Coastal Infrastructure Management Plan

Fa’asalele’aga I District

Implementation Guidelines

August 2002

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Acknowledgement

This plan reflects the partnership between each of the villages within the District and the Government of Samoa in the management of coastal infrastructure. Its preparation involved substantial contributions from many people; in particular, the village representatives to the District Committee, the support from the Ministry of Internal Affairs and the Pulenu'u in each village, without whom the plan would not have been completed.

In addition we also wish to recognise the significant contribution of the key government stakeholders, in particular:

- Ministry of Works
- Samoa Water Authority
- Electric Power Corporation
- Samoa Telecommunications
- Ministry of Agriculture, Forestry, Fisheries and Meteorology
- Samoa Land Corporation
- Samoa Ports Authority

On behalf of the Department of Lands Survey and Environment and Beca International Consultants, we extend
our sincere thanks to each of these groups for enabling this plan to be developed.

Glossary

Coastal Hazard Zones – Defined areas landward of the coast which are or are considered likely to be subject to the effects of hazards over a defined assessment period. In this study, reference is made to four coastal hazard zones: ASCHs (areas sensitive to coastal hazards); CEHZs (coastal erosion hazard zones); CFHZs (coastal flood hazard zones) and CLHZs (coastal landslip hazard zones).

"Do Minimum" option - A Management option that involves continuing with the present maintenance and upgrading programme on an as and when required basis.

Hazard - A source of potential harm or a situation with a potential to cause loss.

Infrastructure – Built structures and networks which support the national, regional or local community.

Lifeline infrastructure Infrastructure that contributes directly to the survival of the community and its ability to respond and recover at the time of extreme events.

Secondary infrastructure Infrastructure that contributes to the every-day development of the community.

Implementation Guidelines – A document to guide land use and resource practices to achieve specified goals, objectives and policies and provide a framework for the implementation of defences and works.

Issue – A specific concern regarding both cause and effect.

Land and Resource Use – The use of land and resources by the community for social, economic or other benefit (e.g. land use includes areas used for villages or crops, resource use includes activities such as sand mining, gravel extraction or fishing).

Monitoring – Process of measuring the effectiveness or impacts of projects and works against predicted standards, levels or outcomes.

Resilience - The ability to be adaptive, responsive and quick to recover.

Community Resilience – The ability for the community to be adaptive, responsive and quick to recover from the adverse effects of hazard.

Natural Resilience – The ability of natural systems to be adaptive, responsive and quick to recover from coastal processes or hazards.

Risk – The chance of something happening that will have an impact on objectives. It is measured in terms of consequence and likelihood. In the Coastal Infrastructure Management Plan context it is the likelihood that infrastructure will be subject to coastal hazards and the potential for loss of property, life or land due to natural processes.

Stakeholders - Those people and organisations who may affect, be affected by, or perceive themselves to be affected by, a decision or activity. The term stakeholder may also include interested parties.

Strategy – Direction or course of action to achieve a defined vision.

Susceptibility - The degree to which infrastructure at risk is likely to be damaged by coastal hazards and how easy/difficult, expensive/cheap it is to replace. In the context of the CIM Plan the term susceptibility is equivalent to the term vulnerability as the Samoan phrase for both susceptibility and vulnerability is the same.

Vision – A desired destiny.

Introduction to the CIM Plan

The Strategic Vision

The District Coastal Infrastructure Management (CIM) Plan for Faasaleleaga I District has been prepared as part of the Government of Samoa's Infrastructure Asset Management Programme (IAMP). The CIM Plan is one of the primary means of implementing the CIM Strategy, which was formally approved by the Government of Samoa in February, 2001, as providing the Strategic direction for the management of infrastructure (both public and private) within the coastal area.

The Strategy has as its central vision "Resilience – Coastal Infrastructure and Communities Resilient to Natural Hazards". The CIM Plan takes this vision and provides the practical tools with which the communities and the government, in partnership, can implement the Strategy.

To be resilient is to be adaptive, responsive and quick to recover so that communities are environmentally, socially and economically sustainable.
(*CIM Strategy*, January 2001).

The Aim of the CIM Plan

The Aim of the CIM Plan is to help communities and government improve resilience by identifying actions and solutions. Not all the solutions may be actioned immediately but the plan will ensure that issues and options are identified for the long-term improvement in resilience of both infrastructure and communities.

The CIM Plan will:

1. Improve the community's awareness of coastal hazard risks;
2. Enable the community and infrastructure providers to reduce coastal hazard risks in villages;
3. Enable the community and infrastructure providers to better adapt, respond and recover from cyclones.

Structure of the Plan

The CIM Plan consists of two parts each serving a separate and distinct purpose.

- ***Plan Development***, which describes the process undertaken in preparing the CIM Plan in conjunction with representatives of the Communities involved and the Government and other stakeholders with interests in the Plan area.
- ***Implementation Guidelines***, which describes the Plans and Actions recommended as outcomes of the process, together with the partner responsible for implementing these outcomes. The participants of the CIM Plan preparation process are acknowledged in the ***Implementation Guidelines***.

Implementation Guidelines

Purpose of the Implementation Guidelines

The Implementation Guidelines describe the solutions proposed that will increase the resilience of the villages in the Plan area and the ways these solutions can be implemented. The solutions are presented for each of the infrastructure items that have moderate to low resilience. Where one solution will provide benefits to other items of infrastructure these "Other Benefits" are also noted. Implementation is considered to be the joint responsibility of both the villages and the government in partnership. The government is responsible for the provision of national and district "Public", infrastructure, while villages are responsible for local and community infrastructure. The responsibility for implementing the proposed actions is also defined. Solutions for both District infrastructure and Village infrastructure, and the responsibility of both partners, should be considered together as they combine to provide for the integrated management of all coastal infrastructure.

The solutions for village infrastructure will usually be the responsibility of the Village and Families in the village to implement. Advice and resources may be available from government to assist the village in implementing these solutions. In most situations these solutions will also provide benefits to both village **and** district infrastructure and should be considered an integral part of managing coastal infrastructure at both levels.

Duration of the Plan

The CIM Plan should be reviewed at five-yearly intervals. During the Plan period, the solutions implemented will be monitored to ensure that they are effective in improving resilience. Some solutions are likely to take longer than five years to implement and the review will take the progress of these into account.

The review of the ***Implementation Guidelines*** and the solutions proposed will be undertaken:

1. As part of the Five-yearly CIM Plan review programme.
2. Once implemented, the solutions will be monitored on either an annual or five-yearly basis to check the effectiveness of the solution. Detailed implementation of the solution will determine the monitoring requirements and Key Performance Indicators.

Participants in the Plan

The CIM Plan is a Partnership between the Government of Samoa and the villages within the Plan area. Both partners have responsibility for different levels of infrastructure in the local communities and the Plan gives an integrated approach to the provision of services and improvement of resilience now and in the future.

This Plan incorporates the Faipule District of Faasaleleaga I.

The Committee for the Faipule District of Faasaleleaga I, confirms the participation of the Villages in the preparation of this Coastal Infrastructure Management Plan for Faasaleleaga I District in partnership with the Government of Samoa and its adoption as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy.

Village Meetings:

- Salelologa 6 May 2002
- Salelavalu 7 May 2002
- 'Iva 8 May 2002
- Vai'afai 9 May 2002
- Vaisaulu 10 May 2002
- Lalomalava 10 May 2002
- Safua 10 May 2002

Village Representatives:

The CIM Plan Committee representing all of the Villages in the area met on 11 June 2002.
Comments on the draft CIM Plan were received from the Committee on 17 July, 2002.

Government Departments and Corporations:

- Department of Lands, Survey and Environment
- Ministry of Internal Affairs
- Treasury Department
- Ministry of Works
- Samoa Water Authority
- Electric Power Corporation
- Samoa Communications Ltd
- Samoa Land Corporation

The Department of Lands, Survey and Environment, as lead Department of Government, on behalf of the participating Government Departments and Corporations, confirms the participation of the Government of Samoa in the preparation of this Coastal Infrastructure Management Plan and its adoption as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy.

Signed: .....

Director of Lands Survey and Environment

Date: 31.07.02

Stakeholders representing businesses and institutions in Salelologa Township:

A meeting was held with stakeholders in businesses and institutions in Salelologa Township on 22 May 2002.

The Government of Samoa adopts the Coastal Infrastructure Management Plan for the Faipule District of Faasaleleaga I as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy (CIMS).

Signed: .....

Minister of Lands, Survey and Environment, Government of Samoa

1 Faasaleleaga I District Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Main Road	• To provide protection in front of the pool and Women's Committee House at Safua. Length of seawall 40 m Design period 50 years Estimated cost $T16,000 Benefit/cost ratio 2.12	• Water • Electricity • Telephone • Village houses	• Prepare Environmental Impact Assessment for the suggested solution in accordance with Step 6 of the CIM Strategy Evaluation Model.
	• To provide protection in front of the northern pool at 'Iva Length of wall 40m Estimated cost $T16,000 Benefit/cost ratio 0.86.		• Prepare Environmental Impact Assessment for the suggested solution in accordance with Step 6 of the CIM Strategy Evaluation Model.
	• To implement regular drainage inspection programme in the District and to ensure that maintenance is undertaken regularly. • To undertake a local education programme on the importance of maintaining drains. • Upgrade drainage culverts where required under Main Road. ***Responsibility: Ministry of Works***		• Undertake inspection of culverts along Main Road. • Identify areas of flooding along Main Road and arrange programme for remedying problem including upgrading culverts and clearing/maintaining roadside drains. Flooding is particularly evident at Vai'afai. • Implement education programme on importance of maintaining roadside drains.
	• To plant and protect mangroves in the inlets encroaching on the road. ***Responsibility: Department of Lands, Survey and Environment/Villages***		• Joint responsibility of the partners to prepare planting programme. • Ensure newly planted areas are fenced and protected from intrusion by domestic animals.
Coastal Road at Salelavalu	• To implement a regular inspection programme for the road edge and to ensure that maintenance is undertaken regularly. ***Responsibility: Ministry of Works***		• Undertake regular inspection and maintenance of Coastal Road.
Local electricity and telephone lines	• Provision of underground electricity and telephone lines. ***Responsibility: Samoa Communications Ltd***		• Include provision for underground telephone lines where practical and feasible in future programmes.
	• Provide an upgraded mobile telephone network ***Responsibility: Samoa Communications Ltd***		• Include provision for expansion of mobile telephone network in future programmes.
	• Avoid co-location of electricity and telephone lines on the same poles. ***Responsibility: Samoa Communications Ltd/ Electric Power Corporation***		• Samoa Communications Ltd and Electric Power Corporation to co-ordinate local overhead networks to avoid co-location of lines.
Lagoon and Reef System	• Provide a network sewage collection and treatment system for Salelologa Township and the nearby villages. ***Responsibility: Department of Lands, Survey and Environment***		• Prepare feasibility study and Environmental Impact Assessment for suggested solution in accordance with the CIM Strategy Evaluation Model Step 6. • Implement recommendations of the Study.
All infrastructure	• Government to identify alternative sustainable sources of sand for commercial supply. • Government and villages to manage reclamation processes. ***Responsibility: Department of Lands, Survey and Environment/Villages***	• District	• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining. • Village/DLSE to apply permit process to applications for reclamations. • Applicants to prepare Environmental Impact Assessment for approval before reclamation commences. • Ensure that new development is undertaken in accordance with an environmental impact assessment that takes into account coastal vegetation and the maintenance of biodiversity.
Coastal Mangroves	• Encourage the replanting of mangroves and other vegetation in areas currently eroding and provide protection of these areas from domestic animals. • Establishment of a reserve area at the southern end of the coastal road around the Salelavalu Headland. ***Responsibility: Department of Lands, Survey and Environment/Villages***	• District	• Identify suitable reserve areas in consultation with Salelavalu residents. • Implement education and other programmes for the establishment and protection of vegetation in coastal areas.

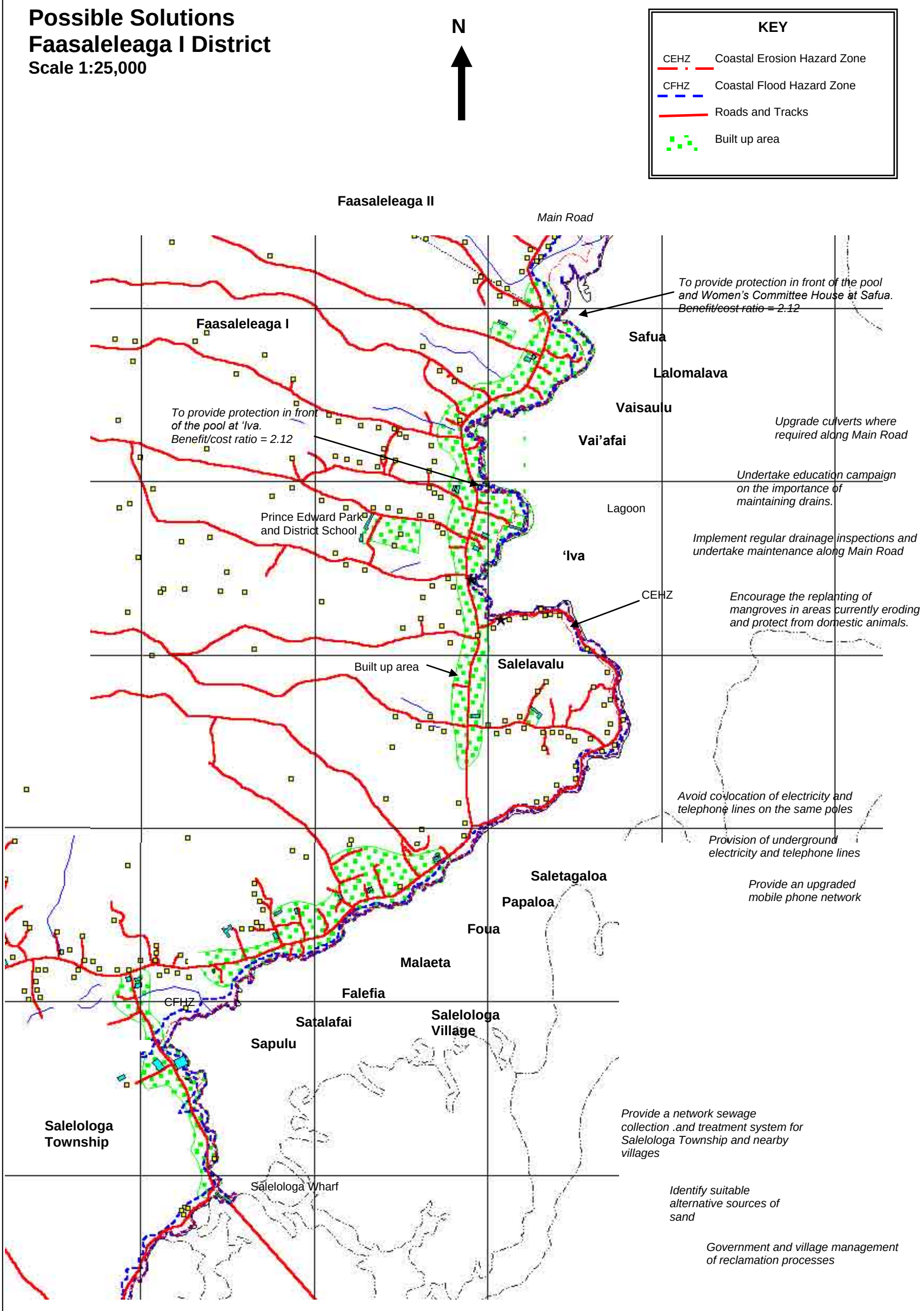
Note: Refer to Maps to see proposed alignments and locations of intervention solutions.

Further Issues Raised During the CIM Plan Process

The following issues have been raised in consultation but fall outside the scope of the CIM Plan as they relate to infrastructure that falls outside the coastal area or is not at risk from coastal hazards. The issues are recorded for further investigation by the responsible agencies so that they may programme a suitable response as part of their Annual Plan and budget processes.

Issue	Responsibility	Comment
Main Road Ford	Ministry of Works	The ford north of Safua is constraining flow along the Safua Stream potentially making inland flooding worse upstream. It is located in Faasaleleaga II District and may be considered in the CIM Plan for that District. The issue is recorded as an item for further investigation by the appropriate agencies.
Main Road at Safua	Ministry of Works	The relocation of the Main Road at Safua was considered and rejected because of the potential social impact and disruption caused by the proposed reconstruction.
Main Road at 'Iva, Vai'afai, Vaisaulu	Ministry of Works	The vertical alignment of the Main Road at 'Iva limits sight-lines and causes a safety problem. The provision of footpaths was suggested as a possible solution to improving safety in this area. This issue is recorded for appropriate action by the Ministry of Works.
Coastal road at Salelavalu	Ministry of Works	The area of road currently protected by a low seawall is subject to flooding. Increasing the height of the seawall will not protect the road from flooding and is likely to limit drainage increasing the time flood waters remain on the road. Increasing the height of the road is not considered necessary as there is alternative access available to either end of the likely flood area. The road itself will remain protected by the seawall and when drained is likely to remain in good condition. An assessment has been made for the provision of a 50-year design seawall along the north coast of the Salelavalu headland. There is little infrastructure in the CEHZ in this area (one house, a pool and the road itself). It is also a hard coast eroding at an average rate of about 0.1 – 0.2 m per year. The economic assessment is: Estimated length of seawall 380m Estimated cost of seawall $T150,000 Benefit/Cost ratio 0.09 The cost of constructing and maintaining the seawall over a 20 year period is 11 times more than the benefits it provides. It is more cost-effective to provide targeted protection for specific "at-risk" infrastructure, such as the pools, than to try to protect the whole length of the coast-line.
Sand Mining Permits	Department of Lands and Survey	Since the transfer of responsibilities to process sand mining permits from Ministry of Works to DLSE paper work necessary to obtain the permits has been processed in Apia. This has led to an increase in costs to the applicants the outcome of which could be an increase in unpermitted activity The issue is recorded as an item for further investigation by DLSE.
Main Water Supply	Samoa Water Authority	The provision of a reliable supply of water for domestic use is necessary for the health and safety of the community. Concerns were raised about the reliability of the current supply. The existing water supply and distribution networks are not at risk from coastal hazards and therefore the issue lies outside the scope of this Coastal Infrastructure Management Plan. The issue is currently being addressed through the Rural Water Supply Project..

Possible Solutions
Faasaleleaga I District
Scale 1:25,000



Faasaleleaga 1 District

Blocked drain behind road at Saletagaloa.

Flood area behind road at Vai'afai caused by culvert outlet invert being lower than surrounding ground levels. Exposed galvanised water pipe to be replaced by new PVC pipe under the EU Rural Water Supply Project.

2 Salelologa Township Infrastructure

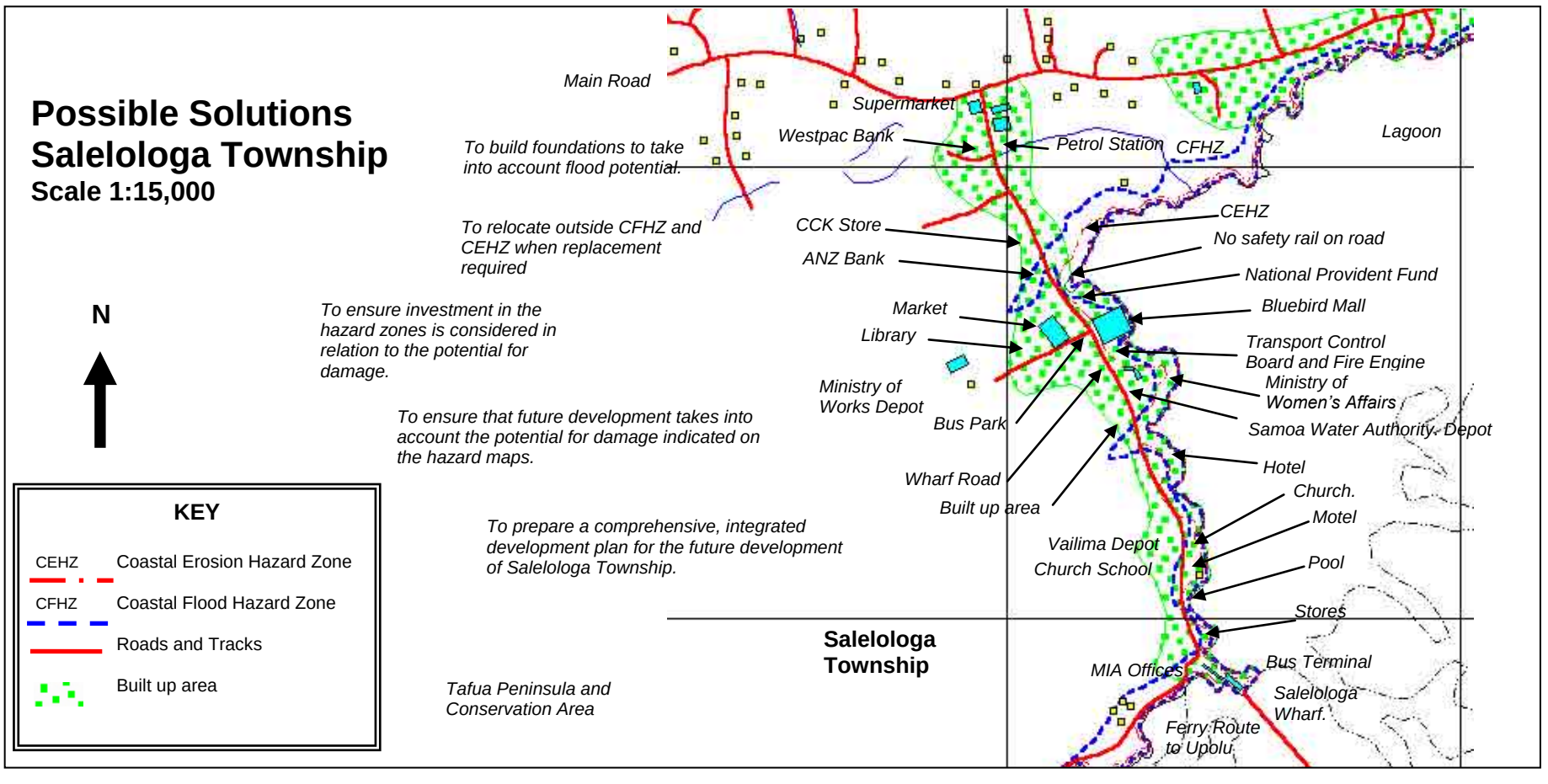
A meeting was held with stakeholders in businesses and institutions in Salelologa Township on 22 May 2002. The following section identifies infrastructure in the existing Township, solutions relevant to that infrastructure and other issues/solutions suggested by the stakeholders.

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Infrastructure in the CEHZ and/or the CFHZ	• To relocate outside CEHZ and CFHZ when buildings require replacement • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding. • To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. ***Responsibility: Government Departments/Commercial Operators/ Village***		• Commercial/Government/Village decision when building to provide long-term protection from coastal hazards. • Commercial/Government/Village decision to relocate in the long-term or when building new premises. • To prepare a comprehensive integrated development plan for new areas of Salelologa including Government and village owned land.
	• To ensure that future development takes into account the potential for damage indicated by the Coastal Hazard Zones ***Responsibility: Ministry of Works***	• Lagoon and reef systems	• Consideration to be made when authorising building permits in the Coastal Hazard zones.
All infrastructure	• To provide facilities for the disposal of waste from commercial and industrial activities. • To provide areas better suited to the establishment of industrial activities in accordance with a comprehensive development plan. ***Responsibility: Department of Lands, Survey and Environment***		• To investigate with industrial and commercial operators methods of disposing of industrial and commercial waste. • To prepare a comprehensive integrated development plan for new areas of Salelologa to identify suitable areas for industrial development.

Further Issues Raised During the CIM Plan Process

The following issues have been raised in consultation with stakeholders in Salelologa Township but fall outside the scope of the CIM Plan as they relate to infrastructure that falls outside the coastal area or is not at risk from coastal hazards. The issues are recorded for further investigation by the responsible agencies so that they may programme a suitable response as part of their Annual Plan and budget processes.

Issue	Responsibility	Comment
Co-ordinating environmental advisory activities between Departments	Department of Lands Survey and Environment	The implementation of these recommendations from the CIM Strategy promotes education and awareness parallel to the implementation of the solutions suggested in the CIM Plan. The issues are recorded as items for further investigation and implementation by DLSE.
Promoting environmental awareness as the primary part of the village beautification programme		
Provision of seawalls to protect private assets in the CEHZ	Commercial Operators	Consideration of seawall protection for private development has not been made in the Plan because this is an investment decision that can only be made by the commercial developer. The investment should be considered against the potential for returns that protection might give.
Wharf Road	Ministry of Works	Provide a safety rail along those lengths of the road that are above the surrounding ground level by more than 1 m. The provision of a safety rail does not improve resilience of infrastructure in the coastal hazard zones but has been raised in consultation and is recorded as a matter for action by the Ministry of Works.
Pool	Salelologa Community	Provide protection and develop the freshwater pool. There are no improvements currently at the pool. Development of future improvements should take into account its location in the coastal hazard zones.



Salelologa Township

Fire Engine and Transport Control Board offices located in Coastal Erosion and Flood Hazard Zones. Approximate edge of inlet from the lagoon shown arrowed.

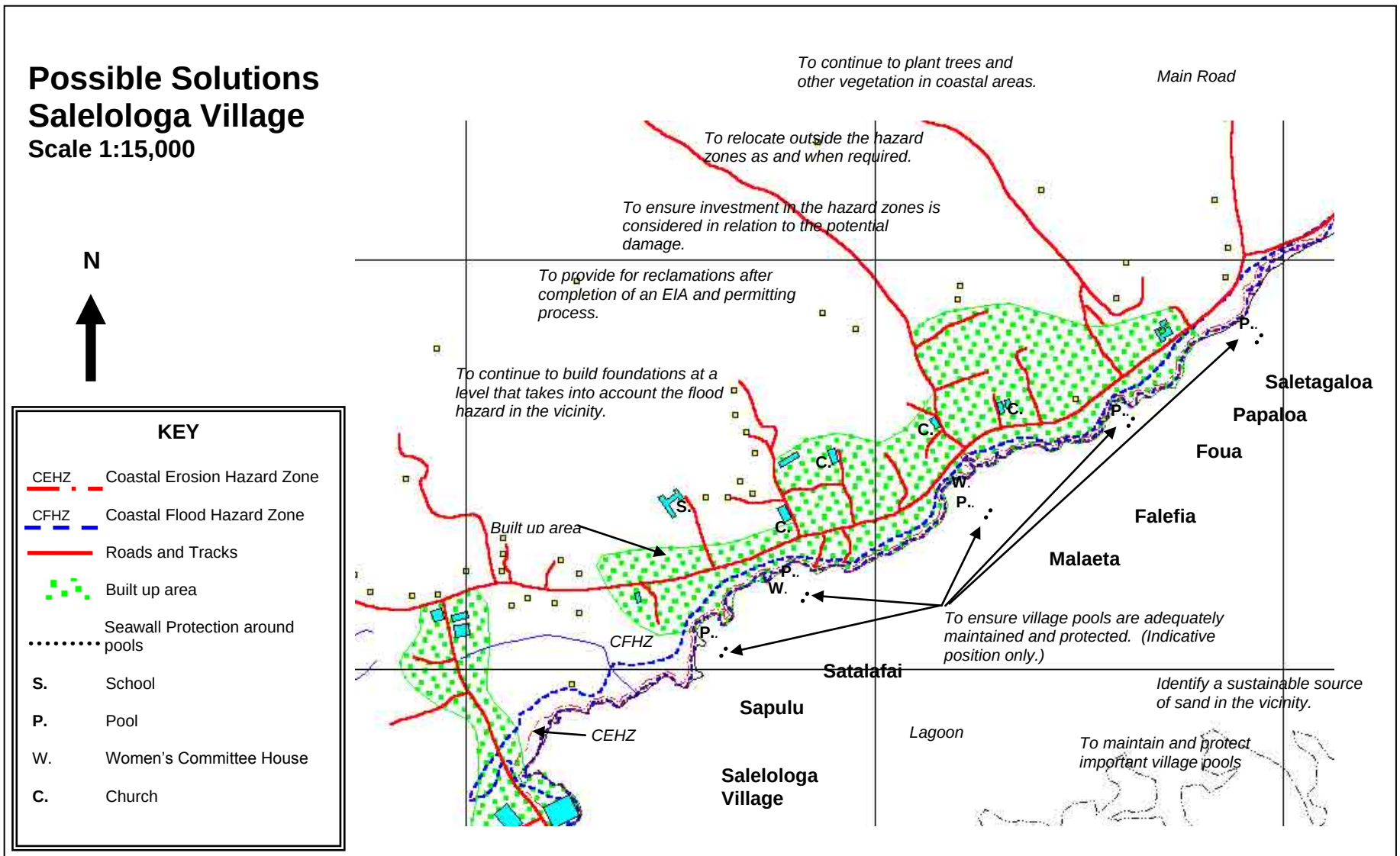
Salelologa wharf. Recently constructed substantial buildings made from concrete block.

Salelologa Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, pools, Women's Committee Houses and reclamations in both the CEHZ and CFHZ	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To relocate outside CEHZ and CFHZ when buildings require replacement • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses.
	• To provide for reclamations only after completion of an Environmental Impact Assessment and an appropriate permitting process ***Responsibility: DLSE/Village***		• Village/DLSE to apply permit process to applications for reclamations. • Applicants to prepare Environmental Impact Assessment for approval before reclamation commences.
	• To ensure important village pools (five) are properly maintained and adequately protected with a seawall. Length of seawall protection 40m Cost of 50-year design seawall $T16,000 Benefit/Cost ratio 1.07 ***Responsibility: Ministry of Works/Village/Families***		• Village to maintain pools as necessary. • Prepare EIA for the provision of protection around the pools in accordance with technical advice from MoW. • Investigate the source of funds to build the walls. • Build walls in accordance with EIA recommendations and approved building permits
	• To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. ***Responsibility: Village/Families***		• Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species.
Village houses in the CFHZ	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CFHZ when buildings require replacement ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from flooding. • Village/Family decision to relocate in the long-term or when building new houses.

NOTE: Seawalls have also been considered in the assessment of solutions for Salelologa Village. The assessment shows that the cost of building and maintaining a seawall the length of the village is one hundred times the benefits it provides to the community. It is more effective to provide a targeted response to specific areas at risk such as the pools identified.

Possible Solutions
Salelologa Village
Scale 1:15,000



Saleloga

Reclamation at Foua close to sea level with toilets draining to the lagoon.

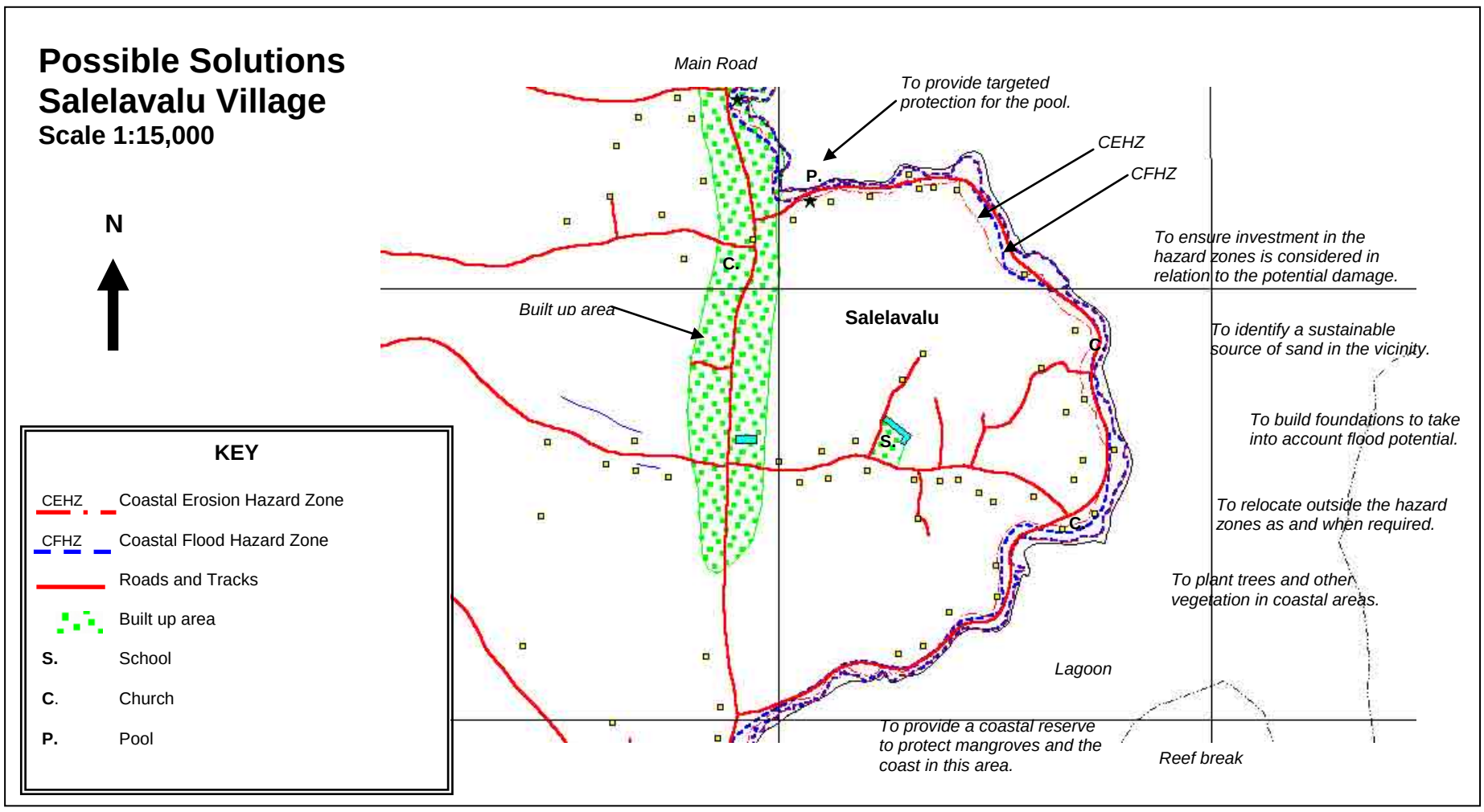
Coastline at Satalafai looking south. Typical rocky headlands with minor reclamations or builtup areas and small rock protection.

3 Salelavalu Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, pool, church and tourism development in CEHZ and CFHZ	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement **Best long-term solution** • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting mangroves and other vegetation in coastal areas and to enable this vegetation to survive. • To provide targeted protection for the pool. Length of seawall protection 40m Estimated cost $T16,000 Benefit/cost ratio 0.80 ***Responsibility: Ministry of Works/Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species. • Prepare EIA for the provision of protection around the pools in accordance with technical advice from MoW. • Investigate the source of funds to build the walls. • Build walls in accordance with EIA recommendations and approved building permits
Coastal Mangroves	• Establishment of a reserve for coastal mangroves at the southern end of the coastal road around the Salelavalu headland ***Responsibility: Department of Lands, Survey and Environment/ Village***		• DLSE in consultation with the village to prepare a management plan for the coastal reserve area. (See Section 1)

NOTE: The provision of two 50-year design seawalls has been considered as part of this assessment. One 380 m long along the north coast of the headland and the second 170 m long on the east coast of the headland opposite the church. The cost of the first is $T155,000 and the cost for the second is $T69,000. The benefit/cost ratio for each is 0.09, which means that the costs are eleven times the benefits it provides compared to the *do minimum* option. It is more effective to provide a targeted response to specific areas at risk such as the pools identified.

Upgrading the work road was raised in consultation. The work road lies outside the coastal hazard area and upgrading and maintenance is an issue that must be addressed outside of the CIM Plan by the village and road users with technical assistance from the Ministry of Works.



‘Salelavalu

Large tree being undermined At Salelavalu.

Work road intersection with Main Road showing scour along left hand side.

4 'Iva Village Infrastructure

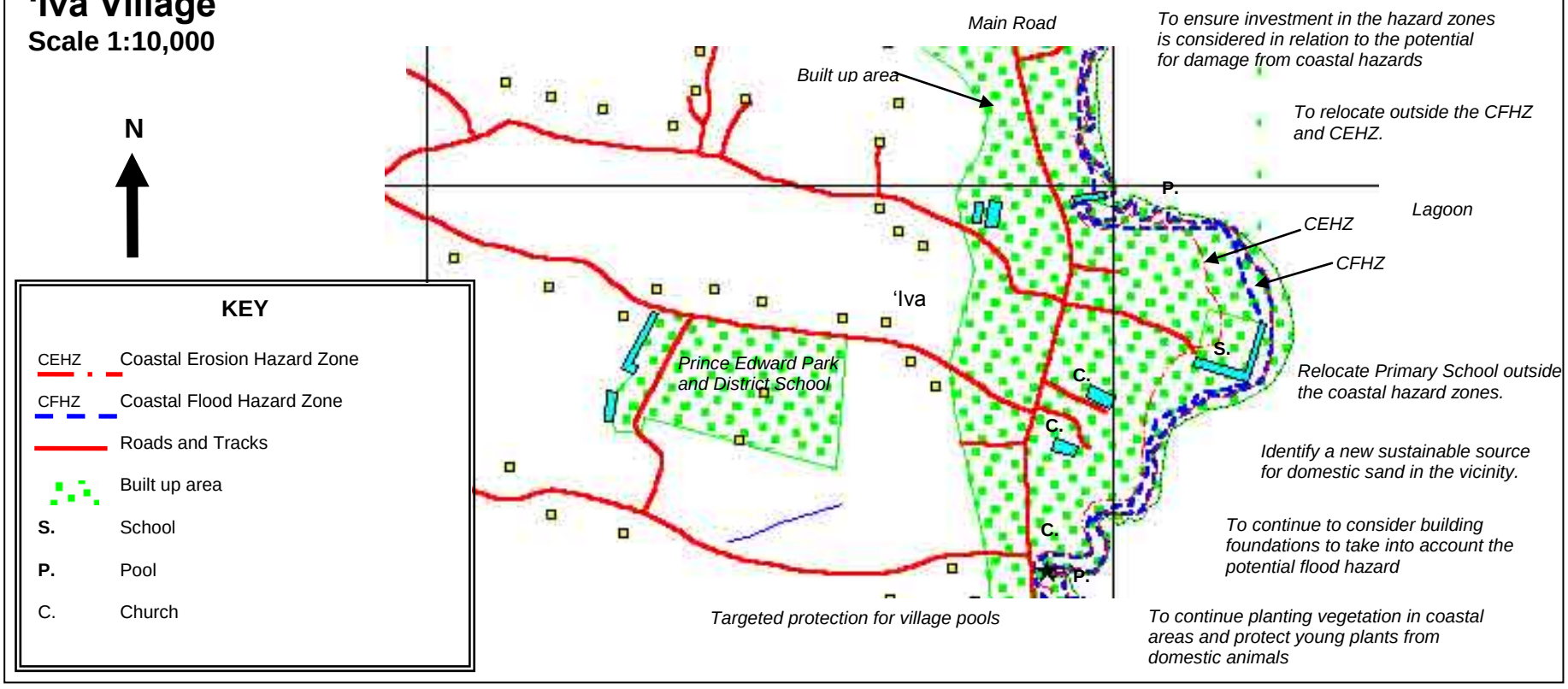
Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Primary school and toilets	• To relocate outside of the CEHZ and CFHZ in the short-term future. **Best long-term solution.** ***Responsibility: Village/Families***		• 'Iva and Vaia'fai villages to identify possible sites for a new school outside the CEHZ and CFHZ. • Investigate source of funds to relocate the school. • Prepare EIA for construction of the school at the new site. • Build school in accordance with EIA recommendations and an approved building permit.
Village Pools	• To provide targeted protection for the Pools. Southern Pool Length of wall 40m Estimated cost $T16,000 Benefit/cost ratio 0.80 Northern Pool (see Section 1) Length of wall 40m Estimated cost $T16,000 Benefit/cost ratio 0.86 ***Responsibility: Ministry of Works/Village***		• Village to manage activities around the pool to limit the potential for contamination. • Prepare EIA for the provision of protection around the pools in accordance with technical advice from MoW. • Investigate the source of funds to build the walls. • Build walls in accordance with EIA recommendations and approved building permits
All village infrastructure	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: Village/DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement Best long-term solution • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting vegetation in coastal areas and to enable this vegetation to survive. ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species.

NOTE: An Economic Assessment of a 50-year design seawall in front of the school indicates that the cost of providing the seawall is about 3 times the benefit it would provide. The seawall would also not protect the buildings from flood hazard.

Length of suggested seawall	200 m
Estimated cost	$T81,000
Benefit/cost ratio	0.36

Seawalls have also been assessed along the northern coast of the village and to the south. The benefit/cost ratios of these are 0.13 for the northern seawall and 0.26 for the southern seawall. It is more effective to provide a targeted response to specific areas at risk such as the pools identified.

Possible Solutions
'Iva Village
Scale 1:10,000



‘Iva

Undermined tree on coast adjacent to Primary School.

Front of Primary School approximately 10m from beachfront.

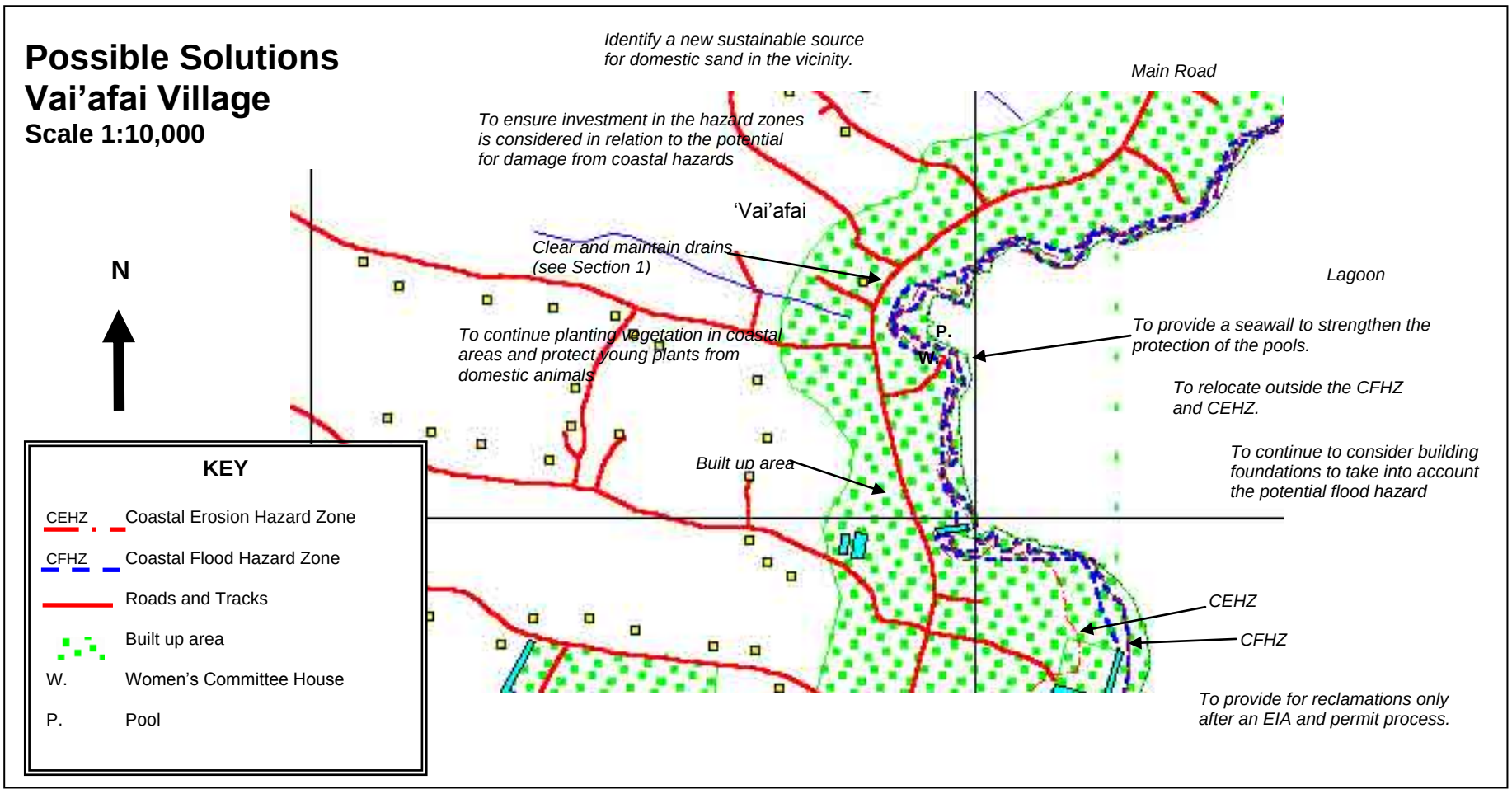
5 Vai'afai Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village Pools	• To provide a seawall to strengthen the protection for the pools. Length of seawall 40 m Design Period 50 years Estimated cost $T16,000 Benefit/cost ratio 1.00 ***Responsibility: Ministry of Works/Village***		• Prepare EIA for the provision of protection around the pools in accordance with technical advice from MoW. • Investigate potential sources of funds to complete the project. • Build in accordance with EIA recommendations and an approved building permit.
Houses and reclamations in the CEHZ and CFHZ	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement **Best long-term solution** • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting vegetation in coastal areas and to enable this vegetation to survive. • To relocate first aid box to a safe location. ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species. • Village/Families to identify safe location for first aid box and relocate as soon as practicable.
	• To provide for reclamations only after completion of an assessment of effects and an appropriate permitting process. ***Responsibility: Village/DLSE***		• Village/DLSE to apply permit process to applications for reclamations. • Applicants to prepare Environmental Impact Assessment for approval before reclamation commences.

NOTE: Consideration has also been given to upgrading inland work roads to provide for relocation. The benefit/cost ratio for a full upgrade is 0.05 and for a partial upgrade to a lesser standard is 0.21. This indicates that upgrading the work roads is not cost-effective at this time. Consideration has also been given to the provision of seawalls along the coast to the north and south of the village pools. The benefit/cost ratio of these seawalls is 0.30 indicating that the cost of construction and maintenance is about three times the benefits they provide. It is more effective to provide a targeted response to specific areas at risk such as the pool identified.

The relocation of the primary school at 'Iva is considered in Section 5 above. It is considered to be the Best long-term solution to the potential for risk from erosion and flooding in this location.

Drainage along the Main Road is considered as a District Issue in Section 1.



Vai'afai

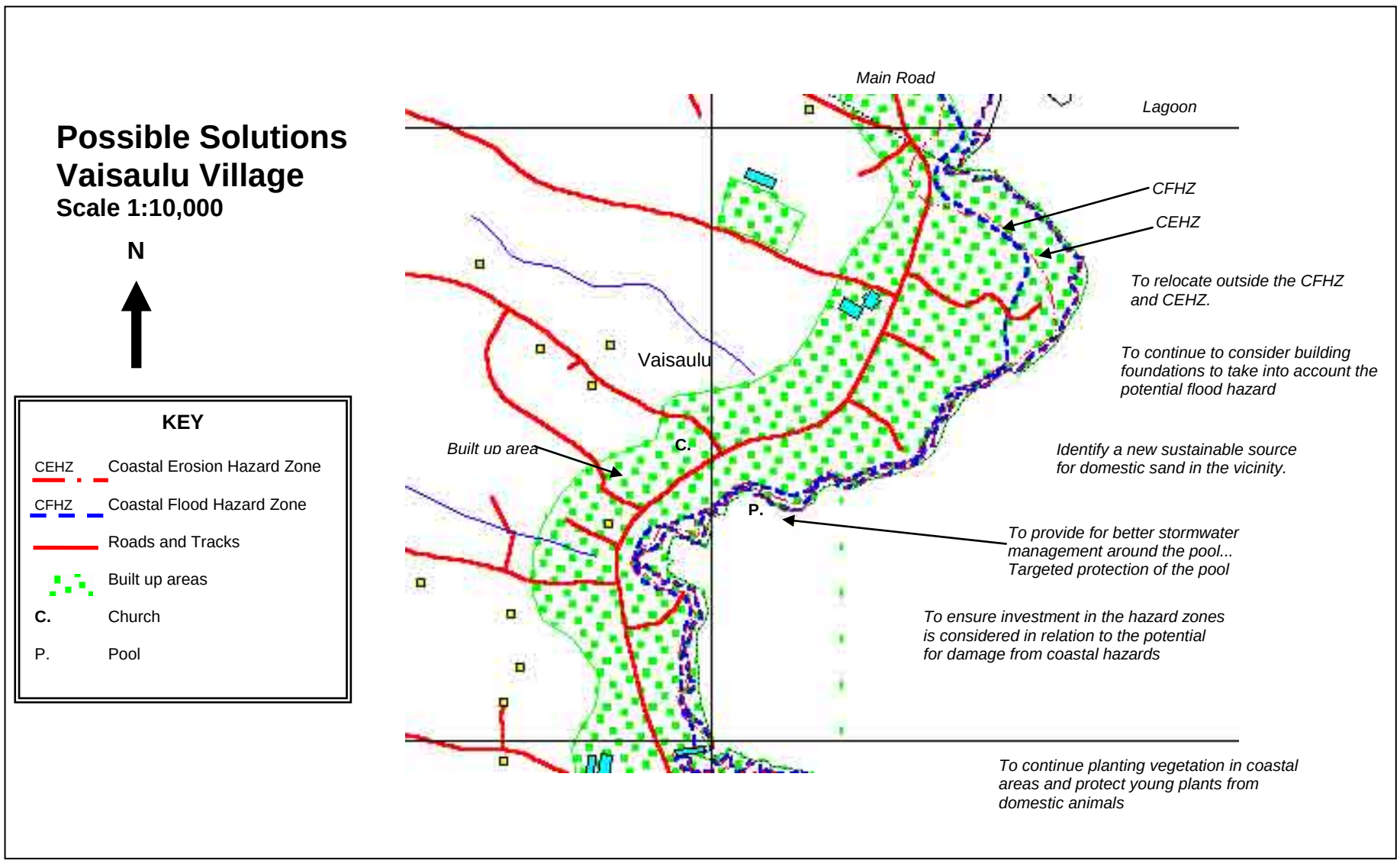
Lagoon inlet to Vaitele Pool.
Women's Committee House behind to the right and toilet in foreground.

Vaitele Pool wall. Small rock construction and location results in high risk and susceptibility to damage.

6 Vaisaulu Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village pool in the CEHZ and CFHZ	• To provide for better stormwater management around the pool • To provide for a seawall to strengthen protection of the pool. ***Responsibility: Ministry of Works/Village***		• Prepare EIA for the provision of protection around the pool including better stormwater management in accordance with technical advice from MoW. • Investigate potential sources of funds to complete the project. • Build seawall in accordance with EIA recommendations and an approved building permit.
All infrastructure	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement **Best long-term solution** • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting vegetation in coastal areas and to enable this vegetation to survive. ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species.

NOTE: The provision of changing facilities at the village pool to encourage tourism is noted for further action by the village and local families with technical assistance from the Ministry of Works.



Vaisaulu

Vaisaulu Pool located at the bottom of a steep slope. Stormwater run-off drains into the pool contaminating the alternative freshwater supply.

7 Lalomalava Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses and hotel buildings in CEHZ and/or CFHZ	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***		• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement **Best long-term solution** • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting vegetation in coastal areas and to enable this vegetation to survive. ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species.

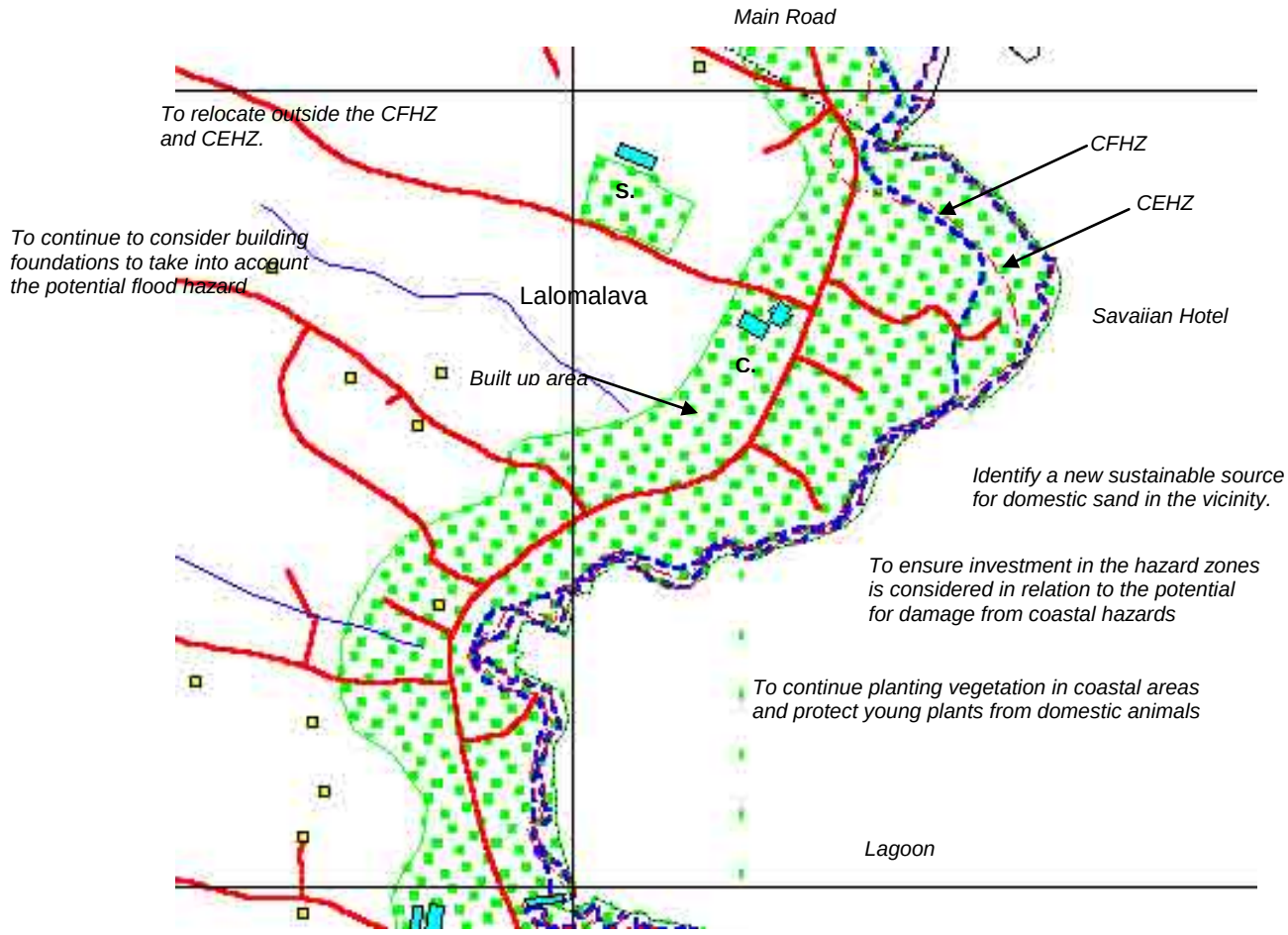
NOTE: Provision of a seawall along the coast to the north of the Savaiian Hotel development has also been considered. The benefit/cost ratio for this seawall is assessed at 0.32, which indicates that the cost of construction and maintenance is three times the benefits it is likely to provide. South of the Hotel development the coast is eroding at a rate of about 0.1 m per year and there are no assets identified in the Coastal Erosion Hazard Zone that require protection.

Possible Solutions
Lalomalava Village
Scale 1:10,000

N

KEY

CEHZ — Coastal Erosion Hazard Zone
CFHZ — Coastal Flood Hazard Zone
Roads and Tracks
Built up areas
C. Church
S. School



Lalomalava

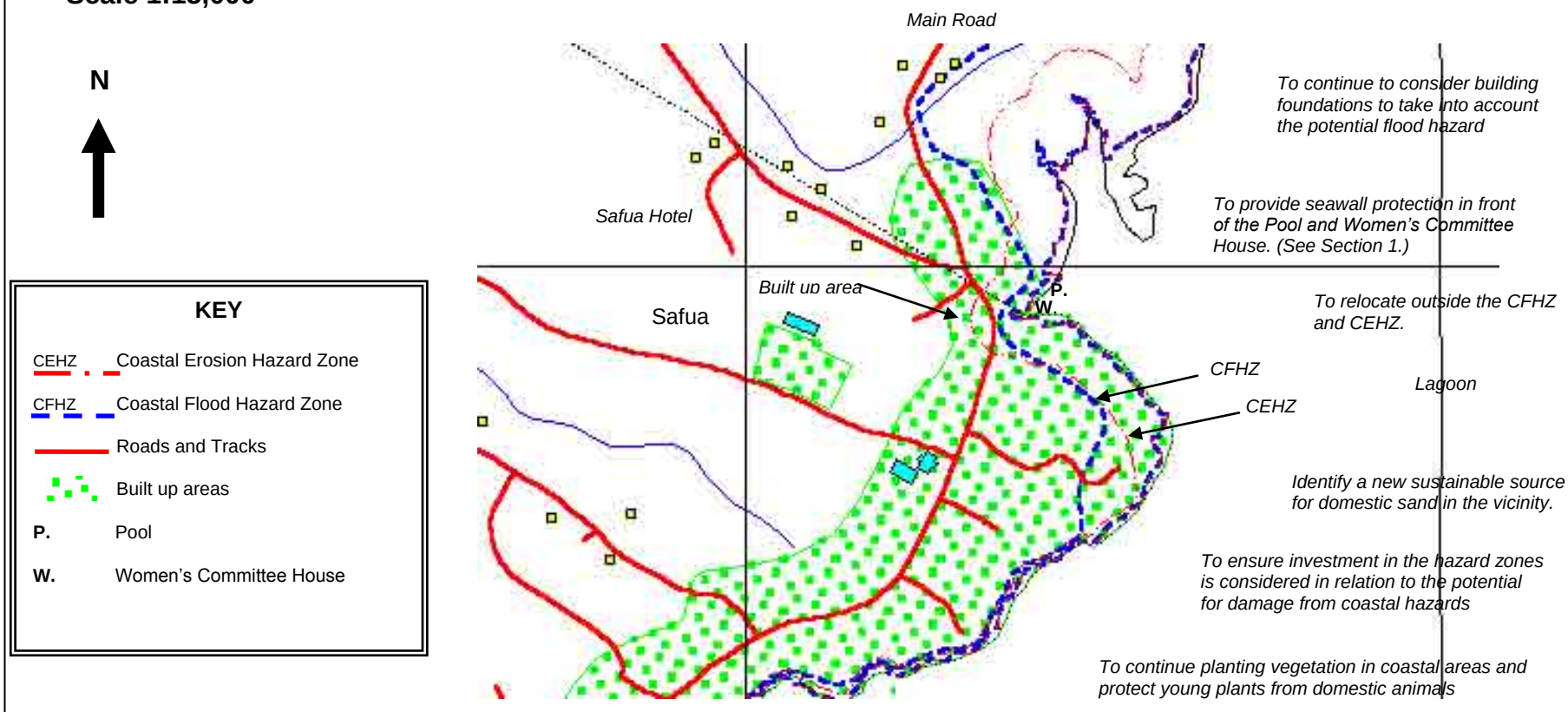
Seawall and reclamation at Savaiian Hotel and adjacent property.

8 Safua Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, women's committee house and pool in CEHZ and CFHZ	• Identify a new sustainable source for domestic sand in the vicinity. ***Responsibility: DLSE***	• Main Road	• Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources. • Prepare Environmental Impact Assessments for identified sites. • Undertake consultation with villages affected by the proposed sand mining.
	• To provide protection in front of the Pool and Women's Committee House to limit the potential for erosion on the Main Road ***Responsibility: Ministry of Works/Village***		• Prepare EIA for the provision of protection around the pools in accordance with technical advice from MoW. (See Section 1).
	• To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. • To relocate outside CEHZ and CFHZ when buildings require replacement **Best long-term solution** • To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding • To continue planting vegetation in coastal areas and to enable this vegetation to survive. ***Responsibility: Village/Families***		• Family decision when building to provide long-term protection from coastal hazards. • Village/Family decision to relocate in the long-term or when building new houses. • Village/Families to recognise the role that vegetation plays in stabilising coastal areas. • Areas of accretion to be planted as soon as practicable with suitable coastal species.

NOTE: Provision of a seawall along the coast to the south of the pool has also been considered. The benefit/cost ratio for this seawall is assessed at 0.32, which indicates that the cost of construction and maintenance is three times the benefits it is likely to provide. It is more effective to provide a targeted response to specific areas at risk such as the pool identified.

Possible Solutions
Safua Village
Scale 1:15,000



Safua

Safua village pool with Women's Committee House behind.

Beach front at Safua showing trees undermined.