Samoan Tourism Authority

Tourism Technical Guidelines for Climate Resilient Practices

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The Treasured Islands of the South Pacific

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PROJECT DETAILS

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EXECUTIVE SUMMARY

Under the project *'Enhancing The Resilience Of Tourism-Reliant Communities To Climate Change Risks'* (a GEF Project under the Least Developing Country Fund (LDCF), Outcome 1 was intended to see c**limate change adaptation mainstreamed into tourism-related policy instruments and public-private partnerships. Two key outputs were intended to guide 'concrete actions on the ground' for this project:-**

1) Output 1.1: Generation of the Tourist Development Area (TDA) Management Plans that integrate efforts to address climate change in 6 Tourism Development Areas involving 12 villages.

2) Output 1.2: Technical Guidelines to support the Management Plans for each of the TDAs to show how to increase resilience through better practices.

These technical guidelines are therefore the second key output of the project and should be read in conjunction with the TDA Management Plans which describe the strategic direction for building resilience for the tourism operators and their reliant communities. This document presents a series of guidelines as a "toolkit" of options that are available to increase resilience to climate change risks and as far as possible preserve the top attributes for tourism and overall community wellbeing as nominated by the communities during engagement forums.

As part of the Samoa Tourism Strategic Marketing Plan for 2014 to 2019, the top attributes for Samoa have been identified as:

- A unique culture with a strong sense of place
- Friendly people and relaxing
- A lush, tropical and unspoilt environment
- Beautiful beaches and crystal clear waters

Climate change processes potentially threaten all of these attributes and these guidelines provide the recipe for operators and their communities to take positive actions to increase their resilience. . There are 6 relevant Tourism Development Areas (TDAs) and their management plans describe the overall direction and planning for implementing both community based and operator focussed activities.

The GEF/LDCF project targets the communities operating small-scale beach fales ('open hut') accommodation and recreational areas. The 6 TDAs selected include:

- South-East Upolu (Saleapaga and Lalomanu);
- South Upolu (Sataoa and Saanapu);
- North-West Upolu (Lepuia'i and Faleu);
- Eastern Savaii (Lano and Manase);
- North-West Savaii (Falealupo and Satuiatua); and
- South-East Savaii (Vailoa and Faaala).

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1. INTRODUCTION

1.1 Overview

This document presents a series of guidelines as a "toolkit" of options that are available to small-scale Tourism Operators and their reliant communities to increase their resilience to climate change risks. These Guidelines should be read in conjunction with the relevant Tourism Development Area (TDA) Management Plans which describe the overall direction and planning for increasing resilience in each of the TDAs. These plans also describe the methodology in working with the communities in determining their values and priorities for the preparation of the Management Plans for the six nominated Tourism Development Areas in Samoa.

In addition to assisting with long term resilience to climate change, some of the methods presented in this document would be highly beneficial to tourism operators' current operations. However, not all of the methods presented in this document area relevant to all areas, so it is important that operators and communities consider the options presented in this document in conjunction with the relevant TDA Management Plan for their specific area.

The preparation of the Management Plan's and associated Technical Guidelines are one aspect of the *Enhancing the Resilience of Tourism-Reliant Communities to Climate Change Risks Project ("the Project").* The objective of the overall Project is to enhance the resilience of tourism-reliant communities to climate change risks by integrating climate change into development policy and instruments and investing in adaptation actions supporting tourism reliant communities. The Project recognises that Samoa's tourism sector, which is a mainstay of Samoa's economy and a core contributor to GDP, is highly vulnerable to the slow onset of climate change impacts.

The Project is being implemented by the Government of Samoa with financial assistance from the Global Environment Facility ("GEF")/Least Developing Countries Fund ("LDCF") through the UNDP. The national executing partners are the Samoa Tourism Authority ("the Authority") and the Ministry of Natural Resources and Environment ("MNRE").

1.2 Focus of Implementation

These technical guidelines are the second key output of the project and should be read in conjunction with the TDA Management Plans which describe the strategic direction for building resilience for the tourism operators and their reliant communities.

The GEF/LDCF project targets the communities operating small-scale beach fales ('open hut') accommodation and recreational areas about 6 TDAs in Upolu and Savaii as follows:

- South-East Upolu (Saleapaga and Lalomanu);
- South Upolu (Sataoa and Saanapu);
- North-West Upolu (Lepuia'i and Faleu);
- Eastern Savaii (Lano and Manase);
- North-West Savaii (Falealupo and Satuiatua); and
- South-East Savaii (Vailoa and Faaala).

Prior consultations and engagement of communities have determined the key focus themes for community development as well as supporting activities for operators within each of the nominated TDAs. Figure 1 and Figure 2 summarize the thematic focus by each of the TDAs.

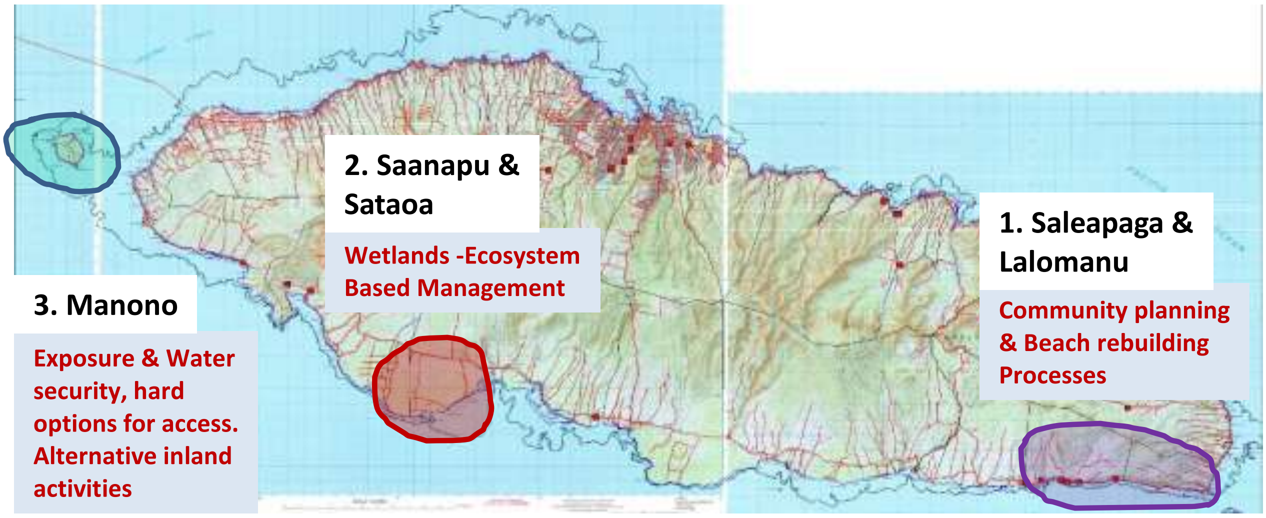


Figure 1: Tourist Development Areas (TDAs) and focus themes in Upolu

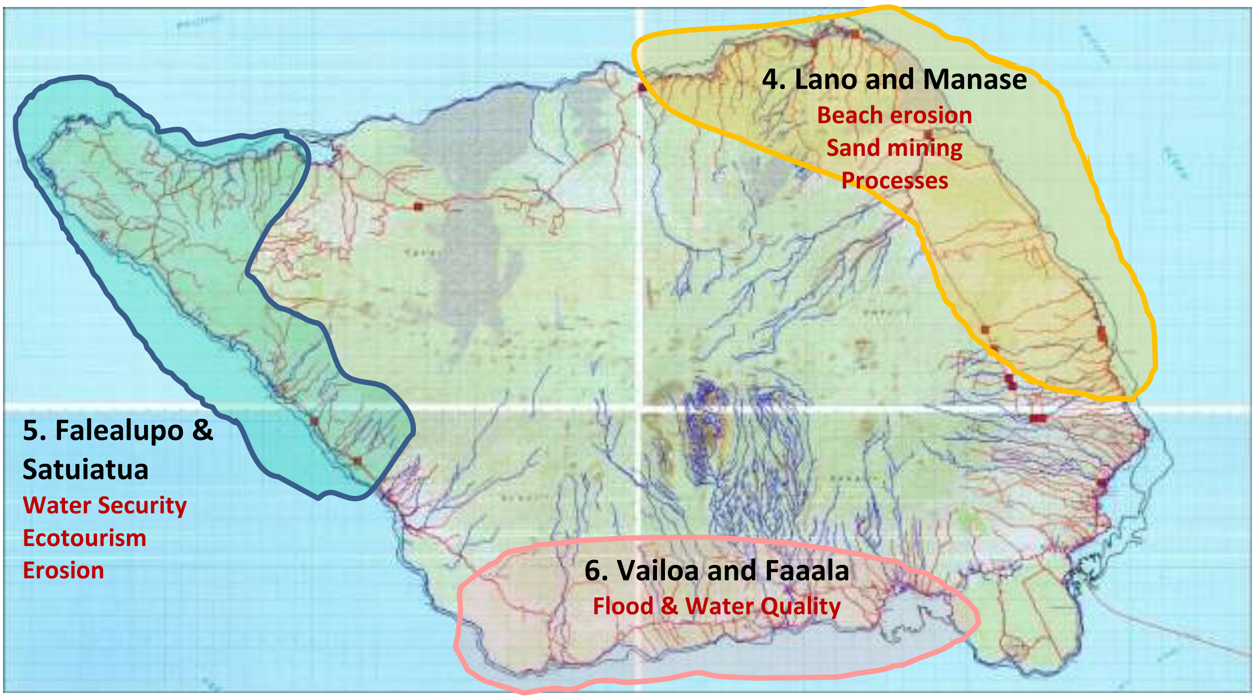


Figure 2: Tourist Development Areas (TDAs) focus themes in Savaii

1.3 Context – What are we dealing with

The beaches and coasts of Samoa are the chief tourism assets for the country. It is where most tourism investment has occurred but unfortunately it is also the area that is most vulnerable to creeping climate change and natural disasters. The focus of the project is on the small scale operators and their reliant communities, and most of these area on or near beaches which attract significant tourism.

We need to not only understand the nature of beaches and coastal strips, and the processes that shape them, but on the likely change to these processes and how they may shape beaches and coastal environs in the future.

For many fale operators on the sandy beaches there are constant pressures to consider coastal erosion, storm surge, king tides, cyclonic events and the sand budgets of beaches and lagoons. Beaches change naturally, but the change is exacerbated by increasing climate change impacts and disaster events.

Figure 3 shows the typical coastal profile of a sandy beach. Figure 4 shows the driving forces for change in a typical situation. Figure 5 shows in simple form the dramatic impact to beach systems that arise with sea level rise.

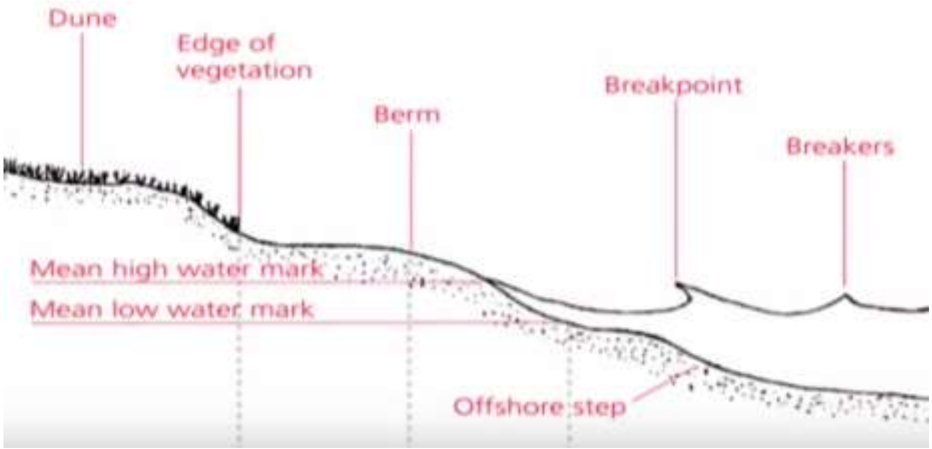


Figure 3: Typical beach profile and features

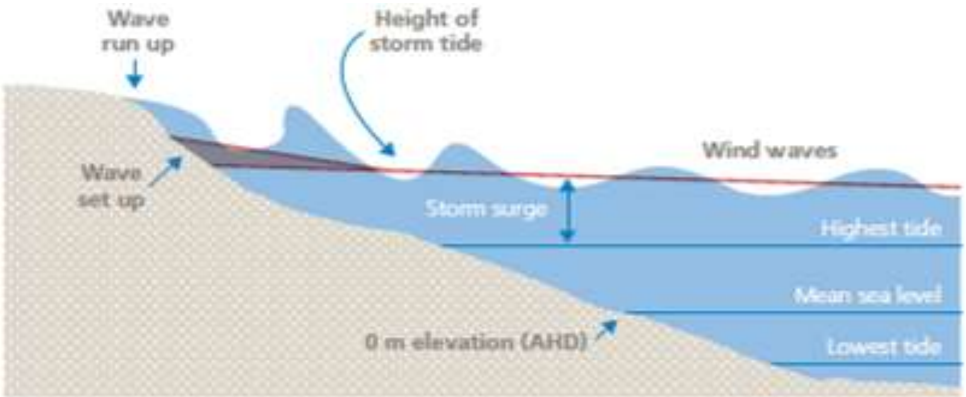


Figure 4: Typical beach event implications

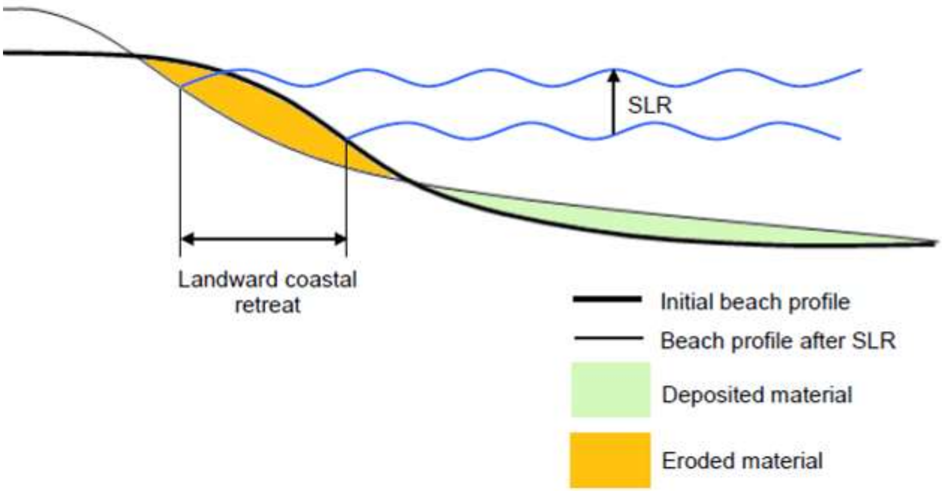


Figure 5: The impacts of sea level rise (SLR) on the beach profile

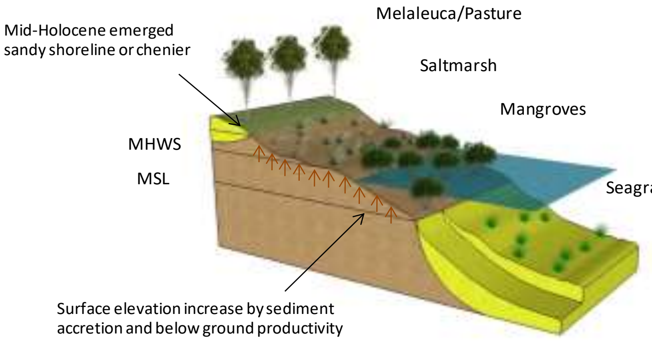


Figure 6: The usual complex of coastal systems

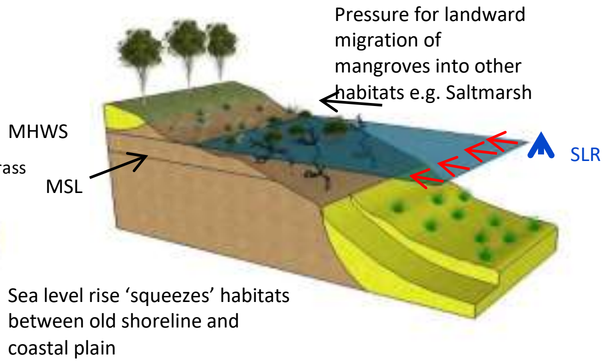


Figure 7: Habitat changes from Sea Level Rise

While the Figure 5 shows simply the potential impacts on beach profiles from sea level rise, we know that coastal environs are a lot more complex. As shown in Figure 6 a healthy coastal system inclusive of a beach system also often contains other important ecosystem features that work together to stabilize the coast and provide a natural 'protection' against climatic and natural disaster events. Seagrass beds stabilize the coastal sand budgets and will elevate the profile during non-storm events so that during extreme events that build-up of sand helps to protect the coast line. Mangroves and saltmarshes stabilize the muddier lower areas between beach areas, assist with land elevation growth through stabilizing sediment accretion. These in turn enable the coastal plain with old dune or wetland systems to become resilient to extreme events.

However with sea level rise the ecosystems become 'squeezed' as mangroves come under pressure for landward migration, 'taking' over prior saltmarsh, rivers or wetlands. Many of the seaward mangrove areas become permanently inundated and die-back of mangroves occur. The seagrass fields come under the influence of different circulation and micro-climate conditions and sand budgets become unstable. Fish spawning, nutrient recycling, land-to-sea migration of species – are all severely affected and the bio-physical systems of the coast that 'protect' it and enable quick recovery after extreme events become severely degraded. Combing ecological disruption with the physical changes leads to situations as shown in Figure 8.

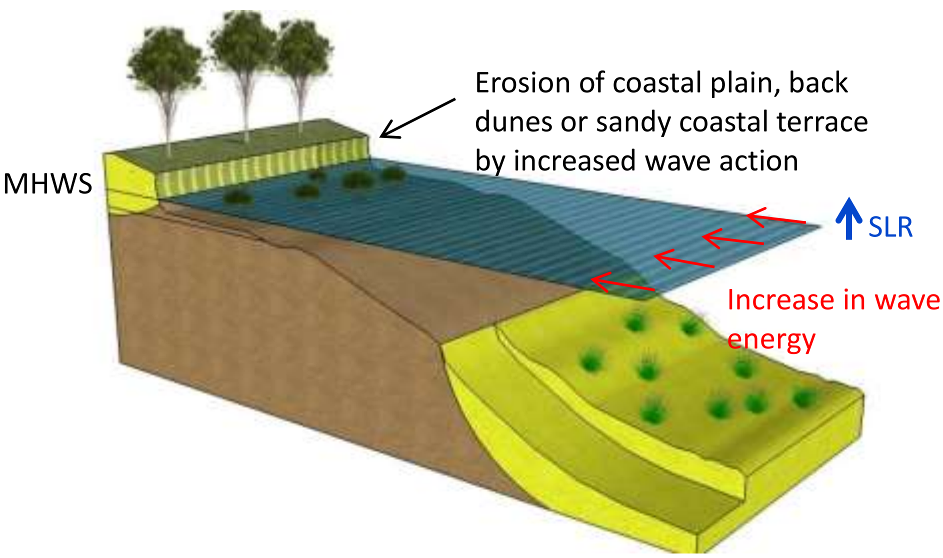


Figure 8: Severe ecological and physical change from climate change

1.4 Adaptation Options

Section 1.3 reveals that there are physical, bio-physical and ecological impacts of relevance to small scale tourism that can be expected from climate change. It is often said that soft adaptation measures are often suited to 'soft' environment situations while hard adaptation measures are best located where the local conditions are 'hard'. For instance in sandy beach areas soft measures such as landscaping, protecting existing vegetation and using pole based construction are best. Hard seawalls will often fail in soft sandy conditions as there are little opportunities to anchor construction to stable bases. While this is a good general rule, as also demonstrated in section 1.3, in the real world the coastal areas are often a complex of sandy beaches, mangroves, saltmarshes or wetlands, rocky outcrops and coastal vegetation on more elevated coastal plains. There are also human, economic and social implications of various options. Critical infrastructure, like roads are often located in vulnerable positions and will need hard engineering adaptation responses to protect them.

Given the complexities of any given situation, modern adaptation planning for diverse coastal systems areas canvass a range and combination of responses grouped as either: protection measures, accommodation measures or planned retreat (or avoidance) measures. As promoted in this project it is known that the most effective (plausible and successful) and efficient (cost effective, longevity) measures for adaptation to climate change especially in the coastal zone - are ecosystem based adaptation (EbA) measures. These are often referred to as 'soft' measures and can be used to protect the coast or accommodate impacts. But other protection or adaptation measures that require engineered responses will be necessary at times. For instance the changes to lagoon wave action and sand budgets, may lead to coastal erosion where it has not been experienced before. Semi or totally submerged barriers can be built in the lagoons or near beaches to protect the beach or other investments nearby. So in terms of 'hard' responses, there does not need to be reliance only on sea walls.

One of the most effective responses for communities is the 'planned retreat' series of options (some refer to this as the 'avoid' option). This is based on the premise that climate change is creeping change – so our responses can be planned over time. Using community or land use planning, communities can agree on where development should progress over time to deal with the growing impacts. Many of our human investments such as housing, public buildings, roads and infrastructure are built on the basis of a finite life of between 40-60 years. So as the life expectancy of buildings and infrastructure nears the end of their designation 'life cycle' communities can relocate facilities. It is good however if there is long term land use planning for communities to reach consensus on where this relocation should occur.

While the preference of the GEF in this project is for the planning for and application of ecosystem-based adaptation ('soft') options, alternative engineering (or 'hard') adaptation options are not ruled out. Large sea-walls have been and continue to be constructed in many areas since the tsunami and Cyclone Evan under other programmes and projects. However hard sea-wall constructions are not conducive to beach based tourism activities (access and aesthetic purposes), so there is a need to canvass all available options (both 'soft' and 'hard') for the project.

Many of the protect, accommodate and planned retreat options were discussed with operators and reliant communities during the GEF project design phase, as well as through the community engagement processes for the TDA Management Plans. These guidelines are based on the outcomes of those various discussions and meetings. Consistent with the past forums the technical guides are divided into five (5) key themes:

- *Community Visioning & Planning (the planned retreat option)*
- *Infrastructure Management (the protect and accommodate options)*
- *Integrated Water Resource Management (the accommodate options targeting water security)*

- *Shoreline erosion & beach protection (the protect and accommodate options specifically for beach environs)*
- *Ecosystem based management (the protect, accommodate and planned retreat options specific to ecosystems conservation)*

The technical guidelines generated under each of these themes all aim to increase the resilience of small scale tourism facilities to climate change risks. Some can best work in unison with each other to offer the best 'resilience' outcome. There are two aspects to this increasing of resilience, these being:

- Increasing resilience to specific climate change processes (for example, retreat from the shoreline when faced with the threat of rising sea levels or increasing water security when faced with the threat of longer drought periods),
- Improving (or at least slowing or preventing the decline) of the health of eco-systems that are a fundamental part of tourism operations in Samoa. There is a significant body of research that suggests that healthy eco-systems are far more resilient and more able to adapt to climate change processes than degraded eco-systems.

Based on the five (5) themes above, the technical guideline options are presented in more detail in following sections:

Section 2 *Community Visioning & Planning*

Section 3 *Infrastructure Management*

Section 4 *Integrated Water Resource Management*

Section 5 *Shoreline erosion & beach protection*

Section 6 *Ecosystem based management*

In additions to these primary themes other sections canvas important messages and guidance:

Section 7 Start-up guidelines

Section 8 Ongoing Monitoring / Education Programmes

2. COMMUNITY VISIONING AND PLANNING

Community visioning and planning for the future development of communities and villages is often the best means to deal with the creeping impacts of climate change. For many of the TDAs this did occur through the GEF project design phase as well as earlier in 2015 with the community engagement forums for the Management Plans. The use of 3D models occurred for each of the TDAs and mapping based on those outputs featured in the TDA Management Plans.

Land use planning with communities undertaken with a visioning and consensus reaching focus, has many redeeming benefits:

- Can identify and limit the use of high risk areas;
- Can be used to plan for and redesign facilities and activities to have less risk;
- Enables plans to relocate assets and activities (retreat) as and when needed;
- Enables the planning for better services that are less at risk;
- Enables communities to identify areas where it is best for sea-walls and soft options (e.g. planting trees, mangroves conservation etc.)
- Enables communities to plan for alternative activities (away from beach) to assist with income after disasters;

The key message in planning for any adaptation response is to 'know the landscape'. For the GEF project design and 3D modelling in 2015, a 'ridge to reef' methodological approach was followed to enable communities to understand the connectivity between catchments, land use, rivers, wetlands, mangroves, beaches, reefs, lagoons and coastal processes. Often this is referred to the landscape approach to land use planning. Figure 9 below typifies the geographical situation for many Samoan communities. It was used to show how even a planned development inland can have potential impacts on the coastal area.

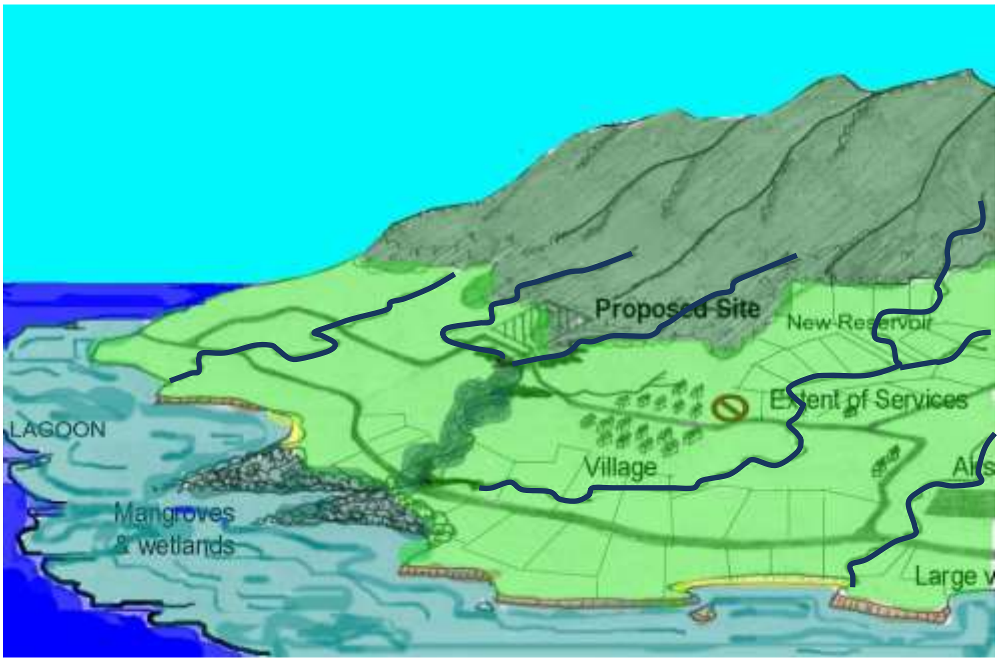


Figure 9: The geographical context of coastal areas with catchments in Samoa

One pertinent message that came from case examples about Samoa was the critical importance of knowing the landscape also in terms of the sub-surface hydro-geological structure and features. The high central volcanic mountains and flat coastal plain features of the Samoan landscape means that any planning of future development needs to be aware of what lies beneath the ground and how certain uses may see pollution or degradation downslope. Figure 10 below works in with Figure 9, to show the implications of a development site mid-slope adjacent to water systems where subsurface hydro-geology results in sub-surface flows coinciding with the development site, leading to pollution of waterways, wetlands, mangroves and coastal waters. Figure 11 then shows how good land use and environmental planning can be used to guide the right assessments to minimize down-stream pollution and degradation. A multi-layer and multi-criteria mapping and analysis process can guide soil and water quality management measures to protect downstream ecological features.

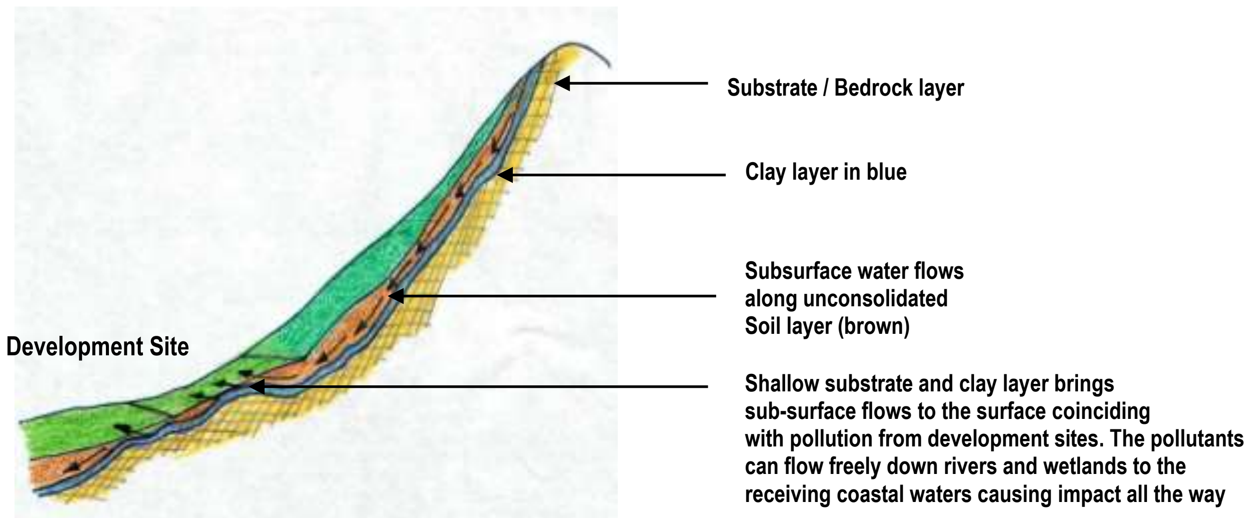


Figure 10: Understanding sub-surface conditions critical to landscape planning

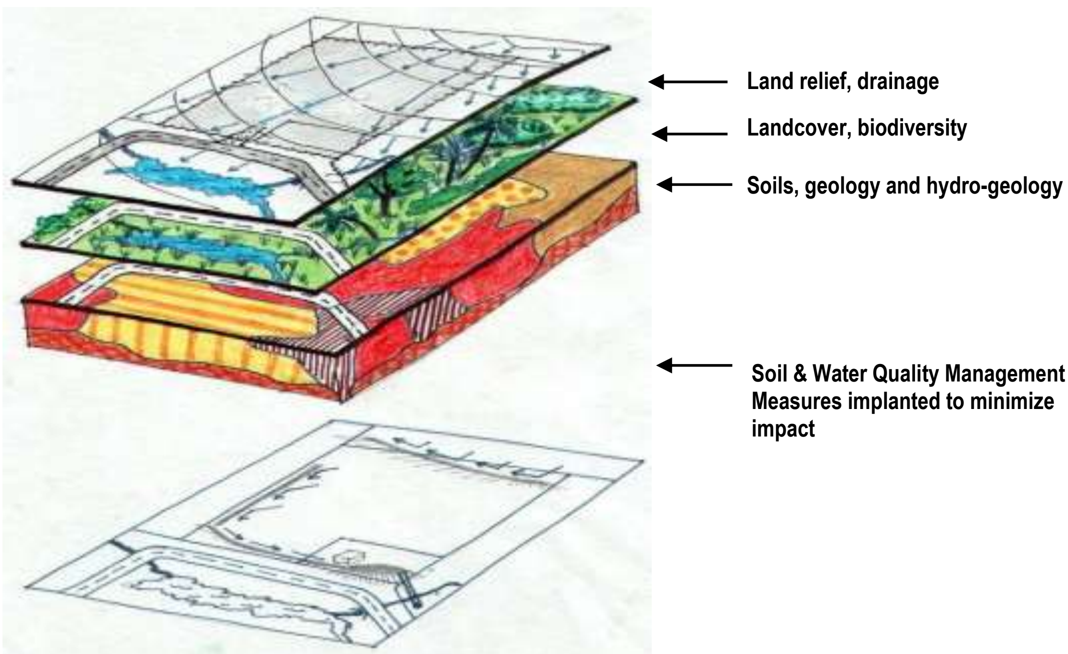


Figure 11: Good landscape and environmental planning leads to good responses to protect the environment

Good landscape planning with the community can also lead to sound choices on future infrastructure location, form and timing. Figure 12 below shows the outcome of working with the communities at Lalomanu and Saleapaga where the potential for increasing resilience canvassed the following:

- Location of fales on the beach and means to increase their resilience;
- The means to protect the main road, but plan for infrastructure on top of the escarpment over time;
- The location of more substantial buildings inland from the key coastal hazard areas (i.e. inland from the main road;
- The best location of disaster evacuation routes and shelters;
- The options for inland tourism opportunities to assist with business survival immediately after disasters.

This figure is a cross-section of the landscape immediately about Lalomanu, which has been based on the 3D model and mapping for the village completed earlier in 2015. This is shown in Figure 13, which is taken from the TDA Management Plan for the South-east Upolu. Such landscape mapping enables decisions to be made about the forms and locations of infrastructure (including buildings).

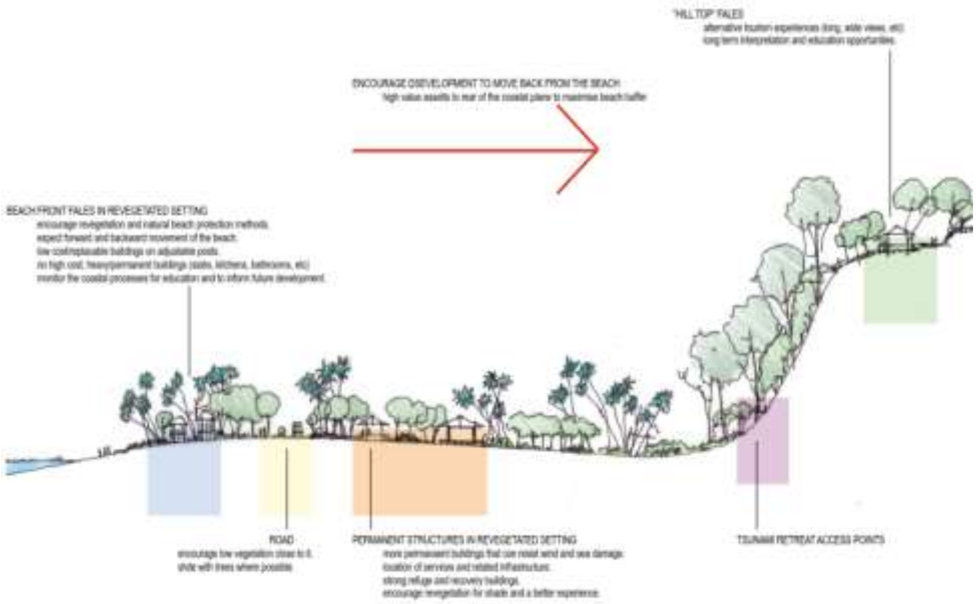


Figure 12: Cross-section of the landscape at Lalomanu – good for infrastructure planning

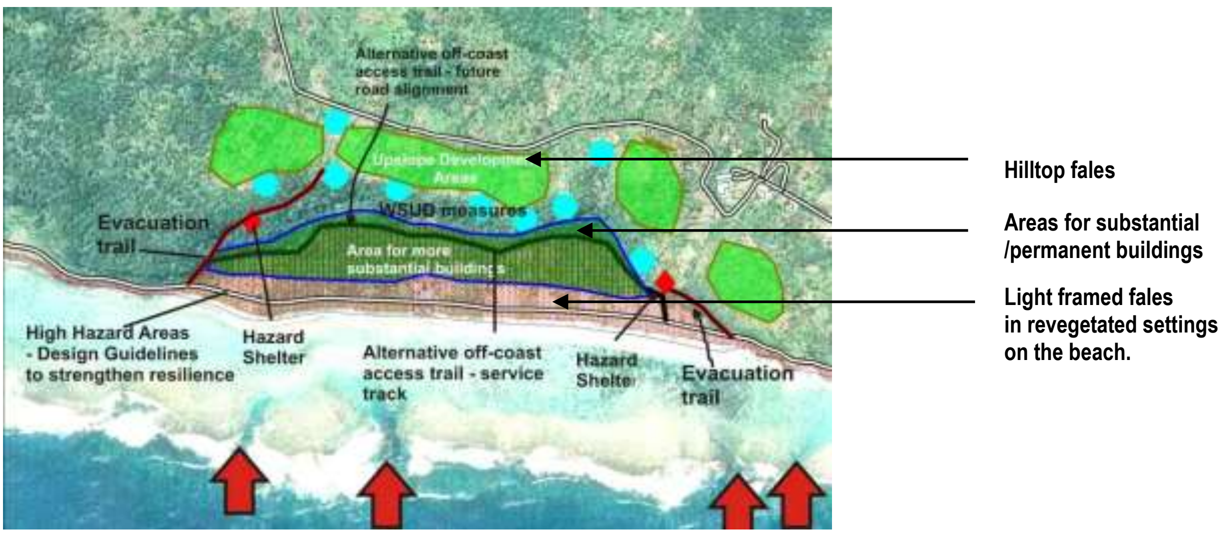


Figure 13: Mapping of Lalomanu from 3D model generated with the village.

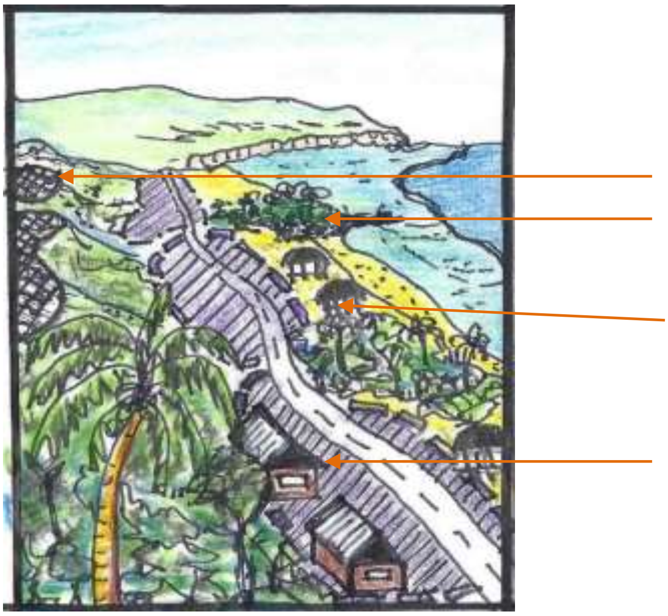


Figure 14: Depiction of infrastructure and building planning

Figure 14 above gives a graphic of the intent of the mapping and cross-section taken from the 3D modelling completed with the communities.

3. INFRASTRUCTURE MANAGEMENT – CLIMATE SMART GUIDELINES

One of the prominent requests from various operators and communities about Upolu and Savaii was information and advice on infrastructure development to assist with resilience building. The operators and reliant communities were aware that infrastructure planning and management needed to firstly be looked at strategically, through the landscape planning so that choices could be made on location, forms of buildings and facilities, future best location of roads, essential services and disaster management facilities.

The working with operators and reliant communities canvassed the following matters:

- construction form and methods;
- use of materials and maintenance to make accommodation more resilient;
- design and siting options for more substantial closed-in fales and facilities;
- ways to reduce pollution from the flooding, poor waste management and wastewater management installations;
- options for site and surrounds drainage, storm water management and effluent disposal.

3.1 Small scale light fales on the Beaches

The Samoan beach fale is used throughout Samoa as the key form of tourist accommodation near beaches. They are sought after to provide the traditional 'beach' experience and are constructed to provide basic shelter during the day and/or overnight accommodation for visitors.

The *STA Beach Fale Manual* provides excellent resource for beach fale construction. With some additional considerations an increased level of resilience to climate change processes can be incorporated within the siting and construction of traditional fales on beaches.

Most operators and reliant communities agreed that the risk of having light framed small fales on the beaches to facilitate the immediate tourist demand – were worth taking. Many expressed that the smaller light fales could be replaced quickly after disasters (estimated family cost ranged between SAT500-1000 per fale), with most of this cost being attributed to work-in-kind through provision of labour.

Many agreed that general resilience of the beaches among the light framed fales could be assisted through better landscaping and planting of bio-shields (planting of large strips of coastal vegetation) to stabilize dunes and sandy terraces. Landscaping among fales provides: stability, creates interest, provides shade and gives privacy between the various fales and the more public use areas. Clever landscaping schemes can be provided to add to the experience and amenity of tourists in a manner which does not restrict views of the sea. This can be achieved through a mix of high canopy trees, and lower shrubs, herbs and grass-covers.

Figure 15: Example of landscaping between fales to improve interest, privacy, shade and to stabilize beaches

3.2 Adjustable Floor Levels

A key point to consider in addition to those presented in the *STA Beach Fale Construction Manual* is that in many locations, there is natural variability of beaches and this can impact on the function and amenity of beach fales. Beach profiles naturally change between storm and extreme events. Siting and managing fales to respond to this variation can be difficult.

Traditional methods have been used previously to raise or lower the floor level of fales as a response to beach variability. These construction methods can be employed by the operators for the lighter fales on the beaches to increase the resilience of the structures and also protect the beach stability. Figure 16 shows the use of telescopic pole based construction techniques that enable fale owners to adjust the floor levels of fales as the beach profile changes between extreme weather events. For very light day fales this technique will enable the fales to be removed by simple lifting apparatus, placed on light tray-back vehicles and cartage to places of safety prior to extreme events. Obviously this last benefit is reliant on successful implementation of early warning systems.

3.3 More Substantial Buildings

As shown in Figures 12-14, more substantial or permanent buildings (buildings and facilities that have high costs to build and replace) should be set back from the beach areas preferably outside of the high hazard coastal zones (Coastal Infrastructure Management Plans, BECA 2001 & 2005). For some TDAs there is minimal chance to set-back substantial buildings from the hazard zone, due to the local geography and the need for these service facilities to be closely located to the beach fale attractions.

For new construction Figure 18 shows the means to lift the living areas and facilities to a higher floor area – above the hazard levels. The ground or bottom floor areas can be used for storage, parking or low cost service facilities. Piers on solid foundations can be shaped and located to divert trash thrown up during extreme events. Light wall cladding can be used, with the knowledge that these may be damaged during extreme events. Figure 19 shows how existing substantial buildings can be made more hazard proof. Hazard proofing existing wooden substantial buildings can also be achieved through lifting structures onto piers from ground based slab foundations – see Figure 20.

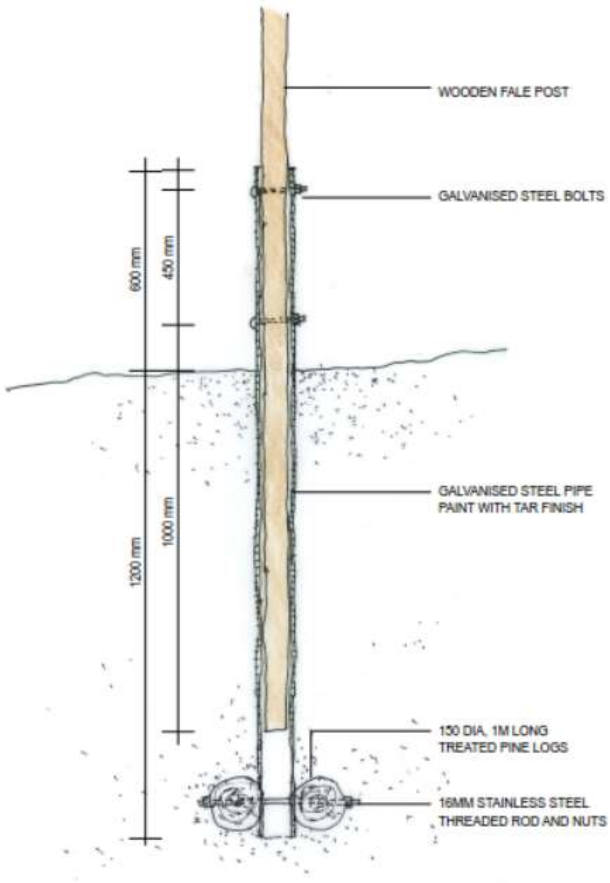
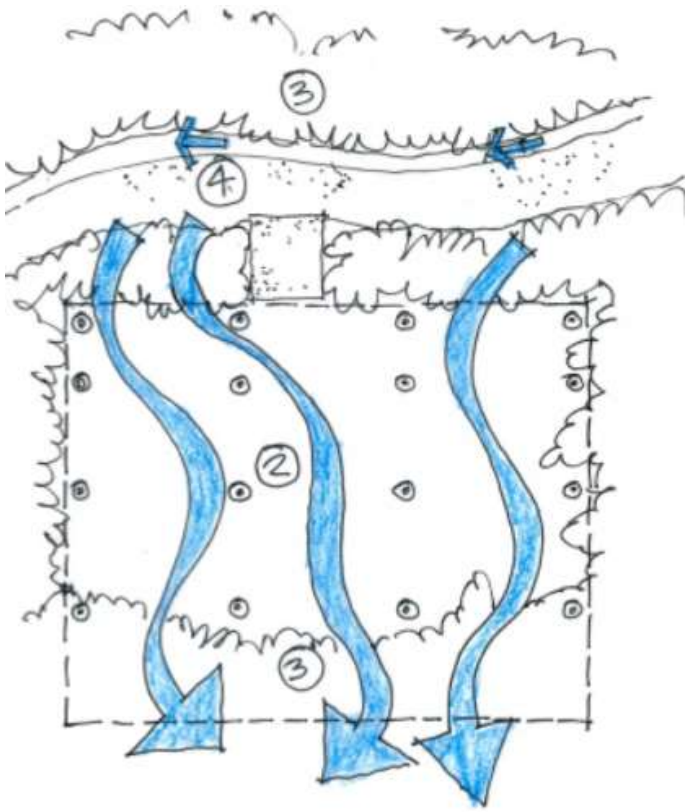


Figure 16: Telescope based pole footing construction technique for light fales on beaches. Enables adjustment of heights based on the ever changing beach profiles, and removal and carting to safety prior to extreme events



Climate Smart Guidelines for Fales on the beach

- Small diameter Pole footings
- Use of telescopic footings for light fales
- No strip or slab footings on the beach or dunes
- Retain existing vegetation to stabilize the beach
- replant damaged or disturbed areas starting with
  naturally regenerating areas
- Control and manage drainage from paths and roads
  (pole foundations assists with this
- Capture the roof water from the more substantial
  fales

Figure 17: Pole based Fale construction assists with water management and reduces erosion

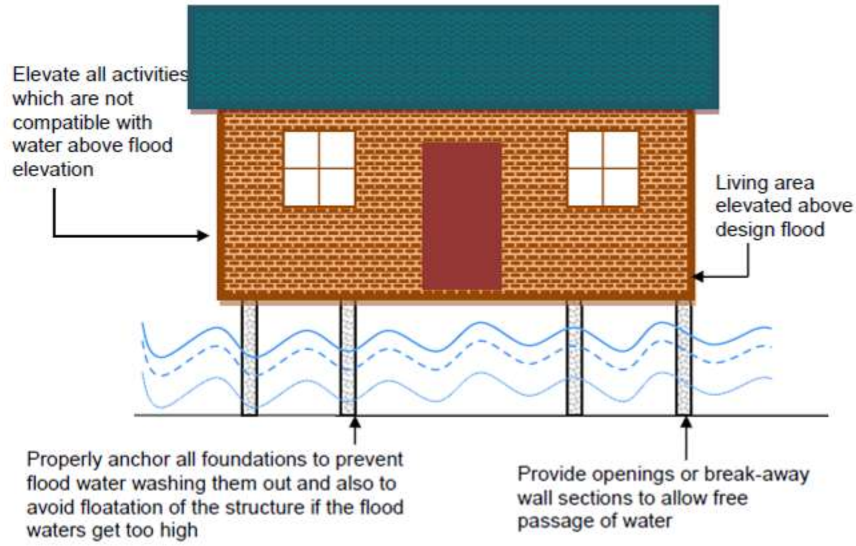


Figure 18: Substantial buildings to be set back from Hazard zones ad lifted so storm waters flow under

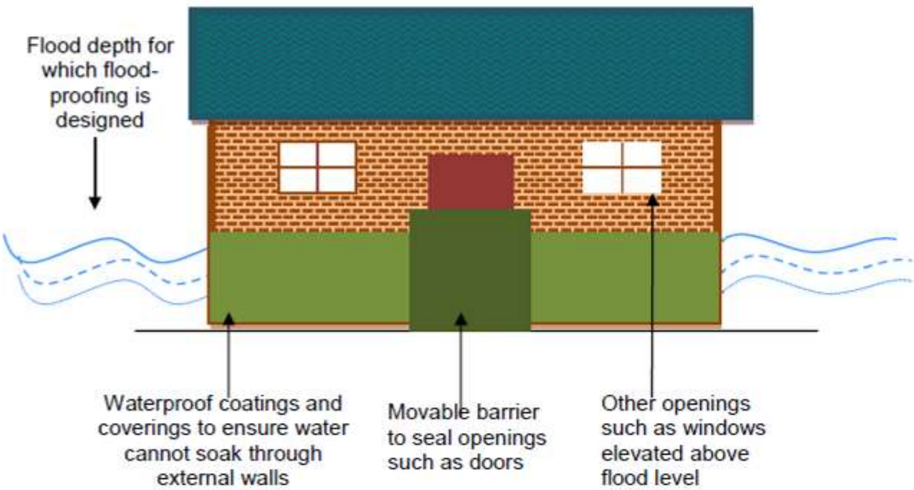


Figure 19: Hazard proofing existing substantial buildings in high hazard zones

Figure 20: Existing wooden substantial buildings can be lifted from concrete foundations onto piers

3.4 Building on Hill-tops and Slopes

As shown on Figures 12-14 an important aspect of this project is to promote the longer term ‘planned retreat’ of building investments away from the hazard areas of the foreshore. This planned retreat option also fulfils the intent to promote more inland tourism opportunities away from hazards areas – to assist with alternative incomes and replacement incomes post extreme disaster events. In many cases about Upolu and Savaii the options for retreat or avoidance are on steep land or on top of escarpments. There is a need to ensure that the building form and location in these situations are also resilient and do not result in pollution or degradation downstream or downslope.

Figure 21 below provides some guidelines for construction on sloping land or near escarpments. Consistent with Figure 17 it promotes pole or pier based construction for a number of reasons:

- Construction is cheaper as it can use local materials;
- Traditional Fale type building forms are attractive to tourist who are after cultural as well as amenity experiences;
- Pole or pier base construction enables less impact on the surrounds;
- Less disturbance to soils and vegetation enables quick growth of landscaping which assists with presentation for tourist;
- Water that is concentrated from roads and tracks can be dispersed down-slope without causing erosion.

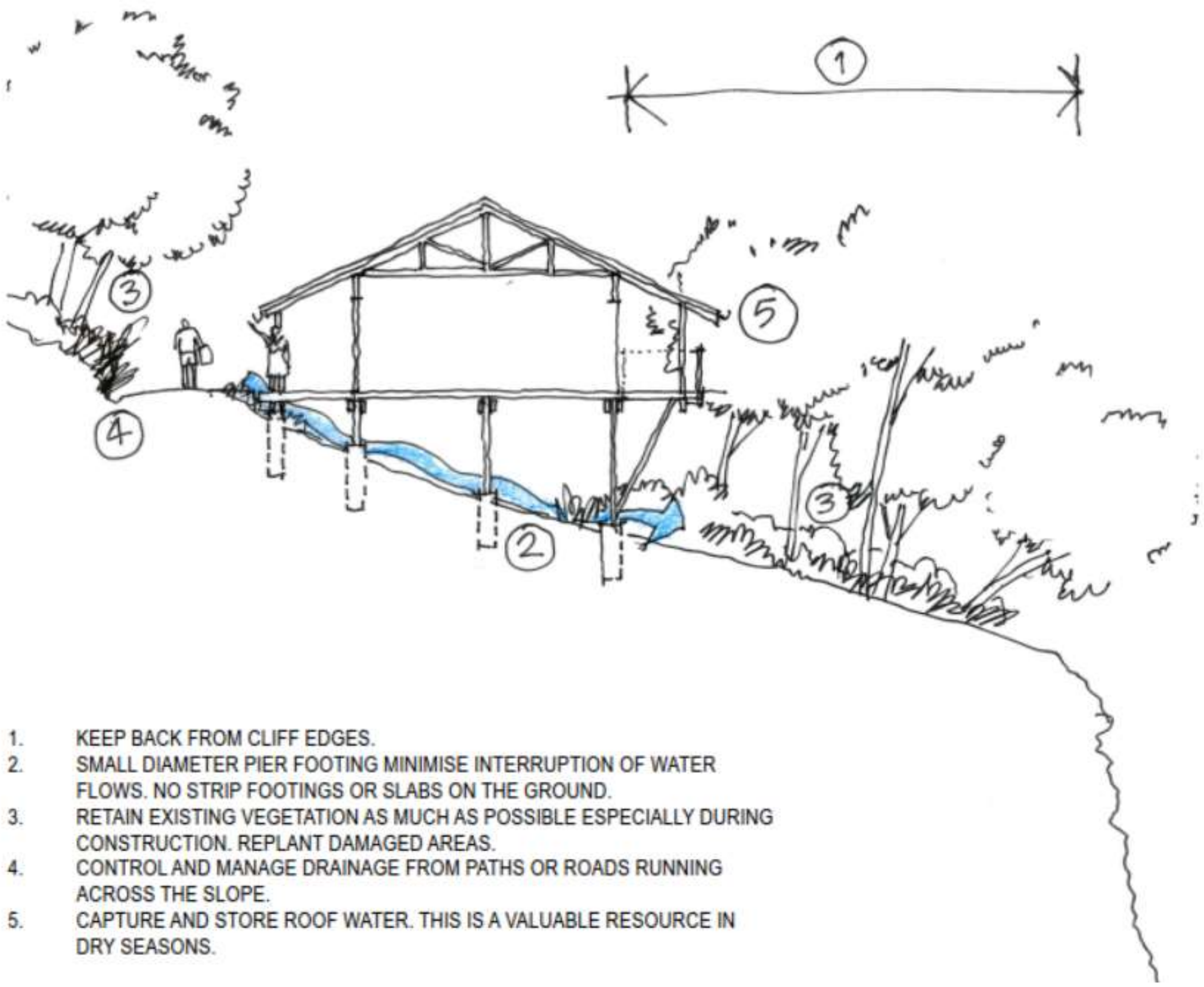


Figure 21: Climate smart fale construction on steep land or on top of escarpments

3.5 Infrastructure for Access and Evacuation

The TDA Management Plans mapped the potential location of evacuation routes and disaster shelters, as part of the community visioning and planning. The GEF project design incorporates disaster evacuation and shelters as key components of increasing the resilience of operators and tourism reliant communities. Subsequent implementation of adaptation measures should see communities reach consensus of final location and forms of evacuation shelters, as well as agreeing on the final alignment of evacuation routes.

For some TDAs, especially for Manono, providing resilient access to the coast from boats will be essential to sustain tourism. Additionally, good access points will provide transport services for essential materials and services, to enable machinery to be brought to Manono to assist with development and to enable access by emergency services. Pier based jetties in strategic locations (where public access to and from boats can be guaranteed) are the best option. Pier based jetties are preferred to concrete wharf or quays are they have far less impact on the coastal areas and do not have impacts of ocean and lagoon circulation processes. Like other forms of coastal infrastructure piers and jetties are best made resilient through good site planning and construction form. The following siting and construction standards should be followed:

- The landing place for the pier/jetty should be on part of the coast that is already naturally stable through rock outcrops (or adjacent to existing concreted parts of the coastline);
- The sea/lagoon side should have near areas of rock outcrops or submerged rocky shores that assist with wave energy deflection;
- There should be no use of explosives or mechanical change to reefs, submerged or semi-submerged rocks to gain boat access to the pier/jetty;
- Access to and from the pier/jetty shall be public access areas that have a grade of less than 10%;
- Piers should be coated steel, cased and founded in concrete drilled into hard base rock or reef beds;
- Piers and cross structures should be placed consistent with cyclone proof marine engineering;
- Steel tubes can be used with hard marine based wood if they meet cyclone construction standards;
- The thoroughfare base of the pier/jetty shall be constructed of wood planks with frames fixed to the piers in a manner that enables some free-play (i.e flexibility) during storm events;
- Piers/jetties can be constructed to accommodate floating pontoon extensions that themselves are fixed with coated steel piers drilled into the lagoon base rock. The pontoons shall be fixed to piers in a manner that enables flexible changes in the level of the walkways to coincide with tides and storm wave levels. Pontoons should include quick release connectors to enable removal and storage when extreme events are approaching (this function needs to coincide with early warning systems).

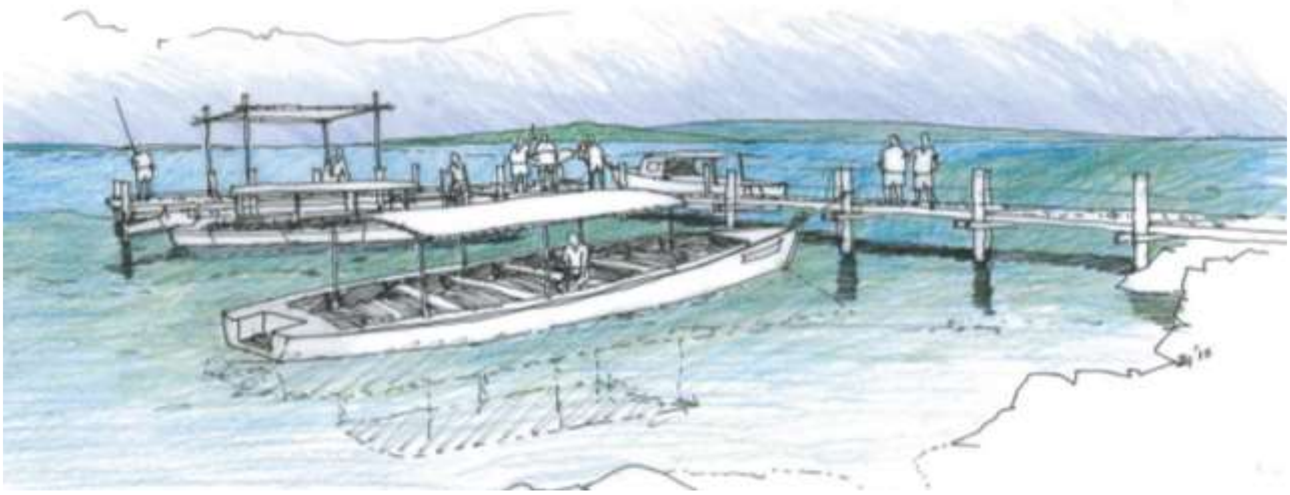


Figure 22: Image of the desired form of piers/jetties

4. INTEGRATED WATER RESOURCE MANAGEMENT

As mentioned previously the community visioning and mapping undertaken with the operators and reliant communities, as described in the TDA Management Plans followed the 'ridge to reef' or landscape planning approach. This is a worthy approach for communities to also see the connectivity between catchments, land use, waterways and rivers, wetlands, mangroves, beaches, lagoons and reefs.

- Ways to protect waterways to improve health
- Erosion and sediment control
- Maintain amenity and protect the receiving lagoons
- Reef health and resilience building
- Options and tools for water harvesting and re-use
- Simple demand-side management measures to conserve freshwater.

4.1 Protecting waterways helps beaches, wetlands, lagoons and reefs

Healthy coastal environs are reliant on healthy waterways and good land use management in the catchments – see Figure 9 in Section 2. Poor land use results in degradation, pollution and erosion, which pollutes the rivers and waterways which in turn affect water quality supply (for drinking), pollutes wetlands, mangroves and beaches. Poor quality water in the lagoons will then affect the reef systems – and coasts lose their natural barriers.

Good land use practices about TDAs should include:

- Not using chemicals close to rivers and waterways;
- Keeping at least a 10 m buffer between cropping areas and rivers and waterways;
- Fencing grazing animals out of river and waterways – at least a 20 m buffer;
- Not using waterways and wetlands, including mangroves for waste dumping;
- Not cutting down mangroves for wood fuel;
- Managing erosion and sedimentation in the catchments, especially along rivers and waterways
- Retaining healthy biodiverse landcover in the catchments.

Figures 23-25 below demonstrate a means to rehabilitate rivers and waterways that are facing erosion and degradation. Community working groups can use local materials to form more natural forms of river bank protection walls that are backfilled with local soils. Vetiver grass is then sown, and as it has a quick growing huge root bulb it stabilizes the river and waterway banks.

Similar methods can be used along the coastlines especially about sandy beaches and these techniques are covered later.

Figure 23: Community using local materials to stabilize the river bank

Figure 24: Backfilling behind the natural log wall and planting of Vetiver grass

Figure 25: After 12 months the Vetiver grass stabilizes the banks

4.2 Erosion and Sediment Control

The best means to stopped erosion and control the sedimentation of rivers, waterways and wetlands – is to limit the amount of land that is disturbed. However with many land use especially during the development phase there is sometimes much disturbance. A little human influence can be exacerbated to become huge erosion issues either downstream or along coastal areas.

Where development does occur in medium to high erosion risk areas the essential endeavour should be to control the concentration of water and as far as practicable dissipate the water energy that causes erosion by controlling the velocity and quantity of water at any given point. One key way to do this is to retain the original vegetation cover or to quickly re-landscape after disturbance.

In additional to replacing vegetation cover, there are a number of simple measures that can be employed to deal with uncontrolled water flows to stem erosion and curb sedimentation of waterways. Figures 26-32 show various options for erosion and sediment control with a description of how best they can be used.

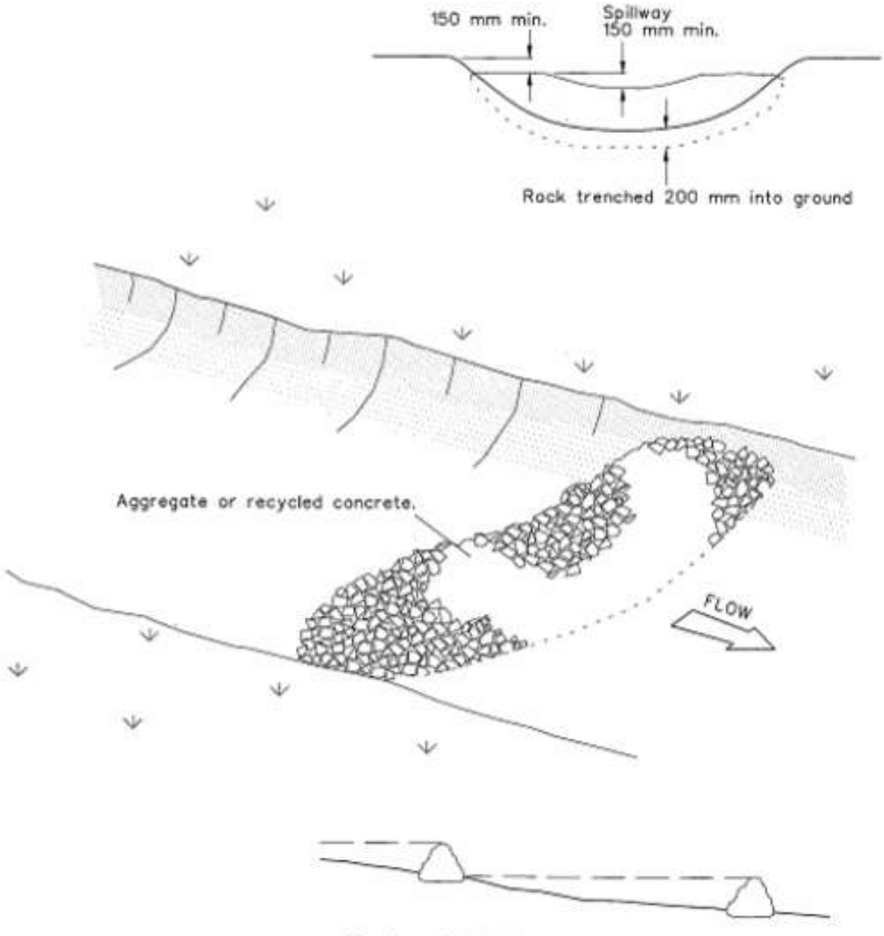


Figure 26: Rock check 'dams' in fast flowing eroding waterways and drainage-ways – reduces the flow velocity and erosive energy (a short term solution requiring other work)

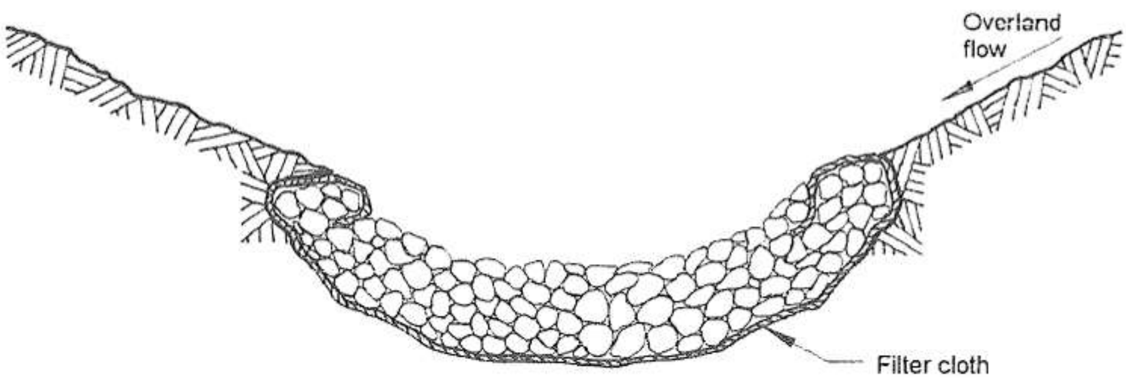


Figure 27: Rock lining the channels to stabilize beds and banks of small drainageways (this is a medium to longer term solution)

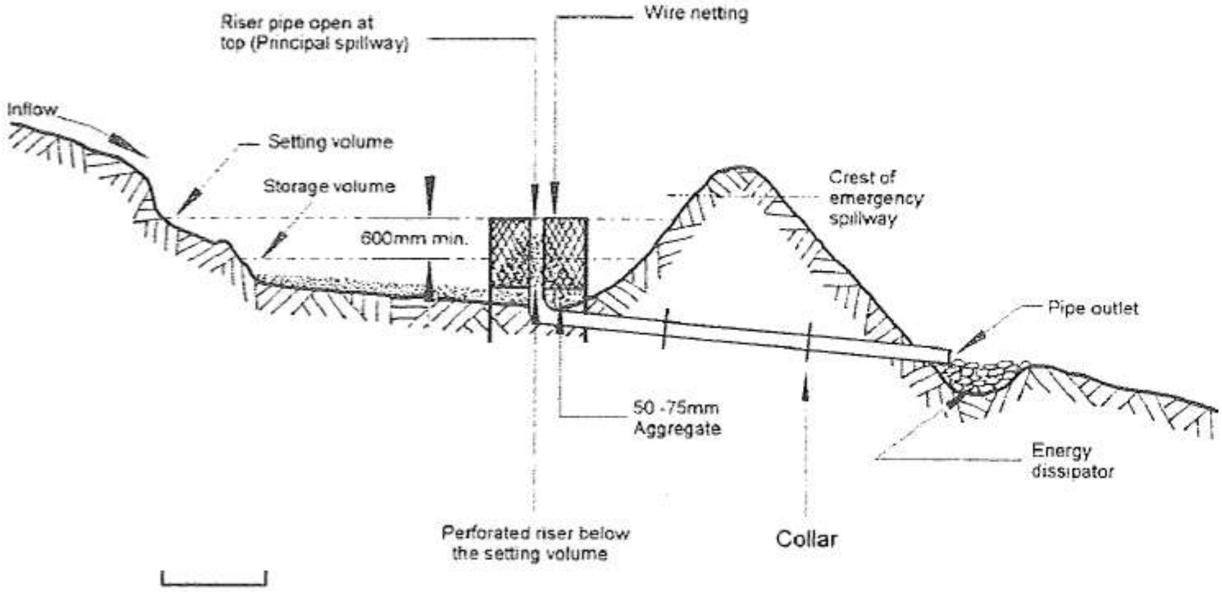


Figure 28: Sediment and water quality control ponds for larger waterways – stops fast flowing water and stops polluted waters entering wetlands, mangroves, beach areas and lagoons (shown on Management Plans as Water Sensitive Urban Design (WSUD) measures)

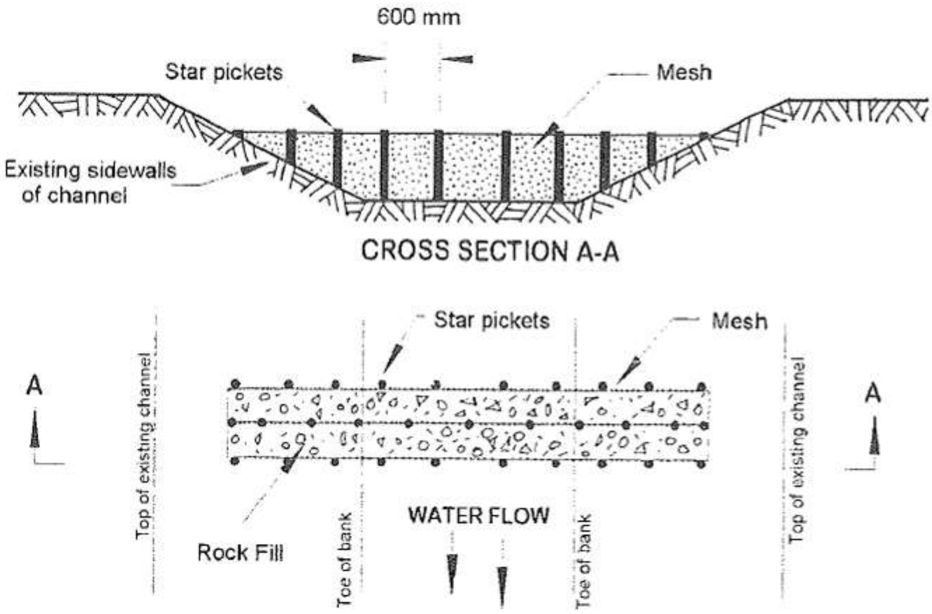


Figure 29: Short term erosion and sediment control during land disturbance and building near waterways and drainage-ways – traps sediment before it flows into sensitive areas.

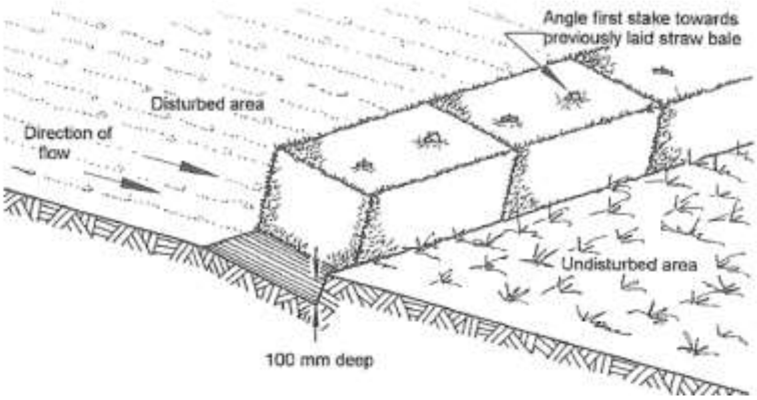


Figure 30: Short term erosion and sediment control – cheaper and effective. Straw bales not available in Samoa, however bundles of vegetation trash can be used

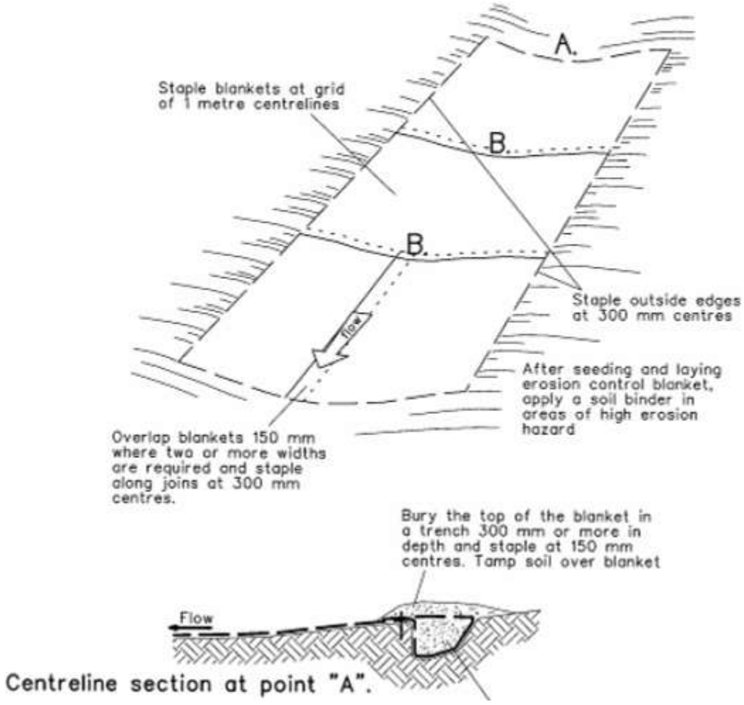


Figure 31: Sediment or Erosion blankets can be used to line drainage-way paths around fales to stop localized erosion. Best if this method is followed up with landscaping and revegetation.

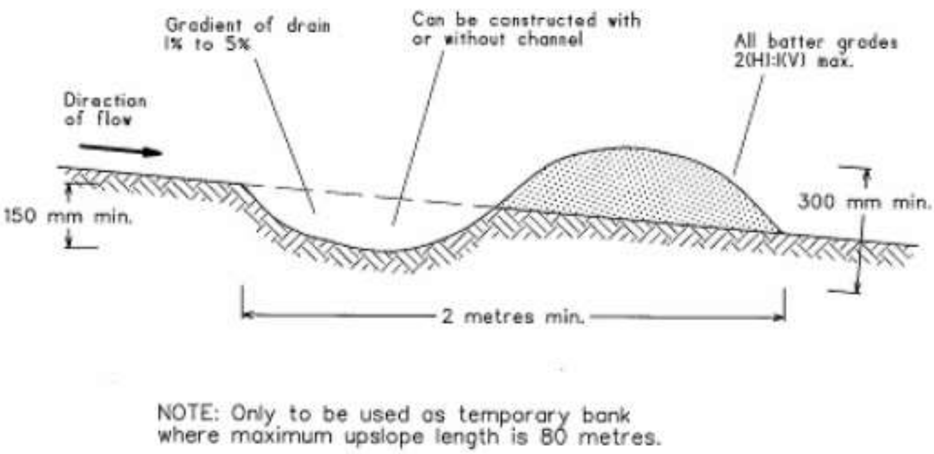


Figure 32: Where there is much flow of water from roads or tracks earth drains & mounds can be used to direct flows across the contours toward stable vegetated areas

4.3 Water Resources Security

4.3.1 Overview

For many communities in the more remote parts of Samoa (particularly the north western parts), both access to water and disposal of waste water is an issue. Adaptation options do include options that a) provide security in supply of potable water to tourists and reliant communities, and b) means to protect water resources, including coastal waters.

4.3.2 Access to Drinking Water

While Samoan communities have developed methods to reduce water consumption during droughts, tourists are not necessarily aware of such measures and are likely to expect good access to water. While the reaction of individuals will vary, if access to water becomes an issue during a tourists stay, this is likely to negatively impact on their experience.

Conversely, the water supplies for tourism operations and the communities that they are part of are not necessarily separate. Many international studies have shown that water use by tourists far exceeds that of the local communities, so in times of restricted water supplies, water use by tourists unfamiliar with community conservation measures may be significantly more than thought reasonable by the local community.

Climate Change processes are predicted to increase the length of dry periods or droughts. This has two aspects:

1. If tourism operations have access to mains water, during times of drought there may be additional restrictions placed on mains water access, and
2. If tourism operators do not have access to mains water (or they do have access, but it's rationed) during times of drought, increased pressure will be brought on the available local supply.

Individual operators can make a substantial difference in the available water supply at their facility through the use of rainwater tanks and associated infrastructure. Supplementing mains water supply also has the potential to reduce water supply costs.

The water supply that can be made available from Rainwater tanks can be used for:

- Showers
- Toilet flushing,
- Hand washing,
- Food preparation and clean up,
- Cleaning,
- Drinking water (although some tourists will not wish to drink from rainwater tanks and will require access to bottled water).

4.3.3 Rainwater Harvesting Systems

A number of development assistance projects have targeted water harvesting and water security since the tsunami and Cyclone Evan. However these initiatives did not cover all tourism operators or the reliant communities. Even so where initial assistance was given in supply of hardware (i.e. tanks and guttering) follow-up service on how to make rainwater harvesting effective did not come about. Figure 33 below shows the most simple storage components necessary for a rainwater harvesting system from buildings that will result in good quality water for tourists. This consists of:

- Guttering,
- Downpipe,
- First flush diverter,
- Tank,
- Outlet.

This system will improve the amount of quality water available throughout the year, but in some cases there may be a need for manual transport form the tank to it's subsequent use. While in many places about Samoa, there are extensive roof areas, very few of these are serviced with guttering that will assist with rainwater harvesting. For many tourism operations with the installation of guttering (and associated downpipes) to catch the runoff from the entire roof area, significantly increased quantities of water can be captured.

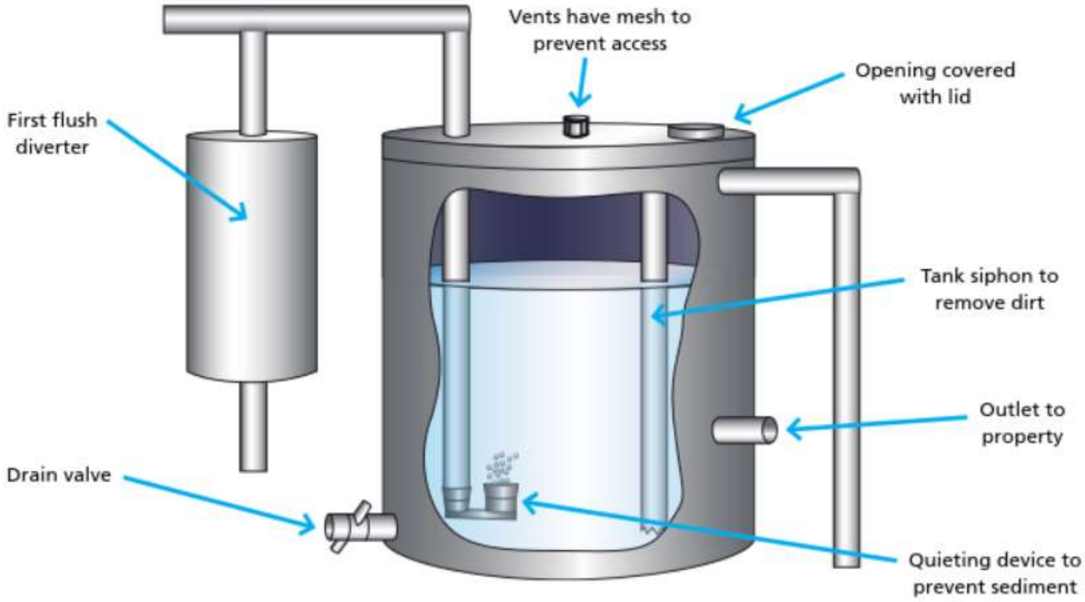


Figure 33: Basic components of efficient water storage system for rainwater harvesting

4.3.4 Rainwater Harvesting – getting it right

For those operators in drought prone areas such as north-west Savaii, getting the right balance between existing and expected demand for water (from tourists and local residents); the roof areas required, and the right volume of tanks – has been an issue. The STA have now been equipped with a simple spread-sheet based rainwater harvesting software which enables such advice to be confirmed.

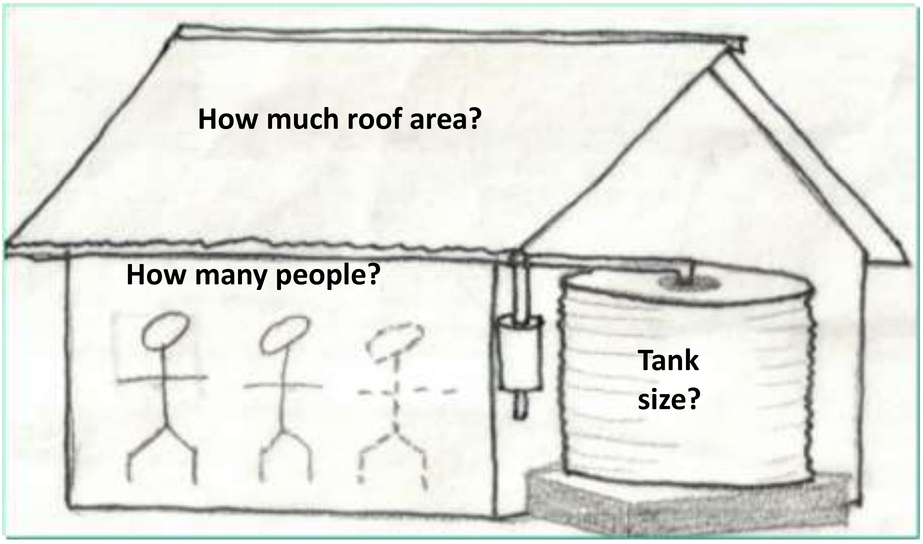


Figure 34: Getting the balance of demand, roof area and tank size to ensure water security during increasing dry periods

For larger tourism operators the spreadsheet software is still relevant but a more comprehensive system of collection, storage and distribution system incorporated within the sites and buildings may be necessary. More advanced options may include:

- Rainwater collection from multiple roofs to a central storage tank (or series of tanks),

- A pump and associated pipework to enable water to be delivered to a header tank, which then feeds by gravity water to various users within the tourist facility

4.3.5 Disposal of Waste Water

Improper disposal of waste water has the potential to cause water quality issues within river, wetlands, estuarine and reef lagoon environments. This is particularly the case with increasing population, or alternatively when a particular area with limited sewerage or septic infrastructure has a sudden, temporary population increase (such as accommodating a large number of tourists during peak tourist season).

With whatever effluent treatment facility (updated septic, composting toilets or advanced packaged water treatment systems (AWTS)) the aim should be to direct waste water outlfows back away from the beach and the waterways.

Research in the Cook Islands (Dept of Fisheries) has shown that land based sources of pollution can enter the coastal sandy terraces and nearby land substrate and emerge in the outer lagoons coinciding with the reefs. This can cause major degradation of reef systems – negating the ability of reefs to act as a natural barrier.

5. EROSION AND BEACH PROTECTION

5.1 Nature of Beaches

Forward and backward movement (erosion and accretion) of beaches over time is a natural process caused by the combination of many factors. During major storm events, beaches erode with sand moving offshore where it is deposited and can assist with protection of the beach that remains. In calm periods following storms, sand will move back onto the beach and the beach will gradually build back up or ‘accrete’.

Foreshore vegetation assists in “damping out” the fluctuations of beach alignment. Vegetation can resist erosion during storms and act to hold the beach together. During calm periods, vegetation catches and binds windblown sand.

Fluctuation in beach alignment is a natural process and needs to be expected.

When communities modify the foreshore, the balance changes and the beaches will response accordingly. For example, the removal of vegetation decreases the protection of the beach during storm events and increased erosion can be expected. Removal of sand for building or other off-shore aesthetic reasons, limits the total sand budget, and greater incidence of beach erosion can be expected. Recovery of the beach is likely to be slower with no vegetation to bind or protect the sand, or with a limited total sand budget.

Constructing buildings on the foreshore can also lead to increased erosion during storm events. Large concrete slabs can concentrate wave action or land based stormwater in front and on either side, accelerating erosion. There tends to be clearing of vegetation associated with the construction of structures on the foreshore and this further increases the likelihood of erosion.

Even without climate change, foreshore areas are exposed and infrastructure (hotels, fales or houses) can face significant risks during storm events.

If pieces of community or private infrastructure (eg hotels, fales or residences) are threatened by beach erosion, structural options are often used protect pieces of such infrastructure. A typical example of such structural protection is a sea wall. These sorts of structural options can be effective in terms of protecting the piece of infrastructure behind them, but will often result in increased erosion in front of them (usually the loss of the beach). This is why over the last 15 years the preference has switched toward non-structural measures such as use of ecosystem based adaptation options, including beach revegetation, setback of built form away from back dunes and coastal sandy terraces, wetland and mangrove rehabilitation, reef seeding and reef protection, and better catchment and land use management.

In the future, climate change processes (specifically sea level rise and increased intensity and frequency of storm/cyclonic events) are likely to exacerbate all of the processes discussed above. In some locations where the shoreline is already retreating, the speed of retreat is likely to accelerate.

5.2 Choices for Beach Protection

While we have previously described the difference between Hard and Soft adaptation options and the Planned Retreat, versus the Protect, versus the Accommodate options, Figure 35 below pictures these choices well in terms of beach protection.

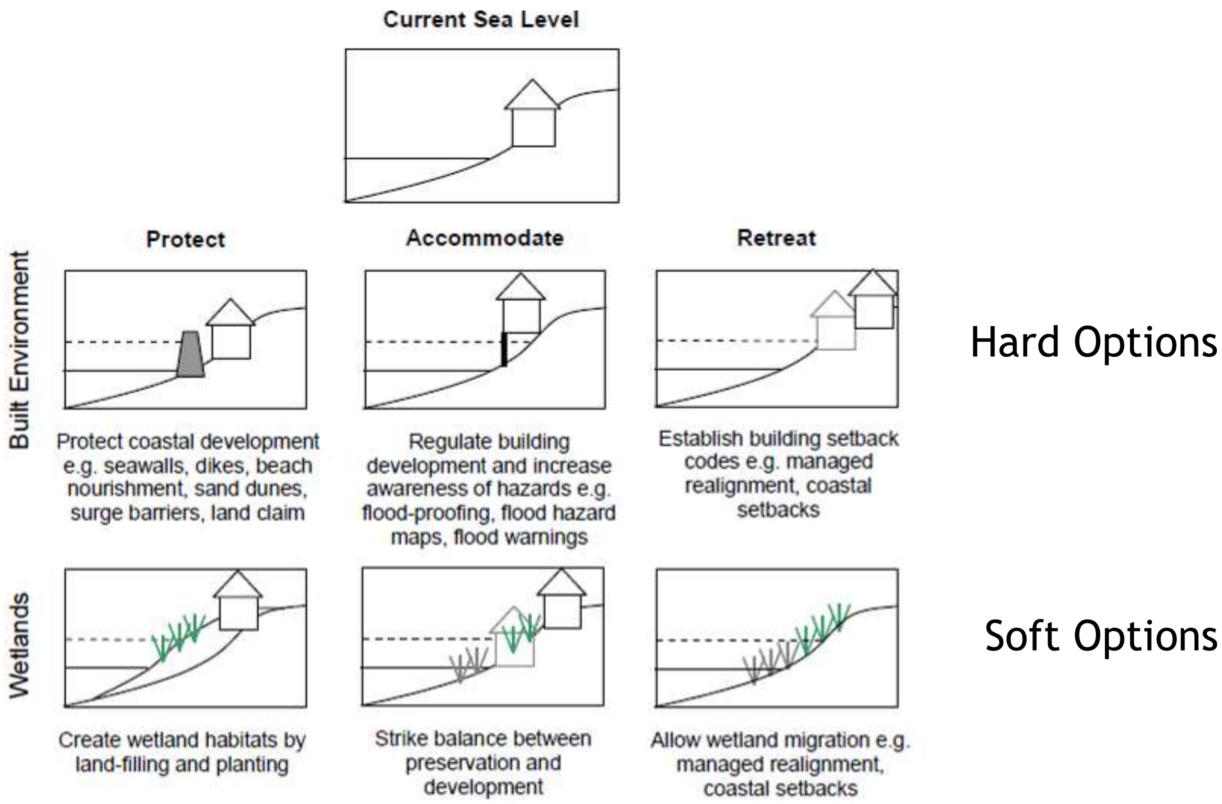


Figure 35: The relationships between various adaptation options in beach coastal management

In the following parts we will consider the Hard options, followed by the Soft options for adaptation, tailored to measures that would mostly be suitable for Samoa.

5.3 Structural or Hard Options

Structural Options or **Hard Options** include sea walls to protect against wave action.

Such options need to be properly designed, constructed and need to be of appropriate extent (normally the entire beach). If such options do not extend far enough, additional problems are caused at the edges of such structures which can cause either the structure to fail, increased erosion for adjacent areas or both.

Sea walls have been constructed and continue to be considered at various locations around Samoa. They are significant engineering exercises, are expensive requiring significant co-ordination and generally beyond the resources of individual operators or communities to construct. They also require very expensive and regular maintenance as often their lifespan is limited.

Coastal Infrastructure in Samoa is generally considered under the Coastal Infrastructure Management (CIM) Plans.

Figure 36: Seawalls as Hard measures are known to be 'brittle' options that require much assessment and tailored design to ensure effectiveness. They will protect assets behind the wall but will often cause more sand erosion along the beach

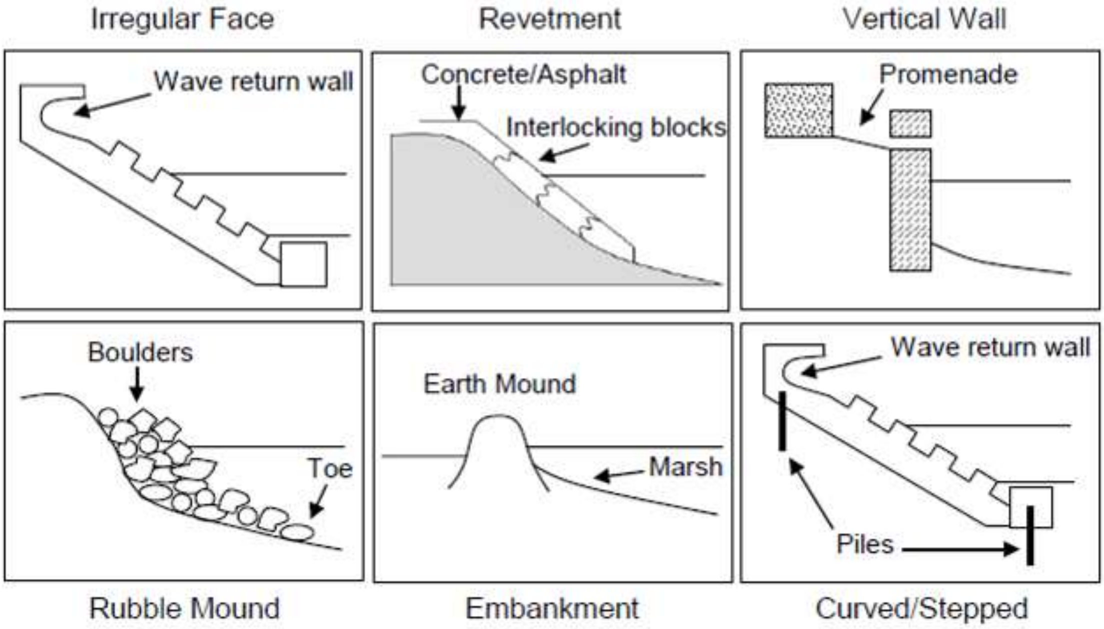


Figure 37: Where seawalls are essential to protect infrastructure, essential services and major development There are a wide variety of design options – each requiring engineering input.

5.4 Alternatives to Seawalls

As seawalls are often very expensive, require much engineering design and sometimes have questionable benefits for beach rehabilitation, alternatives to these structural means to Protect the coastline have included use of Sand bag barriers and walls. Where the level and rate of coastal erosion is large this alternative is cheaper, enables the shaping of the beach front to be graded much to a shape to natural beach profiles, and can incorporate revegetation to ensure longer term stability.

Figure 38: Example use of Sand bags on regraded beach profile with associated vegetation planting

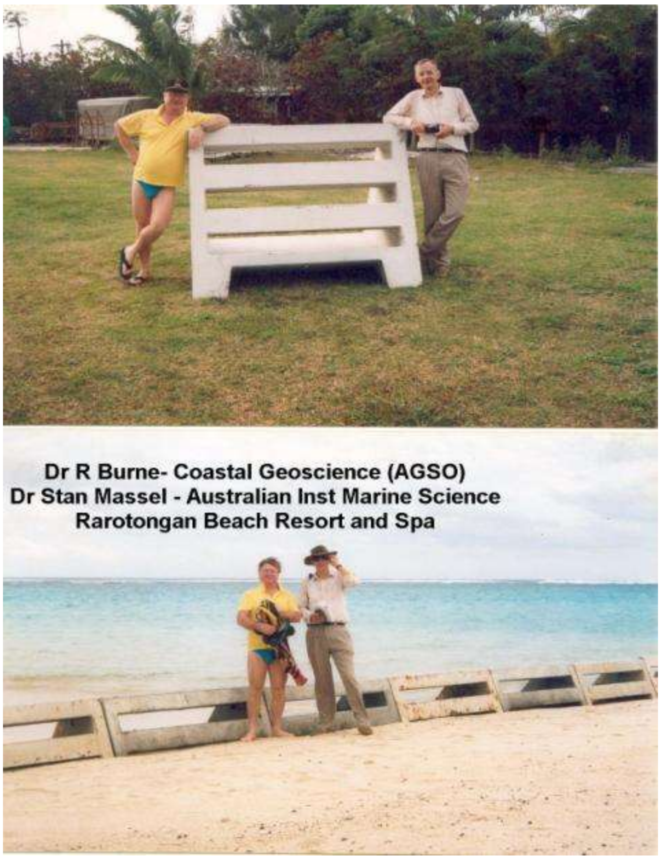


Figure 39: Use of Coastal Protection Units in Cook Islands

Another effective alternative to seawalls is the use of Coastal Protection Units (CPUs). There are a variety of techniques involving submerged and semi-submerged structures placed offshore that are designed to dissipate the wave energy that causes beach erosion.

A coastal protection unit of notable success was invented in the Cook Islands by a local engineer. It involves the use of 2m wide units specifically designed to divert large waves, but allow smaller waves to progress to the beach so that sand can be brought back onto the beach. The units are lined up along the beach on reef or rock lagoon floors some 50-100m offshore. The length of alignment is dependent on the nature of the erosion, but a minimum of 30m has been suggested. The benefits of these units shown in Figure 39 are that they are:

- Cheaper than seawalls
- Moveable
- Effective
- Enables beach planting while sand building up
- Strips of units can be moved along the beach as the targeted length is stabilized

Figure 40: Photo series showing successful build-up of sand but then dramatic impacts of their removal with coinciding beach revegetation

Annex 1 Section 3 shows some successful uses of the CPUs in the Cook Islands. However there are some warnings. Their use needs to coincide with beach and near beach revegetation to stabilize the overall sand budget, before the units are removed.

The series of photos in Figure 40 show the success of trials from 1991-2001 for a resort in Rarotonga. However soon after 2001 the resort was sold on and the new owner removed them before stabilizing the beach with vegetation and addressing erosion from water runoff from the resort. The result was the complete loss of the beach again within 5 years.

At the time of the third photograph the new owner was desperate to save his buildings and resorted to building a seawall. This has protected his building, but has required re-building of the seawall numerous times and has not resulted in the re-establishment of the beach. As tourist are seeking beach related experiences, this has affected his guests.

5.5 Non-structural or Soft Options

In response to both current beach erosion and potential increased beach erosion in the future associated with climate change processes, various structural and non-structural options have been proposed about Samoa. Hard options have been discussed in the previous section.

Non-structural options or **Soft Options** include planned retreat, or the relocation from the coastline of valuable infrastructure. It is important to note that while most effective if undertaken at a community level, planned retreat can be undertaken on an individual basis, if actions are planned over time.

For tourism operators, the following measures are suggested:

1. Create a long term plan for the tourism facility using elements of the guidelines as appropriate. Retreat from the foreshore does not need to occur immediately, but if plans of what the tourist

facility could look like in say, 20-30 years, can be created, then works can be done gradually as time and resources permit;

2. In accordance with the general advice provided as part of the CIM program, avoid significant investment in structures within the Coastal Erosion Hazard Zone (CEHZ);
3. Day use beach fales should be constructed using traditional techniques i.e. on poles with an elevated floor. Concrete slabs should not be used. Ideally, measures allowing the fales to be raised or lowered as the beach profile changes should be incorporated. As described in Section 3.2 adjustable floor levels can be accommodated through use of telescopic footings;
4. Undertake significant investment or 'substantial' buildings (e.g. kitchens, restaurants bathrooms etc.) either outside of or as far to the rear of the CEHZ as possible;
5. Do not incorporate high value facilities (eg kitchens, restaurants, bathrooms etc) as part of day use fales on the foreshore;
6. Measures can be provided (as per following sections on revegetation) to allow and encourage visitor access to the beach in a way that does not damage vegetation;
7. Consider measures undertaken as part of the Village Sustainability Plan and how the tourism facility could co-ordinate with such measures;

Note that as part of the TDA Management Plans, measures for planned retreat are suggested for each TDA.

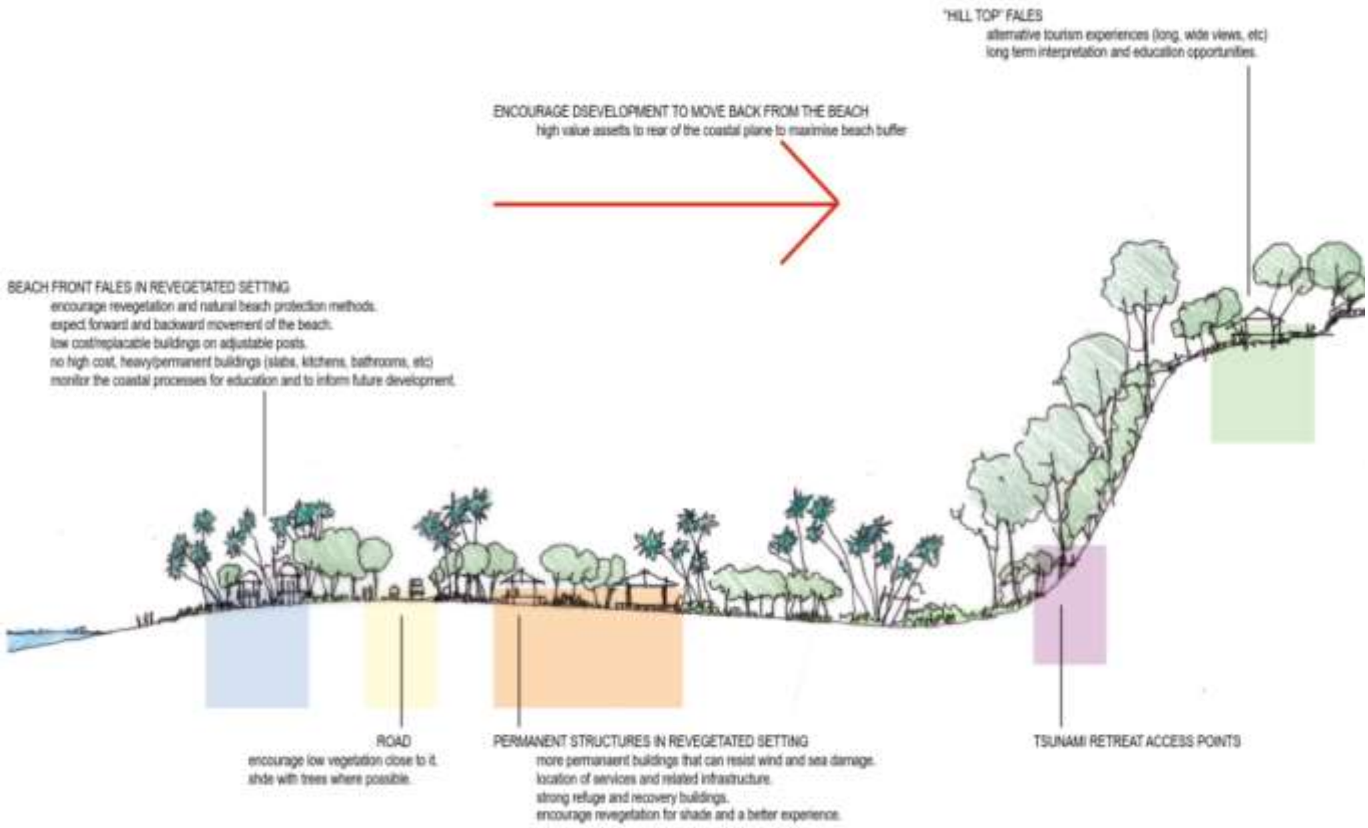


Figure 41: Example of a broad master plan for planned retreat from the coastal plain

5.6 Landscaping for Beach Protection

One of the key attributes of Samoa, identified under the Samoa Tourism's strategic plan has been the "beautiful beaches and crystal clear waters".

Climate change processes threaten the stability of the beaches in various ways, the most significant of which are:

- Rising sea levels resulting in retreat of the coastline, and
- Potentially increased storm/cyclonic intensity causing increased erosion during periods of extreme weather.

Vegetation plays a vital role in ensuring the stability of watercourses and coasts under both normal, calm conditions and also during storms or cyclonic events.

Healthy beach vegetation acts to:

- Prevent wind blowing sand away,
- Reduce the energy of waves and prevent erosion during storms
- Trap sand, shells, broken off vegetation during storms and build the beach during calm periods,
- Filter runoff form the land and protects water quality of the reef.

If beach vegetation is cleared or damaged the beach is likely to experience:

- Increased sand loss through wind action,
- Increased erosion during storms,
- Less recovery during calm periods,
- Worsening water quality within the reef lagoon and subsequent damage to coral.

Revegetation of the foreshore is seen as a critical component in increasing resilience of Samoa's beaches to climate change processes. It is important to note that revegetation of the foreshore does not preclude beach fales. However, the complete clearing of beach vegetation for fales is strongly discouraged. Rather, where located close to the foreshore, fales within the vegetated zone should be encouraged. This has the added benefit (from a tourism perspective) of providing increased privacy for guests of the fales.

SPREP's "Coastal Ecosystem-based Rehabilitation Guide", 2014SPREP provides useful guidance on beach revegetation. Annex 1, Section 2 also includes good examples of beach revegetation and control of beach use to reduce pressures for erosion. Measures provided in the guidelines include:

- Access control – providing paths and walkways for beach access to protect vegetation, while still allowing people access to the beach,
- Beach revegetation – replanting vegetation to help damaged beaches to become healthy again,
- Brush protection – protecting previously damaged areas of beaches,
- Ways people can work with nature – suggestions for ways to manage the beach into the future

5.7 Use of Bioshields

Another useful production by the MNRE, SPREP, Conservation International and others is the production of information on the use of Bioshields. These are essentially the planting of thick bands of vegetation along the beach in strategic location to assist with beach and beach dune stabilization. They can also provide a treed barrier to rocks and trash thrown up during extreme events.

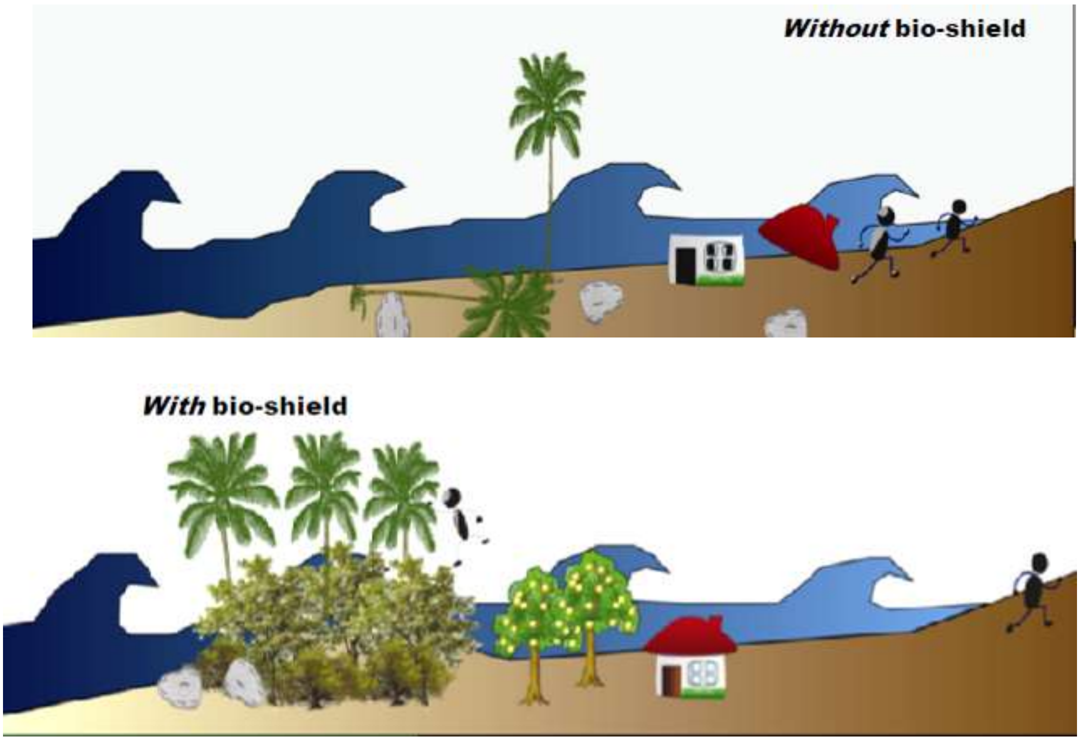


Figure 42: Use of Bioshields for Coastal stability and protection

The brochures produced by the MNRE also give advice on how to plan for and set aside the right amount of land for bioshields. The methods to use are summarized in Figure 43 (box). The mix of species to use for a bioshield are listed in Figure 44 (box).

- Plant a bio-shield of 20-50 metres wide
- Plant in areas out of reach of normal waves and tide
- Use barriers to protect young plants from wind and salt spray
- Use fences to keep animals and people from trampling on the young plants
- Plant dense bush with vertical layers: shrubs, small trees, big trees, herbs, ferns, as well as vines
- Plant hardy coastal plants first; these form a wind buffer to plant more species inland
- Avoid straight-line paths through the trees; these can channel waves and increase damage

Figure 43: Methods for creating a Bioshield

Buffer species to plant along the coast (first 10 metres)

Barringtonia asiatica (futu)
Calophyllum inophyllum (fetau)
Cocos nucifera (niu)
Cordia subcordata (tauanave)
Erythrina variegata (gatae)
Ficus tinctoria (mati)
Guettarda speciosa (puapua)
Hernandia nymphaeifolia (pu'a)
Hibiscus tiliaceus (fau)
Morinda citrifolia (nonu)
Pandanus tectorius (fasa)
Scaevola taccada (to'to'i)
Terminalia catappa (talie)
Terminalia samoensis (talie)
Thespesia populnea (milo)
Tournefortia argentea (tausuni)

Species to plant behind the buffer species (10-50 metres)

Adenanthera pavonina (lopa)
Artocarpus altilis (ulu)
Bischofia javanica (o'a)
Cerbera manghas (leva)
Flacourtia rukam (filimoto)
Flueggea flexuosa (poumuli)
Glochidion ramiflorum (masame)
Inocarpus fagifer (ifi)
Intsia bijuga (ifilele)
Mangifera indica (mago)

For more information contact Conservation International on 21593 or MNRE on 23800
E: cipacific@conservation.org

Figure 44: Species mix for a Bioshield

5.8 Beach Rehabilitation

In many instances resilience of beaches can be increased by rehabilitating existing degraded beach fronts. A key to this is often the control of existing uses along the beach, especially of foot traffic by the tourists. Figure 45 shows the means to control existing pressures and to establish revegetation areas along the beach. Annex 1 Section 2 shows real examples of these methods

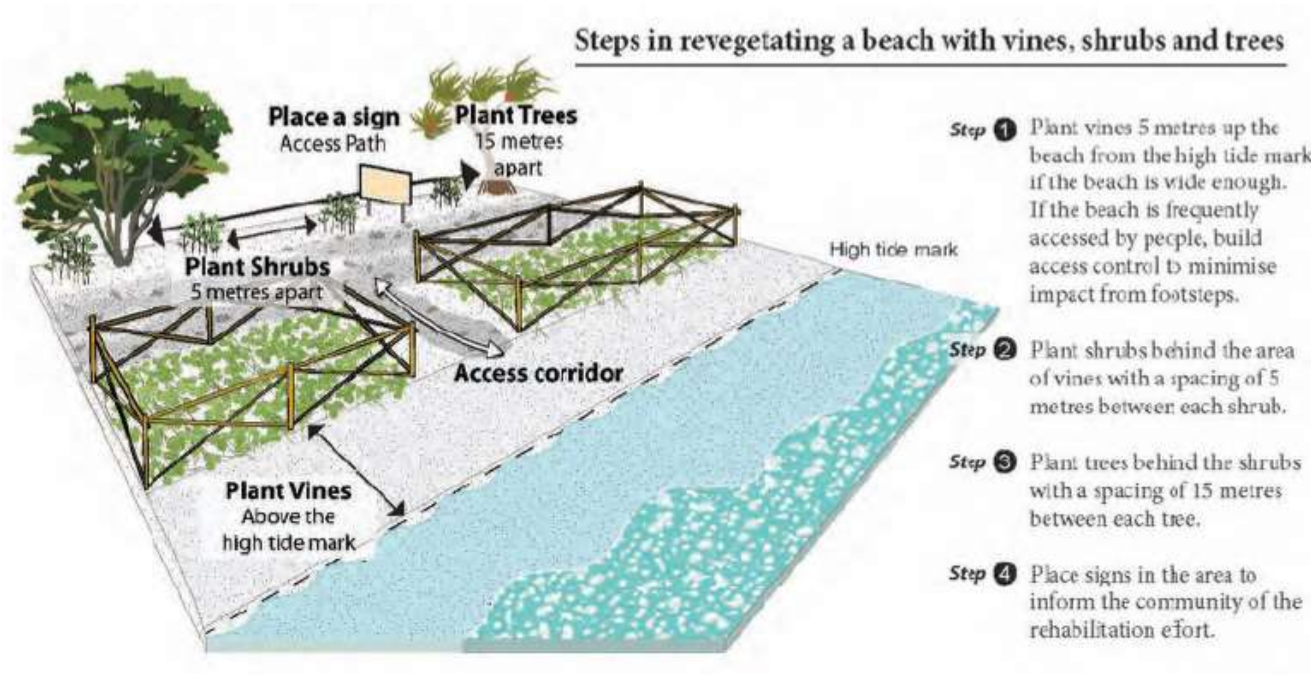


Figure 45: Beach rehabilitation by controlling access and guiding natural or planted vegetation

Often operators are faced with minor erosion of beaches after storm events. There are useful methods that can use local materials to assist with beach recovery. Figure 46 depicts a useful method.

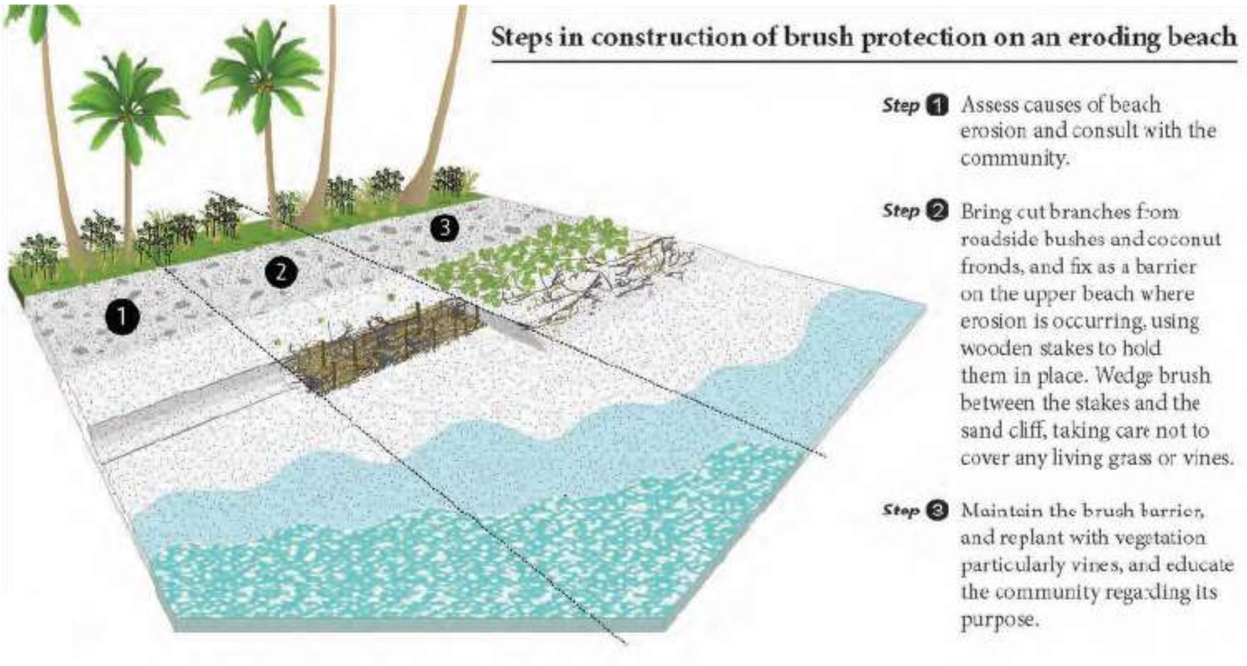


Figure 46: Using local materials to fix existing beach erosion

5.9 Landscaping for Protection, stability and interest

Good landscaping schemes can not only offer protection of the beach systems, and stabilize high erosion risk areas, but it can be placed to assist with providing shade for tourists, privacy between fales and create some interest in the landscape. Tourists are often after new experiences and winding paths through vegetated areas with glimpses of the ocean can provide those experiences.

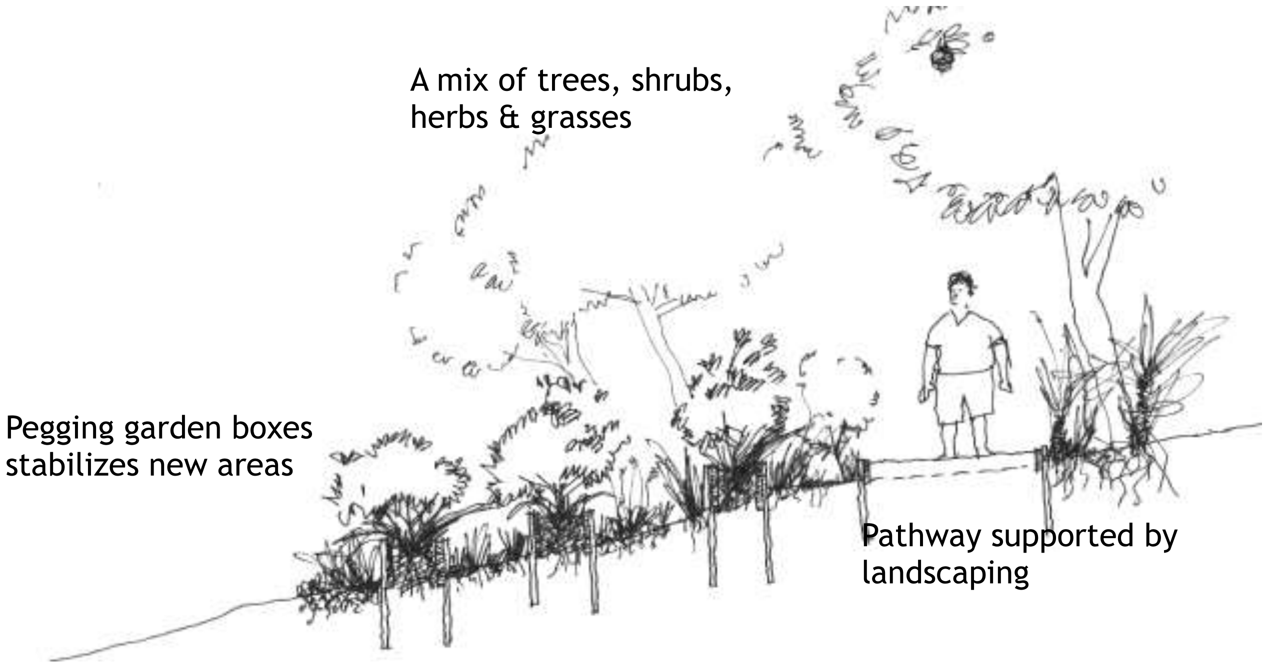


Figure 47: Landscaping methods to stabilize beach terraces and control access off-beach

Figure 48: Landscaping among fales provides: stability, creates interest, provides shade and gives privacy

6. ECOSYSTEM BASED ADAPTATION

Many of the Soft methods described in prior sections make up the various ecosystems based adaptation techniques, especially as regards the protection of existing and encouragement of landscaping to stabilize beaches and near shore areas. Essentially ecosystem based adaptation (EbA) is based on good management of existing natural ecological assets that assist with protecting the coastal systems or enable the best accommodation of change over time. Initiatives could involve:

- Community involvement in coral seeding/gardens;
- Enhancing sea grass bed protection to maintain healthy lagoons and reefs;
- Protecting and enhancing key wetlands and mangrove areas to improve lagoon and reef health;
- Whole of catchment approaches to adaptation options;
- Ecotourism activities and attractions as a means to diversify the tourism base to inland activities;
- Involve tourists in coastal zone adaptation actions such as mangrove planting.

6.1 Targeting wetlands and mangrove protection

There is particular opportunity to employ EbA methods in a couple of TDAs: South Upolu (Saanapu village) and Eastern Savaii (Manase). Both have wetland and mangrove areas that need rehabilitation and protection. These ecological assets can filter pollutants, offer safe harbour for species during extreme events, assist with spawning as well as offering natural defences to retreating coastlines from climate change. If managed well they may also accommodate alternative off-beach tourism activities.

Figure 49 shows community groups involved in extending natural mangrove areas by planting in estuarine areas to help stabilize the foreshore. Figure 50 advocates the mix of mangrove species to suit the changing tidal zone profile.

Figure 49: Planting of mangroves along the coast – to extend existing wetlands

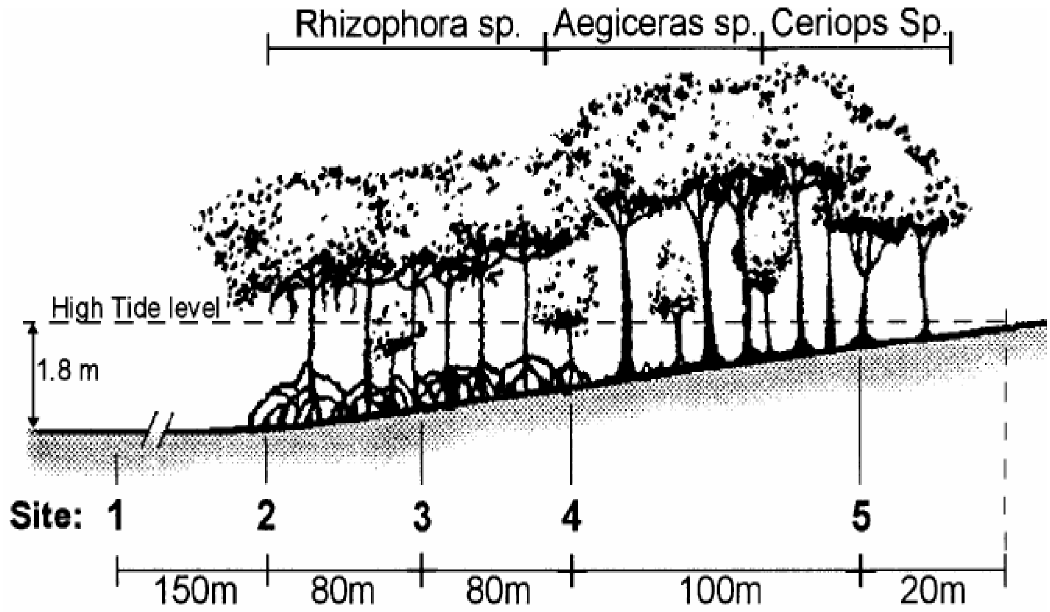


Figure 50: There are different mangrove species suited to parts of the the tidal zone

6.2 Unique Ecosystems offer alternative tourism experiences

In an endeavour to supply alternative tourism experiences close to beach areas about Samoa Fales can be built in sheltered areas, especially that offered by wetlands and mangrove areas. Figure 51 shows a possible fale development form taking advantage of 'still water' in a wetland or mangrove environment. Fales can be built over shallow in sheltered coves or wetland areas. The main part of fale can be anchored on secure rocks/ land, with living areas protruding over the water. Poles in footings in shallow water can be made adjustable to suit tidal areas if need be.

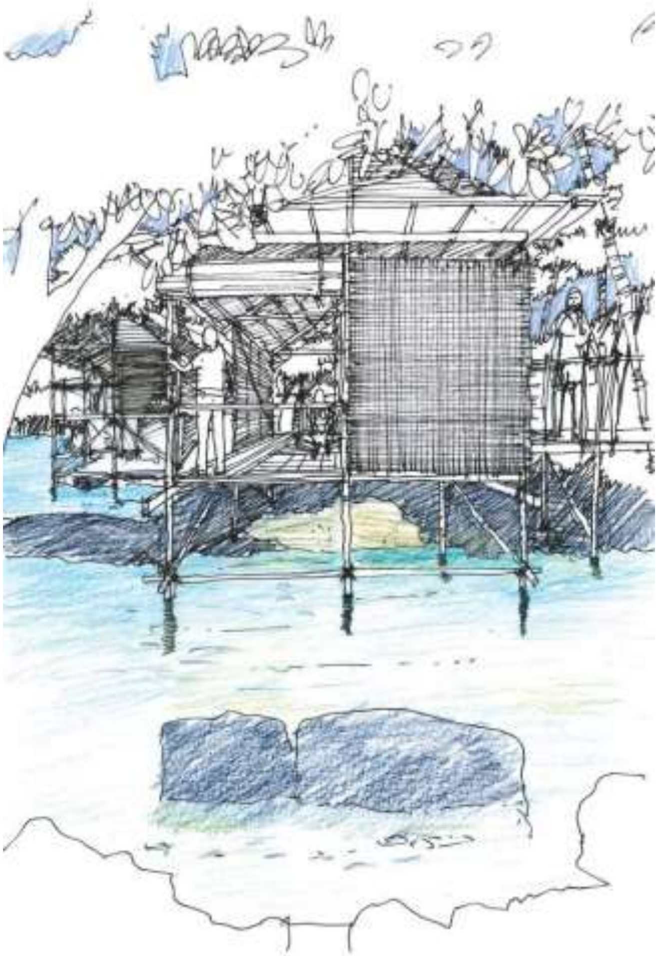


Figure 51: Use of wetland, mangrove and other sheltered still water areas for alternative accommodation

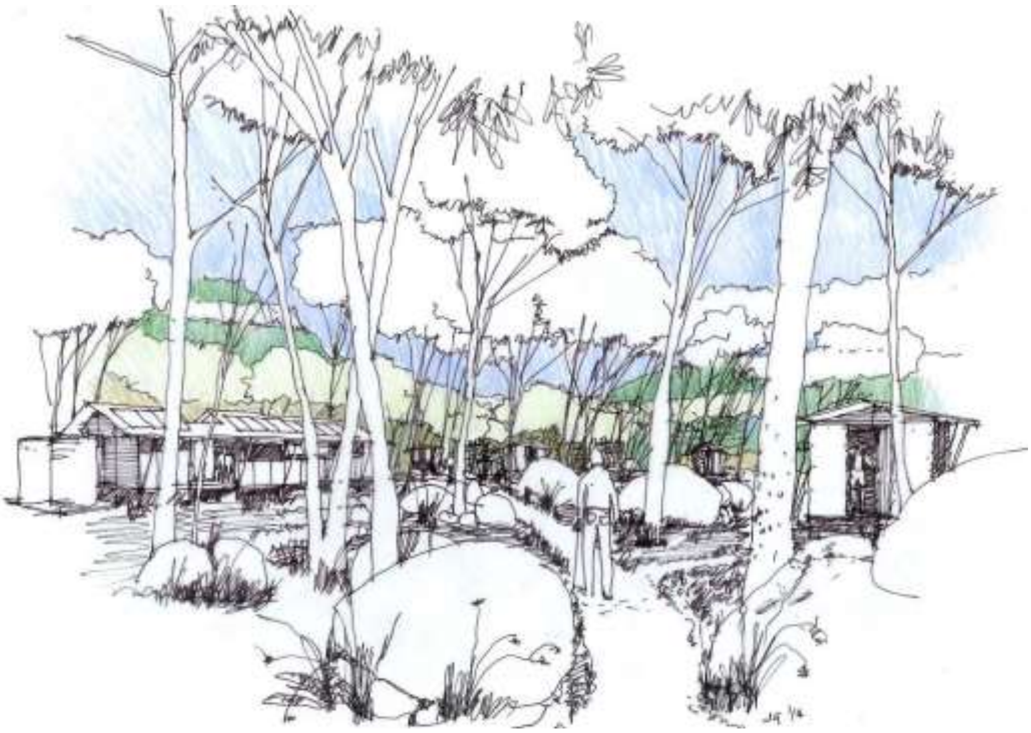


Figure 52: Non –coast based options for accommodation near biodiverse areas. Adds options for tourists and environments that are less hazardous

6.3 Catchment management to assist Ecosystems based adaptation

Consistently in this Technical Guidelines document the connectivity between the catchments, the inland land uses and the health and stability of the beaches and coasts has been explained. In terms of ecosystem based adaptation this connectivity is also extremely important.

Initiatives to rehabilitate wetlands or mangroves for instance will not be effective if land use and development upstream in the catchment results in more and more pollutants flowing to the coast. It is not just a matter of stopping the dumping of wastes in the rivers, streams and waterways, or reducing catchment erosion - but understanding that there are sub-surface flows of pollutants as well. Pollution from grazing animals in close proximity to waterways can enter the ground and flow under the surface toward rivers and waterways. Those pollutants will then flow to the coastal environs. Measures to ensure good land use planning and catchment management, as mentioned in section 4.1, to assist with adaptation include:

- Fencing grazing stock away from rivers, streams and waterways – at least a 20 m buffer;
- Not using chemicals close to rivers and waterways;
- Keeping at least a 10 m buffer between cropping areas and rivers and waterways;
- Not using waterways and wetlands, including mangroves for waste dumping;
- Not cutting down mangroves for wood fuel;
- Managing erosion and sedimentation in the catchments, especially along rivers and waterways
- Retaining healthy biodiverse landcover in the catchments.
- Protecting catchments to protect water reservoirs to assist with water security.

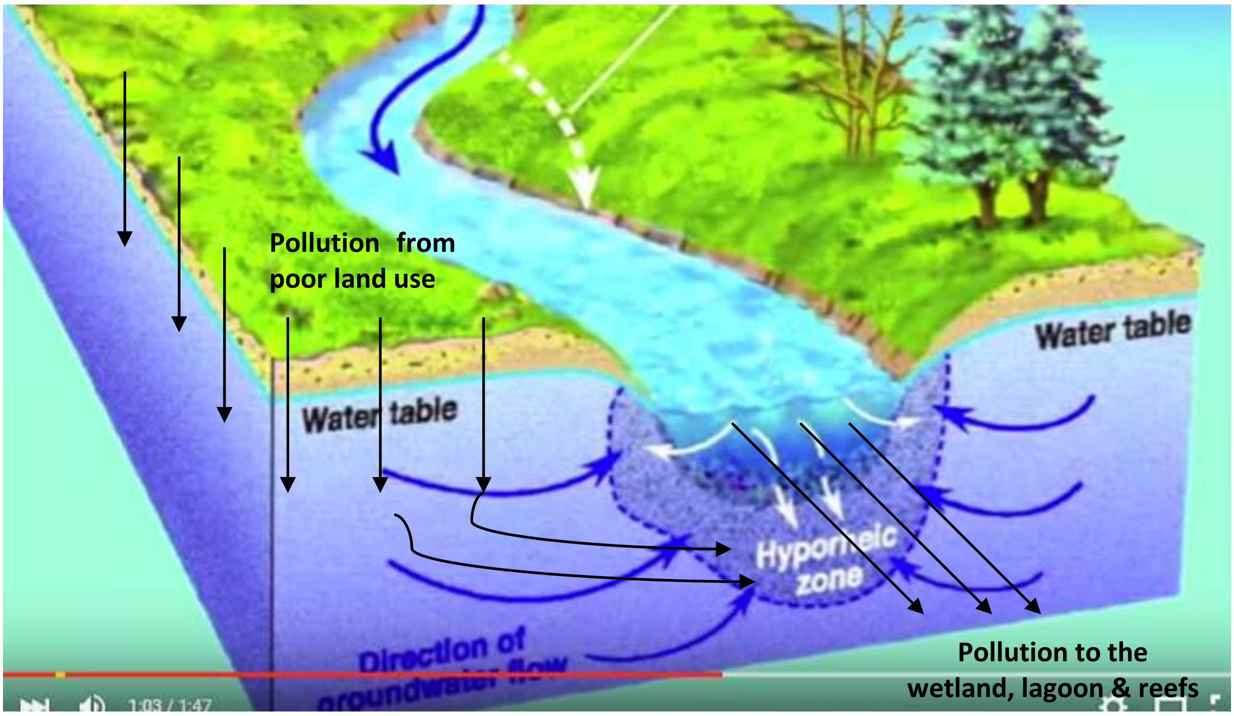


Figure 53: Linking pollution from poor land use to rivers and coasts (Source: Sandwatch)

7. MONITORING AND EDUCATION PROGRAMMES

A key factor in the future resilience of communities (including tourism operators) to the risks posed by climate changes will be a detailed understanding of the natural environment and ongoing processes that the communities are part of.

One of the best ways to build up a detailed understanding of the natural environment is by actively monitoring the processes that are occurring, preferably with programmes with active involvement of schools.

There are several previously established programmes available that provide resources to undertake such monitoring programs. A particular example is the Sandwatch Program (www.sandwatch.org).

The Sandwatch website states:

Sandwatch is a programme through which children, youth and adults work together to scientifically monitor and critically evaluate the problems and conflicts facing their beach environments and then design and implement activities and projects to address some of those issues, whilst also enhancing the beach environment and building ecosystem resilience to climate change. Founded on a series of very simple protocols, Sandwatch appeals to persons of all ages and all backgrounds.

The first Samoan Sandwatch Training Workshop was held from 27-28 August, 2014 in Apia, Samoa, facilitated and supported in collaboration among the **UNESCO Office** for the Pacific States, the **UNDP GEF Small Grants Programme** and the **Sandwatch Foundation.**

The objectives of Sandwatch are to:

- involve children, youth and adults in the scientific observation, measurement and analysis of changes in the beach environment using an inter-disciplinary approach;
- assist Sandwatch groups, with the help of local communities, to apply their information and knowledge to the wise management and enhancement of their beaches;
- integrate the Sandwatch approach into the formal and informal education system and contribute to Education for Sustainable Development;
- contribute to the understanding of how climate change affects beach systems; and
- build ecosystem resilience and contribute to climate change adaptation.

The Sandwatch website provides resources including manuals, background material and videos that could assist a program to be established with the participation of the local school.

In many locations where there are active beach fale tourism facilities, the tourism operators could act as “hosts” for such programs. This would enable the school and community to gain an understanding of the beach dynamics in general, but it would assist the tourism facility gain a specific understanding of a key element (the health of the beach) of their operation.

Other programs could be developed in partnership with educational institutions to monitor water quality and ecological systems.

8. START-UP GUIDELINES

These Technical Guidelines should be the reference point for Operators and reliant communities when generating project proposals under the GEF Project. The Samoa Tourism Authority (STA) has several other resources available to both existing operators and communities who want to improve their existing operations, and to individuals or groups that are contemplating establishing a tourism operation.

Specifically, manuals for tourism operators (in English and Samoan) have been prepared and include:

- A Tour Guide Manual,

This manual provides a basic understanding of the key elements of planning and managing a tour and has been prepared specifically for Samoan tour guides.

- An Attraction Sites Manual

Written for Attraction Site Managers, this manual aims to assist in the day to day running of sites and aims to provide ideas on how to:

- *Look after your visitors,*
- *Improve the site, it's facilities and the environment, and*
- *Make a success of your business*

- A Beach Fale Manual.

Written for Operators who wish to provide shelter for day-visitors, overnight accommodation for touring visitors, or both, this manual consists of three parts.

***Part one** is designed to help you look after your guests,*

***Part two** focusses on how to manage your beach fale; care for your beach and provide security for your guests, and*

***Part three** provides you with general advice about running your business; financial planning, marketing and staff training.*

All these documents and guides should be referred in developing project proposals.

Additionally the STA has a New Development Checklist for operators and proponents. This is attached here at Annex 2 and should be referred to ensure that all other approval processes have been adhered to as part of project designs.

9. REFERENCES

Paeniu L, Iese V, Jacot Des Combes H, De Ramon N'Yeurt A, Korovulavula I, Koroi A, Sharma P, Hobgood N, Chung K and Devi A. (2015). Coastal Protection: Best Practices from the Pacific. Pacific Centre for Environment and Sustainable Development. (PaCE-SD). The University of the South Pacifi c, Suva, Fiji.

Sandwatch Programme, http://www.sandwatch.org/ & https://www.youtube.com/user/sandwatchvideosENG

SPREP, "Coastal Ecosystem-based Rehabilitation Guide" 2014

STA, "Beach Fale Manual" 2014

Tongan Ministry of Commerce, Tourism and Labour and the Tongan Ministry of Health and ESR, "Healthy Tonga Tourism, A guide to safe rainwater harvesting for tourist accommodation businesses in Tonga",

ANNEX 1: EXAMPLES OF VARIOUS ADAPTATION ISSUES AND SOLUTIONS FOR SAMOA

1: Planned Retreat (or Avoid) Adaptation Options

Technology	Description		
Planned Retreat (Avoidance) Option **Community Visioning** **Coastal Planning** **Local Marine Managed Areas protected areas**	***Option supported: managed retreat*** Land use planning, strategic environmental assessments, 'Ridge to Reef' and Landscape Planning – are all approaches that pursue the planned retreat or avoidance options for Adaptation. Measures on the ground include the use of buffers, protected areas and green spaces. Measures are implemented preferably in advance of pressures being acutely experienced. Such measures can cater for accommodation and planned retreat responses. They are proactive, strategic and involved community engagement in their formulation. They are therefore often less contentious in communities where competing matters are complex.		***Costs & Suitability*** Unit costs for community visioning and land use planning vary depending on the status of land use planning systems generally and whether some type of village based planning/development decision-making process exists. For village based visioning/participatory planning exercises up to 1000 people, given the state that limited work has been done in Samoa in this area a reasonable unit cost per reliant community would be approx $USD 10,000 per community

2: Ecosystem Based (Soft) Approaches

<table>
<tr><th>Technology</th><th>Description</th><th colspan="2"></th></tr>
<tr><td>Ecosystem Based Approaches

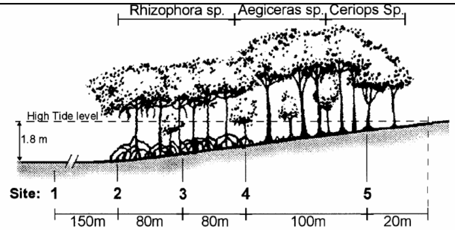
Revegetation and Landscaping

Other alternative descriptions include “Building with nature” techniques</td><td colspan="3">Option supported: managed retreat, accommodation

Ecosystem based approaches and techniques can include the creation, maintenance or restoration of wetlands, mangroves, waterways and dune systems.
In cases where re-vegetation is required to simulate natural forms of dune or back-shore protection, this may involve producing large numbers of seedlings or young plants needed to re-vegetate large areas.
Re-vegetation is a relatively low-cost approach which does not disrupt coastal processes. Indigenous “pioneer” species for dune stabilization are particularly effective as a ‘bridging technique’ so that natural vegetation can be restored.
Mangroves, for example, are a natural form of coastal protection, though they are not suitable for all coastal conditions (they are happiest in fine-grained soft organic muds deposited in sheltered locations). Other types of vegetation such as shrubs, grasses and ground-cover vines have also been used in re-vegetation projects. Some locations may not be suitable for plantation.
Such approaches may only work well over longer (several years) periods of time as establishment time is necessary. The creation of wetlands and mangrove areas requires space – which sometimes may mean - new set-back lines, proactive thinking, relocation of existing facilities and buildings. Artificial wetlands may take decades to replace the biodiversity of natural ones. In turn, this requires a commitment to long-term planning. Re-estabishing or enhancing existing wetlands and mangrove areas is a far more practical and efficient ‘no-regrets’ adaptation measure – which can increase a coastlines resilience as well as enhance bio-physical response after extreme events.</td></tr>
<tr><td>Beach Revegetation</td><td>Revegetation of stressed coastal areas and beaches is best achieved through separating people and buildings away from stressed areas. Beach revegetation will assist with sand balance. Rehabilitation of one or more areas of the beach will assist with the sand balance of the whole beach.
Rehabilitation can be done in stages.

Costs & Suitability
Very dependent on activities proposed and circumstances of the case. Vegetation re-planting - dunes e.g $25/m2.</td><td>
Stage 1: Pathways to direct people; simple fencing to stop access in certain areas; encourage mix of vegetation including coastal grasses</td><td>
Stage 2: Good coastal grass cover assists with re-establishment of associated coastal vegetation.</td></tr>
</table>

	 Final Stages: Shrub and tree cover returns to assist with stablizing foredunes – assisting the sand balance protects the coast	 Continued effort: organizing controlled access points to the beach (which can be varied from time to time) helps to stop pressures and creates interest and privacy	 Use natural regrowth of coastal grasses is very effective in assisting with beach dune stabilization
	Planning for Beach rehabilitation should include consideration of the whole ecosystem ie the offshore, coral reef, intertidal zones, foredune areas, back-dune areas and coastal forest areas.	 Revegetation schemes can be comprehensive…	 …or rely on natural re-generation (called assisted revegetation)

	 Rehabilitation can be achieved through replanting appropriate species, but also through encouragement of natural re-establishing species. A combination of both is usually the most effective.	 Areas where coastal grasses regrowth is occuring should be targeted for revegetation schemes	 Using stable grass cover to assist with shrub and tree revegetation stabilizes the beach and the sand budget – assists with whole of beach processes
Coastal Management **Mangrove & Wetland Management**	 Mangrove rehabilitation replanting also should follow a species association that suits the ecozones of the different species.	 Blocking drainage paths of mangroves and wetlands not good for maintaining healthy systems	 Filled road culverts do not enable the flow and ebb of tides into mangroves/wetlands – affects their health.

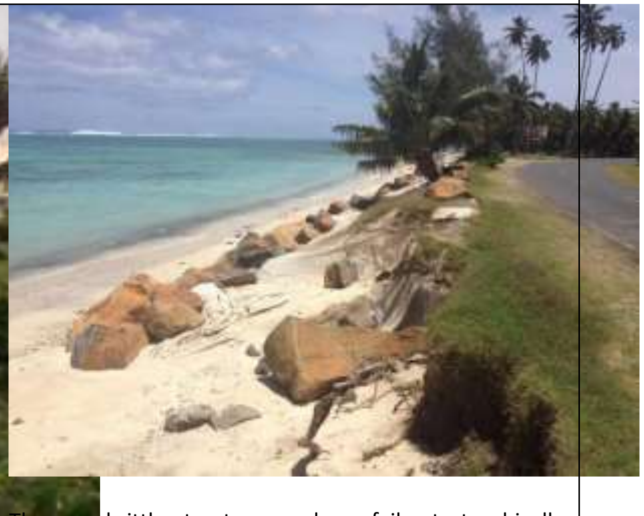
	 Blocking flowpaths of mangroves/wetlands not good for coastal fisheries and habitats	 Despite blocking the flow-path water seeps under and will eventually undermine the structures.	 Wetlands deteriorate as their natural flows and tidal ebbs are blocked.
	 Stressed mangrove and wetlands on Upolu	 The result is very bad smelling and polluted wetlands and mangrove areas. Fish life is seriously affected.	 Use of naturally occuring mangrove shoots should be encouraged
Sand Mining **A threat to ecosystems**	Sand mining and removal of sand from the beach seriously affects the coastal processes and sand balance of beaches. Where the sand balance is affected, erosion will occur more often		

		Signs of sand mining in Upolu	
	 Village practice of shifting sand from beaches to the other sides of roads affects the sand balance. Large flat areas of sand create no interest for tourists	 Filling of dune areas is evident in some tourist areas.	 Example of cutting away of sand to place fales – but then getting the floor levels wrong, as there was no consideration of the sand balance of the beach which is forever changing.

3: Hard or Structural Adaption Measures (including mechanical measures)

Please note that as per the Terms of Reference for this study, while hard structural options may potentially be useful, they should not be considered as the first option for coastal protection when considering tourism projects.

Technology	Description		
Coastal protection units (also known as 'armour units')	***Option supported: protection*** Coastal protection units or 'armour' units are an important component technology of coastal structures, particularly in situations where there are no local or even regional supplies of riprap. Armour units are precast high-strength concrete structures (weighing up to 2 tonnes, with a width of approx 2-3 metres). They are available in many different shapes and sizes. Often these shapes are specifically designed to be interlocking to give a structure made up of such units stability. The key to a successful armour unit design is one which withstands wave motion and in which the units do not start to move about.	 Armour units invented in Cook Islands, enable unit assembly. Easy to place in water using large tractors. Sand builds up after 2-3 years, units can be moved further along the coast. Example of the buildup of sand with placement of units for 6-9 months	 Essential to introduce beach and dune revegetation as the sand and beach profile builds up, so the beach is stabilized before moving units to another location. More recent example where sand is only just beginning to accumulate.
	Costs & Suitability The cost of a typical armour unit can be down to US$ 50 but in the PICs could be up to US$2000 a unit fully implemented. Coastal engineers of the Cook Islands have come up with a technical breakthroughs in the design and effectiveness of coastal protection units and have a number of working modules that have been operational for 5-8 years. Treatments may be suited to TDA 1 and TDA 6. They are moveable and can be replaced along the beaches once desired results have been gained. Armour of a minimum of 50-100m at a time is recommended	 Evidence of convex shape of the beach – a signal of a stablized sand budget on a beach	

Beach Nourishment, replenishment (Identified as a Mechanical measure as it requires machinery and repeat exercises)	***Options supported: managed retreat, accommodation, protection*** ***Beach nourishment may be the creation of a planned beach profile by dumping large quantities of sand onto the beach, or the creation of sand or shingle groynes using a combination of dredgers and mechanical earth movers. Nourishment may re-create the natural beach profile, but often does little to alleviate the erosive forces. Where there are successful uses beach nourishment often does not disrupt collegiate coastal processes. Disadvantages are that nourishment requires heavy equipment and a good supply of sand – often missing in PICS. Typically this is not feasible for small islands and projects. Over time, the sand washes away and nourishment needs to be carried out again.***	Suitability -Extremely expensive when considering follow-up maintenance. Huge dredgers and suction pumps required. Studies would need to be concluded to show there is a sand budget offshore, which is unlikely the case in Samoa. Estimated costs $75,000/km for startup. - Start up costs for Tonga were shown to be US$100 per linear meter, where a known source was identified; - a small scale sand pump with barge would be a minimum US$30,000; - Maintenance sand pumping can be continual (e.g Noosa, Qld), every 2 years or a maximum of 5 years after the initial replenishment. The coastal hydraulic processes need to be studied firstly as replenishing areas under wave force action will negate effectiveness in the first year. There has not been any sand source studies undertaken for Samoa by SOPAC; -total costs for maintenance over 20 years could be as low as US$350 per linear m of recharge, but only where successful sites area identified.	Costs -120m x 5m high sand filled bags for a groyne: approx US$350,000 compared to rock alternative of US$600,000 (2005 estimates) -50m x 4m high sand filled bags for river protection US$220,000 (Maroochydore Shire Council, Qld, 1995) -48m x 4.5m high double layer bags for revetment at 1.5H:1V slope, US$25,000 (materials only, 2000) - US$50 per linear meter for temporary groyne, non-designed -Tonga
Sea walls (or Bulkheads)	***Option supported: protection*** ***Bulkheads and sea walls are retaining walls made of concrete or interlocking rocks whose primary purpose is to hold or prevent sliding of the soil while providing protection from light to moderate wave action. Sea walls are stronger, larger versions of bulkheads designed to prevent the back-shore from heavy wave action. Non-vertical walls on the seaward side more efficiently prevent 'overtopping' as the wave hits. Several aspects of the geometrical design of sea walls together with use of other materials at the base of the wall can improve the performance characteristics of the structure.***	 Bulkheads and sea walls are heavily engineered inflexible structures. Bulkheads and especially sea walls are	 They are brittle structures and can fail catastrophically with no warning. They require maintenance and can give a false sense of security. Inexpensive designs are often

		generally expensive structures requiring proper design and construction supervision. They protect the land area only and frequently cause adverse hydraulic impacts in front of the wall, including down drift. Few designs can be built by manual labour and from local materials. The structures have the side-effect of encouraging beach erosion. Typically they are deployed to protect high land and capital values, where threatened property and buildings cannot easily be relocated. These hard structures with relatively long lives can prevent autonomous coastal change.	ineffective. The south Pacific experience, for example, with inexpensive sea walls has been generally unsuccessful with one or sometimes two generations of sea walls having failed (other examples include areas in the Majuro Atoll and in the Marshall Islands).
	Costs & Suitability ***Small scale -Community based work (Govt and village joint ventures) US $100 - US $750/m (Source IPA, 2012)*** ***Medium to larger scale – can range from US$1,000 - $3,000/m, depending on the size and design requirements.***	 Seawalls should follow the hard with hard and soft with soft approach to coastal management. Seawalls do not work for sand beaches and dune systems. Sometimes when the coastal pressures are not investigated properly seawalls are chosen where they will not work for long. In this case, poor beach sand budgets, catchment changes (increase hydro-geological movement of subterranean water) has weakened the beach profile. This has been exacerbated by filling of land, and placing accommodation units too close to the beach foredune area. Changes to the reef and lagoon system from past use of dynamite and PNG weed has not helped	 Often families are left to try their own seawalls to try and stop the erosion. These can only be considered temporary as the structures are too close to the intertidal zone.

	 ***Example of the use of sand bags to stabilize eroding beach***	 Substantial structures too close to the intertidal zone and beach frontal dune	 Sand bagging will only give temporary relief. Best to setback low-investment structures off the foredune area and revegetated to reform concave beach profile
			Filling of land out into the intertidal zone will only cause ongoing maintenance issues, will cause land side flooding as waters cant find their usual flow paths and will be reliant on seawalls which are not stable.
	Various examples of seawall type treatments where the main issue is structures including seawalls too close or in the intertidal zones and beach frontal dune aeras. Assistance of vegetation in front of structures can be seen to have some relief on impacts. Continued maintenance (and therefore costs) can be seen through the use of fresh rocks over the older darker rocks		

4: Integrated Water Resources Management (Catchment and drainage focus)

Technology	Description		
Better management of water **Flooding and storm drains**	***Option supported: accommodation/protection*** Good site based water management can ensure erosion doesn't degrade coastal areas or undermine structures Flooding and storm drains are technologies to manage the run-off of rain water. They can prevent serious erosion during storms ***Costs & Suitability*** Depending on the circumstance but site based stormwater measures and drains could cost $150/m including labour, materials and small machinery hire.	 Use of sand bags to stem erosion on the wetland side of the coast.	 Blocked drains along sea-walls exacerbate Stormwater management problems
Water Security	**Rainwater harvesting** **-water security** Simple tools can be used to balance roof areas, storage capacity and demand from different size tourism operations.	Water harvesting calculation spreadsheet available at STA – to assist operators calculated their required roof areas, storage areas based on demand (analysis completed by the software)	
Better management of waste water	***Option supported: accommodation*** ***Various component technologies related sewerage schemes would be needed to improve the management of waste-water to reduce potential geotechnical erosion, pollution and recession problems. Use of septic tanks predominates. Outflows from these should be directed away from the beach to vegetable or crop growing areas to take up the nutrients.***	With whatever effluent treatment facility (updated septic, composting toilets or advanced packaged water treatment systems (AWTS), the aim should be to direct waste water back away from the beach and waterways	

5: Climate Smart Design and Siting

Technology	Description		
Sustainable Design	Siting and design of tourism operations can address many disaster as well as increase resilience to slow creeping climate change. Primarily the frontal beach dune areas should only accommodate light framed structures which the owners are willing to replace every 2-3 years. More substantial buildings such as restaurants and toilet blocks and houses should ideally be set back past the coastal hazard zones as mapped by BECA, but at least 75 m back from MSWL. With any structure within the beach zone, raised pole construction should be used and solid concrete foundations avoided (as these create erosion and weakening of structures	 Good layout of the site with landscaping among Fales on poles improves uniqueness, amenity, privacy, interest and lessens impacts of erosion.	 A good example on the left and not so good on the right where the frontal dune area has been filled. This brings impacts onto the neighboring land.
	 Large expansive areas of white sand only creates no interest from tourists, is too bright and subject to erosion	 Landscaping about the Fales can enhance their uniqueness, provide better amenity and privacy and provide cool areas during hot days	 Villagers discussing moving fales in-land and to assist stability with landscaping.

	 Hard structures using concrete foundations on the beach are unsightly and will cause beach erosion	 Hard structures on the beach causing water management and erosion problems. Drainage from the roads are a particular issue	 Mixing will laid out locations of fales with good landscaping creates interest and stabilizes the beach areas
	 Lack of understanding of beach sand budgets and changing beach profiles has led to fale floors being placed at the wrong level. Use of sleeves on the base poles (see diagrammes) will assist with adjusting fale floor heights base on the changing beach profiles. Will enable removal of roof portion before approaching storms and cyclones.	 Large area eroded of sand from tsunami and Cyclone Evan, but made worse by sand mining	 Tractor tyre marks evident from sand mining, however beach still has as healthy convex shape

	 Good example of moving substantial buildings back from the beach and having substantial landscaping consisting of grasses, shrubs and trees	 Another good use of landscaping and small raised garden beds to improve amenity and give some protection	 Good example of light-from buildings on the beach with substantial building back from the danger zone and also on pole foundations. Landscaping retains uniqueness of island experience that tourists are after.
	 Clever use of raised beds with toe in about a large stable tree base. Important to keep substantial vegetation on the beach zone.	 Use of small raised garden/pathway beds using large tree as a base. Provides interest as well as some protection from storms.	 Clever landscaping scheme needed to improve amenity, provide cool areas and stabilize sand to minimize erosion and assist with percolation of water into the ground.

	 Good example of setting buildings back off the main beach and dune system, with sport facilities in the beach (danger) zone, and use of small raised garden beds to offer protection of the more substantial buildings. Landscaping is also cleverly used.	 Again interesting siting of fales mixed with landscaping and small raised garden beds to offer some storm protection. Note the retention of regrowth herbs/shrubs to assist with stabilizing the area.	 Good regrowth areas supported to assist with maintaining the waterway drainage from inland onto the beach. Retaining waterway and riparian vegetation and natural creek profile will limit erosion and pollution of the reefs and lagoons.

ANNEX 2: SAMOA TOURISM AUTHORITY – NEW DEVELOPMENT CHECKLIST