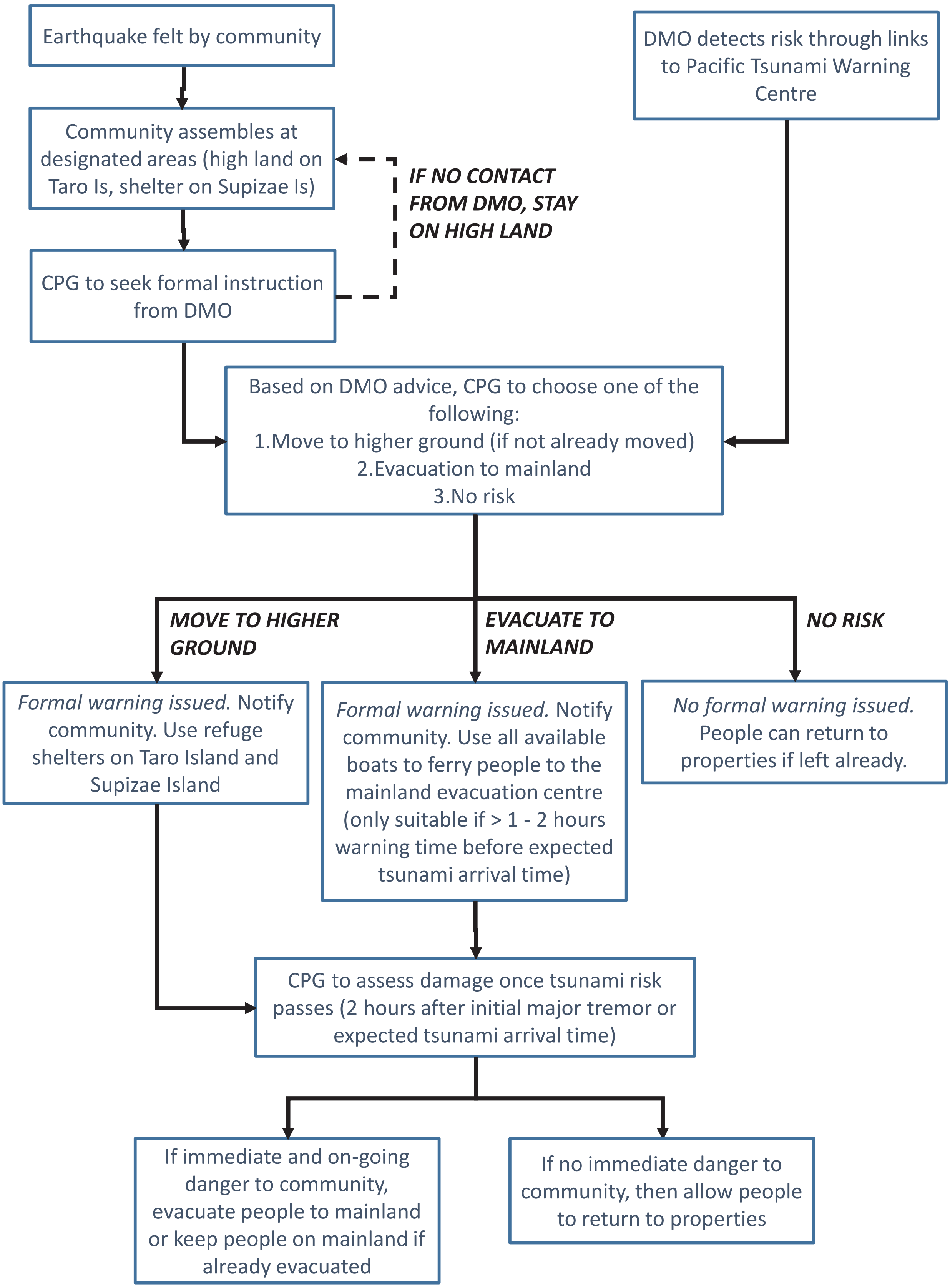


Figure 9-1 Framework for emergency response and evacuation

The high land on Taro Island that is above a level of 3.0m MSL (Figure 9-2) would provide refuge for local tsunami events of up to about a 1 in 100 year (average return internal).

Figure 9-2 Elevated land on Taro Island for tsunami refuge

For local events, there would be insufficient available time to evacuate the Taro Island population to the mainland before a tsunami reaches Taro, so refuge on the high ground is the safest option. For tsunamis that are generated by earthquakes some distance away, wherein the tsunami travel time is more than 2 hours, the amplitude of the tsunami would be significantly reduced, and thus would represent a much lower risk of inundation on Taro Island. Putting this in context, a tsunami that travels some 2 – 4 hours before reaching Taro Island with an amplitude of more than 3 metres, would be generated by an extremely large earthquake (in the order of 9.0 or larger) that would cause enormous devastation across the Pacific (likelihood of occurrence is in the order of 1 in 1000 years). Thus, for all circumstances, evacuation to the mainland is likely to be unnecessary or potentially more hazardous than remaining on high land on Taro Island.

If evacuation to the mainland is to occur, it is important that this should only be done once it is established that it is safe to do so.

An Emergency Response Plan should be prepared based on a series of operational principles, as outlined in Table 9-2.

Table 9-2 Emergency response plan principles

Principle	Details
Warnings from Honiara	Official warnings to come from NDMO (Honiara), sent to the CPG and Police Commander. Warnings to provide as much specific detail as possible. Based on this advice, the CPG needs to consider most appropriate response by the community regarding evacuation.
Warnings to community	While tremors give a good indication for the potential for a tsunami, a formal warning to the community is also required. This should take the form of a siren or similar, which can he heard throughout Taro Island and Supizae Island. The community themselves should also take responsibility for informing neighbours and other community members, especially the elderly, disabled or infirm. Special provisions should also be given to evacuation of elderly and inform patients of the hospital. Consideration should also be given to appropriate procedures for the evacuation of children who may be attending school at the time of a tsunami.
Community preparedness	Warnings will only be effective if the community know what the warning means and how to respond (including where to go and what to take). Community education is therefore important in maintaining awareness of an appropriate emergency response plan.
Available refuge centres (islands and mainland)	Refuge centres on the islands will need to be above 3.5m MSL and constructed to withstand an earthquake. Higher land on Taro Island should be able to accommodate an emergency refuge, while on Supizae Island a new elevated structure would be required to accommodate the population as best as possible (if naturally high land is not available). The refuge centre on Taro Island should be able to store a mobile back-up generator as well as communications equipment. It can also be a dry store for some emergency provisions including non-perishable food and medical supplies, while an attached rainwater tank can provide an emergency short-term supply of water.

Principle	Details
Co-ordination and management by CPG / Police	CPG and the Police Commander have been responsible for co-ordinating previous evacuation events. This is appropriate, however, these officials need to have a good appreciation of their roles in managing the disaster response efforts in emergency situations.
Construction of refuge centre and emergency provisions supply on high ground on Taro Island	During the period of emergency evacuation, critical emergency services should be maintained, including provision of water (via local rainwater tanks or bottles), communications with Honiara and the mainland, back-up power and medical supplies (via a mobile pharmacy/dispensary).
Construction of shelter on Supizae Island	After the tsunami passes, focus will turn to restoration of key services. Priority should be on access (especially via boat to the mainland), communications and water supply. It is likely that the area would contain many hazards including unstable and collapsed structures, live power lines and contaminated pools of water. The community will need to be alerted to such hazards before helping with recovery efforts and clean-up.
Provision of emergency services (water, medicines, power, communications with Honiara and mainland)	As the plan is implemented there will be opportunities for operational improvement. These improvements should be incorporated into future updates of the document, with an overall review of its on-going suitability within about 10 years. It is expected that the tsunami risk profile will not change significantly within this period, however, the community awareness and infrastructure at risk could change.
Recovery of services and facilities	Official warnings to come from NDMO (Honiara), sent to the CPG and Police Commander. Warnings to provide as much specific detail as possible. Based on this advice, the CPG needs to consider most appropriate response by the community regarding evacuation.
Operational review (10 years)	While tremors give a good indication for the potential for a tsunami, a formal warning to the community is also required. This should take the form of a siren or similar, which can he heard throughout Taro Island and Supizae Island. The community themselves should also take responsibility for informing neighbours and other community members, especially the elderly, disabled or infirm. Special provisions should also be given to evacuation of elderly and inform patients of the hospital. Consideration should also be given to appropriate procedures for the evacuation of children who may be attending school at the time of a tsunami.

9.1.3 Development of Emergency Response Plan

An Emergency Response Plan should be prepared by the SIG Disaster Management Office (DMO) as per existing processes and protocols already established by DMO, facilitated through a Provincial Disaster Committee (PDC). These processes and protocols include community workshops to develop locally appropriate responses to emergencies, and development of local risk reduction options. A Plan prepared by DMO will ensure consistency with other provinces, will engage fully with the community, and will engender greater ownership of the response plan by the CPG and DMO.

Participation in DMO's annual evacuation and response drill ("Island Wave") would further increase awareness and preparedness of the community and the CPG in the event of a tsunami.

As confirmed with DMO, a Tsunami Emergency Response Plan would be based on either (1) an earthquake felt by the local community, or (2) a tele-tsunami, whereby the risk is relayed through the Pacific Tsunami Warning Centre. As a local tsunami could strike Taro Island within a very short period of time, the safest refuge for residents and visitors is on the highest ground in the island.

9.2 Asset and Infrastructure Management

Built infrastructure and other similar assets usually have a fixed design life. Once this design life has expired, the effective function of the infrastructure becomes potentially compromised through normal wear or fatigue. Climate change adaptation largely involves managing risks to existing assets and infrastructure until such time that these can be replaced, wherein they can then be moved to avoid future hazards and risks, or redesigned to better accommodate the expected changes as a result of future climate change. Managing existing assets and infrastructure therefore needs to be approached and undertaken in a manner that is risk-appropriate, and indeed does not exacerbate future hazards and risks.

Management of assets and infrastructure from a climate change adaptation perspective needs to consider the follow categories, which are described in more detail in the sections below:

(1) Modifications to existing assets: these are modifications that can be done immediately to provide an immediate benefit of reducing risks;

(2) On-going repair/replacement of existing assets: this incorporates progressive modifications to assets and infrastructure on an as-needed basis, with any new component able to accommodate the expected impacts for the duration of its remaining design life;

(3) New works/assets – Taro Island / Supizae Island: in some areas, such as Taro Island and Supizae Island, future development cannot completely avoid climate change risks. Therefore new works/assets need to be compassionate to the risks relevant to the location. Most important is the protection of life.

(4) New works/assets – Mainland (Lot 9, Lot 277): climate change adaptation is not just about avoiding vulnerable areas, but also about accommodating a future climate patterns. Importantly, new works/assets on the mainland provide an alternative for existing residents of Taro Island and Supizae Island as the risks faced by these islands progressively becomes increasingly untenable.

9.2.1 Modifications to Existing Assets

Details of specific modifications to existing assets that that can be implemented immediately are provided in Table 9-3. The main assets that can be easily modified that are considered to be at greatest risk from tsunami and coastal storm inundation include:

- Hospital back-up generator;
- Sensitive equipment located within various buildings on Taro Island (including the hospital, government buildings, telecommunications building, bank etc);
- Retail goods within various retail outlets (shops, markets etc); and
- Paper copies of archived files held within CPG administration building.

Table 9-3 Details of modifications to existing assets

Asset / Value	Action	Location	Timeframe or Trigger	Responsibility	Indicative Costs
Hospital back-up generator	Raise hospital back-up generator at least 1 metre off the ground in its present location, or move the generator to equivalent higher ground. Would involve construction of a rigid frame with appropriate foundations and placing the generator on top of the frame, or localised build-up of ground levels. An elevated frame should also support full access around the generator.	Taro Hospital	Immediately	CPG	MEDIUM ~ SBD$20-50,000. May be logistical challenge to lift the generator.
Sensitive equipment	Raise sensitive equipment at least 1 metre off the ground, where possible. Equipment could be relocated within the premises or stored on a platform or stand. All electrical outlets should be at least 1 m off the ground level.	Industrial buildings Government buildings Hospital Telecomm building Powerhouse Banks	Immediately	Property owner / business owner	LOW – MEDIUM Cost depends on the equipment (weight, size, function etc).
Retail goods	Raise retail goods in shops, markets at least 1 metre off the ground, where possible. This would involve installing stands, tables etc, which would need to be fixed in place and sufficiently sturdy to hold weight of goods and withstand temporary inundation. An alternative that may be easier and simpler to adopt is to store/display non-perishable goods on lower levels and perishable good on higher levels of stands and shelving.	Retail shops Post office Taro Island market	Immediately	Property owner / landholder	LOW Provision of stands etc. would depend on the retail outlets
Sensitive CPG paper archive files	Move sensitive CPG paper archive files from the admin building to an alternative storage facility (such as elevated storage area within the possible refuge centre on high land, or to a mainland facility (i.e. a Government bldg.) as an alternative)	CPG admin building	Once new refuge centre has been built	CPG	LOW Moving files would take time, but costs would be minimal. Consider electronic scanning of documents at the same time to guarantee longevity.

9.2.2 Repair/Replace Existing Assets

For other significant existing assets on Taro Island, such as buildings and infrastructure items (pipes, roads, towers, etc), structural modifications to mitigation risk from tsunami inundation and coastal erosion would be more costly and would involve decommissioning of the asset for a period of time. It is considered that for significant buildings and infrastructure, modifications to accommodate the risk should be done when the structure is being repaired or replaced as part of periodic maintenance. Given that climate change will not occur rapidly, incorporation of climate change adaptation into routine asset management planning is considered an appropriate approach for major and costly infrastructure.

It is recognised that the existing buildings and other infrastructure on Taro Island, Supizae Island and the mainland foreshores are unlikely to be part of an existing asset management program. Therefore, a first step in the process is to undertake an audit of the integrity of the existing buildings and infrastructure to determine their remaining functional life. The outcomes of this audit should be used to develop an overall asset management plan for repairing or replacing existing assets and infrastructure.

The longer term plan for the CPG is to relocate major services to a new town development on Lots 9 and 277 on the mainland. Therefore, before repairing or replacing existing assets and infrastructure, consideration should be given to diverting that investment into construction of an alternative on the mainland, providing that timing for the mainland investment is short and the community will not be unnecessarily burdened by an absence of an asset or major piece of infrastructure.

The alternative to a repair (low cost investment) or replacement (high cost investment) is to allow the building or infrastructure item to continue to be used in the 'compromised' condition. That is, it is 'managed to fail' wherein nothing is done to rectify the asset, but its use is modified to ensure that the consequences of its diminished value, and ultimate failure, are controlled as far as possible.

A summary of the actions required for addressing the repair or replacement of existing asset is presented in Table 9-4, while a flowchart to assist in the decision-making process for repairing, replacing, relocating or doing nothing, is presented in Figure 9-3.

Table 9-4 Details of repair/replacement of existing assets

Action	Location	Timeframe or Trigger	Responsibility	Indicative Costs
Undertake an initial 'dilapidation audit' of all existing buildings and other infrastructure to determine timeframes for remaining functional life of assets	Taro Island Supizae Island Mainland foreshores of Tarekukure	Immediately	CPG, in collaboration with asset owner. Do be carried out by qualified and experienced structural engineer.	MEDIUM Cost of engineer's time only. Estimate 1 week for detailed structural integrity inspections. Covers cost for audit of all buildings and infrastructure. ~ SBD$200,000 if no existing internal capacity within CPG
Undertake follow-up audits of buildings and infrastructure on an as-needed basis and determine need for repair or replacement if asset function is compromised.	Taro Island Supizae Island Mainland foreshores of Tarekukure	At least 5 years before the designated timeframe for the end of functional life as determined by initial dilapidation audit.	CPG, in collaboration with asset owner. Do be carried out by qualified and experienced engineer.	LOW As required, for specific buildings or infrastructure items only as they approach the end of their functional life
Follow decision flowchart for repair or replacement – see Figure 9-3.	Taro Island Supizae Island Mainland foreshores of Tarekukure	Once the asset reaches the end of its designated functional life	Asset owner	NIL – time only
Repair or replace asset or infrastructure item as required and in accordance with decision flowchart – see Figure 9-3.	Taro Island Supizae Island Mainland foreshores of Tarekukure	As required	Asset owner	VARIABLE Will depend on the building or infrastructure item. Only go ahead if the alternative of a new build on the mainland is not timely.

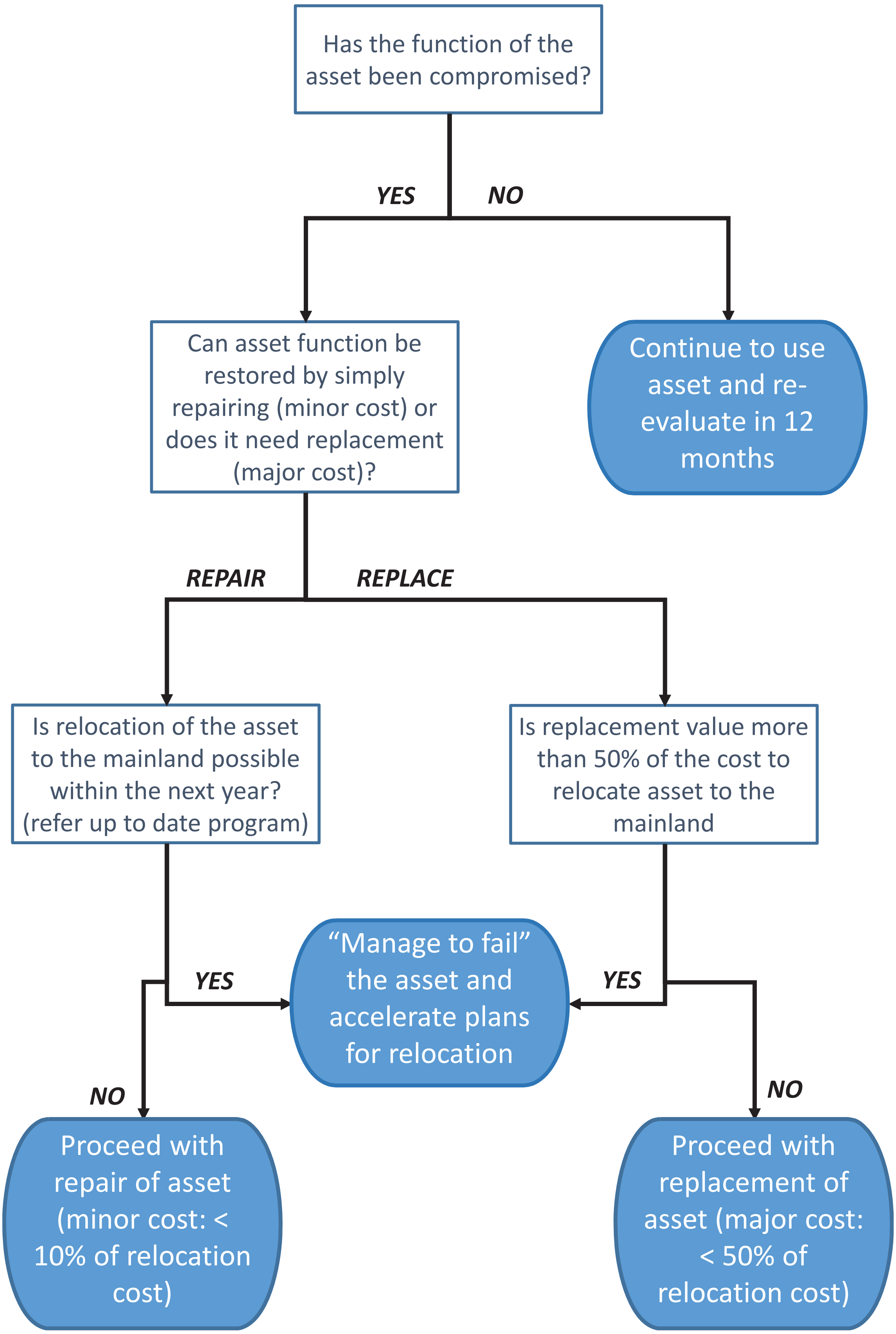


Figure 9-3 Decision flowchart for assets that have reached the end of their functional life

9.2.3 Establishment of New Works/Assets – Taro Island / Supizae Island

Feedback from the community during consultation sessions was that while ever new works were being built on Taro Island, the demand for a new town on the mainland was weakened. Therefore, all new works to be constructed on Taro Island, or Supizae Island, should be considered within the context of climate change adaptation, rather than just building a new asset.

There is significant risk of tsunami and coastal storm inundation, as well as coastal erosion at present on Taro Island (and Supizae Island). It is impossible to fully mitigate this risk in the short term, and only long-term relocation of the population and valued assets would be able to address the existing and future risk profile. Nonetheless, it is considered that there is merit in establishing some new works/assets on Taro Island and Supizae Island that will help increase the resilience of the current population to existing and future risks. Most important to the community is safety and refuge in the event of a large inundation event, and then recovery of services after such an event. High priority works that should be established/constructed to assist in this regard include:

- A refuge centre on higher ground on Taro Island. This would be used as an emergency control centre during events (i.e. HF radio link with Honiara DMO, AM radio receiver for SIBC broadcasts), a storage facility for back-up equipment (refer below), a storage facility for emergency supplies (mostly non-perishable goods, materials etc), a dispensary for emergency medicines (refer below) and collection of rainwater to be used as an emergency supply (see below). Power could also be via solar panels (and back-up batteries) for continuous supply.
- Purchase and maintain a mobile back-up generator (to be stored in new refuge centre on higher ground) to be used as needed for recovery of services after an event. Most important would be hospital and communications, as well as CPG administration, airport terminal and bank.
- Additional rainwater tanks (especially on high ground) to increase resilience to diminished water supply (either through low rainfall or after an emergency event when there may be damage to tanks or general water contamination). This would include the newly constructed recreation facility, which may have a potential rainwater tank capacity of up to 50kL;
- Establishing a mobile pharmacy. The full scope of this action would need to be established with key staff at Taro Hospital to ensure it is practical and effective. In principle, this would involve collecting emergency supplies of medicines at short notice, transporting them to high ground (or the mainland as appropriate), and then dispensed as required from a controlled environment (e.g. the refuge centre on elevated ground on Taro Island) in the event of mass evacuation/mass assembly. As many medicines and vaccines need to be stored at low temperature, the mobile pharmacy would need to consider chilled transportation and alternative storage. The quantity of medicines moved in the event of an emergency needs to balance the expected demand (given it is the main dispensary for the whole of Choiseul Province) and the time needed to collect and move them to a safe location;
- Elevated evacuation shelter on Supizae Island. It is understood that there is no higher ground on Supizae Island, meaning that build infrastructure is the only means of vertical evacuation in the event of a sudden tsunami. The structural integrity and capacity to accommodate existing population, of existing structures on Supizae Island is unknown. Therefore, subject to

assessment of existing structures, a new evacuation shelter should be established, which could double as a local community facility;

- Solid waste management facility. Solid waste is currently disposed on Taro Island on the edges of Mosquito Creek. It is considered that there is little effective management of this waste, with potential for contamination of groundwater, generation of odour, and creation of litter. A dedicated waste management facility should be established to provide appropriate management of locally generated solid waste. It is considered that once established, this facility could provide an on-going service for the new township on the mainland. It is expected that the construction phase of mainland developments will generate a large amount of building waste, which will need to be managed appropriate to avoid environmental impacts.

In addition to the above, new works constructed on Taro Island and Supizae Island should comply with specific development codes and controls, as outlined in Section 9.3. These codes and controls will ensure that all future development within the hazardous areas of Taro and Supizae Islands appropriately take into consideration the consequences of tsunami and coastal storm inundation as well as longer term coastal erosion of foreshores.

Details of these works are provided in Table 9-5.

Table 9-5 Details of new works/assets on Taro Island/Supizae Island

Action	Location	Timeframe or Trigger	Responsibility	Indicative Costs	Details / Specifications
Sirens	Taro Island – mobile units	Immediately	CPG	LOW ~SBD$10,000	Sirens are to be used to inform the community to take shelter on the high ground on Taro Island.
Signage	Taro Island and Supizae Island	Immediately	CPG	LOW ~SBD$10,000	Billboard signage would raise awareness and provide instructions of where to go in the event of an earthquake (i.e. assemble on top of the hill at the Assembly Area).
Evacuation / refuge shelter	Vacant land on top of hill on Taro Island. Currently these is vacant land beside and opposite the church.	Immediately, following land negotiations.	CPG	MEDIUM – HIGH ~ SBD$500,000+	Would involve a large skillion structure to provide protection from elements as well as some covered and a lockable storage area for separate storage components. Include rainwater tank, solar panels, communications equipment, refrigeration (for back-up pharmacy), lighting, non-perishable food and medical supplies. Structure be designed and constructed to withstand an earthquake.
Evacuation / refuge shelter	Supizae Island. Specific site subject to assessment and consideration of alternative use.	Immediately, following appropriate site selection, land negotiations and structure design.	CPG	MEDIUM – HIGH ~ SBD$250,000+	The size would depend on how many people it is to accommodate. Expected minimum size would be 100m2. When not used for emergency refuge it could be utilised as a community facility (covered area with seating etc). Could be utilised as a waiting area for the Taro Island canoe ferry. Structure would need to be elevated, about 2 metres off the ground or located on higher ground on the island (at least 3.5m MSL). Could incorporate a rainwater tank if a roof is included in the design. Structure be designed and constructed to withstand an earthquake.
Mobile back-up generator	On trailer, but to be stored in new elevated refuge centre	Following construction of refuge centre on Taro Island.	CPG	MEDIUM ~SBD$50,000	Minimum 5 – 10 KVa output, e.g. http://genelite.com.au/new/diesel-generators/?product_id=473
Rainwater tanks	Existing and future buildings across Taro	Opportunistically with new buildings or	Landholders	MEDIUM – HIGH ~SBD$20,000 for	10,000 litre tanks should be used where there is a reasonable roof area and sufficient space for the

Action	Location	Timeframe or Trigger	Responsibility	Indicative Costs	Details / Specifications
	Island and Supizae Island, with focus on buildings on higher land.	upgrading of existing systems as required.		large tank (10,000L), SBD$10,000 for small tank (< 5000L)	tank. Smaller tanks (2000 – 5000 litres) can be used on single dwellings, or larger if there is sufficient room and high demand. Very large buildings, such as the new recreation building, could take up to 50kL storage, and would require associated guttering and downpipes.
Mobile pharmacy	Can be moved as required. Containers to be stored at hospital until required.	Immediately, following assessment of specific requirements of contents (quantity, range of medicines and other supplies)	CPG / Hospital	LOW Cost of assessment and transportable containers only	Some supplies and all medicines are degradable, and as such can only be packed on demand (and preferable kept cool). Specific circumstances will dictate how best the mobile pharmacy will operate. Relevant hospital staff should be engaged to ensure it is practical and effective.
Waste Management Facility	Taro Island, Mosquito Creek (existing location)	Within 2 years	CPG	HIGH ~SBD$2m+ initially then ~$500k - $1m annually for on-going management	This would involve purchasing of some equipment, undertaking some earthworks (bunding etc) and on-going site management of the waste facility. I should also include a recycling centre.

9.2.4 Establishment of New Works/Assets – Mainland (Lot 9, Lot 277)

Adaptation to future climate change will ultimately involve relocating assets to avoid existing and future hazards, such as tsunami, coastal storms and flooding. Land has been allocated on Lot 9 and Lot 277 on the mainland adjacent to Taro Island for future development and growth of the Choiseul provincial capital.

Required works associated with the establishment of a new township are significant. This includes major linear infrastructure (roads, power, water supply), public facilities (wharves, public buildings, schools, hospital, amenities) and private development (housing, business enterprises). Costs associated with undertaking these works are very high, and well beyond the financial capacity of the CPG. Consequently, additional funding will need to be allocated from the national development budget, sourced from private enterprise and other donors, in order to facilitate the transition to the new mainland centre.

Given the scale of the works involved, a dedicated project office would need to be set up within the CPG to facilitate and administer the works. There are also some land negotiations that still need to be finalised, and a number of studies are required before infrastructure can be designed and built. Future development on the mainland will also need to comply with appropriate development codes and controls (refer Section 9.3). These will help the new town to develop in a manner, and location, that is considered fit for purpose and reflective of the goals and aspirations for the new town by the community and the CPG as captured through the community engagement process.

A summary of the tasks involved in establishing new works and assets on the mainland on Lot 9 and Lot 277 is summarised in Table 9-6.

9.2.4.1 Program of Works

An indicative program of works is presented in Figure 9-4, which shows the majority of new works to be implemented within the next 15 years. The current program of works relates to the current masterplan developed for the project (refer Section 10). The program also assumes that donor partners can be identified quickly and funding gathered to implement initial planning and assessment tasks as well as landholder negotiations, closely followed by primary infrastructure such as roads, hospital and a new secondary school.

Contingency planning will be a critical function of the Project Office to ensure that alternative programming is implemented in the event of delays in implementation. This includes alternative financing, partial progress/land release (sequencing) and prioritisation of key infrastructure and associated works. It is important to recognise that delays in the construction of new works on Lot 9 and Lot 277 will influence decision-making for existing assets on Taro Island, as outlined in Section 9.2.3. That is, if construction of alternative assets on the mainland is to be deferred, then there will be an increased demand for repairing or replacing assets that reach the end of their functional life (i.e. on-going investment in assets on Taro Island, which is contrary to community desires).

The Project Office will need to maintain an up-to-date record of this Program of Works. This means that it will require regular review and amendment based on the timing and outcomes of preceding tasks (e.g. surveys, feasibility assessments) as well as the success in securing necessary funding for implementation of the actions.

Table 9-6 Details of new works/assets on mainland – Lot 9 and Lot 277

Action	Components / Locations	Timeframe or Trigger	Responsibility	Indicative Costs
Set-up and operate dedicated Project Office	Within CPG	Immediately Refer Figure 9-4 for indicative program.	CPG, funding support through SIG	HIGH Salary and on-cost expenses for 1-2 people full-time in CPG for duration of project (minimum 15 years) ~SBD$500,000 per year
Negotiate and acquire rights to gain access and use privately owned land	• Lot 9 water access (sea boundary) • Lot 277 water access (sea boundary) • Mangroves on northern side of Sui River • Water, power, road corridors	2014 – 2018 Start immediately following establishment of Project Office. Refer Figure 9-4 for indicative program.	CPG and Project Office	UNKNOWN Staff time would have minimal expense (as included above already) but acquisition cost for use of land is unknown (and dependent on negotiations).
Land surveys, feasibility assessments and environmental studies	• Land survey of Lot 277 • Water, wastewater, hydropower, road, wharves feasibility assessments • Environmental Impact Assessments • Subdivision design and preparation of planning framework/codes (refer Section 10.6)	2014 – 2016 Start following establishment of Project Office Refer Figure 9-4 for indicative program.	CPG and Project Office	HIGH SBD$20+ million, not including detailed design of infrastructure
Public works	Design and construction of: • Wharves • Roads • Hospital and clinic • Hydropower scheme • Water supply scheme • Wastewater and solid waste management scheme	2016 – 2030 Start following feasibility assessments, impacts assessment and detailed design of infrastructure Refer Figure 9-4 for indicative program.	CPG and Project Office	VERY HIGH SBD$500+ million in total Typically design and construct contracts required for large infrastructure projects (possibly international contractors).

Action	Components / Locations	Timeframe or Trigger	Responsibility	Indicative Costs
	• Government buildings (including new CPG headquarters) • Government housing • Schools • Recreation areas and tracks Indicative layout of infrastructure on Lot 9 and Lot 277 is presented in masterplan in Section 10.			
Allocation of private lands / allotments	Allocations on Lot 9 and Lot 277 in accordance with masterplan, subdivision design, zoning provisions in local planning scheme (refer Section 10) and development sequencing plan.	Approx 2022 Following final subdivision design and layout for Lot 9 and Lot 277 Refer Figure 9-4 for indicative program.	CPG and Project Office	MINIMAL Staff time only
Private works	Residential and business enterprises located within designated zones on Lot 9 and Lot 277 as per masterplan and local planning scheme. Development codes to outline deemed–to-comply provisions for acceptable development types (refer Section 10.6).	2023 onwards Start following allocation of private allotments Refer Figure 9-4 for indicative program.	Landholders	VERY HIGH ~SBD$200,000 per dwelling or business structure. For a long-term target population in the order of 5,000, approximately 1,000 houses will need to be constructed (including housing associated with Government staff)

Major Activities		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Complete ground survey of Lot 277, with proposed school site to be done as priority	study																	
Set up project office with Project Manager and Project Officer to co-ordinate studies and works and source funding	personnel																	
Project Office to write funding applications, and hold discussions with development partners/donor organsiations. Focus initially on smaller short-term projects, then larger infrastructure works	funding																	
Land negotiations for water access and sea boundary from Lot 9 (starting immediately)	acquisition																	
Development of wharf/port area on Lot 9	works - public																	
Upgrade of existing road (and bridge) between Lot 9 and Lot 277 (nalivoli highway)	works - public																	
Design and construct new Choiseul Bay High School including accommodation on Lot 277	works - public																	
Design and construct Telecom facility / repeater tower on Lot 9	works - private																	
Design and construct Hospital (provincial referral centre), medical incinerator and supporting housing on Lot 9	works - public																	
Design and construct arterial road: Lot 9 with link to wharf and provincial road	works - public																	
Construct light industrial premises on Lot 9 (staged)	works - private																	
Construct retail shops and public conveniences on Lot 9	works - mixed																	
Feasibility assessments for hydropower and water supply from Sui/Sorave R., road network and wharfs	study																	
Environmental Impact Assessment for New Town Development and associated infrastructure	study																	
Land negotiations for water supply, power and road corridors	acquisition																	
Land negotiations for mangrove area on northern side of Sui River	acquisition																	
Design and construct hydropower scheme and mains distribution	works - public																	
Design and construct water supply and mains distribution	works - public																	
Land negotiations sea boundary for Lot 277	acquisition																	
Design and construct wharf at sea boundary of Lot 277, with boat storage and rest area/shelter	works - public																	
Design and construct arterial road: Lot 277 with link to wharf and provincial road	works - public																	
Prepare subdivision design to accord with planning scheme, sequencing and staged land allocation process	study																	
General housing construction, Lot 277 (staged release of land)	works - private																	
Services construction to support general housing (road, water, sewerage, power) (staged implementation)	works - public																	
Design and construct waste management facility on Taro Island and waste transfer station on Lot 277	works - public																	
Design and construct CPG headquarters and administration centre with housing on Lot 277	works - public																	
Construct other government department buildings and facilities with housing on Lot 277	works - public																	
Construct Police station, courthouse, watchhouse with housing on Lot 277	works - public																	
Construct post office, bank, retail shop, markets and churches on Lot 277	works - mixed																	
Construct primary school / pre school with housing on Lot 277	works - public																	
Construct community centre, recreation facilities and public conveniences on Lot 277	works - public																	
Construct community health clinic with housing on Lot 277	works - public																	
Construct guesthouses, vocational centres on Lot 277 and Lot 9	works - private																	
Construct walking tracks / boardwalks between Lot 9 and Lot 277 (through mangroves)	works - public																	

Figure 9-4 Indicative program of works for mainland settlement (Lot 9 and Lot 277)

9.3 Future Development Planning Controls

For future development on the mainland as part of the proposed new town development on Lot 9 and Lot 277, development controls would be in accordance with a new local planning scheme, as summarised in Section 10.6 and presented in full in Appendix G of this report.

For future development on Taro Island (and Supizae Island), the recommended policy position is to avoid or discourage the establishment of new development and further significant investment in redeveloping existing uses. However, the practicalities of this must be considered in the overall context of the proposed relocation of uses from Taro Island to the mainland and continuing to provide for community needs. Subject to available funding, it is expected most development on Taro be progressively relocated between now and 2030. Provisions are proposed in the draft local planning scheme (Appendix G) to ensure that any new development in the interim period before relocation, is carefully considered and designed. Specifically, the provisions require the avoidance of new development, or where this is not possible because relocation is unlikely to occur in the short term, new development is designed to be 'higher and stronger' to better accommodate the risk of inundation from tsunami events.

9.4 Shoreline Revegetation

As outlined in Section 8.8.2, shoreline revegetation on Taro Island (and Supizae Island and the mainland to a lesser degree) aims to provide the following benefits:

- Enhance the environmental values of the island;
- Maximise the buffer between existing development and the ocean;
- Attenuation of storm and tsunami inundation;
- Attraction of sediment accumulation to help limit shoreline erosion; and
- Resilience to future changes as a result of sea level rise and other changes in climate variables.

Table 9-7 outlines details of specific tasks that should be undertaken, largely by CPG, in order to revegetate shorelines around Taro Island on an as-needs basis.

Table 9-7 Details of shoreline revegetation actions for Taro Island

Action	Location	Timeframe or Trigger	Responsibility	Indicative Costs
Form a volunteer community group that has an interest in environmental rehabilitation / protection	Taro Island	Immediately	CPG	MINIMAL Staff time only
Provide co-ordination, resources and direction to community group to: • Clean-up existing areas that are degraded (removing weeds, rubbish etc) • Plant new trees to enhance habitat (mangroves in intertidal areas, dunal species behind shorelines)	Taro Island, prioritised locations based on need, including: • Western edge; • In front of market; • In front of light industrial area; • In front of southern residences and guesthouses; • At ends of airstrip. Areas on Supizae Island and the mainland to be considered in the future once program is established and working well.	Following formation of community group, sourcing of funding and internal resourcing in CPG to provide direction and co-ordination to community efforts. Works would typically be carried out as a group one day per month (or fortnight) depending on available resources and popularity of participation within the community	CPG (possibly supported by local funding agencies)	LOW - MEDIUM Staff time only plus costs for basic equipment and some materials, including seedlings (preferably established as part of a community nursery using local stock). Could consider incentives for participation in the volunteer community group. ~SBD$50,000 per year
Undertake community education regarding the role community group and the value of the rehabilitation (including providing a buffer to storms and tsunami inundation), as well as education on preventing environmental degradation.	Taro Island, and Choiseul Province more generally	Within 1 – 2 years.	CPG (possibly supported by MECDM and/or MPGIS and local funding agencies)	LOW – MEDIUM Costs associated with development of materials (possibly similar materials used in other provinces) as well as printing, distribution, presentations etc. ~SBD$50,000 per year

9.5 Monitoring

The concept of climate change adaptation is largely driven by decision-making that takes into account specific triggers or thresholds. Monitoring therefore represent an essential component of the adaptation planning process so that decision-makers are able to determine whether triggers and thresholds have been reached or exceeded.

For monitoring to be successful, relevant managers and authorities need to commit to investing in and implementing an on-going program of monitoring works. It will not be sufficient for a monitoring program to be actioned for one or two years, and then fade away as motivation or finances become stretched in the future. As monitoring is required to make future decisions, the monitoring program becomes the most important element of an adaptation plan.

In the context of Choiseul Bay and the proposed decisions that are to be made over the coming years (which represent capital investment of well over SBD$1 billion), the cost of monitoring should be minor (although may still be difficult to source specific funding). Monitoring would need to focus on:

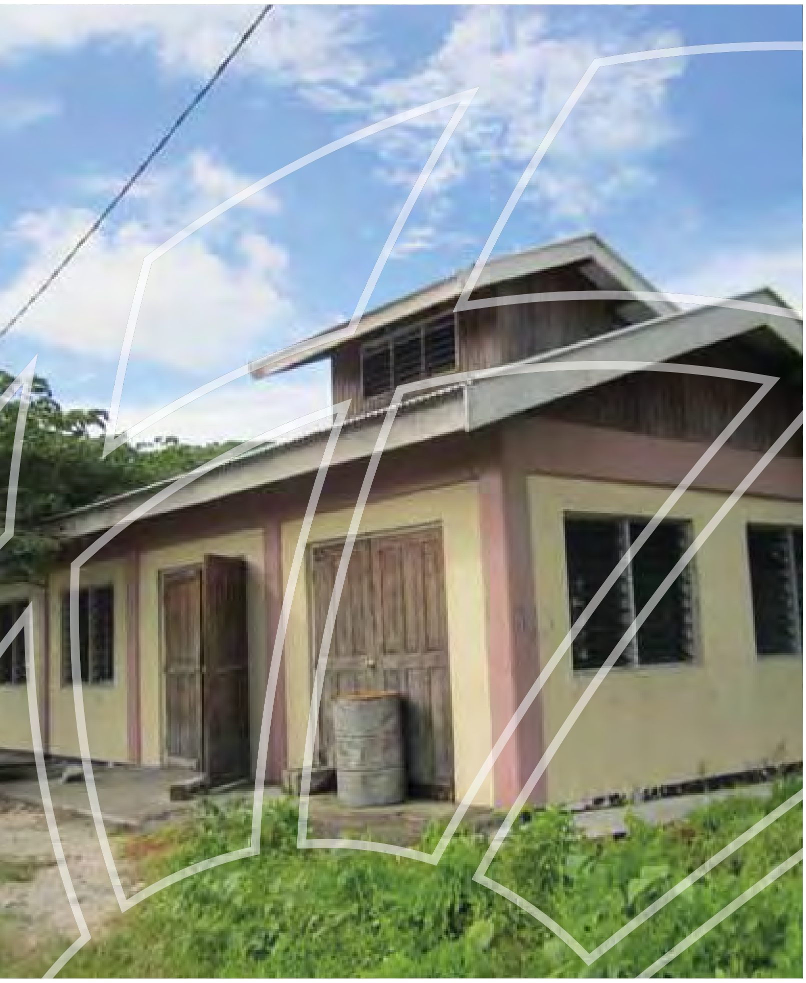
(1) Condition of existing assets and infrastructure; and

(2) Impacts of a changing coastal environment (as a result of sea level rise and changes to other climate variables).

Table 9-8 presents details of specific monitoring tasks that are to be undertaken.

Table 9-8 Details of monitoring activities required

Action	Location	Timeframe and Frequency	Responsibility	Indicative Costs
Asset condition: Initial dilapidation assessment and then on-going assessments of asset condition, as outlined in Table 9-4.	Existing assets on Taro Island, Supizae Island and the Tarekukure (mainland) foreshore	Immediately, and then as-required	CPG and landholders (asset owners)	Refer Table 9-4
Coastal erosion: Undertake periodic beach profiling at approximately 50 – 100 metre intervals along key parts of the shoreline. Where considered useful, install markers (e.g. posts with signage landward of the shoreline) and use sighting poles as part of a basic surveying method that maximised local resources for monitoring (e.g. use Emery method for beach profiling, as has been adopted at Narrabeen Beach for the past 35 years). See http://www.shorelinescat.com/Documents/Beach%20profiling/emerymethod.doc.	Hot spots for coastal erosion include: • Foreshore behind existing jetties (Taro Island and Tarekukure) • Shoreline in front of Taro Island markets • Shoreline in front of Taro Island light industrial area • Western edge of Taro Island	Starting immediately and continuing at 12 monthly intervals, as well as after any significant coastal storm or tsunami event.	CPG	LOW Small cost for initial set-up, then just labour cost. Occasional input from a coastal engineer would be required to review results and interpret outcomes. ~SBD$50,000 for set-up and equipment.
Coastal inundation: When high ocean events occur, capture data on lateral extents of inundation, depths of inundation and directions of flow, at various key locations. Use surveyed benchmarks / posts to determine water levels.	Taro Island – especially low-lying areas behind coastal fringes, the light industrial area and around Mosquito Creek. Supizae Island Mainland foreshores and mangrove fringes	Opportunistically when coastal inundation occurs, noting times and weather conditions at time of event	CPG	MINIMAL Labour costs only. Occasional input from a coastal/flood engineer would be required to review results and interpret outcomes.
Re-run risk assessment based on monitoring results and revise management response if risk level changes (i.e. increase or decrease in level of risk).	As per original risk assessment (refer Section 7).	5 years.	CPG	LOW - MEDIUM SBD $100 – 200,000 for international risk consultant, or alternatively use CPG staff specifically trained in the process



10. New Town Planning

10 Planning for the New Town

10.1 Introduction

Section 8.2 of this report sets out a management framework for the coastal adaptation options considered as part of this project. It distinguishes between management options for future development and management options for existing development. Town planning for the future expansion area on the Choiseul Bay mainland, Taro Island and the northern half of Supizae Island falls within the remit of management options for future development[1] and forms part of the suite of adaptation options recommended in the Adaptation Action Plan (Section 9.3).

As previously described, management options applicable to future development can be classified into the following three types:

- Avoidance;
- Accommodation; and
- Acceptance.

The above strategies are listed in order of the level of resilience (i.e. avoidance provides a higher level of resilience than accommodation; and accommodation provides a higher level of resilience than acceptance). Consequently, in planning for future development on the Choiseul Bay mainland, a strategy of avoidance was used to the greatest extent possible. The 2090 natural hazard mapping prepared for the site identifies permanent and temporary inundation from tsunami, storm tide inundation, flooding, sea level rise and coastal erosion. This mapping was used to identify the 'no go' areas for sensitive uses and has been a key input to informing the location and 'shape' of the new town.

Where a strategy of avoidance has not been possible, a strategy of accommodation and acceptance was used, in that order. For expansion of the town on the mainland, this is limited to only those uses or activities that are not sensitive to natural hazard impacts and will not place people at risk. Provisions in the draft local planning scheme do not support development for sensitive uses expanding or locating in the natural hazard area.

Key considerations taken into account in planning for the mainland expansion included:

- Locational requirements – for example, uses such as ports, maritime infrastructure and other coastal-dependent uses need to be located in coastal areas in order to function efficiently and rely on access to the sea; and
- Potential risk level – for example, for uses that would result in a high consequence rating if impacted by natural hazards (such as residential uses, emergency services, water supply, electricity and telecommunications), it was considered inappropriate to locate these uses within a natural hazard area.

The following sections of this chapter provide:

[1] Once adopted, the local planning scheme will only be triggered by new development (and in some cases redevelopment and new extensions). It does not affect existing lawful development or use rights.

- an overview of background information, planning assumptions and engagement outcomes that have informed the draft concept plans and the strategic masterplan and supporting draft local planning scheme for the future expansion area on the mainland, as well as Taro Island and the northern half of Supizae Island; and
- a description of the draft local planning scheme (presented in full in Appendix G) that will go a significant way towards the development of a local planning scheme (planning scheme) to guide future development in the area.

10.2 Background

Taro Island has been recognised as the capital of Choiseul Province since 1992, soon after the province separated from Western Province on 11 September 1991. Prior to this date, Taro Island was a station of the Western Province.

Initially it was intended that Taro, once fully developed, would be a springboard for development on the mainland, hence, planning for development on the mainland has been in the pipeline for a considerable amount of time. Over the years, a large number of site investigations and background reports have been prepared as a precursor to development on the mainland.

The main documents that have been reviewed for the purpose of preparing this plan for the mainland include:

- Choiseul Bay New Township Report (2013)
- Choiseul Bay Relocation Task Force Committee Report on Stage 1: Choiseul Bay Mainland Township Project (March 200 – December 2000)
- Choiseul Bay Township Project Update Report (2006)
- Choiseul Bay Township Project, ToR for Physical Development Feasibility Study (2005)
- Choiseul Province Development Profile (2001)
- Choiseul Province Mid Term Development Plan (2012)
- Choiseul Township Development Project, An Economic and Financial Study (July 2011)
- Choiseul Township Development Project, Customary Profit Negotiation Report (May 2011)
- Choiseul Township Development Project, Final Report by Focal Point Person (2012)
- Choiseul Township Development Project, Socio-Economic Study (July 2011)
- Choiseul Township Project – Initial Environmental Examination (2009)
- Choiseul Township Project, Transfer of Perpetual Estate (2012)
- Draft Taro Island Local Planning Scheme (1994)
- Land Resources of Solomon Islands, Volume 6 (1976)
- Masterplan Study of Power Development in Solomon Islands, Final Report (2001)
- Mini Hydro Pre-Feasibility Studies (2012)
- Project Profile, Gnalivoli to Tarekukure Coastal Road (undated)

- Survey Report, Proposed Choiseul Province Township Road Centreline Study
- Taro Township Relocation Project, Topographic Survey Report (2014)
- Technical Report, Choiseul Bay Bathometric Survey (2010)

10.3 Site Analysis

Prior to developing a plan for future town expansion on the mainland, it was necessary to first undertake a site analysis to understand the site's opportunities and constraints and its suitability for future development. Key information sources for the site analysis included:

- Information and mapping contained in the background reports listed at Section 10.2) above;
- Site values identified by community members and stakeholders during engagement activities (refer to Section 10.5); and
- The hazard assessment prepared for this project and described at Section 6.

Based on existing information available, the site attributes considered in the analysis included:

- Areas subject to present day and future temporary and permanent inundation (from tsunami, storm tide inundation, flooding, sea level rise and coastal erosion) identified through the Choiseul Bay Climate Change Project;
- Existing development including the Choiseul Bay Provincial Secondary School (CBPSS), medical staff housing, agricultural staff housing, agricultural demonstration farm, forestry division staff housing, old EAGON logging roads and the CEMA wharf;
- Topographic and bathometric data;
- Land forms and soil type data, including mapping of agricultural opportunity areas;
- Environmental values and features including mangroves, rivers, swamps and reefs; and
- Other valuable areas such as recreation, picnic and fishing areas; places where bush materials, stones and gravel are collected; gardens; and tambu sites.

At the time this project was undertaken, detailed topographic data for lot 277 on the mainland was limited to the survey work done by Soland Survey Solutions over 61.14 hectares extending across the western most portion of the lot. This work is being extended to cover the balance of lot 277, however, this was not available at the time of preparing this report.

It is recommended that the draft local planning scheme be reviewed and amended as necessary once the survey data for the balance of Lot 277 becomes available.

The site opportunities and constraints for lot 277 and lot 9 are mapped in Figure 10-1.

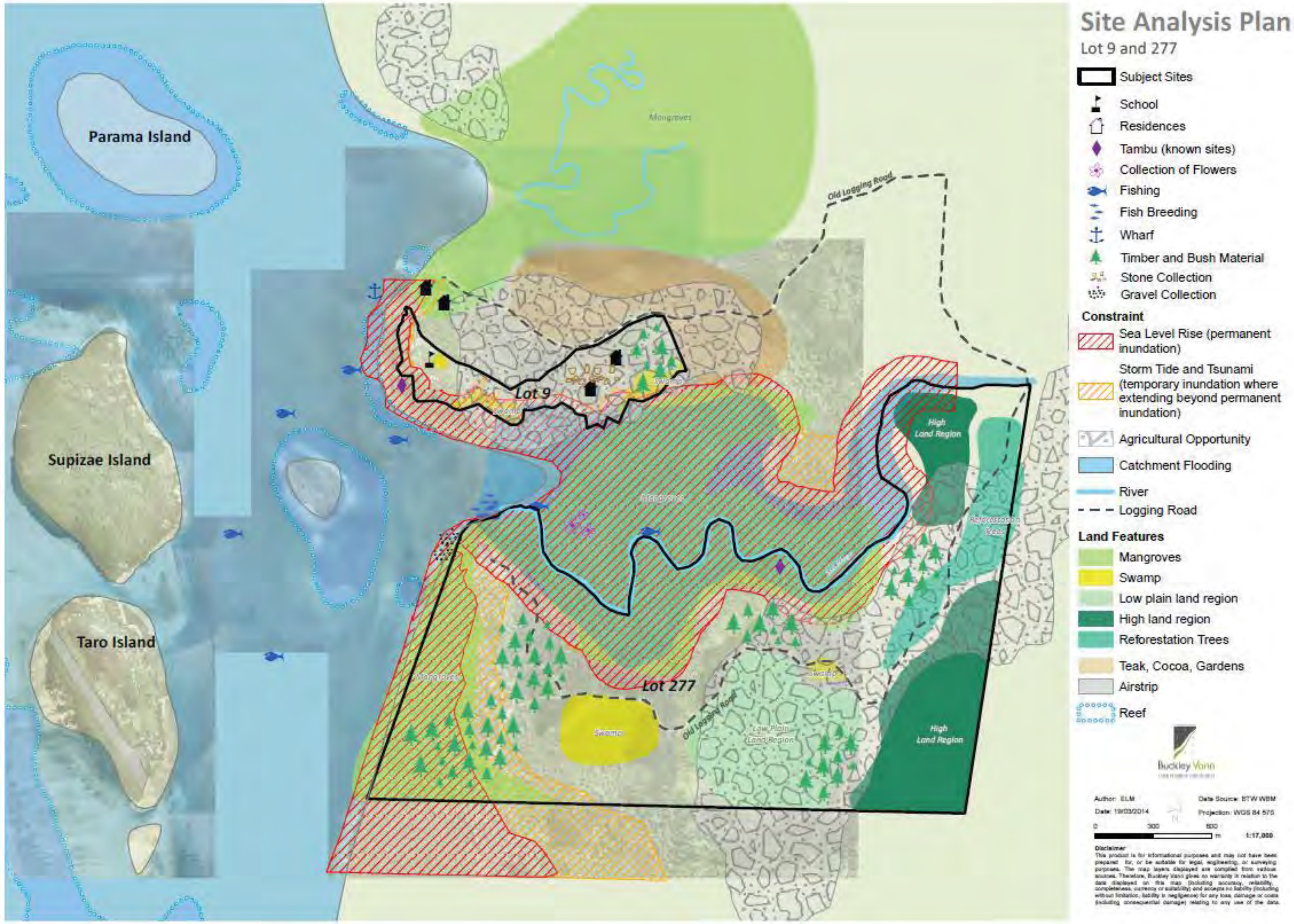


Figure 10-1 Site Analysis of Lot 9 and Lot 277

10.4 Planning Assumptions

10.4.1 Land Ownership

The land parcels that comprise the future town expansion area on the Choiseul Bay mainland are lot 9 on LR3 and lot 277 on LR3. These lots are described and mapped in Section 2.3 (refer Figure 2-4). Both lots are under the custodianship of the premier of Choiseul Province on behalf of the people of Choiseul Province.

Lot 9 on LR3 was acquired by the Choiseul Province through an exchange scheme with the Choiseul Bay Association Trust Board (CBATB) in the early 1990s, which resulted in the surrender of part of Supizae Island by the Choiseul Provincial Government in exchange for lot 9 on LR3. The purpose of the exchange was to facilitate the establishment of a school on lot 9 on LR3 by the responsible authorities.

Negotiations for lot 277 on LR3 reached a resolution in December 2011 with the transfer of the land from the Choiseul Bay Association Trust Board (CBATB) to the Premier of Choiseul Province. The final report on the transfer of the perpetual lease states that the reason for the land purchase was to facilitate relocation of the township on Taro Island to the mainland following a CPG resolution in the 1990s.

Based on advice from the SIG, CPG, community representatives and other stakeholders, the only land available for the establishment of a township on the mainland are the two lots currently under CPG ownership. Accordingly, land outside of lot 9 and lot 277 has not been included in the planning for the relocation of uses from Taro Island and the establishment of a new and expanded town on the mainland.

Notwithstanding this, access to land outside of lot 9 and lot 277 currently under customary ownership will be necessary in order for the development and future expansion of the township. This may include, but is not necessarily limited to:

- Land seaward of lot 9 and lot 277 to facilitate access to the township from the sea and adjoining coastal areas;
- The Sui River and Sorave River for the purpose of establishing hydro-power infrastructure and a town water source to service the town;
- Land between the Sui River, Sorave River and the town along which infrastructure pipes will need to be laid;
- The northern portion of the Sui River for people travelling to the town from surrounding areas;
- Mangrove areas between lot 9 and lot 277 which people may traverse in order to move between the lots; and
- Roads that link lot 9 to lot 277.

For the purpose of this study, it has been assumed that access to the required land can be negotiated with the relevant land owners. It is recommended that these negotiations be pursued as a matter of priority, as indicated in the Program of Works (refer Figure 9-4).

10.4.2 Population Projections and Household Occupancy

Data from the Solomon Islands Population and Housing Census shows that in 2009, Choiseul Province made up 4.9% of the total population of the Solomon Islands and recorded 2.8% population growth per annum, the second highest in the country. It is expected that this rate of population growth will be maintained, which will put pressure on the limited resources available in the province (Pauku: 2011, p 12).

At the time of the census, there were 810 people living on Taro Island. Of these, 428 were male and 382 were female, representing 52.8% and 47.2% of the population respectively. A total of 145 households were counted, which represents a household occupancy rate of approximately 5.59 people per household.

By comparison, in 1990 there were 440 living people on Taro Island, representing an increase of 370 people over a 19 year period and an average annual growth rate of approximately 4.4%, well above the rate of growth for the province as a whole (2.8%). Whilst there are no official population projections for Taro Island or Choiseul Province, an extrapolation of the compound growth rate indicates that the population of Taro Island could be around 1,490 people by 2029 if the same level of growth continued (see Figure 10-2).

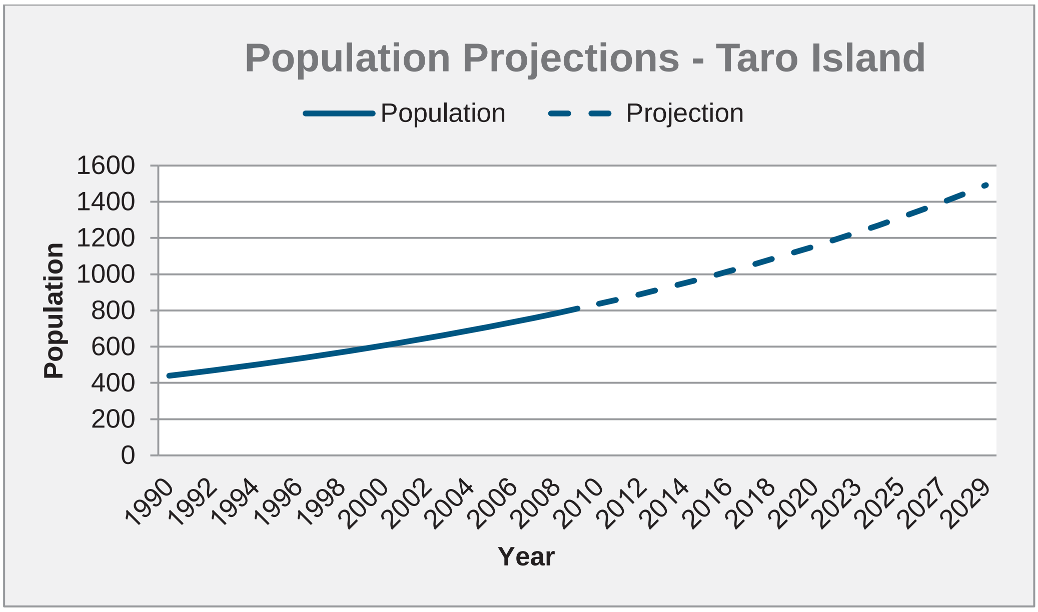


Figure 10-2 Estimate of future population based on historical compound rate of growth – Taro Island

These projections, however, have limited usefulness for estimating the future population of the capital, given the figures are an extrapolation of historical trends, which cannot be expected to continue due to land capacity limitations on Taro Island. Additionally, it is considered very likely that the expansion of the capital to the mainland will attract a higher level of urban migration from elsewhere in the province due to the employment and investment opportunities it presents (Pauku: 2011, p 11).

An alternative method of projecting the future population of the future expansion area is to consider the projections for the province as a whole and the urbanisation rate that might be expected to apply to these figures. If historical growth figures for Choiseul Province are extrapolated to the year 2029, a population of up to 47,000 people might be expected for the province. Estimates of the number of people who might be expected to live in the capital can be taken from the 2009 provincial urbanisation rates as shown in Table 10-1. In this table, excluding Guadalcanal Province, current rates of urbanisation are between 3.0% and 9.3%. Applying this to the projected population for Choiseul Province of 47,000 people, the population of the provincial capital in 2029 might be between 1,410 and 4,371 people.

For planning purposes, the higher estimate of 4,371 people is rounded up to 5,000 people. Hence the draft local planning scheme has been designed to accommodate a capacity of up to 5,000 people.

Table 10-1 Provincial and urban centre populations, 2009

Province		Urban Centre		% Urbanisation
Choiseul	26,372	Taro	810	3.0%
Western	76,649	Gizo	3,547	4.6%
Isabel	26,158	Buala	971	3.7%
Central	26,051	Tulagi	1,251	4.8%
Guadalcanal	93,613	Honiara	64,609	69%
Malaita	137,596	Auki	5,105	3.7%
Makira-Ulawa	40,419	Bauro Central	2,074	5.1%
Temotu	21,362	Luva	1,982	9.3%

10.4.3 Land Area Requirements

In preparing the draft local planning scheme, land area allocations for zones and key land uses were estimated by:

- identifying recommendations for land area allocations contained in background reports;
- interviewing CPG and SIG representatives responsible for the management of key infrastructure on Taro Island (for example, CBPSS Principal, hospital director etc.); and
- estimating land use allocations of existing uses at Taro Island and a comparable provincial capital (Gizo).

The results of the investigations are summarised in Table 10-2 and Table 10-3. The tables also provides the total land area allocation for the zone and a recommended 'land budget' identifying land area requirements for key uses that should be put aside in the draft local planning scheme and considered in the formal land allocation process.

Table 10-2 Zoning areas estimates

Zone in Draft Choiseul Bay Town Local Planning Scheme	Taro (Ha)	Gizo (ha)	Draft Choiseul Bay Town Local Planning Scheme (ha)
Town Centre Core	1.65	5.3	29.6
Community Living	7.31	2	41
Port and Industry	0.15 (port only)	0.25 (port only)	6.8
Low Impact and Service Industry (Lot 9)	0.5	4	6.9
Low Impact and Service Industry (Lot 277)			2.6
Special Purpose – education and health (Lot 9)	-	1	5.3
Special Purpose - cemetery	-	-	1.1
Special Purpose - CBPSS	-	0.5	5.1
Special Purpose – Rural vocational training, agricultural land division & farming demonstration (Lot 277)	-	-	7.7
Special Purpose – Waste Transfer Station and Waste Water Treatment Plant	-	-	6
Special Purpose – landfill (Taro Island)	0.2	-	3.4
Special Purpose – airstrip (Taro Island)	6.52	-	6.7
Limited Development – Taro Island and part of Supizae Island.	-	-	80.6
Environmental and Conservation (small wetland on Lot 277, near proposed community living zone)	-	-	2.4
Open Space and Recreation – local park (Lot 9)	5.5	-	1.9
Open Space and Recreation – sporting hub (Lot 277)	0.71	1	2.0
Open Space and Recreation – separation buffers (Lot 9 and Lot 277)		-	18
Open Space and Recreation – general area to the west (Lot 277)	-	-	57.5
Open Space and Recreation – general area to the east (Lot 277)	-	-	89.8
Future Investigation (Lot 277)	-	-	18.8

Table 10-3 Recommended land budget and area requirements for key land uses

Indicative Key Land Use	Taro Area (ha)	Gizo (ha)	Draft Local Planning Scheme (ha)
Industry vocation training centre	-	-	0.2 (or as determined by needs of the use)
Referral hospital	0.35	1	0.5 to 1.0
Housing for medical staff and carer's accommodation	-	-	0.5
Cemetery	-	-	0.20
Boat storage (2 on lot 277)	-	-	0.1 to 0.5 for each boat storage area
Passenger rest shelter	-	-	0.1
Waste transfer station and waste water treatment plant on lot 277	-	-	Total: 6.5 (Waste Transfer Station: 0.5ha, Waste water treatment plant[2] 0.2ha for control room and access + 5.8ha for treatment beds).
Waste transfer station and waste water treatment plant on lot 9	-	-	Total: 1.0 to 1.5 0.2ha for control room and access + 1.0ha for treatment beds
Central recreation and sport hub (for outdoor playing fields, playground and indoor sports centre)	0.71	-	2.0
Police station and court house	-	0.8	Total if integrated 0.3 – 0.7 Police station: 0.2 – 0.5, Court house: 0.1 -0.2
CPG admin and other government offices	0.92	-	1.0 – 1.2
Community centre	-	-	0.1
Choiseul Bay Provincial Secondary School			5.0 (or as determined by needs of the use)
Primary school	0.27	0.50	0.5 to 1.0
Pre-school and kindergarten	0.27	-	0.5
Transformer station	-	-	0.5 to 1.0 (or as determined by needs of the use)
Rural vocational training centre	-	-	0.5 – 1.0 (or as determined by needs of the use)

[2] A detailed study is required to plan and design the waste water treatment plant on Lot 277 and Lot 9 and confirm the most suitable location having regard to topography, soil type and groundwater characteristics. Land area estimates for both waste water treatment plants also assumes that 20% of this land will be taken up by earth walls and other siting constraints.

In terms of population capacity, the following assumptions have been made:

Community Living Zone

- 41ha of land is allocated to this zone, which equates to a net developable[3] area of 32.8ha once roads and parks have been accounted for
- Of the net developable area, it is assumed that up to 10% of this land will be developed for non-residential uses such as community uses (primary school, kindergarten, community centre etc), home based businesses, small scale corner stores and office uses or, subject to other site constraints
- A variety of lot sizes will be accommodated in accordance with the following:
    - 25% of 400sqm lots = 205 lots
    - 50% of 600sqm lots = 273 lots
    - 15% of 1,000sqm lots = 49 lots
- Occupancy rates will reflect the current occupancy rate on Taro Island (5.59 people / dwelling)
- A total of 527 dwellings can be accommodated within the community living zone, housing an ultimate population capacity of 2,946 people

Town Centre Core Zone

- 29.6ha of land is allocated to this zone, which equates to a net developable area of 23.68ha once roads and parks have been accounted for
- Average lot size within the zone will be 300sqm
- Approximately 50% of businesses will incorporate a residence (such as shop top housing)
- Occupancy rates will reflect the current occupancy rate on Taro Island (5.59 people / dwelling)
- A total of 394 dwellings can be accommodated within the town centre core zone, housing an ultimate population capacity of 2,202 people

Hence, based on the above assumptions[4], the ultimate population capacity for the community living and town centre core zones combined is potentially up to 5,148 people. This means, the planning scheme has zoned sufficient land for urban purposes to accommodate the projected population of the provincial capital, which is expected to be between 1,410 and 4,371 people in 2029. The planning scheme has also identified additional land (18.8ha) as a future investigation area for possible future town expansion (subject to determining land suitability).

Based on these assumptions, there will be no need to expand the town outside of existing urban zoned areas until the population is approaching 3000 people (not expected before 2029). The CPG

[3] Net developable area means the area of land available for development. It does not include land that cannot be developed due to constraints such as flood affected land, steep land, areas of environmental significance. For the purpose of this planning report, net developable area has allowed for 10% of land for roads and 10% of land for parks. No other constraints have been accounted for in this exercise.

[4] Modifying the assumptions around density, lot size and mix and percentage of net developable area will change the expected population capacity. Housing associated with the hospital, carer's accommodation and caretaker's dwellings in industry areas have not been included in the assumptions and would provide some additional population capacity.

will need to carefully monitor the rate of population growth and development in the new town. Once the population reaches around 3000 people, it is recommended that the CPG further consider the planning assumptions underlying the local planning scheme including the amount of available land for development in the industrial, community living and town centre core zones and, determine what this means for population capacity, timing and infrastructure provision. It may be necessary to undertake further planning and infrastructure investigations to determine options and an appropriate planning and policy response including for example, whether there is a need to expand outside of existing zoned areas, or increase consolidation in existing developed areas through changes to density or lot size or, maintain current assumptions and land use strategies.

It will be important for the CPG to work closely with adjoining customary land owners to ensure any plans for development outside of, but adjoining the boundary of the town, is compatible and aligned with the intent of the local planning scheme to the greatest extent possible. This will be particularly important in the context of existing housing on customary land to the north of Lot 9 and potential for conflicts with proposed port and industry uses on Lot 9. The CPG will also need to strongly discourage the removal of mangroves and coastal vegetation within natural hazard areas that extend beyond the boundaries of the town, particularly to the north and south of Lot 277. There is also a risk that development of housing on surrounding customary owned land will compete with residential development in the town.

10.4.4 Infrastructure Provision

Land use planning and infrastructure planning need to be closely integrated and well organised. Planning and sequencing of infrastructure is very important to ensure infrastructure is provided in a way that is affordable, maximises the use of existing infrastructure and is provided in a timely manner to meet the needs of people and development. Another important consideration is to ensure infrastructure is fit for purpose and can be maintained and operated within the resources and means of the local community.

Ideally, infrastructure should lead development and not lag behind. While this is best practice and certainly a highly commendable principle to aspire to, it is often not achievable because of the significant upfront costs involved in providing infrastructure before development occurs. This challenge, common to many governments worldwide, is further complicated in the context of this project because the expansion of the town is ‘split’ over two non-contiguous lots which make up the expansion site. The effect of this is multiple development fronts or growth areas needing to be serviced by infrastructure at the same time and limited opportunity to share infrastructure services and assets. Provision of infrastructure will therefore cost more than if the town was consolidated in one location, as opposed to being a ‘split town’.

Unmanaged multiple development fronts with urban development expanding in different directions can also lead to disjointed and pre-mature development, reduced infrastructure efficiency and increased costs of infrastructure provision. This will be a particularly important issue to manage in the context of developing the Town Centre Core Zone and Community Living Zone on Lot 277 due to the large land areas involved.

An effective way to overcome this issue is to sequence development and limit or carefully manage the number of development fronts to that which is affordable. That is, where infrastructure provision can be provided and maintained within the financial means of the government and community.

Sequencing plans, in prioritising the development of certain areas and land uses, can also be very useful in facilitating a 'critical mass' of land uses, thus avoiding disjointed, isolated and premature development. Establishing a critical mass of land uses will be important for the success of the town centre in particular.

It is recommended a sequencing and staging plan be prepared for the expansion site and this be underpinned by a financial analysis of infrastructure requirements to determine costs and the most efficient and affordable way to deliver infrastructure for the expansion of the town. The release of land for development should be in accordance with the sequencing plan.

The infrastructure to be provided to support the town is described below

10.4.4.1 Water Supply

It is intended that all areas in the town including all housing, industry areas, special purpose areas and the town centre, will have water distributed to each lot by pipeline.

At this stage, and subject to further feasibility assessments, the water supply source is the Sui River. Further studies are required to organise, plan and design the water supply system. Identification and protection of the water supply pipeline corridor and ensuring development does not compromise the corridor and distribution of water to the town, is very important.

The expectation is for each lot and premises to connect to the water supply system. If the water pipeline is not available or the development cannot connect to the pipeline, each lot is provided with an alternative potable water supply source (e.g.: rainwater, bore water) with a minimum storage capacity of 10,000 litres.

It is also important to consider water supply infrastructure for fire fighting purposes. In the absence of a dedicated fire brigade service for the new town, it is recommended fire hydrants be provided, or the reticulated water system provides a tap connection at the front of each lot to allow a hose connection for fire fighting purposes. This should be considered further as part of the overall planning and design of the water supply system.

10.4.4.2 Sewerage and Wastewater Treatment

For sewage and wastewater treatment, it is intended that all urban areas in the town, including all housing, all development in the town centre, some industry uses (where not involving trade waste) and some special purpose areas, will be serviced by a simplified effluent disposal system. This involves each lot or premises having individual septic tanks that are connected by pipe to a centralised waste water treatment facility located on lot 277 and lot 9. Septic tanks on individual lots provide the primary treatment of waste water (allowing for digestion and settlement within the tank), with liquid effluent from the septic tank pumped to the centralised waste water treatment plant for further processing.

Given development in the town will include a range of lot sizes, including lots in the order of 300m^2 (in the Town Centre Core Zone) and 400m^2, 600m^2 and 1000m^2 (in the Community Living Zone), such lot sizes are too small to safely accommodate traditional septic tank effluent disposal techniques and will not provide healthy living environments. The proposed wastewater treatment system avoids the need for local soakaways for effluent disposal by pumping effluent to a centralised facility for treatment (settlement and infiltration).

Industry uses generating trade waste and effluent must provide additional on-site treatment before connecting to reticulated effluent system, or fully treat and dispose of all trade waste and sewage locally. Lots sizes of industrial lands will therefore need to be large enough to provide for this on-site requirement, in addition to any other development requirements.

Further studies are required to assess, organise, plan and design an appropriate sewerage service and wastewater treatment plant specifications.

10.4.4.3 Electricity

Electricity supply to the town is most likely to be generated from a hydro-power facility on the Sui River.

A further study is required to assess, plan, organise and design the hydro-power scheme, identify preferred locations for any supporting infrastructure such as corridors, location for substations or buildings to house equipment and, the electricity supply network.

It is expected that all development and each lot is connected to an electricity supply network in accordance with the requirements of the energy provider.

10.4.4.4 Telecommunications

All development and each lot will be connected to telecommunication services in accordance with the requirements of the provider.

10.4.4.5 Stormwater Management

It is important for stormwater management to be considered early when planning land development. Urban development significantly changes the rainfall and water runoff characteristics of land. Water runs off the land much more quickly and in larger volumes in urban areas compared to a natural state. In urban areas, the increased flow and speed of water runoff also results in erosion impacts and carries pollutants, sediments and contaminants from the land into the rivers, waterways, wetlands and the sea, potentially impacting on water quality and aquatic organisms. To help minimise these damaging impacts, it is important to address stormwater management (quality and quantity) early on and across broad areas of the town, rather than just adopting a site by site basis. This approach means that stormwater management measures can accommodate natural catchments, landform and soil characteristics and inform the subdivision design and detailed layout of the town.

Incorporating water sensitive urban design (WSUD) principles and approaches into the layout of the town means the town will achieve much better stormwater management and water quality outcomes for the environment and community. This approach also means that less hard engineering drainage works will be required and more natural channel or ‘soft’ based stormwater solutions may be possible. The natural solutions are often much cheaper to construct and maintain over time.

It is recommended a further study is undertaken to assess, plan and provide an integrated stormwater management plan for the expansion site. The integrated stormwater management plan should be undertaken prior to any detailed subdivision and layout, and will be used to inform detailed submission plans.

10.4.4.6 Solid Waste Management

It is recommended that the existing landfill on Taro Island, within Mosquito Creek and adjacent to the existing airstrip, is continued but under an appropriate management regime, to cater for the solid waste management needs of the town and broader Province. The design of the landfill will need to include measures (such as a bund wall or other barrier) to minimise risk of natural hazard impacts, particularly from wave overtopping from tsunami and coastal storm inundation.

A waste transfer station to service the needs of Lot 277 will be provided close to the centralised waste water treatment plant. A second waste transfer station will be located on Lot 9 to service the waste management needs of the industry and special purpose uses on Lot 9. The waste transfer stations are important facilities for sorting, recycling, recovering and storing waste before transporting by sea to the landfill disposal site on Taro Island.

A detailed study is needed to ensure the landfill is appropriately designed, managed and operated to ensure wastes do not mix with ground water and other adverse environmental impacts on surface water, air quality and the values of the coastal zone and reef, are avoided. The study should also examine the life span of the facility and future long term waste management needs of the province.

The landfill should be operated and managed in accordance with an approved integrated waste management plan (IWMP) which identifies waste management infrastructure and plans how and by whom waste will be sorted, collected, treated and disposed. The IWMP should also cover the two proposed waste transfer stations.

Burning of rubbish should be avoided as it creates air pollution, bad smells and health hazards from the production of toxic gases.

10.4.4.7 Transport Network

The road layout of the new town will form part of the detailed subdivision design and layout. Provisions have been included in the draft planning scheme to require that new roads are designed and built:

- to include space for walking, cycling and small buses
- are wide enough for street parking and include shady street trees along footpaths
- to include services and drainage in the road verges; and
- are able to support more traffic as the town grows

Minimum reserve widths for different road types are also recommended in the planning scheme.

10.4.4.8 Public Parks and Land for Community Facilities

Infrastructure for recreation and sporting parks, local parks, playgrounds and land for community purposes to provide for the primary school, kindergarten, preschool, community centre, police station and court house, are designed and constructed to service the lots in accordance with their intended purpose.

It is expected a network of parks and community land will be provided throughout the town. Land for public parks, sporting and playgrounds must be of an appropriate size intended for their use, configuration and slope and must be generally flat and useable, meaning at least 30% of the land is not constrained by slope, flooding or other factors.

It is recommended as part of the design and subdivision layout of town, a network of local parks be identified and, well located and unconstrained land be set aside and protected for community facilities in accordance with the recommended land budget allocations in Table 10-3.

10.5 Community and Stakeholder Engagement Outcomes

Community and stakeholder input into the town planning component of this Adaptation Plan was sought during in-country engagement visits 2 and 3 (January and March, 2014). The feedback related to the long term vision for development of the future expansion area; and more specific feedback pertaining to possible concept plan options. This feedback is summarised below.

10.5.1 Vision for the Future Expansion Area

The following suggestions were made about how the future expansion area should be developed:

- The township should be a ‘green’ town and include public areas for recreation, sport, parks and trees;
- The township has to be clean and well looked after with a waste disposal area that is well separated from the town;
- Services and infrastructure, such as water supply, sewage management and good road connections, should be available before development;
- The provincial capital should be the ‘face’ of Choiseul and set the standard for provincial capitals in the Solomon Islands;
- Land and resources in the new township need to be fairly distributed;
- The new township should be safe from natural hazards, such as sea level rise and tsunami;
- It will be important to identify a suitable and secure place to store boats as part of the final Masterplan;
- The port requires good access to deep water and protection from wind and waves;
- A road connecting to nearby villages is needed to facilitate travel between villages; and
- If more land were available (compared to Taro Island) more people would choose to live in the capital.

10.5.2 Concept Plan Options

During the March 2014 in-country visit, the project team presented three draft concept plan options to community members and government representatives and asked for feedback about what aspects of the plans people liked and didn’t like. Each of the three concept plans are provided in Appendix G. Concept plan option 1B was identified as the preferred option because it can generally be contained within land owned by the CPG and it is set back from land vulnerable to permanent and temporary inundation. Specific comments in relation to concept plan option 1B include:

- Locating the Choiseul Bay Provincial Secondary School (CBPSS) somewhere near the location marked as 'option 1', but providing for a setback from the future highway and crocodile habitat;
- Allowing for more than one market with various locations within lot 9 and lot 277 identified as being potentially suitable;
- Removing the area allocated for gardens and allowing lot sizes large enough for people to plant gardens within their own yard;
- Expanding the area of land allocated for 'town centre core' and 'community living' and allocating land for future expansion;
- Providing police or security services on lot 9 and lot 277;
- Locating the provincial referral hospital on lot 9 if it can be separated from industry and if safe for workers and patients and, a medical clinic on lot 277;
- Including an area for a second vocational education centre near the agricultural division on lot 277;
- Providing good road access from the township to the jetty on lot 277;
- Providing a buffer to separate the township from nearby land not in CPG ownership;
- Considering other locations for waste management further away from future development;
- Providing good road connections to surrounding villages and future housing;
- Confirming if water is deep enough for passenger ferries and small cargo ships to use the jetty on lot 9;
- Allowing for a rest area for people to stay overnight near the jetty where smaller cargo ships will dock; and
- Making sure the mangroves are protected from development and not used for dumping waste or public convenience.

These comments are shown spatially in Figure 10-3.

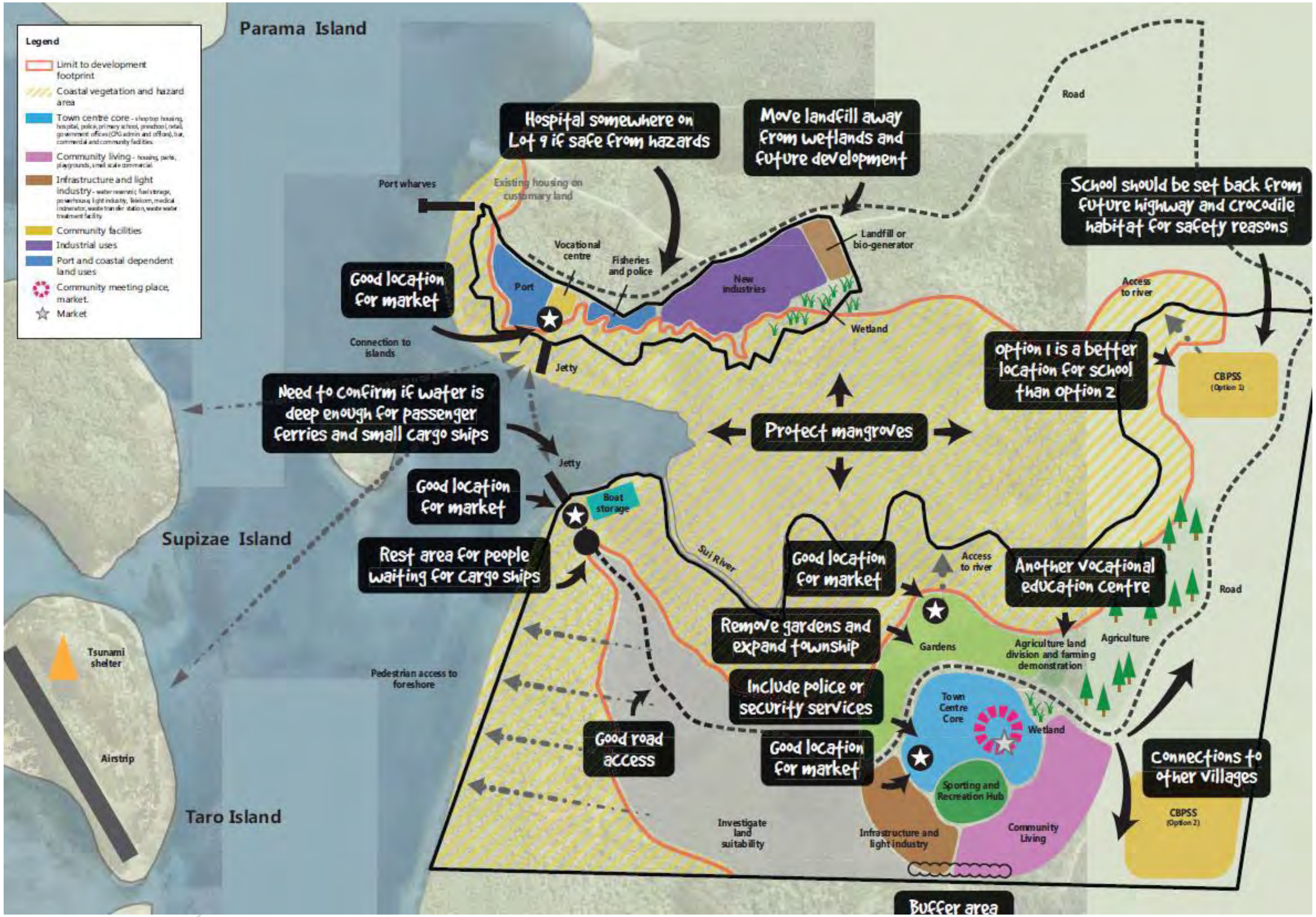


Figure 10-3 General feedback from community and stakeholders on mainland development options

10.6 Draft Local Planning Scheme

10.6.1 Overview

Through consultation for the Choiseul Bay Climate Change Project, it has been suggested that the mechanism under which planning for the future expansion area will occur is Part III of the *Town and Country Planning Act* (TCPA). Accordingly, the draft local planning scheme prepared for this project includes Lot 9 and Lot 277 on the mainland, Taro Island and part of Supizae Island and has been drafted with an intention that it will form the basis of a local planning scheme consistent with the requirements of the TCPA.

The area to which the draft local planning scheme applies is shown in Figure 10-4.

Figure 10-4 Draft local planning scheme area for Choiseul Bay township

According to Part III of the *Town and Country Planning Act*, the purpose of a local planning scheme is as follows:

(1) The purposes of a Local Planning Scheme shall be-

(a) to assist in securing orderly development in the interests of the health, amenity, convenience and general welfare of the community;
(b) to indicate the general principles upon which development in the area will be promoted and controlled;
(c) to assist in the selection of, or to define sites for particular purposes, whether by the carrying out of development thereon or otherwise;
(d) to protect features or areas of social, historical, scenic or architectural importance;
(e) to safeguard routes for highways, pipelines and other services; and
(f) to indicate the stages by which development should be carried out.

Prior to the preparation of the local planning scheme, the area to which the local planning scheme will apply must be declared a 'local planning area' in accordance with the following provisions of the TCPA, as defined below:

Local Planning Areas

(1) The Minister may by notice published in the Gazette declare any area to be a Local Planning Area, and may in like manner amend or revoke any declaration so made:

Provided that no declaration made under this section shall include customary land.

(2) Before making a declaration in accordance with subsection (1) the Minister shall have received a request therefore from, or obtained the consent thereto, of the Provincial Assembly or Town Council within whose boundaries the Local Planning Area is situated.

Whilst the process of declaring a local planning area (in accordance with the above provisions) has not yet commenced, it is anticipated that this process will be followed by the CPG in planning for the future expansion area (and on-going development on Taro and Supizae Islands).

Section 8 of the TCPA also requires a study of the local planning area to be undertaken as soon as practical after the Ministerial declaration of a local planning area. The purpose of the planning study is to examine those matters which may affect the development of the local planning area or the planning of its development and, at all times to keep those matters under review. It is recommended the CPG use or adapt this chapter (Chapter 10) of this report, as the basis of the planning study and to satisfy the requirements of the TCPA. The planning assumptions in Section 10.4 of this report identify the need for further technical studies (eg: water supply and other infrastructure) and will be key inputs into reviewing and updating the planning study report for the local planning area.

10.6.2 Draft Local Planning Scheme Components

In preparing the draft local planning scheme for Taro Island, part of Supizae Island and the future expansion area, the project team has reviewed:

- The Solomon Islands Town and Country Planning Act;
- the draft Taro Island Local Planning Scheme; and

- the Honiara Planning Scheme.

This review was primarily used to gain an understanding of the typical format of planning schemes used in other parts of the Solomon Islands and to identify relevant development standards. In addition, guidance on the policy position and development provisions to be included in the draft planning scheme was obtained through community, government and stakeholder consultation.

The key components of the draft planning scheme are listed below, along with a brief explanation of the purpose and content of each section.

Section 1 - About the planning scheme

- This section provides an explanation of how the planning scheme will operate, how to interpret the planning scheme and identifies development to which the planning scheme applies.
- It includes land use and administrative definitions and rules for assessing development applications

Section 2 - Our vision and masterplan for a new capital

- The masterplan sets the policy direction for the planning scheme which is then filtered through the balance of the planning scheme (i.e. through the zone outcome statements and detailed development provisions)
- It comprises a vision statement including seven vision themes, supporting policies and a masterplan map

Section 3 - Zones and development outcomes

- Zones are used to organise the local planning scheme area in a way that provides an indication of the preferred locations for a range of land uses
- Each of the nine zones includes a purpose statement, a list of permitted / prohibited development and specific development outcomes and requirements

Section 4 - Infrastructure requirements

- This section provides direction on the infrastructure requirements needed to support future development
- It includes consideration of such infrastructure as water supply, sewerage and wastewater treatment, electricity, telecommunications, stormwater management, solid waste management, transport network, public parks and land for community facilities

Section 5 - Subdivision of land requirements

- The subdivision development requirements provides guidance on how to undertake development involving the subdivision of land
- The development requirements in this section of the planning scheme provide guidance on how to achieve good lot layout and design in order to create places that are well-connected, safe, connected to urban services and sensitive to site features

A full copy of the draft local planning scheme is included at Appendix H.

The masterplan map in the draft local planning scheme (reproduced as Figure 10-5) is a more refined version of the preferred concept plan option 1(b) presented to community and government representatives in March 2014 and amended to incorporate consultation feedback and comments summarised in Section 10.5 of this report. It is important that this masterplan is reviewed and adjusted as necessary following completion of the full topographic survey of Lot 277 and Lot 9, to account for any further land constraints in the shape and layout of proposed future development.

10.6.3 Adoption and Gazettal of the Local Planning Scheme

In accordance with the TCPA, the CPG will need to follow a series of prescribed steps in order to establish a Local Planning Area and formally adopt the associated Local Planning Scheme. These steps are outlined in Table 10-4, with an overall timeframe of approximately six months.

Table 10-4 Sequenced Steps to Progress and Finalise the Draft Local Planning Scheme

Action	Timeframe or Trigger	Responsibility
CPG Provincial assembly to write to the SIG Minister requesting declaration of a Local Planning Area in accordance with the TCPA.	Immediately	CPG, led by Chief Planning Officer
CPG and provincial assembly review draft local planning scheme (Appendix H) and supporting planning study report[5], for endorsement of policy content and direction.	Immediately	CPG, led by Chief Planning Officer
Minister considers request and publishes notice in gazette declaring the area to be a Local Planning Area.	Following receipt of request from the CPG for declaration of Local Planning Area. Estimated timeframe - 1 month.	SIG Minister
CPG submits draft local planning scheme and supporting planning study report for approval by the SIG Minister.	Immediately following notification from Minister of declaration of Local Planning Area and notice in gazette.	CPG, led by Chief Planning Officer
SIG Minister approves draft local planning scheme to commence public notification.	Following receipt of draft local planning scheme and planning study report from CPG. Estimated timeframe for Ministerial approval – 1 month.	SIG Minister
CPG undertakes public notification of the draft Local Planning Scheme and supporting planning study report, in accordance with the requirements of section 11 of the TCPA, including a public notification period of at least one month.	Following approval from Minister to commence notification. Allow at least 1 month for public notification including publishing a notice in a locally circulating newspaper.	CPG, led by Chief Planning Officer
CPG considers objections and representations received during the public notification of the draft local planning scheme and makes changes as required.	Following completion of statutory public notification period. Allow 1 month for CPG technical officers to consider submissions and make changes to draft local planning scheme to respond to submissions.	CPG, led by Chief Planning Officer

[5] As indicated previously, Section 8 of the TCPA requires a study of the Local Planning Area to be undertaken as soon as practical after the Ministerial declaration of a Local Planning Area. It is recommended the CPG use or adapt chapter 10 of this report as the basis of the planning study and to satisfy the requirements of the TCPA.

Action	Timeframe or Trigger	Responsibility
CPG Provincial Assembly considers and endorses amended draft local planning scheme and submits draft local planning scheme to Minister for approval, including a statement of compliance with TCPA requirements.	Following consideration of submissions by CPG technical officers. Estimated time - 1 month.	CPG, led by Chief Planning Officer
Minister publishes a notice in the gazette and a notice in at least one locally circulating newspaper of the approval of the Local Planning Scheme.	Estimated time – 1 month.	SIG
Local Planning Scheme takes effect from the date of the notice published in the gazette.	Planning scheme has statutory effect and can be implemented from date of gazettal.	CPG implements local planning scheme through development assessment process.

10.6.4 Implementation of the Local Planning Scheme

The draft local planning scheme sets out the Choiseul Provincial Government and community's vision for the future development of the new capital of Choiseul Province and the intention for new development (and in some cases redevelopment), on Taro Island and Supizae Island. The draft local planning scheme, once gazetted in accordance with the requirements of the TCPA, will be a statutory document and is intended to be used by the Choiseul Province Planning Board and its technical officers in the assessment of development applications.

In addition to following the statutory process for assessing an application for development or planning permission in accordance with the TCPS, it is recommended that all development applications on Taro Island and Supizae Island be referred to technical officers in the National Disaster Management Office for review and comment, prior to a recommendation or decision being made on the application by the Choiseul Province Planning Board or its technical officers. This is to ensure that development decisions on Taro and Supizae Islands appropriately consider natural hazard risks, especially present day tsunami risk, and to ensure development is located and constructed to withstand a tsunami event and in some cases an earthquake event.

It will also be important for the CPG to monitor and enforce compliance with the local planning scheme. This will be especially important to avoid incompatible land uses such as houses establishing in industry zones, open space zones or natural hazard areas or, inappropriate retail uses locating in residential or industry zones. In this context, it is recommended that inspections and enforcement by CPG technical officers be undertaken from the start of the relocation process to the mainland.

Experience from most local and State Governments in Australia indicates that compliance monitoring and enforcement of town planning requirements and conditions of development, is an ongoing task that needs to be properly resourced with personnel who understand the statutory requirements and enforcement process of the relevant planning or environmental legislation, the development approval process and the local planning scheme. Based on feedback received from

CPG representatives on experiences sighted elsewhere in the Solomon Islands, there is concern that unlawful development, especially in the form of ‘shanty’ like housing that is not well constructed or inappropriately located, is very likely to occur in the new town with little to no regard to the local planning scheme. It will therefore be important for compliance inspections and enforcement to begin early in the process and continue indefinitely. This will go a long way towards achieving the vision of the new town and to minimise unlawful uses becoming a major or overwhelming issue for the CPG to manage.

Figure 10-5 Strategic Masterplan for New Town Development on Lot 9 and Lot 277

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Appendices

Appendix A Description of TUFLOW FV

A.1 General Description of TUFLOW FV

TUFLOW FV is a flexible mesh hydrodynamic model that solves the conservative integral form of the Non-Linear Shallow Water Equations (NLWSE), including viscous flux terms and source terms for Coriolis force, bottom friction and various surface and volume stresses. The scheme is also capable of simulating the advection and dispersion of multiple scalar constituents within the model domain.

TUFLOW FV is a commercially available package (see www.tuflow.com/Tuflow%20FV). Key features:

- A flexible mesh finite volume numerical engine, well suited to modelling areas with complex geometries and applications requiring variable resolutions.
- A fast, parallelised numerical scheme that provides fast simulation times on standard desktop computers.
- TUFLOW FV has been extensively benchmarked and tested as part of its development and has been extended to a full 3D baroclinic capacity.
- The software was developed in 2006 and has been used by BMT in a large number of coastal and estuarine modelling projects since 2008.
- TUFLOW FV is used within the SMS “Surface Modelling System”, a commercially available pre and post processor that integrates a number of numerical schemes.
- Hydrodynamic processes, including wind stress forcing from gridded wind datasets or specific cyclonic parameterisations, are accurately represented.

The spatial domain is discretised using contiguous, non-overlapping but irregular triangular and quadrilateral “cells”. Advantages of an irregular flexible mesh include the ability to:

- smoothly resolve bathymetric features of varying spatial scales
- smoothly and flexibly resolve boundaries such as coastlines
- adjust model resolution to suit the requirements of particular parts of the model domain without resorting to a “nesting” approach
- The flexible mesh approach has significant benefits when applied to study areas involving complex coastlines and embayments, varying bathymetries and sharply varying flow and scalar concentration gradients.

A.2 Solution Scheme

Key features of the TUFLOW FV Solution Scheme:

- Intrinsically handles shocks
- Locally (and globally) conservative to numerical precision

- Robust wetting/drying
- Explicit scheme ideally suited to parallelisation

A cell-centred spatial discretisation is employed in TUFLOW FV and requires the calculation of numerical fluxes across cell boundaries. As with many finite volume schemes non-viscous boundary fluxes are calculated using Roe's approximate Riemann solver. Viscous flux terms are calculated using the traditional gradient-diffusion model with a variety of options available for the calculation of eddy-viscosity and scalar diffusivity. The Smagorinksy eddy-viscosity model and the non-isotropic Elder diffusivity model are the options most commonly adopted by users.

Both 1st-order and 2nd-order spatial discretisation schemes are available in TUFLOW FV. The 1st-order scheme assumes a piecewise constant value of each conservative constituent in a model cell. The 2nd-order scheme assumes a 2D linear polynomial reconstruction of the conservative constituents within the cell (i.e. a MUSCL scheme). The Total Variation Diminishing (TVD) property (and hence stability) of the solution is ensured using a choice of gradient limiter schemes.

The 2nd-order spatial reconstruction scheme allows for much sharper resolution of gradients in the conserved constituents for a given level of spatial resolution. This is important for resolving relatively short waves, such as tsunami, without excessive numerical diffusion or without over-refining the spatial mesh discretisation. The numerical resolution of sharply varying current distributions and sharp scalar concentration fronts are also much improved with the 2nd-order scheme.

Spatial integration is performed using a midpoint quadrature rule. Temporal integration is performed with an explicit Euler scheme and must therefore maintain a stable time step bounded by the Courant-Friedrich-Levy (CFL) criterion. A variable time step scheme is implemented to ensure that the CFL criterion is satisfied with the largest possible time step.

In very shallow regions (~<0.05m depth) the momentum terms are dropped in order to maintain stability as the NLSWE approach the zero-depth singularity. Mass conservation is maintained both locally and globally to the limit of numerical precision across the entire numerical domain, including wetting and drying fronts. Regions of the model domain that are effectively dry are readily dropped from the computations.

Mixed sub/super-critical flow regimes are well handled by the FV scheme which intrinsically accounts for flow discontinuities such as hydraulic jumps or bores that may occur in trans-critical flows.

TUFLOW FV accommodates a wide variety of boundary conditions, initial conditions and other input specifications to ensure its applicability and ease of use for a range of applications.

Appendix B Risk Register

Risk Register

Value	There is a risk that......	Existing controls	Likelihood Present	Likelihood 2030	Likelihood 2055	Likelihood 2090	Consequence	Risk level Present	Risk level 2030	Risk level 2055	Risk level 2090
Taro Island											
CPG Headquarters	Temporary inundation of CPG headquarters by tsunami or storms causes disruption of Government services		P	P	P	P	Moderate	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion of CPG headquarters causes loss of Government services				R	P	Major			MEDIUM	HIGH
	Temporary inundation of CPG headquarters by tsunami or storms causes loss of Government records		P	P	P	P	Major	HIGH	HIGH	HIGH	HIGH
	Temporary inundation of CPG headquarters by tsunami or storms causes diminished capacity to respond to emergency		P	P	P	P	Major	HIGH	HIGH	HIGH	HIGH
CPG Admin	Temporary inundation by tsunami or storms causes disruption to service	Most services provided in other locations in the province	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to infrastructure and equipment		P	P	P	P	Moderate	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation causes loss of service					R	Moderate				LOW
	Permanent tidal inundation causes loss of infrastructure and equipment					R	Moderate				LOW
Telecommunications	Temporary inundation of telecommunications equipment by tsunami or storms causes disruption to communciations	Battery bank that allows communications to continue for a few hours	P	P	P	P	Major	HIGH	HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion of telecommunications equipment causes loss of communications					P	Catastrophic				EXTREME
	Temporary inundation of electricity generator by tsunami or storms causes disruption to communications	Battery bank that allows communications to continue for a few hours	P	P	P	AC	Major	HIGH	HIGH	HIGH	EXTREME
	Permanent tidal inundation or shoreline erosion of electricity generator causes loss of communications				P	AC	Catastrophic			EXTREME	EXTREME
Hospital	Temporary inundation by tsunami or storms causes disruption to Provincial medical services/administration	Evacuation to higher ground on Taro Island or to mainland (e.g. school)	R	R	R	P	Catastrophic	HIGH	HIGH	HIGH	EXTREME
	Temporary inundation by tsunami or storms causes diminished capacity to respond to emergency and provide care for patients	Evacuation to higher ground on Taro Island or to mainland (e.g. school); Referral to other Provincial clinics	R	R	R	P	Catastrophic	HIGH	HIGH	HIGH	EXTREME
	Temporary inundation by tsunami or storms causes loss of equipment and medicines	Evacuation to higher ground on Taro Island or to mainland (e.g. school)	R	R	R	P	Moderate	LOW	LOW	LOW	MEDIUM
	Permanent tidal inundation causes loss of full medical services and administration functions					R	Catastrophic				HIGH
	Permanent tidal inundation causes loss of infrastructure, equipment and drugs					R	Major				MEDIUM
Hospital backup generator	Temporary inundation by tsunami or storms causes disruption of full medical services and administration functions		R	R	R	P	Catastrophic	HIGH	HIGH	HIGH	EXTREME
	Permanent tidal inundation causes loss of full medical services and administration functions					R	Catastrophic				HIGH

Risk Register

Value	There is a risk that……	Existing controls	Likelihood				Consequence	Risk level			
			Present	2030	2055	2090		Present	2030	2055	2090
Taro Island											
Airport	Temporary inundation by tsunami or storms causes disruption to use of airstrip	Use of ship / boat	P	P	P	AC	Major	HIGH	HIGH	HIGH	EXTREME
	Temporary inundation by tsunami or storms causes damage to airstrip	Use of helicopters rather than fixed wing aircraft	P	P	P	AC	Major	HIGH	HIGH	HIGH	EXTREME
	Permanent tidal inundation or shoreline erosion (including loss of western lands) causes loss of airstrip	Use of ship / boat			P	P	Catastrophic			EXTREME	EXTREME
Powerhouse	Temporary inundation by tsunami or storms causes disruption to electricty generation	Back-up generators for some assets/services including hospital and telecommunications	P	P	AC	AC	Major	HIGH	HIGH	EXTREME	EXTREME
	Permanent tidal inundation causes loss of electricty generation			AC	AC	AC	Major			EXTREME	EXTREME
	Permanent tidal inundation causes loss of infrastructure and equipment			AC	AC	AC	Catastrophic			EXTREME	EXTREME
Market	Temporary inundation by tsunami or storms causes disruption to use of market	Alternative location of market during period of inundation	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes disruption to income source	Alternative location of market during period of inundation	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes disruption to social interaction	Alternative location of market during period of inundation	AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to food provision	Alternative location of market during period of inundation	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of use of market	Alternative markets at Supizae and mainland		AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes permanent loss of income	Alternative markets at Supizae and mainland		AC	AC	AC	Minor		MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of social interaction	Alternative markets at Supizae and mainland		AC	AC	AC	Insignificant		LOW	LOW	LOW
	Permanent tidal inundation or shoreline erosion causes loss of food provision	Alternative markets at Supizae and mainland		AC	AC	AC	Minor		MEDIUM	MEDIUM	MEDIUM
Retail shops (CBD)	Temporary inundation by tsunami or storms causes disruption to use of shops	Use of shops elsewhere on Taro Island	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes disruption to income source		AC	AC	AC	AC	Moderate	HIGH	HIGH	HIGH	HIGH
	Temporary inundation by tsunami or storms causes disruption to food provision	Use of shops elsewhere on Taro Island	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of use of shops			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes permanent loss of income			AC	AC	AC	Major		MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of food provision			AC	AC	AC	Moderate		HIGH	HIGH	HIGH

Value	There is a risk that……	Existing controls	Likelihood				Consequence	Risk level			
			Present	2030	2055	2090		Present	2030	2055	2090
Taro Island											
Bank and post office	Temporary inundation by tsunami or storms causes disruption to service		AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to equipment and infrastructure		AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of service			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of equipment and infrastructure			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
Primary school	Temporary inundation by tsunami or storms causes disruption to school service		R	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to school equipment and infrastructure		R	P	P	P	Moderate	LOW	LOW	MEDIUM	MEDIUM
	Permanent tidal inundation causes loss of school service					R	Moderate				LOW
	Permanent tidal inundation causes loss of school equipment and infrastructure					R	Moderate				LOW
Residences	Temporary inundation by tsunami or storms causes disruption to use of residences	Use of residences or other buildings in safe location (e.g. high school on mainland)	P	P	AC	AC	Moderate	MEDIUM	MEDIUM	HIGH	HIGH
	Permanent tidal inundation or erosion causes loss of residences				P	AC	Major			HIGH	EXTREME
Fisheries building and Rural Water Supply Office	Temporary inundation by tsunami or storms causes disruption to service		AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to equipment and infrastructure		AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation causes loss of service			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation causes loss of equipment and infrastructure			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
Light industrial/Fuel storage and supply	Temporary inundation by tsunami or storms causes disruption to service	Fuel sourced from different outlet	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes damage to equipment and infrastructure		AC	AC	AC	AC	Moderate	HIGH	HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of service			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of equipment and infrastructure			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
Wharf	Temporary inundation by tsunami or storms causes disruption to use	Use of wharf on mainland (Lot 9)	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes damage to infrastructure		AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of use			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of infrastructure			AC	AC	AC	Minor		MEDIUM	MEDIUM	MEDIUM

Risk Register

Value	There is a risk that……	Existing controls	Likelihood				Consequence	Risk level			
			Present	2030	2055	2090		Present	2030	2055	2090
Taro Island											
Western edge of island	Permanent tidal inundation or shoreline erosion causes loss of environmental service/buffer			AC	AC	AC	Moderate		HIGH	HIGH	HIGH
	Temporary inundation by tsunami or storms causes damage to gardens	Use of crops from gardens elswhere on island	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes disruption of use of toilet area		AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes disruption to recreation	Recreation occurs in multiple locations	AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes loss of boat storage area		AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to use of medical incinerator		AC	AC	AC	AC	Moderate	HIGH	HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of use of the area			AC	AC	AC	Minor		MEDIUM	MEDIUM	MEDIUM
Gardens beside airstrip	Temporary inundation by tsunami or storms causes damage to garden plants	Alternative gardens and purchase from market	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to income source	Alternative gardens	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to social interaction		P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to food provision	Alternative gardens and purchase from market	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to self-sufficiency	Alternative gardens	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Permanent tidal inundation causes loss of garden plants					P	Minor				LOW
	Permanent tidal inundation causes loss of income source					P	Moderate				MEDIUM
	Permanent tidal inundation causes loss of social interaction					P	Minor				LOW
	Permanent tidal inundation causes loss of food provision					P	Minor				LOW
	Permanent tidal inundation causes loss of self-sufficiency					P	Minor				LOW
Bar	Temporary inundation by tsunami or storms causes disruption to recreation		AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to infrastructure		AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of recreation			AC	AC	AC	Insignificant		LOW	LOW	LOW
	Permanent tidal inundation or shoreline erosion causes loss of infrastructure			AC	AC	AC	Minor		MEDIUM	MEDIUM	MEDIUM
Playing fields and sports buildings	Temporary inundation by tsunami or storms causes disruption to recreation		P	P	P	AC	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to infrastructure		P	P	P	AC	Minor	LOW	LOW	LOW	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of recreation					P	Minor				LOW
	Permanent tidal inundation or shoreline erosion causes loss of infrastructure					P	Moderate				MEDIUM

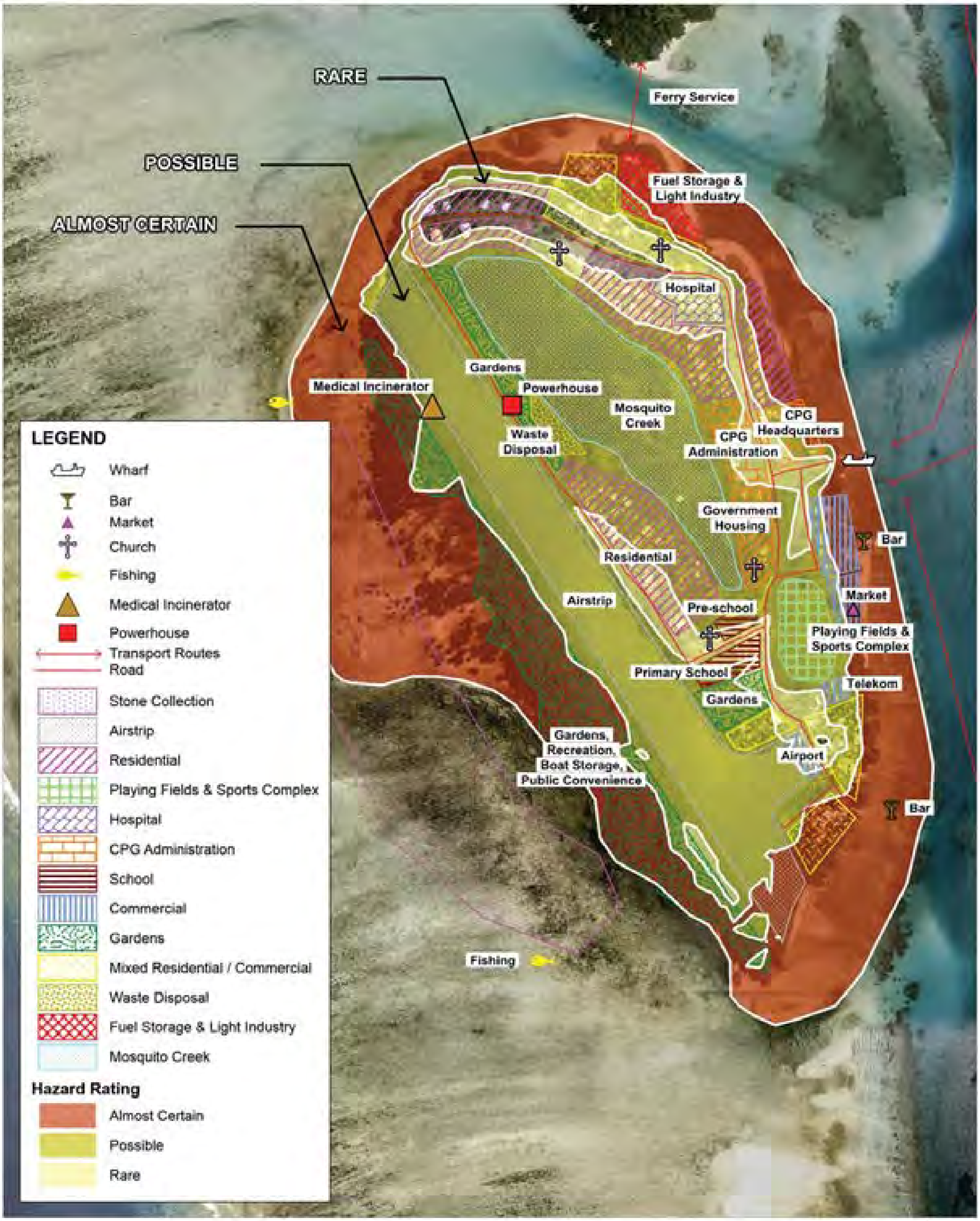
Risk Register

Value	There is a risk that……	Existing controls	Likelihood				Consequence	Risk level			
			Present	2030	2055	2090		Present	2030	2055	2090
Taro Island											
Picnic/swimming area	Temporary inundation by tsunami or storms causes disruption to recreation	Multiple recreation areas	AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
	Permanent tidal inundation or shoreline erosion causes loss of recreation area	Multiple recreation areas		AC	AC	AC	Insignificant		LOW	LOW	LOW
Guesthouses and rental business	Temporary inundation by tsunami or storms causes disruption to service	Several gueshouses available	P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes damage to assets		P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes loss of income		P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of service				P	AC	Moderate			MEDIUM	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of asset (near southern edge of island)				P	AC	Major			HIGH	EXTREME
	Permanent tidal inundation or shoreline erosion causes loss of income				P	AC	Major			HIGH	EXTREME
Mosquito creek	Temporary inundation by tsunami or storms interfering with waste causes public nuisance (incl. health)		P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Permanent tidal inundation interfering with waste causes public nuisance (incl. health)			P	P	AC	Moderate		MEDIUM	MEDIUM	HIGH
	Permanent tidal inundation causes loss of fauna/flora habitat			P	P	AC	Minor		LOW	LOW	MEDIUM
Water supply	Temporary inundation by tsunami or storms causes decrease of availability of freshwater	Use of alternative water sources: tanks, wells and from Sui River	P	P	AC	AC	Moderate	MEDIUM	MEDIUM	HIGH	HIGH
	Permanent tidal inundation and groundwater changes causes loss of freshwater	Use of alternative water sources: tanks and from Sui River			P	AC	Major			HIGH	EXTREME
Sewerage (septics)	Temporary inundation by tsunami or storms causes increased rate of flooding of septics	Construction of new septic system	P	P	AC	AC	Major	HIGH	HIGH	EXTREME	EXTREME
	Permanent tidal inundation and groundwater changes causes loss of use of septics				AC	AC	Major			EXTREME	EXTREME
Community hall	Temporary inundation by tsunami or storms causes disruption to use of hall		P	P	P	P	Insignificant	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to hall		P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to social interaction		P	P	P	P	Insignificant	LOW	LOW	LOW	LOW
	Permanent tidal inundation causes loss of hall				R	P	Moderate			LOW	MEDIUM
	Permanent tidal inundation causes loss of social interaction				R	P	Minor			LOW	LOW
Church	Temporary inundation by tsunami or storms causes disruption to use of church	Service can be held in alternative location	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes damage to church	Service can be held in alternative location	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Temporary inundation by tsunami or storms causes disruption to spiritual and social wellbeing of community	Service can be held in alternative location	P	P	P	P	Minor	LOW	LOW	LOW	LOW
	Permanent tidal inundation causes loss of church					P	Major				HIGH
	Permanent tidal inundation causes loss of spiritual and social wellbeing of community	Service can be held in alternative location				P	Minor				LOW

Risk Register

Value	There is a risk that……	Existing controls	Likelihood				Consequence	Risk level			
			Present	2030	2055	2090		Present	2030	2055	2090
Taro Island											
Road	Temporary inundation by tsunami or storms causes disruption to use of road		P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Temporary inundation by tsunami or storms causes damage to road		P	P	AC	AC	Minor	LOW	LOW	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of use of road				P	AC	Moderate			MEDIUM	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of road				P	AC	Major			HIGH	EXTREME
Mainland sites (Lot 9 and 277) and other locations											
Mangrove ecosystems	Temporary inundation by tsunami or storms causes damage to mangroves	Extensive area of mangroves	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes decrease in area of mangroves	Extensive area of mangroves		AC	AC	AC	Moderate		HIGH	HIGH	HIGH
Freshwater swamp ecosystems	Temporary inundation by tsunami or storms causes damage to freshwater swamp	Intermittently inundated by high tides	R	R	R	R	Minor	LOW	LOW	LOW	LOW
	Permanent tidal inundation causes decrease in area of freshwater swamp						Major				
Pig hunting grounds	Permanent tidal inundation causes decrease in area of pig hunting grounds	Alternative locations					Insignificant				
Timber / bush materials	Permanent tidal inundation causes loss of bush materials	Alternative sources available					Insignificant				
Gravel source	Permanent tidal inundation or shoreline erosion causes loss of gravel source	Alternative sources available	AC	AC	AC	AC	Insignificant	LOW	LOW	LOW	LOW
Gardens and crops	Temporary inundation by tsunami or storms causes damage to gardens and crops	Alternative gardens available					Minor				
	Permanent tidal inundation causes decrease in garden area						Moderate				
Farming land	Temporary inundation by tsunami or storms causes damage to farming land						Minor				
Cultural sites	Temporary inundation by tsunami or storms causes damage to cultural sites						Moderate				
	Permanent tidal inundation causes loss of cultural sites						Catastrophic				
	Permanent tidal inundation causes loss of access to cultural sites						Catastrophic				
Fuel Depot (on midway island???)	Temporary inundation by tsunami or storms causes damage to fuel depot		AC	AC	AC	AC	Moderate	HIGH	HIGH	HIGH	HIGH
	Temporary inundation by tsunami or storms causes loss of income		AC	AC	AC	AC	Moderate	HIGH	HIGH	HIGH	HIGH
	Temporary inundation by tsunami or storms causes disruption to fuel supply	Alternative fuel supply locations	AC	AC	AC	AC	Minor	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of fuel depot			P	P	P	Major		HIGH	HIGH	HIGH
	Permanent tidal inundation or shoreline erosion causes loss of fuel supply			P	P	P	Moderate		MEDIUM	MEDIUM	MEDIUM
	Permanent tidal inundation or shoreline erosion causes loss of income			P	P	P	Major		HIGH	HIGH	HIGH
High School	Temporary inundation by tsunami or storms causes damage to infrastructure					R	Minor				LOW
	Temporary inundation by tsunami or storms causes disruption to education service					R	Minor				LOW

Appendix C Hazard Likelihood and Values Mapping



Title:
2014 Taro Island Temporary Hazard Likelihoods and Key Assets/Values

Figure: C.1

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N

0 100 200m
Approx. Scale

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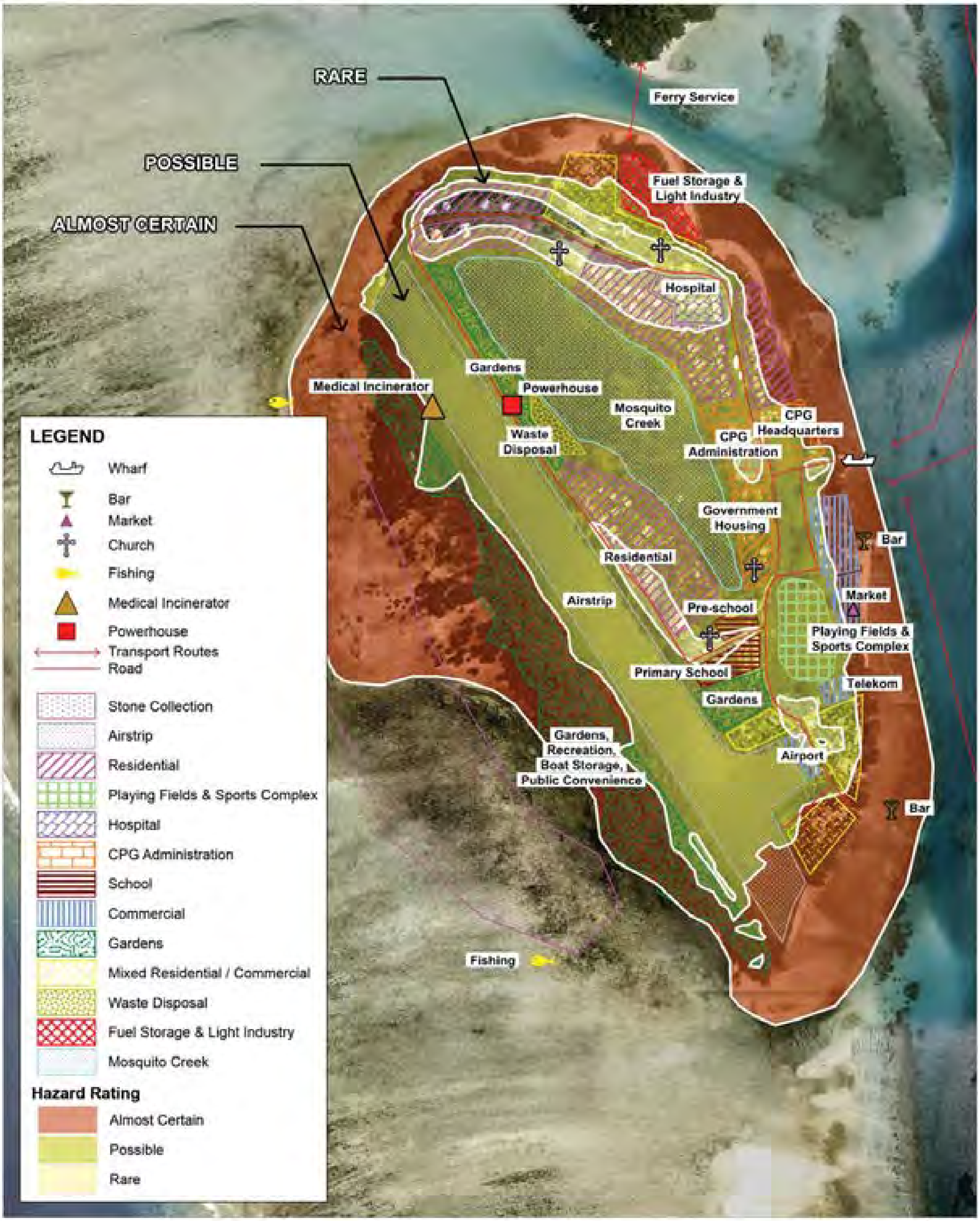

Title:

2030 Taro Island Temporary Hazard Likelihoods and Key Assets/Values

Figure: C.2

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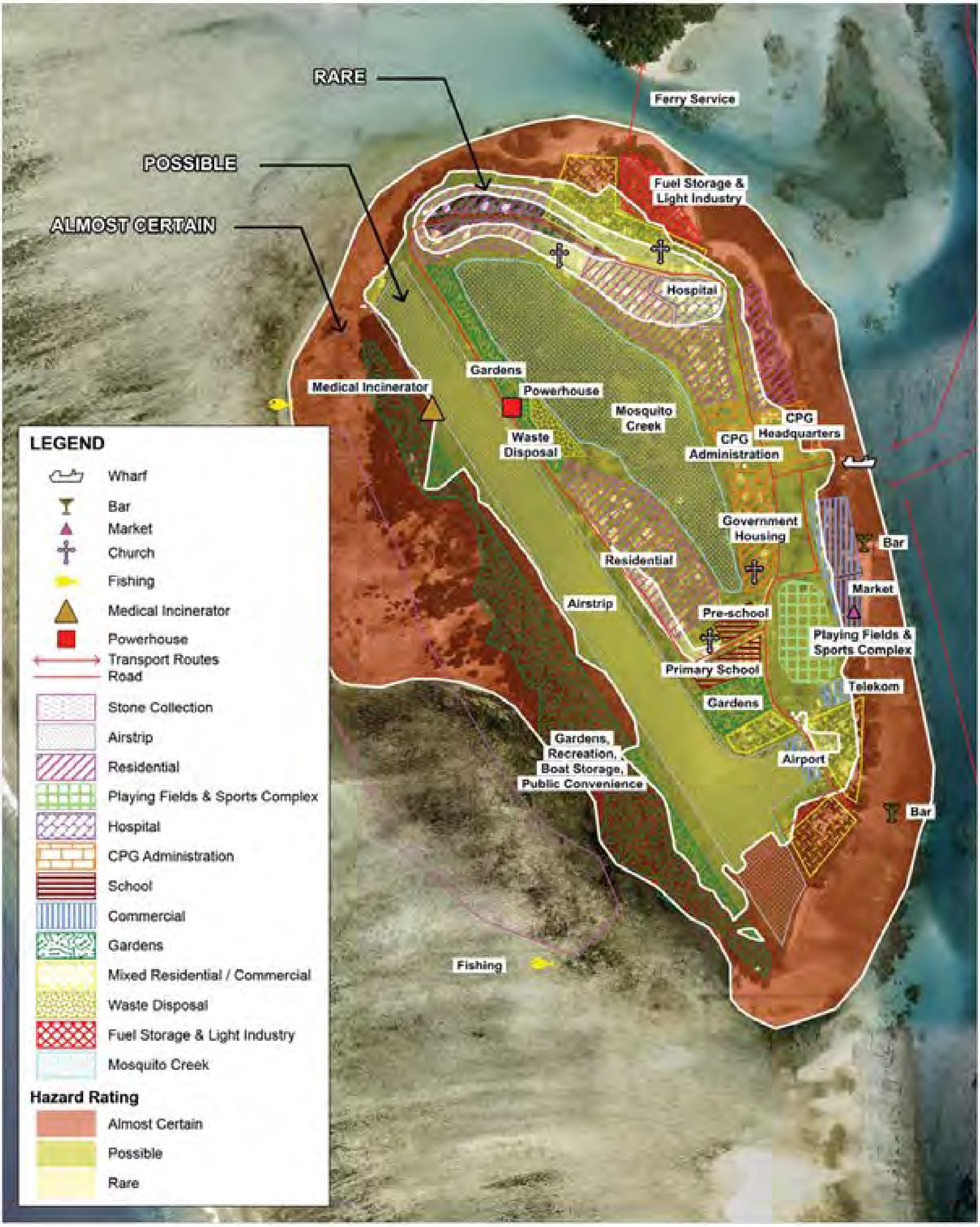

Title:

2055 Taro Island Temporary Hazard Likelihoods and Key Assets/Values

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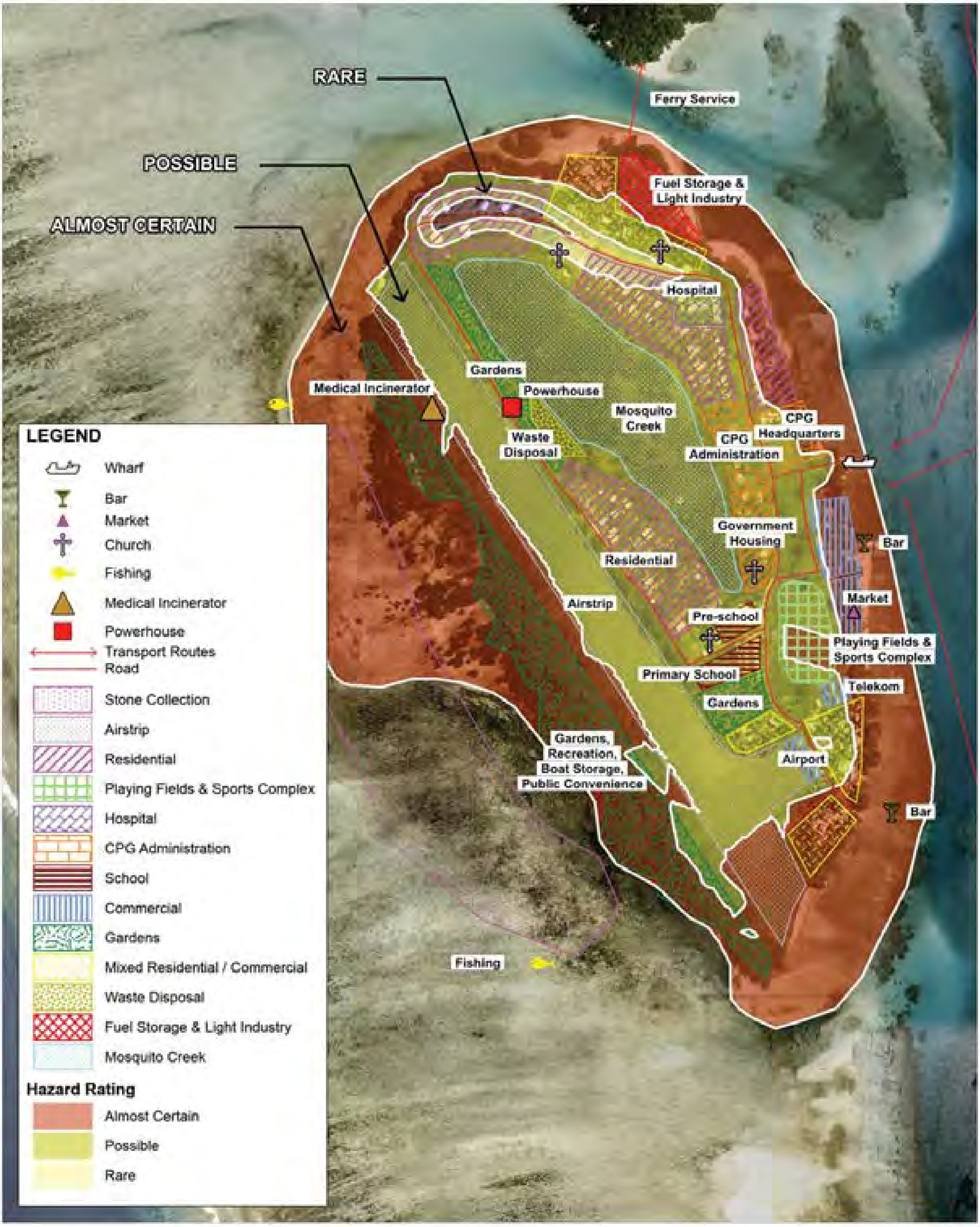

Title:
2090 Taro Island Temporary Hazard Likelihoods and Key Assets/Values

Figure: C.4

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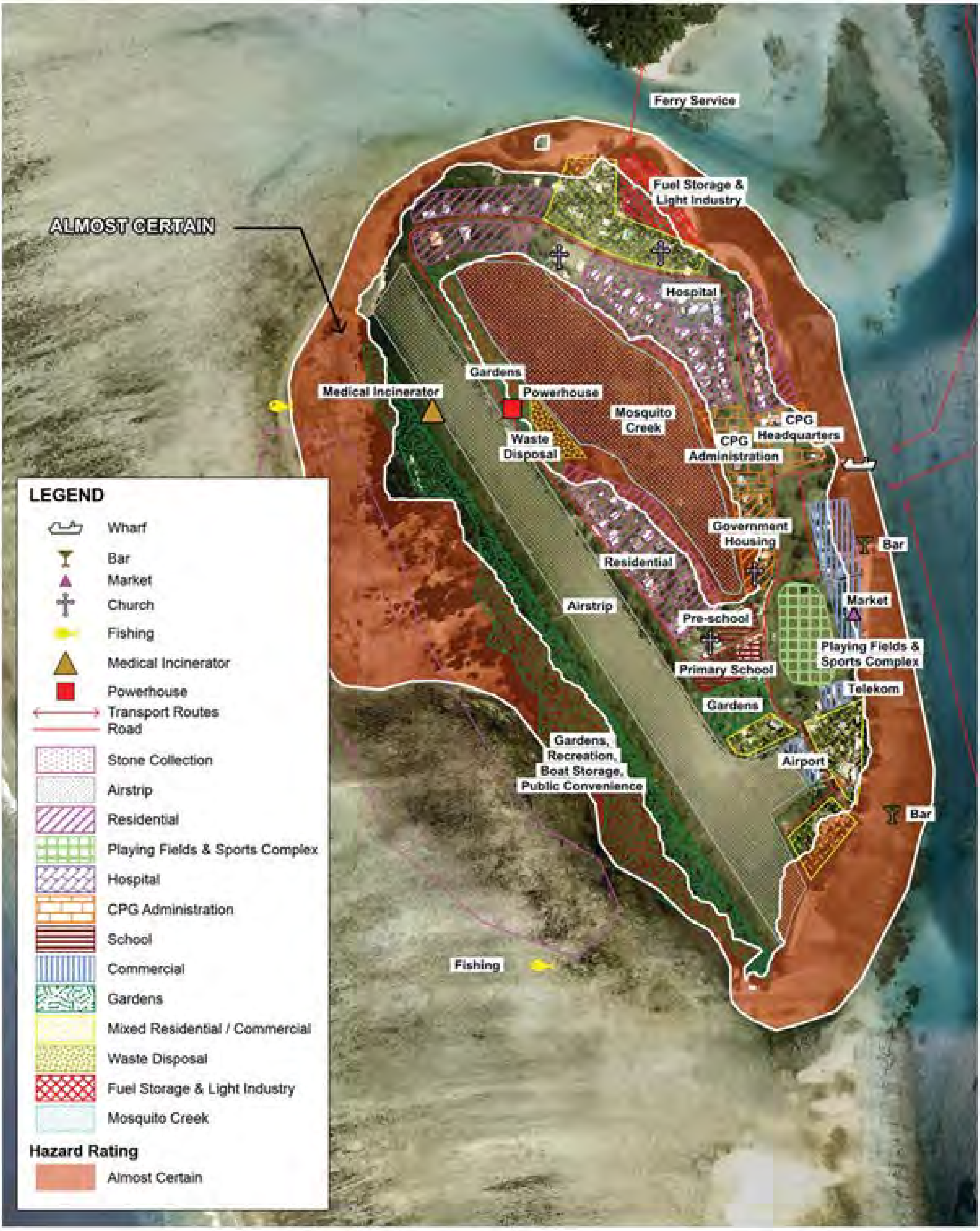

Title:

2014 Taro Island Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.5

Rev: A

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Approx. Scale

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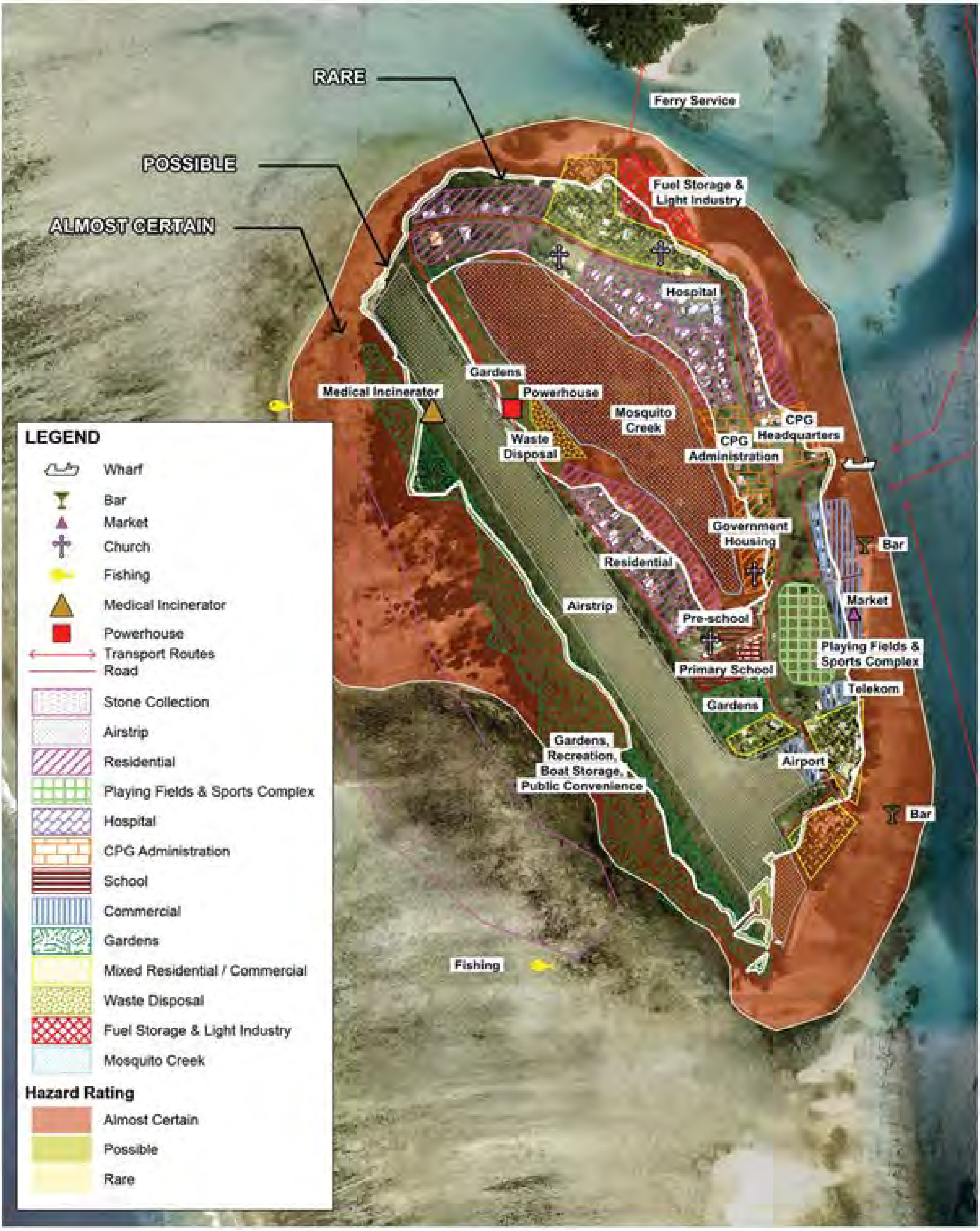

Title:

2030 Taro Island Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.6

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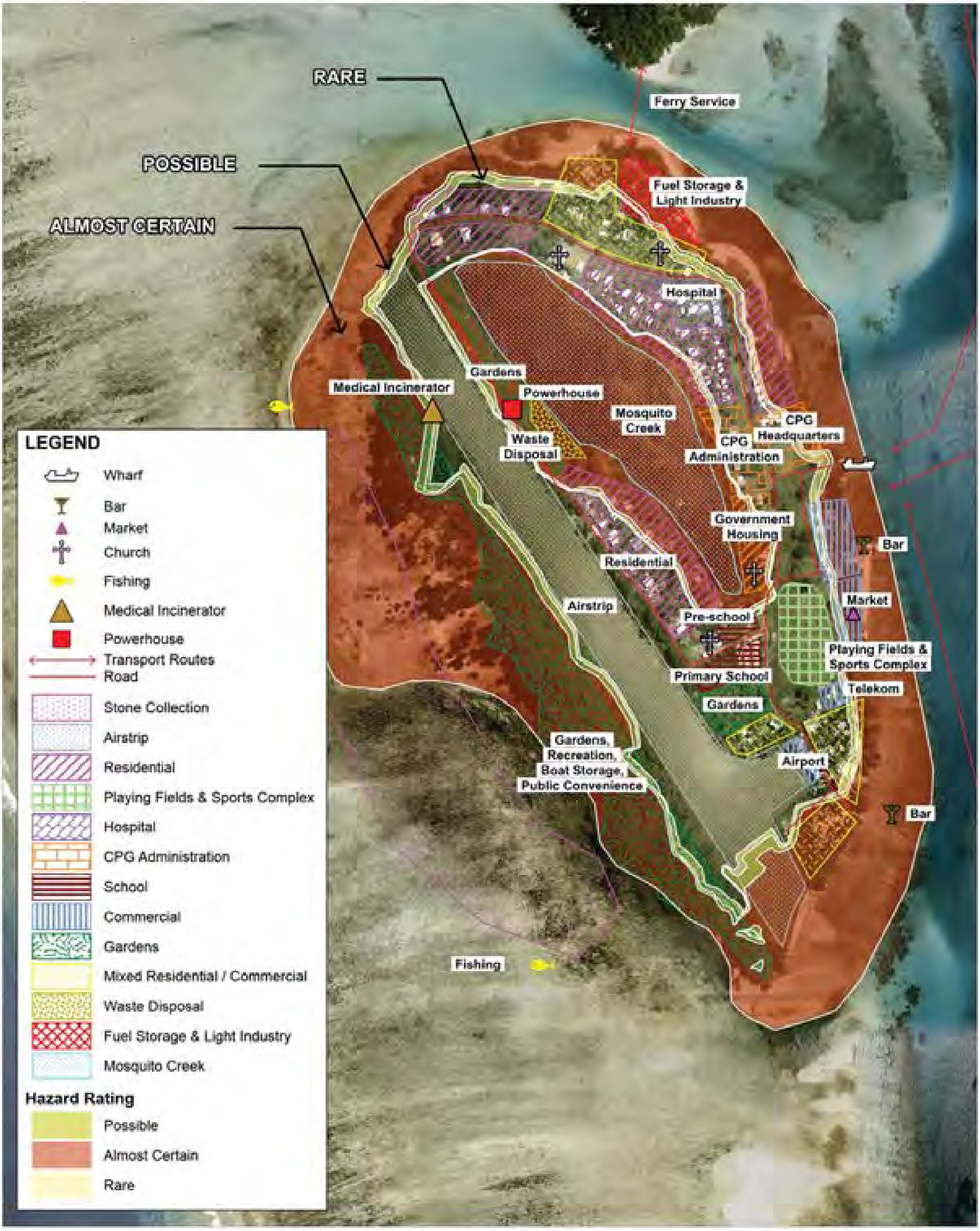

Title:
2055 Taro Island Permanent Hazard Likelihoods and Key Assets/Values

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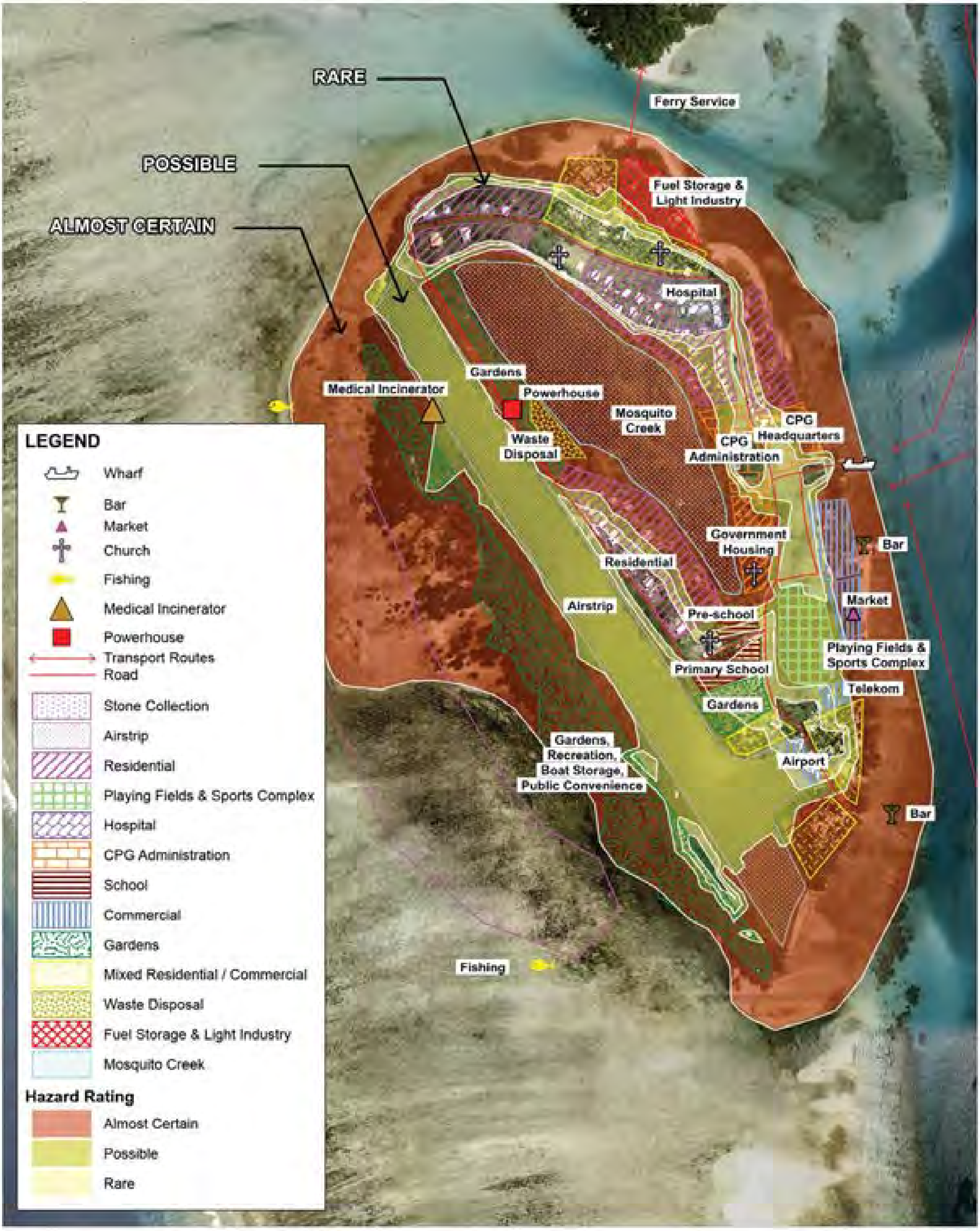

Title:
2090 Taro Island Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.8

Rev: A

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Approx. Scale

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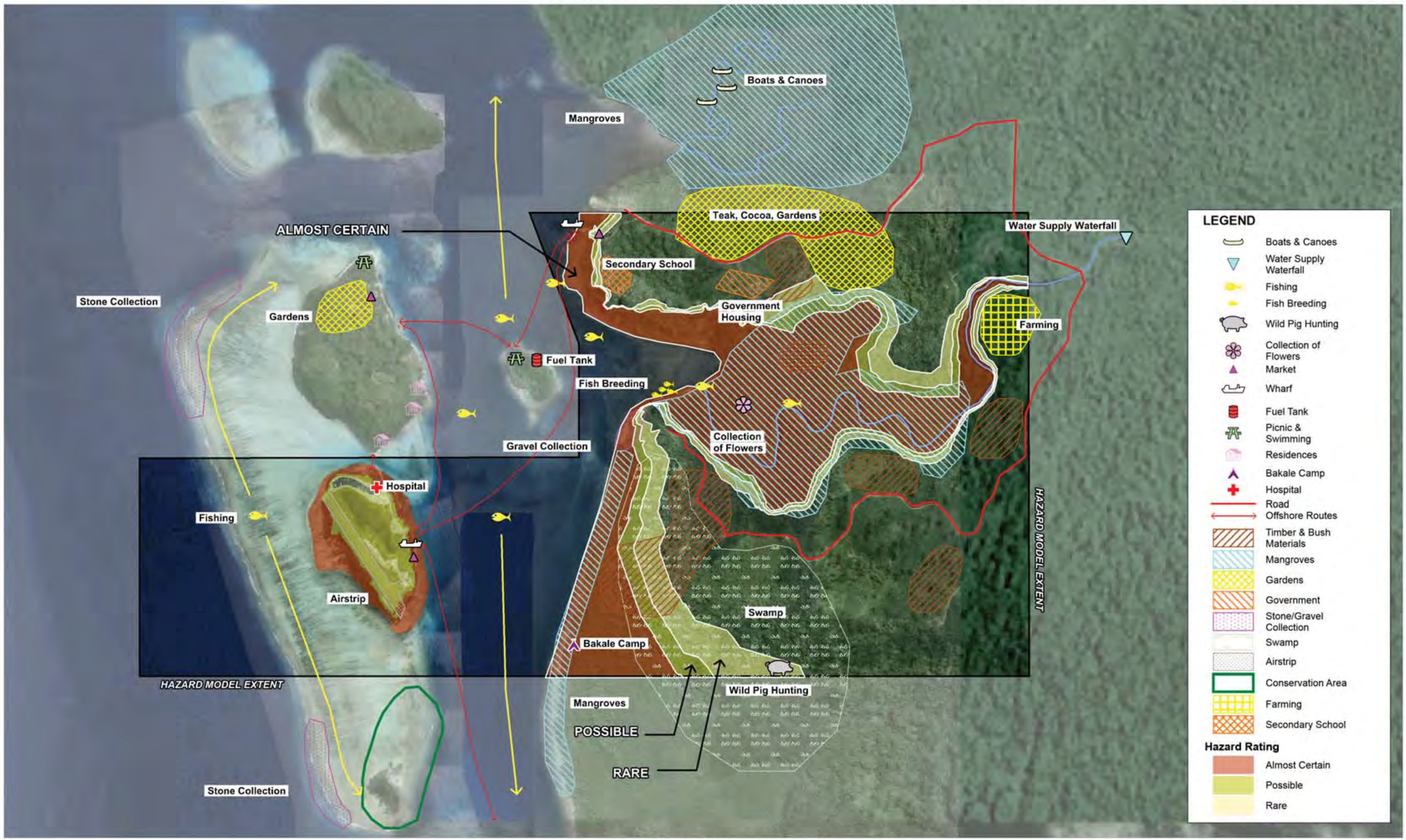

Title:
2014 Mainland Temporary Hazard Likelihoods and Key Assets/Values

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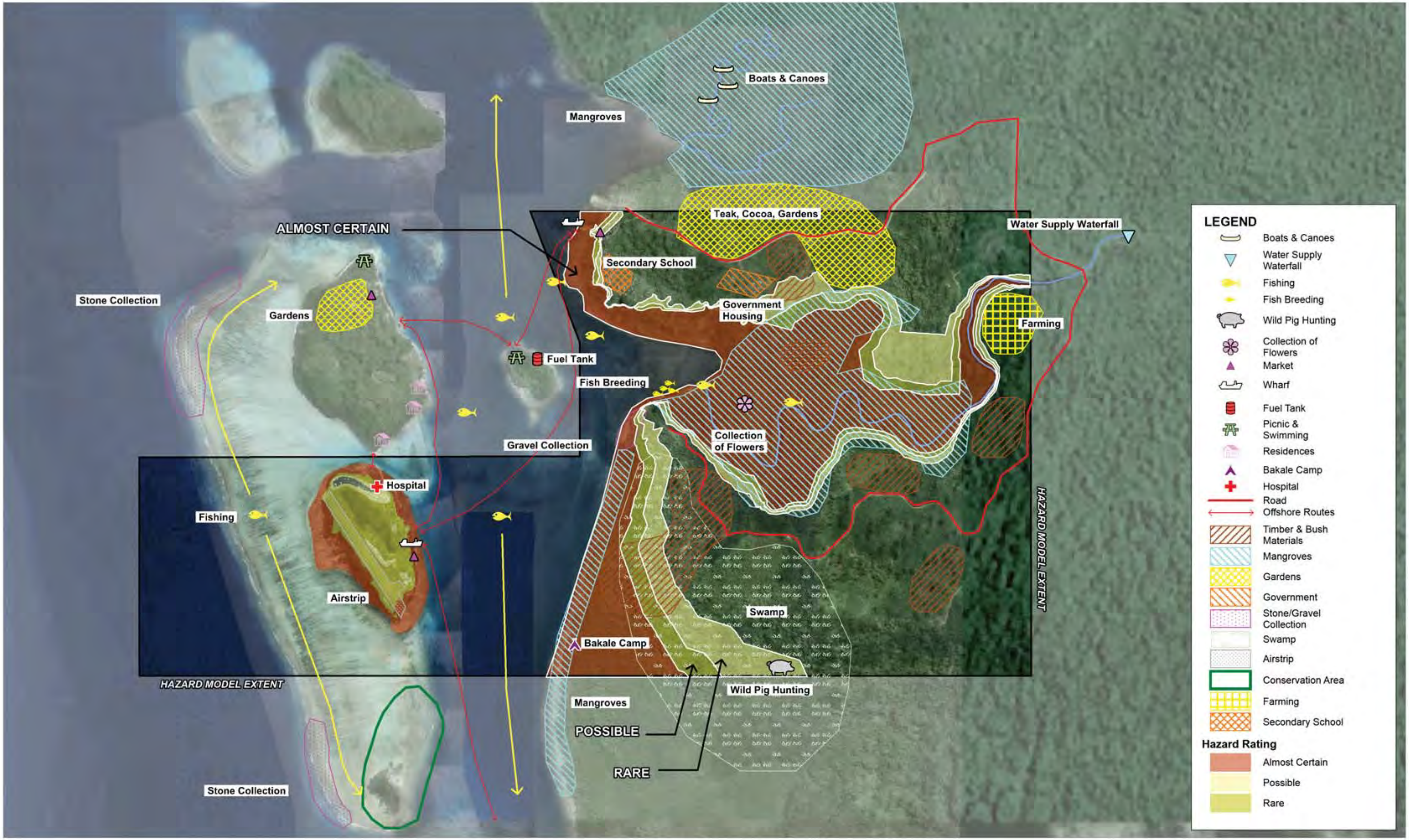

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2030 Mainland Temporary Hazard Likelihoods and Key Assets/Values

Figure: **C.10**

Rev: **A**

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Approx. Scale

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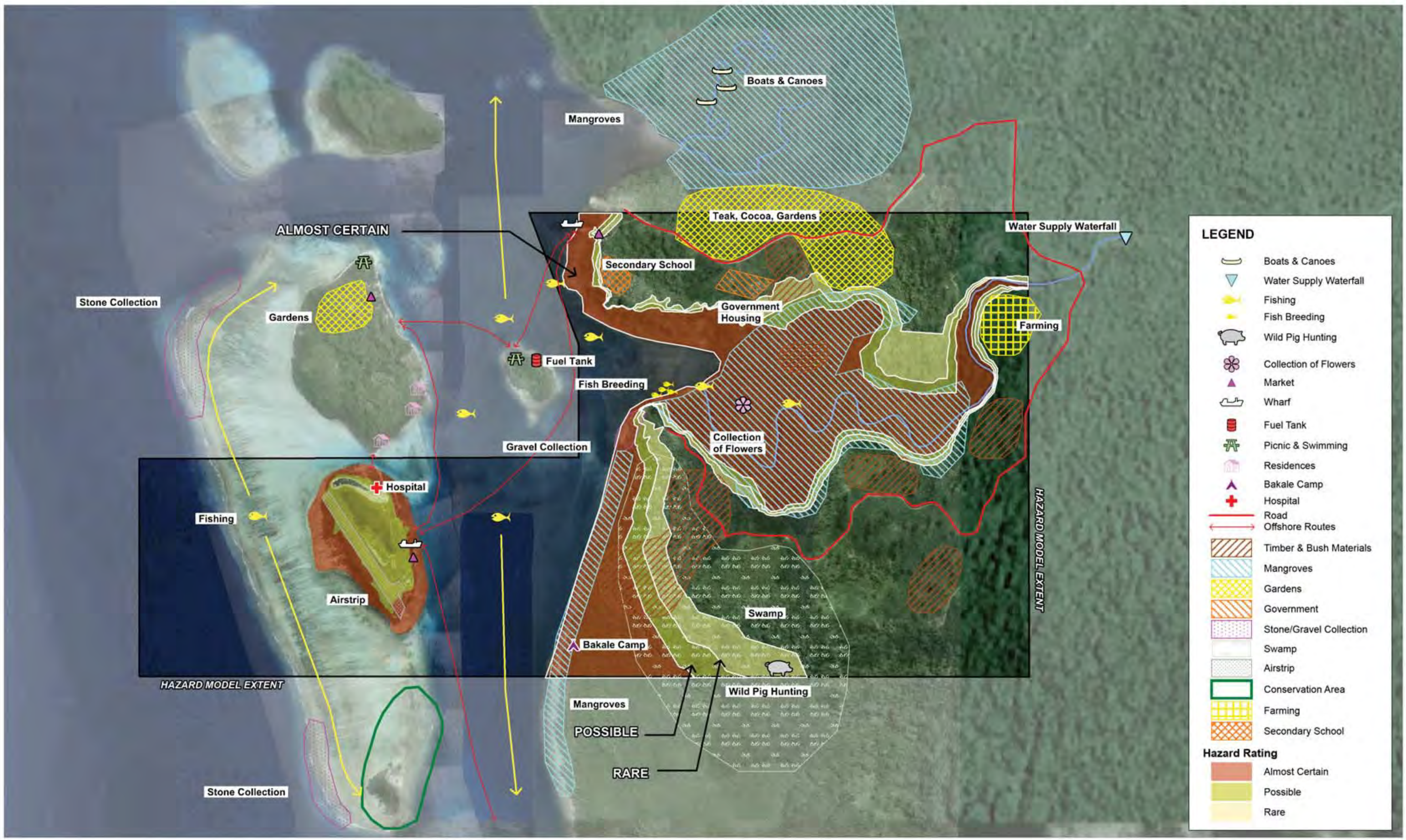

Title:
2055 Mainland Temporary Hazard Likelihoods and Key Assets/Values

Figure: **C.11**

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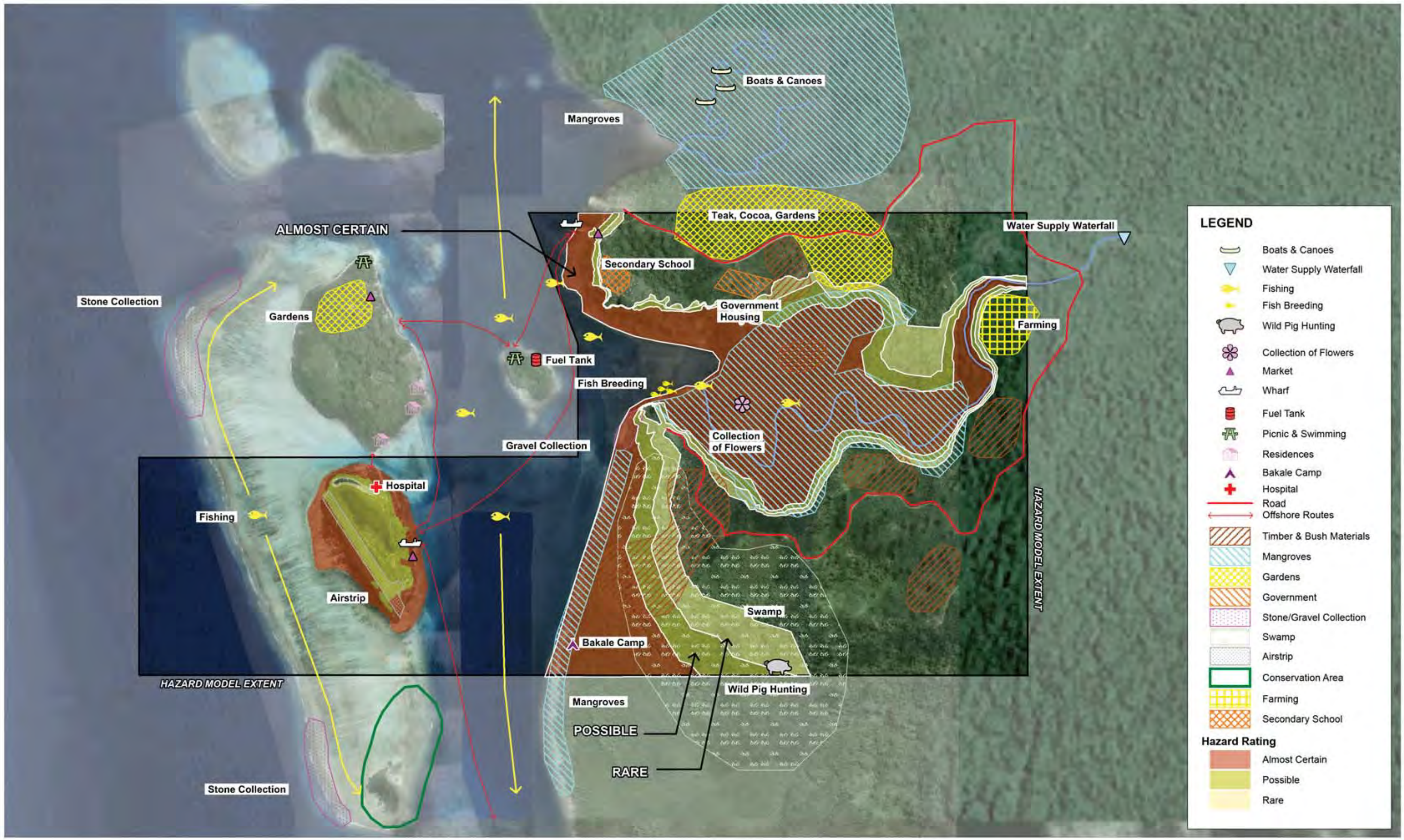

Title: 2090 Mainland Temporary Hazard Likelihoods and Key Assets/Values	Figure: C.12	Rev: A

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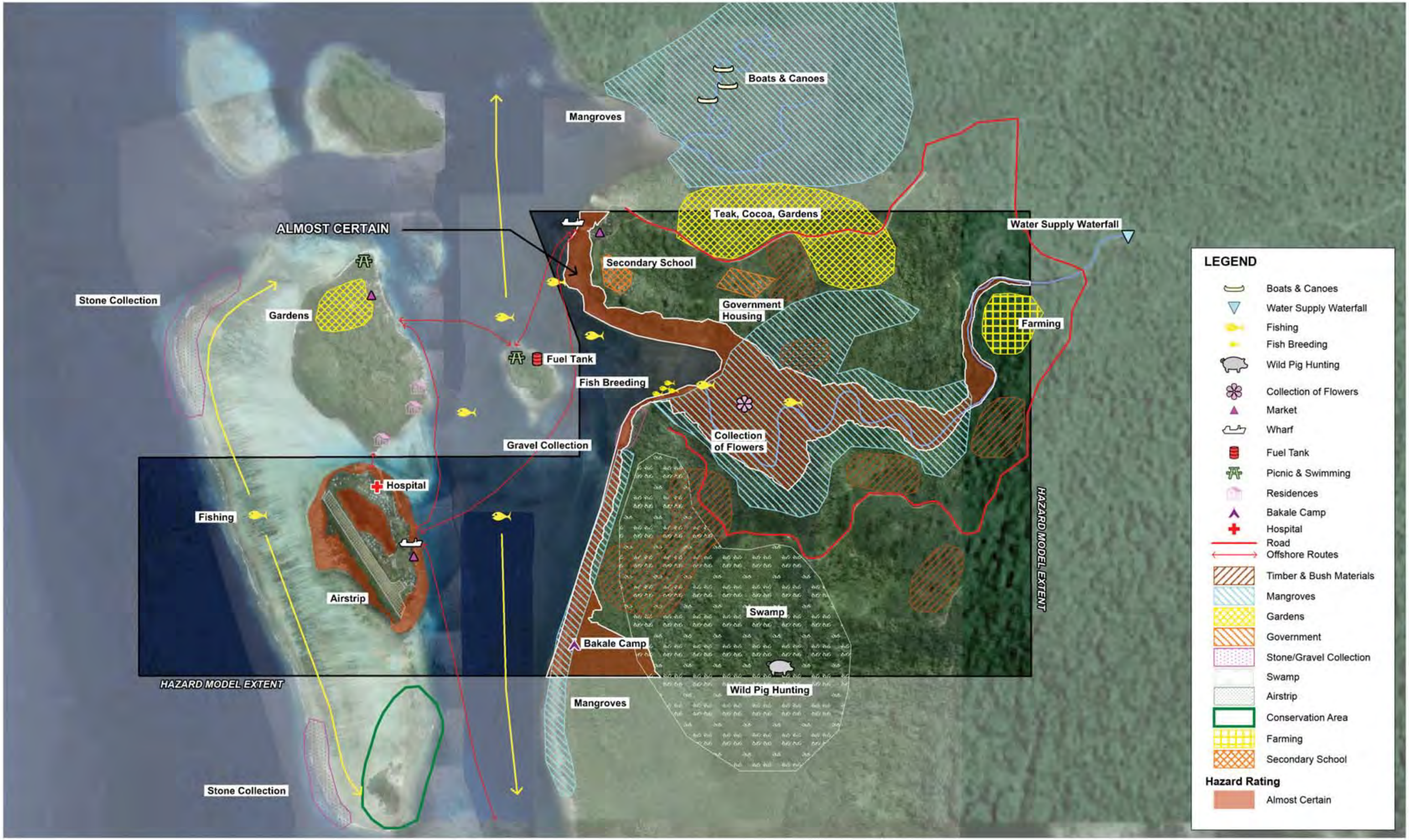

Title:

2014 Mainland Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.13

Rev: A

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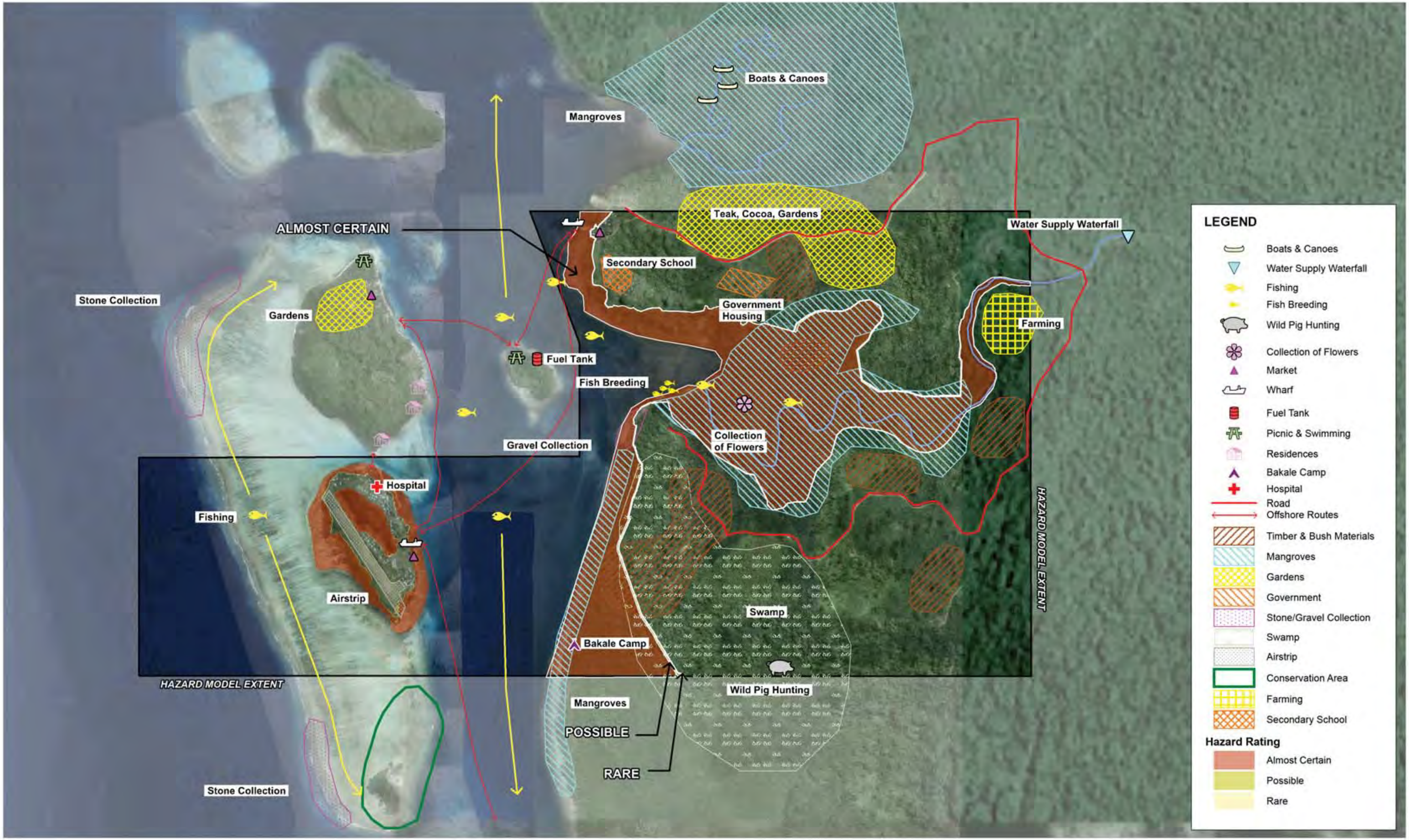

Title:
2030 Mainland Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.14

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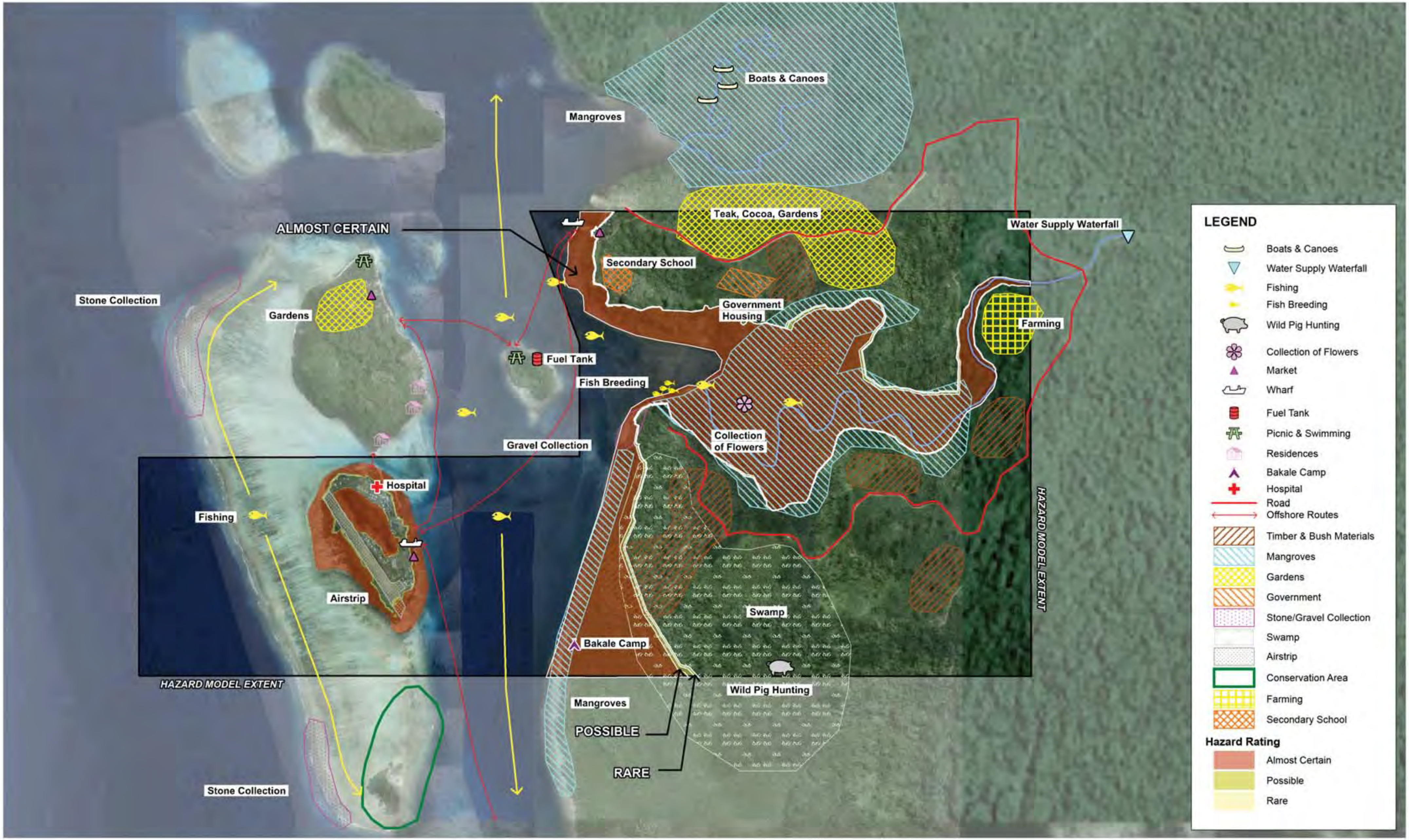

Title:

2055 Mainland Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.15

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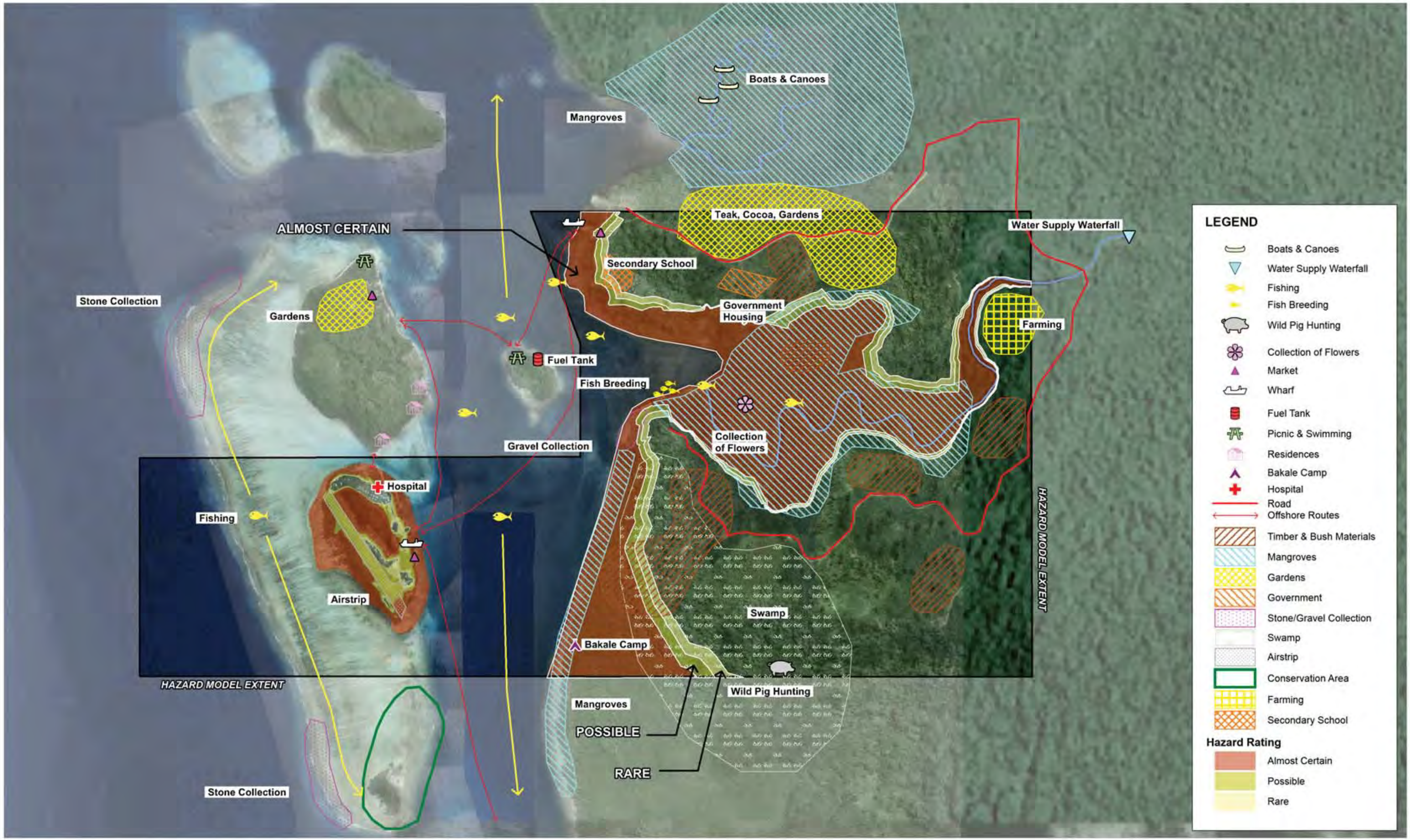

Title:
2090 Mainland Permanent Hazard Likelihoods and Key Assets/Values

Figure: C.16

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N

0 0.5 1km
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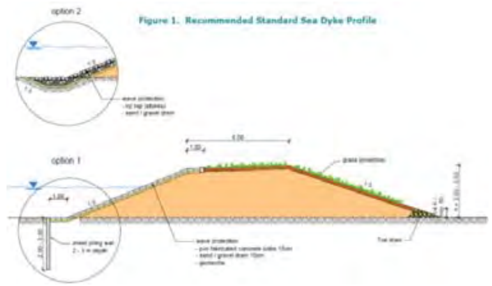
Appendix D Adaptation Options Toolkit

Table D-1 'Protect' adaptation options for existing development

Protect (existing development in a hazard area)						
Seawall	A hardened wall along the shoreline	Short - Medium Term	MEDIUM - HIGH COST Loss of sandy beach in front of the wall – there is no beach – loss of amenity Expensive capital outlay plus needs ongoing maintenance and re-designed, particularly to accommodate to sea level rise. Is problematic if built in sections (i.e. for individual properties) because beach continues to erode at ends of seawall.	Hold shoreline in current position (i.e. the land behind the beach is protected at the sacrifice of the beach)	Rock suitable for seawall would need to be quarried locally. Mining of coral rock is not appropriate. A more feasible alternative is to use sandbags, which have the advantage of being manually handlable and filled with a local source of sand.	 Kiribati http://www.climate.gov.ki/wp-content/uploads/2013/05/Shoreline-Protection-Guidelines-1-of-2-main-guidelines.pdf http://www.hornsby.nsw.gov.au/__data/assets/pdf_file/0017/41291/Environmentally-Friendly-Seawalls.pdf
Beach and mangrove stabilisation	Planting / ensuring vegetation is consistent along shoreline to provide buffer from wave and surge attack	Short term option only – will be limited in stopping shoreline receding due to sea level rise	LOW COST May be cost effective in short term, but doesn't provide an engineering solution to a receding coastline over the long term. Can form part of other long term solutions (e.g. sand nourishment).	In short term, provides a buffer from storms and helps dissipate tsunami surge.	Would be feasible in some locations on Taro Island, with locally appropriate species.	 Kiribati http://www.wetlands.org/Portals/0/Indonesia%20docs/Best%20practice%20Guidelines%20on%20Restoration%20of%20Mangroves%20in%20Tsunami%20Affected%20Areas.pdf

Protect (existing development in a hazard area)						
Groynes	A revetment built perpendicular to shore to capture sand that is transported alongshore	Long Term	HIGH COST The interruption of longshore transport may cause erosion to updrift beaches Unlikely to be effective for long term sea level rise (groynes don't increase sediment budget for beach)	Retains a sandy beach in current position, which is subject to longshore drift In some scenarios, can provide recreational amenity (fishing) with access to waters edge	As for seawalls, the most appropriate construction material would be sandbags, rather than quarried rock or coral boulders. Longshore drift is not significant on Taro Island or the mainland, so value of groynes would be limited.	 Australia (source: SGS) See also http://www.leovanrijn-sediment.com/papers/Coastalstructures2013.pdf
Levee Banks / Surge Barrier	Embankment to prevent intrusion of saltwater/storm tide (e.g. coastal inundation) around critical facilities or infrastructure	Medium Term	HIGH COST Capital costs and then maintenance costs. Would need to be designed to accommodate rising seas, depending on expected life of facility or infrastructure being protected. Once a levee is overtopped, the water can be trapped behind levee (cannot drain back into the sea).	Prevent flooding of facilities and infrastructure in some areas	May help to limit the inundation of Taro Island. Could be integrated with infrastructure upgrade (e.g. roadways, airstrip) The effectiveness of the barrier would depend on its crest elevation – the higher the crest the more effective it will be at impeding inundation. However, the higher the elevation the more impractical it is and the higher cost (as base width also needs to increase).	 Source: GIZ (Vietnam) http://kiengiangbiosphereserve.com.vn/project/uploads/contents/thang_6/factsheet_/8.SEA_DYKE_DESIGN.pdf
Beach nourishment	Putting sand on the beach from land-based or marine sources	Short Term – Medium Term depending on rates of erosion and sea level rise and availability of sand	HIGH COST Very expensive option that requires on-going top-up (ie every 5-10 yrs and up to once a year by 2090)	Retains a sandy beach in current position Largely retains beach amenity	There is unlikely to be many local areas where sand can be dredged. Also, the cost of transporting a dredger to Choiseul would be prohibitive. Therefore, sand nourishment is not a feasible option.	 United Kingdom http://www.goldcoast.qld.gov.au/documents/bf/fs-gc-beach-nourishment.pdf

BMT WBM

Protect (existing development in a hazard area)						
Offshore breakwater	Building a hardened structure just offshore to dampen waves and surge attacking the shoreline	Medium Term	HIGH COST Very expensive to build and maintain. As there is already a natural reef serving this purpose, emphasis should be placed on protecting the existing reef from quarrying, pilfering etc	An artificial reef may provide some protection against tsunami surges and large storm waves, but would have limited benefit for protection against a receding shoreline unless it is combined with extensive sand nourishment.	Additional offshore structures would not be suitable for Choiseul Bay. Protection of the existing reef is essential, including preventing removal of coral rock and boulders, which naturally helps to dissipate wave energy before impacting on Taro Island.	 James Point, WA

Table D-2 'Accommodate' adaptation options for existing development

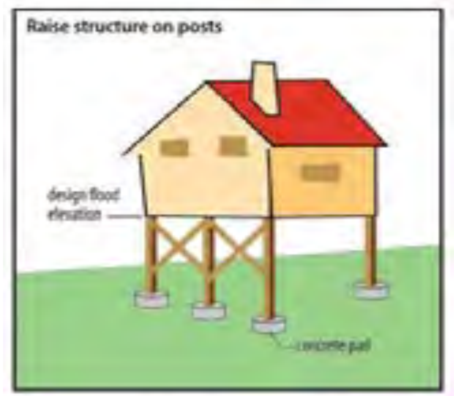
Accommodate (existing development in a hazard area)						
Redesign/retrofit building or infrastructure (including for example the airstrip, local drainage, water supply, sanitation, buildings)	Make modifications to a building or infrastructure to withstand shoreline recession or coastal inundation	On-going strategy as buildings or structures need to be maintained, repaired or replaced.	MEDIUM COST Over long term, modifications may not be able to stop recession impacts. Design modification may not be able fully reduce risk and may be very expensive (retreat or accept damage a better/cheaper option)	Allows extended life for existing asset. The specific details will be different for each asset being considered. Adaptation works would be best done when assets are undergoing maintenance works, to minimise costs and disruption	It is considered that this would be feasible for a number of key assets that are currently at risk on Taro Island. Of highest risk is community assets that are needed for post-event recovery. Could be part of a proactive strategy of upgrades for areas of high/extreme risk as a schedule of upgrades	 http://www.fema.gov/media-library-data/20130726-1514-20490-7165/p_348.pdf
Emergency management	Monitoring and warning systems including evacuation strategies. This is only feasible if there is sufficient warning time to respond. Would also include local shelters if not time to evacuate	Short to medium term until hazards become more extreme and regular	MEDIUM COST Initial capital outlay for new systems and processes Requires continuing investment in coordination and education that must be trialled and updated. Will still need to be done in conjunction with other strategies	If effective, can reduce or eliminate risk of loss of life. Pre-warning and education can help to minimise loss of property.	Emergency management would be effective for Taro Island given its small location. Warnings could be spread quickly. Providing there is a central location to go to, this would be a feasible solution for smaller to mid sized tsunami and storm wave situations. Education of the community regarding what to do in the event of a tsunami or storm would be critical to the success of this option	 http://ptwc.weather.gov/ http://www.bom.gov.au/tsunami/about/atws.shtml
Insurance	Taking out coverage of buildings and structures in current and future hazard areas. .	Short term or as long as insurance companies are willing to insure	LOW COST (ANNUAL PREMIUMS) Premiums will increase over time with increasing numbers of claims Risk that insurance company will not payout due to definition of event. Government to become insurer of last resort?	If able to be insured, assets can be re-built as a result of claims or insurance moneys can pay for the relocation landward or redesign	This would be largely impractical for the existing development (maybe with the exception of larger government buildings), and as such, insurance would be an unfeasible option.	http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTFINANCIALSECTOR/EXTDISASTER/0,,contentMDK:23093927~menuPK:8707838~pagePK:64168445~piPK:64168309~theSitePK:8308421,00.html

Table D-3 'Retreat' adaptation options for existing development

Planned Retreat (existing development in a hazard area)						
Relocate item of infrastructure or development	Relocating roads, buildings etc landward beyond the hazard zone	Can be progressive over time (if the building or structure is easily re-locatable) Otherwise best as a long term option	HIGH COST A suitable alternative location must exist for the asset to move to. If not done at the end of an asset life, there may be lost asset value in premature replacement.	The shoreline is able to recede naturally. The relocation can mean a brand new building / road / facility as a replacement for an old one The new facility would be less susceptible to damage and can help with emergency management.	It is expected that few, if any, existing assets would practically be able to be moved/relocated. The more feasible solution would be to ensure that any replacement structure at the end of the design life is located away from the existing hazards.	 http://www.gfdrr.org/sites/gfdrr.org/files/Chapter_5_To_Relocate_or_Not_to_Relocate.pdf
Abandon (sacrifice) item of infrastructure or development	Allow the land or building to be lost to the sea	Long term strategy	LOW COST The community may lose public facilities or land Question over loss of land value.	The shoreline can recede naturally, although shorelines may be lined with abandoned and derelict structure in the future. Particularly suitable for park land and low cost facilities (e.g. access ways, walkways)	There may be some infrastructure that can be abandoned as sea level rises in the future. It is expected that most building materials could be reused/recycled as other structures are built elsewhere. Removal of existing coastal defence works may result in increased exposure to erosion of some parts of the shoreline.	 North Carolina, USA
Land swap / exchange	Properties at highest risk are swapped for alternative sites at lower risk	Long term strategy	LOW COST (IF ALTERNATIVE LAND IS AVAILABLE) Suitable land must be available to swap (i.e. it must have an appropriate land tenure). Some land owners may be unwilling to accept land swap	Property owners are provided with an adequately alternative. The risks to the public are reduced. Land swap can involve relocating assets to a new site or abandoning assets at the former site and rebuilding new assets at the new site.	Land is available on Lot 9 and Lot 277 for relocation of existing occupancy from Taro Island and Supizae Island. Land swap would be a practical and effective means of transferring the existing population that is located in high risk area to an equivalent low risk area.	http://www.lockyervalley.qld.gov.au/images/PDF/grantham_factsheet_final.pdf http://www.floodcommission.qld.gov.au/__data/assets/pdf_file/0015/11715/QFCI-Final-Report-Chapter-11-Buy-backs-and-land-swaps.pdf
Development approval based on distance to shoreline or frequency of inundation	New developments/ redevelopments are legal until a trigger is reached, at which time the development needs to be removed. This 'trigger-limited consent' is a variation on the more common time-limited development consent.	Medium term strategy until hazard become immediate and frequent	LOW COST May be difficult to implement for redevelopments where owners have an expectation to have the same rights for a new building as they had with the old building	Property owners are aware of lifespan of development – no need for compensation = low cost to public.	It would be difficult to implement approval for new development on the understanding that the development would not be allowed to be protected in the future. This option is not feasible for Choiseul Bay.	

Table D-4 'Avoid' adaptation options for future development

Avoid (future development in a hazard area)						
Rezoning of land to more appropriate zone	Change land use through amendment of the planning instrument to not allow future vulnerable development in hazard areas or at least restrict development to be compassionate to the risk profile	Long term solution	LOW COST Potential impediment to economic growth and to accommodating population growth Existing land values may reduce Existing owners would have an investment-backed expectation to be able to develop land	Maintains current risk profile (by not allowing new vulnerable development within hazard areas)	It is possible to restrict future developments within hazard zones by preventing intensification of development. Alternative locations should be identified where such developments can be permitted – needs to be part of a larger masterplan for development.	www.gns.cri.nz/content/download/.../MS67_**Riskbased_planning**_report.pdf
Setbacks/building lines	New buildings are to be built a required distance back from the relevant hazard line or erosion scarp Only temporary or re-locatable structures are permitted to be located in hazard areas seaward of a formal setback or building line	Long term solution	LOW COST Reduced area within property boundary for development potential	Minimal cost to public Prolonged life of development	Would be feasible for the mainland, however, on Taro Island there is high risk across the entire island that would largely prohibit most future development. Would need to be integrated as part of a future masterplan	http://www.griffith.edu.au/__data/assets/pdf_file/0019/313363/Planning_Principles_Milestone4.pdf http://www.sydneycoastalcouncils.com.au/sites/default/files/coastalcouncilsplanningforclimatechange.pdf
Protecting/Filling the land	Associated with new development, establishing protection structures (seawalls, levees) or otherwise filling the land to elevations that prevent inundation providing this does not compromise natural buffers that act to minimise impacts of ocean surge and waves.	Long term solution	HIGH COST Large costs on the owner to import fill to construction protection works Potential drainage, erosion and landscape issues with neighbouring lands Protection measures can fail and require maintenance over time	Works can avoid/limit the risk of current and future hazard Works would need to be designed for the full lifespan of the proposed development.	There is limited opportunity for filling of low-lying land, especially on Taro Island. Whilst protection measures could be put in place, the suitability of the development should first be questioned and whether there is a better alternative location for the development.	 Port Coogee, WA

Table D-5 'Accommodate' adaptation options for future development

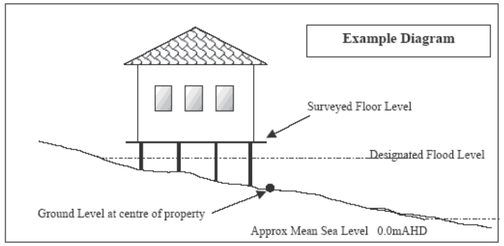
Accommodate (future development in a hazard area)						
Consider life span (design life) of all new development in setting location in the hazard zone	The effective lifespan of the proposed building or structure (e.g. 30 years, 50 years, 70 years) is considered, with a view to abandonment or dismantling at the end of the design life. In this context, construction could be by a relocatable, temporary or sacrificial structure. Structures could be built to be easily decommissioned, de-assembled or re-locatable	Medium term strategy unless in immediate hazard zone	MARGINAL COST Shorter lifespan of the building or structure – owners/community may not be willing to part with it once hazards become immediate	Cost of building/structure may be reduced if shorter design life elements are incorporated If effective, this strategy can help avoid the risk during the functional life of the building	Life span for development in Choiseul Bay is likely to be influenced by available materials, skilled workers and space. There is existing risk that overshadows future increases in risk. It would be impractical to have shorter design life based on risk management. Shorter design life should be considered in context of masterplan for relocation of services and facilities to the mainland	
Design with appropriate floor level height	Design of floor heights consider future flood levels and allows for current and future hazard from inundation to be minimised	Medium term strategy until hazard becomes immediate and frequent	MARGINAL COST Increases cost of building Higher building may interrupt landscapes and not be in character with other buildings	No cost to broader public. Cost is borne by the landowner. Damages would be reduced when building impacted.	There should be a minimum floor level set above the ground level, with allowance for water to flow under the building in the event of significant storm surge or tsunami impact. This should be relatively easy to implement.	 Source (GCCC)

Table D-6 'Accept' adaptation options for future development

Accept (future development in a hazard area)						
Do nothing	No attempt to avoid or accommodate coastal hazards for new development	Short term	NO ADDITIONAL COSTS Risks to future populations. Future generations bear cost of impacts as risks worsen with time.	No imposition on new development. Permit future development to proceed without any constraints.	This could be feasible for Choiseul Bay providing that the people undertaking the development have full knowledge that the development faces risks and that it could be damaged or destroyed as a result. This would require caveats etc on development consents that outline who accepts liability in the event that damage occurs.	

Appendix E Community and Stakeholder Engagement Records

Appendix F Community Booklets

THANK YOU FOR HAVING YOUR SAY ON THE CHOISEUL TOWNSHIP CLIMATE CHANGE PROJECT !

Community Booklet – March 2014

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THANK YOU FROM THE PROJECT TEAM

In January 2014, project team members (Lyn, Simon and Kylie) from the 'Choiseul Township Climate Change Project' visited Taro Island and surrounding communities to get your input into this important project.

The team enjoyed their time in the Solomon Islands and would like to thank everyone, particularly the Choiseul Provincial Government, for making the trip a great success!

This booklet provides a summary of the engagement program, the information that was collected and the next steps for the project.

Choiseul Provincial Government workshop

WHAT IS THE CHOISEUL TOWNSHIP CLIMATE CHANGE PROJECT?

The aim of the Choiseul Township Climate Change Project is to prepare a plan that will:

- Show how climate change hazards may affect Taro Island and the future expansion area now and in the future;
- Make recommendations about how to protect the community and valuable areas from climate change hazards; and
- Guide how and when development should happen in the future expansion area.

A lot of work has already been done by the Solomon Islands Government and Choiseul Provincial Government and some development has started to happen. This work will be taken into account in the Choiseul Township Climate Change Project.

Talking to community members at Supizae

WHAT THE PROJECT TEAM DID DURING THEIR VISIT IN JANUARY

During their time in Solomon Islands, the project team:

- Participated in a workshop with the Choiseul Provincial Government
- Held information sessions near the Taro Market
- Participated in a community workshop with the Taro Island community
- Visited Supizae, Poroporo, Moli and Nukiki to talk to community members in nearby villages
- Hosted a movie night
- Met with Solomon Islands Government in Honiara

In total, the project team spoke to over 200 community members!

The purpose of this visit was to understand what is important to community members, government representatives and NGOs about Taro Island and the future expansion area.

WHAT FEEDBACK DID THE PROJECT TEAM RECEIVE?

Feedback about the project

- Generally people felt pleased to hear that the project is being done and are eager to move to an area on the mainland that is safe from climate change impacts and tsunami.
- Community members wanted to be involved.

Important areas and values

- Areas that have environmental importance – conservation areas, mangroves, the reef, the creek on Taro and the Sui River;
- Places that provide valuable natural resources – fishing areas, mangroves, food gardens, places where stones can be collected and where building materials can be found;
- Buildings and infrastructure providing a critical service to the province – the hospital, airstrip, telekom, generator, businesses, fuel storage, employment, bank, waste disposal and provincial government services;
- Other buildings and structures important for the health and wellbeing of the community – churches, schools, swimming areas, picnic areas, soccer field, residences and the market.

The locations of these important areas and values are shown on the following pages.

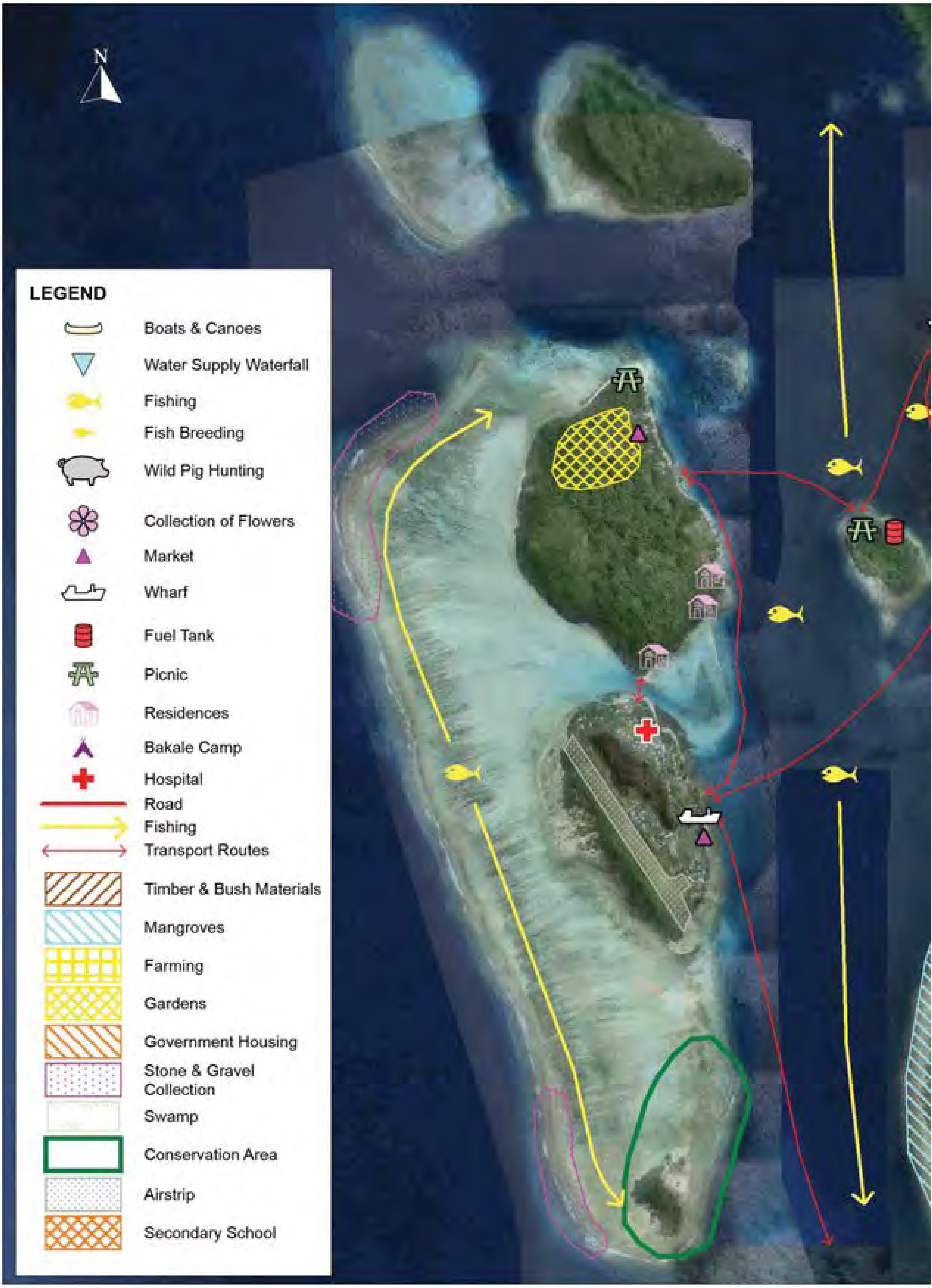
Vision for the new township

- The township should be a 'green' town and have public areas for recreation, sport, parks and trees;
- The township has to be clean with a waste disposal area that is separate from the town;
- Services and infrastructure should be available before development such as water supply, sewage management and good road connections;
- The provincial capital should be the 'face' of Choiseul; and
- Land and resources in the new township need to be fairly distributed.

Comments about the future expansion area

- The new township has to be safe from natural hazards such as sea level rise and tsunami.
- Some people thought it would be better to develop the town inland from the mangroves. To provide protection from coastal hazards. Others thought that the possibility of reclaiming land along the coastline should be investigated.
- Identify a suitable and secure place to store boats.
- The port requires good access to deep water and protection from wind and waves.
- A road connecting to nearby villages is needed so that people can get around easily.
- If more land were available (compared to Taro Island) more people would choose to live in the capital and develop businesses.

Taro Map - Important Areas Mapped by the Community



Choiseul Bay Area Map


0
0.5
1km
Approx. Scale

NEXT STEPS

The project team will visit Taro Island again to seek your input at various stages of the project. The purpose of each visit will be:

January visit (completed)

- Discuss climate change and tsunami hazards and how these might impact Taro Island and the future expansion area.
- Find out about the places, buildings and infrastructure important to the community.

March visit

- Discuss places, buildings and infrastructure that are most at risk from climate change, and what to do about to these impacts.
- Present information about the land features of the future expansion area that need to be taken into account in the planning.
- Seek feedback on a draft concept plan for the future expansion area.

May visit

Discuss and seek feedback on the draft plan which will include:

- Options for what can be done to minimise climate change risks on Taro Island; and
- A draft plan for how the future expansion area could be developed.

PROJECT TEAM:

Lyn Leger
Environmental Consultant

Simon Albert
Scientist

Kylie Rolley
Town Planner

Shannon McGuire
Town Planner

BMT WBM
Australian Aid

Thank you for having yor say on the CHOISEUL TOWNSHIP CLIMATE CHANGE PROJECT !

Community Booklet – May 2014

Choiseul Township Climate Change Project

Thank you from the Project Team

In March 2014, project team members (Lyn, Simon, Kylie and Shannon) from the 'Choiseul Township Climate Change Project' visited Taro Island and surrounding villages to get your input into this important project. This was the team's second visit following an initial visit in January 2014.

This booklet provides a summary of the information collected from the community and the next steps for the project.

Thank you again to everyone, particularly the Choiseul Provincial Government (CPG) and the Taro Island community, for making the trip a great success!

Choiseul Provincial Government workshop - Taro Island

What is the Choiseul Township Climate Change Project?

The Choiseul Township Climate Change Project will:

- Show how natural hazards and climate change may affect Taro Island and the new township in Choiseul Bay, now and in the future;
- Provide advice about how to make these risks smaller and better protect the community and valuable areas; and
- Guide how and when development should happen in the new township as well as on Taro Island.

A lot of work has already been done by the Solomon Islands Government and Choiseul Provincial Government and some development has started to happen. This work is being taken into account in the Choiseul Township Climate Change Project.

Meeting with the Community

In March the team updated community and government and asked for feedback about:

- Hazard and risk maps – showing the vulnerability of the community to hazards such as tsunami and storms, both now and in the future;
- Adaptation options – a range of options that can help manage tsunami and climate change risks; and
- Concept plan for the new township – options for how the new township on the mainland can be developed.

So far the project team has spoken to over 300 community members during their visits!

The feedback from the community and the CPG is given in the following pages.

Talking to community members Poroporo

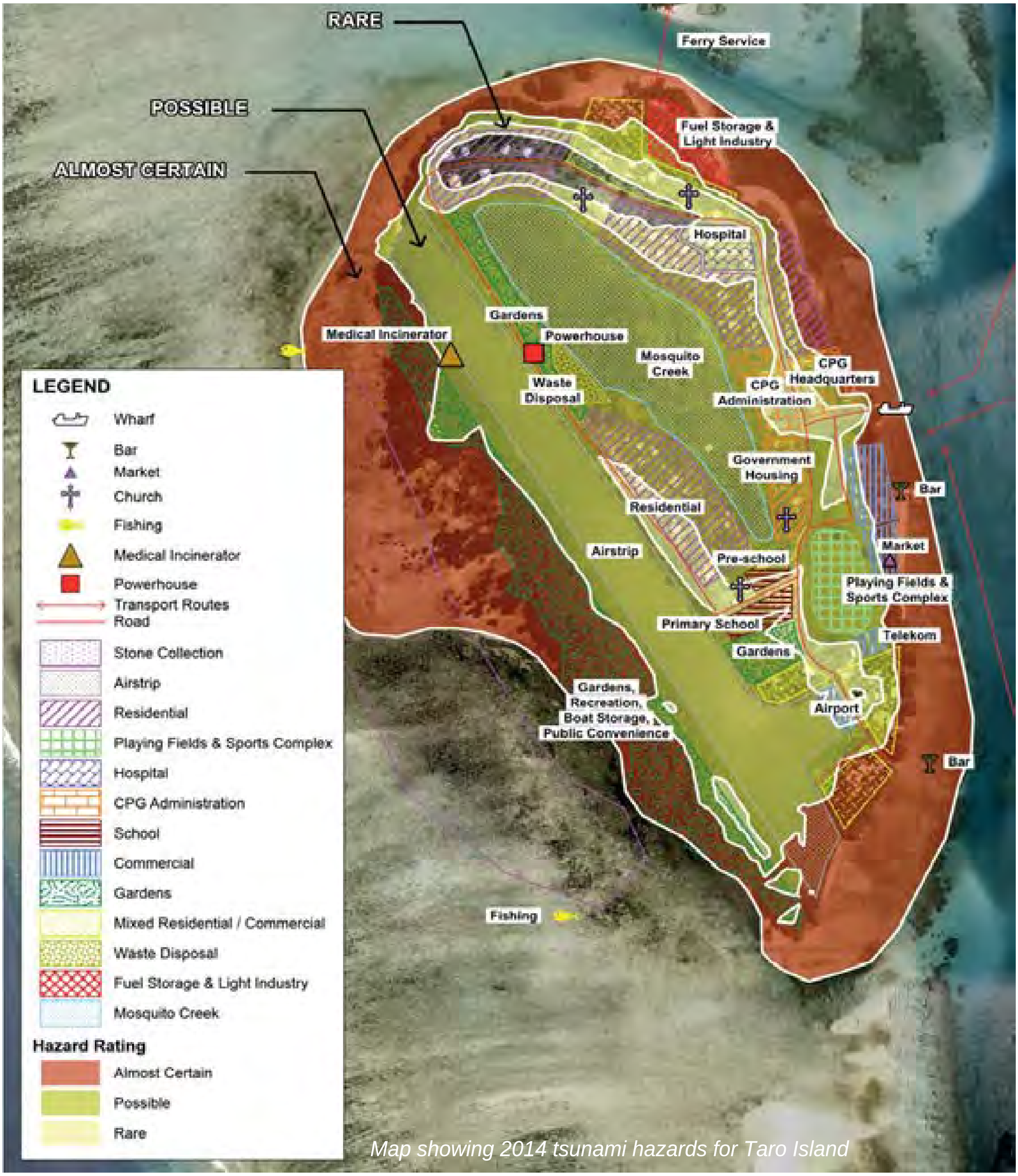
Talking to community members Supizae

What you told us

The project team received a lot of good information and feedback during our visit. Some of the comments made by community members are presented below.

Hazards and Risk Map

The example below shows how tsumaim hazards interact with the valued assets on Taro Island.



Map showing 2014 tsunami hazards for Taro Island

Community members were asked what assets on Taro Island and the mainland would be impacted the most if they were affected by the hazards, either now or in the future. We asked them to think about risk as a combination of the chance of hazard occurring (likelihood) and the impact (consequence) if a hazard does occur. The list of highest priority assets identified by the community included:

- Choiseul Provincial Government buildings
- Telecommunications infrastructure (buildings and the back up generator)
- The hospital
- The airstrip and associated buildings
- The power house
- Residences
- Guest houses and rental businesses
- Water supply
- Roads


Telecommunications Building


The Power House


The Hospital


The Air Strip

Adaptation Options

Adaptation options are ways of managing risk. This is generally achieved by reducing the chance of impact by hazards, or reducing the effect on the community if an asset is impacted.

Adaptation options for the high priority assets that were suggested by the community are provided in the table below.

Assets	Summary of adaptation options suggested by the community
• Taro Island generally	• Plant trees along the coast as a buffer • Build sea walls, groynes or wave breakers • Prepare a tsunami evacuation and recovery plan • Raise buildings • Make sure new buildings are elevated off the ground
• Choiseul Provincial Government (CPG) buildings	• Make digital backups of data and store at Honiara • Archive older documents in an elevated room in the CPG offices or on the mainland
• Telecommunications infrastructure	• Raise the buildings and the generator platform • Build new or back up services on the mainland • Build sea wall in front of the generator or around the whole facility
• The hospital	• Relocate to the mainland • Build groynes or sea walls • Revise the evacuation plan and develop an education program • Raise or relocate the pharmacy and generator • Build a multi-purpose safe house on high ground • Remove the roof and build another storey • Upgrade CBPSS to cater for evacuations
• Airstrip and associated buildings	• Make the airstrip higher and longer • Relocate airstrip to the mainland • Provide a fast ferry service • Use a nearby airport or helicopter in an emergency • Build sea wall at southern end of the airstrip
• The Powerhouse	• Raise the powerhouse or relocate to higher ground • Find an alternative power source • Install solar panels for houses
• Residences	• Raise houses off the ground • Relocate to mainland • Build new houses to a safe standard (i.e. raised off the ground)
• Guest houses and rental businesses	• Raise off the ground • Close business and open new business on mainland
• Water supply	• Install guttering and water tanks on existing buildings (private and communal) • Construct a pipeline from the mainland • Build a desalination plant
• Road	• Raise all or parts of the road • Build a sea wall or groyne • Consider alternate route

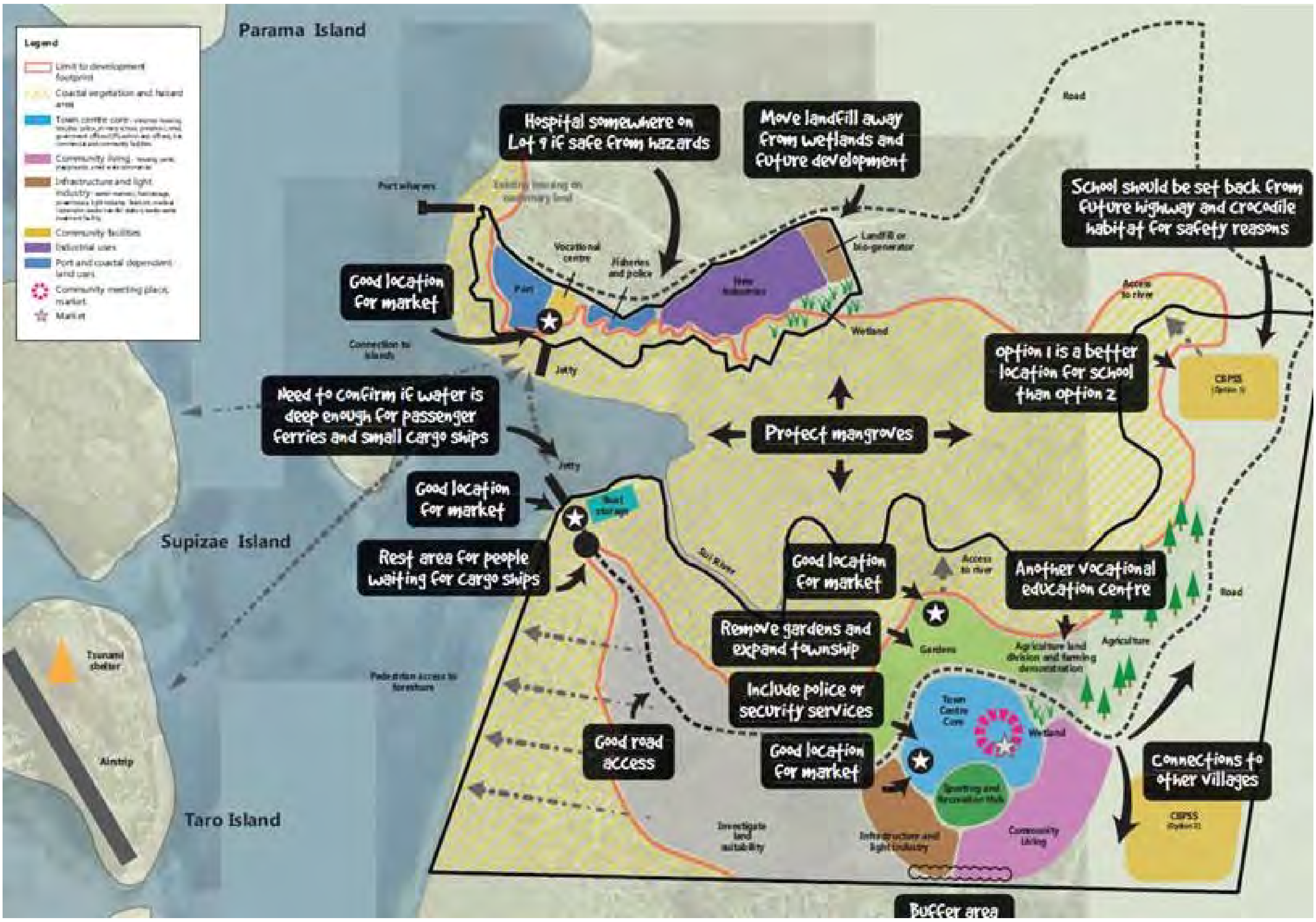
All these options have now been considered by the project team, the Choiseul Provincial Government and the Solomon Islands Government. Some of these community suggestions have been incorporated into the Adaptation Plan for Choiseul Bay.

Concept Plan Options for the New Township

The project team is working with the Choiseul Provincial Government to prepare a plan for the new township on the mainland. This land is owned by the Choiseul Provincial Government and is shown on the map below.

Three concept plans were presented to community members and government representatives. We asked people for feedback on what they liked and didn't like. The best option was called 1B. Shown below is Option 1B with community comments included.

An amended concept plan has been developed based on this feedback and is now under consideration by Choiseul Provincial Government and the Solomon Islands Government.



Next Steps

The Choiseul Provincial Government will be responsible for making the Adaptation Plan happen.

The Choiseul Provincial Government will present the Plan to the communities of Taro Island and surrounding villages in June 2014. This will include a presentation of the concept plan 1B for the new township area on the mainland.

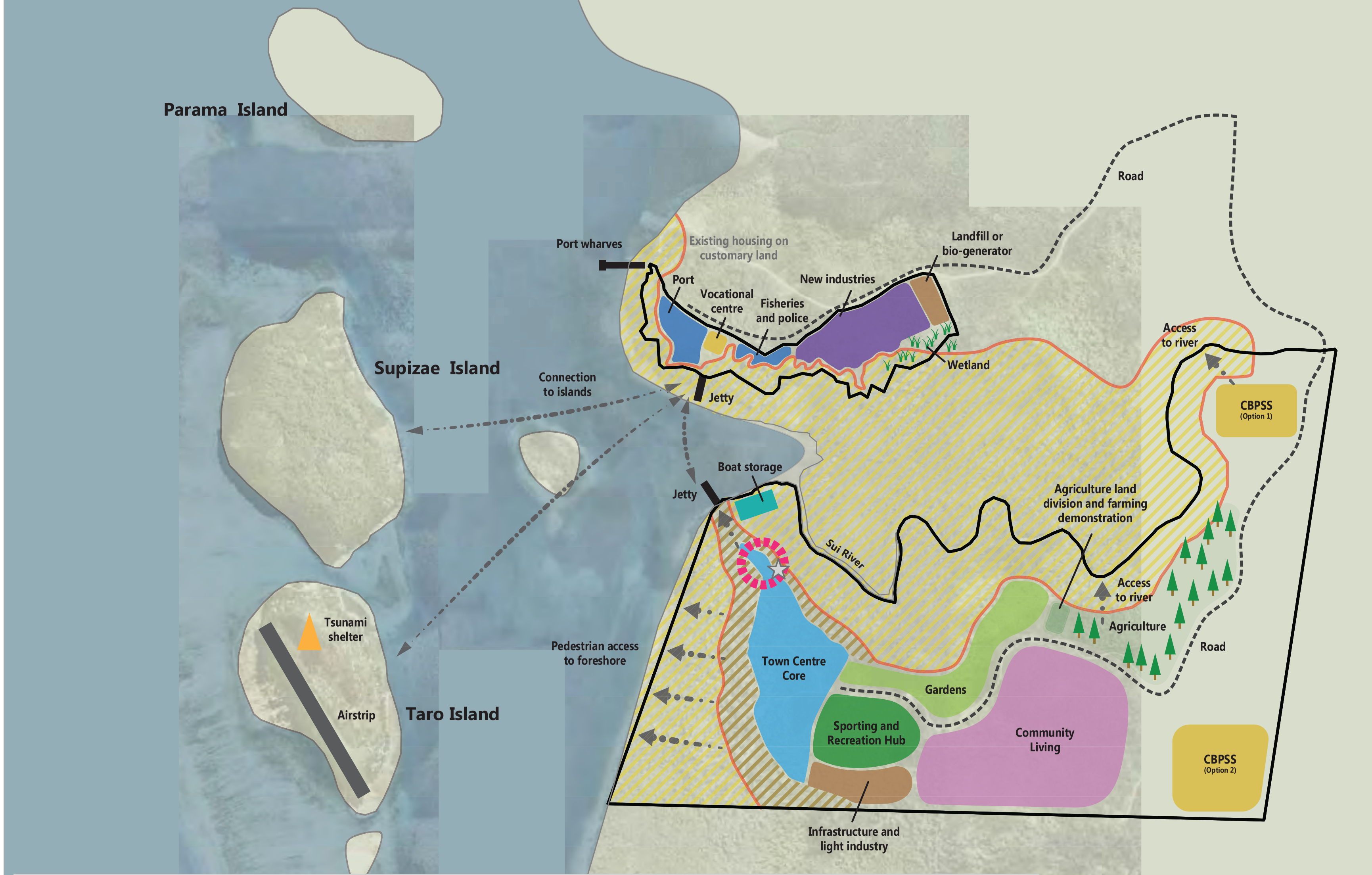
Implementation of the Plan will take much effort and funding assistance, especially the development of the new town on the mainland. The steps we have taken over the last 6 months will help Choiseul Provincial Government to seek more funding to make the new town a reality in the future.

Thank you to everyone for your time and involvement in this project so far. Every member of the project team has thoroughly enjoyed working with you.

BMT WBM Australian Aid

Appendix G Concept Options Presented to Community and Stakeholders, March 2014

Preliminary Draft Concept Plan - New Capital for Choiseul Province



Assumptions - All Options
- All options include two potential locations for the CBPSS.
- It is assumed the relocation of priority assets and services from Taro Island will proceed on a priority basis based on the level of risk. These key assets include CPG offices/headquarters and services, the hospital and Telekom.
- It is assumed the airstrip will remain on Taro Island in longer term and will be upgraded for Dash 8 aircraft and defended from coastal hazards.
- Airstrip relocation options could be considered, including the lower areas of Lot 277 (under option 2), or elsewhere outside of Lot 9 and Lot 277,if the risk from coastal hazards make the long-term defence of the airstrip unviable.
- A 2090 population of 5,000 residents has been assumed based on extrapolated current growth rates (Taro Island and Supizae Island), and anticipated economic and climate change related migration.

Assumptions - Option 1A
- Assumes most land outside of coastal hazard area on Lot 9 and Lot 277 can be developed. Port activities, coastal dependent uses, fisheries and industry uses focus on Lot 9. Town centre and community living focus on Lot 277.
- Major reservation on feasibility given unknown suitability of land towards front of Lot 277 for town centre uses and level of risk from mosquito habitat (freshwater wetlands).
- Ability to reclaim very large swamp unknown.
- Need to confirm land suitability of lot 277 before further consideration.
- If feasible, it is a desirable option because it doesn't require further land acquisition and can provide a convenient arrangement of uses free from major coastal hazards and access to coast.
- A drawback of this option is that it doesn't integrate the existing settlements on customary land immediately north of Lot 9.
- Can allow for expansion to begin with moderate capital investment, for example, jetty, road, land reclamation of swamp etc.
- This option assumes only land in Lot 9 and Lot 277 is available and should only be considered if it is confirmed the front of Lot 277 is suitable for development.

FOR DISCUSSION
Draft Concept Plans - 2090

Option 1A
Lot 9 and Lot 277

Legend
- Limit to development footprint
- Coastal vegetation and hazard area
- Less sensitive uses - markets, sports ovals, parks.
- Town centre core - shop top housing, hospital, police, primary school, preschool, retail, government offices (CPG admin and offices), bar, commercial and community facilities.
- Community living - housing, parks, playgrounds, small scale commercial.
- Infrastructure and light industry - water reservoir, fuel storage, powerhouse, light industry, Telekom, medical incinerator, waste transfer station, waste water treatment facility.
- Community facilities
- Industrial uses
- Port and coastal dependent land uses
- Community meeting place, gateway entrance to town, market
- Market

Author: ELM
Date: 12/03/2014
Data Source: BTW WBM
Projection: WGS 84 57S
0 400 800 m 1:20,000

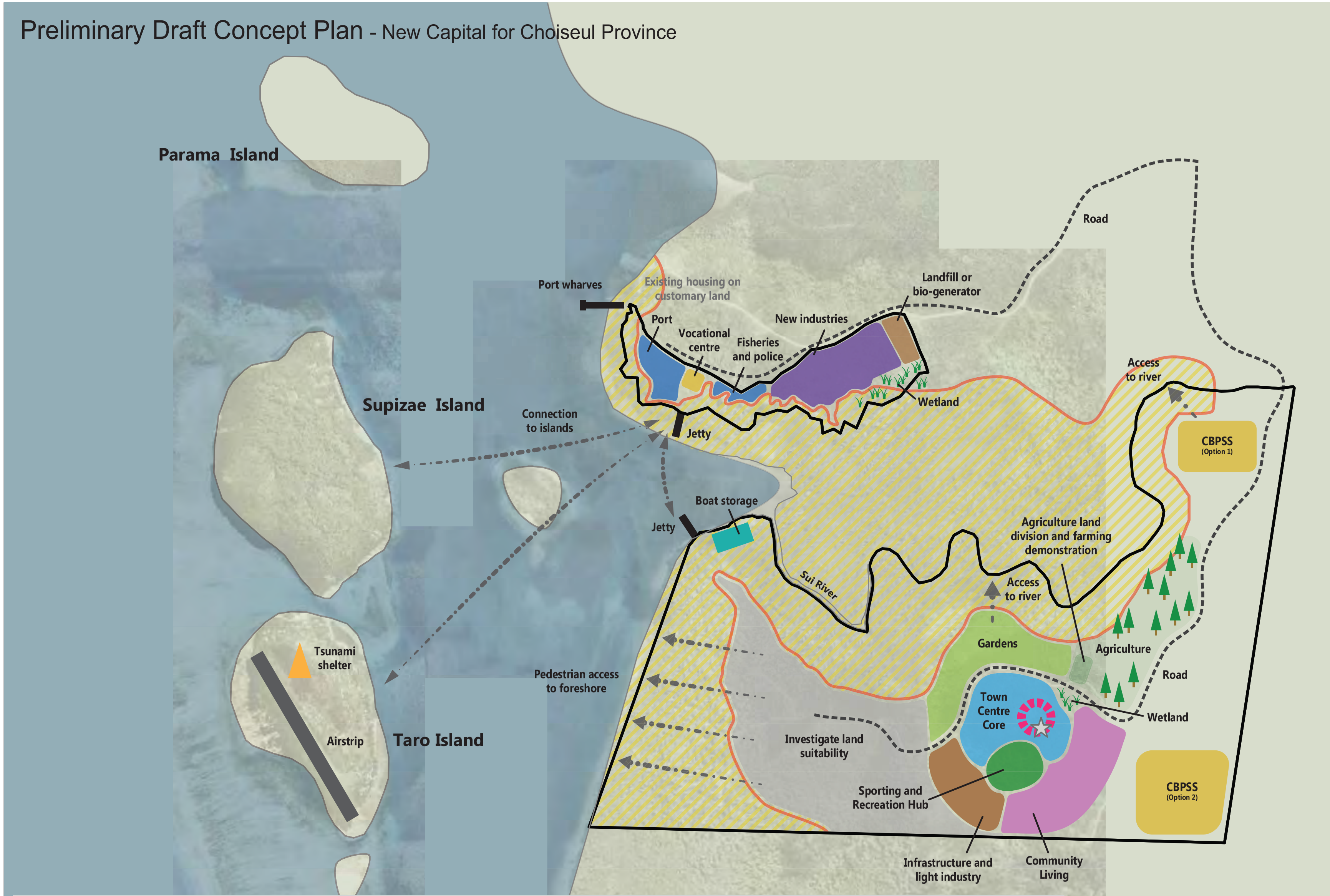
Disclaimer
This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. The map layers displayed are compiled from various sources. Therefore, Buckley Vann gives no warranty in relation to the data displayed on this map (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

FOR DISCUSSION

Draft Concept Plans - 2090

Option 1B

Lot 9 and Lot 277



Legend

- Limit to development footprint
- Coastal vegetation and hazard area
- Town centre core - shop top housing, hospital, police, primary school, preschool, retail, government offices (CPG admin and offices), bar, commercial and community facilities.
- Community living - housing, parks, playgrounds, small scale commercial.
- Infrastructure and light industry - water reservoir, fuel storage, powerhouse, light industry, Telekom, medical incinerator, waste transfer station, waste water treatment facility.
- Community facilities
- Industrial uses
- Port and coastal dependent land uses
- Community meeting place, market.
- Market

Assumptions - All Options

- All options include two potential locations for the CBPSS.
- It is assumed the relocation of priority assets and services from Taro Island will proceed on a priority basis based on the level of risk. These key assets include CPG offices/ headquarters and services, the hospital and Telekom.
- It is assumed the airstrip will remain on Taro Island in longer term and will be upgraded for Dash 8 aircraft and defended from coastal hazards.
- Airstrip relocation options could be considered, including the lower areas of Lot 277 (under option 2), or elsewhere outside of Lot 9 and Lot 277,if the risk from coastal hazards make the long-term defence of the airstrip unviable.
- A 2090 population of 5,000 residents has been assumed based on extrapolated current growth rates (Taro Island and Supizae Island), and anticipated economic and climate change related migration.

Assumptions - Option 1B

- This option assumes only Lot 9 and Lot 277 is available for development and it has been confirmed the front of Lot 277 is not suitable for development as per Option 1A.
- Assumes the front of Lot 277 is not suitable for development and locates town centre and community living to the back of Lot 277. Uses on Lot 9 should generally be the same as Option 1A – port, coastal dependent uses, industry and fisheries etc.
- Important to avoid delay in relocating priority assets (CPG offices, hospital and Telekom) in short term while outcome of land acquisition negotiations progress. Priority assets of hospital, CPG admin offices and Telekom might need to locate to Lot 9 as a temporary measure, but would eventually need to locate to Lot 277 to ensure the town centre is not fragmented. It is very important for these assets to be part of the town centre.
- Land slip hazard will need to be considered for upper areas of Lot 277 as topography is unknown in detail.
- Potentially changes the nature of the community from coastal to an inland focus.
- Loss of readily accessible cultural and economic links to coastal resources.
- The option does not negate the potential for customary owners north of Lot 9 to provide residential land in competition with residential areas on Lot 277, in areas with ready coastal access and therefore being more desirable.

Author: ELM
Date: 12/03/2014
Data Source: BTW WBM
Projection: WGS 84 57S

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FOR DISCUSSION

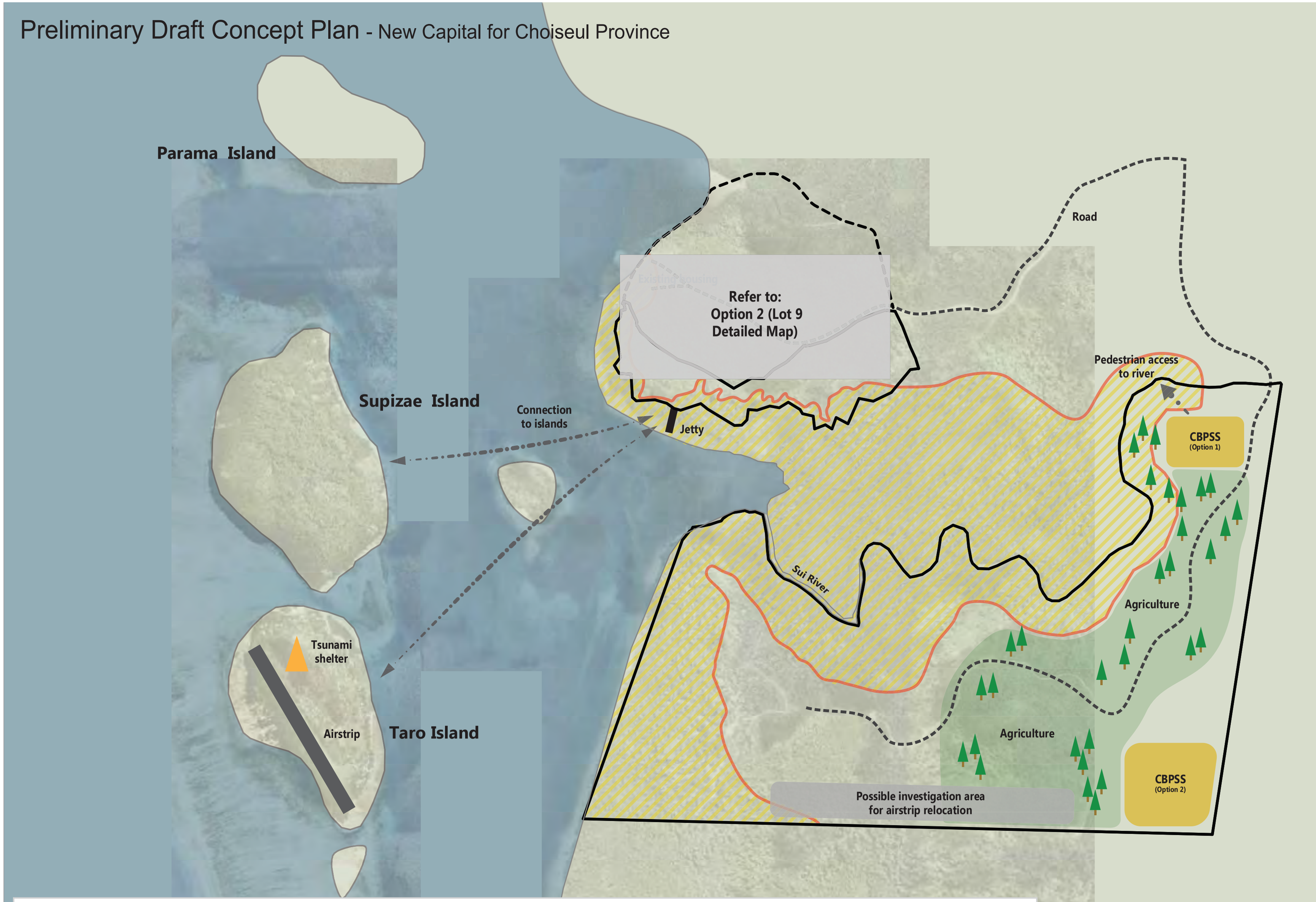
Draft Concept Plans - 2090

Option 2 (preferred)

Lot 9 and Lot 277

Legend

- Limit to development footprint
- Coastal vegetation and hazard area
- Community facilities



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- A 2090 population of 5,000 residents has been assumed based on extrapolated current growth rates (Taro Island and Supizae Island), and anticipated economic and climate change related migration.

Assumptions - Option 2

- This is the preferred option from a land use planning basis because it provides a well configured land area that will allow for a well located and well laid out provincial capital that is free from coastal hazards and minimises fragmentation of uses - will be less capital intensive and the town will be compact.
- Sufficient land for future growth is difficult to deliver given that a large component of the land is not currently owned by CPG and may not be able to be achieved.
- Important to consider “no regrets” short-term relocation priorities from Taro Island to areas within Lot 9 to avoid the risk of delay or not taking priority relocation actions until land acquisition negotiation is finalised.
- Lot 277 or parts not needed for township or other uses, could be offered as part of a land swap in negotiating the acquisition of land north of Lot 9.
- Lower parts of Lot 277 could be investigated for airstrip relocation if required.
- Other areas of Lot 277 could be considered for the CBPSS, forestry and agricultural uses and the dump/landfill.
- This option has the potential to integrate existing settlements on customary land north of Lot 9 into the township area.

Author: ELM
Date: 12/03/2014
Data Source: BTW WBM
Projection: WGS 84 57S

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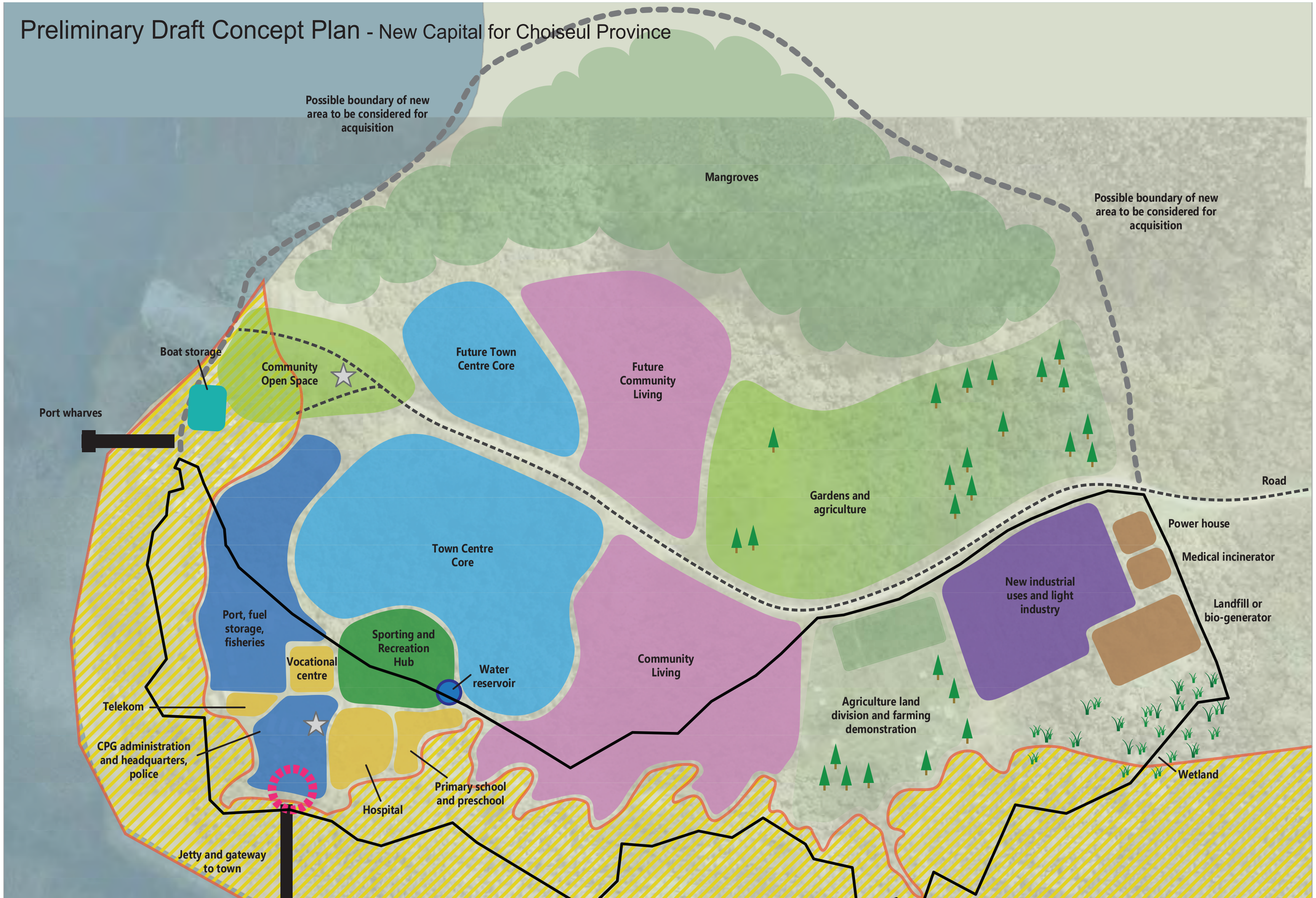
FOR DISCUSSION

Draft Concept Plans - 2090

Option 2 (preferred)

(Lot 9 Detailed Map)

Lot 9 and expansion to adjoining land to the north.



Legend

- Limit to development footprint
- Coastal vegetation and hazard area
- Town centre core - shop top housing, hospital, police, primary school, preschool, retail, government offices (CPG admin and offices), bar, commercial and community facilities.
- Community living - housing, parks, playgrounds, small scale commercial.
- Infrastructure and light industry - water reservoir, fuel storage, powerhouse, light industry, Telekom, medical incinerator, waste transfer station, waste water treatment facility.
- Community facilities
- Industrial uses
- Port and coastal dependent land uses
- Community meeting place, gateway entrance to town, market.
- Market

Assumptions - All Options

- All options include two potential locations for the CBPSS.
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Appendix H Draft Local Planning Scheme

DRAFT
Choiseul Bay Township
Local Planning Scheme
June 2014

Table of Contents

Our vision for Choiseul Bay Town

1 About Our Local Planning Scheme

1.1 Introduction

The Choiseul Bay Township Local Planning Scheme 2014 (planning scheme) has been prepared to provide a framework for managing development in Choiseul Bay Township, Taro Island and part of Supizae Island.

The planning scheme seeks to advance the purpose of the *Town and Country Planning Act* (as amended) by ensuring land is used in accordance with properly considered policies based on sound information and, to ensure development promotes the welfare of people and protects or creates an environment that supports community needs.

In seeking to achieve this purpose, the planning scheme sets out the Choiseul Provincial Government and community's vision for the future development of the new capital of Choiseul Province and the intention for development on Taro and Supizae Islands.

The planning scheme is intended to be used by the Choiseul Province Planning Board and its technical officers in the assessment of development applications to:

(a) assist in securing the orderly development of the new town in a manner that promotes the health, amenity, convenience and general welfare of the community
(b) provide the planning principles, desired outcomes and development requirements upon which development in the area will be promoted and controlled
(c) assist in the selection of, or to define sites for particular purposes
(d) protect features or areas of environmental, cultural, social, historical or scenic value and importance
(e) identify natural hazard areas where sensitive uses and vulnerable development is not supported
(f) safeguard corridors and allocate sufficient land for infrastructure such as major roads, waste management, parks, community uses, pipelines and other services
(g) indicate the stages by which development should be carried out.

The planning scheme will be reviewed every five (5) years in accordance with the requirements of the *Town and Country Planning Act* (the Act) to ensure the planning and development of the new Choiseul Bay Township responds to the needs of the community and to any changes at the local, provincial and national levels.

This planning scheme applies to Choiseul Provincial Government (CPG) owned land including all premises, roads, waterways and coast fronting the sea identified on Map 1. The planning scheme does not apply to or have any statutory effect on development of surrounding customary land. The CPG will talk with adjoining customary land owners about their future plans to ensure consistency and compatibility with the planning scheme.

Map 1. Choiseul Provincial Local Planning Scheme Area

1.2 Local planning scheme components

The planning scheme includes the following components:

(a) About the local planning scheme;
  - Interpretation
  - Definitions
  - Rules for assessing a development application.

(b) Our Vision and strategic plan for a new capital;

(c) Zones and development outcomes:
  - Town Centre Core Zone
  - Low Impact and Service Industry Zone
  - Port and Industry Zone
  - Community Living Zone
  - Special Purpose Zone
  - Open Space and Recreation Zone
  - Environment and Conservation Zone
  - Limited Development Zone
  - Future Investigation Zone.

(d) Infrastructure requirements

(e) Subdivision development requirements.

1.2.1 **Definitions**

A term used in this planning scheme has the meaning assigned to that term by:

(a) The *Town and Country Planning Act*; or

(b) The definitions in Schedule 1 of the planning scheme; or

(c) The ordinary meaning where that term is not defined in the Act or Schedule 1 of the planning scheme.

1.2.2 **Maps**

To remove any doubt, maps provide information to support the outcomes of the planning scheme and are part of the planning scheme.

1.2.3 **Development to which this planning scheme applies**

The planning scheme applies to development as defined by section 14(2) of the *Town and Country Planning Act* being:

- the carrying out of building, engineering, mining or other operations in, on, over or under land; or
- the making of any material change in the use of any buildings or other land.

The planning scheme also applies to the subdivision of land or reconfiguring a lot.

For the purpose of the Act, the following operations and land uses are deemed not to constitute development of land:

(a) *the carrying out of works for the maintenance, improvement or other alterations of any building, if the works effect only the interior of the building or do not materially affect the external appearance of the building;*

(b) *The carrying out of any works by a highway authority required for the maintenance or improvement of a road if the works are carried out on land within the boundaries of the road;*

(c) *The carrying out by any Government Department, Provincial Assembly, Town Council, Area Council or statutory undertaker of any works for the purpose of inspecting, repairing or renewing; any sewers, mains, pipes, cables or other apparatus, including the breaking open of any street or other land for that purpose;*

(d) *The use of any buildings or other land within the curtilage of a dwelling house for any purpose incidental to the enjoyment of the dwelling house;*

(e) *The use of any land for the purpose of agriculture, livestock keeping, fishing and forestry;*

(f) *Any other operation or use of land which may be prescribed in regulations made by the Minister.*

1.3 Rules for assessing a development application

When assessing and deciding whether to approve an application for planning permission to develop land, the Board and its technical officers shall consider the wider impact of the development on the environment and community.

The following assessment rules shall be applied:

(1) The proposed development does not conflict with the *Town and Country Planning Act* as amended and any policy directions and regulations issued by the Minister in accordance with the Act provided.

(2) The proposed development complies with the *Environmental Health Act* and the *Environmental Protection Act* where relevant.

(3) Development is consistent with the strategic plan map, vision and policies of the strategic plan, in this planning scheme. An application is not approved where the land use or development poses a significant conflict with the strategic plan or, will compromise achievement of the vision. An application conflicting with the strategic plan is only approved where it can be demonstrated there are sufficient planning grounds, including community need or benefit, to overcome the conflict and approve the development.

(4) Development is consistent with the purpose of the zone and achieves compliance with the relevant development outcomes and requirements of the zone in this planning scheme. Development complying with the zone purpose statement and development outcomes and requirements, is consistent with the planning scheme.

(5) Where there is an inconsistency between the provisions of the planning scheme, the vision and strategic plan policies prevail over all other elements in the planning scheme, to the extent of the inconsistency or conflict.

(6) Conditions imposed on a development approval for a planning permit will be reasonable or relevant to the development and its impacts.

(7) The locations of key land uses (such as the CPG Government offices, police station, transformer station, primary school) identified on the strategic plan map (schedule 2) are indicative locations only. A development application may demonstrate an alternative location for these key uses in the same zone.

(8) Representations made by a government authority or government appointed service provider in relation to the development, including their rights and needs, will be considered as part of the assessment of a development application. In particular, development applications on Taro Island and Supizae Island will be referred to technical officers in the National Disaster Management Office for review and comment, prior to a decision being made on the development application.

(9) Representations on planning grounds made by a member of the public will be considered as part of the assessment of a development application.

(10) Any other matters which are considered reasonable and relevant to planning.

The Choiseul Provincial Government may choose to refer any or all development applications to other groups, organisations and customary land owners for comment and third party advice. This will help ensure development is achieving the community vision.

2 Our strategic plan for the new capital

2.1 Strategic plan

The strategic plan sets the policy direction for the planning scheme and forms an important basis for decision making in ensuring appropriate development occurs for the life of the planning scheme. The strategic plan map for Choiseul Bay Township is provided in Schedule 2.

The strategic plan comprises the vision statement, seven vision themes, supporting polices and a strategic plan map. The strategic plan represents the complete policy direction for the Choiseul Bay planning scheme area and must be read in its entirety as the policy direction for the planning scheme area.

For the purpose of articulating the policy direction for the planning scheme, the strategic plan is structured in the following way:

(a) an overall vision statement

(b) there are seven (7) vision elements or themes that work together to articulate the vision and the complete policy direction for the planning scheme area. These include:
   - Provincial town
   - Prosperous town
   - Safe town
   - Clean and green town
   - Living town
   - Connected town
   - Well-serviced town.

(c) a series of principles and policies for each vision theme that refine and further describe the vision, desired outcomes and policy direction sought for development in the planning scheme area

(d) a strategic plan map which identifies spatially the future intent for development in the planning scheme area. Locations for key land uses have been indicatively identified on the strategic plan map. These locations are indicative only and alternative locations may be identified.

2.2 Our vision for a new Capital for Choiseul Province

2.3 Policies to achieve the vision

Provincial Town

Choiseul town is designed to function as a 'complete' town and sets the standard for provincial capitals in the Solomon Islands.

Vision principles and policies

(a) The provincial capital is the government, economic and cultural centre of Choiseul Province. All provincial capital services for the Choiseul Province including major government services and community facilities such as for education, health and cultural purposes locate within Choiseul town and are well integrated to ensure a logical and well functioning town.

(b) Choiseul town is a modern town, proud of its seaside and island origins and is home to around 5,000 people.

(c) Gateways into the town provide attractive, practical and memorable entrances into the provincial capital and are designed to be safe, appropriate to use and suit different types of visitors.

(d) The town is easy to get around and laid out in a logical manner with enough space for future expansion.

(e) Public spaces, public buildings and infrastructure are attractive, high quality and distinctive and act as landmarks in the town.

(f) The Provincial Government shows leadership and works closely with the community in the planning and development of the town.

(g) The Provincial Government works closely with customary land owners to ensure land use and activities outside of provincial government owned land are compatible and well integrated with town activities to the greatest extent possible.

Prosperous Town

Choiseul town is a prosperous provincial capital with a diverse economy (consisting of government services, agriculture, tourism, aquaculture, forestry, marine industries and service industries) supported by a thriving port and busy airstrip.

Vision principles and policies

(a) The provincial capital has a strong economic role within Choiseul Province and provides employment and services for residents and for people in surrounding villages and in other areas of the province.

(b) Access to land and employment opportunities are available to all people and these resources are shared fairly across the community.

(c) Markets are well located in the town and are busy places, where people from all over the province come to sell their fresh produce and to meet and talk with others.

(d) The Town Centre Core is bustling with a range of retail, business, commercial, entertainment, community facilities, shop top housing, cultural and park facilities. Buildings are attractive and are designed to address and enhance the street and public spaces.

(e) The natural environment including the sea, mangroves, bush and beautiful views are important for the prosperity of our town and communities. This is what tourism visitors come to see.

(f) Industries that rely on access to the coast are:
- located close to the water; and
- minimise disturbance to mangroves.

(g) Enough land is allocated to allow for a well-functioning port now and into the future.

(h) The airstrip on Taro Island is expanded and protected as a key piece of economic infrastructure.

(i) Enough land is allocated to allow for a range of existing and new industries (including education, agriculture, aquaculture, forestry, tourism, other marine industries and service industries) now and into the future.

(j) Opportunities are taken for industries to co-locate where they can work together and share resources. It is very important that industry uses near the provincial referral hospital on Lot 9 are separated by a buffer and limited to low impact industry uses to maintain the safety of the hospital and not impact on the health and well-being of patients or medical staff.

(k) The economy is supported by a strong, healthy and well-educated workforce.

Safe Town

Communities are safe from possible threats caused by natural hazards, property crime and the spread of disease.

Vision principles and policies

(a) New development that is sensitive to natural hazards including sea level rise, coastal erosion, tsunami, storm tide inundation and flooding, locates outside of the 2090 future hazard areas.

(b) Community resilience to coastal hazards is improved by relocating assets from Taro Island to the mainland over time, as coastal hazard risks worsen or when assets reach the end of their useful life.

(c) Uses and services on Taro Island that are most vulnerable to coastal hazards are relocated to the mainland as a matter of priority. New development and buildings on Taro are discouraged, but may be considered in limited circumstances and only where buildings can be built higher and stronger to withstand inundation from a 1 in 100 year tsunami.

(d) Mangroves are retained for the protective functions they provide from coastal inundation, erosion and tsunami and are protected for their environmental and natural resource values.

(e) Mangroves are maintained free from rubbish and waste and are not used as a public convenience.

(f) Emergency tsunami refuge shelters are available on Taro Island and Supizae Island to provide a safe place for people in the event of a tsunami. The tsunami refuge shelters are located on land at or above 3.5 metres MSL, or higher if practical.

(g) On the mainland, limited activities may locate within a natural hazard area only if:

- the use is temporary and can be easily relocated to a safer location when natural hazard risks worsen; or
- the use is not sensitive to risks from coastal hazards.

(h) The town has a reliable and safe water supply and appropriate sewage treatment solutions to support healthy communities.

(i) Public convenience toilet facilities are provided on lot 9 and lot 277.

(j) Housing and community uses are separated from places where mosquitos live and breed.

(k) The layout of the town promotes casual surveillance and provides for the secure storage of property including boats.

Living Town

Living Town

Choiseul town offers a mix of quality housing and lot sizes and a range of community facilities to support a cohesive, strong and healthy living environment for its residents and visitors.

Vision principles and policies

(a) Choiseul town provides a complete range of community facilities including recreation and sporting fields, places for children to play, a multi-purpose sports centre, community meeting places, provincial and local health facilities, cemetery, education facilities, court house, police station, churches and other government services.

(b) The community's education needs are met through the provision of high quality education facilities including a kindergarten, preschool, primary school, secondary boarding school and two new technical vocational centres for rural and industry training.

(c) All community facilities are of a high standard and are well located so they can be safely and easily reached from houses and places of employment and there is enough land to allow for future expansion.

(d) The secondary school is located in the north-eastern corner of Lot 277 with sufficient land for expansion and is safely setback from mangroves, crocodile habitat and the future Gnalivoli Highway.

(e) The referral hospital serving the whole of the province is located on Lot 9 and a health clinic on Lot 277 provides medical services to local people and visitors in the town.

(f) The community is safe and has access to police and justice services. An integrated court house, police station and watch house is located on Lot 277. A police presence or other form of security service is also provided on Lot 9.

(g) Accommodation is provided to cater for carers coming to Choiseul town to support family members seeking medical treatment.

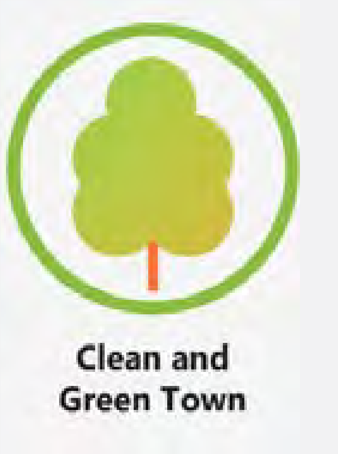
(h) The housing needs of families, visitors and government workers are met through different housing types and lot sizes. Lot sizes allow enough room for traditional outdoor kitchens and housing is appropriately located and integrated within the town.

(i) Everyone has equal access to housing on the mainland and no one is left behind on Taro Island, unless they choose to stay. Some affordable or temporary housing is provided on the mainland to facilitate the relocation of people who are socially, physically or financially disadvantaged.

(j) A rest shelter for passengers waiting for boats and cargo ships is located close to the jetty on Lot 277, but outside of the 2090 natural hazard area for tsunami, storm tide inundation, coastal erosion, sea level rise and flooding.

(k) Places that are important for cultural practices such as fishing, hunting and gathering, including tambu sites, are protected for these purposes.

(l) The layout of the town supports the efficient use of land and infrastructure; ensures co-located uses can be good neighbours; and separates incompatible uses.



Clean and Green Town

Choiseul town is clean and free from rubbish. Development is sensitive to the natural environment and maintains and provides lots of shady trees.

Vision principles and policies

(a) Choiseul town is clean and there are no traces of rubbish in the streets or nearby waters. People are proud of their clean and tidy town.

(b) The landfill on Taro Island is well managed to protect the environment and is located in the right place - separate from where people live and sited and designed so as not to pollute our water resources.

(c) The community cares for the mangroves, swamps, wetlands, reefs, forests and sea for their many cultural and natural benefits.

(d) The reef surrounding Taro Island has regenerated as people no longer collect coral and building materials from the reef.

(e) Community gathering spaces are well located in the town, are shady, attractive and available for all people to use.

(f) Town services are efficient, affordable and environmentally friendly.

(g) The mangroves are maintained for their protective functions against coastal hazards and for other economic benefits.

(h) Activities are only located close to the coast if disturbance to mangroves is minimised.

(i) Wide areas of mangroves and bush have been kept beside our rivers, streams, creeks and swamps to protect the high quality of the water we drink and use for other purposes.

(j) The Sui River is protected as an important water resource and for generating hydro-power for the town.

(k) We use our water wisely and recycle where we can.

(l) Development of the town is sensitive and responsive to the natural water cycle and is based on water sensitive urban design principles. This means development protects water quality of surface and ground waters, minimises polluted water discharge to waters and minimises changes to the natural landform and hydrological behaviour of catchments.

(m) Our town has retained and planted many trees to provide shade and coolness in our hot climate. Our streets are lined with shady trees to make walking more comfortable and to create an attractive town.

Connected Town

Choiseul town is easy to get around and well connected with neighbouring villages and other areas outside the province.

Vision principles and policies

(a) Good sea transport connections are available between Choiseul town, Taro Island, the port and Supizae Island.

(b) The road network is designed to be flexible to accommodate different transport modes including walking, cycling and vehicles.

(c) The street system connects different parts of the town, has a clear hierarchy and is generally based on the grid system. Steep or more hilly land may need a more responsive street pattern and layout.

(d) Street design is carefully undertaken to create places that are safe, quiet and healthy, especially for people walking and for children.

(e) The design of the main streets in our town centre are active, vibrant and safe places for people. Our main streets are designed for people and not just ‘cars and speed’ as being the main design objective.

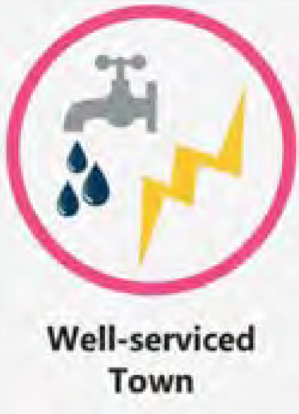
(f) The Choiseul Province Link Road around the island and the Sui River bridge crossing is important to the functioning of the provincial capital and connects the town with other villages and communities in the province.

(g) A well designed boardwalk through the mangroves connecting the town on Lot 277 to the port, hospital and industry area on Lot 9 is provided, subject to the Choiseul Provincial Government acquiring this land.

(h) Communities within the Choiseul Province are connected to other provinces and Honiara via a busy airstrip and thriving port.

(i) Safe and easy access to the sea is supported by convenient access tracks and secure boat storage.

(j) The corridor for the future Gnalivoli Highway is protected and is developed to meet the needs of the town and Choiseul Province as a whole. Sensitive uses such as the secondary school and housing maintain a separation buffer from the future highway. Development does not encroach into the corridor for the future highway and enough land is set aside and protected for this key infrastructure.



Well-serviced Town

Reliable, affordable, efficient and clean town services (such as water, electricity, solid waste management, telecommunications, stormwater management and sewage treatment) are available.

Vision principles and policies

(a) The full range of town services and infrastructure is available to meet community needs, including:
- a safe and reliable water supply and appropriate sewage treatment solutions to support healthy communities;
- a reliable, continuous and green source of electricity generated from hydro-power on the Sui River;
- telecommunications;
- stormwater management (quantity and quality of water);
- solid waste management.

(b) Waste transfer stations on Lot 9 (for industry) and Lot 277 (for the main town) provide important facilities for sorting, recycling, recovering and storing waste before transporting by sea to the well managed landfill disposal site on Taro Island.

(c) A waste water treatment plant is located on Lot 9 (for industry) and Lot 277 (for housing and town centre uses). All housing, industry and town centre core uses are connected to a simplified effluent disposal system where liquid effluent from individual septic tanks is pumped to a centralised waste water treatment plant.

(d) Services and infrastructure are provided in a timely manner to meet people's needs, does not lag behind development and is affordable.

(e) Land allocated for infrastructure including infrastructure corridors and community facilities, is well located and reserved for these purposes in the long term. Development does not encroach into these areas.

(f) Development occurs in an orderly and logical way, uses land wisely and maximises the use of existing infrastructure to reduce the cost of providing infrastructure. This is achieved by sequencing and staging the release of land for development over time.

(g) Infrastructure and services that may cause nuisance to residents are separated from housing and community uses.

(h) All new development including residential and non-residential, is provided with an appropriately sized rain water tank for water supply purposes.

3 Zones

3.1 Preliminary

Zones organise the planning scheme area in a way that provides for the location of preferred and compatible land uses.

All land in the planning scheme area is allocated to a zone. Zones are mapped and included in Schedule 3.

Each zone identifies the following:

(a) The purpose of the zone;
(b) A list of development that is permitted in the zone subject to a development application for a planning permit;
(c) A list of prohibited development that is not supported in the zone; and
(d) Development outcomes and requirements that achieve the purpose of the zone.

3.2 Zoning controls

3.2.1 Town Centre Core Zone

Purpose of the zone

The purpose of the Town Centre Core Zone is to provide for a diverse mix of uses, employment opportunities and is the main place for business and community activities. The Town Centre Core Zone is the heart of the town and includes retail, commercial, residential, health services, administration (like the CPG headquarters and other government offices), community, cultural, recreational, entertainment and other uses capable of servicing the town and greater Choiseul Province. Development is well designed and creates a nice looking town and includes parks, meeting places for people and lots of shade trees. Business activities locate in the zone and is the only retail and commercial hub in the town.

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Business activities including Community activities for a Club, Child care centre, Community use, Educational establishment, Emergency services, Health care services or Hospital
- Function facility
- Garden centre where the total use area does not exceed 100m^2 in area
- Hardware and trade supplies where the total use area does not exceed 200m^2 in area
- Housing activities, excluding a dwelling house
- Nightclub entertainment facility
- Park
- Place of worship
- Service industry where not exceeding 100m^2 in gross floor area
- Substation
- Theatre
- Utility installation
- Veterinary services

Prohibited Development

- Agricultural supplies store
- Outdoor sales
- Industry activities
- Any other use not listed as permitted development

Development outcomes and requirements - where in the Town Centre Core Zone:

(1) The Town Centre Zone is the heart of our community and is the main place for business, retail and community activities. It is very important that retail and commercial uses do not establish in other zones to maintain the viability of the Town Centre Core as the business hub of the town.

(2) A range of business activities such as offices, food and drink outlets, shops and markets, hardware and trade supplies, service industries, community uses and government offices are supported in the zone.

(3) Enough land is allocated for important public uses, community uses and government services and such land and uses are protected from being used or redeveloped for other purposes. The Choiseul Provincial Government offices, police station, court house, a health clinic (or hospital) and community centre locate in the zone. It is important that community use buildings and government buildings look smart. Minimum land area requirements are recommended for the following uses:

a. Police station and court house: 3000m^2 to 7000m^2
b. Choiseul Provincial Government administration and other government offices: 1.0 to 1.2 ha
c. Community centre: 1000m^2
d. Referral hospital: 0.5 to 1.0ha
e. Primary school: 0.5 to 1.0ha
f. Kindergarten and preschool: 5000m^2

(4) Housing options such as a dwelling unit, dual occupancy, multi-unit dwelling, caretaker's accommodation, short term accommodation (such as a motel) or hostel are supported, where located above a ground floor business activity (such as 'shop top housing') or, to the rear of the business activity. The image below explains this:

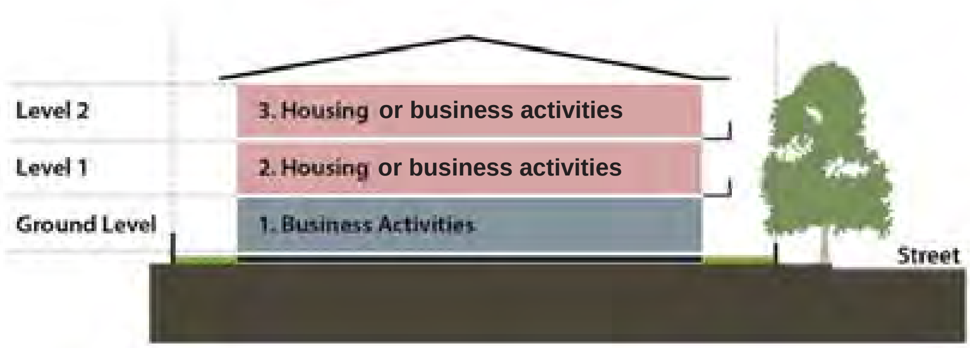


Image – Building use mix in our Town Centre Core Zone, if involving housing or residential uses.

(5) All sites have somewhere for our people to store their cars without having to park on the street. Housing activities have one (1) car parking space for each unit.

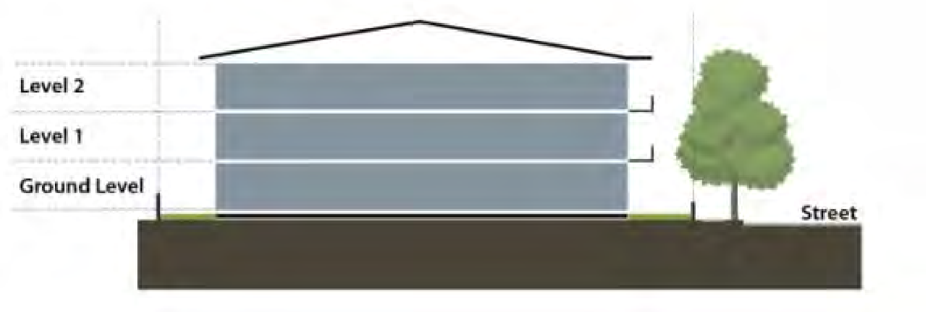
(6) The Town Centre Core Zone is an important meeting place for people in our town and from other villages in Choiseul Province. Development provides open space areas in the zone (including parks, playgrounds and bench seating) that are cool and have many shade trees.

(7) Markets are well located in the zone and are very busy places where people from outside the town come to sell their fresh produce. Markets are located so that noise and smell does not disturb other business and residents. There is opportunity for the market in the town centre to be a 'cold room' market as it will be connected to electricity.

(8) The town centre adjoins a centrally located recreation hub that is intended to accommodate outdoor fields, children's playgrounds and a possible indoor sports centre. Development does not compromise the use of this area for recreation activities. Development also provides road frontage along the entire length of its boundary where adjoining the recreation hub to ensure it is a safe place and can be accessed by all.

(9) There are three gateway entrances to the town that need special design treatment to ensure these areas present well to visitors and people entering our town. Special attention is given to the design of buildings, setbacks and landscaping in these areas. There may be opportunity to include appropriate interpretive signage about the town in these locations.

(10) Buildings in the Town Centre Core Zone are the largest and highest in our town. Building height is a maximum of 12m or 3 storeys, whichever is less. This image below explains this.

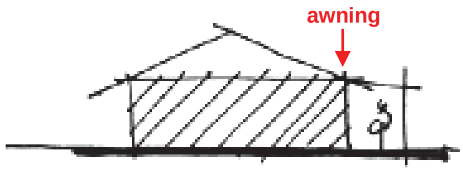


(11) Buildings do not cover more than 80% of the total site area. The image below explains this:

(12) Buildings are setback from the street:
- (a) The same distance as other buildings next to the site; or
- (b) 0 metres if there is no building next to the site.

(13) Where adjoining land in the Community Living Zone, Environment and Conservation Zone or Open Space and Recreation Zone, development in the Town Centre Core Zone is setback at least 6 metres from the adjoining boundary.

(14) In the Town Centre Core Zone, new buildings fronting streets have:
- (a) concrete walking paths at the front of the site that are at least 1.5m wide;
- (b) shady street trees that line the concrete walking paths;
- (c) awnings over the footpath which:
  - (i) cover all the footpath (the full length and width);
  - (ii) line up with awnings on building next to the site;



(15) New buildings face the street and have doors and verandahs that look over the street.

(16) Development impacts (such as light, noise, smell and what we see) do not harm nearby housing areas.

(17) Development protects and does not damage places of importance for cultural practices such as fishing, hunting and gathering and tambu sites.

(18) Development is setback from wetlands, swamps, waters and significant wildlife habitats and protects these values and features.

(19) Roads and walking pathways lined with shady street trees are provided along all streets in our Town Centre Core Zone to connect the heart of our town to places where we live.

(20) Business uses and activities (including storage and operation) in the Town Centre Core Zone do not encroach into the adjoining Open Space and Recreation Zone, Community Living Zone or the Environment and Conservation Zone.

(21) No buildings are constructed on land identified in the natural hazard area as shown on the zoning map (schedule 3). This land is at risk from permanent and/or temporary inundation from tsunami, storm tide inundation, sea level rise, coastal erosion and flooding and it is not safe to establish development in these areas.

3.2.2 Low Impact and Service Industry Zone

Purpose of the zone

The purpose of the Low Impact and Service Industry Zone is to provide for a range of service and low impact industry uses to support local employment and economic development, in locations that are separated from sensitive land uses such as houses and community uses including schools and health care facilities. Some small scale non-industrial and business uses that support industrial activities and the convenience needs of workers may locate in the zone, where they do not compromise the long term use of the land for industrial purposes. Development in the zone avoids impacts to environmental and natural resources and is located and operated to manage the health, wellbeing and safety of the community and not result in impacts of air, noise, odour or waste water emissions.

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Agricultural supplies store
- Caretaker's accommodation
- Emergency services
- Food and drink outlet on Lot 9 where the gross floor area of the use does not exceed 100m^2.
- Funeral parlour
- Garden centre
- Hardware and trade supplies
- Industrial activities being low impact industry or service industry
- Outdoor sales
- Park
- Shop on Lot 9 where the gross floor area of the use does not exceed 100m^2
- Showroom
- Service station
- Substation
- Telecommunications facility
- Transport depot
- Utility installation
- Warehouse

Prohibited Development

- Any other use not listed as permitted development

Development outcomes and requirements - where in the Low Impact and Service Industry Zone:

(1) Our Low Impact and Service Industry Zone is important for local employment and our economy and this land is protected from non-industrial and other incompatible uses. The exception to this is that a caretaker's residence, vocational (industrial) training centre, bulk landscape supply, outdoor sales, service industry and agricultural supplies store may locate in the zone.

(2) A small scale shop or food and drink outlet where servicing the convenience needs of workers and industrial activities, may locate in the zone on Lot 9. These uses do not compromise the long term use of the land for industrial uses or compromise the economic viability of the town centre core. A shop use or food and drink outlet use does not exceed $100m^2$ in gross floor area.

(3) Low impact and service industry uses are built and operated within the Low Impact and Service Industry Zone, and nowhere else.

(4) We do not support noxious and hazardous industry, high impact industry or medium impact industry in this zone.

(5) The Low Impact and Service Industry Zone on Lot 9 does not impact on the operation of, or disturb, the provincial referral hospital or associated housing for medical staff and family carer's accommodation by producing smoke, loud noise, bad smells or bright lights. Industry uses and development maintain a minimum setback distance of 60m from the Special Purpose Zone that supports the hospital.

(6) The interface between the Low Impact and Service Industry Zone on Lot 9 and the adjoining Open Space and Recreation Zone and the Special Purpose Zone (cemetery) is also carefully managed through the siting, design and operation of industry activities. Development is well setback from and maintains a buffer to these other uses.

(7) The Low Impact and Service Industry Zone on Lot 277 does not disturb housing and other sensitive uses in the Community Living Zone by producing smoke, loud noise, bad smells, bright lights or bringing industrial traffic through residential streets. Industry uses are setback from and maintain a vegetated separation buffer of at least 60m from the Community Living Zone. This is important to protect the safety and well-being of existing and future residents.

(8) All industry uses are well setback from the road and landscaped with native plants and trees.

(9) Development does not pollute the land, the sea, the waterways or places of cultural importance through the disposal of contaminated or dirty water or solid waste.

(10) Development protects and does not damage places of importance for cultural practices such as fishing, hunting and gathering and tambu sites.

(11) Development is setback from wetlands, swamps, waters and significant wildlife habitats and protects these values and features.

(12) Development is sensitive and responsive to the natural water cycle and is based on water sensitive urban design principles. This means, development protects water quality of surface and ground waters, does not discharge polluted waters to waterways, does not cause erosion impacts and avoids filling or disturbance to wetlands.

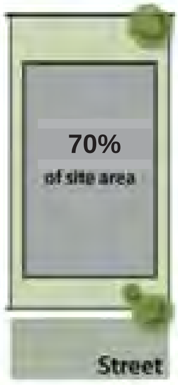
(13) Roads and walking pathways lined with shady street trees are provided along all streets in the zone and connect to other places in our town. 1 Shade tree is provided every 10m along the walking pathway beside the street.

(14) Industry uses and activities (including any storage) in the Low Impact and Service Industry Zone do not encroach into the adjoining Open Space and Recreation Zone, Community Living Zone, Special Purpose Zone or the Environment and Conservation Zone.

(15) No buildings are constructed on land identified in the natural hazard area as shown on the zoning map (schedule 3). This land is at risk from permanent and/or temporary inundation from tsunami, storm tide inundation, sea level rise, coastal erosion and flooding.

(16) Buildings are not higher than 12 metres above ground level. This is shown in the image below:

(17) Buildings do not cover more than 70% of the total site area. This is shown in the image below:



(18) Buildings are setback at least:

(a) 3 metres from the boundary that faces a street;
(b) 0 metres from a side boundary with another lot in an industry zone; or
(c) 6 metres from a side boundary if the property is next to land that is not inside an industry zone;
(d) 0 metres from a rear boundary with another lot in an industry zone; or
(e) 8m from the rear boundary if the property is next to land that is not inside an industrial zone.

(19) On-site car parking is provided to meet the needs of workers and visitors. One (1) parking space is provided on-site per $100m^2$ of gross floor area.

3.2.3 Port and Industry Zone

Purpose of the zone

The purpose of the Port and Industry zone is to support significant economic development in locations that are separated from sensitive land uses such as housing and the hospital. The zone is to provide mainly for port and port related industry uses for which a location adjoining or near the sea is important. This zone also provides for a range of low and medium impact industrial development. Some non-industrial and business uses that support industrial activities, where they do not compromise the long term use of the land for industrial purposes, may also occur in the zone. It is important that all industry activities in the zone are developed in a way that minimises impacts to environmental and natural resource values. Industry uses are also designed, built and operated to make sure our town is a safe place to live and the health, wellbeing and safety of people is protected from impacts of air, noise and odour pollution.

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Aquaculture
- Bulk landscape supplies
- Caretaker's accommodation
- Emergency services
- Food and drink outlet where the gross floor area of the use does not exceed $100m^2$
- Industrial activities being medium impact industry, low impact industry or marine industry
- Landing
- Major electricity infrastructure
- Park
- Port services
- Renewable energy facility
- Shop where the gross floor area of the use does not exceed $100m^2$
- Service station
- Substation
- Telecommunications facility
- Transport depot
- Utility installation
- Warehouse

Prohibited Development

- High impact industry
- Noxious and hazardous industry or Special Industry
- Garden Centre
- Agricultural supply store
- Any other use not listed as permitted development

Development outcomes and requirements - where in the Port and Industry Zone

(1) Port and related industry uses and low impact and medium impact industry uses locate in the zone.

(2) Noxious and hazardous industries, high impact industries or special industries do not locate in this zone or anywhere else in our town. This is very important because these types of industrial activities will negatively impact on the operation and future safety of our provincial referral hospital on Lot 9 and result in disturbances to medical staff and patients.

(3) The efficiency and safety of existing and future industry activities within the Port and Industry Zone is protected from the intrusion of incompatible non-industry uses. Non-industry uses acceptable within the zone may include caretaker's accommodation, fisheries and associated government offices and a police station or other form of security presence. The zone will also provide for a medical incinerator, fuel storage, public convenience, waste transfer station and telecom facility. There may also be opportunity to establish a cannery in the zone which would maximise synergies with fisheries.

(4) A small scale shop or food and drink outlet where servicing the convenience needs of workers and industrial activities, may locate in the zone on Lot 9. These uses do not compromise the long term use of the land for industrial uses or compromise the economic viability of the town centre core. Shop or food and drink outlet uses do not exceed $100m^2$ in gross floor area.

(5) Development does not pollute our land, our water, our town and places of spiritual and cultural importance through the disposal of contaminated or dirty water or solid waste.

(6) A waste water treatment plant is provided on Lot 9 and at least 1.5ha of land is allocated and maintained for this purpose.

(7) Industry uses generating trade waste and effluent must provide additional on-site treatment before connecting to the reticulated effluent system. Development provides for an on-site trade waste treatment facility where required and ensures there is enough land area to accommodate this. Development for the purpose of a waste transfer station is provided to collect and segregate waste into recyclables and other waste streams to be transported to the landfill on Taro Island. The waste transfer station is managed in accordance with an approved integrated waste management plan which identifies and plans how and by whom waste will be segregated, collected, treated and disposed.

(8) Development is designed, built and operated so that smoke, noise, smell, dust and light impacts are not harmful to our people, country, hospital, airport, places of cultural significance and the way we live our lives.

(9) Development is designed, built and operated to make sure that our town and community is a safe place to live. The interface between the Port and Industry

Zone and sensitive uses including existing housing on customary land to the north of the zone and the provincial referral hospital to the east of the zone, must be carefully managed through the siting, design and operation of industry activities to minimise impacts on the health, wellbeing and safety of people.

(10) Port development and any industry use (including storage areas) does not encroach into the Open Space and Recreation zone which serves as a separation buffer between the industry zone and the provincial referral hospital in the Special Purpose Zone.

(11) All industry uses are setback from sensitive uses being the hospital on Lot 9 and existing houses (to the north of Lot 9) by at least:

(a) 150 metres for medium impact industry; and

(b) 300 metres for port uses.

(12) No industrial development, with the exception of maritime infrastructure (such as a jetty or wharf), is built on land identified in the natural hazard area shown on the zoning map (schedule 3). This land is at risk from permanent and/or temporary inundation from tsunami, storm tide inundation, sea level rise, coastal erosion and flooding. Development of maritime infrastructure wherever possible, is designed and constructed to withstand natural hazard impacts.

(13) Development protects and does not damage places of importance for cultural practices such as fishing, hunting and gathering and tambu sites.

(14) Buildings are not higher than 12 metres above ground level in our Port and Industry Zone. This is shown in the image below.

(15) Buildings do not cover more than 70% of the total site area. This is shown in the image below.

(16) New buildings are setback 3.0 metres from the boundary that faces a street:

(17) New buildings are setback from the side property boundary:

(a) 0m along a boundary with another lot in an industry zone; or

(b) 6m if the property is next to land that is not inside an industry zone.

(18) New buildings are setback from any rear property boundary 0m along the boundary with another industry in the industry precinct or, 8m where the rear boundary is next to land that is not inside an industry zone.

(19) On-site car parking is provided to meet workers' and visitors' needs and avoid on-street parking. One (1) parking space is provided on-site per $100m^2$ of gross floor area.

(20) At least 1 shade tree is provided for every 10 metres of street frontage.

(21) A safe and efficient walking path and road access is provided to connect our port and industry area with the main township.

(22) Development does not result in negative impacts on nearby environmental and natural resource values.

3.2.4 Community Living Zone

Purpose of the zone

The purpose of the Community Living Zone is to provide for different types of housing such as houses on smaller lots, larger lots and multiple units to meet the different housing needs of people in our community including large families, elderly, single people and government workers. The zone is well serviced with infrastructure and is supported by a range of community uses, local parks and playgrounds that cater for the local community making it easy for our people to access community services. Some small scale non-residential uses catering for the needs of the local community and where compatible with residences, may also locate in the zone.

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Animal keeping where limited to no more than 6 chickens and 2 pigs per lot
- Housing activities
- Community activities
- Child care centre
- Education establishment
- Park
- Place of worship
- Office use or shop (being a corner store), but only where the gross floor area of the shop or office does not exceed $100m^2$
- Utility installation

Prohibited Development

- Animal keeping other than as described above
- Cemetery
- Industry uses
- Office uses other than as described above
- Warehouse uses
- Any other development or uses not described above

Development outcomes and requirements – where in the Community Living Zone

For development in the Community Living Zone, the development outcomes and requirements sought for the zone are as follows:

(1) Different types of housing such as houses on smaller lots, larger lots and multiple units are provided to meet the different housing needs of people in our community including large families, elderly, single people, visitors and government workers.

(2) Residential development locates in the Community Living Zone and does not encroach into the Environment and Conservation Zone or the Open Space and Recreation Zone.

(3) No new housing is built on land identified in the natural hazard area as shown on the zoning map (schedule 3). This land is at risk from permanent and/or temporary inundation from tsunami, storm tide inundation, sea level rise, coastal erosion and flooding and it is not safe to construct houses in these areas.

(4) Development protects and does not damage places of importance for cultural practices such as fishing, hunting and gathering and tambu sites.

(5) Community uses such as the primary school, kindergarten, community centre, churches and recreation activities are grouped together so that everyone in our community has easy access to a good range of facilities and services. Minimum land area requirements are recommended for the following uses:

- a. Community centre: 1000m^2
- b. Primary school: 0.5 to 1.0ha
- c. Kindergarten and preschool: 5000m^2

(6) A range of useable and accessible open spaces, including local parks and children’s playgrounds are available for the use and enjoyment of all residents. It is important for these areas to be highly accessible and visible by housing.

(7) All new housing is designed and built for our lifestyle and hot humid climate. This includes ensuring lot sizes allow enough room for outdoor traditional kitchens and vegetable gardens.

(8) Building height and size does not look out of place with other buildings near the site.

(9) Buildings or structures are a maximum of 2 storeys or 8.5 metres in height, whichever is less. This is shown in the images below.

(10) Buildings or structures for housing do not cover more than 60% of the site area. This is shown in the image below.

(11) Buildings are setback from the main street frontage and from each other for privacy, to reduce risk of fire hazard (especially with outdoor kitchens) and to create an attractive view from the street. Buildings are setback:

(a) a minimum distance of 6 metres from the main street frontage:
(b) at least 2 metres from any side property boundary, but for an outdoor traditional kitchen the setback is at least 3 metres from the side boundary;
(c) at least 6 metres from any rear property boundary.

(12) Industrial development does not occur in the Community Living Zone and industry uses will not be supported in the zone.

(13) Business and commercial type activities do not generally occur in our Community Living Zone. However, where there is a demonstrated community need, business and commercial uses may locate in the zone where:

(a) the development is small in size and does not exceed 100m2 in gross floor area; and
(b) if involving a hospitality or retail use, development is limited to only a corner store, restaurant, cafe, club or a motel up to 20 rooms; and
(c) development does not cause noise or traffic disturbance to people living in the area; and
(d) locates close to the Town Centre Core Zone.

(14) Land for our primary school and kindergarten is protected and these uses are located close together in a central position within the zone, to make it easy and safe for children and families to get to school. At least 5000m2 to 1ha of land is allocated for these uses so there is enough land for them to grow and expand in the future.

(15) Home based business is supported in all areas of the Community Living Zone, as long as it is small in size, does not compete with other uses in the Town Centre Core Zone and does not disturb people living in the area by way of noise, smell or light.

(16) Development is setback from wetlands, swamps, waterways and significant wildlife habitats.

(17) Development is sensitive and responsive to the natural water cycle and is based on water sensitive urban design principles. This means, development protects water quality of surface and ground waters, does not discharge polluted waters to waterways, does not cause erosion impacts and avoids filling or disturbance to wetlands.

(18) Roads and walking pathways lined with shady street trees are provided along all streets in our Community Living Zone to connect important places in our town (such as the community centre, primary school, medical clinic, sport and recreation area, children's playground, churches, Choiseul Provincial Government offices and training centres), to places where we live.

3.2.5 **Special Purpose Zone**

Purpose of the zone

The purpose of the Special Purpose Zone is to provide for development that is consistent with the use intended for the Special Purpose Zone within which it is located, as identified on the zoning map (schedule 3).

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Air services infrastructure being a helicopter landing pad near the provincial hospital on Lot 9
- Substation where not located in the same Special Purpose zoning as the hospital or Choiseul Bay Secondary College
- Telecommunications facility
- Utility installation
- Any purpose and related activity specified in the relevant Special Purpose zoning for the subject site

Prohibited Development

- Any other use not listed as permitted development

Development outcomes and requirements - where in the Special Purpose Zone:

(1) Special Purpose Zone – Hospital and Industry Vocational Training Centre

(a) Development for the purpose of an industry vocational training centre is established on the western portion of the zone to maximise synergies with the Port and Industry Zone.

(b) Development for the purpose of a hospital and carer's accommodation servicing all of Choiseul Province is established on the eastern portion of the zone. At least 0.5 to 1.0ha of land is allocated and protected for the purpose of the provincial referral hospital development.

(c) The provincial hospital and carer's accommodation uses are adequately separated from existing and future industry uses to ensure that patients, medical staff and visitors are safe from potential industrial hazards.

(d) An area within the zone is reserved for a helicopter landing pad, which is protected from the encroachment of development for any other purpose.

(2) Special Purpose – CBPSS

(a) Development for the purpose of the Choiseul Bay Provincial Secondary School (CBPSS), serving the secondary school needs of the province, is adequately separated from the future Gnalivoli Highway and nearby crocodile habitat to ensure the safety of students and staff.

(b) Access to the Sui River from the CBPSS is designed to reduce the risk of crocodile attack and maximise the safety of people.

(c) Appropriate signage is included to warn and discourage children from entering known crocodile habitat areas.

(3) Special Purpose – Cemetery

(a) The cemetery is designed to allow for future expansion as demand for space increases over time. At least 0.5 to 1.0ha of land is allocated for the cemetery use.

(b) The cemetery is setback from the main access road into lot 9 and from the adjoining Low Impact and Service Industry Zone, to reduce visual and noise impacts on visitors to the cemetery.

(c) Seating and an informal public recreation space is provided within or adjoining the cemetery.

(4) Special Purpose – Rural Vocational Training Centre, Forestry, Agriculture and Farming Demonstration

(a) Development for the purpose of a rural vocational training centre and the agricultural land division and demonstration farm are established close together to maximise synergies between the activities.

(b) The forestry division may also establish in the zone to maximise synergies with the rural vocational training centre.

(c) The best quality agricultural land within the zone is preserved for farming activities.

(d) The proximity to the Sui River may also present an opportunity for a transformer substation associated with the proposed hydro-power scheme to locate in the zone. Such a facility should locate towards the rear of the zone and outside of the natural hazard area, unless an alternative location in a different zone is supported by a detailed study.

(e) During construction and earthworks are managed to avoid runoff and pollution entering nearby waterways and wetlands, including the Sui River

(5) Special Purpose – Airport

(a) Development does not encroach into the area designated for the Taro airstrip and nor does it interfere with the operation or safety of air services in any way.

(b) Development does not interfere with the potential future expansion of the airstrip necessary for it to accommodate Dash 8 aircraft.

(c) Subject to a detailed assessment demonstrating feasibility, the airstrip may be expanded to accommodate Dash 8 craft. This may also involve expansion or upgrading of the airport passenger terminal.

(d) Any future expansion or redevelopment of air services infrastructure is designed to withstand and minimise natural hazard impacts from tsunami, storm tide inundation, coastal erosion and sea level rise.

(6) Special Purpose – Landfill

(a) Development for the purpose of a solid waste landfill is located in Mosquito Creek on Taro Island. A detailed study is undertaken to ensure the landfill is appropriately designed, managed and operated to avoid adverse impacts on the environment including surface water, ground water, air quality and the values of the coastal zone and reef.

(b) The landfill is operated and managed in accordance with an approved integrated waste management plan (IWMP) which identifies waste management infrastructure and plans how and by whom waste will be segregated, collected, treated and disposed.

(c) Burning of rubbish is avoided as it creates air pollution, bad smells and health hazards from the production of toxic gases.

(d) The design of the landfill also includes measures (such as a bund wall or other barrier) to minimise risk of natural hazard impacts, particularly from tsunami and coastal storm inundation.

(7) Special Purpose – Waste Water Treatment Plant and Waste Transfer Station

(a) Development for the purpose of a waste water treatment plant and associated drying beds for bio-solids is provided to the west of the town on lot 277. At least 6.5ha of land is allocated and protected for this purpose. An additional 1ha of land is allocated on lot 9 for this purpose. The centralised waste water treatment plant is intended to treat waste water from septic tanks and incorporate relatively passive treatment technologies that use natural processes to treat wastewater to a high standard for infiltration into ground water. Further studies are required to determine the suitability of the site and assess, organise, plan and design an appropriate sewerage service and wastewater treatment plant specifications for Lot 277 and lot 9. Subject to the recommendations of these studies, the preferred location for the waste water treatment plant sites:

(i) Are adjacent to the existing estuarine wetland areas to enable infiltration of treated effluent into groundwater without impacting adjoining land uses;

(ii) Contain suitable aquifer characteristics such as presence of sand, coral or an alluvium dominated aquifer below the estuarine muds;

(iii) Are preferably sited at an elevation of 2m above MSL or higher to prevent excessive groundwater mounding. Top of bank ponds and wetlands are above the 1 in 100 year inundation level. The base of the vertical wetland is free of tidal influence.

(b) The waste water treatment plants are located, designed and operated in accordance with an approved environmental management plan for the activity.

(c) Any outfalls for post treatment of residual fluids maintain an adequate distance and setback from the sea, shoreline and town.

(d) It is important to make sure sufficient land is allocated for the waste water treatment plant and associated drying beds for treatment of bio-solids. ha

(e) Development for the purpose of waste transfer station is provided to collect and segregate waste into recyclables and then transport waste to the landfill on Taro Island. The waste transfer station is managed in accordance with an approved integrated waste management plan which identifies and plans how and by whom waste will be segregated, collected, treated and disposed.

3.2.6 **Open Space and Recreation Zone**

Purpose of the zone

The purpose of the Open Space and Recreation Zone is to provide spaces and facilities for a range of sporting and recreation activities that provide opportunities for all members of the community to participate in informal and formal recreation and sporting activities. Areas within the zone such as parks, playing fields and playgrounds are easily accessible by the community. Development may include built structures such as shelters, public toilet facilities, picnic tables, clubhouses, indoor sports centre or stadium, gymnasiums, public swimming pools, tennis courts and other infrastructure to support the activities and provide safe access. Some land in the zone may also include areas of environmental importance (such as wetlands and habitats), separation buffers between incompatible uses and other land that is generally unsuitable for development.

Permitted Development

- Vegetation clearing, excavation, subdivision, amalgamation and adjustment of lots
- Club
- Environment facility
- Food and drink outlet, if less than 100m2 in gross floor area and supporting a recreation activity
- Major sport, recreation and entertainment facility being a sports centre or stadium
- Nature-based tourism
- Park
- Recreation activities
- Telecommunications facility
- Tourist attraction
- Utility installation
- Animal husbandry in locations not being used for recreation activities
- Animal keeping in locations not being used for recreation activities
- Cropping in locations not being used for recreation activities
- Wholesale nursery in location not being used for recreation activities

Prohibited Development

- Housing activities
- Intensive animal husbandry
- Intensive horticulture
- Rural industry
- Aquaculture
- Any other use not listed as permitted development

Development requirements and outcomes - where in the Open Space and Recreation Zone:

(1) This zone is protected for open space and recreation uses.

(2) The community focal point for recreation activities will be the centrally located sports and recreation hub on Lot 277 adjoining the Town Centre Core Zone and Community Living Zone. At least 2.0ha of land is allocated and protected for a variety of recreation purposes such as outdoor playing fields (for soccer, netball and others sports), a possible future sports centre or stadium and a children's playground, centrally located in the town.

(3) Other uses do not occur in this zone unless they are for a food and drink outlet or are small in size and support the use of the zone for open space and recreation.

(4) Land within this zone that is not used for outdoor sports such as soccer fields, is protected as informal places for our community to play, exercise and meet others.

(5) Infrastructure needed for informal recreation purposes, including walking tracks, park seating, public toilets, picnic tables, shelters and playground equipment are provided in locations that are highly accessible and visible from housing. This makes our parks and open space areas safe.

(6) Some land in the zone is used as a separation buffer between incompatible uses (such as between housing and industry on Lot 277 and between the referral hospital and industry zones on Lot 9) or, to identify the edge of the town where no further growth will occur and to prevent sprawling development. These separation buffers are very important and are maintained for the purpose of a buffer. This is particularly important for the protection and safety of the referral hospital on Lot 9. No industry uses including any storage or other associated activities, are supported in the Open Space and Recreation Zone.

(7) The Open Space and Recreation Zone surrounding the Choiseul Bay Province Secondary School functions as a separation buffer and provides opportunities for the school to use the land for growing plants and gardens. It is important the school is well setback from the future highway and from the mangrove forests along the Sui River which contain crocodile habitat.

(8) Other land in the zone contains constrained land such as large wetlands, swamps, hilly land and agricultural land opportunities. These areas are maintained in a natural state to the greatest extent possible. Development such as housing, town centre core uses and industry uses do not expand into the Open Space and Recreation Zone. There is enough land zoned to accommodate urban development and the growth of the town well beyond the life of the planning scheme.

(9) Impacts of development on nearby residents are managed through adequate separation distances and the siting, design and operation of recreation activities.

(10) A range of useable and accessible open spaces, including local parks are available for the use and enjoyment of all residents.

(11) Development for recreation activities is highly accessible and connected to the places where we live in the town.

(12) Concrete walking tracks link areas of open space to the rest of our town.

(13) Development is sensitive and responsive to the natural water cycle and is based on water sensitive urban design principles. This means, development protects water quality of surface and ground waters, does not discharge polluted waters to waterways, does not cause erosion impacts and avoids filling or disturbance to wetlands

3.2.7 Environment and Conservation Zone

Purpose of the zone

The purpose of the environmental management and conservation zone code is to protect and manage areas identified as supporting important ecological values, wildlife habitats for plants and animals, maintaining water quality and supporting other natural processes associated with the sea, river and land. Development protects the natural, cultural and spiritual values of the Sui River, mangrove forests, swamps, wetlands, island reefs, bush and the sea.

The zone also includes land at risk from natural hazards of tsunami, storm tide inundation, coastal erosion, sea level rise and flooding. It is very important the mangroves are maintained for their protective functions against natural hazard impacts and these areas are maintained in a natural state to the greatest extent possible. The important environmental and natural resource values of the zone are protected for current and future generations and to ensure their ongoing contribution to the natural environment and to the health and safety of our land and people.

Permitted Development

- Limited vegetation clearing and limited excavation where associated with uses identified as permitted development
- Landing
- Housing activity where limited to:
  - a passenger rest shelter adjacent to the jetty on Lot 277; and
  - only where located outside of the natural hazard area.
- Nature-based tourism not involving tourist and visitor short-term accommodation
- Market
- Roadside stall
- Warehouse for the purpose of providing secure boat storage adjacent to the jetty and river access points on Lot 277
- Utility installation

Prohibited Development

- Any other use not listed as permitted development

Development outcomes and requirements – where in the Environment and Conservation Zone:

For development in the Environment and Conservation Zone, the development outcomes and requirements sought for the zone are as follows:

(1) Environmental and natural resource values within the zone, particularly those that have a strong connection to our people and culture, are protected from the negative impacts of development located within and adjoining the zone.

(2) This zone is protected in its natural state, with development only being supported where it is for a conservation or environment activity or low impact nature based recreation activity that does not damage the land.

(3) Development does not impact on the ability of local people to access watercourses and other culturally significant areas for traditional practices and recreation purposes.

(4) The zone also includes land that is known to be at significant risk from natural hazards resulting in permanent or temporary inundation from tsunami, storm tide inundation, sea level rise, coastal erosion and flooding events. Development does not clear the mangrove forests or other coastal vegetation within land identified as a natural hazard area on the zoning map (schedule 3). This vegetation provides an important protective function against natural hazard impacts of coastal erosion and reducing wave impacts from tsunami and storm tide inundation events.

(5) Clearing of vegetation in the zone is not supported, unless the clearing is for:

(a) local people to access the sea, watercourses and other culturally significant areas for traditional practices (such as collection of bush materials and bush foods);
(b) the construction of maritime infrastructure (such as a jetty, wharf, boat ramp or boat storage facility);
(c) construction of a road to improve access to the sea;
(d) pedestrian access (such as a pathway or raised boardwalk through the mangroves and wetlands) to improve access to the sea;
(e) a community market by the sea on Lot 277.

(6) Wide and continuous areas of mangroves and vegetation are kept beside the Sui River, streams, creeks, swamps and wetlands. This vegetation functions as an important buffer to maintain and protect the high quality water we drink and use for other purposes. It is also important for our people's health and the quality of the environment that these areas are not used as a public convenience (toilet) or to dispose rubbish.

(7) Areas of cultural importance are protected from development.

(8) Development being housing or any other use in the Town Centre Core Zone, Special Purpose Zone or an industry zone, does not encroach into or locate in the Environment and Conservation Zone.

(9) Development is sensitive and responsive to the natural water cycle and is based on water sensitive urban design principles. This means, development protects water quality of surface and ground waters, does not discharge polluted waters to waterways, does not cause erosion impacts and avoids filling or disturbance to wetlands.

3.2.8 **Limited Development Zone**

Purpose of the zone

The purpose of the Limited Development (constrained land) Zone is to identify land known to be at significant risk from permanent or temporary inundation from tsunami, storm tide inundation, sea level rise or coastal erosion. These constraints, particularly areas at risk from tsunami inundation, affects nearly all land on Taro Island and part of Supizae Island[1] and pose severe restrictions on the ability of the land to be developed for urban purposes. This land is only suited to very limited forms of development and it is important that development maintains the safety of people. It is intended that existing development and uses in the zone (except the airstrip and a new landfill), will be relocated onto the mainland of Lot 9 or Lot 277 by around 2030. The establishment of new development and buildings on vacant land in the zone is discouraged. In limited circumstances, new development or redevelopment of existing uses may occur, where it can be demonstrated that relocation to the mainland is unlikely to occur within the next 5 years and development can be designed and constructed to maintain the safety of people from natural hazard impacts.

Permitted Development

- Building work where the habitable floor level is at least 1metre above natural ground level, to minimise impacts of tsunami inundation
- Environment facility
- Emergency services
- Utility installation

Prohibited Development

- Subdivision of land
- Any other use not listed as permitted development

[1] Only the northern part of Supizae Island (where owned by the Choiseul Provincial Government) is within the local planning scheme area and has been included in the Limited Development Zone. The balance of Supizae Island is owned by customary land owners. While the planning scheme has no statutory effect over customary land, the balance of Supizae Island is very likely to be subject to the same natural hazard risks as Taro Island. The CPG will liaise with customary land owners to ensure any development decisions on Supizae Island maintain the safety of people.

Development outcomes and requirements – where in the Limited Development Zone[2]:

(1) The establishment of new development including new buildings (such as housing) or the redevelopment or expansion of existing development in the zone is not supported, unless it is demonstrated that:

(a) relocation to the mainland of the equivalent existing development is unlikely to occur within a 5 year period; and

(b) development can be sited, designed and constructed to maintain the safety of people from the risk of a present day 1 in 100 year tsunami. This means all habitable rooms of buildings have a minimum floor level of at least 1 metre above natural ground level.

(2) A building with floor levels greater than 1 metre above natural ground level is designed and constructed to withstand the depth and force of waters and debris associated with a present day 1 in 100 year tsunami. This means a building is designed to prevent buoyancy and floating off its foundations. This is achieved by ensuring the building is suitably reinforced and the frame and associated structural members are strongly fixed and braced to the foundations[3].

(3) Minor building work not exceeding $50m^2$ for the purpose of an industry use that is an extension to an existing industry activity may occur within the Limited Development Zone.

(4) A tsunami refuge shelter, incorporating enclosed and lockable storage areas, is constructed on Taro Island and Supizae Island to provide a safe place to store emergency supplies and communications in the event of a tsunami, and also for providing shelter to all people particularly the elderly, children, infirm and patients of the hospital. The refuge shelter is located and designed to be above the present day 1 in 100 year tsunami event, which is expected to inundate up to approximately 3.0 to 3.5m above MSL[4] (mean sea level) and, is constructed to

[2] Applications for development and planning permission will be referred to the National Disaster Management Office for review and comment, prior to a recommendation and decision being made on the development application.

[3] Sandy soils require deep foundations because these soils are highly erosive. Flowing or swirling water erodes out the base of foundations resulting in the structure becoming very unstable and collapsing.

[4] The ground level for Taro Island around the markets, Choiseul Provincial Government offices and hospital is approximately 1.5m above MSL. Best available science and hazard modelling indicates the ‘present day’ 1 in 20 year tsunami will inundate up to approximately 2.0-2.5m MSL and, the ‘present day’ 1 in 100 year tsunami will inundate up to approximately 3.0-3.5m MSL, depending on the tide conditions. The small hill behind Mosquito Creek (near the existing church) rises to approximately 4.0m MSL, with only about 2ha being higher than 3.0m MSL. Being the highest point on Taro Island, this area provides the greatest level of protection from inundation and should be used for the construction of the refuge shelter. Ground levels on Supizae Island are currently unknown, and as such, a suitable location for a refuge shelter on Supizae Island is yet to be determined.

withstand a 1 in 100 year local earthquake[5]. The refuge shelter is to be located on the small hill behind ‘Mosquito Creek’ (proximate to the church) on land at or above 3.5 MSL, or higher if practical;

(5) The refuge shelter is to be fitted with a 10,000 litre rain water tank. Lockable storage compartments are to be stocked with emergency non-perishable food, medical provisions (including a mobile pharmacy), a radio, a mobile generator and other clean-up equipment for use immediately following a tsunami event.

[5] A 1 in 100 year (on average) local seismic event, would be of approximate magnitude 8.2 Mw and where the epicentre of the earthquake is within about 100km of Taro Island (similar magnitude to 2007 Gizo event).

3.2.9 **Future Investigation Zone**

Purpose of the zone

The purpose of the Future Investigation Zone is to identify land that may potentially be suitable for town expansion purposes and to protect this land for development until it is needed at a future time. The planning scheme has allocated enough zoned land to accommodate the expected growth of the town (such as housing, industry and town centre uses) for the life of the planning scheme and beyond 2030. This zone may also contain areas of land unsuitable for development due to environmental values, steep land or other constraints. It is intended to investigate the suitability of this land for possible future urban development. Development that is likely to compromise appropriate long term development potential of this area will be avoided and discouraged.

Permitted Development

- Rural activities limited to animal husbandry, animal keeping, cropping or permanent plantation.
- Recreation activities being a park.

Prohibited activities

- Any other use not identified as permitted development.

Development outcomes and requirements – where in the Future Investigation Zone:

(1) Development in the Future Investigation Zone does not compromise the future development potential of the area for town expansion or other uses and activities.

(2) The suitability of land for future town expansion is investigated, prior to any urban development occurring.

(3) Development is able to respond to land constraints including but not limited to topography, flooding, environmental values, waterways and steep land.

(4) Land must be developed in an orderly sequence, provide for integration of development with the existing town including community infrastructure, open space and important natural features, wildlife corridors and habitats are protected.

(5) Roads and other transport corridors are coordinated and interconnected to ensure access to our town and to where people live.

4 Infrastructure

4.1 Planning assumptions and population projections

There are no official population projections for Taro Island. For the purpose of this planning scheme, projections for Choiseul Province as a whole, together with the expected urbanisation rate, has been used to project future population growth of the mainland expansion area[6].

Extrapolating historical growth rates for Choiseul Province to the year 2029, a population of up to 47,000 people might be expected for the entire province. Estimates of the number of people who might be expected to live in the capital can be taken from the 2009 provincial urbanisation rates shown in the table below.

The table shows that, excluding Guadalcanal Province, current rates of urbanisation are between 3.0% and 9.3%. Applying this to the projected population for Choiseul Province of 47,000 people, the population of the provincial capital in 2029 might be between 1,410 and 4,371 people. For planning purposes, the higher estimate of 4,371 people is rounded up to 5,000 people.

Provincial and Urban Centre Populations, 2009

Province		Urban Centre		% Urbanisation
Choiseul	26,372	Taro	810	3.0%
Western	76,649	Gizo	3,547	4.6%
Isabel	26,158	Buala	971	3.7%
Central	26,051	Tulagi	1,251	4.8%
Guadalcanal	93,613	Honiara	64,609	69%
Malaita	137,596	Auki	5,105	3.7%
Makira-Ulawa	40,419	Bauro Central	2,074	5.1%
Temotu	21,362	Luva	1,982	9.3%

[6] At the 2009 census, there were 810 people living on Taro Island. There was an increase of 370 people over a 19 year period and an average annual growth rate of approximately 4.4%. An extrapolation of the compound growth rate indicates the population of Taro could be around 1,491 people by 2029 if the same level of growth continued. An estimate of future population based on historical compound rate of growth has limited usefulness in the context of planning for the new town. This is because the figures are based on extrapolation of historical trends and cannot be expected to continue due to land capacity limitations on Taro and because the mainland expansion is likely to attract a higher level of urban migration due to employment and economic opportunities.

The local planning scheme has zoned enough land to accommodate an ultimate capacity of up to 5,000 people. The following planning assumptions have been made to achieve this population capacity:

Community Living Zone

- 41ha of land is allocated to this zone, which equates to a net developable[7] area of 32.8ha once roads and parks have been accounted for
- Of the net developable area, it is assumed that up to 10% of this area will be developed for non-residential uses such as community uses (primary school, kindergarten, community centre etc), home based businesses, small scale corner store and office uses or subject to other site constraints.
- A variety of lot sizes will be accommodated in accordance with the following:
    - 25% of 400sqm lots = 205 lots
    - 50% of 600sqm lots = 273 lots
    - 15% of 1,000sqm lots = 49 lots
- Occupancy rates will reflect the current occupancy rate on Taro Island (5.59 people / dwelling)
- A total of 527 dwellings can be accommodated within the community living zone, housing an ultimate population capacity of 2,946 people

Town Centre Core Zone

- 29.6ha of land is allocated to this zone, which equates to a net developable area of 23.68ha once roads and parks have been accounted for
- Average lot size within the zone will be 300sqm
- Approximately 50% of businesses will incorporate a residence (such as shop top housing)
- Occupancy rates will reflect the current occupancy rate on Taro Island (5.59 people / dwelling)
- A total of 394 dwellings can be accommodated within the town centre core zone, housing an ultimate population capacity of 2,202 people

Hence, based on the above assumptions[8], the ultimate population capacity for the community living and town centre core zones combined is potentially up to 5,148

[7] Net developable area means the area of land available for development. It does not include land that cannot be developed due to constraints such as flood affected land, steep land, areas of environmental significance. For the purpose of this planning report, net developable area has allowed for 10% of land for roads and 10% of land for parks. No other constraints have been accounted for in this exercise.

[8] Modifying the assumptions around density, lot size and mix and percentage of net developable area will change the expected population capacity. Housing associated with the hospital, carer's accommodation and caretaker's dwellings have not been included in the assumptions and would provide some additional population capacity.

people. Therefore, there is sufficient zoned land to accommodate the projected population of the provincial capital, which is expected to be between 1,410 and 4,371 people in 2029. The planning scheme has also identified additional land (18.8ha) as a future investigation area for possible future town expansion (subject to determining land suitability).

Based on these assumptions, there will be no need to expand the town outside of existing urban zoned areas until at least 2029, or until the population is around 4000 people. Expansion of the town outside of existing zoned areas is not supported.

4.1.1 **Infrastructure requirements for development**

It is important for land use planning and infrastructure planning to be integrated and well organised. This ensures that development is provided with suitable infrastructure to service its needs and the infrastructure provided is safe and helps support the prosperity of our town and community.

Planning and sequencing infrastructure is very important to ensure infrastructure is provided in a way that is affordable and maximises the use of existing infrastructure. The best way to achieve this is to sequence development and limit the number of development fronts. Too many development fronts growing in different directions throughout the town makes disjointed development and the cost of providing infrastructure more expensive.

Development in our town is provided with all the necessary infrastructure to meet the needs of development. In some instances, the infrastructure needed to service the development may not be available. Where infrastructure is not yet available, development must demonstrate how the development will be serviced with the required infrastructure. If development cannot be adequately serviced, it may mean that development is pre-mature, out of sequence or not the most appropriate land use.

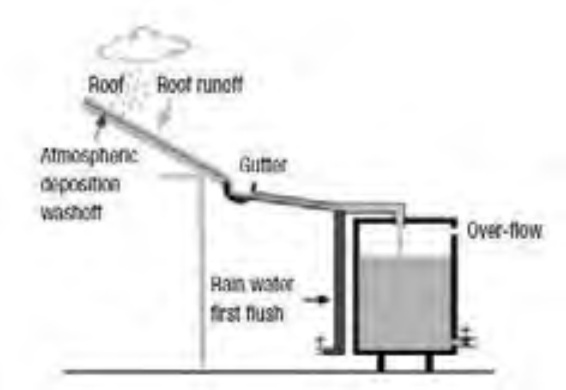
The infrastructure to be provided to support the town is described in the following sections.

4.1.2 **Water supply**

It is intended that all urban areas in the town including all housing, industry areas, special purpose areas and the town centre, will have water distributed to each lot by pipeline. The water supply source is the Sui River and a further study is required to organise and plan the water supply system. Identification and protection of the water supply pipeline corridor and ensuring development does not compromise the corridor and distribution of water to the town, is very important.

All development is provided with an appropriate water supply. This is achieved by:

- Each lot is connected to the water supply system; or
- Where the water supply pipeline is not available, each lot and premises is provided with an alternate potable water supply source (eg: rainwater, borewater) with a minimum storage capacity of 10,000 litres. This is explained in the image below.



Source: After the Tsunami: Sustainable Building Guidelines – South East Asia, UNEP 2007

- In the absence of a dedicated fire brigade, fire hydrants are provided or the reticulated water system provides a tap connection at the front of each lot to allow a hose connection for fire fighting purposes.

4.1.3 **Sewerage and waste water treatment**

For sewage and waste water treatment, it is intended that all urban areas in the town, including all housing, all development in the town centre, some industry uses (where not involving trade waste) and some special purpose areas, will be serviced by a simplified wastewater management sewerage system. This involves each lot or premises having individual septic tanks that are connected by pipe to a centralised waste water treatment facility located on Lot 277 and Lot 9. Septic tanks on individual lots provide the primary treatment of waste water (allowing for digestion and settlement within the tank) with liquid effluent from the septic tank pumped or flowing by gravity to the centralised waste water treatment plant for further processing. The centralised facility will incorporate relatively passive treatment technologies that use natural processes to treat wastewater to a high standard for infiltration into groundwater.

Given development in the town will include a range of lot sizes, including lots in the order of 300m^2 (in the Town Centre Zone) and 400m^2, 600m^2 and 1000m^2 (in the Community Living Zone), such lot sizes will be too small to safely accommodate traditional septic tank designs and will not provide healthy living environments. The proposed wastewater treatment system avoids the need for local soakaways for effluent disposal by pumping effluent to a centralised facility for treatment (settlement, biological treatment and infiltration).

Industry uses generating trade waste and effluent must provide additional on-site treatment before connecting to the reticulated effluent system, or fully treat and dispose of all trade waste and sewage locally. Lot sizes of industrial land must be large enough to provide for this on-site requirement, in addition to any other development requirements.

Based on the planning assumptions identified in this report, the land area requirements for a wastewater treatment facility[9] on Lot 277 and Lot 9 are estimated to be 6ha and 1ha respectively and can be broken down into the following components:

[9] Land area requirements for wastewater treatment facility assumes a population of 5,500 which is higher than the population projections used in this report of 5,000. The land area requirements for wastewater

LAND AREA ESTIMATES (hectares) FOR LOT 277

Initial Land Requirements	Existing Taro Is population	Ultimate population (5,000)
Facultative Lagoon/Reed Bed	0.60	3.4
Vertical Flow Subsurface Wetland	0.43	2.3
Sludge Reed Beds (Composting)	0.03	0.18
Ancillary (access, control room)	0.2	0.2
Total	**1.3**	**6.01**

LAND AREA ESTIMATES (hectares) FOR LOT 9

Initial Land Requirements	Ultimate population
Facultative Lagoon/Reed Bed	0.5
Vertical Flow Subsurface Wetland	0.3
Sludge Reed Beds (Composting)	0.02
Ancillary (access, control room)	0.2
Total	**1.00**

Further studies are required to assess, organise, plan and design an appropriate sewerage service and wastewater treatment plant specifications for Lot 277 and Lot 9. Subject to the recommendations of these studies, the preferred location for the waste water treatment plant:

- Is adjacent to the existing estuarine wetland areas to enable infiltration of treated effluence into groundwater without impacting adjoining land uses;
- Provides suitable aquifer characteristics such as presence of sand, coral or alluvium dominated aquifer below the estuarine muds;
- Is preferably sited at an elevation of 2m above MSL or higher to prevent excessive groundwater mounding. The top of bank of ponds/wetlands should be above the 1 in 100year inundation level. The base of the vertical wetland is free of tidal influence.

All development is provided with appropriate sewage disposal: This is achieved by:

- Development of each lot provides a septic tank connected to the sewerage service. This is explained in the image below:

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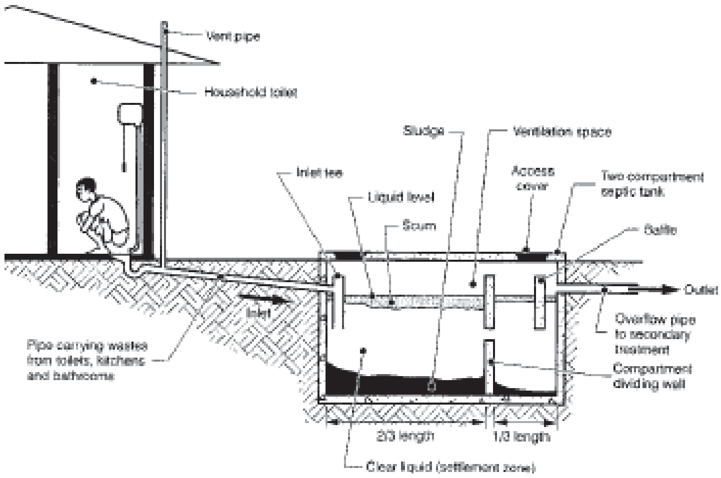
treatment are estimates only and need to be confirmed by a detailed study. Land area estimates for both waste water treatment plants also assumes that 20% of this land will be taken up by earth walls and other siting constraints.



Source: After the Tsunami: Sustainable Building Guidelines – South East Asia, UNEP 2007

- The design and operation of septic tanks on land in the Community Living Zone and Town Centre Core Zone do not have soakaways, soak pits, infiltration trenches or provide for on site irrigation.
- For industrial uses generating trade waste, development must provide an on-site trade waste and effluent treatment and disposal system. Lots sizes are large enough to provide for this system.
- Untreated sewage is not discharged to any fresh water source including the Sui River, wetlands, groundwater, other waterways or the sea.
- Septic tanks are located and designed to ensure easy access for sludge removal and maintenance and are sufficiently setback from houses.
- Wastewater is not disposed into public drains or to the street.
- Any outfalls for post treatment of residual fluids maintains an adequate distance and setback from the sea, shoreline and town

4.1.4 **Electricity**

Electricity supply to the town is to be generated from a hydro-power facility on the Sui River. A further study is required to plan and organise the electricity supply network.

All development is provided with appropriate electricity supply. This is achieved by:

- All development and each lot is connected to an electricity supply network in accordance with the requirements of the energy provider.

4.1.5 **Telecommunications**

Development and each lot is provided with telecommunication services. This is achieved by:

- All development and each lot is connected to telecommunication services in accordance with the requirements of the provider.

4.1.6 **Stormwater management**

It is important for stormwater management to be considered early on when thinking about land development. Urban development significantly changes the rainfall and water runoff characteristics of land. Water runs off the land much more quickly and in larger volumes in urban areas compared to a natural state. In urban areas, the increased flow and speed of water runoff also results in erosion impacts and carries pollutants, sediments and contaminants from the land into the rivers, waterways, wetlands and the sea, potentially impacting on water quality and aquatic organisms. To help minimise these damaging impacts, it is important to address stormwater management (quality and quantity) early on and across broad areas of the town, rather than just adopting a site by site basis. This approach means that stormwater management measures can accommodate natural catchments, landform and soil characteristics and inform the subdivision design and detailed layout of the town. Incorporating water sensitive urban design (WSUD) principles and approaches into the layout of the town means the town will achieve much better stormwater management and water quality outcomes for the environment and community. This approach also means that less hard engineering drainage works will be required and more natural channel or 'soft' based stormwater solutions may be possible. The natural solutions are often much cheaper to construct and maintain over time.

A further study is required to plan and provide an integrated stormwater management plan for the town.

Development ensures:

- water sensitive urban design principles are incorporated into the layout and design of development to minimise increase in flows from urban development and to maintain water quality of our waters for our health, community needs and natural environment values.
- The collection and conveyance of stormwater from a catchment to its receiving waters occurs with minimal nuisance, danger or damage.
- Stormwater drainage and design limits flooding of public and private property both on site and downstream.
- Filling or excavation is designed and built in a way that does not cause erosion, landslip, worsen flooding or damage views of our land.
- Filling or excavation does not cause ponding on the premises or adjoining land.
- Stormwater is treated on–site so that any stormwater leaving the site is not dirty, contaminated or could cause harm to our natural environment, our waterways or the sea.

4.1.7 **Solid waste management**

A landfill to cater for the solid waste management needs of the town and broader Province is provided on Taro Island, within Mosquito Creek and adjacent to the existing airstrip. A waste transfer station to service the needs of Lot 277 will be provided close to the centralised waste water treatment plant. A second waste transfer station will be located on Lot 9 to service the waste management needs of the industry and special purpose uses on Lot 9.

A further study is needed to ensure the landfill is appropriately designed, operated and managed to ensure waste does not mix with ground water or result in other environmental impacts. Sufficient protection (such as a bund wall or other barrier) is provided to ensure waves from the sea (such as tsunami or storm tide inundation) do not overtop the landfill.

4.1.8 **Transport network**

The road layout of the new town will form part of the detailed subdivision design and layout.

New roads are designed and built to a high quality standard and:

- are able to support more traffic as our town grows;
- have space for walking, cycling and public transport;
- are wide enough for street parking;
- include services and drainage;
- include shady street trees along footpaths;
- development is provided with road dimensions in accordance with the table below:

Road hierarchy classification		Catchment size (no of dwellings)	Minimum reserve width	Minimum carriageway width	Minimum verge width each side
Residential access street for Community Living Zone		0-74 houses	15.5m	6.5m sealed	4.5m
Collector road for Town Centre Core Zone	Minor	75-299 houses	16.5m	7.5m sealed	4.5m
	Major	300-599 houses	20m	11m sealed	4.5
Industrial access street for development in an industry zone		<8ha	21m	12m sealed	4.5
Industrial collector street for development in an industry zone		<30ha	23m	14m sealed	4.5

4.1.9 **Public parks and land for community facilities**

Infrastructure for recreation and sporting parks, local parks, playgrounds and land for community purposes to provide for the primary school, kindergarten, preschool, community centre, police station and court house, are designed and constructed to service the lots in accordance with their intended purpose.

A network of parks and community land is provided throughout the town. Land for public parks, sporting and playgrounds is of an appropriate size, configuration and slope and must be generally flat and useable, meaning at least 30% of the land is not constrained by slope, flooding or other factors. Well located and unconstrained land is set aside and protected for community facilities in accordance with the recommended land budget allocations or specific needs of these uses.

Opportunities to locate recreation parks close to other community infrastructure, transport hubs and valued environmental and cultural assets are maximised.

5 Subdivision (Reconfiguring a Lot) Development Requirements

Development being the subdivision of land complies with the following requirements.

(1) Provides for good design and layout. This means, the layout of new lots:
   - (a) is sensitive to site features, the natural environment, wetlands, waterways and views of our town;
   - (b) is easy to get to, and around, by people walking, cycling and driving;
   - (c) considers stormwater management and incorporates water sensitive urban design principles;
   - (d) is linked to all areas of our town; and
   - (e) creates a safe environment for our people and visitors by allowing for buildings that face the street and can be easily seen from the street.

(2) Makes sure lot sizes are suited to the types of development we want in Choiseul Bay Township. This means the layout, size, length and width of lots are suitable for the use of the land indicated on the strategic plan map (schedule 2) and zoning map (schedule 3).

(3) Provides a range of lot sizes to provide for a mix of different housing types in our Community Living Zone and Town Centre Core Zone.

(4) Does not involve the creation of new lots outside of our Township Centre Core Zone, Community Living Zone, Special Purpose Zone, Port and Industry Zone, the Low Impact and Service Industry Zone or the Open Space and Recreation Zone.

(5) Land in the Limited Development Zone, Environment and Conservation Zone, and Future Investigation Zone is not suitable for further subdivision.

(6) Protects areas of cultural and spiritual importance including our tambu sites.

(7) The design and layout of lots and infrastructure protects our natural environment, and is setback from important vegetation, waterways, wetlands and other important environmental features;

(8) Ensures lots are laid out so that our town remains a safe place to live. This means no new lots are created on land within the natural hazard area identified on the zoning map (schedule 3) to avoid putting people and property at risk from tsunami, storm tide inundation, flooding, sea level rise and coastal erosion hazards.

(9) Ensures new lots have access to services and infrastructure (water, stormwater drainage, sewerage, power, telecommunications and rubbish collection).

(10) Each lot has a separate access and fronts a bitumen road with drainage.

(11) New roads are designed and built to a high quality standard, and:

(a) are able to support more traffic as our town grows;
(b) have space for walking, cycling and public transport;
(c) are wide enough for street parking;
(d) include services and drainage.

(12) Subdivision (reconfiguration of lots) results in lots that:

(a) are not an awkward shape and are big enough for a building which can comply with the requirements of this planning scheme;
(b) for industrial development, lots are large enough to accommodate an on-site trade waste and effluent treatment and disposal facility;
(c) have access to infrastructure and services;
(d) are different sizes to suit the needs of our community;
(e) are large enough to have car parking and yards;
(f) comply with the minimum lot sizes and frontage requirements identified in the table below:

Zone	Average Minimum Lot Size	Minimum Frontage Length
Community Living Zone	A mix of lot sizes ranging from 400m^2, 600m^2 and 1000m^2.	15 metres
Town Centre Core Zone	300m^2	10 metres
- Port and Industry Zone; or - Low Impact and Service Industry Zone	1,000m^2	25 metres
Special Purpose Zone	No minimum lot size specified	No minimum frontage specified
Open space and Recreation Zone	2000m^2	40m
Environment and Conservation Zone	No new lots created	No new lots created
Limited Development Zone	No new lots created	No new lots created
Future Investigation Zone	20ha	No minimum frontage specified

Schedule 1 – Definitions

The planning scheme includes administrative definitions and use definitions

Administrative Definitions

Administrative definitions assist with the interpretation of the planning scheme but do not have a specific land use meaning. The administrative definitions listed here are the definitions for the purpose of this planning scheme.

A term listed in table below has the meaning set out beside that term in column 2 under the heading.

Table 1 - Index of administrative definitions

(1) Index for administrative definitions	
Access Building height Dwelling Filling or excavation Gross floor area Ground level Habitable room Hazardous material Irregular lot Natural hazard area Planning assumptions	Private open space Public open space Rear lot Sensitive land use Setback Site Site cover Storey Waterway Water quality Wetland

Table 2 - Administrative definitions

Column 1 **Term**	**Column 2** **Definition**
Act	Means the *Town and Country Planning Act 1996* as amended
Access	The entry of persons and vehicles onto a lot, either existing or proposed, from a road which abuts the frontage of that lot.
Building height	The vertical distance between the ground level and the highest point of the building roof (apex) or parapet at any point but not including non-load bearing antenna, aerial, chimney, flagpole or the like.
Dwelling	A building or part of a building used or capable of being used as a self-contained residence which must include the following: - food preparation facilities; - a bath or shower; - a toilet and wash basin; - clothes washing facilities. This term includes outbuildings, structures and works normally associated with a dwelling.

Column 1 Term	Column 2 Definition
Filling or excavation	Means the removal or importation of material to or from a lot that will change the ground level of the land. Can include land forming, embankments, raised access roads, building pads, channel banks and drain banks and associated structures.
Gross floor area	The total floor area of all storeys of the building, including any mezzanines, (measured from the outside of the external walls and the centre of any common walls of the building), other than areas used for: - building services; or - a ground floor public lobby; or - a public mall in a shopping complex; or - parking, loading or manoeuvring of vehicles; or - balconies, whether roofed or not.
Ground level	The level of the natural ground or, where the level of the natural ground has been changed, the level as lawfully changed.
Habitable room	A room used for normal domestic activities, and: - includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom; but - excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes-drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Hazardous material	A substance with potential to cause harm to persons, property or the environment because of 1 or more of the following— - the chemical properties of the substance; - the physical properties of the substance; - the biological properties of the substance. Without limiting the first paragraph, all dangerous goods, combustible liquids and chemicals are hazardous materials.
Cultural heritage place	A place, area, land, landscape, building or work which is of cultural heritage significance.
Irregular lot	A lot that is not rectangular in shape. This term does not include an internal lot.
Natural hazard area	An area shown as a natural hazard area on the strategic plan map (schedule 2) or zoning map (schedule 3) of this planning scheme. It is an area at risk from: - temporary inundation by tsunami, storm tide inundation and/or flooding; or - permanent inundation by sea level rise or coastal erosion.
Planning assumptions	Assumptions about the type, scale, location and timing of future growth; or area(s) within a planning scheme area for which the planning authority carries out demand growth projections.
Private open space	An outdoor space for the exclusive use of occupants of a building.

Column 1 Term	Column 2 Definition
Projection area(s)	Area or areas within a planning scheme area for which a planning authority carries out demand growth projections.
Public open space	Outdoor spaces that are generally accessible to the community and provide for a range of sport, recreation, cultural, entertainment or leisure pursuits.
Rear lot	A lot which has access to a road by means only of an access strip which forms part of the lot, or by means only of an easement over adjoining land.
Sensitive land use	Means each of the following defined uses: child care centre, community care centre, community residence, community use, dual occupancy, dwelling house, educational establishment, health care services, hospital, hostel, multiple dwelling, office, relocatable home park, residential care facility, retirement facility, short term accommodation, tourist park.
Setback	For a building or structure, the shortest distance measured horizontally from the outer most projection of a building or structure to the vertical projection of the boundary of the lot.
Site	Any land on which development is carried out or is proposed to be carried out whether such land comprises the whole or part of one lot or more than one lot if each of such lots is contiguous.
Site cover	The proportion of the site covered by a building(s), structure(s) attached to the building(s) and carport(s), calculated to the outer most projections of the building(s) and is expressed as a percentage. The term does not include: - any structure or part thereof included in a landscaped open space area such as a gazebo or shade structure; - basement car parking areas located wholly below ground level.

Storey	A space within a building which is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not:
	- a space that contains only:
	  ▪ a lift shaft, stairway or meter room; or
	  ▪ a bathroom, shower room laundry, water closet, or other sanitary compartment; or
	  ▪ accommodation intended for not more than three vehicles; or a combination of the above;
	- a mezzanine.

Waterway	Means any of the following: - a creek, river, stream or watercourse; or - an inlet of the sea into which a creek, river, stream or watercourse flows; or - a dam or weir.
Water quality	The ecosystem health of aquatic systems (including surface, soil and underground waters), including processes affecting or involving the physical, chemical and biological characteristics of water.

Column 1 Term	Column 2 Definition
Wetland	An area that is mapped on the zoning map – schedule 3 or an area that has the following characteristics: - it is an area of permanent or periodic inundation, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.

Land Use Definitions

Defined activity groups

(1) Defined uses listed in the Table 3 are able to be clustered into activity groups.

(2) An activity group listed in column 1 clusters the defined uses listed in column 2.

(3) An activity group is able to be referenced in other parts of the planning scheme.

(4) The activity groups listed here are the defined activity groups for the purpose of the planning scheme.

Table 3 - Defined activity groups

Column 1 **Activity group**	**Column 2** **Uses**
Housing activities	Caretaker's accommodation Dual occupancy Dwelling house Dwelling unit Home based business Hostel Multiple dwelling Non-residential workforce accommodation Relocatable home park Residential care facility Retirement facility Short-term accommodation Tourist park
Business activities	Agricultural supplies store Food and drink outlet Function facility Funeral parlour Garden centre Hardware and trade supplies Market Office Outdoor sales Sales office Service station Shop Shopping centre Showroom Theatre Veterinary services

Column 1 **Activity group**	Column 2 **Uses**
Community activities	Cemetery Club Child care centre Community care centre Community use Educational establishment Emergency Services Health care services Hospital Place of worship
Industrial activities	Bulk landscape supplies High impact industry Low impact industry Marine industry Medium impact industry Research and technology industry Service industry Warehouse
Recreation activities	Indoor sport and recreation Outdoor sport and recreation Park
Rural activities	Animal husbandry Animal keeping Aquaculture Cropping Intensive animal industry Intensive horticulture Permanent plantation Roadside stall Rural industry Wholesale nursery

Use definitions

(1) Use definitions have a specific meaning for the purpose of the planning scheme.

(2) Any use not listed in Table 5 column 1 is an undefined use.

(3) A use listed in Table 5 column 1 has the meaning set out beside that term in column 2.

(4) Column 3 of Table 5 identifies examples of the types of activities which fall within the use identified in column 1.

(5) Column 4 of Table 5 identifies examples of activities which do not fall within the use identified in column 1.

(6) Columns 3 and 4 of Table 5 are not exhaustive lists.

(7) Uses listed in Table 5 columns 3 and 4 which are not listed in column 1 form part of the definition and have their ordinary meaning.

(8) The use definitions listed here are the definitions used in this planning scheme.

Table 4 - Index of use definitions

Index for use definitions		
Agricultural supplies store	Hardware and trade supplies	Permanent plantation
Air services	Health care services	Place of worship
Animal husbandry	High impact industry	Port services
Animal keeping	Home based business	Relocatable home park
Aquaculture	Hospital	Renewable energy facility
Bulk landscape supplies	Hostel	Residential care facility
Caretaker's accommodation	Hotel	Resort complex
Cemetery	Indoor sport and recreation	Retirement facility
Child care centre	Intensive animal industry	Roadside stall
Club	Intensive horticulture	Rural industry
Community care centre	Landing	Rural workers accommodation
Community residence	Low impact industry	Service industry
Community use	Major electricity infrastructure	Service station
Crematorium	Major sport, recreation and entertainment facility	Shop
Cropping	Marine industry	Shopping centre
Detention facility	Market	Short-term accommodation
Dual occupancy	Medium impact industry	Showroom
Dwelling house	Motor sport facility	Special industry
Dwelling unit	Multiple dwelling	Substation
Educational establishment	Nature-based tourism	Telecommunications facility
Emergency services		Theatre

Index for use definitions		
Environment facility Extractive industry Food and drink outlet Function facility Funeral parlour Garden centre	Nightclub entertainment facility Non-resident workforce accommodation Office Outdoor sales Outdoor sport and recreation Park	Tourist attraction Tourist park Transport depot Utility installation Veterinary services Warehouse Wholesale nursery Winery

Table 5 - Land use definitions

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Agricultural supplies store	Premises used for the sale of agricultural products and supplies including agricultural chemicals and fertilisers, seeds, bulk veterinary supplies, farm clothing, saddlery, animal feed and irrigation materials.		Bulk landscape supplies, garden centre, outdoor sales wholesale nursery
Air services	Premises used for any of the following: ▪ the arrival and departure of aircraft; ▪ the housing, servicing, refuelling, maintenance and repair of aircraft; ▪ the assembly and dispersal of passengers or goods on or from an aircraft; ▪ any ancillary activities directly serving the needs of passengers and visitors to the use; ▪ associated training and education facilities; ▪ aviation facilities.	Airport, airstrip, helipad, public or private airfield	

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Animal husbandry	Premises used for production of animals or animal products on either native or improved pastures or vegetation. The use includes ancillary yards, stables and temporary holding facilities and the repair and servicing of machinery.	Cattle studs, grazing of livestock, non-feedlot dairying	Animal keeping, intensive animal industry, aquaculture, feedlots, piggeries
Animal keeping	Premises used for boarding, breeding or training of animals. The use may include ancillary temporary or permanent holding facilities on the same site and ancillary repair and servicing of machinery.	Aviaries, catteries, kennels, stables, wildlife refuge	Aquaculture, cattle studs, domestic pets, feedlots, grazing of livestock, non-feedlot dairying, piggeries, poultry meat and egg production, animal husbandry
Aquaculture	Premises used for the cultivation of aquatic animals or plants in a confined area that may require the provision of food either mechanically or by hand.	Pond farms, tank systems, hatcheries, raceway system, rack and line systems, sea cages	Intensive animal industry
Bulk landscape supplies	Premises used for bulk storage and sale of landscaping and gardening supplies, which may include soil, gravel, potting mix and mulch, where the majority of materials sold from the premises are not in pre-packaged form.		Garden centre, outdoor sales, wholesale nursery
Caretaker’s accommodation	A dwelling provided for a caretaker of a non-residential use on the same premises.		Dwelling house

Column 1 **Use**	Column 2 **Definition**	Column 3 **Examples include**	Column 4 **Does not include the following examples**
Car wash	Premises primarily used for commercially cleaning motor vehicles by an automatic or partly automatic process.		Service station
Cemetery	Premises used for interment of bodies or ashes after death.	Burial ground, crypt, columbarium, lawn cemetery, pet cemetery, mausoleum	Crematorium, funeral parlour
Child care centre	Premises used for minding, education and care, but not residence, of children.	Crèche, early childhood centre, kindergarten, outside hours school care	Educational establishment, home based child care, family day care
Club	Premises used by persons associated for social, literary, political, sporting, athletic or other similar purposes for social interaction or entertainment. The use may include the ancillary preparation and service of food and drink.	Club house, guide and scout clubs, surf lifesaving club, RSL, bowls club	Hotel, nightclub, place of worship, theatre
Community care centre	Premises used to provide social support where no accommodation is provided. Medical care may be provided but is ancillary to the primary use.	Disability support services, drop in centre, respite centre, integrated Indigenous support centre	Childcare centre, family day care, home based child care, health care services, residential care facility
Community residence	Any dwelling used for accommodation for a maximum of six persons who require assistance or support with daily living needs, share communal spaces and who may be unrelated. The use may include a resident support worker engaged or employed in the management of the residence.	Hospice	Dwelling house, dwelling unit, hostel, residential care facility, short-term accommodation

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Community use	Premises used for providing artistic, social or cultural facilities and community support services to the public and may include the ancillary preparation and provision of food and drink.	Art gallery, community centre, community hall, library, museum	Cinema, club, hotel, nightclub, place of worship
Crematorium	Premises used for the cremation or aquamation of bodies.		Cemetery
Cropping	Premises used for growing plants or plant material for commercial purposes where dependant on the cultivation of soil. The use includes harvesting and the storage and packing of produce and plants grown on the site and the ancillary repair and servicing of machinery used on the site.	Fruit, nut, vegetable and grain production, forestry for wood production, fodder and pasture production, plant fibre production, sugar cane growing, vineyard	Permanent plantations, intensive horticulture, rural industry
Detention facility	Premises used for the confinement of persons committed by a process of law.	Prison, detention centre	
Dual occupancy	Premises containing two dwellings on one lot (whether or not attached) for separate households..	Duplex	Dwelling house, multiple dwelling
Dwelling house	A residential use of premises for one household that contains a single dwelling. The use includes out-buildings and works normally associated with a dwelling and may include a secondary dwelling.		Caretaker's accommodation, dual occupancy, hostel, short-term accommodation, student accommodation, multiple dwelling
Dwelling unit	A single dwelling within a premises containing non residential use(s).	"Shop-top" apartment	Caretaker's accommodation, dwelling house

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Educational establishment	Premises used for training and instruction designed to impart knowledge and develop skills. The use may include outside hours school care for students or on-site student accommodation.	Pre-preparatory, preparatory and primary school, secondary school, special education, college, university, technical institute, outdoor education centres	Childcare centre, home based child care, family day care
Emergency services	Premises used by government bodies or community organisations to provide essential emergency services, disaster management services including management support facilities for the protection of persons, property and the environment.	State emergency service facility, ambulance station, rural fire brigade, auxiliary fire and rescue station, urban fire and rescue station, police station, emergency management support facility, evacuation centres	Community use, hospital, residential care facility
Environment facility	Facilities used for the conservation, interpretation and appreciation of areas of environmental, cultural or heritage value.	Nature-based attractions, walking tracks, seating, shelters, boardwalks, observation decks, bird hides	
Extractive industry	Premises used for the extraction and processing of extractive resources and associated activities, including their transportation to market.	Quarry	
Food and drink outlet	Premises used for preparation and sale of food and drink to the public for consumption on or off the site. The use may include the ancillary sale of liquor for consumption on site.	Bistro, café, coffee shop, drive-through facility, kiosk, milk bar, restaurant, snack bar, take-away, tea room	Bar, club, hotel, shop, theatre, nightclub

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Function facility	Premises used for conducting receptions or functions that may include the preparation and provision of food and liquor for consumption on site.	Conference centre, reception centre	Community use, hotel
Funeral parlour	Premises used to arrange and conduct funerals, memorial services and the like, but do not include burial or cremation. The use includes a mortuary and the storage and preparation of bodies for burial or cremation.		Cemetery, crematorium, place of worship
Garden centre	Premises used primarily for the sale of plants and may include sale of gardening and landscape products and supplies where these are sold mainly in pre-packaged form. The use may include an ancillary food and drink outlet.	Retail plant nursery	Bulk landscape supplies, wholesale nursery, outdoor sales
Hardware and trade supplies	Premises used for the sale, display or hire of hardware and trade supplies including household fixtures, timber, tools, paint, wallpaper, plumbing supplies and the like.		Shop, showroom, outdoor sales and warehouse
Health care services	Premises for medical, paramedical, alternative therapies and general health care and treatment of persons that involves no overnight accommodation.	Dental clinics, medical centres, natural medicine practices, nursing services, physiotherapy clinic	Community care centre, hospital

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
High impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring, treating of products and have one or more of the following attributes: ▪ potential for significant impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; ▪ potential for significant offsite impacts in the event of fire, explosion or toxic release; ▪ generates high traffic flows in the context of the locality or the road network; ▪ generates a significant demand on the local infrastructure network; ▪ the use may involve night time and outdoor activities; ▪ onsite controls are required for emissions and dangerous goods risks.	Abattoirs, concrete batching plant, boiler making and engineering and metal foundry	Tanneries, rendering plants, oil refineries, waste incineration, manufacturing or storing explosives, power plants, manufacturing fertilisers, service industry, low impact industry, medium impact industry, special industry
Home based business	A dwelling used for a business activity where subordinate to the residential use.	Bed and breakfast, farm stay, home office, home based childcare	Hobby, office, shop, warehouse, transport depot

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Hospital	Premises used for medical or surgical care or treatment of patients whether or not residing on the premises. The use may include ancillary accommodation for employees and ancillary activities directly serving the needs of patients and visitors.		Health care services, residential care facility
Hostel	Premises used for the accommodation of more than one household where each resident: ▪ has a right to occupy one or more rooms; ▪ does not have a right to occupy the whole of the premises in which the rooms are situated; ▪ does not occupy a self-contained unit; ▪ shares communal rooms, or communal facilities outside of the resident's room, with one or more of the other residents. It may include: ▪ rooms not in the same building on site; or ▪ provision of a food or other service; or ▪ on site management or staff and associated accommodation.	Boarding house, monastery, rooming accommodation, off-site student accommodation	Hospice, community residence, dwelling house, short-term accommodation, multiple dwelling

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Hotel	Premises used primarily to sell liquor for consumption. The use may include short-term accommodation, dining and entertainment activities and facilities.	Bar , pub, tavern	Nightclub
Indoor sport and recreation	Premises used for leisure, sport or recreation conducted wholly or mainly indoors.	Amusement parlour, bowling alley, gymnasium, squash courts, enclosed tennis courts	Cinema, hotel, nightclub, theatre
Intensive animal industry	Premises used for the intensive production of animals or animal products in an enclosure that requires the provision of food and water either mechanically or by hand. The use includes the ancillary storage and packing of feed and produce.	Feedlots, piggeries, poultry and egg production	Animal husbandry, aquaculture, drought feeding, milking sheds, shearing sheds, weaning pens
Intensive horticulture	Premises used for the intensive production of plants or plant material on imported media and located within a building or structure or where outdoors, artificial lights or containers are used. The use includes the storage and packing of produce and plants grown on the subject site.	Greenhouse and shade house plant production, hydroponic farms, mushroom farms	Wholesale nursery
Landing	A structure for mooring, launching, storage and retrieval of vessels where passengers embark and disembark.	Boat ramp, jetty, pontoon	Marina

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Low impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring, treating of products and have one or more of the following attributes: ▪ negligible impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; ▪ minimal traffic generation and heavy-vehicle usage; ▪ demands imposed upon the local infrastructure network consistent with surrounding uses; ▪ the use generally operates during the day (e.g. 7am to 6pm); ▪ offsite impacts from storage of dangerous goods are negligible; ▪ the use is primarily undertaken indoors.	Repairing motor vehicles, fitting and turning workshop	Panel beating, spray painting or surface coating, tyre recycling, drum re-conditioning, wooden and laminated product manufacturing, service industry, medium impact industry, high impact industry, special industry
Major electricity infrastructure	All aspects of development for either the transmission grid or electricity supply networks. The use may include ancillary telecommunication facilities.	Powerlines greater than 66kV	Minor electricity infrastructure, substation
Major sport, recreation and entertainment facility	Premises with large scale built facilities designed to cater for large scale events including major sporting, recreation, conference and entertainment events.	Convention and exhibition centres, entertainment centres, sports stadiums, horse racing	Indoor sport and recreation, local sporting field, motor sport, park, outdoor sport and recreation

Column 1 **Use**	Column 2 **Definition**	Column 3 **Examples include**	Column 4 **Does not include the following examples**
Marine industry	Premises used for waterfront based marine industries involved in any activity relating to the manufacturing, storage, repair or servicing of vessels and maritime infrastructure. The use may include the provision of fuel and disposal of waste.	Boat building, boat storage, dry dock	Marina
Market	Premises used for the sale of goods to the public on a regular basis, where goods are primarily sold from temporary structures such as stalls, booths or trestle tables. The use may include entertainment provided for the enjoyment of customers.	Flea market, farmers market, car boot sales	Shop, roadside stall

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Medium impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring, treating of products and have one or more of the following attributes: ▪ potential for noticeable impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; ▪ potential for noticeable offsite impacts in the event of fire, explosion or toxic release; ▪ generates high traffic flows in the context of the locality or the road network; ▪ generates an elevated demand on the local infrastructure network; ▪ onsite controls are required for emissions and dangerous goods risks; ▪ the use is primarily undertaken indoors; ▪ evening or night activities are undertaken indoors and not outdoors.	Spray painting and surface coating, transport depot, wooden and laminated product manufacturing (including cabinet making, joining, timber truss making or wood working) **Note**—additional examples may be shown in SC1.1.2 industry thresholds.	Concrete batching, tyre manufacturing and retreading, metal recovery (involving a fragmentiser), textile manufacture, chemically treating timber and plastic product manufacture, service industry, low impact industry, high impact industry, special industry
Motor sport facility	Premises used for organised or recreational motor sports whether on or off-road, which may include permanent, temporary or informal provision for spectators and other supporting uses.	Go-karting, lawn mower race tracks, trail bike parks, 4WD and all terrain parks, motocross tracks, off road motorcycle facility, motorcycle or car race tracks	Major sport, recreation and entertainment facility, outdoor sport and recreation

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Multiple dwelling	Premises that contain three or more dwellings.	Apartments, flats, units, townhouses, row housing	Rooming accommodation, dual occupancy, duplex, granny flat, residential care facility, retirement facility
Nature-based tourism	The use of land or premises for a tourism activity, including tourist and visitor short-term accommodation, that is intended for the conservation, interpretation and appreciation of areas of environmental, cultural or heritage value, local ecosystem, and attributes of the natural environment. Nature-based tourism activities typically: ▪ maintain a nature based focus or product; ▪ promote environmental awareness, education and conservation; ▪ carry out sustainable practices.	Environmentally responsible accommodation facilities including lodges, cabins, huts and tented camps	Environment facility
Nightclub entertainment facility	Premises used to provide entertainment, which may include cabaret, dancing and music. The use generally includes the sale of liquor and food for consumption on site.		Club, hotel, tavern, pub, indoor sport and recreation, theatre, concert hall
Non-resident workforce accommodation	Premises used to provide accommodation for non-resident workers. The use may include provision of recreational and entertainment facilities for the exclusive use of residents and their visitors.	Contractor’s camp, construction camp, single person’s quarters, temporary workers accommodation	Relocatable home park, short-term accommodation, tourist park.

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Office	Premises used for an administrative, secretarial or management service or the practice of a profession, where no goods or materials are made, sold or hired and where the principal activity provides for the following: ▪ business or professional advice; ▪ service of goods that are not physically on the premises; ▪ office based administrative functions of an organisation.	Bank, real estate agent, administration building	Home based business, shop, outdoor sales
Outdoor sales	Premises used for the display, sale, hire or lease of products where the use is conducted wholly or predominantly outdoors and may include construction, industrial or farm plant and equipment, vehicles, boats and caravans. The use may include ancillary repair or servicing activities and sale or fitting of accessories.	Agricultural machinery sales yard, motor vehicles sales yard	Bulk landscape supplies, market

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Outdoor sport and recreation	Premises used for a recreation or sport activity that is carried on outside a building and requires areas of open space and may include ancillary works necessary for safety and sustainability. The use may include ancillary food and drink outlet(s) and the provision of ancillary facilities or amenities conducted indoors such as changing rooms and storage facilities.	Driving range, golf course, swimming pool, tennis courts, football ground, cricket oval, pony club	Major sport, recreation and entertainment facility, motor sport, park, community use
Park	Premises accessible to the public generally for free sport, recreation and leisure, and may be used for community events or other community activities. Facilities may include children's playground equipment, informal sports fields and ancillary vehicle parking and other public conveniences.	Urban common	Tourist attraction, outdoor sport and recreation
Permanent plantation	Premises used for growing plants not intended to be harvested.	Permanent plantations for carbon sequestration, biodiversity or natural resource management	Forestry for wood production, biofuel production
Place of worship	Premises used by an organised group for worship and religious activities. The use may include ancillary facilities for social and educational activities.	Church, chapel, mosque, synagogue, temple	Community use, child care centre, funeral parlour, crematorium

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Port services	Premises used for the following: ▪ the arrival and departure of vessels; ▪ the movement of passengers or goods on or off vessels; ▪ any ancillary activities directly serving the needs of passengers and visitors or the housing, servicing, maintenance and repair of vessels.	Marina, ferry terminal	Landing
Relocatable home park	Premises used for relocatable dwellings (whether they are permanently located or not) that provides long-term residential accommodation. The use may include a manager's residence and office, ancillary food and drink outlet, kiosk, amenity buildings and the provision of recreation facilities for the exclusive use of residents.		Tourist park
Renewable energy facility	Premises used for the generation of electricity or energy from renewable (naturally reoccurring) sources.	Solar farm, wind farm, tidal power	Wind turbine or solar panels supplying energy to domestic or rural activities on the same site

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Research and technology industry	Premises used for innovative and emerging technological industries involved in research design, manufacture, assembly, testing, maintenance and storage of machinery, equipment and components. The use may include emerging industries such as energy, aerospace, and biotechnology.	Aeronautical engineering, computer component manufacturing, medical laboratories, computer server facility	
Residential care facility	A residential use of premises for supervised accommodation where the use includes medical and other support facilities for residents who cannot live independently and require regular nursing or personal care.	Convalescent home, nursing home	Community residence, dwelling house, dual occupancy, hospital, multiple dwelling, retirement facility
Resort complex	Premises used for tourist and visitor short-term accommodation that include integrated leisure facilities including: ▪ restaurants and bars; ▪ meeting and function facilities; ▪ sporting and fitness facilities; ▪ staff accommodation; ▪ transport facilities directly associated with the tourist facility such as a ferry terminal and air services.	Island resort	

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Retirement facility	A residential use of premises for an integrated community and specifically built and designed for older people. The use includes independent living units and may include serviced units where residents require some support with health care and daily living needs. The use may also include a manager's residence and office, food and drink outlet, amenity buildings, communal facilities and accommodation for staff.	Retirement village	Residential care facility
Roadside stall	Premises used for the roadside display and sale of goods in rural areas.	Produce stall	Market
Rural industry	Premises used for storage, processing and packaging of products from a rural use. The use includes processing, packaging and sale of products produced as a result of a rural use where these activities are ancillary to a rural use on or adjacent to the site.	Packing shed	Intensive animal husbandry, intensive horticulture, roadside stall, wholesale nursery, winery, abattoir, agricultural supply store
Rural workers accommodation	Any premises used as quarters for staff employed in the use of land for rural purposes, such as agriculture, intensive animal husbandry and forestry, conducted on a lot in the same ownership whether or not such quarters are self-contained.	Farm workers accommodation	Short-term accommodation building, caretaker's accommodation, dual occupancy, dwelling house, nature or rural based tourist accommodation, non-resident workers accommodation, multiple dwellings

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Service industry	Premises used for industrial activities that have no external air, noise or odour emissions from the site and can be suitably located with other non-industrial uses.	Audio visual equipment repair, film processing bicycle repairs, clock and watch repairs, computer repairs, dry cleaning, hand engraving, jewellery making, laundromat, locksmith, picture framing, shoe repairs, tailor	Small engine mechanical repair workshop, cabinet making, shop fitting, sign writing, tyre depot, low impact industry, medium impact high impact industry, special industry
Service station	Premises used for the sale of fuel including petrol, liquid petroleum gas, automotive distillate and alternative fuels. The use may include, where ancillary, a shop, food and drink outlet, maintenance, repair servicing and washing of vehicles, the hire of trailers, and supply of compressed air.		Car wash
Shop	Premises used for the display, sale or hire of goods or the provision of personal services or betting to the public.	Hairdresser, liquor store, department store, discount department store, discount variety stores, betting agencies, supermarket, corner store	Food and drink outlet, showroom, market
Shopping centre	Premises comprising two or more individual tenancies that is comprised primarily of shops, and that function as an integrated complex.		

Column 1 **Use**	Column 2 **Definition**	Column 3 **Examples include**	Column 4 **Does not include the following examples**
Short-term accommodation	Premises used to provide short-term accommodation for tourists or travellers for a temporary period of time (typically not exceeding three consecutive months) and may be self-contained. The use may include a manager's residence and office and the provision of recreation facilities for the exclusive use of visitors.	Motel, backpackers, cabins, serviced apartments, accommodation hotel, nature-based tourism, farm stay, resort complex, serviced apartment	Hostel, rooming accommodation, tourist park
Showroom	Premises used primarily for the sale of goods of a related product line that are of a size, shape or weight that requires: ▪ a large area for handling, display or storage; ▪ direct vehicle access to the building by members of the public for loading and unloading items purchased or hired.	Bulky goods sales, motor vehicles sales showroom, bulk stationary supplies	Food and drink outlet shop, outdoor sales

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Special industry	▪ Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring, treating of products and have one or more of the following attributes: ▪ potential for extreme impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; ▪ potential for offsite impacts in the event of fire, explosion or toxic release; ▪ onsite controls are required for emissions and dangerous goods risks; ▪ the use generally involves night time and outdoor activities; ▪ the use may involve the storage and handling of large volumes of dangerous goods; ▪ requires significant separation from non-industrial uses.	Tanneries, rendering plants, oil refineries, waste incineration, manufacturing or storing explosives, power plants, manufacturing fertilisers	Low impact industry, medium impact industry, high impact industry, service industry

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Substation	Premises forming part of a transmission grid or supply network for electricity and used for: ▪ converting or transforming electrical energy from one voltage to another; or ▪ regulating voltage in an electrical circuit; or ▪ controlling electrical circuits; or ▪ switching electrical current between circuits; or ▪ a switchyard; or ▪ communication facilities for workforce operational and safety communications.	Substations, switching yards	Major electricity infrastructure, minor electricity infrastructure
Telecommunications facility	Premises used for systems that carry communications and signals by means of radio, including guided or unguided electromagnetic energy, whether such facility is manned or remotely controlled.	Telecommunication tower, broadcasting station, television station	

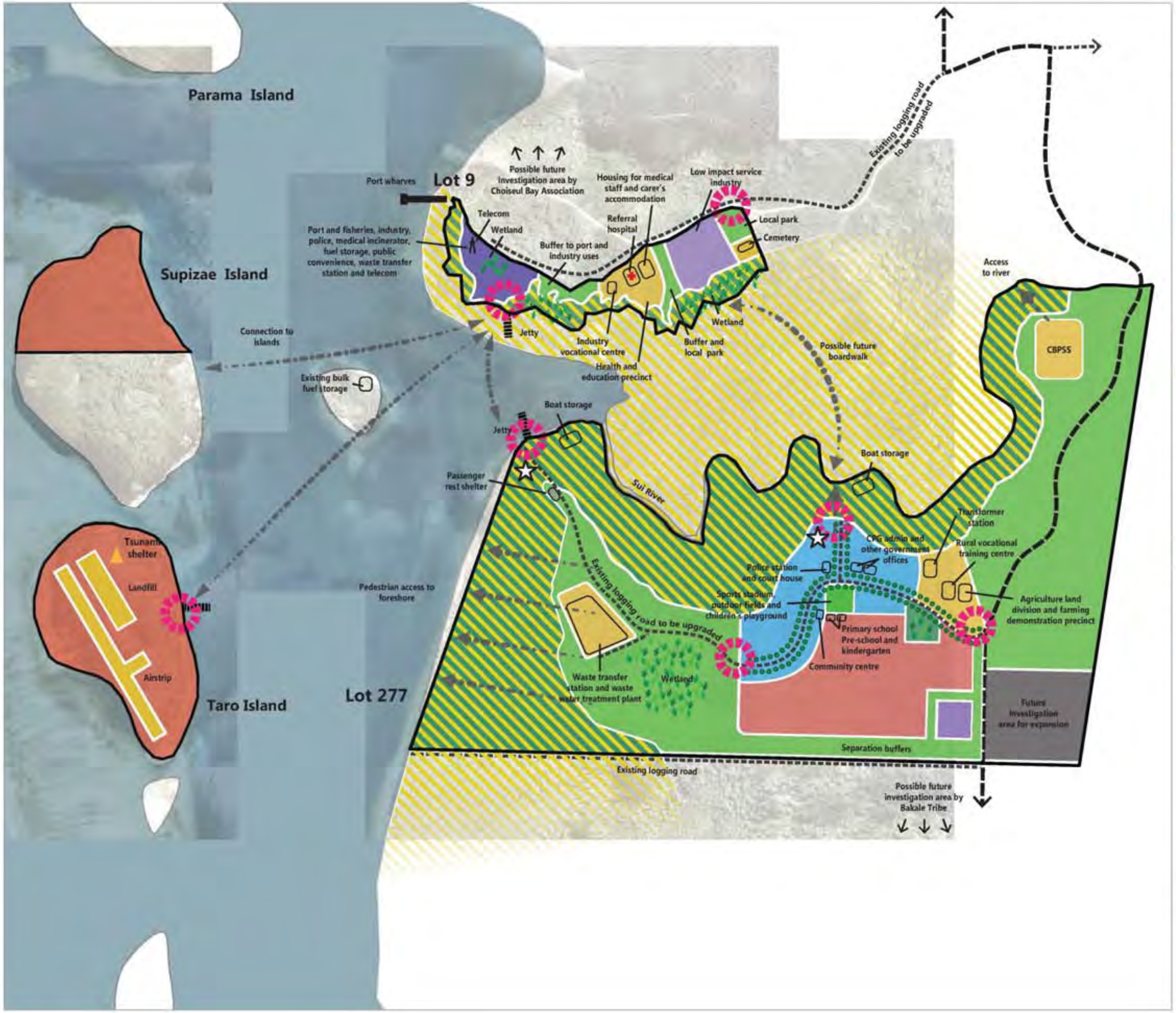
Column 1 **Use**	Column 2 **Definition**	Column 3 **Examples include**	Column 4 **Does not include the following examples**
Theatre	Premises used for providing film, live entertainment or music to the public and may include provision of food and liquor for consumption on the site. The use may include the production of film or music, including associated ancillary facilities, which are completely complimentary to the production, such as sound stages, wardrobe and laundry facilities, makeup facilities, set construction workshops, editing and post-production facilities.	Cinema, movie house, concert hall, dance hall, film studio, music recording studio	Community hall, hotel, indoor sport and recreation facility, temporary film studio
Tourist attraction	Premises used for providing on- site entertainment, recreation or similar facilities for the general public. The use may include provision of food and drink for consumption on site.	Theme park, zoo	Hotel, major sport, recreation and entertainment facility, nightclub

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Tourist park	Premises used to provide for accommodation in caravans, self-contained cabins, tents and similar structures for the public for short term holiday purposes. The use may include, where ancillary, a manager's residence and office, kiosk, amenity buildings, food and drink outlet, or the provision of recreation facilities for the use of occupants of the tourist park and their visitors, and accommodation for staff.	Camping ground, caravan park, holiday cabins	Relocatable home park, tourist attraction, short-term accommodation, non-resident workforce accommodation
Transport depot	Premises used for the storage, for commercial or public purposes, of more than one motor vehicle. The use includes premises for the storage of taxis, buses, trucks, heavy machinery and uses of a like nature. The term may include the ancillary servicing, repair and cleaning of vehicles stored on the premises.	Contractor's depot, bus depot, truck yard, heavy machinery yard	Home based business, warehouse, low impact industry, service industry

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Utility installation	Premises used to provide the public with the following services: ▪ supply or treatment of water, hydraulic power or gas; ▪ sewerage, drainage or stormwater services; ▪ transport services including road, rail or water; ▪ waste management facilities; ▪ network infrastructure. The use includes maintenance and storage depots and other facilities for the operation of the use.	Sewerage treatment plant, mail depot, pumping station, water treatment plant	Telecommunications tower, major electricity infrastructure, minor electricity infrastructure, substation, renewable energy facility, transport depot
Veterinary services	Premises used for veterinary care, surgery and treatment of animals that may include provision for the short-term accommodation of the animals on the premises.		Animal keeping
Warehouse	Premises used for the storage and distribution of goods, whether or not in a building, including self-storage facilities or storage yards. The use may include sale of goods by wholesale where ancillary to storage. The use does not include retail sales from the premises or industrial uses.	Self storage sheds	Hardware and trade supplies, outdoor sales, showroom, shop

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Wholesale nursery	Premises used for the sale of plants, but not to the general public, where the plants are grown on or adjacent to the site. The use may include sale of gardening materials where these are ancillary to the primary use.		Bulk landscape supplies, garden centre

Schedule 2 – Strategic Plan Map



Strategic Plan

For Choiseul Bay Town and Taro Island

Legend

- Local planning scheme area and land owned by CPG

Zones

- Limited Development
- Environment and Conservation
- Open Space and Recreation
- Town Centre Core
- Community Living
- Port and Industry
- Low Impact and Service Industry
- Future Investigation
- Special Purpose

- Natural Hazard Area and Coastal Vegetation
- Indicative Location of Key Land Uses
- Gateway Entrance
- Indicative Location for Market
- Indicative Location for Future Highway
- Existing Logging Road
- Street Trees
- Key Access Routes
- Wetland
- Jetty Location (subject to detailed assessment)
- Tsunami Shelter

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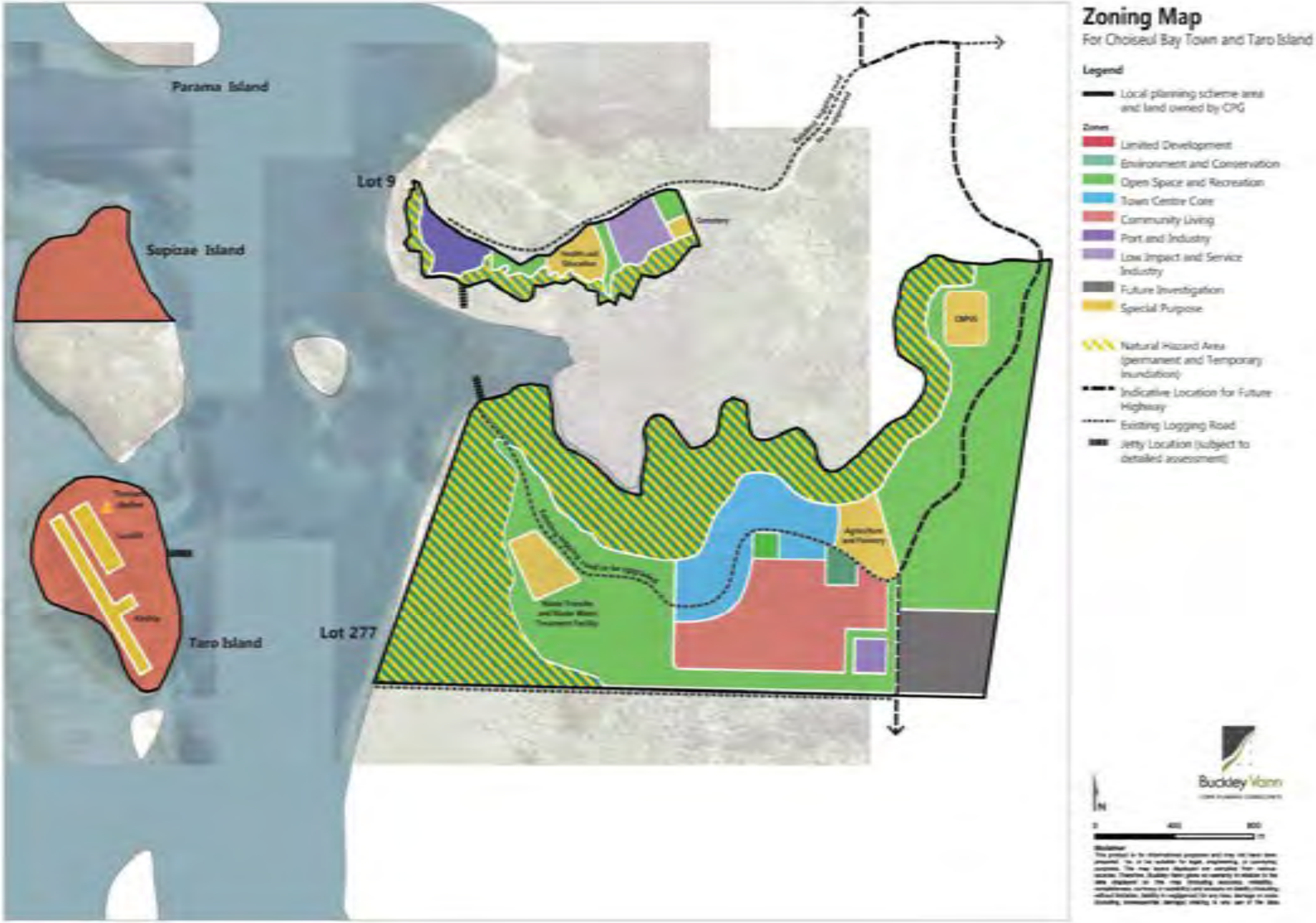
Schedule 3 – Zoning Map


Zoning Map
For Choiseul Bay Town and Taro Island
Legend
Local planning scheme area and land owned by CPG
Zones
Limited Development
Environment and Conservation
Open Space and Recreation
Town Centre Core
Community Living
Port and Industry
Low Impact and Service Industry
Future Investigation
Special Purpose
Natural Hazard Area (permanent and Temporary Inundation)
Indicative Location for Future Highway
Existing Logging Road
Jetty Location (subject to detailed assessment)
Parama Island
Supizae Island
Taro Island
Lot 9
Lot 277
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