



GOVERNMENT OF TUVALU



TUVALU

Infrastructure Strategy and Investment Plan

"Fakafoou – To Make New"



With technical support from
Pacific Region Infrastructure Facility

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The Tuvalu Infrastructure Strategic Investment Plan was endorsed and adopted by the Tuvalu Cabinet on December 7th 2016 as a guide to infrastructure investment over the next 10 years and it is linked to the Tuvalu Asset Management Framework.

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Abbreviations

AF	Adaptation Fund
Cm	centimeter
GCF	Green Climate Fund
GOT	Government of Tuvalu
MCA	Multi-Criteria Analysis
m	meter
mm	millimeter
NGO	nongovernmental organisation
PRIF	Pacific Region Infrastructure Facility
PSIP	Public Sector Investment Program
RVRP	Recovery and Vulnerability Reduction Plan
SDE	Special Development Expenditure
TANGO	Tuvalu Association of Nongovernmental Organisations
TEC	Tuvalu Electricity Corporation
TISIP	Tuvalu Infrastructure Strategy and Investment Plan
TKII	Te Kakeega II National Strategy for Sustainable Development 2005–2015
TKIII	Te Kakeega III National Strategy for Sustainable Development 2016–2020
TTC	Tuvalu Telecommunications Corporation

Currencies

Money values are expressed in Australian dollars (A\$), Euros (€), New Zealand dollars (NZ\$), or U.S. (US\$) dollars, as indicated.

Executive Summary

The Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2016–2025 was endorsed by the Tuvalu Cabinet on 7 December 2016 as an update of the TISIP that was prepared in 2011. This update extends to include social and economic infrastructure, covering the sectors listed below while focusing on investments of major national significance at a minimum capital cost of A\$400,000. An update of recent developments in each of these sectors in relation to infrastructure investment is provided in Section 2: Maritime Transportation, Air Transportation, Land Transportation, Water and Sanitation, Waste Management, Energy, Telecommunications, Coastal Protection, Education, Health, Multi-Sectoral (e.g. urban or Outer Island projects involving multiple sectors), and Other Government Buildings.

TISIP 2016–2025 falls under *Te Kakeega III*, Tuvalu's National Strategy for Sustainable Development 2016–2020 (TKIII). It includes the infrastructure requirements that were identified in the Tropical Cyclone Pam Recovery and Vulnerability Reduction Plan, prepared by the Government of Tuvalu in 2015.

TISIP 2016–2025 includes projects that are ongoing or for which funding has been committed, together with 12 projects as of March 2016, that have been identified from a "long list" based on a prioritisation methodology. Section 3 contains the details of ongoing, committed and proposed projects.

The "long list" originates from a range of sources, including the *Te Kakeega III* National Strategy for Sustainable Development 2016–20 (TKIII); Public Sector Investment Program (PSIP) within the annual Budget; Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2011; Recovery and Vulnerability Reduction Plan; sector plans; and agency corporate plans, as well as from interviews with stakeholders in infrastructure sectors. It is noted that the PSIP includes a list of unfunded projects; this list, however, is not comprehensive and represents a "fully fledged" pipeline of investment projects (i.e., next-generation projects to follow those which are in progress or for which funding is committed). TISIP 2016–2025 contributes by strengthening the PSIP into a comprehensive pipeline of projects that will require in-depth preparation, appraisal, prioritisation, and sequencing.

The "long list" includes proposals designed to ensure that recent key infrastructure assets that were put in place in recent times are kept in good condition and fully operational thus reflecting the outputs of asset management framework. It also ensures that sufficient funding is available to complete those projects whose costs are not fully covered currently (in cases where funding commitments do not cover the full project cost), prior to initiating new investment projects.

In terms of methodology, each project on the list has been screened as follows:

- strategic alignment to ensure that the project is consistent with TKIII;
- time frame to ensure that the demand for the project falls within a 10-year period; and
- state of readiness to ensure that the scope of the project is sufficiently developed prior to implementation.

The projects that fell within the above criteria were then ranked according to the Multi-Criteria Analysis (MCA), a similar approach to that used in the original TISIP. MCA is a rapid appraisal technique that weighs the criteria based on a scoring system to establish the priority of a project. Section 3.3 further describes the MCA criteria, as well as the weighting and scoring system.

It should be noted that MCA does not establish the viability of projects (i.e., the precise relationship between benefits and costs); rather, it establishes the ranking of projects in relation to their performance against selected criteria. As such, it identifies those projects that justify further development along the project pipeline but does not warrant final approval of the project. Prior to implementation, projects must be fully documented and subject to more scrutiny from various assessments, such as the level of cost benefit analysis and environmental impact. This assessment, in some cases, identifies those projects that require modification or redesign.

TISIP 2016–2025 represents a total investment of approximately A\$213 million over a 10-year period (i.e., A\$21.3 million per annum, on average). This includes ongoing projects in 2016, those for which funding has been committed, and those that have been proposed and are considered a high priority.

Provision is made for climate proofing the new assets, and allowances for the whole of life cost analysis of projects are included for design, contingencies, and incremental maintenance requirements (Section 3.2). Furthermore, almost 25% of the infrastructure investments that are being considered for the 2016–25 period will consist of coastal protection works for which previously untapped resources of climate change adaptation funding are being sought. Section 4 provides details of the composition and phasing of the infrastructure investment plan, including potential sequencing of investments (Section 4.1).

Of the total TISIP 2016–2025 (i.e., ongoing, committed, and proposed projects), 60% by number and 67% by value represent new investment, while the balance represents the upgrade or periodic maintenance of existing infrastructure. The total increase in annual maintenance requirements from TISIP implementation (i.e., by end-2025) is estimated at A\$3.4 million.

The projects with the highest priority are shown in Table 1. Profiles of these projects, including climate proofing options where appropriate, are included in Appendix 2. The 12 projects are spread across nine sectors. Three projects are located in Funafuti—two of which are of significance to the nation as a whole—while nine involve one or more outer islands.

Activities, which include various studies and assessments, have been identified as complementary to the infrastructure investment plan set out in TISIP 2016–2025. These are included in Section 4.2. Some may be eligible for inclusion in future TISIP updates once the feasibility studies are completed.



Table 1. Priority Projects Based on the Multi-Criteria Analysis
(in millions of Australian dollars)

Sector	Project	Estimated capital cost*
Telecommunications	Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands	4.0
Maritime Transportation	Upgrade of container storage and handling facilities	1.2
Energy	Additional investment in renewable energy beyond World Bank project	13.0
Land Transportation	Periodic maintenance: reseal of Funafuti roads	9.0
Waste Management	Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)	7.5
Energy	Solar photovoltaic systems: battery replacement	12.0
Coastal Protection	Nukufetau coastal protection	1.0
Health	Additional funding for mini-hospitals in Nanumea and Vaitupu	1.5
Water and Sanitation	Development of three water reserves on each island	8.4
Coastal Protection	Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)	42.0
Air Transportation	Periodic maintenance: reseal of Funafuti International Airport runway	13.0
Health	Additional funding for construction of Outer Island clinics	0.5

*Including incremental costs for climate proofing.

Section 5 and Section 6 cover the financing and implementation of projects, while Section 7 addresses the building of resilience into the design and planning of infrastructure investments. The latter also provides incremental costs of climate proofing the priority projects of the plan.

TISIP 2016–2025 should be viewed as a key contributor to the strengthening of the infrastructure investment proposal pipeline of the Government of Tuvalu as a result of rigorous project preparation, appraisal, prioritisation, and sequencing of investments. This pipeline, including the maintenance requirements, will be the basis on which sector ministries will frame their submissions for the annual Budget,¹ and on which central agencies, such as the Ministry of Finance and Economic Planning, will conduct their appraisals. It provides a mechanism to improve the linkages between investment planning and annual budgeting processes.

An achievement of the TISIP 2016–2025 is the link that has been established between the investment plan and the development of the Asset Management Framework. The latter will provide a significantly more systematic approach to identify the maintenance requirements and investment needs associated with the replacement, upgrade, and added capacity of infrastructure asset stock.

Consideration, in due course, should be given to shifting the focus of TISIP from that of a formal infrastructure investment plan to that of an infrastructure management and investment process. The advantages would include process continuity, linkage facilitation vis-à-vis the Asset Management Framework and PSIP, and improved sustainability as a component of Tuvalu's planning and budget framework.

¹ As noted elsewhere in this document, this takes into account that a number of the proposed projects in the investment plan require further feasibility work prior to funding consideration.

1 Introduction

1.1 Tuvalu Infrastructure Strategy and Investment Plan

The Tuvalu Infrastructure Strategy and Investment Plan (TISIP) was prepared in 2011 and adopted by the Government of Tuvalu in February 2012. The infrastructure investment priorities set out in TISIP were guided by the *Te Kakeega II* National Strategy for Sustainable Development 2005–2015.

The objective of TISIP was to provide a country-led and prioritised investment plan for Tuvalu’s economic infrastructure for the next 5-10 years. It identified the investment needs and priorities for economic infrastructure and assessed the financial resources essential to support implementation. The plan aims to improve collaboration between national stakeholders and international development partners in the planning and financing of infrastructure development and maintenance, as well as to strengthen the capacity of government to plan and manage the development of its economic infrastructure. Since planning and budgeting priorities change over time under various circumstances, it was proposed that TISIP be updated every two years.

The Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2016–2025 is an update of the TISIP prepared in 2011. It was prepared in 2016 by the Ministry of Public Utilities and Infrastructures and the Ministry of Finance and Economic Development—in close collaboration with line ministries, state-owned enterprises, and development partners—and it was supported by the Pacific Region Infrastructure Facility. The TISIP 2016–2025 was endorsed by the Tuvalu Cabinet on 7 December 2016.

TISIP 2016–2025 covers the following infrastructure sectors shown below. The list is an expansion of that in the original TISIP of 2011, which was restricted to Economic Infrastructure. The additions include Coastal Protection, Education, Health, and Other Government Buildings and are a consequence of the strong focus posed on climate change and the environment in TKIII, as well as the intention of government to ensure social inclusion.

Sector code	Sector	Sector code	Sector
MT	Maritime Transportation	TL	Telecommunications
AT	Air Transportation	CP	Coastal Protection
LT	Land Transportation	MS	Multisector (e.g., urban or outer island projects involving multiple sectors)
WS	Water and Sanitation	ED	Education
WM	Waste Management	HE	Health
EN	Energy	GB	Other Government Buildings

The updated TISIP has a 10-year time frame up to and including 2025. A more detailed coverage of the first five years, up to and including 2020, is consistent with the TKIII time frame.

TISIP 2011 focused on major infrastructure projects of national significance and set a minimum capital cost of A\$400,000. This investment threshold has been retained in TISIP 2016-2025.

1.2 Te Kakeega III

Development activity in Tuvalu, including investment in infrastructure, is guided by Tuvalu's *Te Kakeega III* (TKIII) National Strategy for Sustainable Development which covers the 2016–20 period. The strategy supports the theme adopted for the 2015 National Summit for Sustainable Development, namely "Protect and Save Tuvalu. Improve the quality of life and prosperity for all". The strategic areas identified in TKIII are as follows:

- Strategic Area 1: Climate Change
- Strategic Area 2: Good Governance
- Strategic Area 3: Growth and Stability
- Strategic Area 4: Health and Social Development
- Strategic Area 5: Falekaupule and Island Development
- Strategic Area 6: Private Sector Employment and Trade
- Strategic Area 7: Education and Human Resources
- Strategic Area 8: Natural Resources
- Strategic Area 9: Infrastructure and Support Services
- Strategic Area 10: Environment
- Strategic Area 11: Migration and Urbanisation
- Strategic Area 12: Oceans and Seas

Strategic Area 9, Infrastructure and Support Services, includes seven priority areas: water and sanitation, telecommunications, power and renewable energy, waste management, civil aviation, maritime transport, and roads. TKIII builds on TKII, adding emphasis on climate change, environment, migration and urbanisation, and oceans and seas.

1.3 Recovery Vulnerability Reduction Plan

Following the extensive damage caused by the 2015 storm surges of Tropical Cyclone Pam, the Government of Tuvalu prepared the Recovery and Vulnerability Reduction Plan (GOT, 2015) which identified the immediate, medium-term, and long-term actions necessary to respond to the event. The total budget amounts to A\$90.7 million and includes A\$6.3 million relating to immediate responses, A\$13.2 million to medium-term actions, and A\$71.2 million in long-term rehabilitation. Significant investments in repairs to infrastructure and coastal protection are taken into consideration, thus overlapping with TISIP 2016-2025.

1.4 Government of Tuvalu Planning and Budgeting Framework

Line ministries (and the public enterprises they supervise) are responsible for identifying and developing project proposals for new or replacement infrastructure, as well as its relevant maintenance requirements. Proposals are submitted to the Ministry of Finance and Economic Development during the yearly budget exercise. The Public Sector Investment Program (PSIP) is then included in the Budget for consideration and approval by Cabinet and Parliament. It includes a list of projects to be funded by government (under the category of Special Development Expenditure) and development partners, as well as those projects that have been approved but which await funding. While the development of the PSIP involves a rudimentary assessment of proposal merits, it does not amount to a formal project appraisal.

The submission of project proposals that require external assistance is not intrinsic to the budget process. There is no requirement that they be incorporated into the PSIP prior to submission to development partners for assistance; rather, some projects may be ultimately added to the PSIP once committed to by development partners. Certain larger projects, particularly those financed by multilateral development institutions such as the World Bank and Asian Development Bank—which provide Tuvalu with finance on a grant basis—may not be reflected in the PSIP.

Table 2 summarises the processing of project proposals that require external assistance from development partners. These vary depending on the cost of the project.

Table 2. Process for Project Proposals Seeking External Assistance from Development Partners

Cost range	Process
Less than A\$10,000	Appraisal by Aid Coordination Unit of the Ministry of Finance and Economic Development prior to submission to donors through the Ministry of Foreign Affairs
A\$10,000 to A\$100,000	Appraisal by Aid Coordination of the Ministry of Finance and Economic Development prior to submission to Project Review Committee
A\$100,000 to A\$1,000,000	Submission by line ministries to Development Coordination Committee
Greater than \$1,000,000	Submission by line ministries to Cabinet

Source: Compiled from the draft Operating Procedures Manual, 2014 of the Aid Coordination Unit of the Ministry of Finance and Economic Development.

Project proposals for external assistance are initiated by line ministries. Appraisal by the Aid Coordination Unit of the Ministry of Finance and Economic Development is only required for smaller projects, while larger projects are submitted to the Development Coordination Committee or Cabinet. This provides very little opportunity for this Ministry to play a role in the formal appraisal of these larger projects. It is noted that the Financial Instructions require all projects that seek external assistance to be processed and evaluated by the Planning, Budget, and Aid Coordination department of the Ministry of Finance and Economic Development,² although this does not appear to be followed in practice.

1.5 Preparation of Asset Management Framework

Preparation of an asset management framework and plan is underway as an activity associated with the update of the infrastructure investment plan (PRIF, undated). Once complete, this will provide more information than is currently available on the historical cost, replacement value, and annual maintenance requirements of the current stock of infrastructure assets in Tuvalu. An Asset Health Index will include a combination of indices that relate to the physical condition, service levels, and vulnerability of each major asset. An Asset Capacity Adequacy Index will also be prepared, which will provide details of additional assets that may be required.

These indices not only will be helpful in determining maintenance requirements, asset replacements, upgrades, and capacity addition, but they will be invaluable in future updates of the infrastructure investment plan, as well as for the long list of proposed priority investment projects under each TISIP 2016–2025 update. The indices will also provide more detailed information on the maintenance requirements of existing assets to enable more accurate estimates of maintenance expenditures for the subsequent infrastructure investment plan.

² See paragraphs 242 and 243 of Chapter 13 under "Applications to Donor Agencies" in GoT (2014).

2 Infrastructure Sector Update

2.1 Drivers

An analysis was made in TISIP 2011 of the key drivers of Tuvalu's demand for infrastructure. This remains current, with the key drivers for infrastructure development as follows:

- population growth and economic activity;
- isolation and small size of the nation, as well as the dispersion of its nine islands;
- lack of resources; and
- few options to increase economic growth based on international competitiveness.

An emerging driver of infrastructure demand constitutes climate change and its natural hazards. These now prominently feature in Tuvalu's strategies for national sustainable development.

2.2 Maritime Transport

With regard to the Maritime Transportation sector, there have been major infrastructure developments since TISIP 2011. These include (i) launching of the *Nivaga III*, a vessel donated by the Government of Japan to provide shipping services between the atoll of Funafuti and Tuvalu's Outer Islands; (ii) feasibility work by the Asian Development Bank with regard to an Outer Island maritime infrastructure project; and (iii) an assessment of this sector, also by the Asian Development Bank. The maritime infrastructure project is for the construction of harbours on four outer islands for small work boats that load and unload the *Nivaga III* and other inter-island vessels.

TISIP 2011 lists, as a priority, the project of ancillary facilities that will improve cargo handling at the Port of Funafuti. Since it is a project that is still outstanding, it is included in the long list for TISIP 2016–2025. TISIP 2011 also contains the upgrade of Outer Island ports as a medium-term priority (also listed in the Recovery and Vulnerability Reduction Plan (RVRP) and addressed by the Asian Development Bank project), while the fisheries harbour project—a medium-term priority in TISIP 2011—is considered in TISIP 2016–2025.

The TKIII key performance indicator for the Maritime Transportation sector relates to the implementation of a maintenance plan for all government vessels. The target date for enforcement is 2016.

2.3 Air Transportation

The resealing of the Funafuti International Airport runway has been completed under the World Bank's Pacific Aviation Investment Program, while other investments—as well as the upgrade of the airport's terminal and navigational aids—will soon commence under the same program. Periodic maintenance, in particular eventual resealing, is part of TISIP 2016–2025.

Proposals for a new international airport and the reinstatement of domestic air services are considered in TISIP 2011, both of which are contained in the list for TISIP 2016–2025. The carrying out of feasibility studies has been noted in order to more clearly define these projects.

The key performance indicators in TKIII for the Air Transportation sector relate to the feasibility studies on domestic air services (completed), surveillance of sites for airstrips by 2017, reconstruction of airstrips in Nanumea and Nukufetau by 2017, and a search for funding for the construction of other airstrips by 2018/19. Further feasibility studies relate to the relocation of the international airstrip (completed), access to funding by 2017, and the introduction of legislation for domestic air services by 2017.

2.4 Land Transportation

The resealing of roads on Funafuti atoll has been completed with additional financing under the World Bank's Pacific Aviation Investment Program. Periodic maintenance of this asset, as well as its eventual resealing, forms part of TISIP 2016–2025.

A key performance indicator for the sector in TKIII is enactment of legislation for a Land Transportation Authority. The target date for this is 2017.

2.5 Water and Sanitation

The Government of Tuvalu has adopted a sustainable and integrated water and sanitation policy (*Fakanofonofoga Mo Vai Mote Tuma*) that covers the period 2012–21. This policy promotes measures to improve water security as well as to develop more sustainable sanitation systems.

TISIP 2011 strongly focused on the Water and Sanitation sector, since Tuvalu had been experiencing a serious drought at the time. Of the three projects assigned high priority, the water consolidation project was pursued vigorously with major programs to improve rain water catchment and storage at the household and community levels, as well as to provide back-up capacity to small desalination plants. The other two projects to expand the use of composting toilets on Funafuti and the Outer Islands, respectively, have met with less success—perhaps due to community resistance to the technology—although they remain in the 2016 national Budget as being funded by the European Union's Falevatie Phase II project.

The establishment of three water reserves on each island was identified as a project in the RVRP. It also is included in the long list.

A key performance indicator in TKIII for the Water and Sanitation sector relates to sufficient storage water on all islands for a drought up to six months. An additional indicator is that which relates to the reduction in the number of buildings that lack efficient guttering and water tanks.

2.6 Waste Management

The Solid Waste Agency of Tuvalu continues to implement the integrated solid waste plan developed in 2005, and is currently preparing a National Waste Policy for the 2017–26 period and an Integrated Waste Management Plan for the 2017–21 period. Older landfills on Funafuti have been replaced with a new landfill under a project funded by the Government of New Zealand to repair the environmental damage associated with borrow pits, although this landfill has very little remaining capacity. Waste management is likely to be identified as a focal sector for European Union funding, which is currently being negotiated under its 11th European Development Fund. Tuvalu is also covered by the Solid Waste Initiative by the Japan International Cooperation Agency (JICA) and Secretariat of the Pacific Regional Environment Programme under the Japanese Technical Cooperation Project Promotion of Regional Initiative Solid Waste Management in the Pacific Islands (J-PRISM).

2.7 Energy

Implementation of the Tuvalu government policy to shift from fossil fuel-based power generation to renewable energy continues under the Tuvalu Electricity Corporation's master plan for renewable electricity and energy efficiency. This covers the 2012–20 period.

Stage 2 and Stage 3 of the plan to shift to renewable energy were considered high-priority projects in TISIP 2011, while Stage 4 is a long-term priority. Significant progress has been made with the implementation of solar photovoltaic systems on Funafuti and the Outer Islands through programs funded by the European Union, the Government of New Zealand, and the Government of the United Arab Emirates. An additional program is being developed by the World Bank to extend renewable energy coverage, provide battery storage for a more flexible power grid, and carry out pilots in wind generation. This program also will benefit electricity consumers throughout the country, as well as improve the efficiency of the Tuvalu Electricity Corporation. Also, Tuvalu is part of a five-year project, launched by the Japanese International Cooperation Agency in 2015, to introduce hybrid power generation systems. In sum, it is estimated that the renewable energy penetration as a result of these projects will reach approximately 40%.

There will be an emerging need for the replacement of batteries associated with solar photovoltaic systems. This is taken into account for the 2016–25 period.

Key performance indicators in TKIII for the Energy sector are a renewable energy power production target of 100% by 2020, an increase in energy efficiency by 30% on Funafuti by 2020, the installation of grid-connected wind power by 2018, and a reduction in fuel use by the Transportation sector. Further indicators include a monitoring of the number of buildings/homes that use alternative energy sources and the volume of imported fossil fuels over the previous five years.

2.8 Telecommunications

The Tuvalu Telecommunications Corporation (TTC) has a corporate plan for 2016, which includes the upgrade of bandwidth by end of year through agreements with the telecommunication companies, Kacific Broadband Satellite and ABS. The aim is to develop a network core on Funafuti with a 50 megabit bandwidth, and to connect all Outer Islands to 2G mobile services. It is intended to phase out landlines on Outer Islands, due to the high cost, and to rely fully on mobile services. Services on Funafuti were upgraded to 3G in 2015. TTC's exclusive rights were revoked in 2011, although it remains the sole operator.

TKIII notes that telecommunications services in Tuvalu are currently of poor quality and are unprofitable as they hold back development. They are in urgent need of improvement. A joint New Zealand/World Bank mission reviewed TTC and the Telecommunications sector in Tuvalu in 2015, including its infrastructure and institutional support needs. This may lead to a support program for the sector, a critical development since improved telecommunications services (i.e., international and national connectivity by way of mobile and internet services) are vital to the economic and social development of Tuvalu. The proposed program of support would include the following:

- Assist the Ministry of Communications and Transport to develop and implement a policy for information communications technology, new and amended legislation, and relevant reforms for the Information and Communications Technology sector.
- Assist with the restructuring of the Telecommunications sector, including TTC.
- International connectivity (i.e., cable or long-term satellite arrangement).
- Project management support.

TISIP 2011 includes high-priority projects that extend mobile and internet services to all Outer Islands, as well those that relate to the power of telecommunications facilities—using renewable energy—on Outer Islands. The installation of a fibre-optic cable to Fiji represents a medium-term project, an option still in force although alternatives may also be considered. Work continues on the development of services for the Outer Islands. The further upgrade of satellite-based mobile and internet services for Funafuti and the Outer Islands, in addition to the fibre-optic cable to Fiji, are included in the long list of proposed projects for prioritisation under this TISIP 2016–25 update.

Key performance indicators in TKIII for the Telecommunications sector relate to the monitoring of the number of households with internet access, land lines, and mobile phones.

2.9 Coastal Protection

This Coastal Protection sector has been added to TISIP 2016–2025 based on the strong emphasis placed by TKIII on climate change, the environment, and the oceans and seas. The sector is also prominent in the RVRP.

Major coastal protection works on three islands (Funafuti, Nanumea, and Nanumaga) are included in the long-term program under RVRP and TISIP 2016–2025. Application for funding is being processed through the Green Climate Fund. The Government of Tuvalu is proposing other coastal protection works for Nukufetau, as well as a second stage of the Vaiaku waterfront coastal protection works. Coastal protection works for other Outer Islands is planned for a later stage. The Japan International Cooperation Agency is undertaking a pilot project to examine the effectiveness and adequacy of gravel beach nourishment for the purpose of reducing vulnerability to natural disaster and climate change.

The TKIII key performance indicators for the Coastal Protection sector include the monitoring of the coastline reclaimed from erosion, cyclones and storm surge. It also includes sea defences built on all islands of Tuvalu.

2.10 Multi-Sector

TISIP 2011 includes the medium-term priority of a broad-based program of small-scale infrastructure investment on Tuvalu's Outer Islands. This is being pursued through the Special Development Expenditure category under the national Budget, with an allocation of A\$2.88 million for Outer Island projects in the 2016 Budget.

2.11 Education

The Education sector has been added to TISIP 2016–2025 as part of the drive towards social as well as economic infrastructure. Recent efforts to improve infrastructure in the Education sector have included the refurbishment of the Motofoua Secondary School on Vaitupu, funded by the Government of Japan, and the provision of funding by Australian Aid to refurbish Nauti Primary School on Funafuti. TKIII indicates that a feasibility study should be undertaken in relation to a new high school for Nanumea within the 2016–25 period.

Strategies in TKIII in relation to infrastructure for the Education sector include building Outer Island sports facilities, a multi-purpose gym, and a youth recreation centre. They also call for improving library and archive facilities.

2.12 Health

The TISIP 2016-2025 now includes the Health sector, which reflects the government's intention to address social infrastructure. Princess Margaret Hospital is being refurbished with assistance from the Government of Japan, while the Ministry of Health's Health Reform Strategy 2016-2019 includes proposals for new mini-hospitals in Nanumea and Vaitupu, as well as upgrades to Outer Island clinics. While a portion of the funding is earmarked for these projects in the 2016 Budget, the need to secure additional funding to ensure completion will be included in TISIP 2016-2025.

Strategies identified in TKIII for the Health sector include the upgrade of health infrastructure.

2.13 Other Government Buildings

This sector is added to cater for social infrastructure. The government considered two new unfunded projects in the long list which were prioritised during the TISIP 2016-2025. These are a new police complex and a modern Parliament House.



3 Prioritisation Process

3.1 Establishing Project Lists

3.1.1 Ongoing and committed projects

Table 3 reflects the major infrastructure projects that are ongoing or for which funding is committed. They form part of the prioritised and sequenced infrastructure investment plan for the next 10 years, which includes proposed high-priority projects for which funding is yet to be committed. Documenting the sequencing of ongoing and committed projects over the plan period will help identify the scope available for new projects in terms of financing and implementation capacity.

Table 3. Major Ongoing and Committed Infrastructure Projects

Sector	Project	Reference	Estimated cost (US\$ or A\$ million)	Timing	Funding Source
Maritime Transportation	Harbours at Nanumaga, Niutao, Nui, Nukulaelae	MT 1	US\$12.91	2017–20	Asian Development Bank Outer Island Maritime Infrastructure Project
Air Transportation	Reseal of Funafuti roads also included	AT 1	US\$20.79	2012–17	World Bank Aviation Investment Program: Tuvalu
Land Transportation	See Air Transportation				
Water and Sanitation	Composting toilets	WS 1	A\$0.75	2016	European Union Falevatie Phase II
Waste Management	Recycling and Transfer Station: Phase 1 and Phase 2	WM1	A\$0.7	2016–17	2016 Budget (funding from Special Development Expenditure)
Energy	Renewable Energy	EN 1	A\$2.0	2016	2016 Budget (Outer Islands). Funding from European Union
	Renewable energy on Funafuti (920 kW batteries, estimated to achieve 40% renewables)	EN 2	US\$9.1	2016–20	World Bank Energy Sector Development Project
	Biogas	EN 3	A\$0.4	2016	2016 Budget. Funding from European Union
	Hybrid power generation				Japan International Cooperation Agency:
Telecommunications					

Sector	Project	Reference	Estimated cost (US\$ or A\$ million)	Timing	Funding Source
Coastal Protection	Vaiaku waterfront recreation reserve	CP 1	A\$3.4	2015-16	A\$670,000 in 2016 Budget
	Beach nourishment				Japan International Cooperation Agency
Multi-sector	Outer Island projects	MS 1	A\$2.88	2016	2016 Budget (funding from Special Development Expenditure)
				2016	Ridge to Reef ¹ (A\$4.2 million in 2016 Budget) and NAPA II (\$4.4 m in 2016 Budget) includes some infrastructure.
Education	Australia Aid: Nauti Primary School (12 classrooms)	ED 1	A\$4.1	2016-17	2016 Budget.
	Nanumea and Nukufetau Classrooms	ED 2	A\$2.63	2016	2016 Budget (funding from Special Development Expenditure).
Health	Japan International Cooperation Agency: Princess Margaret Hospital Renovation	HE 1	A\$1.2	2016	2016 Budget.
	Mini-hospitals for Nanumea and Vaitupu	HE 2	A\$0.5	2016	2016 Budget (funding from Special Development Expenditure). Total project cost \$2 million.
	Outer Island clinics	HE 3	A\$0.2	2017	Ministry of Health (Health Reform Strategy 2016-19). Range of funding sources, but lack of coordination noted.
Other Government Buildings	New office for Fisheries Department	GB 1	A\$5.0	2017	New Zealand Ministry of Foreign Affairs and Trade.
	Renovation of Government Complex (new Judiciary building)	GB 2	A\$2.0	2016	2016 Budget (Special Development Expenditure).
	Pacific Islands Forum housing	GB 3	A\$3.14	2016	2016 Budget (Special Development Expenditure).
	New Class B housing	GB 4	A\$0.83	2016	2016 Budget (Special Development Expenditure).

¹ These projects are added to Table 3 for completeness. They have not been allocated a reference number since the infrastructure investment amount is not significant.

3.1.2 Long List of proposed projects

A long list of proposed projects for which funding has not yet been sourced is provided in Table 4. These projects have been screened, scored, and ranked using the prioritisation methodology described in Section 3.3. Subsequent developments include the commencement of work on the Nukufetau coastal protection project (Project CP2) and the announcement that funding has been approved from the Green Climate Fund for the coastal protection infrastructure project for the three islands of Funafuti, Nanumea, and Nanumaga (Project CP3).

The list of projects originates from a range of sources, including the *Te Kakeega III* National Strategy for Sustainable Development 2016–20 (TKIII); Public Sector Investment Program (PSIP) within the annual Budget; Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2011; Recovery and Vulnerability Reduction Plan; sector plans; and agency corporate plans, as well as from interviews with stakeholders in infrastructure sectors. It is noted that the PSIP includes a list of unfunded projects; this list, however, is not comprehensive and represents a “fully fledged” pipeline of investment projects (i.e., next-generation projects to follow those which are in progress or for which funding is committed).

Many of the projects in the list remain at the concept stage, with only limited documentation available and an absence of detailed costing. With TISIP 2016–2025 and other sources, however, it may be possible to build up the PSIP in the annual Budget into a more comprehensive project pipeline with more scrutiny in terms of project preparation, appraisal, prioritisation, and sequencing. TISIP will inform the PSIP by offering consolidated information on the infrastructure project pipeline that forms a large part of the PSIP. Sector ministries will draw on TISIP to frame their annual Budget submissions in preparation of the PSIP.

With regard to the Asset Management Framework, the list pre-empts those projects designed to ensure that major infrastructure assets are maintained in good condition and are fully operational by anticipating the eventual output of asset management work. An example is a project that relates to the periodic maintenance of the recently completed resurfacing of Funafuti’s roads and airport runway, the latter of which is expected to be essential in approximately 10 years. Another is the replacement of solar photovoltaic system batteries that have recently been installed and are expected to be replaced in coming years, possibly around 2023.

Table 4. Long List of Proposed Projects for Screening, Scoring, and Ranking
(as of March 2016)

Sector	Project	Reference	Estimated cost (A\$ or US\$ million)	Timing	Notes
Maritime Transportation (including Fisheries infrastructure)	Upgrade of container storage and handling facilities	MT 2	A\$1.2	2017	Included in TISIP 2011. Proposal awaited from Department of Marine
	Mooring of buoys in Outer Islands for inter-island vessels	*	TBD	2019	Technical investigation required, which could be included as a complementary measure in TISIP 2016–2025 if appropriate.
	Fisheries infrastructure for Funafuti (wharf repair, slipway repair, replacement vessel)	MT 3	A\$10.0	2019	Proposal developed, but not funded as yet
Air Transportation	Periodic maintenance: reseal of Funafuti International Airport runway	AT 2	US\$10.0	2025 approx.	Could be linked with resealing of roads.
	Feasibility study of Funafuti International Airport relocation	*	TBD	TBD	TKIII. Preparatory studies could be included in the TSIP 2016–2025 as complementary measures, if appropriate.
	Options to reinstate domestic air services	*	TBD	TBD	TKIII. Preparatory studies could be included in the plan as complementary measures, if appropriate.
Land Transportation	Periodic maintenance: resealing of Funafuti roads	LT 1	US\$6.5	2025 approx.	Could be linked with runway reseal.
Water and Sanitation	Development of three water reserves on each island	WS 2	A\$8.4	2019–20	Included as a medium-term project in Recovery and Vulnerability Reduction Plan.
Waste Management	Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)	WM 2	A\$7.5	2017–21	Waste management identified as a focal sector for 11 th European Development Fund, although no final commitment to funding to date.

Sector	Project	Reference	Estimated cost (A\$ or US\$ million)	Timing	Notes
Energy	Additional investment in renewable energy beyond World Bank project	EN 4	A\$13.0	2021-22	Tuvalu Electricity Corporation Master Plan for renewable energy has a target of 750 kilowatts of additional renewable energy capacity per annum from 2016-20 (i.e., photovoltaic and possibly wind).
	Solar photovoltaic systems: battery replacement: 2 in 2023 4 in 2024 6 in 2025	EN 5		2023 onward	Battery storage is being included in solar photovoltaic systems, and batteries will need to be replaced periodically.
Telecommunications	Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands	TL 1	A\$4.0	2017	Cost represents estimate of infrastructure required to implement current agreements with Kacific Broadband Satellite and ABS. Cost of further upgrades not yet identified.
	Submarine fibre-optic cable from Fiji	TL 2	A\$33.0	2021	Included as a medium-term project in the TISIP 2011.
Coastal Protection	Nukufetau coastal protection	CP 2	A\$1.0	2017	
	Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)	CP 3	A\$42.3	2020-24	Included as a long-term measure in the Recovery and Vulnerability Reduction Plan. Application made to Green Climate Fund.
	Vaiaku Waterfront coastal protection, Stage 2	CP 4	A\$4	2017	Waterfront recreation reserve.
Multisector					
Education	Feasibility study of a new high school on Nanumea		TBD	2019	TKIII. Preparatory studies could be included in the plan as complementary measures, if appropriate.
	Upgrading of Tuvalu sports ground	ED 3	TBD	2018	Mentioned as an unfunded project in the Budget.
	Gymnasiums for all islands	ED 4	TBD	2020	Mentioned as an unfunded project in the Budget.

Sector	Project	Reference	Estimated cost (A\$ or US\$ million)	Timing	Notes
Health	Additional funding for mini-hospitals on Nanumea and Vaitupu	HE 4	1.5	2016–19	Government funding of A\$0.5 million in the 2016 Budget.
	Additional funding for construction of Outer Island clinics	HE 5	1	2016–19	Ministry of Health's Health Reform Strategy 2016–2019. Range of funding sources, although gaps may remain.
Other Government Buildings	New Parliament House	GB 5	5.4	2020	Included as an unfunded project in the Public Sector Investment Program in the Budget.
	New police complex	GB 6	0.43	2018	Included as an unfunded project in the Public Sector Investment Program in the Budget.

* Included in this infrastructure investment plan as complementary activities.

Notes: TISIP = Tuvalu Infrastructure Strategy and Investment Plan; TKIII = Te Kakeega III, National Strategy for Sustainable Development 2016–2020.

3.2 Whole of Life Costing

TISIP 2011 described the key stages in the life cycle of infrastructure assets (GOT, 2012:39–40) all of which involve costs. These costs are as follows:

- Concept development and planning: planning studies, concept design, and associated assessments, such as environmental impact.
- Detailed design and documentation: detailed designs and specifications, as well as contract documentation.
- Construction or supply: construction or supply of infrastructure, including allowance for escalation and contingencies.
- Contract supervision: work that is done to the required standard, in accordance with contract requirements.
- Operation and maintenance: operating and maintaining infrastructure over its useful life; maintenance includes routine small-scale activities undertaken regularly, as well as periodic maintenance for larger-scale activities at longer intervals.
- Disposal or decommissioning: disposal of the asset, which may include decommissioning, removal, and clean-up.

Typically, cost estimates in the early stages of project development (including those sourced in relation to the list of priority projects) relate to construction and supply, excluding those costs registered above. While it is difficult to apply whole of life costing in a context where calculations are approximate aggregates with little breakdown into cost elements, the estimates in the prioritised and sequenced infrastructure investment plan (Table 10) attempt to apply this principle and build in allowances for design and supervision, as well as contingencies and maintenance costs.

3.3 Prioritisation Methodology

TISIP 2016–2025 focuses on major infrastructure projects of national significance, such as those of a capital cost greater than A\$400,000. Ongoing and committed projects form part of the infrastructure investment plan, together with a shortlist of proposed projects that are considered as high priority. Following the shortlisting of the list, the projects were screened and ranked by applying the Multi-Criteria Analysis (MCA) approach to establish their priority.

The original long list (Section 3.1.2) was based on the reviews of TKIII, PSIP in the Budget, sector plans, corporate plans, original TISIP 2011, and Recovery and Vulnerability Reduction Plan, among others, together with interviews with stakeholders in the various infrastructure sectors. Future updates to the TISIP 2016–2025 will depend on the Asset Management Framework and Plan (once completed), Asset Health Index, and Asset Capacity Adequacy Index, all of which will assist in identifying projects for the “long list”. These will include major assets that are nearing the end of their economic life, need upgrading, or should be added to the asset stock.

The list does not include projects that are ongoing or for which funding is already committed. It focuses only on those projects at the planning stage for which funding has yet to be committed. Project information is current as of March 2016.

3.3.1 Screening process

Projects were first evaluated under the following criteria:

- strategic alignment to confirm that projects are consistent with TKIII;
- timing to confirm that projects are required within the next 10 years; and
- readiness to confirm that the project is sufficiently developed to warrant prioritisation (at a minimum, the scope of the project must be clear).

3.3.2 Multi-Criteria analysis approach

The projects that progressed beyond the initial screening were ranked according to the MCA approach, which is similar to that used in the original TISIP. MCA is a rapid appraisal technique, used to guide project prioritisation in the absence of more complete project documentation and cost-benefit analysis. MCA identifies criteria relevant to the weighting for project prioritisation, in accordance with a project's perceived significance, and then applies a scoring system that captures the project's performance against the criteria.

It should be noted that MCA does not establish the viability of projects (i.e., the precise relationship between benefits and costs); rather, it establishes the ranking of projects in relation to their performance against selected criteria. As such, it identifies those projects that justify further development along the project pipeline but do not warrant final approval of the project. Prior to implementation, projects must be fully documented and subject to more scrutiny from various assessments, such as the level of cost benefit analysis and environmental impact. In some cases, a need to modify or re-think the project may be required as a result.

Criteria as a consequence of the MCA are, of necessity, general in nature given the need to apply them to projects across all infrastructure subsectors. It is essential that criteria are measured to the extent that they allow projects to be ranked. Criteria and subcriteria should also be kept to a manageable number to prevent the prioritisation exercise from becoming cumbersome.

3.3.3 Prioritisation criteria

The fourth column of Table 5 provides the prioritisation criteria used in TISIP 2016–2025. They are presented in the context of the original TISIP 2011, Recovery and Vulnerability Reduction Plan, and TKIII.

Table 5. Project Prioritisation Criteria

Criteria used in TISIP 2011	RVRP strategic objectives	TKIII strategic areas	Criteria used in TISIP 2017-2026	Links to TKIII strategic areas
<p>1. Policy</p> <p>Will the project contribute toward meeting long-term National Sustainable Development Plan goals?</p> <ul style="list-style-type: none"> Addresses long-term goals Addresses short-term goals <p>2. Economic</p> <p>Will the project contribute to national economic development and growth?</p> <ul style="list-style-type: none"> Does it add to Exports: Foreign Exchange? Does it have the potential to enhance private sector activity and jobs? Is this project critical to continuing an existing essential service? Does the project contribute to other sectors? <p>3. Financial</p> <p>Will the project contribute to national revenue?</p> <ul style="list-style-type: none"> Is there potential for user charges to recover full cost of service? Does the project cover the costs of operations and maintenance? Have all other refurbishment and repair options been exhausted for this service? <p>4. Social</p> <p>Will the project lead to improved living standards?</p> <ul style="list-style-type: none"> Does it contribute to meeting a minimum level of service standards? Does it enhance service delivery? Does it lead to health improvements? 	<p>1. Households are appropriately supported to recover from the Tropical Cyclone Pam crisis.</p> <p>2. To support the construction and repair of damaged infrastructure (coastal protection, sea walls, permanent shelters, and community infrastructure).</p> <p>3. Chronic levels of food security and malnutrition are addressed through integrated programming to build resilience.</p>	<p>Strategic Area 1: Climate change</p> <p>Strategic Area 2: Good Governance</p> <p>Strategic Area 3: Growth and Stability</p> <p>Strategic Area 4: Health and Social Development</p> <p>Strategic Area 5: Falekaupule and Island Development</p> <p>Strategic Area 6: Private Sector, Employment and Trade</p> <p>Strategic Area 7: Education and Human Resources</p> <p>Strategic Area 8: Natural Resources</p> <p>Strategic Area 9: Infrastructure and Support Services</p> <p>Strategic Area 10: Environment</p>	<p>1. Climate Change/ Environment</p> <p><i>a. Resilience of the asset</i></p> <p>How resilient is the asset to the potential effects of climate variability, climate change, and natural hazards?</p> <p><i>b. Disaster risk management or climate change adaptation function</i></p> <p>Does the project have specific objectives or components relating to disaster risk management or climate change adaptation for the broader community?</p> <p><i>c. Impact on the environment</i></p> <p>Will the project have positive, neutral, or negative impacts on the environment (e.g., land, coastal and marine environments, water resources)?</p> <p>2. Economic</p> <p><i>a. Impact on costs and efficiency of infrastructure users</i></p> <p>Will the project result in lower costs for infrastructure users through lower tariffs or slower growth in tariffs, time savings, reduced operating costs?</p> <p><i>b. Impact on economic growth and employment</i></p> <p>Will the project facilitate expansion of industries (e.g., fisheries, agriculture, wholesale and retail, tourism)?</p> <p><i>c. Maintenance of essential services</i></p> <p>Is the project critical to maintaining essential economic infrastructure services?</p>	<p>1 5, 9, 10, 12</p> <p>3, 6, 8, 9</p>

Criteria used in TISIP 2011	RVRP strategic objectives	TKIII strategic areas	Criteria used in TISIP 2017-2026	Links to TKIII strategic areas
<p>5. Environmental</p> <p>Will the project contribute to a better environment?</p> <ul style="list-style-type: none"> Does it directly improve the physical environment? Does it impact the environment negatively? <p>6. Readiness</p> <p>What is the project's readiness?</p> <ul style="list-style-type: none"> How advanced is it in the planning stage? How advanced is identification of a development partner? Are there land or social owner impacts? <p>7. Maintenance</p> <p>Will it be adequate?</p> <ul style="list-style-type: none"> Is there the current technical capability to maintain infrastructure? Is there an appropriate organisational structure to maintain infrastructure? Is there the financial capacity to maintain infrastructure? 		<p>Strategic Area 11: Migration and Urbanisation</p> <p>Strategic Area 12: Oceans and Seas</p>	<p>3. Social</p> <p><i>a. Improved social services</i></p> <p>Will the project facilitate improvements in the delivery of health and/or education services?</p> <p><i>b. Service coverage</i></p> <p>Will the project extend social service coverage to new areas and/or more people and prevent loss of coverage?</p> <p><i>c. Other social benefits</i></p> <p>Will the project have other social benefits for the community (e.g., improving the lives of women and children, assisting vulnerable/disadvantaged groups, alleviating poverty, responding to rural/urban drift, improving safety)?</p> <p>4. Project Sustainability</p> <p><i>a. Financial</i></p> <p>Will the project be able to support the ongoing costs of operation and maintenance through user charges, among others?</p> <p><i>b. Technical</i></p> <p>Will the technology used in the project be appropriate and able to be operated and maintained?</p> <p><i>c. Institutional</i></p> <p>Will the institution responsible for the project have sufficient capacity for implementation, operation and maintenance?</p>	<p>4, 5, 7, 9, 11</p> <p>2, 5, 9</p>

Note: TISIP = Tuvalu Infrastructure Strategy and Investment Plan; RVRP = Recovery and Vulnerability Reduction Plan; TKIII = Te Kakeega III, National Strategy for Sustainable Development 2016–2020.

3.3.4 Scoring methodology

The scoring methodology from 1 to 4, applied to TISIP 2016–2025, is similar to that used in the original TISIP 2011. This is as follows:

- 1 Nil or weak performance against criterion
- 2 Moderate performance against criterion: lower range
- 3 Moderate performance against the criterion: upper range
- 4 Strong performance against the criterion.

Table 6 provides more detailed information on the meaning of scores for each of the 12 subcriteria used in the project prioritisation process.

Table 6. Notes on Scoring with the Multi-Critical Analysis Approach

Prioritisation criteria	Range of scores	Notes on scoring
1. Climate Change/Environmental		
<i>a. Resilience of the asset</i>	1	Asset has low resilience
How resilient is the asset to the potential effects of climate variability, climate change, and natural hazards?	2	Asset has some resilience
	3	Asset has moderate resilience
	4	Asset has high resilience
	<i>Resilience in this context relates to the level of risk (associated with the potential effects of climate variability, climate change, and natural hazards) to the delivery of the services the asset is intended to deliver over its design life (low risk equates to high resilience).</i>	
<i>b. Disaster risk management or climate change adaptation function</i>	1	No adaptation function
Does the project have specific objectives or components related to disaster risk management or climate change adaptation for the broader community?	2	Low level of adaptation function
	3	Moderate level of adaptation function
	4	High level of adaptation function
	<i>An adaptation function in this context is a specific design objective addressing disaster risk management or climate change adaptation for the broader community.</i>	
<i>c. Impact on the environment</i>	1	High negative impact on the environment
Will the project have positive, neutral, or negative impacts on the environment (e.g., land, coastal and marine environments; water resources)?	2	Some negative impact on the environment
	3	Some positive impact on the environment
	4	High positive impact on the environment
	2. Economic	
<i>a. Impact on costs and efficiency of infrastructure users</i>	1	No positive impact on costs and efficiency of infrastructure users
Will the project result in lower costs for infrastructure users through lower tariffs or slower growth in tariffs, time savings, reduced operating costs?	2	Low positive impact on costs and efficiency of infrastructure users
	3	Moderate positive impact on costs and efficiency of infrastructure users
	4	High positive impact on costs and efficiency of infrastructure users
	<i>b. Impact on economic growth and employment</i>	1
Will the project facilitate expansion of industries (e.g., fisheries, agriculture, wholesale and retail, tourism)?	2	Low positive impact on economic growth
	3	Moderate positive impact on economic growth
	4	High positive impact on economic growth

Prioritisation criteria	Range of scores	Notes on scoring
<i>c. Maintenance of essential services</i>	1	No impact on maintaining essential economic infrastructure services
Is the project critical to maintaining essential economic infrastructure services?	2	Low impact on maintaining essential economic infrastructure services
	3	Moderate impact on maintaining essential economic infrastructure services
	4	High impact on maintaining essential economic infrastructure services
3. Social		
<i>a. Improved social services</i>	1	No positive impact on delivery of social services
Will the project facilitate improvements in the delivery of health and/or education services?	2	Low positive impact on delivery of social services
	3	Moderate positive impact on delivery of social services
	4	High positive impact on delivery of social services
<i>b. Service coverage</i>	1	No extension of social service coverage.
Will the project extend social service coverage to new areas and/or more people, or prevent loss of coverage?	2	Minor extension of social service coverage.
	3	Moderate extension of social service coverage.
	4	Major extension of social service coverage.
<i>c. Other social benefits</i>	1	No other social benefits.
Will the project have other social benefits for the community (e.g. improving the lives of women and children, assisting vulnerable/disadvantaged groups, alleviating poverty, responding to rural/urban drift, improving safety)?	2	Low level of other social benefits.
	3	Moderate level of other social benefits.
	4	High level of other social benefits.
4. Project Sustainability		
<i>a. Financial</i>	1	No capacity to meet operations and maintenance (O&M) costs (<10%).
Will the project be able to support the ongoing costs of operation and maintenance through user charges, among others?	2	Low capacity to meet O&M costs (10% to 49%).
	3	Moderate capacity to meet O&M costs (50% to 80%).
	4	High capacity to meet O&M costs (>80%).
<i>b. Technical</i>	1	Technology not appropriate.
Will the technology used in the project be appropriate and be able to be operated and maintained?	2	Significant issues with appropriateness of technology.
	3	Minor issues with appropriateness of technology.
	4	No issues with appropriateness of technology.
<i>c. Institutional</i>	1	Very weak institutional capacity.
Will the institution responsible for the project have sufficient capacity for implementation, operation and maintenance?	2	Low level of institutional capacity.
	3	Moderate level of institutional capacity.
	4	High level of institutional capacity.

3.3.5 Weighting methodology

As in the original TISIP 2011, equal weights were applied to the four major criteria in TISIP 2016–2025. These are as follows:

Climate Change/Environment	25%
Economic	25%
Social	25%
Project Sustainability	25%

3.4 Outcome of the Process

The prioritisation methodology was discussed with the staff of Planning, Budget, and Aid Coordination on 9 March 2016. A meeting of senior officials subsequently was held on 17 March 2016 to apply the prioritisation methodology to the scoring and ranking of projects on a draft basis. The draft was then presented on 7 July 2016 at a workshop of infrastructure sector stakeholders for review and finalisation.

The screening, scoring, and ranking process applied draws on that used in the original TISIP 2011, albeit with some simplification. While initial scores in TISIP 2011 were prepared by individuals and subsequently processed, in TISIP 2016–2025 scores were prepared on a consensus basis by an expert group. Table 7 compares the two processes.



Table 7. Comparison of Scoring and Ranking Processes

Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2011	Tuvalu Infrastructure Strategy and Investment Plan 2016–2025
Initial screening	Initial screening
Criteria selection (7 criteria, subdivided into 20 questions)	Criteria selection (4, each with 3 subcriteria)
Criteria weighted evenly	Criteria weighted evenly
Scoring using; modified Delphi Technique (individual scoring compiled into anonymous results).	Draft scoring by senior officials, with support from technical assistance team, by consensus (scores from 1 to 4).
Coordinated by TISIP Taskforce (Director from each of the infrastructure sectors; planning, economic, and Cabinet representatives; and two private sector representatives (Tuvalu Association of Nongovernmental Organisations, Chamber of Commerce)).	Criteria weights applied and criteria scores consolidated for each project into a score out of 100, enabling projects to be ranked.
Individual scoring by Taskforce members (scores from 1 to 4 for each of the 20 questions across the seven criteria).	Draft scores reviewed by July 2016 workshop of stakeholders (working in groups by major criteria, rather than by sector) to produce final priority ranking.
Group discussion to eliminate outliers.	Sequencing of projects based on funding and implementation capacity considerations.
Scores for the 20 questions were normalised into high, medium, and low bands (with a score of 3, 2, or 1 allocated accordingly) to avoid clustering.	Final review by Steering Committee.
Average score calculated for each criteria (given that there were differing numbers of questions per criteria)	
Scores by criteria were summed for each project, and projects ranked by the total score.	
Sanity check: review of scores and standard deviations in results (requiring some adjustment of results).	
Sequencing of projects based on funding and implementation capacity considerations.	
Issues identified with the scoring and ranking process included sector bias and inconsistencies in scoring, and the TISIP Taskforce made some changes in finalising the ranking of priority projects.	

Of the 23 projects included in the long list in Table 4, four were eliminated as a result of their requiring more clarification on their scope of work prior to being scored and ranked. This additional technical work is included in the list of measures that are complementary to the infrastructure investment plan (Section 4.2).

Nineteen projects were scored and ranked with the MCA approach. Figure 1 shows the total scores and Figure 2 provides their breakdown by major criteria group.

As noted above, the scoring process was undertaken in two rounds. Draft scores were prepared by a group of senior government officials who brought to the table knowledge of the projects from central and sector agency perspectives. These scores were subsequently reviewed at a consultation workshop with a larger group of stakeholders from the infrastructure sectors. Based on this review, adjustments were made to 25 from a total of 228 scores (i.e., 19 projects times 12 subcriteria scores for each project). This represents adjustment to 11% of the scores. While some changes in the rankings were made, overall, there was a high degree of consistency in the two rounds of scoring. The top-ranked project and the top 12 projects remained the same, despite some reorder within the group.

Figure 1. Project Prioritisation Results

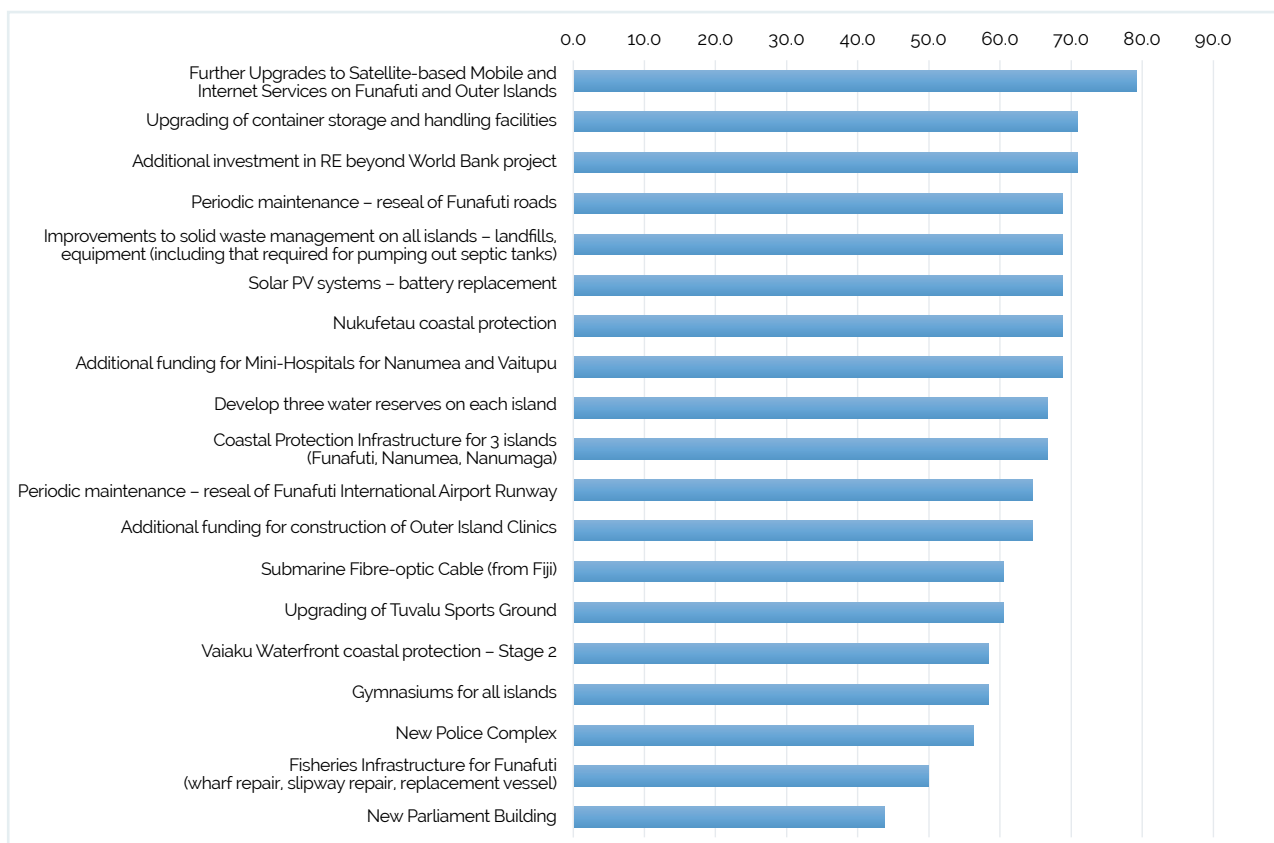
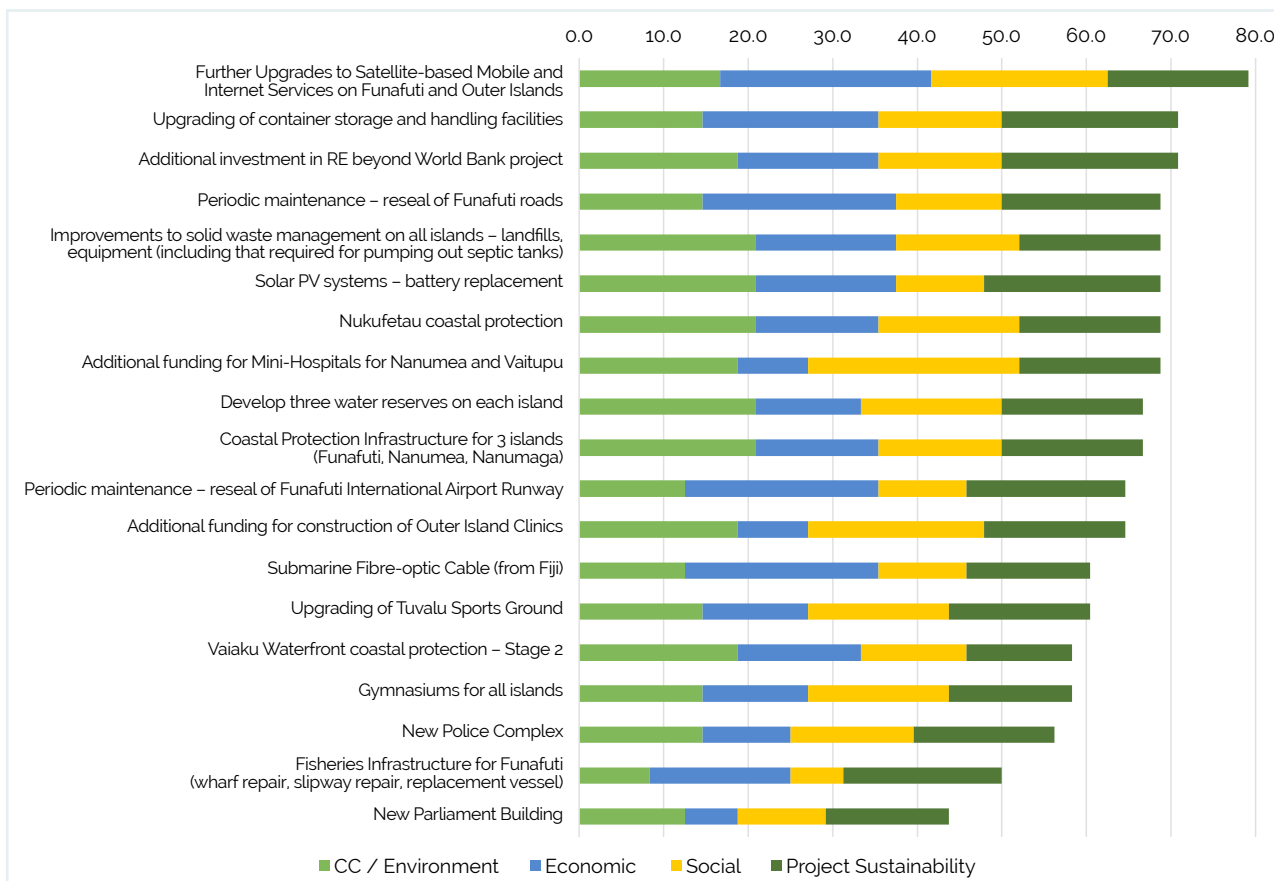


Figure 2. Project Prioritisation Results by Criteria Group



Twelve projects scored 65 or above out of 100 with the MCA approach. These are considered as projects of higher priority after taking into account implementation capacity and funding availability, and the requirements for ongoing and committed projects. Table 8 shows the highest ranked projects.

Table 8. Highest-Ranked Projects as a Result of the Multi-Criteria Analysis
(in millions of Australian dollars)

Sector reference.	Project	Estimated capital cost
TL	Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands	4.0
MT	Upgrading of container storage and handling facilities	1.2
EN	Additional investment in renewable energy beyond World Bank project	13.0
LT	Periodic maintenance: reseal of Funafuti roads	9.0
WM	Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)	7.5
EN	Solar photovoltaic systems: battery replacement	12.0
CP	Nukufetau coastal protection	1.0
HE	Additional funding for mini-hospitals on Nanumea and Vaitupu	1.5
WS	Develop three water reserves on each island	8.4
CP	Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)	42.0
AT	Periodic maintenance: reseal of Funafuti International Airport runway	13.0
HE	Additional funding for construction of Outer Island clinics	0.5

The 12 projects are spread across nine sectors. Three projects are located on Funafuti (two of which are of significance to the nation as a whole), while nine involve one or more Outer Islands.

Figure 3 demonstrates the priority of new investments in terms of their location in Tuvalu. Figure 4 illustrates their sectoral composition.

Figure 3. Location of Priority New Investments
(by estimated capital cost)

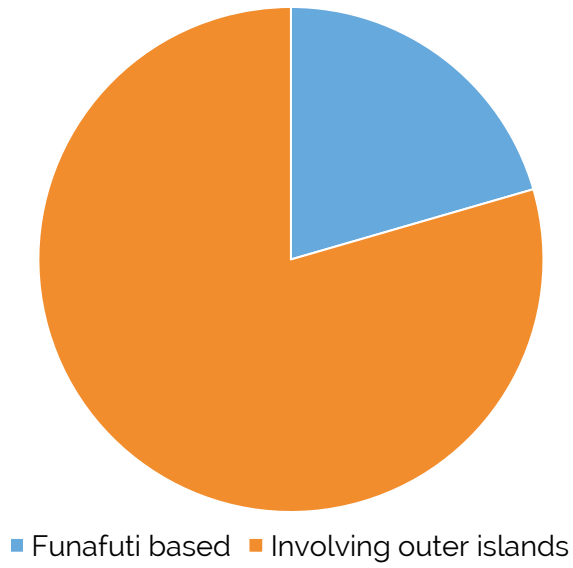
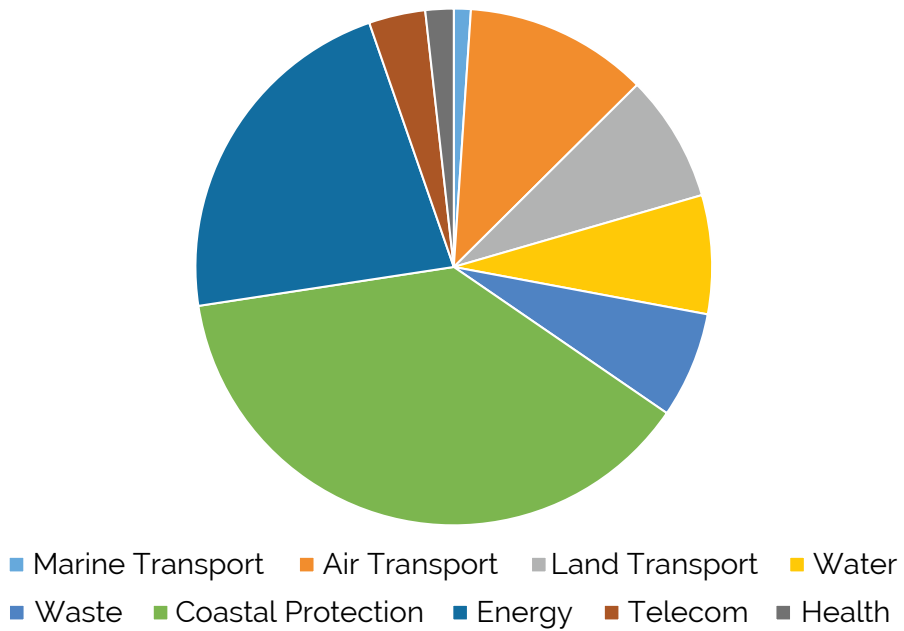


Figure 4. Sectoral Composition of Priority New Investments
(by estimated capital cost)



Further projects that were included in the prioritisation exercise which could be considered in future updates of the investment plan are listed in Table 9.

Table 9. Other Projects Included in the Prioritisation Exercise
(in millions of Australian dollars)

Sector reference	Project	Estimated capital cost
TL	Submarine fibre-optic cable (from Fiji)	33.0
ED	Upgrading of Tuvalu sports ground	TBD
CP	Vaiaku waterfront coastal protection: Stage 2	4.0
ED	Gymnasiums for all islands	TBD
GB	New police complex	0.5
MT	Fisheries infrastructure for Funafuti: wharf repair, slipway repair, replacement vessel	10.0
GB	New Parliament House	5.4



4 Prioritised Infrastructure Investment Plan

4.1 Prioritisation and Sequencing of Investments

TISIP 2011 developed an infrastructure investment plan that took into account funding estimates. The plan included an investment of A\$15.1 million per annum over 10 years, with A\$7.3 million per annum as new capital expenditure and the balance representing the cost of operation and maintenance of new infrastructure (GOT, 2012:55 No.250).

TISIP 2016–2025 includes a higher level of investment, totalling approximately A\$213 million over 10 years (i.e. A\$21.3 million per annum, on average), given that the plan covers various additional sectors that are preeminent in TKIII. The investment includes ongoing projects for 2016, those for which funding is already committed, and those proposed that have been ranked as high priority.³ Provision is made for the climate proofing of new assets (Section 7.2) and allowances are included for the whole of life costing of projects, including design, contingencies, and incremental maintenance requirements. Furthermore, almost a quarter of those proposed infrastructure investments for the 2016–25 period relate to coastal protection works for which previously untapped sources of climate change adaptation funding are being sought.

Table 10 reflects a potential sequencing of investments under the Tuvalu Infrastructure Strategy and Investment Plan (TISIP) 2016–2025. The state of development of some projects in the investment plan (i.e., those that remain at the conceptual stage) indicates that the inclusion of particular projects in the plan should not be interpreted as having been formally approved or endorsed by the Government of Tuvalu. It is essential that every project follow established government processes for project approval, and be subject to a feasibility study, cost benefit analysis, and environmental impact assessment, among others, prior to implementation. Table 10 includes an allowance for annual infrastructure maintenance costs equal to an estimated average of 2% of the capital cost for all projects. While the actual maintenance costs expressed as a percentage of project capital cost are expected to vary for different projects over a broad range of 1% to 4%, project designs have not progressed sufficiently at the time of writing this report to allow for accurate estimates of maintenance costs.

As such, the major contribution of TISIP 2016–2025 is the strengthening of the government's infrastructure investment proposal pipeline and the diligent project preparation, appraisal, prioritisation, and sequencing of investments. Sector ministries and central agencies will consider the pipeline in terms of the annual Budget⁴ and by central agencies in appraising submissions, thereby improving linkages between the investment planning and annual budgeting processes. TISIP 2016–2025 provides a mechanism that links the investment plan to the development of the Asset Management Framework, establishing a more systematic method to identify the maintenance requirements and investment needs for replacing, upgrading, and adding capacity to the infrastructure asset inventory.

³ Table 8 lists the proposed projects that are considered high priority, based on the Multi-Criteria Analysis approach.

⁴ As noted elsewhere in this document, a number of the proposed projects under consideration in the investment plan require further feasibility work prior to funding eligibility.

Table 10. Potential Sequencing of Investments
(in millions of Australian dollars)

Ref.	Sector/Project	Status	Est. Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Maritime Transport													
MT 1	Outer island maritime infrastructure project	Committed	17.0		5.0	5.0	5.0	2.0					
MT 2	Upgrading of container storage and handling facilities	Proposed	1.2		1.2								
Air Transport													
AT 1	World Bank Aviation Investment Program - Tuvalu	Ongoing	27.4	1.0	1.0								
AT 2	Periodic maintenance – reseal of Funafuti International Airport Runway	Proposed	13.0										13.0
Land Transport													
LT 1	Periodic maintenance – reseal of Funafuti roads	Proposed	9.0										9.0
Water and Sanitation													
WS 1	Falevatie phase II	Ongoing	0.8	0.8									
WS 2	Develop three water reserves on each island	Proposed	8.4			4.1	4.1						
Waste Management													
WM 1	Transfer and recycling station Phase 1 and 2	Committed	0.7	0.4	0.3								
WM 2	Improvements to solid waste management on all islands – landfills, equipment (including that required for pumping out septic tanks)	Proposed	7.5			2.5	2.5	2.5					
Energy													
EN 1	EU renewable energy	Ongoing	2.0	2.0									
EN 2	World Bank energy sector development project	Committed	12.0		3.0	3.0	3.0	3.0					
EN 3	Biogas project	Committed	0.4	0.4									
EN 4	Additional investment in RE beyond World Bank project	Proposed	13.0						6.5	6.5			
EN 5	Solar PV systems – battery replacement	Proposed	12.0								2.0	4.0	6.0

■ Ongoing

■ Committed

■ Proposed

Ref.	Sector/Project	Status	Est. Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Telecommunications												
TL 1	Further Upgrades to Satellite-based Mobile and Internet Services on Funafuti and Outer Islands	Proposed	4.0		2.0	2.0							
	Coastal Protection												
CP 1	Vaiaku Waterfront Recreation Reserve	Ongoing	3.8	0.7									
CP 2	Nukufetau Coastal Protection	Proposed	1.0		1.0								
CP 3	Coastal Protection Infrastructure for 3 islands (Funafuti, Nanumea, Nanumaga)	Proposed	42.3				3.0	8.0	9.0	11.0	11.3		
	Multi-sector												
MS 1	Outer Islands projects	Committed	2.9	2.9									
	Education												
ED 1	Nauti Primary School (12 classrooms)	Committed	4.1	1.8	2.3								
ED 2	Nanumea and Nukufetau Classrooms	Committed	2.6	2.6									
	Health												
HE 1	PMH renovation	Committed	1.2	1.2									
HE 2	Mini-Hospitals for Nanumea and Vaitupu	Committed	0.5	0.5									
HE 3	Outer Islands clinics	Committed	1.0	0.2									
HE 4	Additional funding for Mini-Hospitals for Nanumea and Vaitupu	Proposed	1.5		1.5								
HE 5	Additional funding for construction of Outer Island Clinics	Proposed	0.5		0.5								
	Other Government Buildings												
GB 1	New office for Fisheries Department	Committed	5.0	1.0	2.0	2.0							
GB 2	Renovation of Government complex	Committed	2.0	2.0									
GB 3	Pacific Islands Forum housing	Committed	3.1	3.1									
GB 4	New class B housing	Committed	0.8	0.8									
	Allowance for design and supervision, and contingencies, for proposed projects (20% of capex)				1.2	0.9	1.3	2.9	3.1	3.5	2.7	0.8	5.6
	Allowance for maintenance (average of 2% of all capex cumulative)			0.4	0.8	1.2	1.5	1.9	2.2	2.5	2.8	2.9	3.4
				21.8	21.9	20.7	20.5	20.3	20.8	23.5	18.7	7.7	37.0

■ Ongoing ■ Committed ■ Proposed

Note: The estimated capital costs in Column 4 of the table represent the total cost of each project, while the costs programmed over the 2016–25 period cover only the projected expenditure in these years.

Table 11 sets out the potential funding modalities for the 12 proposed priority projects that have been identified in TISIP 2016–2025.

Table 11. Potential Funding Modalities for Proposed Priority Projects
(in millions of Australian dollars)

Project	Sector	Estimated capital cost	Funding modality
Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands	Telecommunications	4.0	Public enterprise/ Development partner
Upgrade of container storage and handling facilities	Maritime Transportation	1.2	Government of Tuvalu
Additional investment in renewable energy beyond World Bank project	Energy	13.0	Public enterprise/ Development partner
Periodic maintenance: reseal of Funafuti roads	Land Transportation	9.0	Government of Tuvalu/ Development partner
Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)	Waste Management	7.5	Development partner
Solar photovoltaic systems: battery replacement	Energy	12.0	Public enterprise/ Development partner
Nukufetau coastal protection	Coastal Protection	1.0	Government of Tuvalu/ climate change adaptation funding
Additional funding for mini-hospitals in Nanumea and Vaitupu	Health	1.5	Government of Tuvalu
Development of three water reserves on each island	Water and Sanitation	8.4	Government of Tuvalu/ Development partner
Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)	Coastal Protection	42.0	Climate change adaptation funding
Periodic maintenance: reseal of Funafuti International Airport runway	Air Transportation	13.0	Government of Tuvalu/ Development partner
Additional funding for construction of Outer Island clinics	Health	0.5	Government of Tuvalu

4.2 Complementary Measures

The following measures were identified as complementary to the infrastructure investment plan set out in TISIP 2016–2025. The completion of these could assist in identifying projects for consideration in future updates once the feasibility studies are completed.

- condition assessments of complex assets (e.g., ships and coastal protection structures);
- development of a national building code, technical specifications, and construction standards
- technical assessment of those options that provide for the mooring of buoys for inter-island vessels in the Outer Islands;
- feasibility study relating to the relocation of Funafuti International Airport;
- study of options to reinstate domestic air services;
- feasibility study of the reticulated sewerage system in Funafuti; and
- feasibility study relating to a new high school in Nanumea.

Ongoing technical assistance is required to support the implementation of the Asset Management Framework in areas such as development of a national building code, technical specifications, and construction standards. These are essential to improve the climate change resiliency of various infrastructure assets.

It is anticipated that technical support will be necessary to perform a condition assessment of complex assets (e.g., ships and coastal protection structures). The cost of this assistance is estimated at A\$200,000.

4.3 Maintenance Implications of the Investment Plan

Table 12 estimates the maintenance implications of the TISIP 2016–2025 Plan. Calculations are made based on the end-date.



Table 12. Maintenance implications of Tuvalu Infrastructure Strategy and Investment Plan 2016–2025, Based on Plan End-Date
(in millions of Australian dollars)

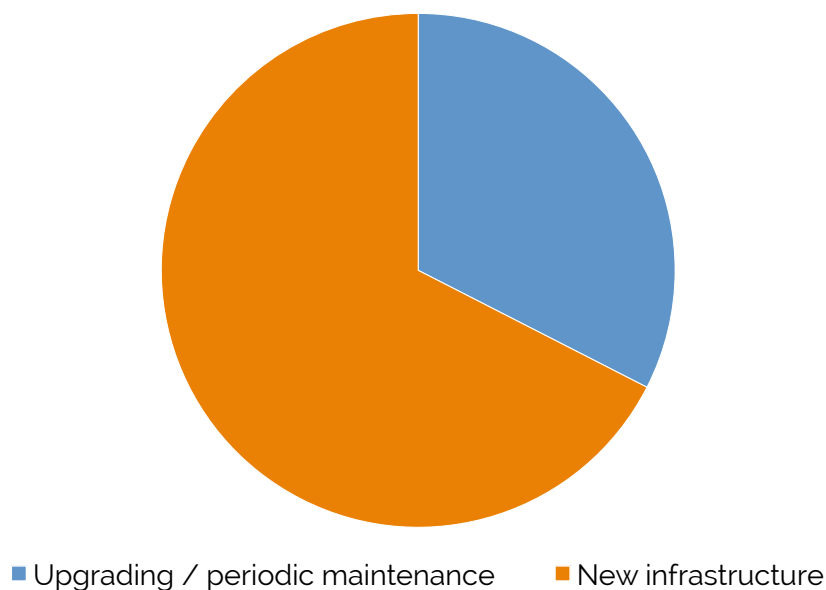
Ref.	Project	Funding status	Type of project Periodic maint. (PM) / Upgrading (U) / New (N)	Capex 2016-25 (\$m)	Maint. rate (per annum)	Est. annual maint. (\$m)	Capacity to self- fund maint.	Responsibility for maintenance
MT 1	Outer island maritime infrastructure project	Committed	N	17.0	2.0%	0.34	Low	GOT
MT 2	Upgrading of container storage and handling facilities	Proposed	U	1.2	2.0%	0.02	Moderate	GOT
AT 1	World Bank Aviation Investment Program - Tuvalu	Ongoing	PM	2.0	2.0%	0.04	Low	GOT
AT 2	Periodic maintenance – reseal of Funafuti International Airport Runway	Proposed	PM	13.0	2.0%	0.26	Low	GOT
LT 1	Periodic maintenance – reseal of Funafuti roads	Proposed	PM	9.0	2.0%	0.18	Low	GOT
WS 1	Falevatie phase II	Ongoing	N	0.8	2.0%	0.02	Low	Households
WS 2	Develop three water reserves on each island	Proposed	N	8.4	2.0%	0.17	Low	Kaupule
WM1	Recycling and transfer station Phase 1 and 2	Ongoing	N	0.7	2.0%	0.01	Moderate	GOT
WM 2	Improvements to solid waste management on all islands – landfills, equipment (including that required for pumping out septic tanks)	Proposed	U	7.5	2.0%	0.15	Low	GOT
EN 1	EU renewable energy	Ongoing	N	2.0	2.0%	0.04	Moderate	PE
EN 2	World Bank energy sector development project	Committed	N	12.0	2.0%	0.24	Moderate	PE
EN 3	Biogas project	Committed	N	0.4	2.0%	0.01	Low	GOT
EN 4	Additional investment in RE beyond World Bank project	Proposed	N	13.0	2.0%	0.26	Moderate	PE

Ref.	Project	Funding status	Type of project Periodic maint. (PM) / Upgrading (U) / New (N)	Capex 2016-25 (\$m)	Maint. rate (per annum)	Est. annual maint. (\$m)	Capacity to self- fund maint.	Responsibility for maintenance
EN 5	Solar PV systems – battery replacement	Proposed	PM	12.0	2.0%	0.24	Moderate	PE
TL 1	Further Upgrades to Satellite-based Mobile and Internet Services on Funafuti and Outer Islands	Proposed	U	4.0	2.0%	0.08	Moderate	PE
CP 1	Vaiaku Waterfront Recreation Reserve	Ongoing	N	0.7	2.0%	0.01	Low	GOT
CP 2	Nukufetau Coastal Protection	Proposed	N	1.0	2.0%	0.02	Low	Kaupule
CP 3	Coastal Protection Infrastructure for 3 islands (Funafuti, Nanumea, Nanumaga)	Proposed	N	42.3	2.0%	0.85	Low	Kaupule
MS 1	Outer islands projects	Committed	N	2.9	2.0%	0.06	Low	Kaupule
ED 1	Nauti Primary School	Committed	U	1.8	2.0%	0.04	Low	GOT
ED 2	Nanumea and Nukufetau Classrooms	Committed	N	2.6	2.0%	0.05	Low	GOT
HE 1	PMH renovation	Committed	U	1.2	2.0%	0.02	Low	GOT
HE 2	Mini-Hospitals for Nanumea and Vaitupu	Committed	N	0.5	2.0%	0.01	Low	GOT
HE 3	Outer Islands clinics	Committed	U	1.0	2.0%	0.02	Low	GOT
HE 4	Additional funding for Mini-Hospitals for Nanumea and Vaitupu	Proposed	N	1.5	2.0%	0.03	Low	GOT
HE 5	Additional funding for construction of Outer Island Clinics	Proposed	U	0.5	2.0%	0.01	Low	GOT
GB 1	New office for Fisheries Department	Committed	N	5.0	2.0%	0.10	Low	GOT
GB 2	Renovation of Government complex	Committed	U	2.0	2.0%	0.04	Low	GOT
GB 3	Pacific Islands Forum housing	Committed	N	3.1	2.0%	0.06	Low	GOT
GB 4	New class B housing	Committed	N	0.8	2.0%	0.02	Low	GOT
						3.40		

Notes: GOT = Government of Tuvalu; PE = public enterprise.

The total increase in annual maintenance requirements from plan implementation to the end-date of 2025 is estimated at A\$3.4 million. The projects classified above involve investment in new infrastructure, upgrading of infrastructure, and periodic maintenance of infrastructure. For investments that involve new infrastructure (Figure 5), maintenance requirements represent additions to the maintenance task. For investments involving the upgrade or periodic maintenance of existing infrastructure, however, additional maintenance requirements will be offset to a greater or lesser extent by savings relating to the existing level of maintenance spending (i.e., assuming that some maintenance is being undertaken). Analysis of this data reveals that 60% of TISIP 2016–2025 projects by number and 67% by value (i.e., by capital cost) represent new investment, while the balance represents the upgrade or periodic maintenance of existing infrastructure.

Figure 5. Proportion of New Infrastructure in Investment Plan
(by estimated capital cost)



The updated TISIP projects are classified as having high, moderate, or low capacity to self-fund maintenance. Analysis of the data reveals that no TISIP 2016–2025 projects exhibit a high capacity to self-fund maintenance, 23% by number and 26% by value exhibit moderate capacity, and 77% by number and 74% by value exhibit low capacity. For those projects exhibiting a moderate capacity, cost recovery should assist in addressing the maintenance task.

Finally, TISIP 2016–2025 projects are classified by the institution responsible for maintenance. An analysis reveals that the Government of Tuvalu will be responsible for the maintenance of 67% of projects by number and 42% by value, Kaupule for 13% by number and 32% by value, public enterprises for 17% by number and 25% by value, with households also bearing some responsibility, albeit minimal. A more complete picture of asset maintenance requirements and responsibilities will emerge once the Asset Management Framework is operational.

5 Funding Considerations

5.1 Government

Table 13 provides a summary of government finance in accordance with the medium-term fiscal framework published with the annual Budget. Domestic revenues, including distribution from the Tuvalu Trust Fund, are sufficient to meet recurrent expenditures. Nonrecurrent expenditures, however—including the Special Development Expenditure (SDE) category and transfers to the Tuvalu Trust Fund⁵—result in a significant domestic funding gap, financed by budget support and other recurring assistance from development partners. An overall budget deficit of A\$6 million remains in the 2016 Budget, while a balance or an overall surplus is achieved in most years.

Table 13. Summary of Government Finance
(in millions of Australian dollars)

	2014 Actual	2015 Forecast	2016 Budget	2017 Projection	2018 Projection
Domestic revenue	39.5	43.6	54.6	50.9	48.8
<i>less: Recurrent expenditure</i>	35.9	38.2	46.0	46.5	47.3
Structural balance	3.6	5.5	8.6	4.4	1.5
<i>less: Non-recurrent expenditure</i>	4.7	12.2	26.2	10.0	10.0
Domestic funding gap	(1.1)	(6.8)	(17.6)	(5.6)	(8.5)
<i>Development assistance (recurrent and budget support)</i>	11.6	8.3	11.6	8.9	8.4
Budget surplus/deficit	10.6	1.5	(6.0)	3.3	(0.1)

Source: Government of Tuvalu 2016 National Budget and Medium-Term Fiscal Framework 2016–2018.

The SDE finances a significant amount of infrastructure investment, with approximately 85% of the A\$21.6 million allocation in the 2016 Budget earmarked for the infrastructure covered by this plan. Of this, an initial contribution of A\$5 million is designated for a new Tuvalu Climate Change and Disaster Survival Fund⁶ to address the impacts of climate change and natural hazards. SDE projections in the medium-term fiscal framework amount to A\$10 million in 2017 and 2018, respectively, while actual expenditure achieved over the period 2013–15 ranges from A\$3 million to A\$9 million.

A debt sustainability analysis, undertaken by the International Monetary Fund,⁷ concluded that Tuvalu is at high risk of debt distress, with fiscal sustainability under threat from increases in the public expenditure financed by foreign grants. Public and publicly guaranteed debt stood at A\$US14.6 million (i.e., 41% of gross domestic product) at the end of 2013. There are no proposals for new borrowings to finance infrastructure investments, given that bilateral development partners and multilateral finance institutions currently provide grant finance for these investments.

⁵ Transfers to the Tuvalu Trust Fund are a means of banking higher-than-average revenues from sources such as the licensing of foreign fishing fleets.

⁶ The fund is established under the Climate Change and Disaster Survival Fund Act 2015.

⁷ Tuvalu—Staff Report for the 2014 Article IV Consultation: Debt Sustainability Analysis.

5.2 Public Utilities

There are two public enterprises involved in the development of infrastructure and provision of infrastructure services in Tuvalu. These are the Tuvalu Electricity Corporation (TEC) and the Tuvalu Telecommunications Corporation (TTC).

TEC is undergoing significant change in its mode of operation, with renewable energy sources—solar photovoltaic systems, in particular—becoming increasingly important. This change is not yet reflected in financial results, with a small loss (i.e., net loss after tax of just over A\$50,000) being recorded in 2014, despite receipt of a grant for fuel from the Government of Japan approaching A\$1 million. At that point, TEC's fuel costs, alone, exceeded the value of its electricity sales. The audit report on TEC's financial statements for 2014 denotes that working capital and shareholder funds were negative at December 2014. Projections (ADB, 2015) indicate that lower expenditure on fuel, as a result of the expansion of solar generation, will move TEC from a net loss to a situation of modest net profit (prior to any subsidies and grants) by 2017.

TTC incurred losses in 2013 and 2014 of approximately A\$186,000 and A\$124,000, respectively. Shareholder funds were negative at the end of 2013, although they amounted to just over A\$400,000 at the end of 2014, following an injection of funding by the government to repay debt to the National Bank of Tuvalu.

A process is in place for the government to fund the community service obligations of both public enterprises. It is important that this process is fully maintained.

Neither TEC nor TTC is in a position to fund major capital expenditures. TEC should be in a position to fully fund routine maintenance—at least from 2017 when the impact of expansion of solar generation begins to flow through into financial results. More expensive periodic maintenance is likely to continue to require external assistance. TTC continues to record losses and, therefore, is not in a position to fully fund routine or periodic maintenance.

5.3 Development Partners

Tuvalu receives assistance from a broad range of development partners, some of which involves investment in infrastructure. Development assistance received in recent years, in relation to infrastructure investment, is summarised below.

Australia's bilateral assistance to Tuvalu is budgeted at A\$6.6 million for financial year 2015/16, while the total level of official development assistance to Tuvalu in that year is valued at A\$10.2 million. The program focuses on three objectives: good governance, economic growth and stability; education and human resources; and environment and climate change. Support for investment in infrastructure has included the project underway to rebuild Nauti Primary School and support for long-term recovery efforts following Tropical Cyclone Pam.

New Zealand's bilateral assistance to Tuvalu is budgeted at NZ\$3.6 million for financial year 2015/16, with other funding in that year valued at NZ\$11.4 million. Major infrastructure projects, supported by New Zealand in recent years, have included renewable energy (i.e., solar photovoltaic systems for five islands at a total cost of NZ\$20 million) and reversing environmental damage caused by the borrow pits from airfield construction in World War II at a total cost of NZ\$12 million, while a new fisheries complex is in the pipeline at a total cost of NZ\$5 million.

The European Union allocated €5.4 million to Tuvalu under its 10th European Development Fund, with focal sectors being water, sanitation, and waste management. In addition, it allocated €2.25 million for renewable energy (i.e., solar photovoltaic systems for three islands and a biogas project). Under the 11th European Development Fund, it allocated €6.8 million for investments in the Waste sector, the program for which is being developed.

The development assistance to Tuvalu by the Government of Japan focuses on the following priority areas: environment/climate change (including long-term research, short-term measures such as structures, and solid waste management) and overcoming vulnerability (including support for education, health, maintenance of infrastructure with emphasis on maritime transport infrastructure, and fisheries). Major infrastructure projects supported by the Government of Japan in recent years have included the improvement of educational facilities at Motofoua Secondary School, improvement of the medium-wave radio broadcasting network, renovation of Princess Margaret Hospital, desalination and solar power generation, rehabilitation of TEC's diesel generation system, eco-technological management of Tuvalu against sea level rise (now completed), and provision of the Nivaga III vessel. Ongoing regional projects are those for introduction of a hybrid power generation system and for pilot gravel beach nourishment.

The Government of Taipei, China is currently providing US\$6.5 million per annum in budgetary support. This is in addition to a range of technical assistance initiatives.

The Asian Development Bank is preparing an Outer Island maritime infrastructure project for US\$12.4 million. This will also involve grant finance.

The World Bank is providing grants for major infrastructure projects, such as the Tuvalu component of the Pacific Aviation Investment Program (US\$20.8 million, including additional financing to reseal Funafuti's roads). It is also currently developing a renewable energy project (US\$9.1 million).

5.4 Finance for Climate Change Adaptation

5.4.1 Tuvalu's climate change policy

Climate change issues have been mainstreamed into other key sectors since TISIP 2011. Cross-sectoral linkages are now better understood and multisectoral infrastructure investments are being designed to reduce vulnerability and increase the resilience of infrastructure in order to improve community living standards, quality of life, and environmental health.

Tuvalu's new development and climate change policies reflect this approach. Climate change is mainstreamed into all sectors of the new development policy. Priority is given to coastal protection on Funafuti and the Outer Islands to increase resilience and to promote sustainability.

The development and application of an Asset Management Framework provides a useful tool to identify assets that are most vulnerable to climate change events. It also serves to propose climate-proofing measures to be included in financial assistance programs.

Several catastrophic climate change events have occurred in Tuvalu since 2012. These present a challenge to the resilience of local infrastructure and the preparedness of the government, local Kaupule councils, and residents on the Outer Islands. Tropical Cyclone Pam resulted in more than A\$10 million in damage to Tuvalu and its islands in March 2015. Most islands experienced wave overtopping, with powerful waves moving coastal features inland.

5.4.2 Climate change financing: developments

Tuvalu's Climate Change and Development Policies have been updated to include the Paris Agreement which falls within the 21st Conference of the Parties (COP21) of the United Nations Framework on the Convention on Climate Change. Climate change financing mechanisms were strengthened to fund innovative solutions to increase resilience and reduce the risk of economic, social, and environmental loss to catastrophic climate change events. TKIII incorporates this policy shift with Climate Change and Disaster Risk Reduction highlighted as a central theme for government policy in all sectors including Infrastructure.

The Government of Tuvalu (GOT) has made some organisational changes to reflect the new emphasis on climate change adaptation and mitigation and disaster risk reduction. The Climate Change Unit and the Disaster Risk Reduction Unit are now under the Office of the Prime Minister. Established institutional arrangements under the Office of the Prime Minister and the Ministry of Foreign Affairs, which includes the Environment Unit, can facilitate access to multilateral funds.

The Paris Agreement is a key driver for climate financing in Tuvalu. More than 175 countries ratified the agreement to facilitate funding for Climate Change Adaptation, including climate proofing of core infrastructure investments. Direct access to the Adaptation Fund (AF), the Global Environment Facility, and the Green Climate Fund (GCF) is provided for in the agreement, although this access must be preceded by an accreditation process.

The GOT was instrumental in securing the inclusion of Article 8 on Loss and Damage. This will ensure a rapid response to climate change disasters with international support. The establishment of climate pooling and risk-sharing insurance should lead to more cofinancing by bilateral and multilateral donors. Signatories have pledged to reach a goal of US\$100 billion per annum for mitigation and adaptation projects, while significantly increasing adaptation finance from current levels, and to further provide appropriate technology and capacity-building support.

5.4.3 Tuvalu Climate Change and Disaster Survival Fund Act 2015

The Tuvalu Survival Fund was established in 2016 with an initial contribution by the government of A\$5 million. Its aim is to channel climate change and disaster risk reduction contributions through one fund. This fund provides a reserve to enable rapid response for emergency assistance in evacuating residents—if necessary—providing food and temporary housing, and rebuilding damaged infrastructure.

5.4.4 Bilateral donors

For the past decade, Australia, New Zealand, and Japan have been financing climate-change-related infrastructure projects to improve the resilience of infrastructure and communities to climate change events. They have been involved in supporting coastal protection and environmental management.

5.4.5 Multilateral and regional donors

Multilateral donors include the United Nations Development Programme and the European Union, both of which have offices in Fiji. The Pacific Community and the Secretariat of the Pacific Regional Environment Programme are regional organisations that have climate change programs and provide training. These agencies focus on capacity building by providing training in Tuvalu and the region.

5.4.6 Multilateral climate change funds

Multilateral funds for climate change investments and environmental protection are available under the GCF, AF, Least Developed Country Fund, Special Climate Change Fund, and Global Environment Facility. Accreditation to these funds is critical to secure direct access. Established institutional arrangements under the Office of the Prime Minister and the Ministry of Finance and Economic Planning can facilitate accessibility to these funds.

5.4.7 Implications for current and proposed projects

Recent and current spending on projects involved in climate proofing infrastructure in Tuvalu are estimated at a combined US\$150,000 to US\$5 million for each project. This does not include spending to repair damage caused by tropical cyclones and other natural hazards, which has been estimated at A\$6 million for immediate needs (Recovery and Vulnerability Reduction Plan 2015).

There are three potential sources of financing for adaptation measures. These comprise the GOT through capital expenses, bilateral and multilateral donors, and internationally dedicated climate change financing. Table 14 summarises the potential for accessing funding sources that provide financing for infrastructure investment.

There is a high potential for accessing the AF and the Global Environment Facility, as the former has designated the Ministry of Finance and Economic Planning as the National Implementing Agency. The GOT plans to submit a Funafuti Coastal Protection Project to the AF for climate proofing funding by June 2016.

Many of these funds are replenished on a rolling basis, so access may increase in the future. The focal point for access to these resources is through the Ministry of Finance and Economic Planning, supported by the Climate Change Coordination Unit and Disaster Risk Reduction Unit (both of which are in the Central Policy and Planning Unit, Office of the Prime Minister). Tuvalu also aims to achieve National Implementing Entity status, which would allow direct access and management of available international dedicated climate change financing (e.g., AF).

To help ensure that climate change adaptation and disaster risk management measures are fully integrated as part of the planning and implementation of infrastructure, more emphasis is required to integrate these measures into sector activities and objectives from the outset of negotiations of various country strategies and agreements between the GOT and financiers.

5.4.8 Current progress

Accreditation

The GOT is working to align climate change projects and activities with its laws and policies for Climate Change and Disaster Risk Reduction. Some legal and policy updates are needed, although in general, the GOT has followed through with its Climate Change and Disaster Risk Reduction Policy (2012) in terms of mainstreaming climate change activities into other sectors. This should facilitate the accreditation process with the international climate change funds (i.e., AF, GCF).

Donor coordination

Current government priorities for Coastal Protection will attract funds from different sources (Table 14) as risk sharing becomes attractive to donors, especially new ones such as the GCF. Establishing an operational funding window with GCF as cofinancier may provide a starting point.

Program Integration

The Climate Change and Disaster Risk Reduction Policy (2012) includes Infrastructure asset protection against climate change as one of its main goals. Investment in infrastructure planning, implementation, and climate proofing will involve collaboration between ministries and departments to reduce vulnerability and risk and increase the resilience of infrastructure assets.

Table 14. Climate Change Financing for Resilience, Adaptation, and Climate Proofing Measures for Current and Future Projects

Fund	Access	Comment
<p>Adaptation Fund (AF), Global Environment Facility and Green Climate Fund.</p> <p>(The AF and Global Environment Facility are Trust Funds managed by the World Bank in Washington, D.C., and have clear funding access guidelines. The AF is established to provide direct access while the Global Environment Facility requires an administrating partner, often the United Nations Development Programme).</p> <p>The Green Climate Fund, located in the Republic of Korea, so far, has funded one project in the Pacific, cofinanced with the Asian Development Bank.</p>	<p>Ministry of Finance and Economic Planning accreditation as National Implementing Entity (2015-2017).</p> <p>Technical assistance for AF accreditation process, provided by UN Environment.</p> <p>Government of Tuvalu is preparing accreditation documents and proposals.</p> <p>Government of Tuvalu seeks accreditation under same guidelines as the Adaptation Fund.</p>	<p>Eligible activities include institutional, community, and infrastructure vulnerability reduction measures. Potential source of future financing for coastal protection, climate proofing of infrastructure, and enabling environment improvements. Ministry of Finance and Economic Planning has been selected as the National Implementing Entity for AF grants, and is currently working to complete the accreditation process.</p> <p>A total budget of A\$42 million is being sought from the AF and Green Climate Fund.</p>
<p>New Zealand Official Development Assistance</p> <p>Tuvalu Survival Fund</p>	<p>Vaiaku waterfront recreation reserve</p> <p>Phase I completed 2015</p>	<p>The Vaiaku Waterfront Recreation Reserve Project in Tuvalu was funded under this program in conjunction with the filling in of 10 borrow pits. There are currently plans by the Government of Tuvalu to propose the Funafuti coastal protection project under this adaptation fund. This fund can be accessed through the Regional Pacific Adaptation to Climate Change Program.</p>
Asian Development Bank	Outer Island Maritime Infrastructure Project and infrastructure resilience activities	<p>Asian Development Bank has provided a number of technical assistance projects with regard to building climate change resilience in Tuvalu. This planned infrastructure will involve the construction of jetties and small harbours on three Outer Islands.</p> <p>Asian Development Bank resources available to Tuvalu under ADF12 (2017-20) include A\$0.92 million for disaster risk reduction. This can be used to support stand-alone disaster risk reduction projects and strengthen the disaster resilience of infrastructure investments (i.e., climate proofing).</p>
Australia	Australia funds a number of infrastructure programs in water supply and education.	The Australian Government is funding school construction. Climate change proofing for infrastructure will be integrated into the infrastructure support in water, sanitation, and school building construction projects.
World Bank	Transport, disaster risk reduction, renewable energy, telecommunications (planned)	The World Bank is providing grant funding through its Pacific Aviation Investment Program for airstrip and road paving, disaster risk reduction for damage from Tropical Cyclone Pam, and funding for renewable energy to 2020.
European Union	Renewable energy	The European Union can potentially provide adaptation funding through global and regional climate change support programs. (European Union Global Climate Change Alliance Project).
Japan International Cooperation Agency	Introduction of hybrid power generation Beach nourishment	Japan International Cooperation Agency has a regional program of support for hybrid power generation, which covers Tuvalu.

5.5 Finance for Maintenance

In recognition of the lack of attention to asset maintenance in recent decades, a Deferred Maintenance Fund was established in 2015. Deferred maintenance is defined as asset maintenance that was not performed when it should have been and has been put off or delayed for a future period. The Deferred Maintenance Fund is managed jointly by the Secretary for Public Utilities and Infrastructure and the Secretary for Finance and Economic Development (with quarterly reporting to the Development Coordination Committee and Cabinet). It covers the following assets:

- buildings
- ships and vessels
- infrastructure
- plant, machinery, and equipment
- information communications technology hardware (excluding laptops and computers)
- other fixed assets, excluding vehicles.

The Deferred Maintenance Fund is set up as an account within the Tuvalu Development Fund and receives an annual appropriation in the Budget, from which it received A\$500,000 in 2015. A similar amount was allocated in the 2016 Budget, although it does not appear to have been transferred to the Tuvalu Development Fund and has therefore lapsed⁸. The 2017 Budget includes an allocation of A\$300,000 to the fund.

Upon completion of the Asset Management Framework, the GOT will prepare a 10-year maintenance schedule for all assets with a purchase price greater than A\$20,000. This will identify critical and urgent maintenance that will be given priority under the fund.

The Deferred Maintenance Fund has a balance of A\$447,000 as of January 2017. In future years, it will be advantageous to include a statement of the receipts into and expenditures from the fund with annual Budget documentation, as well as with the annual financial statements that are only available with some time lag.

Routine maintenance is covered separately within the recurrent budgets of ministries, and was allocated a total of A\$1.6 million in 2016, which covers all GOT ministries, including those responsible for infrastructure. At present, it is difficult to judge the adequacy of this allocation, due to incomplete information on assets and their maintenance requirements. Preparation of an Asset Management Framework and plan is underway as an activity associated with the preparation of TISIP 2016–2025 (PRIF, undated). Once complete, this will provide more detailed information than is currently available on the historical cost, replacement value, and annual maintenance requirements of the current stock of infrastructure assets in Tuvalu.

The maintenance implications of the investment plan associated with TISIP 2016–2025 are addressed in Section 4.3. It will be appropriate to review and update these maintenance implications once the Asset Management Framework is complete and better information is available on maintenance requirements.

5.6 Summary

Finance for investment in infrastructure and maintenance of infrastructure is expected to originate from a combination of assistance from development partners and GOT funding. There are also emerging prospects of accessing a significant amount of international funding dedicated to climate change adaptation.

⁸ The Government of Tuvalu operates under cash basis accounting. Any unspent funds from a current year's budget allocation do not carry over to the next year. Unspent funds are therefore transferred from the deferred maintenance fund to the Tuvalu Development Fund to avoid them from lapsing.

It is difficult to quantify the level of funding likely to be available for infrastructure investment from these sources over the 10-year timeframe of TISIP 2016–2025. Though the bilateral programs of traditional donors have some predictability, the focal areas to be supported by these programs will vary over time. Other bilateral and multilateral development partners have less predictable levels of funding, and again, the sectoral focus of their assistance may change over time. Multilateral finance institutions are currently financing a significant level of infrastructure investment on a grant basis, although there is no certainty that this will continue. Access to international funding for climate change adaptation involves a significant amount of negotiation and planning. Furthermore, it should be kept in mind that funding is not independent of the quality of projects available for implementation. In other words, well prepared and viable projects are more likely to secure funding from the range of sources available.

The financial position of GOT is also subject to change, with implications for the resources available to finance infrastructure through the SDE category. Self-financing of major infrastructure investments by public enterprises and financing through GOT borrowing are unlikely to play any significant role in the foreseeable future.

The TISIP 2016–2025 assumes that an investment program at a level of just over A\$20 million per annum can be financed. The program includes ongoing and committed as well as proposed projects; allows for project costs beyond the estimated capital cost such as design cost, contingencies and annual maintenance; makes allowance for climate proofing; and includes projects to be financed by international climate change adaptation funding which is currently untapped. It is recommended that the TISIP 2016–2025 be further updated at regular intervals in order to adjust for new developments in terms of funding.



6 Implementation of the Tuvalu Infrastructure Strategy and Investment Plan

TISIP 2016–2025 recognises that, in addition to financing constraints, the investment plan is also faced with constraints in implementation capacity. These constraints relate to the construction industry (external and local); suppliers in Tuvalu and abroad; the capacity of the Government of Tuvalu (GOT) to plan, budget for, and supervise construction or supply contracts; and the capacity of funding agencies to deliver programs (often from afar in the case of Tuvalu).

6.1 Lessons Learned

A recent report (GOK, 2015) has identified lessons learned in Kiribati in monitoring and managing a large infrastructure development program that involves a range of funding agencies. This may have relevance in Tuvalu. The infrastructure development program in Kiribati has peaked at a scale that is double the national Budget and is triple the number of major projects normally in progress.

The lessons learned from Kiribati include the following:

- A national infrastructure plan that prioritises and sequences infrastructure investments has the potential to play an important role in reducing program bunching and inter-project issues, as well as to seek out linkages among sectors and projects.
- It is essential that there is central oversight and management of investment plans, including guidance in relation to the medium- and long-term strategies of individual infrastructure sectors and their linkages.
- It is essential to build capacity in sector planning for infrastructure sectors, either in line or central agencies (or both), and to strengthen sector coordination committees by ensuring that these have clear terms of reference and an adequate secretariat.
- Government should develop its own capacity to support the administration of complex projects, including those funded by international financial institutions.
- The project support team model for multiple output projects and the management contractor model for single output construction projects appear to work well, and they are preferred to the project management unit model at the line ministry level, which tends to be vulnerable to staff rotation, capacity, and performance issues.

A recent estimate (ADB, 2016) indicates that Tuvalu's annual capital spending on infrastructure is currently in the order of A\$20 million, of which approximately A\$3.5 million (or 18%) is managed through to delivery by the Public Works Department.

6.2 Future Role of the TISIP

Infrastructure planning in small island states is perhaps best served by strong sectoral planning processes that produce plans for each of the key infrastructure sectors. This is combined with a strong national planning and budgeting system to produce a comprehensive public sector investment program. The processes include a strong project appraisal capacity activity to vet the project proposals developed by line ministries, as well as sound asset management systems.

In such an ideal environment and recognising the shortage of planning capacity both in line and central agency in small island states, the preparation of a plan that combines infrastructure sectors and which occupy a niche between sectoral and national planning may not be considered a high priority in terms of public expenditure management.

In the case of Tuvalu, the coverage and quality of sector planning for the infrastructure sector is disparate. Some sectors have master plans that include future investment schemes, although not prioritised or costed and lacking the institutional mechanisms to monitor and update the plans. At the national level, TKIII provides significant overall guidance to infrastructure planning, although a comprehensive public sector investment program is lacking and project appraisal activity is given little attention. As such, a plan that brings together the infrastructure sectors, introduces sound and quantitative prioritisation methodology and develops a schedule for high priority investments required over the medium term, becomes essential.

With this in mind, the recommendation of TISIP 2011 to update the plan every two years remains valid. Updates constitute working documents that require a minimal cost to produce. Their focus should rest on the following priorities:

- maintain a pipeline of infrastructure investment projects;
- review priorities;
- improve the standard of project preparation and documentation;
- improve the project appraisal activity;
- develop training and capacity building programs; and
- link the investment plan to the development of the Asset Management Framework, and plan to provide a more systematic process to identify asset maintenance and investment needs for the replacement, upgrade, and addition of assets.

The implementation progress of TISIP 2011 was reviewed in 2013 and the TISIP 2016-2025 is the first TISIP update. Subject to Steering Committee agreement,⁹ it is recommended that future updates remain the responsibility of the Department of Planning, Budget, and Aid Coordination of the Ministry of Finance and Economic Planning. Based on the current workload and low resource capacity of the department, some technical support to prepare the updates is likely to be necessary from local and/or international sources.

Consideration should be given to shifting the focus of this work in due course from the preparation of a formal infrastructure investment plan to that of supporting an infrastructure maintenance and investment process. This would not only provide continuity and strengthen the link between the Asset Management Framework and the Public Sector Investment Program in the annual Budget, but it would have better prospects for ensuring that it is a sustained component of Tuvalu's planning and budget framework.

⁹ The Steering Committee is chaired by the Secretary of Public Utilities and Infrastructure.

6.3 Other Stakeholders

6.3.1 Private sector

The major private sector organisation in Tuvalu is the Tuvalu National Private Sector Organization, which was established in 2012 and combines the Chamber of Commerce and the former Tuvalu Private Sector Organization. The Tuvalu National Private Sector Organization currently has 50 members from an estimated 200 plus businesses in Tuvalu, and it aims to promote the interests, well-being, and growth of Tuvalu's private sector. The private sector takes a keen interest in the coverage and quality of infrastructure services as a major consumer of these services.

Private businesses involved in infrastructure provision include a major hardware supplier and a number of smaller suppliers; individuals involved in repair and maintenance of buildings, vehicles and machinery; and individuals engaged in smaller construction jobs. As indicated, most of these businesses are operated by individuals rather than companies. Larger buildings, civil works, and significant maintenance works are handled either by the Public Works Department or foreign contractors.

Larger projects undertaken by foreign contractors often engage locally available skills, although these arrangements are more in the nature of employment than subcontracting. Tuvaluans based overseas are beginning to take an interest in bidding for work in Tuvalu, and, in a couple of instances, have registered construction companies locally.

6.3.2 Nongovernmental organisations

The Tuvalu Association of Nongovernmental Organisations (TANGO) is an umbrella institution for local nongovernment organisations (NGO) in Tuvalu. TANGO aims to support the sustainable development of these NGOs by providing training, services, and information, and by encouraging collaboration and communication among local NGOs, government, and international agencies. TANGO currently has 52 member organisations and, of relevance to infrastructure planning, it engages with communities in areas such as Coastal Protection, Water and Environment, and Waste Management projects. TANGO provides a focal point for the expression of community views on the coverage and quality of infrastructure services.

TANGO is a member of the National Advisory Council on Climate Change, which has contributed to the development of coastal protection and other infrastructure-related responses to climate change. TANGO is also engaged in programs funded by the European Union in Water Supply and in Sanitation and Waste Management, which involve some funding being channelled through NGOs.

7 Building Resilience into the Design and Planning of Infrastructure Investments

7.1 Climate Change and the Vulnerability of Infrastructure Assets

The International Panel on Climate Change explores vulnerability through three core concepts. These are, firstly, exposure or the magnitude to which a system is physically in harm's way; secondly, the sensitivity or criticality of a system (i.e., its likelihood to be affected by a shock); and thirdly, the adaptive capacity of a system to cope or adjust to the negative impacts.

Vulnerability is the degree to which a system is susceptible or unable to cope with adverse effects of climate change (IPCC, 2007). The main threats and impacts of climate change in Tuvalu are shown in Table 14.

The Infrastructure Asset Management project will propose measures to increase resilience and reduce vulnerability of assets. Resilience is the ability of a system to continue to operate after a catastrophic event.

Climate change events can cause catastrophic impact on land, especially near the coast, resulting in loss and damage to core public infrastructure assets. Losses from the wave overtopping of islands in Tuvalu caused by Tropical Cyclone Pam on 11–13 March 2015 were estimated at US\$10 million initially, with more than half the damage occurring on the Outer Islands where there is less infrastructure and more vulnerability to catastrophic climate events. This is because some of the islands have no lagoon, and infrastructure, such as electric cables and telephone lines, has been placed close to the shore.

Table 15. Main Climate Change Threats, Impacts Causing Loss and Damage to Assets, and Resilience Measures to Protect Them

Threat	Impact	Loss and damage	Resilience measures
1. Cyclone	Wind, trees falling, wave overtopping land (3–4 meter waves)	Buildings, roofs	Building codes enforced, stronger roofs
2. Storm surge	Flooding, erosion	Foundations, coastline	Elevate houses, building code, land reclamation
3. Sea level rise	Erosion, seepage	Coastline	Beach nourishment
4. Temperature	Health, asset failure	Roads, power transformers, generators, cables	Improved design specs, improved ventilation

7.2 Climate Proofing and Measures to Increase Resilience

Climate proofing measures to increase resilience of infrastructure to climate change events should be considered for all new infrastructure projects. An approach is outlined below and summarised in Table 15.

Table 16. Core Public Infrastructure Assets and Resilience Measures for Climate Proofing

Infrastructure assets	Design criteria to increase resilience	Maintenance measures	Standards	Strategies
1 New beach recreation and coastal protection areas created	Groynes Tetrapods to dampen waves and protect from erosion	Monitor erosion and land degradation Plant and replace trees	Coastal protection	Integrate program with collaboration between ministries
2 Seawalls	Geotextile bags	Monitor performance	Strong performance Minimize costs	Coordinate implementation
3 Buildings	More durable roof and foundations	Roof maintenance Leaks	Appropriate materials	Stronger materials
4 Public Infrastructure	Wharves, airstrip, roads Design for changing climate	Monitoring and preventative maintenance	Standards for asset management and climate change	Redesign airstrip: stronger base course, asphalt, better drainage
5 Telecommunications, (satellite dishes, cables)	Connectivity improved Backup systems Bandwidth adequate	Maintenance budget and requirements	Early warning system, Evacuation O3B or Kasifik satellite Backup systems	Greater bandwidth, more options, corrosion protection for towers
6 Power systems (diesel generators, solar panels, inverters, transmission and distribution lines)	Maintain backup Fasten solar panels Treat to reduce corrosion	Monitor and preventative maintenance	Standards for corrosion protection, Protective mounting	Corrosion protection for backup transformers
7 Transportation systems (airstrip, roads, wharf, boats)	Stronger pavement and base course	Boat maintenance records	Regular maintenance	Improve design and drainage
8 Water supply and sanitation (water storage tanks, septic tanks, trucks)	Septic tanks with floors Improved rainwater catchment and storage	Monitor water quality Water treatment	Beach nourishment Rainwater storage improvement, water conservation	Compost toilets where acceptable Redesign lower to the ground
9 Waste Management, (trucks, compactor)	Recycling plan Hazardous waste disposal	Sorting Compacting Deposit system for cans and glass bottles	Safety handling waste	Need for compactor and waste management system
10 Outer island assets (buildings, jetties, seawalls, roads, water tanks, vehicles)	Outer island needs (stronger houses, reliable water supply, safer boat landings)	Water supply	Flood protection	Anchor water tanks

7.2.1 Coastal protection projects and beach development

Several coastal protection projects have been proposed with no clear ownership or assigned responsibility for monitoring and maintenance of the coastal protection assets. These include new beach areas, seawalls, and jetties. More than 70,000 cubic meters (m³) of sand was dredged from the Funafuti lagoon in late 2013 at a cost of US\$1.4 million, creating a beach in front of the government building and Vaiaku Lagi Hotel to a length of 270 m and extending 100 m into the sea by December. In January 2014, 20 m was lost after Tropical Cyclone Ula and in February 2014, 10 m was lost. Groynes, made from large 2 m³ Geotextile bags filled with sand, are being constructed to increase the resilience of the asset. Erosion rates and turbidity will be closely monitored and further coastal protection structures will be installed if needed. These may include wave breaks.

Groynes were also used on a Beach Nourishment project, funded by the Japan International Cooperation Agency, where 4,500 m³ of sand was deposited along a 177 m stretch of coastline as a pilot project of between 2 m x 50 m (approximate) groynes (northern side: 51.4 m, southern side: 46.1 m) made of large boulders imported from Fiji at a cost of ¥200 million (i.e., approximately US\$2 million). Losses have been much less and the water turbidity has decreased.

7.2.2 Seawalls

Resilience measures need to be included in the design of seawalls to be established on Nukufetau Island to replace an 80 m, 20 year old seawall made from concrete blocks and gabions. Designs, using smaller sandbags, have been proposed for this US\$1 million project to protect a vulnerable area of coastline where the wave action causing shoreline erosion is strong.

7.2.3 Jetties and mini-harbours

The Asian Development Bank is funding the construction of jetties, forming mini-harbours, on three Outer Islands at a cost of US\$10 million. This will improve the safety of boat landings. Various design options are currently being examined to maximize resilience and asset life.

7.2.4 Buildings

Many government buildings have color-bonded roofs to protect them from corrosion. The GOT is seeking funding for a new Parliament House which will use climate proofing design. This includes aluminium or color-bonded roofs with windows treated with anti-corrosion coating. Metal parts need to be treated with the most cost-effective coatings. Studies have shown that corrosion rates will increase by up to 20% in the warm, humid climates of the Pacific region.

In Tuvalu, corrosion of steel is already a major problem. It reduces the life of core assets, including power transformers, telecommunications towers, and metal parts.

7.2.5 Airstrip and roads

The airstrip and roads were sealed in 2015. It appears, however, that no climate proofing considerations were included in the design. The base course is only 8 cm of crushed coral rock, surfaced with a 1–2 cm asphalt chip seal. The base course extends only 30 cm over the edge of the runway, so drainage may be inadequate. Cracks and soft spots have begun to appear on the runway. A higher grade of heat-tolerant asphalt should be used on the next seal. The runway has degraded from 50 tonnes of landing capacity in 1992 to 20 tonnes due to sea-water infiltration of the sub-base as a result, in part, to sea level rise. The recommended base course is 20 cm, with an asphalt layer of 10 cm to climate proof the airstrip.

Roads should also be monitored for damage from wave overtopping and inadequate drainage. Culverts should be designed to accommodate higher rainfall intensity. Failure was observed on a causeway where the concrete shoulder had collapsed from overtopping by sea water.

7.2.6 Telecommunications

It is essential that climate proofing measures be introduced to protect critical telecommunications assets. One of the legs at the base of a telecom tower collapsed during a recent cyclone, whereby the tower tilted and had to be supported with blocks. It has not yet been repaired. The TTC reported that phone lines on some of the islands were damaged, since they had been installed too close to the sea. Resilience measures for telecommunications equipment include anticorrosion treatment, stronger foundations to support the towers, and functioning backup equipment.

7.2.7 Waste management

An efficient waste management system increases the resilience of road and other assets to catastrophic events. Waste is collected twice a week and a beach clean-up is organised once a week. Tuvalu is not litter free, although papers and plastics are rapidly removed from the roads after an event and the airstrip is cleaned daily. Stones thrown onto the roads from wave overtopping are quickly removed. This vigilance ensures that failures in the road network and damage are controlled.

A new waste dump has been established at the north tip of Fongafale Island, filled with 3,000 tonnes of solid waste from the ten borrow pits that were filled in under a project funded by the Government of New Zealand. Much of the waste is non-biodegradable (e.g., plastics, electronic waste, steel) and could be segregated. An old incinerator burns medical waste at the site and a new one has been ordered.

The Solid Waste Agency of Tuvalu should consider introducing a recycling program for aluminium cans. The use of plastic bags should be discouraged. The agency plans to acquire a compactor to reduce the volume of the waste and to facilitate recycling. This will improve resilience to wave overtopping as the waste management system is developed.

7.2.8 Outer Island assets

Assets on the Outer Islands include buildings, communications equipment, jetties, seawalls, unsealed roads, water tanks and vehicles. These assets are vulnerable to wave overtopping, flooding, and high winds. Some water tanks were reported to have tipped over and been contaminated by sea water. Resilience measures include ensuring there are backup systems in place and that there is a supply of water that cannot be contaminated. The Emergency Warning and Disaster Risk Reduction systems can improve the resilience of these assets.

7.2.9 Issues and possible actions

Climate Change

Climate change threatens all assets, especially those that are critical and exposed. Cyclones are expected to become more intense and, combined with sea level rise, wave overtopping of roads is expected to occur more often with more damage to assets and risk to people.

Resilience

Climate proofing of assets is required to increase their resilience to catastrophic climate change events and reduce vulnerability. The cost of climate proofing should be estimated and included in future infrastructure projects.

Risk reduction

Resilience measures can reduce the risk of infrastructure failure after a catastrophic event relating to climate change, as well as increase donor confidence in infrastructure investments. Disaster risk reduction systems and access to the Tuvalu Survival Fund can ensure rapid response to catastrophic climate change events and increase the resilience of infrastructure assets. The GOT should include a section on risk management and climate proofing measures to increase resilience in future proposals for infrastructure project funding.

7.3 Cost Estimates for Climate Proofing TISIP 2016-2025 Projects

Eight of the 12 projects entering TISIP 2016–2015 as high priorities have been identified as having a significant need for climate proofing, and the incremental costs—which have been included in the estimated capital costs of the projects—are set out in Table 16. It should be noted that these incremental costs are broad estimates that can be refined as the projects are further developed. Further information on climate proofing options for these projects is provided in the project profiles in Appendix 2.

Table 17. Incremental Costs of Climate Proofing¹
(in millions of Australian dollars)

Reference	Project	Estimated capital cost including incremental cost	Climate proofing resilience measures	Incremental cost of climate proofing
TL 1	Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands	4.0	Reinforce foundations Anticorrosion treatment ²	0.2
MT 2	Upgrading of container storage and handling facilities	1.2	N/A	n.a.
EN 4	Additional investment in renewable energy beyond World Bank project	13.0	Nontoxic batteries Anticorrosion ³	1.0
LT 1	Periodic maintenance: reseal of Funafuti roads	9.0	Higher grade asphalt Improved Drainage	0.5
WM 1	Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)	7.5	Waste management plan, including hazardous waste and recycling program	1.0
EN 5	Solar photovoltaic systems: battery replacement	12.0	Nontoxic battery selection	0.5
CP 2	Nukufetau coastal protection	1.0	Resilient seawall design	0.2
HE 4	Additional funding for mini-hospitals on Nanumea and Vaitupu	1.5	N/A	n.a.
WS 2	Develop three water reserves on each island	8.4	N/A	n.a.
CP 3	Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)	42.0	Groynes jetties breakwaters Seawalls	5.0
AT 2	Periodic maintenance: reseal of Funafuti International Airport runway	13.0	Higher grade asphalt ⁴	3.0
HE 5	Additional funding for construction of Outer Island clinics	0.5	N/A	n.a.

Sources: Airport Runway Construction costs (see <http://www.fdot.gov/planning/Policy/To%20Delete/costs/Airports.pdf>); Waste management costs (see <http://siteresources.worldbank.org/INTUWM/Resources/340232-1208964677407/Cointreau.pdf>).

Note: N/A = not applicable.

¹ Estimates are in broad terms.

² Climate proofing is needed to reduce exposure of these critical assets by locating them as far as possible from the shoreline. Reinforced concrete support needed for towers along with anticorrosion treatment for metal parts to climate proof against increasing corrosion rates.

³ Lithium ion batteries dominate the market but are difficult to dispose of. Newer and cheaper flow batteries are being developed.

⁴ Polymer modified asphalt cement may be an option for climate proofing to increase the asphalt mixture's durability and resistance to rutting and thermal cracking.

Appendix 1: List of Consultations

Organisation	Name	Position
Government of Tuvalu	Hon. Enele Sopoaga	Prime Minister
Ministry of Finance and Economic Planning	Hon. Maatia Toafa	Minister
	Letasi Iulai	Permanent Secretary
	Niuatui Niuatui	Director, Department of Planning, Budget, and Aid Coordination
	Nuausala Nuausala	Economic Adviser, Department of Planning, Budget, and Aid Coordination
	Tusipese Morikao	Budget Adviser, Department of Planning, Budget, and Aid Coordination
	Sarah Moses	Budget Management Adviser, Department of Planning, Budget, and Aid Coordination
	Lototasi Morikao	Acting Assistant Secretary, Department of Planning, Budget, and Aid Coordination
	Seipua Scott	Financial Accountant, Treasury
	Lokeni Tehumu	Asset Register Officer, Treasury
	Savali Matio	Aid Coordination Unit
	Fenua T Peleti	Aid Coordination Unit
	Tepua Apelemo	Public Enterprise Reform and Monitoring Unit
	Climate Change Unit, Office of the Prime Minister	Pepetua Latasi
Sumeo Silo		Disaster Management
Jamie Ovia		Project Development Officer
Fafetai Namoto		Data and Information Officer
Loloma Homasi		Climate Change Policy Coordinator
Kate Morioka		Climate Change and Disaster Risk Reduction Advisor
Ministry of Communication and Transport	Taukave Poolo	Permanent Secretary
	Asela Peneueta	Assistant Secretary
	Telaulini Niuatui	Airport Manager
	Taula Katea	Director Meteorology
	Niko Iona	Meteorology Officer
	Elifaletai Ene	Meteorology
	Vasa Tuisiga	Shipping and Port Officer
	Tanielu Italeli	Assistant Director, Marine
	Dominic Legoe	Consultant, Outer Islands Maritime Infrastructure Project

Organisation	Name	Position
Ministry of Public Utilities and Infrastructures	Avafoa Irata	Permanent Secretary
	Kapuafe Lifuka	Director, Dept of Energy
	Charles Leepo	Architect, Public Works Dept.
	Tapuaki	Electrician, Public Works Dept.
	Fakalogo	Energy Technician, Dept. of Energy
Ministry of Education, Youth and Sports	Atabi Ewekia	Acting Permanent Secretary
	Peteli Paulo	National Quality Assurance Officer
	Kaai Fanoiga	School Supervisor
	Capt. Sione Paueli	Chief Executive Officer, Tuvalu Maritime Training Institute
Ministry of Health	Isaia Taape	Permanent Secretary
Ministry of Natural Resources	Faatasi Malologa	Director, Department of Lands and Survey
	Sam Finikaso	Department of Fisheries
	Garry Preston	Advisor, Department of Fisheries
Environment Unit, Ministry of Foreign Affairs, Environment, Trade, Tourism, and Labour	Mataio Tekinene	Director of Environment
	Faoliu Teakau	Environment Unit
	Moe Saitala	Environment Unit
Ministry of Home Affairs and Rural Development	Susana Telakau	Director of Solid Waste Agency of Tuvalu
	Temetiu Maliga	Director of Rural Development
Tuvalu Electricity Corporation	Mafalu Lotolua	General Manager
Tuvalu Telecommunications Corporation	Semeti Lopati	General Manager
	Anisi	Operations Manager
	Enileta Kausea	Financial Controller
Tuvalu National Private Sector Organization	Kitiona Tausi	Chief Executive Officer
Tuvalu Association of Non-Governmental Organizations	Tomu Hauma	Coordinator
	Roger Moresi	Vice-President
Asian Development Bank	Beatrice Olsson	Country Coordination Officer, Pacific Subregional Office
Department of Foreign Affairs and Trade	Lily-Anne Homasi	Senior Program Manager, Tuvalu
European Union	Ileana Miritescu	Attaché Infrastructure & Natural Resources
Japan International Cooperation Agency	Yumi Nakagawa	Pacific and Southeast Asia Division 6
New Zealand Ministry of Foreign Affairs and Trade	Howard Markland	Development Programme Manager
World Bank	Lucy Pan	Economist
Pacific Region Infrastructure Facility Coordination Office	Lorena Estigarribia	Technical Manager

Appendix 2: Profiles of High-Priority Projects

TISIP 2016-2025

PROJECT PROFILE

Project title:

Upgrading of container storage and handling facilities

TISIP Reference number:

MT 2

Location:

Funafuti

Responsible agency:

Ministry of Communication and Transport

Project description:

This project involves paving of additional areas at Funafuti port to facilitate the handling and storage of containers. These operations are carried out in a confined space, and the rough surfaces make operations of forklifts and other equipment difficult and dangerous. The project was identified as a priority in TISIP 2011, but remains outstanding.

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services. Maritime transport is identified as one of seven priority areas within infrastructure.

Links with corporate plan or sector plan:

None identified

Planned implementation period:

Start: 2017

End: 2017

Project cost:

Estimated capital cost: A\$1.2 million

Estimated annual maintenance cost: A\$24,000

Project benefits:

More efficient and safer port operations, resulting in time savings and less damage to cargo for users of port services and extended life of cargo handling equipment.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management:

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No

Project title:

Periodic maintenance: reseal of Funafuti International Airport runway

TISIP Reference number:

AT 2

Location:

Funafuti

Responsible agency:

Ministry of Communication and Transport

Project description:

This project involves the periodic maintenance of the airport runway reseal, completed in 2015 with funding from the World Bank under the Pacific Aviation Investment Program. It is estimated that a further reseal will be required after 10 years (in 2025).

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which stresses the need to maintain international air services. Air transport is one of seven priority areas identified within infrastructure. It is noted that TKIII supports the need for a feasibility study of a new international airport for Tuvalu (either on Funafuti or on Nukufetau), and the progress of that study should be monitored, included as a complementary measure in TISIP 2016-2025).

Links with corporate plan or sector plan:

None identified

Planned implementation period:

Start: 2025

End: 2025

Project cost:

Estimated capital cost: A\$13 million

Estimated annual maintenance cost: A\$260,000, not all incremental

Project benefits

Maintaining an essential service (international air services to Tuvalu)

Linkage with the Asset Management Framework.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 2

Climate proofing necessary (underline): Yes / No

Climate proofing options

Threat	Vulnerability	Loss and damage	Climate proofing resilience measures
1. High Temperatures	Rutting, cracks	Higher maintenance costs	More frequent resealing, temperature-tolerant asphalt
2. Storm surges	Wave overtopping	Ponding and potholes	Higher-grade asphalt
3. Sea level rise, king tides	Salt water intrusion	Undermining of base course, increased salt corrosion of asphalt layer	Higher-base course Add sub-base, if required, at next repaving
4. Cyclones	Safety, asset failure	Reduced life of airstrip	Improved design specifications More frequent inspection and maintenance to detect and repair damage caused by rutting, fatigue, and thermal cracks

Climate change threats

Higher temperatures and salt water intrusion are the main threats to the airport runway caused by climate change. Salt water intrusion has been observed with increasing frequency over the past 10 years. High temperatures have damaged the asphalt seal on the airstrip in 2016 with rutting and thermal cracking observed, despite the fact that the runway was completely resealed in 2015. Previous major reseals were in 1990 and 2000.

Climate proofing resilience measures

Regular maintenance will be needed to repair cracks and other damage to the tarmac.

Resealing with a thin surface coat may be needed every two to three years instead of every 10–15 years before climate change impacts become pronounced. Polymer modified cationic emulsified asphalt tack coat CQS-1HP has been used for runway resealing.

A complete reseal is estimated to be required in 2025. This could involve excavation, adding a base and sub-base course, compaction, and paving with a heat-resistant asphalt. Asphalt content can be reduced to a range between 4.8% and 5.2% to allow more voids in the mix and to produce a stiffer surface course at higher temperatures. Crushed trap rock aggregate at 100% has been used in the surface course mix with less asphalt cement content, resulting in a stiffer asphalt surface and less prone to shoving failure.

Project title:

Periodic maintenance: reseal of Funafuti roads

TISIP 2016-2025 Reference number:

LT 1

Location:

Funafuti

Responsible agency:

Ministry of Public Utilities and Infrastructures

Project description:

This project involves the periodic maintenance of the Funafuti roads resealing that was completed in 2015 with funding from the World Bank under the Pacific Aviation Investment Program. It is estimated that a further reseal will be required after 10 years (in 2025).

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which stresses the need to maintain infrastructure assets. Roads is identified as one of seven priority areas identified within infrastructure.

Links with corporate plan or sector plan:

None identified

Planned implementation period:

Start: 2025

End: 2025

Project cost:

Estimated capital cost: A\$9 million

Estimated annual maintenance cost: A\$180,000, not all incremental

Project benefits

Maintaining an essential service (roads within Funafuti).

Linkage with the Asset Management Framework.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 2

Climate proofing necessary (underline): Yes / No

Climate proofing options

Threat	Vulnerability	Loss and damage	Resilience measures
1. Cyclones	Flooding	Accelerated stone loss and surface oxidation	More frequent AC cold mix patch repairs
2. Storm surges	Flooding, erosion, ponding	Concrete failure on causeway	Cold mix surfacing, infill surface treatment
3. Sea level rise and king tides	Salt water intrusion Multiple depressions Surface oxidation	Base course undermined from seepage Potholes, depressions Aggregate stripping and raveling	Beach nourishment Waterproof reseal, reshape roads to improve drainage using cold mix asphalt
4. Temperatures	Melting asphalt and chip seal	Potholes, rutting, surface depressions, stone loss	Stronger chip seal and cold mix asphalt, maintenance

Climate change threats

Wave overtopping from higher storm surges and cyclones is the main threat to the roads caused by climate change. This includes the 15.5 kilometers of sealed roads on Funafuti atoll and the unsealed roads on the Outer Islands.

Temperature increase and salt water intrusion can undermine the sealed roads causing potholes and failure in the asphalt surface. Concrete repairs on a short causeway joining Funafuti to a neighbouring islet were damaged by storm surge and will need repair.

Traffic load is light with only three to five trucks and 30–40 motor scooters an hour on most days.

Climate proofing resilience measures

Road maintenance will be needed on an ongoing basis to repair potholes and cracks.

Resealing with a thin surface coat may be needed every 2–3 years instead of every 5–8 years before climate change impacts became pronounced.

A complete reseal is estimated to be required in 2025. This could involve excavation, adding a base and sub-base course, compaction, and paving with a heat-resistant asphalt. The elevation of the road could be raised 30–40 centimeters in some areas to reduce future damage from wave overtopping and king tides.

Project title:

Develop three water reserves on each island

TISIP 2016-2025 Reference number:

WS 2

Location:

Outer Islands

Responsible agency:

Ministry of Public Utilities and Infrastructures

Project description:

This project will establish three water reserves on each island to improve water security in times of drought, other natural hazards, and in response to climate change. The project is identified as a medium-term priority in the Recovery and Vulnerability Reduction Plan.

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which stresses the need to improve water security. Water and sanitation is one of seven priority areas identified within infrastructure.

Links with corporate plan or sector plan:

The project is consistent with the goals and strategies set out in Tuvalu's Sustainable and Integrated Water and Sanitation Policy 2012-2021 (Fakanofonofoga Mo Vai Mote Tumaa).

Planned implementation period:

Start: 2019

End: 2020

Project cost:

Estimated capital cost: A\$8.4 million

Estimated annual maintenance cost: A\$168,000

Project benefits

Maintaining an essential service (water security) in Outer Islands, particularly in times of drought, other natural hazards, and in response to climate change.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 4

Climate proofing necessary (underline): Yes / No

Climate proofing options

Threat	Vulnerability	Loss and damage	Resilience measures
1. Cyclones	Salt water intrusion	Plastic water tanks overturned	Anchor tanks, stronger concrete cisterns
2. Storm surges	Flooding, erosion	Plastic tank foundations damaged	Cisterns protected
3. Sea level and king tides	Wave overtopping, salt water intrusion	Coastline	Stronger cistern construction
4. Temperatures	Drought	Plastic tanks cracked, water supplies depleted	Larger cisterns needed

Climate change threats

This project will be designed to reduce the vulnerability of current water supply reserves on the Outer Islands. Currently, there is insufficient water storage in permanent cisterns. Plastic, above-ground water tanks can only last 5–10 years before cracking and cannot be repaired. Some were reported to have overturned during Tropical Cyclone Ula in December 2015 due to high winds. Long-term exposure to elevated temperatures could quite possibly result in stress cracking. Tanks with fiberglass reinforcement on the walls can deal with higher temperatures.

Climate proofing

Climate proofing measures are not required for this project if it is well designed with the location of new cisterns in protected areas away from high wave and wind threats.

Project title:

Improvements to solid waste management on all islands: landfills, equipment (including that required for pumping out septic tanks)

TISIP 2016-2025 Reference number:

WM 2

Location:

Funafuti and Outer Islands

Responsible agency:

Solid Waste Agency of Tuvalu

Project description:

This is a wide-ranging project to improve solid waste management on Funafuti and Outer Islands. It includes development of adequate landfills, arrangements for hazardous waste, recycling centres, and provision of equipment for rubbish collection, sorting, and processing of green waste.

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which places waste management among seven priority areas identified within infrastructure.

Links with corporate plan or sector plan:

The project links with the Tuvalu Integrated Solid Waste Plan, prepared in 2005. It is noted that waste management is identified as the focal sector for European Union assistance to Tuvalu under the 11th European Development Funding, which is currently being negotiated. The project also aligns with the soon-to-be-adopted National Waste Policy 2017-2026 and Integrated Waste Management Plan 2017-2021.

Planned implementation period:

Start: 2017
End: 2021

Project cost:

Estimated capital cost: A\$7.5 million
Estimated annual maintenance cost: A\$150,000

Project benefits

Improving environmental health in Tuvalu through improved waste management.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner (potentially)
Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 2
Climate proofing necessary (underline): Yes / No

Climate proofing options

Threat	Vulnerability	Loss and damage	Climate proofing resilience measures
1. Cyclones	Wave overtopping	Dump breached, loss of garbage to sea	Elevate the site
2. Storm surges	Salt water intrusion, flooding, erosion	Pits fill with water	Build up the site, line pits
3. Sea level and king tides	Salt water intrusion, erosion	Breach of dumpsite walls	Geotextile fabric liners
4. Temperatures	Health concerns, toxic waste	Fires and possible explosions of heated chemical waste	Separation of hazardous and toxic waste

Climate change threats

The waste management system is vulnerable to climate threats due to the low elevation of the site. Cyclones and storm surges along with sea level rise and king tides could cause salt water infiltration and breaching of the dump site.

Climate proofing measures

Climate proofing measures can include reinforcement of the pits. There is room at the site to construct new pits lined with geotextile fabric and a collection system for the liquids that filter through it. Layering can be used to stabilise the system and reduce health threats.

A waste management and monitoring plan can be developed to monitor salt water intrusion, to include a recycling program and system to collect, segregate, and dispose of hazardous waste.

Methane gas can be captured as a biogas and used to generate electricity, using household and other waste.

Project title:

Additional investment in renewable energy beyond World Bank project

TISIP 2016-2025 Reference number:

EN 4

Location:

Funafuti and Outer Islands

Responsible agency:

Tuvalu Electricity Corporation and Ministry of Public Utilities and Infrastructures

Project description:

This project builds on completed renewable energy projects funded by New Zealand, the European Union, and the United Arab Emirates, as well as an upcoming project funded by the World Bank. They aim to transition Tuvalu from fossil fuel-based power generation to renewable energy (particularly solar photovoltaics).

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which includes a goal of 100% of power generation from renewable sources by 2020, although it is understood that the timeline for this target is being extended to 2025. Power and renewable energy, together, are identified as one of seven priority areas for infrastructure.

Links with corporate plan or sector plan:

The project links with the Tuvalu Electricity Corporation's Master Plan for Renewable Electricity and Energy Efficiency in Tuvalu (Enetise Tutumau 2012-2020).

Planned implementation period:

Start: 2021

End: 2022

Project cost:

Estimated capital cost: A\$13 million

Estimated annual maintenance cost: A\$260,000

Project benefits

Transitioning from fossil fuel-based power generation to renewable sources. The World Bank estimates that 40% penetration of renewable energy will be achieved on completion of their planned project.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No

Careful selection of batteries warranted and waste management plan is needed for battery disposal. Nontoxic batteries recommended to avoid the need for disposal of hazardous waste.

TISIP 2016-2025

PROJECT PROFILE

Project title:

Solar Photovoltaic systems: battery replacement

TISIP 2016-2025 Reference number:

EN 5

Location:

Funafuti and Outer Islands

Responsible agency:

Tuvalu Electricity Corporation and Ministry of Public Utilities and Infrastructures

Project description:

Renewable energy projects (i.e., solar photovoltaic systems) are now being implemented with battery storage to improve flexibility in the power grids on each island. These batteries will require replacement in a cycle of approximately seven years.

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which includes a goal of 100% of power generation from renewable sources by 2020, although it is understood that the timeline for this target is being extended to 2025. Power and renewable energy, together, are identified as one of seven priority areas for infrastructure.

Links with corporate plan or sector plan:

The project links with the Tuvalu Electricity Corporation's Master Plan for Renewable Electricity and Energy Efficiency in Tuvalu (Enetise Tutumau 2012-2020).

Planned implementation period:

Start: 2023

End: onwards

Project cost:

Estimated capital cost: A\$12 million (2023-2025)

Estimated annual maintenance cost: S\$240,000

Project benefits

Maintaining an essential service (power).

Transitioning from fossil fuel-based power generation to renewable sources. The World Bank estimates that 40% penetration of renewable energy will be achieved on completion of their planned project.

Linkage with the Asset Management Framework.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No

Waste management plan is needed for battery disposal. Nontoxic batteries recommended to avoid the need for disposal of hazardous waste.

Climate threats

Higher corrosion rates of solar equipment inverters, batteries, and wind turbines. Reduced battery life due to higher temperatures.

Climate proofing measures

Ensure solar inverters and batteries are shaded and elevated when in operation.

Select batteries for cost efficiency and low maintenance requirements.

Ensure that used batteries can be sent to a recycling facility. Arrangements should be included in the purchase contract at the time of sale.

TISIP 2016-2025**PROJECT PROFILE****Project title:**

Further upgrades to satellite-based mobile and internet services on Funafuti and Outer Islands

TISIP 2016-2025 Reference number:

TL 1

Location:

Funafuti and Outer Islands

Responsible agency:

Tuvalu Telecommunications Corporation / Ministry of Communication and Transport

Project description:

The project involves the upgrade of telecommunications equipment on Funafuti and Outer Islands to cater for new satellite access agreements designed to improve mobile phone and internet services throughout Tuvalu.

Links with TKIII strategic areas:

The project links with Strategic Area 9 of TKIII: Infrastructure and Support Services, which notes that telecommunications services in Tuvalu are of poor quality and unprofitable, are holding back development, and are in urgent need of improvement. Telecommunications is identified as one of seven priority areas for infrastructure.

Links with corporate plan or sector plan:

The project links with the Tuvalu Telecommunications Corporation's corporate plan for 2016. A joint New Zealand/World Bank mission reviewed the entity and the telecommunications sector in Tuvalu in 2015, including infrastructure requirements and institutional support needs. This may lead to a program of support to the sector. This is a critical development, as improved telecommunications services (i.e., international and national connectivity via mobile and internet services) are vital to the economic and social development of Tuvalu.

Planned implementation period:

Start: 2017

End: 2018

Project cost:

Estimated capital cost: A\$4 million

Estimated annual maintenance cost: A\$80,000

Project benefits

Maintaining an essential service (telecommunications), with important linkages to all other sectors of Tuvalu society and the economy.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No (due to strategic importance of the assets)

Climate threats

Corrosion rates of concrete foundations will be accelerated due to increased carbonation.

Corrosion rates of steel parts will also be high.

Climate proofing

Stronger grades of concrete should be used for foundations.

Galvanised steel used, where possible, and anti-corrosion coating on all metal parts.

TISIP 2016-2025

PROJECT PROFILE

Project title:

Nukufetau coastal protection

TISIP 2016-2025 Reference number:

CP 2

Location:

Nukufetau

Responsible agency:

Office of the Prime Minister

Project description:

The project involves putting in place coastal protection infrastructure on the seaward side of Nukufetau's main islet.

Links with TKIII strategic areas:

Climate change has been added as the first strategic area in TKIII, with a goal of protecting Tuvalu from the impacts of climate change and emphasising resilience, mitigation, and adaptation.

Links with corporate plan or sector plan:

The project links with Te Kaniva, Tuvalu Climate Change Policy, 2012: Charting Tuvalu through the challenges of climate change.

Planned implementation period:

Start: 2017

End: 2017

Project cost:

Estimated capital cost: A\$1 million

Estimated annual maintenance cost: A\$20,000

Project benefits

More secure communities, with assets in all social and economic sectors better protected.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No (to ensure resilience)

Climate change threats

This project involves the replacement of a seawall on Nukufetau. The seawall is composed of gabions and has been protecting a vulnerable area of the coast exposed to strong currents for the past 20 years. A new seawall of other coastal protection structure is needed to dampen the force of waves and currents on the bank and reduce the damage from wave overtopping during cyclones or storm surges.

Climate proofing measures

A hydrodynamic survey needs to be conducted before the coastal protection structure is designed.

A channel needs to be dredged before the seawall is rebuilt and reinforced.

It is likely that a hard structure will be chosen to replace the existing seawall. This could be in the form of a new seawall with groynes to buffer wave action.

Climate proofing costs

The climate proofing costs of 23% of baseline costs for coastal protection will include an analysis of the most cost-effective designs adapted to the new climate regime (i.e., significant wave heights over 1.5 meters). Costs for beach replenishment and reinforced concrete were estimated to increase four to five times from $H_s = 0.7$ meters to $H_s = 1.7$ meters.

TISIP 2016-2025

PROJECT PROFILE

Project title:

Coastal protection infrastructure for three islands (Funafuti, Nanumea, Nanumaga)

TISIP 2016-2025 Reference number:

CP 3

Location:

Funafuti, Nanumea, Nanumaga

Responsible agency:

Office of the Prime Minister

Project description:

This project is a centrepiece of efforts to protect communities from the impact of natural hazards (i.e., cyclones and storm surges) and climate change. A submission has been made to the Green Climate Fund for project funding.

Links with TKIII strategic areas:

Climate change has been added as the first strategic area in TKIII, with a goal of protecting Tuvalu from the impacts of climate change and emphasising resilience, mitigation, and adaptation.

Links with corporate plan or sector plan:

The project links with Te Kaniva, Tuvalu Climate Change Policy, 2012: Charting Tuvalu through the challenges of climate change.

Planned implementation period:

Start: 2020
End: 2023

Project cost:

Estimated capital cost: A\$42 million
Estimated annual maintenance cost: A\$850,000

Project benefits

More secure communities, with assets in all social and economic sectors better protected.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner (submission to Green Climate Fund)
Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3
Climate proofing necessary (underline): Yes / No (to ensure resilience)

Climate change threats

This project involves the establishment of cost-effective coastal protection structures on Funafuti and two Outer Islands. Threats from climate change are mainly due to increased wave swells and storm surges during cyclones.

Climate proofing measures

A hydrodynamic survey needs to be conducted before the coastal protection structure is designed.

Key parameters are the significant wave heights (H_s) and the maximum wave heights (H_m) for exposed areas. In the Funafuti lagoon, the significant wave height is estimated at 0.7 meters (m). Beach replenishment is considered a cost-effective option if protected by groynes and an offshore breakwater. On the exposed Outer Islands of Nanumea and Nanumaga, the significant wave height is from 1.7 m to 3 m, so protection measures such as Seabees may be the most cost effective.

Climate proofing costs for coastal protection include an analysis of the most cost-effective designs adapted to the new climate regime (significant wave heights over 1.5 m). Costs for beach replenishment and reinforced concrete were estimated to increase four to five times from a significant wave height of 0.7 m to 1.7 m, according to the table below.

Indicative Cost per Linear Meter¹ for Coastal Protection Works, Assuming Local Materials (in Australian dollars)

Protection method	Details	Design life ² (years)	Low wave energy ($H_s = 0.7$ meters)	Moderate wave energy ($H_s = 1.5$ meters)	High wave energy ($H_s = 3$ meters)
Rock revetment: high density	Assumes basalt or similar > 2,600 kilograms (kg)/cubic meter (m ³)	50	675	3,000	10,700
Rock revetment: low density	Assumes limestone, coral or similar) ~ 2,200 kg/m ³	30	850	4,200	N/A
Mass concrete	Assumes local aggregates are used	30	2,500	10,000	N/A
Reinforced concrete	High strength (50 megapascals) marine-grade concrete	25	1,700	6,700	N/A
Grout-filled bag wall	Bags secured with a grout mix	5	950	N/A	N/A
Geosynthetic container: 1 layer	Assumes 0.75 m ³ containers for low wave and 2.5 m ³ for moderate wave	10	1,900	3,900	N/A
Geosynthetic container: 2 layer		20	3,350	7,100	N/A
Seabees: Imported materials	Includes concrete cap and rock toe	25	1,200	3,300	12,500
Tetrapods: Imported concrete	Includes rock toe	30	N/A	5,100	31,000
Grouted coral wall	Assumes 1:3 ratio concrete: coral block	5	900	N/A	N/A

Protection method	Details	Design life ² (years)	Low wave energy ($H_s = 0.7$ meters)	Moderate wave energy ($H_s = 1.5$ meters)	High wave energy ($H_s = 3$ meters)
Beach replenishment (sand, gravel)	Assumes 1:12 slope and 20% loss of material each year	5	1,000	4,200	17,500
Timber wall	Assumes piles driven and H6 marine-grade timber	15	2,400	N/A	N/A
Gabion basket	Assumes local aggregates and PVC coated wire	7	650	N/A	N/A
Terrafix blocks	Assume T60 blocks	15	1,300	N/A	N/A
Small hand-placed bags	Assumes good quality polyester geotextile	2	350	N/A	N/A

Source: Pacific Region Infrastructure Facility, "Affordable Coastal Protection Report 2016" (Draft).

¹ Costs are indicative for comparative purposes only and should not be used for project costing.

² Design life assumes typical term of effectiveness in Pacific environment with no or minimal maintenance.

³ N/A indicated method is not suitable for that wave climate.

Estimates in the above table are consistent with the 270 m long x 100 m wide beach created by dredging in Vaiaku, Funafuti in 2015.

Dredging cost estimates for the beach replenishment in Funafuti were A\$1.4 million for 70,000 cubic meters sand or A\$20/cubic meter, or A\$1.4 m / 270 m = A\$5,185/m of beach, designed for 10% loss each year at H_s 1.5 m.

Geosynthetic bags: Groynes: 2,400 bags/100 m groyne x 2 groynes x 2 cubic meter x \$20/cubic meter = \$711/m

Offshore breakwater = $(6,480 * 20 * 2) / 270 = A\$960/m$ Total bags: \$1,671/m.

Project title:

Additional funding for mini-hospitals on Nanumea and Vaitupu

TISIP 2016-2025 Reference number:

HE 4

Location:

Nanumea and Vaitupu

Responsible agency:

Ministry of Health

Project description:

This project involves the development of mini-hospitals on two islands to improve health services. Special Development Expenditure is provided in the 2016 Budget to initiate the project, although further funding is necessary to complete the project in 2017.

Links with TKIII strategic areas:

The project links with Strategic Area 4 in TKIII: Health and Social Development, which notes that new medical infrastructure, the upgrade and extension of existing facilities, and the procurement of new equipment form a major part of strengthening and improving health services. Specific reference is made to the two mini-hospitals.

Links with corporate plan or sector plan:

The project is included in the Ministry of Health's Health Reform Strategy 2016-2019.

Planned implementation period:

Start: 2016

End: 2017

Project cost:

Estimated capital cost: A\$1.5 million

Estimated annual maintenance cost: A\$30,000

Project benefits

Expanding the coverage of hospital services to include two Outer Islands.

Improving the quality of health services on two Outer Islands.

Ensuring the completion of projects included in the GOT Budget.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner

Maintenance: None identified / GOT / Kaupule / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3

Climate proofing necessary (underline): Yes / No

TISIP 2016-2025

PROJECT PROFILE

Project title:

Additional funding for construction of Outer Island clinics

TISIP 2016-2025 Reference number:

HE 5

Location:

Outer Islands

Responsible agency:

Ministry of Health

Project description:

This project involves the upgrading of health clinics on Outer Islands to improve health services. Special Development Expenditure is provided in the 2016 Budget to initiate the project, although further funding is necessary to complete the project in 2017.

Links with TKIII strategic areas:

The project links with Strategic Area 4 in TKIII: Health and Social Development, which notes that new medical infrastructure, the update and extension of existing facilities, and the procurement of new equipment form a major part of strengthening and improving health services.

Links with corporate plan or sector plan:

The project is included in the Ministry of Health's Health Reform Strategy 2016-2019.

Planned implementation period:

Start: 2016
End: 2017

Project cost:

Estimated capital cost: A\$0.5 million
Estimated annual maintenance cost: A\$10,000

Project benefits

Improving health services on Outer Islands.
Ensuring the completion of projects included in the GOT Budget.

Project status (underline):

Concept / Project document / Feasibility study / GOT approval / Funding commitment

Funding source (underline):

Capital: None identified / GOT / Public Enterprise / Development Partner
Maintenance: None identified / GOT / Public Enterprise / Development Partner

Climate change / Disaster risk management

Resilience score in MCA analysis: 3
Climate proofing necessary (underline): Yes / No

Appendix 3: References

Note that the following comprises a list of citations, as well as well as background documents that are not cited:

- ABM (Australian Bureau of Meteorology) and CSIRO. 2011. *Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview; and Volume 2: Country Reports*. Australian Bureau of Meteorology and Commonwealth Scientific. www.pacificclimatechangescience.org/publications/reports/report-climate-change-in-the-pacific-scientific-assessment-and-new-research/.
- ADB (Asian Development Bank). 2015. *Country Operations Business Plan: Tuvalu 2016–2018*. October. Asian Development Bank. Manila. www.adb.org/sites/default/files/institutional-document/176145/cobp-tuv-2016-2018.pdf.
- _____. 2015. *Institutional Strengthening of the Ministry of Finance and Economic Development*. Trip Report TA-8100 TUV (November) of the Public Enterprise Specialist under Asian Development Bank. Manila.
- _____. 2015. *Outer Island Maritime Infrastructure Project*. Project Design Advance: Project Administration Manual. Project No. 48484-003. Asian Development Bank. Manila. www.adb.org/sites/default/files/project-document/177033/48484-003-pam.pdf.
- _____. 2016. *Institutional Strengthening of the Ministry of Finance and Economic Development*. Interim Report TA-8100 TUV, February, p.4. Advisor – Public Works Department. Asian Development Bank. Manila. p. 4.
- AECOM New Zealand Limited. 2013. *Pacific Aviation Investment Program (PAIP): Environmental Management Plan - Funafuti International Airport (FUN) and Road*. Interim Working Document (Draft). November.
- GOK (Government of Kiribati). 2015. *Infrastructure Sector Coordination Support: Lessons Learned*. July. Government of Kiribati. Kiribati.
- GOT (Government of Tuvalu). 2005. *Tuvalu Integrated Solid Waste Plan*. Final Working Draft. May. Funafuti. Government of Tuvalu.
- _____. 2005. *Te Kakeega II National Strategy for Sustainable Development 2005–2015*. Economic Research and Policy Division, Ministry of Finance, Economic Planning, and Industries. Funafuti. Government of Tuvalu. www.adb.org/sites/default/files/linked-documents/cobp-tuv-2015-2017-sd-02.pdf.
- _____. 2012. *Te Kaniva, Tuvalu Climate Change Policy, 2012: Charting Tuvalu through the Challenges of Climate Change*. Funafuti. Government of Tuvalu.
- _____. 2012. *Tuvalu Infrastructure Strategy and Investment Plan, "Fakafoou. To Make New"*. February. Funafuti: Government of Tuvalu. www.pacificdisaster.net/pdnadmin/data/original/TUV_2012_Infrastructure_Plan.pdf.
- _____. 2013. *TISIP Progress Status*, August. Funafuti. Government of Tuvalu.
- _____. 2014. *Tuvalu Government Financial Instructions: Made under Section 5 of the Public Finance Act. Version 2014.02*. Funafuti: Government of Tuvalu. www.tuvaluaudit.tv/wp-content/uploads/2016/05/Financial-Instructions.pdf.
- _____. 2015. *Climate Change and Disaster Survival Fund Act 2015*. Funafuti. Government of Tuvalu. <http://extwprlegs1.fao.org/docs/pdf/tuv152292.pdf>.
- _____. 2015. *Tropical Cyclone Pam Recovery and Vulnerability Reduction Plan*, May. Funafuti. Government of Tuvalu.

_____. 2016. *Health Reform Strategy 2016–2019*. Funafuti, Tuvalu. Ministry of Health.

_____. 2016. Te Kakeega III, National Strategy for Sustainable Development 2016 to 2020. Funafuti. Government of Tuvalu. www.adb.org/sites/default/files/linked-documents/cobp-tuv-2017-2019-ld-02.pdf.

_____. 2016. National Budget 2016. Funafuti. Government of Tuvalu.

_____. 2016. *National Budget, Medium-Term Fiscal Framework 2016 to 2018*. Funafuti. Government of Tuvalu.

IMF (International Monetary Fund). 2014. *Tuvalu 2014 Article IV Consultation*. Staff Report, August. Washington, DC. International Monetary Fund. www.imf.org/external/pubs/ft/scr/2014/cr14253.pdf.

IPCC (Intergovernmental Panel on Climate Change). 2007. www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml.

Pacific Community. 2013. *Sustainable and Integrated Water and Sanitation Policy 2012–2021*. Fiji: SPC—Applied Geoscience and Technology Division (SOPAC). <http://reliefweb.int/sites/reliefweb.int/files/resources/Tuvalu%20Water%20Policy%202013%20A5.pdf>.

PRIF (Pacific Region Infrastructure Facility) (undated). Tuvalu Asset Management Framework and Infrastructure Management Support. TA 8345 REG. Sydney: Pacific Region Infrastructure Facility.

TEC (Tuvalu Electricity Corporation). 2012. *Enetise Tutumau 2012–2020: Master Plan for Renewable Electricity and Energy Efficiency in Tuvalu*. Funafuti. Tuvalu Electricity Corporation. http://prdrse4all.spc.int/system/files/master_plan_for_renewable_electricity.pdf.

Tuvalu Electricity Commission. 2014. *Annual Report 2014*. Funafuti. Tuvalu Electricity Commission.

Tuvalu Telecommunications Corporation. 2014. *Annual Report 2014*. Funafuti. Tuvalu Telecommunications Corporation.

_____. 2016. *2016 Corporate Plan*. Funafuti. Tuvalu Telecommunications Corporation.

Department of Communities and Local Government. 2009. *Multi-Criteria Analysis: A Manual*. January. London. Government of the United Kingdom. http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf.

World Bank. 2011. *Country Assistance Strategy for Tuvalu for the period FY 2012–2015*. 4 November. Washington, DC. International Development Association.

_____. 2014. *Proposed Grant and Proposed Small Island Developing States Initiative Grant to Tuvalu for an Energy Sector Development Project*. Project Appraisal Document No. PAD662. Washington, DC. International Development Association, World Bank. <http://documents.worldbank.org/curated/en/519561468102907968/pdf/PAD6620PADoP140010Box385398BoOUO090.pdf>.

_____. 2015. *Pacific Aviation Investment Program: Tuvalu*. Progress Report No. 9. Washington, DC. World Bank.

_____. 2016. *Proposed Additional Grant and a Proposed Restructuring to Tuvalu for the Tuvalu Aviation Investment Project*. Project Paper. March. Washington, DC. International Development Association.

