

FINAL Initial Environmental Examination (IEE) of Western Subprojects

Cyclone Pam Road Reconstruction Project

49319



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Acronyms and abbreviations

ADB	Asian Development Bank
AP	affected persons
BBB	'build back better'
CCAs	Community Conservation Areas
CCP	community consultation plan (for the Project)
CEMP	Contractor's Environmental Management
CPRRP	Cyclone Pam Road Recovery Project
CLMO	Customary Lands Management Office
DCZ	Designated Conservation Zone
DEPC	Department of Environment and Conservation
DFAT	Department of Foreign Affairs and Trade
DOL	Department of Lands
DP	displaced persons
DSC	design and supervision consultants
EARF	Environmental; Assessment and review Framework
EIA	Environmental Impact Assessment
EMC	Environmental Management and Conservation
EMP	Environmental Management Plan
EMMP	Environmental Management and Monitoring Plan
EPC	Environmental Protection and Conservation
ERR	Efate Ring Road
ERP	Emergency Response Plan
ESO	Environmental Safety Office
FDA	Foreshore Development Act
FDP	Foreshore development Permit
GDP	Gross Domestic Product
GRM	Grievance Redress Mechanism
IEE	Initial Environmental Examination
LAA	Land Acquisition Act
MCC	Ministry of Climate Change
MDG	Millennium Development Goals
MIPU	Ministry of Infrastructure and Public Utilities
MDG	Millennium Development Goal
MOU	Memorandum of understanding
NO	Nitrogen Oxides
NGOs	Non-government organisations
PAA	Priorities and Action Agenda
PAM	project administration manual
PEA	Preliminary Environmental Assessment
PIU	Project Implementation Unit
PMU	Project Management unit (within MIPU)
POL	Petrol Oil Lubricant
PRC	Program Recovery Committee (within Prime Minister's Office)
PSD	Primary Sector Development
PWD	Public Works Department (within MIPU)
RE	Resident Engineer
SDG	Sustainability Development Goal
SO ₂	Sulphur Dioxide
SPS	Safeguard Policy Statement 2009 (of ADB)
SPCZ	South Pacific Convergence Zone
SSF	Social Safeguard framework
SSO	Senior Safeguard Officer
UNESCO	United Nations Educational, Scientific and Cultural Organization
VEMC	Vanuatu Environmental Management and Conservation
VIAR	Vanuatu Impact Assessment Report
VTSSP	Vanuatu Transport Sector Support Program
WRM	Water Resources Management

Executive Summary

Introduction

Severe Tropical Cyclone Pam (TC Pam) was a category 5 cyclone that impacted Vanuatu on 13 March 2015. The ensuing damage resulted in vital infrastructure including roads, bridges, housing, and sewerage and water supply systems being damaged and destroyed. Large flows and debris build-up caused damage to bridges, including to piers, abutments and scour protection. Approaches to bridges, causeways and culverts collapsed or were washed away and road pavement stability was affected in a number of locations.

The Cyclone Pam Road Reconstruction Project (the Project/CPRRP) aims to accelerate economic and social recovery in Vanuatu's Cyclone Pam-affected areas and contribute to Ni-Vanuatu resilience. The development objective is to restore socioeconomic activities of people around the Efate ring road to pre-cyclone levels. This will be achieved by providing disaster resilient road and bridge infrastructure by reconstructing priority assets, i.e., "building back better" (BBB).

This document is the initial environmental examination (IEE). The IEE is part of the Project Feasibility Study Report and identifies baseline conditions and impacts and addresses the anticipated environmental impacts of the Project with a set of design mitigations to control environmental risk. It also provides guidance to the construction contractor in the preparation of the Contractor's Environmental Management Plan (CEMP) to address site specific pre-construction and construction risks and how to deal with any concerns or issues raised during the construction phase.

Two IEEs were prepared:

- > One for the western area of Efate encompassing eight of 20 the subprojects (this document)
- > One for the eastern area of Efate, encompassing twelve subprojects

Legislation and policy

The Project needs to satisfy the requirements of the Vanuatu Environmental Management and Conservation Act No. 12 as amended by the Environmental Management and Conservation (Amendment) Act No. 28 (EPC Act). The EPC Act states that all projects, proposals or development activities that:

- (a) cause or are likely to cause significant environmental, social and/or custom impacts; or
- (b) cause impacts relating to the matters listed in subsection (2);

are subject to an environmental impact assessment (EIA).

The Department of Environment and Conservation (DEPC) were consulted and it was agreed that the Project will conduct the preliminary environmental assessment (PEA) based on the IEE and additional information templates to be submitted to the Department. A determination of the need for further assessment and issues related to the environmental permit will then be made by the DEPC.

A consent will also be required under the Foreshore Development Act, another key piece of environmental planning legislation which concerns the protection and development of the foreshore. The foreshore is defined as, "the land below the mean high water mark and the bed of the sea within the territorial waters of Vanuatu."

The subprojects are on the Efate ring road (Efate's coastal road) and some structures are located in the inter-tidal zone. As a result, there are four subprojects which may require a Foreshore Development Permit (FDP). Presently, due to the small scale and short duration of construction, and the low risks associated with the impacts of the Project on the environment, a waiver for this permit is being requested from the Minister of Internal Affairs for the four sites considered to be affected by this legislation. However, landowner consent is being sought as part of the memorandum of understanding process, and permit applications prepared.

In compliance with the Asian Development Bank (ADB) Safeguards Policy Statement 2009 (SPS), the overall Project has been classified as category B.

Existing environment

The table below summarises the existing environment in the vicinity of the eight subprojects proposed in Western Efate.

ES1 – Summary of subproject existing environmental conditions

Subproject	Physical environment	Biological environment	Socio-economic environment
Prima Bridge	The geology and soils of the area are alluvium. The floodplain makes up an area of approximately 30 km ² of this type of material and is the largest area of alluvial soils in Efate. The presence of significant amounts of this material has led to sedimentation in the river bed.	No mature trees Vegetation consists primarily of bamboo, papaya, banana, cassava and tall grasses A highly modified environment made up of secondary vegetation and various weeds. The river supports local species of fish and crustaceans	A school is situated north-east of the bridge, with an entrance not far from the bridge, down an informal pathway. Population density is relatively high. The river near the bridge is used for washing and bathing
Mele Bridge	The geology and soils of the area are alluvium. The floodplain makes up an area of approximately 30 Km ² of this type of material and is the largest area of alluvial soils in Efate. The presence of significant amounts of this material has led to sedimentation in the river bed.	A highly modified environment Small stand of mature trees north-east of the bridge Small garden south-west of bridge, consisting of banana and cassava plants Clearing of vegetation had just occurred in the north-east during site visit October 2016	A golf course south-west of the bridge. Population density is relatively high. Area immediately downstream used for washing and gardening
Klems Hill Landslip	This site is made up of a long narrow outlier of volcanic pumice (breccia) and is sloping steeply up from the alluvial floodplain below	Well vegetated; primarily regrowth from previous erosion nearby site	There are residences below the current drainage lines which are not immediately below the proposed works more than 300 metres downslope in village of Melemaat
Creek Ai Culvert	The project is located within a small pocket of alluvium on the northern section of the creek which becomes volcanic pumice (breccia) further upstream and is unusual as the only one of the streams in the western area directly flowing out of volcanic material directly above the alluvial deposits adjacent to the coast. Flows of the Creek have been greatly altered by earthworks and reclamation along either side of the culvert, both up and downstream. Heavy algal blooms downstream present during October site visit suggests	Creek Ai has been identified as an important environment area Home to the Creek Ai Goby only recently identified which is described as near threatened. It is a heavily vegetated stream; heavily modified and cleared around the culvert. Mature mango and coconut trees are nearby. Fish species upstream of culvert are primarily freshwater species; downstream sees some brackish water and coastal species. Species are amphidromous returning for spawning areas upstream after drifting as larvae into saltwater. Creek Ai is the only stream listed in the Vanuatu National	One residence adjacent to culvert Used for washing and bathing downstream Creek provides boat docking area, with access to the sea for fishing during high tide

Subproject	Physical environment	Biological environment	Socio-economic environment
	cattle grazing upstream and watering in Creek and/or uncontrolled development activity.	Biodiversity Strategy Action Plan in its highest category as an Important Place.	
Havannah Culvert	Steep drop downstream of culvert that is heavily eroded.	Large, mature trees dominate the environment.	Resort just north-west of culvert, but protected by thick perimeter wall.
Tanolu Bridge	Located adjacent to the coast The Sanoa Marine Protected Area (community-led initiative) is nearby	There are mangroves present upstream but the immediate vicinity of the bridge is highly modified due to the proximity of the village also upstream Fauna species associated with mangroves present in large numbers (e.g. fiddler crabs, mangrove crabs, mudskippers, hermit crabs)	Residence situated north-east of bridge. A bench is located south-west of the bridge for use as waiting area for busses. For people travelling and commuting from the adjacent offshore islands. Mangroves are exploited in the area upstream for charcoal production
Marona Bridge	The geology is a large pocket of alluvium which forms a small floodplain with approximately four kilometres of channel and is surrounded on all sides by steeper older raised limestone. Water quality is affected by upstream sources of pollution with algal blooms observed downstream of the structure which may be due to cattle watering in the stream or use of fertilizer and insecticides.	Vegetation primarily tall grasses. One mature tree north-east of bridge that should be noted during design as it is the only large tree in the area and within the sub-Project impact area. The ecosystem has been significantly modified in the vicinity of the proposed bridge.	Isolated location with very few, isolated sensitive receptors
Malatia Culvert	The wetland area inland of the bridge has been affected by draining and pockets of local agriculture. Geology and soil based on a small pocket of alluvium following the northern section of the river.	Mangrove ecosystem of approximately 6 hectares is important resource due to the loss of other mangrove systems in Efate. This system is currently affected by a proposed Stage 2 of a marina sub-division which may affect its further viability	No adjacent sensitive receptors. This area is known for harvesting of mangroves to make charcoal for household heating and cooking

Proposed works

There are eight subprojects on the west of the island, two of which require major works such as new bridges. There were three options developed and then evaluated and selected for each of the subproject sites.

Together, the selected (preferred) options at each site form the Project scope. It is now best described in terms of the number of new bridges, new culverts, rechannelling works, road formation and pavement works and ancillary works for the western area, as summarised below:

- > Mele and Marona require new single-span, steel truss bridges, to replace existing bridge and culvert structures:
 - Mele will require approximately 600 cubic metres of spoil to be removed to build new abutments and approximately 2000 cubic metres of spoil to be removed for river channelling, with access required to the river. Truck traffic generated was estimated at three movements per hour per

working day for eight weeks. It will be necessary to use pile driving equipment for approximately 3-4 weeks.

- Marona will require significant abutment earthworks and spoil disposal of 300 cubic metres, as the existing deposition of sediments on the eastern side of the current structure will be removed to improve the waterway area under the new high level bridge. Access will be required for a temporary diversion during construction. It will be necessary to use pile driving equipment for approximately 3-4 weeks
- > Prima bridge requires addition of footpaths, replacement of guardrail and river rechannelling. The works will require approximately half of the volume of spoil removal required for Mele Bridge, for both bridge abutment earthworks and river channelling, with access required to the river. Truck traffic generated was estimated at three movements per hour per working day for four weeks. It will be necessary to use pile driving equipment for approximately 3-4 weeks
- > Tanoliu bridge requires replacement of timber decking with prefabricated concrete planks, and cleaning of existing steel beams by grit blasting and then repainting
- > Creek Ai requires a new multi-cell box culvert with greater flood immunity to replace existing low-level pipe culverts to improve channel geometry and riverine fauna passage
- > Malatia requires a series of new relief culverts to increase waterway area for mangrove wetland conservation
- > Roadworks at Havannah culvert will not alter the culvert. New guardrails, concrete pavement and scour protection will be constructed
- > Klems Hill requires slope stability work involving bored piles, erosion control and perimeter drainage works
- > Drainage and scour protection to sites as required
- > Safety improvements and improved access for laundry and washing at Mele and Prima bridges
- > No construction camp was considered necessary for the construction of the western subprojects

Concept design drawings are included in Appendix A – Engineering Report of the main feasibility study report. Detailed design drawings were issued separately.

Anticipated environmental impacts

In general terms, and based on the field work carried out, the site-specific environmental impacts of the majority of subprojects were found to be low risk. Of these, the construction phase impacts were considered to be more substantive than the pre-construction or operational phases.

The western areas have higher population densities and existing traffic volumes, which generates more potential for significant environmental risk. The relative priority for construction of the western subprojects reflects this, as they were generally ranked higher than most of the eastern subprojects. In some of the smaller, more remote subprojects to the north, there is potential for more significant construction impacts even though the actual area in the vicinity of the constructed is a heavily modified environment.

The subprojects in the western area will lead to a number of pre-construction, construction and operational impacts.

Chapter 5 describes the potential impacts and risks in detail of the eight subprojects in the Western area for all three phases of the Project. It also proposes specific mitigating measures for each of the subprojects which are considered to have higher risks due to the more sensitive existing environment surrounding the sub-project. Routine mitigation measures for all subprojects are also described.

It was concluded that the construction phase of the project will lead to the majority of more significant risks if unmitigated. However, due to the localised nature of activities, the scale and duration of construction required and the relatively low population density in the vicinity of most subprojects, the impacts were generally assessed as being of low significance without mitigation. A minority of subprojects showed moderate to high direct or indirect impacts without mitigation or management intervention.

It should be emphasised that for most Subprojects the works will focus on reconstruction within existing corridors which were generally found to be highly modified due to the past operation of the Ring Road. For most subprojects, the road corridor does not traverse stream sections which include critical or natural habitats. With the exception of Creek Ai and Malatia, subprojects in western Efate are not located in, or adjacent to, protected areas or conservation areas. The final design will include environmental enhancements to address cyclone damage with design mitigations to build back better.

Design mitigations

Design mitigations have been proposed to address these issues. Also, a baseline study of a sample of freshwater streams is being undertaken to identify flora and fauna which could require additional measures; the results of which will be integrated into the updating of the environmental management plan (EMP). The baseline study will form the basis for a restocking and/or conservation program for specific species in designated stream sections to further reduce risk.

ES2 – Proposed design mitigations

Subproject	Proposed Design Mitigation/ Management Program
Malatia Culvert involving repair and enhancement of existing and new culvert construction in wetland mangrove environment	The culvert will be augmented with an open box design additional culvert further to the north to maximise the tidal flow into the wetland. A roadside attraction point may be discussed with the local community to improve public awareness of the importance of mangrove ecosystems. This location is one of the largest areas of mangrove (although heavily modified on its boundaries) on the island of Efate
Creek Ai Culvert involving the need for protection and management of freshwater fish and invertebrates	The culvert will be replaced with much larger open box design to improve flood immunity and reduce sedimentation associated with the older pipe designs and will promote fish and crustacean passage both upstream and downstream. Low flow flute design will be included at the lowest level within the base slab design.
Morona Bridge involving the need for protection and management of freshwater fish and invertebrates	A new higher level bridge will replace the existing part-bridge, part-pipe culvert design, which will substantially improve conditions for fish and crustacean passage both upstream and downstream
All freshwater streams including Creek Ai and Morona (and Epau, Neslep, Lamin, Pangpang, La Cressonniere in eastern Efate)	A baseline biodiversity study of freshwater fish and invertebrates was proposed to be conducted in selected subprojects to promote selective restocking programs, but this was not accepted. This work could be carried in close coordination with a new project being carried out for the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biodiversity by the Queensland Institute of Technology and local freshwater fish aquaculture project in Mangaliliu, Onesua and Epau villages.

In order to reduce environmental impact risks, the following measures will be required by, or are included in, the design. Specific mitigations required for Creek Ai, Morona and Malatia culverts are:

> Creek Ai:

- The design is for large, multi-cell box culverts, which will significantly improve the flow characteristics of the stream compared to the existing piped culverts which were supported by a large concrete embankment which effectively was acting to dam the flow at low flows
- The base slab of the box culverts will also feature a low flow channel to maximise flow depth during the distinct dry season in this area

- A separate sub-plan on temporary river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys being undertaken are understood and implemented by the Engineer and Contractor
 - Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is currently being obtained from the DEPC biodiversity officer
 - Subject to the results of further sample studies on this stream and inputs from government agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with TC Pam
 - A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime
- > Marona:
- A separate sub-plan on river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys are understood and implemented by the Supervising Engineer and Contractor
 - Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons
 - Subject to the results of further sample studies on this stream and inputs from GOV agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with Cyclone Pam
 - A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime
- > Malatia:
- The design for the site incorporates the build back better principle to facilitate recovery from the effects of TC Pam and enhance the sustainability of the mangrove wetland
 - An additional relief culvert will be built further to the west, to allow circulation of high tides to the backwater areas
 - Any works with the potential to affect river flow will be timed at periods of low tide and also will avoid any endemic fish and invertebrate fauna spawning seasons
 - A mangrove replanting area on the north side of the road (i.e., between the road and Undine Bay) will be established, with species subject to recommendation by DEPC and landowner agreement
 - Dialogue with landowners will include discussion of a dedicated road side rest area with a community education display, identifying the features and explaining the importance of the ecosystem to the local fisheries. It could be operated and maintained by the local landowners or their agreed representatives operating a concession

There are site specific noise mitigations required for Mele Bridge, Klems Hill landslip and Marona Bridge, due to the need for the use of pile driving equipment. The noise impact analysis predicted that Mele, Melemaat would be subject to excessive noise.

The excessive noise of the pile driver will require mitigations including:

- > Notification to all receptors and the Contractor will prepare a schedule of operations that will be approved by village chiefs. The construction schedule will identify days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Restricting the hours of operation to agreed times

- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > Complaints regarding noise will be dealt with in accordance with the community consultation plan (CCP) which includes the grievance redress mechanism (GRM)

The need for temporary traffic diversions outside of the nominal road corridor was assessed as being of moderate significance for health and safety as there is a relatively high population density with potential for nuisance and land use impacts. The need to carry out river channelling to increase channel cross sectional area and reduce sedimentation means that construction access to the waterway is also necessary for both Prima and Mele bridges. This will result in short term hydrology and water quality issues and potential for impacts on freshwater fish and crustaceans.

Environmental management and mitigations

The adoption of the “build back better” principle led to the development of environmental enhancements (in addition to the mitigations) where risk to some elements of natural habitat could be reduced, damage to the natural environment from the cyclone could be restored and/or positive ecological and socioeconomic impacts could be maximised.

It was considered important to take account of the extreme shock of very high flood flows on the ecology of the smaller freshwater streams with relatively lower normal discharges, caused by TC Pam. The design accounts for the fact that there was high rainfall accompanying the cyclonic winds, which created large and fast moving flows and debris build up resulting in high water pressure and flood damage. Flood waters broke river banks and cut through the approach roads and a number of rivers relocated from their original course. In so doing, rivers and streams meandered and widened both up and downstream of the bridges.

The ecology of the freshwater streams in the north western Efate, including Creek Ai and Marona river were subject to these flood flows and may have affected the resilience of endemic fish and crustacean populations. The combination of design mitigations as well as the implementation of a CEMP to address direct and indirect construction impacts will mitigate the effects of TC Pam and construction risks.

An EMP was prepared. This includes the proposed design mitigation measures in locations where areas of existing natural habitat were considered to require rehabilitation and/or enhancement. The EMP also provides guidance to the Contractor for the preparation of the CEMP, with management and mitigation principles and a guide to the development of a monitoring system.

The complete environmental mitigation and monitoring matrix focused on the preparation of the CEMP for each construction tender package, is set out in **Table 7-4**. It outlines the management and mitigation principles and provides guidance for the Contractor responsible for the preparation of a CEMP. It also provides guidance on the necessary monitoring program that will be required to ensure compliance with the EPC Act and ADB requirements during implementation of the subprojects.

An integral part the EMP structure is the grievance redress mechanism (GRM) and will be responded to by the Contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards due diligence report (DDR).

Conclusion and recommendation

With the proposed design mitigation measures included and implementation of a CEMP with site specific and routine construction mitigation measures, the identified risks can be lowered to an acceptable level to satisfy ADB SPS requirements. As a result, an EIA is not considered necessary, but this will be a matter for determination by the Director, DEPC.

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1 Introduction

Severe Tropical Cyclone Pam (TC Pam) was a category 5 cyclone that moved through Vanuatu on 13 March 2015. Passing just east of the island of Efate, the ensuing impact resulted in severe damage to infrastructure including roads, bridges, housing, telecommunications, and sewerage and water supply systems. 17,000 buildings were destroyed or damaged, livelihoods dependent on agriculture were compromised^[1] and 11 fatalities were suffered.^[2]

Large waterway flows and debris build-up caused damage to bridges, including to piers, abutments and scour protection. Road approaches to bridges, causeways and culverts collapsed or were washed away and road pavement stability was affected in a number of locations. The major damage to the transport sector was to the Efate Ring Road. This road is a 120 km sealed two-way road, providing transport services to the rural population (about 29,150 people) around the Efate Island and connects to the capital (Port Vila, with an urban population of 55,525); it is the only road link servicing the rural population of Efate.

This disaster caused the Vanuatu's gross domestic product (GDP) growth to contract to 0.9 per cent in 2015, down from 2.3 per cent in 2014^[3]. TC Pam had a notable effect on tourism, with immediate and future bookings affected for up to 12 months.

On 25 August 2015, the Government of the Republic of Vanuatu (the government) requested the assistance of the Asian Development Bank (ADB) to assess the damage to roads and their structures on the island of Efate. ADB provided this assistance by scoping the Project, confirming loan and grant funding availability and procuring a design and supervision consultant (DSC).

Nineteen (19) sites were initially identified in the scope of work. During the inception phase of the Project, this was expanded to 20, including eight bridges, nine culverts, two road sections and one landslide.^[4]

This initial environmental examination (IEE) covers the eight subprojects located on the west of the island:

- > Prima Bridge
- > Mele Bridge
- > Klems Hill landslide
- > Creek Ai Culvert
- > Havannah Culvert
- > Tanoliu Bridge
- > Marona Bridge
- > Malatia Culvert

^[1] Widespread crop destruction occurred to 80% of Vanuatu's rural communities (Government of Vanuatu, 2015)

^[2] Government of Vanuatu. 2015. *Post Disaster Needs Assessment Report*. Port Vila.

^[3] <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=VU>, accessed 03/08/2016

^[4] Bridges: Prima, Mele, Tanoliu, Marona, Epule, Lamin, Pangpang, Rentapau; Roads: Onesua, Teouma-Rentapau; Culverts: Creek Ai, Havannah, Malatia, Sara, Epau, Neslep, La Cressonniere, Eton Beach, Eton Dry Creek; Geotechnical: Klems Hill. Inception Mission MOU, Para.12 (i)

2 Policy and legal framework

2.1 Government of Vanuatu

2.1.1 Policy Background

2.1.1.1 *Sustainability Development Goals (2015)*

The Millennium Development Goals (MDGs) were replaced by the Sustainability Development Goals by the United Nations in 2015. There are now 17 goals replacing the eight MDGs and the work will build on the good progress made on the MDGs by Vanuatu. One of the priority areas set out in the Millennium Development Goals (MDGs) for Vanuatu was to 'ensure environmental sustainability'. It aimed to integrate the principles of sustainable development into the country policies and programs and reverse the loss of environmental resources (UNDP, 2005). 3.1.5. Priorities and Action Agenda for Vanuatu 2006-2015 The Priorities and Action Agenda (PAA) 2006-2015 set out the national strategic priorities which includes 'Primary Sector Development (natural resources and the environment)'. Three important sectors highlighted were agriculture, forestry and fisheries and their priority and strategic areas needed for improvement and increased production. The three sectors account for an estimated 15% of the total GDP and for almost all merchandise exports. Environment and disaster management are also highlighted in the PAA. Environmental management is the responsibility of the DEPC, although other departments including agriculture, forestry and fisheries also have some responsibilities in relation to environmental conservation.

One initiative arising from the MDGs was to build the Efate Ring Road to modern highway standards, which since construction in 2008-2010, facilitated the further economic development of Shefa Province. This Project will repair structures and pavements on the ring road following the devastating effects of TC Pam.

2.1.1.2 *Disaster Risk Reduction and Disaster Management National Action Plan 2006-2016*

The Disaster Risk Reduction and Disaster Management National Action Plan 2006-2016, prepared by the Pacific Islands Applied Geoscience Commission in partnership with the Government of Vanuatu and The Pacific Disaster Risk Management Partnership Network, details 11 guiding principles for disaster risk management. These include that it is a sustainable development issue and that it requires a strong governance framework with clear policies and legislation. The plan is structured around eight main themes:

- > Governance and policy context
- > Mainstreaming disaster risk reduction and disaster management in national planning and budgetary processes
- > Mainstreaming disaster risk reduction
- > Strengthening disaster management
- > Information, information system and knowledge management
- > Capacity building
- > Monitoring, evaluation and reporting
- > Implementation of the National Action Plan

Each theme has an associated set of actions, expected results, identification of a responsible agency or agencies, indicators, and completion dates.

Climate change and disaster risk reduction using build back better policies is a key component of planning for this Project.

2.1.2 Legislation

2.1.2.1 *The Environmental Management and Conservation Act No. 12 as amended by The Environmental Protection and Conservation (Amendment) Act No. 28*

The Environmental Protection and Conservation Act 2002 (EPC Act) is the umbrella environmental legislation in Vanuatu. The EPC Act is administered by the department of Environmental Protection and Conservation (DEPC) and focuses on four main areas:

- > Administration
- > Environmental impact assessments
- > Biodiversity
- > Bio-prospecting laws and community conservation areas (CCAs)

The Amendment Act makes a number of important changes directly relevant to climate change:

- > Includes a definition of climate change
- > Adds the concept of ecosystem services and processes to the Act
- > Applies the precautionary principle to any decision made regarding the environment that may risk human health or threaten damage to the environment
- > Specifies that any decision made under the terms of the Act must be guided by consideration of climate change adaptation and mitigation issues

Further amendments include enforcement provisions, environmental impact assessment procedures, bio-prospecting processes, and details of what constitutes an offence.

The Act states that all projects, proposals or development activities that: (a) cause or are likely to cause significant environmental, social and/or custom impacts; or (b) cause impacts relating to the matters listed in subsection (2); are subject to an EIA. Subsection 2 lists projects that:

- a) affect coastal dynamics or result in coastal erosion;
- b) result in the pollution of water resources;
- c) affect any protected, rare, threatened or endangered species, its habitat or nesting grounds;
- d) result in the contamination of land;
- e) endanger public health;
- f) affect important custom resources;
- g) affect protected or proposed protected areas;
- h) affect air quality;
- i) result in the unsustainable use of renewable resources;
- j) result in the introduction of foreign organisms and species;
- k) result in any other activity prescribed by regulation.

The Project is not likely to cause significant environmental, social and/or custom impacts. While it does have the potential to result in pollution of water resources, the mitigation and management measures that are being required will ensure that no water pollution is generated as part of the works. Further, the Project will have a positive effect on reducing or reversing coastal erosion by stabilisation or embankment construction for some subprojects. It does not trigger any of the other matters listed in Subsection 2.

Under the Act, proponents of these activities must make an application for environmental permit. The application is on the prescribed form and includes additional information as required (by way of this IEE) for the Project and each application will require a PEA, to be conducted by DEPC. The DEPC determines whether further assessment is required, and/or recommend that an environmental permit (with or without conditions) be issued for the activity.

2.1.2.2 *Foreshore Development Act [Cap 90] and the Foreshore Development (Amendment) Act 2013*

The Foreshore Development Act concerns the protection and development of the foreshore. The foreshore is defined as the land below the mean high water mark and the bed of the sea within the territorial waters of Vanuatu (including the ports and harbours thereof); and including land below mean high water mark in any lagoon having direct access to the open sea. The Act states that no person shall undertake, or cause or permit to be undertaken, any development on the foreshore of the coast of any island in Vanuatu without having first obtained the written consent to such development of the Minister responsible for town and country planning.

The Foreshore Development (Amendment) Act 2013 amends the Foreshore Development Act with respect to:

- > Consent of Minister required for foreshore development
- > Powers of an enforcement officer (defined by this Act)
- > Registration of existing developments
- > Offences
- > Minister's power to make Regulations

The Schedule to the principal Act is repealed.

The subprojects are on the Efate ring road (Efate's coastal road) and some structures are located in the inter-tidal zone. As a result, there are four subprojects which may require a Foreshore Development Permit (FDP). Presently, due to the small scale and short duration of construction, and the low risks associated with the impacts of the Project on the environment, a waiver for this permit is being requested from the Minister of Internal Affairs for the four sites considered to be affected by this legislation. However, landowner consent is being sought as part of the memorandum of understanding process, and permit applications prepared.

2.1.2.3 *The Fisheries Act No. 10 of 2014*

An Act to repeal the Fisheries Act [CAP 315] and to make provision for the management, development and regulation of fisheries within Vanuatu waters, and for the control of fishing vessels entitled to fly the flag of Vanuatu outside of Vanuatu waters in a manner consistent with Vanuatu's international obligations, and for related matters.

Some of the subprojects are located near the coast and all watercourses associated with the Project, drain into the seas. It, therefore, has the ability to impact on fisheries. The minimal works associated with the Project, coupled with stringent mitigation and management measures will ensure however that the Project does not have a negative impact on fisheries in Vanuatu.

2.1.2.4 *The Forestry Act [Cap 276]*

The Forestry Act (No. 26 of 2001) was developed following a review of the previous Forestry Act (Cap 147 of 1981). The accompanying regulations were developed in 2002 and the Act was subsequently gazetted in 2003. The Forestry Act provides for the protection, development and sustainable management of forests and for the regulation of the forestry sector in Vanuatu and covers:

- > Forestry sector planning
- > Requirements for commercial forestry operations
- > Protection of the forest environment
- > Reforestation
- > Timber export

The Project does not include any subprojects located within forest environments.

2.1.2.5 Water Resources Management Act 9 of 2002

The Water Resources Management Act allows for the designation of policies to protect water resources; and provides for water conservation zones to be established. Section 7 of the Act states that 'a person must apply to the Director for the right to construct, operate or maintain works for any purpose that does not comply with Section 4 or 5, including:

- a) any work in or adjacent to any water or any bore; or
- b) any work whose purpose is to supply water to any other person.'

The majority of subprojects are located across watercourses. As such, this Act applies to the Project and an application to the Director will be made prior to works commencing.

2.2 ADB Safeguard Policy Statement

Safeguard policies are generally understood to be operational policies that seek to avoid, minimise, or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process. ADB's safeguard policy framework--Safeguard Policy Statement, 2009 (SPS)--consists of three policies on the environment, indigenous peoples, and involuntary resettlement.

2.2.1 Environmental safeguards

ADB's environmental safeguards aim to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the Project decision-making process. The SPS requires borrowers to identify Project impacts and assess their significance; examine alternatives; and prepare, implement, and monitor environmental management plans. The SPS requires borrowers to consult people likely to be affected by the Project and disclose relevant information in a timely manner and in a form and in languages understandable to those being consulted.

Proposed projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts.

Projects are classified into the following four categories:

- > **Category A** – A proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required
- > **Category B** – The proposed project's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required
- > **Category C** – A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed
- > **Category FI** – A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities have minimal or no environmental impacts or risks

The Project was classified on a preliminary basis as a Category B project for environment¹ and this IEE forms part of satisfying the requirements of the SPS. An IEE describes the environmental condition of a project, including potential impacts, the formulation of mitigation measures, and the preparation of institutional requirements and environmental monitoring for the Project.

2.2.2 Environmental Assessment and Review Framework

An Environmental Assessment and Review Framework (EARF) was prepared for the Project in 2015. This document is required for projects where the types of activities to be undertaken and types of subprojects to

¹ ADB, 2015, Environmental Assessment and Review Framework, Para, 90

be implemented are known in general terms but only a small number of subprojects might be identified during project appraisal. The framework sets out the processes to be followed for the Project as a whole and for individual subprojects as and when they are identified. The framework covers the types of subprojects to be implemented (in terms of identifying generic impacts and mitigations) and clearly identifies the process to be followed (from screening through to monitoring) and the implementation arrangements (procedures, roles, responsibilities, and budget).

3 Description of the Project

3.1 Project components and location

3.1.1 Purpose

The target impact of the Project is to accelerate economic and social recovery in Vanuatu's Cyclone Pam-affected areas^[5] and contribute to Ni-Vanuatu resilience. The development objective (outcome) is to restore socioeconomic activities of people around the Efate ring road to pre-cyclone levels.^[6] This will be achieved by providing climate and disaster resilient road and bridge infrastructure by protecting and reconstructing priority assets, i.e., to "build back better" (BBB).

3.1.2 Rationale

When TC Pam damaged pavements and structures on the Efate Ring Road, many communities were isolated for days and weeks. This prevented critical supplies and services from being able to reach the villages, and disrupted economic activities for many months. Therefore, the rationale for the Project is that by improving the connectivity security of the Efate Ring Road, economic and social endeavours can be pursued with greater confidence, leading to economic growth and development.

The 20 sites were evaluated and prioritised according to criteria including TC Pam damage, criticality to road network, structure longevity, population served and traffic growth forecasts. At least three options were considered at each site, and these were assessed in conjunction with the priority of each site.

Complementary benefits, such as social facility improvements, environmental protection, climate change adaptation and road safety were integrated. Extensive consultation was carried out to ensure that adverse unintended consequences will not be imposed during construction and operation.

3.1.3 Subproject locations

There are 20 subprojects in the Project. The locations of each are shown in the Figure below. This IEE covers the eight subprojects on the west of Efate Island as shown in **Figure 3-1** and **Table 3-1**.

Note that Teouma and Ulei bridges are not part of the scope of works of this Project and are shown in the figure for reference only.

3.1.4 Existing road and crossing conditions

Site measurements and observations were made during site visits to determine the form and condition of the existing roads and structures. No as-built drawings or geotechnical information for the structures is available. Thus, the observations, measurements and knowledge of current and former staff and contractors was essential to forming a picture of the current conditions, age of the structures, likely remaining service life and maintenance requirements.

The ring road pavements around Efate are in generally good condition. There are some areas near the coast, however, where the storm surge has damaged the pavement.

The crossings on the west of the island are in various states of disrepair due to TC Pam. Damage ranges from destruction of guardrails to distorted steel deck panels and degraded pavement. The current condition of each subproject and relevant photos are discussed in the sections below.

^[5] PAM, Para. 2

^[6] *ibid*



Figure 3-1 Subproject locations

3.1.5 Prima Bridge

Prima Bridge is a single-span, two-lane ("Double Wide") Acrow 300 Bailey type bridge with a TSR3 (Triple Single Reinforced) configuration and a steel deck. The bridge comprises eight (8) standard 10 foot panels giving the bridge an overall length of 24.384 m (80 feet). It has a width of 7.2 m and 1.0 m clear width cantilevered footways are provided on both sides of the bridge. The bridge is supported on concrete abutments but it is not known if these are piled. Protection to the abutments is provided by gabion basket walls.

3.1.6 Mele Bridge

Mele Bridge crosses the Tepukoa River and was originally a single span structure but as a result of Tropical Cyclone Dani in January 1999, the area behind the east abutment was washed out and a second span was subsequently added with the original east abutment being modified to become what is now the centre pier.

Mele Bridge is now a two-span continuous steel composite bridge with two traffic lanes and a 1.6 m clear width footway on the downstream side. It has a skew angle of about 25-degrees. The overall length of the bridge is 20 m with two equal spans. The clear carriageway width between kerbs is 6.8 m and the overall width is 8.8 m which includes the footway. Traffic barriers are provided on both sides of the bridge and these comprise galvanised steel posts and rails.

Existing guard rail height is less than the standard height required. Vegetation is overgrown along the footpath and thereby causes pedestrians to walk on the edge of the pavement. Although significant number of pedestrians use the bridge footway there is no separation barrier provided between the carriageway and the footway.

3.1.7 Klems Hill land slide and road side drain

Klems Hill sustained a superficial landslide on the cutting surface above the road for approximately 300 m and significant scouring on the slope below the road. The road is a concrete pavement on an approximate 15% gradient. The drainage system is partially blocked, exacerbating the effects of the TC Pam rain event.

The road pavement itself at Klems Hill is in good condition. There are sections of road pavement embankment support, however, that are becoming compromised due to erosion.

3.1.8 Creek Ai Culvert

Creek Ai culvert is a two-lane concrete structure comprising three (3) semi-circular corrugated metal pipes each with a radius of 0.8 m. After sustaining damage to the southern end of the structure, the overall length 12.4 m, the carriageway width is 7.3 m and the overall width is 7.8 m. It is being operated as a single lane due to the narrow temporary connection at the southern end. The structure has no kerbs or traffic barriers and there are no guardrails on the approaches. The pipe at the west end is substantially blocked, there is an apron slab on the downstream side but this has been extensively damaged. The culvert is located approximately 300 m upstream from the coastline. The culvert at Creek Ai is currently compromised and results in closures when the flows are high due to large rain events.

3.1.9 Havannah Culvert

Havannah is a single culvert structure. The pipe culvert is in good condition. The guardrails and the pavement have sustained damage and will be replaced and repaired. In addition, the scour protection is not adequate and new measures were designed.

3.1.10 Tanoliu Bridge

Tanoliu Bridge is located in the village of Tanoliu, adjacent to the coastline. It is a single-span, single lane bridge comprising two (2) steel girders supporting a 190mm thick timber deck and having an overall length of 8.4 m. The ends of the beams are cast into the concrete wall abutments. "T" section cross braces are provided at the mid-span and quarter span locations and equal angle cross-bracing is provided in the end bays adjacent to the abutments. The bridge has no footway or traffic barriers but continuous timber kerbs are provided along both edges of the bridge; the clear width between kerbs is 3.3m. Guardrails are provided at all four corners of the bridge. There are no utilities on the bridge however there are overhead power lines that pass about 3m horizontally away from the upstream edge of the bridge.

The Vanuatu Impact Assessment Report prepared in April 2015 stated "There was no impact on the bridge and its approaches due to Cyclone Pam."

3.1.11 Marona Bridge

The structure at Marona is a hybrid structure comprising a single-lane, single span bridge and a multi-cell culvert.

There are no significant structural issues at the site. The bridge beams, deck slab and crossheads were noted as being in sound structural condition. The culvert pipes were all noted as being in good condition with no evidence of corrosion, local collapse or significant siltation.

The Vanuatu Impact Assessment Report prepared in April 2015 stated, "Part of the bridge approach was washed away and five bridge kerbs were damaged. Silt has built up inside the pipes in the causeway structure and the upstream end was blocked."

3.1.12 Malatia Culvert

Malatia Culvert is in working condition but is not large enough for high flows. Extra culverts will be required. In addition, the pavement is in poor condition and appears to be settling or eroding underneath. The culvert has four cells comprising corrugated metal pipes with a minimum internal diameter of 1.5 m. The culvert carries two lanes comprised of a sealed pavement width of 5.6 m and 0.6 m wide unsealed shoulders. 24 m long reinforced concrete parapets are provided along the edges and these have a height of approximately 500 mm above pavement level. The upper section of the parapet beam appears to have been cast onto a pre-existing concrete edge beam that is supported on gabion baskets.

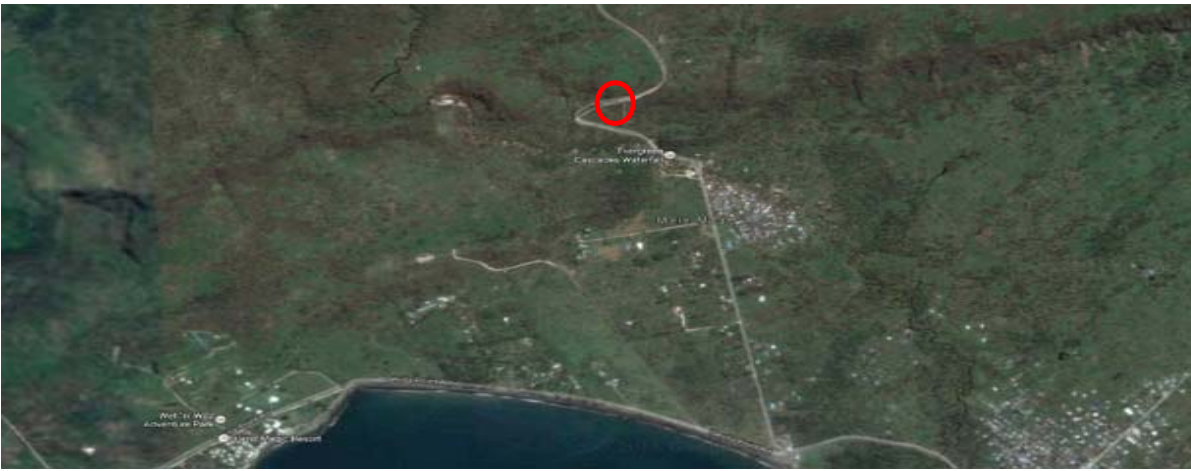
The culvert is located in an area of mangroves, approximately 80 m from the coastline and is in the tidal zone. About 50 m south-east of the site there are coconut plantations on both sides of the road. At the time of the inspection the culvert pipes were free-flowing with no debris blockages. The inspection was made at just after high tide and it was observed that the water level was close to the pipe obvert.

At the culvert site the road has a straight horizontal and vertical alignment, however, there is a sharp curve approximately 130 m to the east.

3.1.13 Subproject locations summary

Table 3-1 Location of subprojects

Subproject	Waterway	Location
Prima Bridge	La Colle River	5.3 km north-west of Port Vila; ~ 750m from the coastline
		
Mele Bridge	Tepukoa	7.5 km north-east of Port Vila ~350m Upstream of the coastline

Subproject	Waterway	Location
		
Klems Hill land slide and road side drain	N/A	14 km north west of Port Vila
		
Creek Ai Culvert	Creek Ai	29 km north west of Port Vila
		
Havannah Culvert	Non-permanent stream	34 km north west of Port Vila

Subproject	Waterway	Location
		
Tanoliu Bridge	Palao River	Tanoliu Bridge is located in the village of Tanoliu adjacent to the coastline 36 km north west of Port Vila
		
Marona Bridge	Marona River	1.5 km upstream the coast 40 km north west of Port Vila
		
Malatia Culvert	Malatao River	50 km north west of Port Vila

Subproject	Waterway	Location
		

3.2 Project scope

There are eight subprojects on the west of the island, which require major works, including two new bridges.

Together, these preferred options at each site form the Project scope. It is now best described in terms of the number of new bridges, new culverts, road formation and pavement works and ancillary works for the western area, as summarised below:

- > Mele and Marona require new single-span, steel truss bridges, to replace existing bridge and culvert structures:
 - Mele will require approximately 600 cubic metres of spoil to be removed to build new abutments and approximately 2000 cubic metres of spoil to be removed for river channelling, with access required to the river. Truck traffic generated was estimated at three movements per hour per working day for eight weeks. It will be necessary to use pile driving equipment for approximately 3-4 weeks.
 - Marona will require significant abutment earthworks and spoil disposal of 300 cubic metres, as the existing deposition of sediments on the eastern side of the current structure will be removed to improve the waterway area under the new high level bridge. Access will be required for a temporary diversion during construction. It will be necessary to use pile driving equipment for approximately 3-4 weeks
- > Prima bridge requires addition of footpaths, replacement of guardrail and river rechannelling. The works will require approximately half of the volume of spoil removal required for Mele Bridge, for both bridge abutment earthworks and river channelling, with access required to the river. Truck traffic generated was estimated at three movements per hour per working day for four weeks. It will be necessary to use pile driving equipment for approximately 3-4 weeks
- > Tanoliu bridge requires replacement of timber decking with prefabricated concrete planks, and cleaning of existing steel beams by grit blasting and then repainting
- > Creek Ai requires a new multi-cell box culvert with greater flood immunity to replace existing low-level pipe culverts to improve channel geometry and riverine fauna passage
- > Malatia requires a series of new relief culverts to increase waterway area for mangrove wetland conservation
- > Roadworks at Havannah culvert will not alter the culvert, but new guardrails, concrete pavement and scour protection will be constructed

- > Klems Hill requires slope stability work involving bored or driven piles, erosion control and perimeter drainage works
- > Drainage and scour protection to sites as required
- > Safety improvements and improved access for laundry and washing at Mele and Prima bridges
- > No construction camp was considered necessary for the construction of the western subprojects

All concept designs are included in Appendix A – Engineering Report, of the main feasibility study report. The options considered, site priority and the selected option at each subproject site is discussed in more detail below (refer **Section 3.6** for discussion on the site prioritisation process).

3.2.1 Prima Bridge

Prima was ranked as priority site No.4, due to its high traffic volume, high population nearby and serviced by the bridge and opportunity for gender-related improvements. Given this, the minimal option (Option A) – undertaking repairs without upgrading it to withstand damage during the next significant event – was not considered acceptable.

Option B, to complete Option A works and replace corroded deck panels, will address long term maintenance costs. This option will not reduce the frequency of waterway overtopping (and bridge closure). PWD requested that this option be selected for detailed design, to optimise the overall cost of the Project.

Option C, a new single-span, two-lane steel truss bridge, was initially recommended at this site. However, Option B was considered to effectively address the site requirements and was selected by PWD.

Key issues resolved during detailed design were:

- > Brand and suitability of deck panel replacement products

3.2.2 Mele Bridge (BR02)

A new single-span steel truss bridge, is recommended at this site. As priority number 1, a new structure that adequately addresses the site objectives (safety, flood and erosion impacts, community) is warranted.

Key issues resolved during detailed design were:

- > Nature of community access and washing facilities to be provided
- > Extent of utilities relocation
- > Extent of approach road reconstruction, including location of Mele Golf Course property access
- > Need for temporary traffic diversion, including temporary crossing structure
- > Access to allow river channelling and sediment removal

3.2.3 Klems Hill land slide and road side drain (GT01-2)

Klems Hill was ranked as priority site No.7, due to its criticality to ring road connectivity, extent of damage sustained in TC Pam, relatively high traffic volume and high population serviced by the road. Given this, the minimal option (Option A) – Repairs and adding top-of-batter drainage – was not considered acceptable.

Option B is to complete Option A works, stabilise the cutting surface by removing overhangs, support the downslope road embankment and improve the road drainage structures including a toe of batter drain. As priority number 7, a series of interventions that adequately address the site objectives (slope stabilisation, drainage improvements) are warranted. Option B is recommended at this site.

Option C, which would include a range of specialised geotechnical stabilisation methods, including soil nails and shotcrete is not considered to be necessary or suitable in the institutional and technical context.

Key issues resolved during detailed design were:

- > Extent of utilities relocation
- > Extent of existing cross-drainage
- > Size and type of piles to support the downslope of the road embankment at the head of the gully

3.2.4 Creek Ai Culvert (CT01)

Creek Ai was ranked as priority site No.5, due to its criticality and vulnerability to ring road connectivity, extent of damage sustained in TC Pam, relatively high traffic volume and high population serviced by the bridge. Given this, the minimal option (Option A) – undertaking repairs without upgrading it to withstand damage during the next significant event – was not considered acceptable.

Option B, to provide a new low level culvert, will address increasing the waterway, but will not notably reduce the frequency of waterway overtopping and debris blockage (and bridge closure). This was also not considered acceptable.

Option C, a new, higher road level, two-lane concrete box culvert structure, is recommended at this site. As priority number 5, a new structure that adequately addresses the site objectives (connectivity security) is warranted.

Key issues resolved during detailed design were:

- > Extent of approach road reconstruction and road geometry conformance
- > Extent of utilities relocation – overhead power lines are adjacent to the existing structure
- > Type and fixing of guardrails to the structure
- > Form of low-flow provision to enable fish passage
- > Need for temporary traffic diversion, including temporary crossing structure
- > Extent of nearby developments and land ownership

3.2.5 Havannah Culvert (CT02)

Havannah was ranked as priority site No.9. This was on account of its criticality to ring road connectivity, extent of damage sustained in TC Pam, relatively high traffic volume and high population serviced by the bridge. Given this, the “do-something” option (Option A) – simply repairing it and providing some additional scour protection and allowing it to be subjected to damage during the next significant event – was not considered acceptable.

Option B is recommended at this site. Option B is to complete Option A works, and provide a concrete road pavement as a causeway for high flows in the event of blockage. As priority number 9, these works that adequately address the site objectives (road safety, scour protection) are warranted.

Option C, which would involve the removal and replacement of the existing pipe culvert with twin pipe culverts is not considered to be necessary.

Key issues resolved during detailed design were:

- > Extent of utilities relocation and protection

3.2.6 Tanoliu Bridge (BR03)

Tanoliu was ranked as priority site No.3, due to its criticality to ring road connectivity, lack of universal access provision, high future maintenance cost and opportunity for gender-related improvements. Given this, the minimal option (Option A) – undertaking repairs on the substandard, non-universal access single lane bridge and leaving high ongoing maintenance costs – was not considered acceptable.

Option B, to complete Option A works and repaint the steel girders with a durable paint system, will reduce the frequency of maintenance, but does not address the vulnerability of the structure to coastal corrosion attack and preserves the substandard single lane structure. PWD requested that this option be selected for detailed design, to optimise the overall cost of the Project. With the inclusion of the replacement of timber deck with concrete, the corrosion susceptibility and cost and frequency of future maintenance is adequately managed.

Option C, a new single-span, two-lane concrete bridge, was initially recommended at this site. However, Option B was considered to effectively address the site requirements and was selected by PWD.

Key issues resolved during detailed design were:

- > Nature of community access and facilities
- > Extent of utilities relocation – overhead power lines are close to the existing structure
- > Need for temporary traffic diversion or road closures
- > Extent of mangrove and fish habitat re-establishment

3.2.7 Marona bridge and culvert (BC01)

Marona was ranked as priority site No.2. This was on account of its criticality and vulnerability to ring road connectivity, extent of damage sustained in TC Pam. Given this, the “do-something” option (Option A) – simply repairing it and allowing it to be subjected to damage during the next significant event – was not considered acceptable.

Option B, to complete Option A works and raise the level of the entire structure, will reduce the frequency of waterway overtopping (and bridge closure), but debris can still get trapped, preserves the substandard single lane structure and may introduce new issues such as structure settlement.

Option C, a new single-span steel truss bridge, is recommended at this site. As priority number 2, a new structure that adequately addresses the site objectives (safety, waterway capacity, connectivity security) is warranted.

Key issues resolved during detailed design were:

- > Requirement and nature of community access and facilities
- > Extent of utilities relocation – overhead power lines are directly over the existing structure
- > Extent of approach road reconstruction
- > Need for temporary traffic diversion, including temporary crossing structure

3.2.8 Malatia culvert (CT04)

Malatia was ranked as priority site No.13. This was on account of its criticality to ring road connectivity, vulnerability to climate change and low traffic volumes. Given this, the “do-something” option (Option A) – simply repairing the damaged scours and pavement dip and allowing it to be subjected to damage during the next significant event – was not considered acceptable.

Option B is recommended at this site. Option B is to backfill scouring and provide bank protection (Elcorock® or similar) as required. In addition, relief culverts will be installed western end and above existing pipes to increase the waterway area. Pavement materials will be removed and replaced with a reinforced pavement (Tensarmat® or similar). As priority number 13, these works that adequately address the site objectives (road safety, scour protection) are warranted.

Option C, which would involve the construction of a new culvert with an increased waterway area and raised road level is considered to significantly disturb the existing natural ecosystem and is not considered to be necessary.

Key issues resolved during detailed design were:

- > Extent of nearby developments and land ownership
- > Stability of the existing culvert structure

3.3 Construction staging

Tender packaging and construction staging of the works has not yet been confirmed. It is likely, however that high priority subprojects will be completed earlier (refer **Section 3.6**).

3.3.1 Tree removal

Given that the scope of works is confined to the existing road corridor, there is expected to be very few trees removed during construction. The concept design shows that the only site where noteworthy vegetation removal will take place for the permanent works is during the scaling and trimming of Klems Hill will be required. Detailed design will confirm.

The construction methodology may require clearing for access, materials storage and site facilities. Clearing will mostly be limited to secondary vegetation which are existing introduced weeds, grasses and shrubs.

3.3.2 Road safety proposals

Guardrails were replaced at every site where guardrails were either existing or required. All existing guardrails at structures were either substandard in alignment, height, connectivity, length or a combination of these. There was no guardrail in several locations where guardrails should have been present and these are provided in the concept design.

Handrails and footways were provided to all new structures and retrofitted to several others.

Concrete footpaths, up to 25 m long, were designed at each site where a bridge footway (either existing or new) ends. This improves pedestrian safety as it prevents vegetation growing on the approach to the footway. And it provides greatly improved access for people with disabilities.

3.4 Construction activities

3.4.1 Equipment and workforce

All sites will require site establishment facilities, road construction equipment (rollers, gravel delivery trucks, water cart, bitumen sealing trucks) and guardrail installation.

At Mele, Tanoliu and Marona, where bridgeworks and river channelling are proposed, specific equipment and workforce requirements are estimated to be:

- > Pile driving rig (Mele and Marona only)
- > Excavation equipment (track mounted excavators, up to 35 tonne)
- > Mobile crane
- > Concrete delivery, pumping and formwork
- > Grit blasting equipment (Tanoliu only)
- > The workforce is expected to peak at 40-50 workers

At Klems Hill, specific equipment and workforce requirements are estimated to be:

- > Bored pile and anchor rig
- > Excavation equipment (rubber tyred and track mounted excavators, up to 35 tonne)
- > Concrete delivery, pumping and formwork
- > The workforce is expected to peak at 20 workers

At Prima, Creek Ai, Havannah and Malatia, specific equipment and workforce requirements are estimated to be:

- > Excavation equipment (track mounted excavators, up to 35 tonne)
- > Mobile crane
- > Concrete delivery, pumping and formwork
- > The workforce at each site is expected to peak at 20 workers

3.4.2 Temporary storage areas

Temporary laydown areas will be established nearby to each location of major works; specifically, where new bridges and culverts will be constructed. These areas would be clearly identified in the site-specific CEMP to be prepared by the Contractor. Subprojects where minor works such as repair of guardrails are required, will not need a temporary storage area.

3.4.3 Source materials

Fill and road base and concrete aggregate materials will be required at some subproject sites. The source (quarry) to be used will be decided by the construction Contractor, based on the required fill characteristics and the economics of transport.

To operate a quarry, the owner or operator must hold a permit under the Quarry Act, issued by the Department of Geology, Mines, and Water Resources. It will be the Contractor's decision as to whether they will select to open their own quarry and submit the relevant permit application, or obtain materials from quarries with existing, valid permits. For the purposes of this assessment, it was assumed that all quarries to be used will be owned and operated by the private sector and all have operating permits in place.

Water will be required for construction activities including drilling, road pavement construction, concrete curing, dust suppression, washing, amenities and ablutions. The Contractor will determine their need for water and the source. If water is required to be used from the waterways, an application to the Department of Geology, Mines, and Water Resources is required under the Water Resources Management Act. A water extraction permit may be granted, defining the conditions of the protection, management and use of water including stormwater and wastewater.

Due to the small quantities of concrete required for construction, and the possibility of pre-casting several elements, concrete batching is expected to take place off-site in a commercial batching plant and/or pre-casting yard. If an on-site concrete batching plant is required, this will need to be addressed in the CEMP.

3.4.4 Other permits

The Contractor will need to seek advice from Airports Vanuatu on the requirements for and Airspace Permit. For all work that requires craneage or piling within the controlled airspace radius of Bauerfield Airport, a permit may be required. This is expected to affect Mele and Klems Hill subproject sites.

3.5 Operation and maintenance

There are operation and maintenance requirements for bridges, culverts and paved road.

Bridge maintenance is determined by the type of bridge being built. Pre-engineered truss type bridges, such as those proposed for Mele and Marona, have maintenance inspection requirements due to the number of components and connections and the risk of vehicle collision damage to the ends of the bridge. To reduce the risk of the latter, guardrails are provided to the bridge approaches and a traffic barrier will be installed on the inside of the truss, to protect the structural members from direct damage.

Sedimentation and blockage by debris of open drains, culverts and under bridges is an ongoing routine maintenance requirement. Based on the observation of the existing culverts with relatively low flows such as Creek Ai and Morona, there is an understanding that such routine maintenance programs have not included such works. The proposed design mitigates this by the rebuilding of culverts with significantly larger cross-sectional area, to reduce blockage risk from debris and slow flow. The minimum low-flow allowances will also enhance fish and crustacean passage.

3.6 Analysis of priority and options

Environmental factors were included in the multi-criteria analysis of sites by scoring each subproject site on a three-point scale as follows:

1. Modified environmental conditions with no significant environmental issues to address
2. Modified environmental conditions with proposed design mitigations to address cyclone damage and reduce risk of subproject impact
3. High risk of significant subproject impacts with design and standard construction mitigations

Environmental factors were weighted in relative terms at 7% of the total. The agreed site prioritisation result, undertaken in consultation with PWD, is listed in the table below.

Table 3-2 Site prioritisation

Code	Site*	Weighted Score	Revised Rank
BR02	Mele Bridge	1.14	1
BC01	Marona bridge and culvert	1.10	2
BR03	Tanolu Bridge	1.09	3
BR01	Prima Bridge	1.04	4
CT01	Creek Ai Culvert	1.02	5
BR05	Lamin Bridge	1.00	6
GT01-2	Klems Hill land slide and road side drain	0.97	7
RD01	Onesua Storm Surge repair	0.95	8
CT02	Havannah Culvert	0.90	9
CT05	Sara culvert	0.89	10
CT07	Neslep culvert	0.85	11
RD02	Pavement works - Teouma to Rentapau	0.83	12
CT04	Malatia culvert	0.78	13
CT10	Eton Dry Creek culvert	0.76	14
CT06	Epau culvert	0.69	15
CT09	Eton Beach culvert	0.59	16
BR07	Rentapau Bridge	0.56	17
CT08	La Cressonniere culvert	0.51	18
BR06	Pangpang Bridge	0.49	19
BR04	Epule Bridge	0.47	20

* Highlighted subprojects are located in the western area of Efate

In parallel with the site prioritisation process and also being informed by the information gathered from communities, surveys and geotechnical investigations, potential works options were developed for each site. These options were classified into three types, A, B and C, according to complexity and cost of the works. Each option included elements of the build back better (BBB) concept.

To guide the development of options, the purpose of any works at each site was established. The activity of thinking about the objectives at each site caused strategic thinking to be applied across a range of sites as well as concentrating the latter discussion of alternatives. Building on the BBB concept, common strategies applied were safety improvements, securing connectivity, increasing structure longevity enhancing environmental and community amenity. Each option developed was checked back against the established site objective, to ensure that each option achieved the purpose, to a greater or lesser extent.

Option A was generally a “repair and restore” scope of work.

Option B generally included all of the works under Option A with a form of enhancement.

Option C was generally a reconstruction option.

The options presented were further developed collaboratively by the DSC team, including the views and information gathered from PWD, agencies, site observations, historical data and experience and community views and concerns. These were presented at the Options Workshop on 24 August 2016 for comment and discussion. After the workshop, comments were considered, combined with additional information gathered, and the options were revised to produce alternatives that were subject to economic analysis, social and environmental screening, engineering feasibility and climate change considerations for this feasibility study.

A preferred option was recommended at each site in the draft feasibility study. This was reviewed by PWD and ADB, who provided comments that changed the scope of work at Prima and Tanoliu (in the western area). These finalised options now form an overall Project scope of work (see **Section 3.2**).

3.7 Build back better

Each option presented for consideration in the feasibility study contains elements to build the infrastructure back better than it was before TC Pam. Known as “build back better” (BBB), the concept is to not only restore roads and their drainage, formations and structures to their former levels of functionality, but to include features that increase the future resilience of critical assets. The underlying intention is that when a similar natural disaster strikes Efate, these structures will not fail in the same ways that caused losses and economic disruption in the aftermath of TC Pam.

The success of BBB relies on the conduct of routine and periodic maintenance. This requires commitment from government for planning and budgeting and from MIPU in particular to implement regular inspections of assets and perform the works recommended by such inspections.

Scopes of work that formed options A, B and C included increasing levels of BBB elements. The prioritisation of sites and matching of appropriate scopes to these sites will ultimately determine the strength of BBB that can be applied to a particular site.

The BBB principles adopted for this Project include:

- > Climate change design parameters
- > Resilience to future disasters
- > Road and pedestrian safety
- > Permits
- > Environmental restoration
- > Community engagement

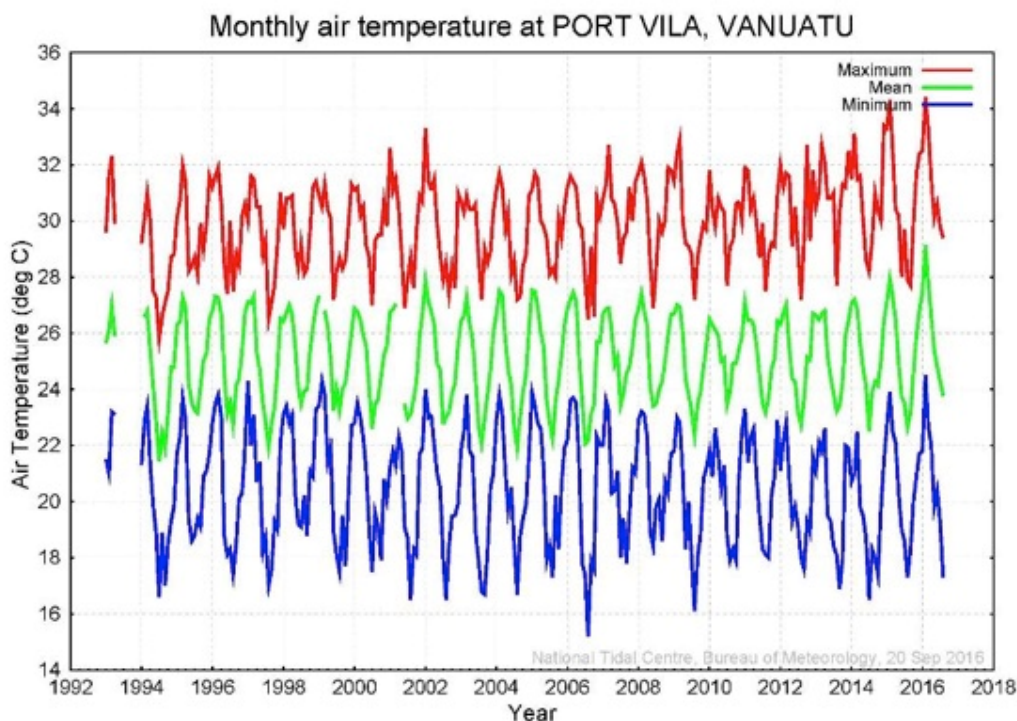
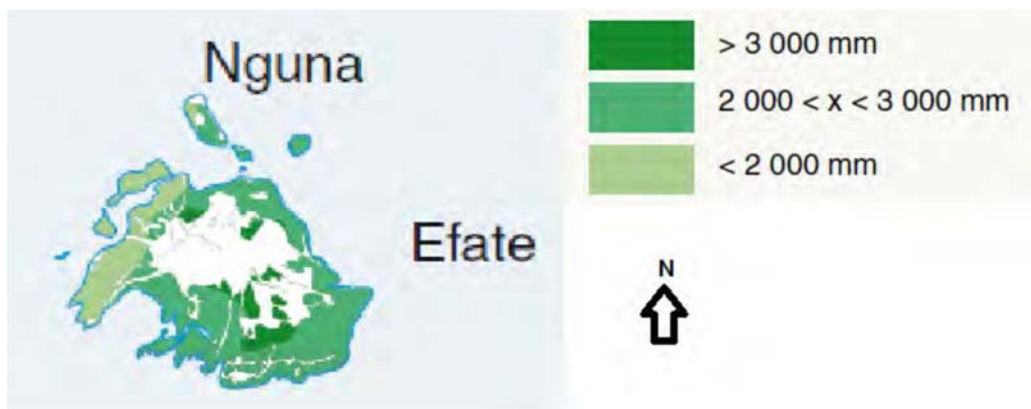


Figure 4-2 Monthly air temperatures in Port Vila

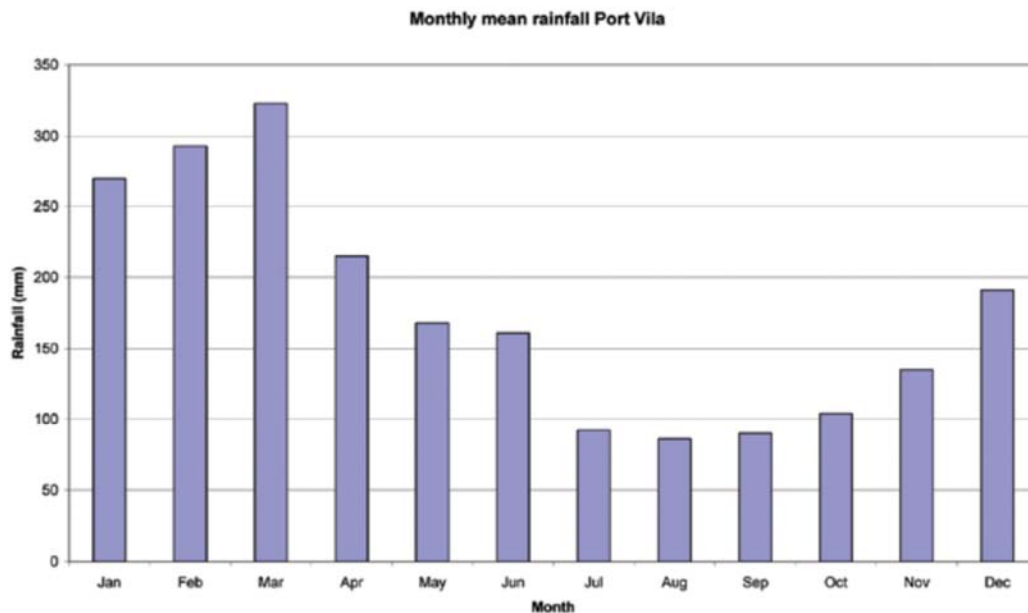
Rainfall distribution patterns across Vanuatu is determined by seasonal wind flow, topographic features (i.e. rain shadow effects) and the South Pacific Convergence Zone (SPCZ). During the wet (hot) season, rainfall is higher on the south east, the windward side. On Efate, annual rainfall ranges from 2400-3000 mm on the east and is almost half that amount on the leeward/west side. The wettest month in Vanuatu is usually March and the driest month is August (Government of Vanuatu, 2014).



Source: Simeoni and Lebot, 2012

Figure 4-3 Rainfall pattern

Mean rainfall in Port Vila, in the south west of the island) is presented in the figure below. The wettest month in Vanuatu is usually March and the driest month is August.



Source: Vanuatu Meteo, 2016

Figure 4-4 Mean rainfall, Port Vila

Cyclone season in Vanuatu is between November and April, when it receives 2-3 cyclones a season on average. The greatest frequency is in January and February. Historically, during the course of ten years, Vanuatu is hit by three to five destructive cyclones.

4.2.2 Geology and soils

Vanuatu is composed of 83 volcanic islands formed during the Miocene Era. The Project is located on Efate, a volcanic and raised coral island in the Shefa province of Vanuatu. The geology is composed of volcanic deposits, estimated to be less than 3 million years old. The island has manganese, limestone, pozzolana and possibly gold deposits (Republic of Vanuatu, 2014).

The geology of Efate, as described by Ash et al, (1978), comprises three major rock formations:

- > Efate Pumice Formation – a Pliocene-Pleistocene series of submarine pumice tuff and breccias occurring the central part of the island
- > Pleistocene Basalt Volcanic Formation –this cannot be demonstrated in the field because of poor exposure
- > Late Pleistocene to Recent Reef Limestone Formation – an extensive series of limestone terraces overlaying the two older volcanic formations. It has an extensive outcrop totalling nearly 500 km² on Efate and near-shore islands (Ash et al. 1978)

Alluvial soil areas are limited across the island with the largest area on the floodplain to the south east of the island with two larger rivers – the La Colle and Tepukoa and where both Prima and Mele subprojects are located. In relative terms erosion rates have been found to be low compared to other Pacific countries (Dumas P,M Fossey, 2009).

4.2.3 Hydrology

Fresh water is an important resource in Vanuatu and is used for the following purposes around the islands:

- > Household use, including washing; often done at source
- > Traditional taro irrigation/cultivation
- > Small scale aqua culturing of introduced fish, *Tilapia niloticus* and freshwater prawn, *Macrobrachium lar*

- > Drinking water for domesticated animals

In the capital, Port Vila, aquifers are the main source of water, and the urban water supply is distributed by UNELCO. These aquifers are under increasing pressure from housing, agriculture, tourism and land development. Outside of the areas of the reticulated supply, no formal assessment has been made on the available water resources (SPC, 2012).

4.2.3.1 Surface water

The western area of Efate has a number of surface water sources, including creeks, rivers and lakes. With the exception of Klems Hill, each subproject is located at a waterway crossing on the Efate ring road. In the west, these are:

- > La Colle River
- > Tepukoa River
- > Creek Ai
- > Havannah Creek
- > Tanoliu
- > Marona
- > Malatia

4.2.3.2 Groundwater

Anecdotal evidence suggests that groundwater resources in some parts of Vanuatu such as around Port Vila are diminishing. Anecdotal evidence and sporadic water quality testing also indicate “hotspots” for water pollution. Infrequent testing programmes and poorly maintained records mean creating a comprehensive water resource picture is difficult (SOPAC, 2007).

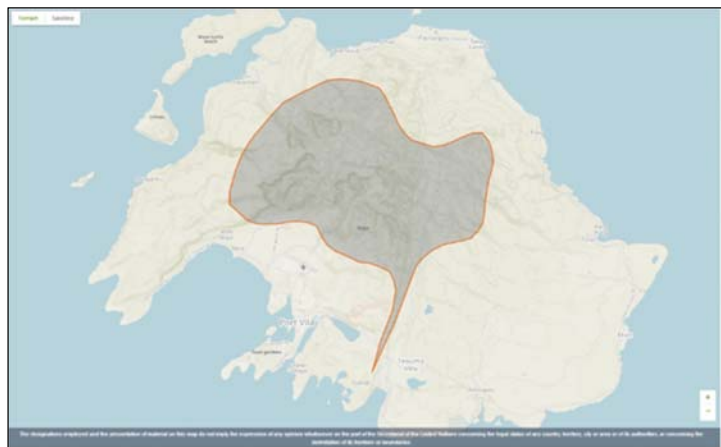
4.3 Biological resources

Mangrove ecosystems only cover 0.2% of the total land area of Vanuatu, primarily on Malekula Island (~2,000 ha). Other sizable stands occur in another eight (8) of the 80 islands. On Efate, mangroves only cover 10 ha (0.1%) of the island. They have been previously cleared for various developments as well as being felled for firewood and building materials.

This is evident at Havannah Bay, where anecdotal evidence suggests that mangroves have been removed for coastal development. The historical mangrove coverage is currently under further investigation.

4.3.1 Sensitive areas

There are 34 protected areas in Vanuatu, covering 538 km² (4% of total land area). Only one is located on Efate – Central Efate forest conservation area (Teouma) in the centre of the island (see **Figure 4-5** below). Approximately half of this area is in the western area, as defined for this IEE (refer **Figure 4-1**).



Source: Protected Planet, 2016

Figure 4-5 Central Efate forest conservation area

Vanuatu has eight (8) existing wetland sites (2009 Wetland Inventory), two (2) of which are on Efate Island. Neither are within close proximity to subproject sites in western Efate (Government of Vanuatu, 2014).

The Vanuatu National Biodiversity Strategy Action Plan (Environment Unit, 1999) lists places and habitats of conservation significance in three categories. Those relevant to western Efate are:

- > Important places
 - Bat caves in Malo, north west Malekula, Efate, Santo and Vanua Lava
 - Mangroves on Efate, Malekula, Santo and Vanua Lava
 - Rivers on Maewo, Tanna, Vanua Lava and Efate
 - Creek Ai
- > Places that are damaged or degraded due to human impact
 - Mangroves throughout Vanuatu
 - Rivers on Tanna, Efate, Maewo and Vanua Lava
- > Vulnerable places
 - Mangroves throughout Vanuatu
 - Rivers on Tanna, Efate, Maewo

4.3.2 Terrestrial flora and fauna/land cover

4.3.2.1 Birds

Vanuatu has 126 recorded bird species, including 11 endemic, 16 migrant and 8 introduced species. One endemic species is now extinct (Republic of Vanuatu, 2014). The endemic species relevant to the western area are presented in the table below.

Table 4-1 Endemic bird species

Scientific name	Common name	Conservation status	Habitat
<i>Ptilinopus tannensis</i>	Tanna Fruit Dove	Least concern	Endemic to Vanuatu, it occurs on most islands. It inhabits old-growth rainforest, and also degraded habitats with large fruiting trees, including open woodland, parkland, plantations and gardens. It is most common in the lowlands and hills, but is also present in mountains to at least 1500 m
<i>Charmosyna palmarum</i>	Green Palm Lorikeet	Vulnerable	as a fluctuating range in the Santa Cruz islands of the Solomon Islands and in Vanuatu. It appears to occupy high montane altitude forest at elevations in excess of 1,000 m, but flocks regularly descend to coastal trees, especially to feed on coconut blossoms
<i>Aplonis zelandica rufipennis</i>	Rusty-winged Starling	Not yet assessed	Central and North Vanuatu and Banks Group
<i>Erythrura (cyaneovirens) regia</i>	Royal Parrot Finch	Vulnerable	The bird is endemic to Vanuatu. It has been recorded from most islands in the archipelago but has not been observed for many years on several islands, such as Aneityum, and may be locally extinct on these. There are recent records, often

Scientific name	Common name	Conservation status	Habitat
			of single birds, on Gaua, Espiritu Santo, Efate and Epi.

Source: Republic of Vanuatu, 2014; IUCN RedList 2016

4.3.2.2 Mammals

Vanuatu's terrestrial mammal species are represented solely by nine (9) known bat species and two (2) subspecies (see table below). One has become extinct in Vanuatu; and another is awaiting verification. They also have nine (9) marine mammal species (Government of Vanuatu, 2014):

- > Dugong – *Dugong dugong*
- > Humpback Whale – *Megaptera novaeangliae*
- > Blainville's Beaked Whale – *Mesoplodon densirostris*
- > Ginkgo-toothed Beaked Whale – *Mesoplodon ginkgodens*
- > Hector's Beaked Whale – *Mesoplodon hectori*
- > Pantropical Spotted Dolphin – *Stenella attenuata*
- > Striped Dolphin – *Stenella coeruleoalba*
- > Spinner Dolphin – *Stenella longirostris*
- > Fraser's Dolphin – *Lagenodelphis hosei*

Table 4-2 Bats of Vanuatu

Scientific name	Common name	Status	Habitat/distribution
Fruit bats (<i>Pteropodidae</i>)			
<i>Notopteris macdonaldi</i>	Fijian Blossom-bat	Vulnerable	restricted to Fiji and Vanuatu. Occurs in Efate, among other islands. Roosts in caves and forages in lowland forests and intermediate altitude vegetation.
Insectivorous bats			
<i>Miniopterus tristis</i>	Great Bent-winged Bat	Least Concern	A native species, known from the islands of Espiritu Santo and Efate in Vanuatu. Roosts only in caves and forages in agricultural areas and disturbed lowland forest near sea level
<i>Miniopterus australis</i>	Little Long-fingered Bat	Least Concern	Native to Vanuatu, this bat is found roosting in colonies in caves and tunnels, and may also be found roosting in tree holes. It forages for insects in rainforest, Meleleuca swamps and dry sclerophyll forests. Unlikely to be affected by this proposal

Source: IUCN RedList

4.3.2.3 Reptiles and amphibians

Vanuatu has 40 amphibian and reptile species, 32 of which are native, nine (9) are endemic and four (4) are introduced (Government of Vanuatu, 2014).

Table 4-3 Amphibians and reptiles of Vanuatu

Scientific name	Common name	Status	Habitat/distribution
Amphibia			

Scientific name	Common name	Status	Habitat/distribution
<i>Litoria aurea</i>	Green and golden bell frog	Vulnerable	This frog was introduced to Vanuatu in the 1960s and is native to Australia. It is found in Efate, Malekula and Santo islands. The natural habitat requirements of the species have proved difficult to define because it has been associated with almost every type of water body except fast-flowing streams. There also appears to be some confusion over whether or not forested habitats are utilized by the species (Hero et al 2004).
Reptilia			
<i>Brachylophus bulabula</i>	Banded Iguana	Endangered	Banded Iguanas are native to Fiji and were Introduced to Vanuatu by a reptile dealer in the 1960s. It is found on Efate Island. The Fiji Banded Iguana lives in both wet and dry forest, but wetter forests contain preferred plant species. Iguanas are sometimes found in marginal habitats of non-native plants, native hibiscus, and degraded forest around resorts and also along ocean margins, but always where trees are at least six meters in height (Fisher et al 2012)
<i>Gehyra oceanica</i>	Oceanic Gecko	Least concern	This is a nocturnal, arboreal gecko. It occurs in primary and secondary forested habitats and coastal thickets. It also occurs in edificarian habitats such as rural gardens and urban areas and many populations are commensal with humans (Fisher et al 2015). IT is known to occur on Efate Island.
<i>HeMIPU DPWactylus frenatus</i>	Common House Gecko	Least concern	This gecko was introduced to Vanuatu. It is a nocturnal species which is found on boulders, beneath rocks or rotting logs, on trees, and, most commonly on buildings. This species is found in both villages and large urban areas; it is usually found close to electric lights at dusk. In addition, this species also occurs in a diverse range of habitats, including rain forests, savannahs, and deserts (Ota and Whitaker 2010). This species is found on Efate Island.
<i>Lepidodactylus vanuatuensis</i>	Vanuatu Gecko	Least concern	Endemic to Vanuatu, this gecko is known from Efate, Espiritu Santo and Anatom Islands. It is likely, however to occur on all main islands (Hamilton et al 2013).
<i>Emoia nigromarginata</i>	Vanuatu Silver Vineskink	Least Concern	Endemic to Vanuatu, it has been recorded from Efate Island, Pentecost Island, Malakula Island, Espiritu Santo Island, and Ambrym Islands, although it is possible that this species is limited to Efate Island and specimens from other islands may represent different species. This is an arboreal species, found in areas covered by seral or climax forest, and to a lesser extent , in areas with reduced tree cover such as strand forest, partly cleared forest, tree-studded pastures and gardens and plantations (Hamilton et al 2013).
<i>Emoia sanfordi</i>	Vanuatu Green Tree Skink	Least Concern	Endemic to Vanuatu, this skink is found from the Torres Islands south to Efate. This is a strongly arboreal species, and can be found in overgrown coconut plantations, primary forest, secondary forest, rural gardens, trees within villages (Harlow 2013).
<i>Lipinia noctua</i>	Moth Skink	Not yet assessed	An arboreal skink that occurs in Santo, Malo, Aore, Pentecost, Malakula, Ambrym, Epi, Efate, Tanna, and Anatom. (Reptiledatabase 2016)

Source: IUCN Redlist, www.iucnredlist.org/

Sea turtles are protected by Fisheries Regulations Order No. 28 of 2009 developed under the Fisheries Act No. 315 of 2009. In some islands of Vanuatu, sea turtles are hunted as protein for the traditional new yam harvesting season from the month of April to June every year. The traditional harvesting has been accommodated in this Regulation through a quota system that allocates a quota each year for the islands still practicing this tradition (Government of Vanuatu, 2014).

4.3.2.4 Flora

There are 171 families of plants in Vanuatu with 842 genera and over a thousand species. The department of Forestry maintains the Vanuatuflora database on their website (Republic of Vanuatu, 2014).

Thirteen species of mangroves are found in Vanuatu, listed below. The exact species at Malatia and Tanoliu have not yet been positively identified and information has been sought from DEPC to confirm. This will allow the EMP to properly inform the contractor of replanting requirements:

- > *Avicennia marina*
- > *Bruguiera gymnorhiza*
- > *B. parviflora*
- > *Ceriops tagal*
- > *Excoecaria agallocha*
- > *Heritiera littoralis*
- > *Lumnitzera littorea*
- > *Rhizophora sylosa*
- > *R. mucronata*
- > *R. apiculata*
- > *Sonneratia caseolaris*
- > *S. alba*
- > *Xylocarpus granatum*

4.3.3 Estuarine and freshwater flora and fauna

Previous studies on the freshwater fauna of Vanuatu (Keith et al 2010) indicate that there are nine (9) eel species, six (6) *Microphis spp.* (pipefish), 37 other fish species and 29 crustacean species in the country. On Efate Island, six (6) endemic species were found (see table below) (Republic of Vanuatu, 2014).

Table 4-4 Endemic freshwater species

Scientific name	Common name	Conservation status	Habitat
<i>Sicyopterus alensis</i>	Creek Ai goby	Near threatened	This species inhabits clear fast flowing streams with gravel and rocky substrate. It feeds by scraping algae from rocks. The species is amphidromous and the embryonic development takes place in freshwater. Larvae are carried to sea after hatching and develop into post-larvae over 70–80 days, ready to return to freshwater. There has been a documented decline in this species' range since the species was described (within two or three years). The habitat range of this species continues to decline (P. Keith pers. comm. 2011, Lord 2009).
<i>Stiphodon mele</i>	Mele's stiphodon	Data deficient	This species inhabits clear and high gradient streams with rocky substrate. Individuals are mostly found on riverbeds on top of rocks and also found swimming in open water in currents between rocks or large pools (Keith et al. 2009).

Scientific name	Common name	Conservation status	Habitat
			During a 2009 survey of the Mele River in Vanuatu, only two specimens were collected (D. Boseto, pers. obs. August 2009). The species appears to be naturally rare.

4.3.4 **Invasive species**

There are nine known invasive species occurring in Efate Island, as listed in the Global Invasive Species Database (ISSG 2016); three flora species and six fauna species. Only one of the fauna species and several of the flora species were observed at the subproject sites:

- > *Achatina fulica* – Giant African Snail (seen at several subproject sites)
- > *Lantana camara* – Wild Sage (TBC by DEPC)
- > *Macfadyena unguis-cati* – perennial, climbing liana (TBC by DEPC)

4.4 **Socioeconomic, land and cultural resources**

4.4.1 **Land use systems**

Vanuatu has a total land area of 1.23 million hectares. Land use division is as follows (as at 2011):

- > Agricultural land – 15.3%
 - Arable land – 1.6%
 - Permanent crops – 10.3%
 - Permanent pasture – 3.4%
- > Forests – 36.1%
- > Other – 48.6%

74% of this (900,000 ha) was forested in 1993. In 2010, forested area was estimated at 440,000 ha (36%) so there was a period of significant clearing of native vegetation. All logging activity has now been stopped.

4.4.2 **Community profiles**

The following figures and information was obtained from the 2009 Census, a more detailed description of the communities (and impacts upon them) may be found in the social safeguards Due Diligence Report.

4.4.2.1 ***Mele – Mele Area Council***

Mele is located 8 km northwest of Port Vila and is part of the Mele Area Council. It is the largest village on Efate with a population of 2118 in 388 households. Of these 1069 are males and 1049 are females.

Unlike many of the villages on Efate further from Port Vila, Mele has ease of access to amenities and basic services that are readily available in Port Vila. There is relatively more development within and around the village, which has largely contributed to the livelihoods of the people. There are numerous tourist resorts with accommodation, bars, cafes and restaurants, outdoor adventures and tours, gardens, lookouts, picnic and swimming areas and waterfall tours nearby and along Devils Point Road.

Thus, the main sources of income come from tourist related activities, as well as agriculture, rearing of pigs and chickens, and fishing. A large portion of the population have paid jobs in Port Vila town. There are a number of retail shops which are either family owned and operated or are community cooperatives. Sand mining activities for supply of construction aggregates, is also an income generator for the villagers.

Mele Trustees Ltd was established to manage the village resources, in particular, land and natural resources and to fairly distribute benefits to the community. Nevertheless, individuals and or families are also engaged in the sale of customary land to interested individuals.

Mele, being the largest village on Efate, has the most diverse representation of religious denominations. They include Presbyterian, Assemblies of God, Neil Thomas Ministries, Jehovah's Witnesses, Mormons,

Seventh Day Adventists, United Pentecostal and Islam. There are other Christian denominations that do have a church building within the Mele area, but have members in the village community.

French and English-speaking primary schools, a few kindergartens and a health clinic are all accessible and located within the village. Children from Mele also travel to and from school in Port Vila. Most diseases are treated at the clinic which serves the Mele Area Council, including several nearby villages. Mele shares many of its services such as health centres and schools with the nearby Melemaat Village. Melemaat Village is located on land that traditionally belongs to Mele Village. Villagers there originated from Maat Village on Ambrym island, and were relocated by the government to this current site on Efate, due to a volcanic eruption that occurred in 1951. The villagers at Melemaat also have gardens around Klems Hill and work in the tourism industry around the area as well as in Port Vila town.

Mele is connected to the UNELCO power grid and has its own water supply with the source located at Klems Hill above the Teae River. Mobile phone reception and network coverage is generally good and most villagers own a mobile phone.

The Project sites within this area are: Klems Hill, Mele bridge and Prima bridge.

4.4.2.2 *Mangaliliu – North West Area Council*

Mangaliliu, located 18 km from Port Vila, is part of the North West Efate Area Council. The locals are originally from Lelepa Island, but have migrated to live on the mainland. Of the population of 266 villagers, 136 are males and 130 are females. It has 56 households.

Like other villages, the main sources of income are from subsistence agriculture and fishing activities. Occasionally, income is generated through tourist related activities involving community members, such as cultural site visits, and picnic and swimming areas. Villagers are also involved in the production of charcoal which is used for cooking on charcoal stoves. This is sold in the village and is also transported for sale at the Port Vila central market.

An English-speaking primary school and Aid Post are all accessible and located within the village. However emergency cases are either referred to either Lelepa Health Centre, or transported to main Port Vila Central Hospital.

Mangaliliu is the site of the UNESCO World Heritage Site – the home of Chief Roimata, an iconic chief who lived in the 17th Century. Upon his death, 50 of his wives were also buried alive with him on the renowned Eretoka or Hat Island.

A land sub-division has also been established near the village, where investors have started purchasing land and have started constructing permanent houses.

The Project site within this area is: Creek Ai culvert.

4.4.2.3 *Tanolu – North West Efate Area Council*

Tanolu village is located 25km from Port Vila. It comes under the jurisdiction of the North West Efate Area Council and has a population of 158, of which 80 are males and 78 are females. There are 29 households. Tanolu has close ties with Moso Island, a nearby island that has a population of about 240, known for fishing charters and picnic areas. It also has close ties with the village of Malafau about 2 km north of Tanolu (on the mainland), with a population of about 30. They also depend on agriculture and fishing as the main economic activities.

The main sources of income for the Tanolu villagers are from agriculture with some fishing activities. A large portion of adults comprise the workforce at a number of tourist resorts in the surrounding area such as the 4-star Havannah Resort. A few also commute to Port Vila for paid jobs, working in private companies, shops and hotels. There are also occasional tourist activities, such as cultural tours and local food tasting, in which community members are involved in. Women sell handicrafts and artefacts on the road stalls. Villages are also involved in production of charcoal which is sold in Port Vila.

The increased economic activities around the area, has improved livelihoods of the villagers. This is reflected in the dwelling or housing types in the village, where most are permanent buildings. The village has its own water supply system sourced from a local spring, and some private water tanks.

The National Disaster Management Office (NDMO) has recently set up a disaster centre within the village, due to the area being vulnerable to natural disasters and there being a secondary school nearby.

The village has a secondary and primary school – Ulei Primary and Junior Secondary Schools, within 200m of the village. Students from other villages and islands also attend at the Junior Secondary School.

Various Christian affiliated denominations are represented in the village – the main ones being Presbyterian Church (largest membership), Assemblies of God and Jehovah's Witnesses.

Tanolu was formerly used as a base for the Americans during World War II. Many artefacts, such as Coca Cola bottles and remains of artillery equipment, can still be seen around the area. The old American swimming pool still exists near Ulei Junior Secondary School and is still frequently being used by students, villagers and visitors.

The Project sites within this area are: Marona culvert and Tanoliu bridge.

4.4.2.4 Siviri – North Efate Area Council

Siviri Village (30 km from Port Vila) is part of the North Efate Area Council with a population of 97 resident villagers. Of these, 51 are males and 46 are females. There are 21 households. The population of Siviri has decreased over the past decade. Some families have moved to resettle at Malufau village, several kilometres away from the main Siviri village (about 2 km north of Tanoliu), due to reasons related to land disputes within the community. The other reason for this move was for the benefit of living closer to fertile land, 8km from Siviri village, which is utilised for agricultural purposes and is the main gardening grounds for the villagers.

The main source of income for the village is mainly subsistence agriculture and fishing. The men are usually engaged in fishing and women are involved in the sale of garden produce and cooked food, such as the local *laplap*, shellfish and fish, all at the Port Vila central market. There are also tourist activities within the area such as the Siviri cave and beach and swimming areas which can be hired by the public for picnics.

The majority of the children from Siviri attend Malatia Primary School, which is located approximately 1.5 km eastwards from the village. Secondary school students either attend Onesua Presbyterian College or commute to Port Vila to attend school. A communal water supply is available in the village with some individual villagers owning tanks storing rainwater. An aid post within the village provides basic health services, while emergencies and serious cases are referred to the Paunangisu Health Centre and the Port Vila Central Hospital.

Anecdotal reports indicate that numerous land sales have taken place around the area. To the east of Siviri village is the Undine Bay Plantation, a former commercial coconut plantation but now leased. A section of this leased land was turned into a marina by a private developer who is also the lessee of that part of the land. Private boats and yachts use the marina. The entrance to the marina is adjacent to the Malatia river mouth.

Part of the Undine Bay Plantation lease was reportedly taken over by UNELCO and the company has recently used the some of this land for a solar power project.

The Project site within this area is: Malatia culvert.

4.4.3 Economy

The majority (73.9%) of the Vanuatu population lives in rural areas and 65% of the labour force are engaged in agricultural production. This is primarily subsistence production for their own use; as such the economic value of primary production is disproportionately small (Department of Strategic Policy, Planning and Aid Coordination, 2011).

Gross domestic product (GDP) in 2015 was USD 685 million, with growth rates of 2% in 2013, 2.3% in 2014 and an estimated 0.9% in 2015 (due to TC Pam). The structure of Vanuatu's GDP in 2015 (est.) was comprised of:

- > Services – 61.1%
- > Primary (agriculture, including forestry and fisheries) sector – 30.2%
- > Manufacturing – 8.7% (CIA, 2015)

The high proportion of GDP generated in services is a reflection of:

- > Tourism-related activities – restaurants, hotels, and transportation
- > Public administration
- > Offshore financial services sector (Department of Strategic Policy, Planning and Aid Coordination, 2011).

Since 2002, the Vanuatu government has increased efforts to promote tourism by improving flight connections, resorts, and cruise ship facilities. Australia and New Zealand are the main source of tourists (CIA, 2015). Economic development in Vanuatu is hindered by:

- > Dependence on a small number of commodity exports
- > Vulnerability to natural disasters
- > Long distances from main markets and between constituent islands (CIA, 2015)

Tax revenue is derived mainly from import duties (CIA, 2015).

4.4.4 Traffic volumes

Traffic data was obtained by conducting a traffic count at three locations (Mele, Rentapau, Takara) on the ring road and by holding interviews with selected drivers (origin and destination survey). The 24-hour traffic counts were conducted over three days, from 3-5 August 2016. The days selected aligned with a cruise ship day, normal work day, and peak market transport day.

The data has been contrasted and compared against data from previous traffic counts in 2008 and 2010, as well as a recent traffic count conducted by PWD in August. The data was used to inform a traffic growth forecast required for the pavement design and economic analysis and as a baseline for monitoring and evaluation (MandE) indicators.

4.5 Subproject specific existing environment

The environmental conditions at each subproject site on the west of Efate are presented in the table below.

Table 4-5 Subproject specific existing environment

Subproject	Physical environment	Biological environment	Socio-economic environment
Prima Bridge	The geology and soils of the area are alluvium. The floodplain makes up an area of approximately 30 km ² of this type of material and is the largest area of alluvial soils in Efate. The presence of significant amounts of this material has led to sedimentation in the river bed.	No mature trees Vegetation consists primarily of bamboo, papaya, banana, cassava and tall grasses A highly modified environment. The river supports local species of fish and crustaceans	A school is situated north-east of the bridge, with an entrance not far from the bridge, down an informal pathway. Population density is relatively high. Used for washing and bathing 
Mele Bridge	The geology and soils of the area are alluvium. The floodplain makes up an area of approximately 30 km ² of this type of material and is the largest area of alluvial soils in Efate. The presence of significant amounts of this material has led to sedimentation in the river bed.	Small stand of mature trees north-east of the bridge Small garden south-west of bridge, consisting of banana and cassava plants Clearing of vegetation had just occurred in the north-east during site visit October 2016	A golf course south-west of the bridge. Population density is relatively high. Used for washing 
Klems Hill Landslip	This site is made up of a long narrow outlier of volcanic pumice (breccia) and is sloping steeply up from the alluvial floodplain below	Well vegetated; primarily regrowth from pervious erosion nearby site	There are residences below the current drainage lines which require careful design mitigation

Subproject	Physical environment	Biological environment	Socio-economic environment
			
Creek Ai Culvert	The project is located within a small pocket of alluvium on the northern section of the creek which becomes volcanic pumice (breccia) further upstream) and is unusual as the only one of the streams directly flowing out of volcanic material directly above the alluvial deposits adjacent to the coast. Flow in the creek was also heavily affected by Cyclone Pam with very high and fast flow flows. Normal flow of the Creek has also been greatly altered by earthworks and reclamation along either side of the culvert, both up and downstream. Heavy algal blooms downstream present during October site visit suggests cattle grazing upstream and watering in Creek and/or uncontrolled development activity. It could also be temporary dependence in the lower section of the creek on tidal movements due to lack of significant freshwater flows.	Creek Ai has been identified as an important environment area Home to the Creek Ai Goby only recently identified which is described as near threatened. It is a heavily vegetated stream; heavily modified and cleared around the culvert. Mature mango and coconut trees are nearby. Fish species upstream of culvert primarily freshwater species; downstream sees some brackish water and coastal species. Species are amphidromous returning for spawning areas upstream after drifting as larvae into saltwater. Creek Ai is the only stream listed in the Vanuatu National Biodiversity Strategy Action Plan in its highest category as an Important Place.	There are two residences adjacent to culvert Used for washing and bathing downstream Creek provides boat docking area, with access to the sea for fishing during high tide 

Subproject	Physical environment	Biological environment	Socio-economic environment
Havannah Culvert	Steep drop downstream of culvert that is heavily eroded.	Large, mature trees dominate the environment.	Resort just north-west of culvert 
Tanoliu Bridge	Located adjacent to the coast The Sanoa Marine Protected Area (community led initiative) is nearby	There are mangroves present upstream but the immediate vicinity of the bridge is highly modified due to the proximity of the village also up stream Fauna species associated with mangroves present in large numbers (e.g. fiddler crabs, mangrove crabs, mudskippers, hermit crabs)	Residence situated north-east of bridge. A bench is located south-west of the bridge for use as waiting area for busses. For people travelling and commuting from the adjacent off shore islands. Mangroves are exploited in the area for charcoal production. 
Marona Bridge	The geology is a large pocket of alluvium which forms a small floodplain with approximately four kilometres of channel and is surrounded on all sides by steeper older raised limestone. Water quality is affected by upstream sources of pollution with algal blooms observed downstream of the structure which may be due to cattle watering in the	Vegetation primarily tall grasses. One mature tree north-east of bridge that should be noted during design as it is the only large tree in the area and within the sub-Project impact area. The ecosystem has been significantly modified in the vicinity of the proposed bridge.	Isolated location with no adjacent sensitive receptors

Subproject	Physical environment	Biological environment	Socio-economic environment
	stream or use of fertilizer and insecticides.		
Malatia Culvert	The wetland area inland of the bridge has been affected by draining and pockets of local agriculture. Geology and soil based on a small packet of alluvium following the northern section of the river	Mangrove ecosystem of approximately 6 Ha is important resource due to the loss of other mangrove systems in Efate. This system is currently affected by a proposed Stage 2 of a marina sub-division which may affect its further viability.	No adjacent sensitive receptors. This area is known for harvesting of mangroves to make charcoal for household heating and cooking. 

5 Environmental impacts and mitigation measures

5.1 Screening of potential impact

All subprojects were assessed for all three phases of the Project: pre-construction, construction and operations, across three components of the environment, for each major activity.

Impact mitigation matrices using a range of relative criteria, were completed, using the assumption that proposed design and standard pre-construction and construction mitigations are not implemented. The effect of implementing design and standard construction mitigations will be to lower environmental risk. The complete matrices are in **Appendix A**. A description of the impacts and proposed mitigation measures for each subproject in western Efate is set out below.

5.2 Prima Bridge

5.2.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor
- > Additional land beside the bridge will be required for access to the bridge surrounds
- > Presence of both foreign and local construction workers of up to 30 on-site personnel
- > Preparation of a working area near the bridge inside the corridor for in channel works.

5.2.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the bridgeworks with maximum flood levels taken into consideration.

5.2.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover. Plant species near the bridge are common in the designated subproject area.

There will be mitigating measures included in the CEMP to ensure minimization of impacts from vegetation removal which include:

- > Vegetation clearance during surveying and demarcation activities of trees along the river banks. There are no road side trees of significant height that will be affected
- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.2.1.3 *Social environment*

It is normal practice for PWD contractors to pay damages for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the bridge. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.2.2 Construction impacts

5.2.2.1 *Physical environment*

Construction involves the following activities:

- > Earthmoving for channel and bank excavations and stockpiling of materials for reuse in Elcorock® bags
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Transportation of construction materials such as sand, gravel, cement and guard rail components
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Removal of sediments and re-channelling of the river immediately up and downstream of the bridge
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)
- > Preparation of a temporary construction access into the channel to carry out scour protection and river channelling, possibly both up and downstream
- > Excavated sediments to be used in situ in Elcorock® bags
- > Removal of any excess sediments by tip trucks

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The bridge is located near the mouth of the La Colle river which is part of a large alluvial floodplain, including part of the Port Vila urban area. Consequently, during flood conditions (which are frequent due to high rainfall in this section of the study area) there is potential for significant loss of topsoil and sandy sub-soil from urban agriculture and other types of urban development.

Sedimentation of the river has occurred which will require removal as in the case of Mele bridge.

The risk of sedimentation and erosion caused by the construction is considered low but if required, soil erosion and sedimentation impacts will be mitigated by:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the Contractor causes damage to agricultural land upstream, productive land or gardens
- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion
- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed
- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors

Water quality

As noted above, the work will involve sediment extraction using excavators and trucks and moving construction materials within a laydown area adjacent to the waterway. Silt runoff from the material laydown area is anticipated. There is also potential for spillages of petrol, oil and lubricants (POL) and other chemical spillages and such runoff has the potential of degrading water quality.

Excavation of the sediments of approximately 1800 cubic metres will generate turbidity in the river. The discharge of water under the bridge is relatively high so dilution of pollution would be high. However, the risk to water quality is considered moderate even without mitigations in place. Mitigating measures include:

- > Diversion of the main flow for progressive sediment excavation will reduce the risk of substantially increasing turbidity and be subject to an approved site specific sediment extraction plan as part of the CEMP
- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place
- > A waste management sub-plan as part of the CEMP
- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.2.2.2 Biological environment

Flora and fauna

The bridgeworks will be carried out within the existing road corridor and therefore minimal impacts on vegetation are expected. The work area and establishment of material stockpile areas and site amenities for the bridgeworks will require removal of secondary weed vegetation. To minimise clearance, facilities will be constructed in unused open space and, upon completion, will be revegetated back to pre-construction condition or better

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers, This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

There will be times during construction that the flow of the river will need to be diverted for excavation of sediments, which has the potential to disrupt fish habitat and invertebrate species which require movement both from the sea upstream and downstream from freshwater. The waterway is likely to support a range of species of fish and invertebrates. Information about the diversity and abundance of specific species in this river is presently limited. Of the five species of freshwater fish found in coastal rivers in Efate, three were listed as being data deficient and one was considered to be of least concern. However, there is one other species which was listed as near-threatened (i.e. the Creek Ai Gobi (*Sicyopterus aiensis*)). This species has not been found in the larger rivers with tidal influence, such as the La Colle.

Due to the volume of discharge of the river, significant disturbance to other species is considered to be unlikely (i.e., it may occur once or twice during the activity unless mitigating measures are applied). There are no known protected areas in the waterway and the upstream area is mainly urban land use. The risk to protected species was considered low even when unmitigated.

In order to mitigate the low risk of disruption, any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is presently being sought from the DEPC biodiversity officer.

5.2.2.3 Social environment

Public access and local mobility

There will be a need to create a temporary construction access to the downstream and upstream side of the bridge to remove sediments and carry out bank stabilisation. No traffic diversion will be required during construction, as there will not be a new bridge. The traffic generated during spoil removal was estimated to be three movements per hour per working day for three weeks.

The approximate time of operation of the temporary access will be up to three months. The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Traffic controllers will be required to use traffic control when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road

- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified

Health and safety

There will be a low risk of impacts on community health and safety as there is no proposed accommodation construction camp for the western subprojects.

Some of the risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation
 - Provision of safe and clean facilities including sanitation and drinking water
 - Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise levels

Construction noise will cause moderate to low disturbance to the neighbouring community within the immediate semi-rural area, resulting from the use of machinery such as dump trucks and excavators.

As shown in **Table 5-1** the immediate vicinity of the bridge is not used for any activities (i.e. radius up to 61 metres). However, within 100 metres there are 19 receptors, one of which is a local school to the north west, some residences and commercial facilities. The residential and school receptors will be slightly affected by some of the machinery, as the activity will exceed the daytime standard for residential receptors.

Using an attenuation rate of 6 dBA per doubling of distance, the projected noise was found to be within the standard at the main village, using the accepted daytime level of 55 dBA for residential land use in the village. All other noise sources exceeded the standard at the residential and school facility, however, were found to be at acceptable levels at the village.

Table 5-1 Noise attenuation at Prima Bridge*

Distance from source (m)	15.24	30	61	122	244	488	975
Number of receptors	0	0	0	19	19	60	500+
Dump truck	76	70	64	58	52	46	40
Excavator	81	75	69	63	57	51	45

* Daytime (7am-10pm) maximum noise levels: Residential = 55 dBA; Commercial = 70 dBA

Source: U.S. Federal Highway Administration and IFC

The excessive noise of the machinery will require mitigations, including:

- > Notification to all receptors. Contractor will prepare a schedule of operations that will be approved by village chiefs and the Engineer. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > An integral part the EMP structure is the grievance redress mechanism (GRM) and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards due diligence report (DDR).

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.2.3 Operations impacts

5.2.3.1 *Physical environment*

Although unrelated to the Project physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who

works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

Sedimentation in the channel occurs from natural effects and human activities. As the upstream catchment is in an urban floodplain, sedimentation within the channel is an ongoing long term impact at Prima. Mitigation of this issue requires strict control of building and land use within the Municipality of Port Vila requiring implementation and enforcement of a land use control plan.

5.2.3.2 Biological environment

Flora and fauna and protected areas

There are no protected areas in the subproject area. It is envisaged, the operation of the bridge would not have any impact on any protected area.

5.2.3.3 Social environment

Noise

Ambient noise levels are assessed to be low against typical rural standard conditions.

5.3 Mele Bridge

5.3.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor;
- > Additional land beside the bridge will be required for access to the upstream river bed and bridge surrounds
- > Presence of both foreign and local construction workers of up to 30 on-site personnel
- > Preparation of a working area near the bridge inside the corridor for bridge preparation and superstructure

5.3.1.1 Physical environment

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the bridge with maximum flood levels taken into consideration.

5.3.1.2 Biological environment

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence. A separate storage yard for POL would be required in a separate location. Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover. Plant species near the bridge are common in the designated project area.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > If necessary not at this stage, vegetation clearance during surveying and demarcation activities of trees along the river banks. There are no road side trees of significant height that will be affected
- > Construction workers will be informed about general environmental protection and the need to avoid un-necessary felling of trees wherever possible

5.3.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay damages for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There will be a need for a temporary diversion near the bridge across the river to enable normal traffic flow to continue. The MOU consultation with the landowners to include temporary use of the land is underway.

5.3.2 Construction impacts

5.3.2.1 Physical environment

Construction involves the following activities:

- > Earthmoving for channel and bank excavations and stockpiling of materials for reuse in Elcorock® bags
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Transportation of construction materials such as sand, gravel, cement and guard rail components
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Piling works which will require pile-driving for approximately one month
- > Roadworks to new bridge approaches, road side drains and pavement as required
- > Removal of sediments and re-channelling of the river immediately up and downstream of the bridge
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)
- > Preparation of a temporary construction access into the channel to carry out scour protection and river channelling, possibly both up and downstream
- > Excavated sediments to be used in situ in Elcorock® bags
- > Removal of any excess sediments by tip trucks

Air quality

The quality of air within the subproject area is very good and typical of a rural setting. During the day the main sources of pollution are from traffic exhaust from all types of vehicles and at night traffic becomes very sparse. The coastal location and the prevailing south-easterly winds also ensure excellent air quality. The area has a distinct dry season so dust impacts are considered a moderate risk.

During the construction phase the other activities that might have impacts on air quality are the machines used such as excavators and vehicles transporting materials on site. Some Sulphur Dioxide (SO₂) and nitrogen oxides (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions

- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The bridge is located near the mouth of the Bokua river which is part of a large alluvial floodplain, including part of the Port Vila urban area. Consequently, during flood conditions (which are frequent due to high rainfall in this section of the study area) there is potential for significant loss of topsoil and sandy sub-soil from urban agriculture and other types of urban development.

The impact of the rechannelling works will be positive in the longer term and improve stream flow through the bridge and make the new bridge less vulnerable to scour and erosion around its footings and head walls from the frequent flooding that occurs. There is potential for some soil erosion in gaining access to the river so that an excavator could be used and surrounding land owners will be consulted in order to identify a proposed access location(s).

The risk of sedimentation and erosion caused by the construction is considered low but if required, soil erosion and sedimentation impacts will be mitigated by:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the Contractor causes damage to agricultural land upstream, productive land or gardens
- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion
- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed
- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors
- > If necessary (currently considered unlikely due to onsite demand for clean fill) suitable emplacement sites will be designated in consultation with land owners and village chiefs. Emplacement sites will not be permitted on the rivers, or on garden land or in areas used for livelihood production by villagers.

Water quality

As noted above, the work will involve pile driving, extraction using excavators and trucks and moving construction materials within a laydown area adjacent to the waterway. Silt runoff from the material laydown area is anticipated. There is also potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality.

Excavation of the sediments of approximately 1800 cubic metres will generate turbidity in the river. The discharge of water under the bridge is relatively high so dilution of pollution would be high. However, the risk to water quality is considered moderate even without mitigations in place. Mitigating measures include:

- > Diversion of the main flow for progressive sediment excavation will reduce the risk of substantially increasing turbidity and be subject to an approved site specific sediment extraction plan as part of the CEMP
- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material

- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP
- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.3.2.2 Biological environment

Flora and fauna

The bridgeworks will be carried out within the existing road corridor and therefore minimal impacts on vegetation are expected. The work area and establishment of material stockpile areas and site amenities for the bridgeworks will require removal of secondary weed vegetation. To minimise clearance, facilities will be constructed in unused open space and, upon completion, will be revegetated back to pre-construction condition or better

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

There will be times during construction that the flow of the river will need to be diverted for excavation of sediments, which has the potential to disrupt fish habitat and invertebrate species which require movement both from the sea upstream and downstream from freshwater. The waterway is likely to support a range of species of fish and invertebrates. Information about the diversity and abundance of specific species in this river is presently limited. Of the five species of freshwater fish found in coastal rivers in Efate, three were listed as being data deficient and one was considered to be of least concern. However, there is one other species which was listed as near-threatened (i.e. the Creek Ai goby (*Sicyopterus aiensis*)). This species has not been found in the larger rivers with tidal influence, such as the Bokua.

Due to the volume of discharge of the river, significant disturbance to other species is considered to be unlikely (i.e., it may occur once or twice during the activity unless mitigating measures are applied). There are no known protected areas in the waterway and the upstream area is mainly urban land use. The risk to protected species was considered low even when unmitigated.

In order to mitigate the low risk of disruption, any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is presently being sought from the DEPC biodiversity officer.

5.3.2.3 Social environment

Public access and local mobility

There will be a need to create a temporary construction access to the downstream and upstream side of the bridge to remove sediments and carry out bank stabilisation. No traffic diversion will be required during construction, as there will not be a new bridge. The traffic generated during spoil removal was estimated to be three movements per hour per working day for three weeks.

The approximate time of operation of the temporary access will be up to three months. The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Traffic controllers will be required to use traffic control when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified

Health and safety

There will be a low risk of impacts on community health and safety as there is no proposed accommodation construction camp for the western subprojects.

Some of the risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation

- Provision of safe and clean facilities including sanitation and drinking water
- Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise levels

Construction noise will cause moderate disturbance to the neighbouring community of Mele village due to the need for the temporary use of a pile driver. The village is located approximately 400 metres away to the north west. Within 200 metres of the bridge there are six commercial facilities on the northern side of the road and three on the south western side, also commercial.

Using an attenuation rate of 6 dBA per doubling of distance, the projected noise was found to be within the standard at the main village, using the accepted daytime level of 55 dBA for residential land use in the village. All other noise sources exceeded the standard at the commercial premises, however, were found to be at acceptable levels at the village.

Table 5-2 Noise attenuation at Mele Bridge*

Distance from source (m)	15.24	30	61	122	244	488	975
Number of receptors	0	0	0	2	9	388	388+
Vibratory pile driver (dBA)	101	95	89	83	77	71	65
Concrete mixer truck (dBA)	79	73	67	61	55	49	43
Concrete pump truck (dBA)	81	75	69	63	57	51	45
Dump truck (dBA)	76	70	64	58	52	46	40
Excavator (dBA)	81	75	69	63	57	51	45

* Daytime (7am-10pm) maximum noise levels: Residential = 55 dBA; Commercial = 70 dBA
Source: U.S. Federal Highway Administration and IFC

The excessive noise of the machinery will require mitigations, including:

- > Notification to all receptors. Contractor will prepare a schedule of operations that will be approved by village chiefs and the Engineer. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental Discovery of Archaeological Resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.3.3 Operations impacts

5.3.3.1 *Physical environment*

Although unrelated to the Project, physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

Sedimentation in the channel occurs from natural effects and human activities. As the upstream catchment is in an urban floodplain, sedimentation within the channel is an ongoing long term impact at Prima. Mitigation of this issue requires strict control of building and land use within the Municipality of Port Vila requiring implementation and enforcement of a land use control plan.

5.3.3.2 *Biological environment*

Flora and fauna and protected areas

There are no protected areas in the subproject area. It is envisaged, the operation of the bridge would not have any impact on any protected area.

5.3.3.3 *Social environment*

Noise

Ambient noise levels are assessed to be low against typical rural standard conditions.

5.4 Klems Hill

5.4.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the designated area to be controlled by the contractor
- > Presence of both foreign and local construction workers of up to 10 on site personnel
- > Preparation of a working area near the landslide inside the corridor for site preparation for slope stabilisation and erosion control works

5.4.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Disaster risk mitigation measures to stabilise the slope (bored piles) were integrated into the design. Increases in the intensity and duration of storms was included in the design of road side drains and erosion protection.

5.4.1.2 Biological environment

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Vegetation clearance during surveying and demarcation activities of any trees or crops across the slope.
- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.4.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There will be no need for realignment of the road but there may be a need for temporary stoppage of traffic using a one way stop go system with traffic controllers.

5.4.2 Construction impacts

5.4.2.1 Physical environment

Construction involves the following activities:

- > Earthmoving for excavation and scaling of the upslope and stockpiling of materials for reuse
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Transportation of construction materials such as sand, gravel, cement and guardrail components
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Construction of cut-off drain above the slope
- > Connection of cut-off drainage above the slope to road side drains as required
- > Piling works which will require pile boring for approximately one month
- > Temporary stockpiles of topsoil, subsoil and materials for revegetation works

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The exposed escarpment and higher altitude of the site and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The landslide is located up the slope approximately two thirds of the way up Klems Hill and is approximately. The slip area is approximately 60 m long at the 90-120 m contour. The crest of the slope above the failure is at contour 142 m.

The vast majority of the soil and subsoil lost during the cyclone across the road, blocked drains, lost from the upslope and downslope gully. The downslope drainage gully can be seen as the vertical scar between the two road angles in **Figure 5-1**, approximately 300m long. The impact of the construction on further soil erosion and sedimentation is considered very low.



Figure 5-1 Klems Hill

Nonetheless, the frequent and high intensity rainfall that can occur in this area, mitigations will be maintained and include:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the contractor causes damage to agricultural land upstream, productive land or gardens
- > Work to reduce the steepness of slopes will be monitored for signs of further spalling and remedial temporary works be put in place such as contour banks and cut-off drains above the potential failure
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed

- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors
- > No side casting of spoil downslope will be permitted

Water quality

As noted above, the work will involve sediment extraction using excavators and trucks and moving construction materials within a laydown area adjacent to the landslide. Silt runoff from the material laydown area is anticipated. There is also potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality. High intensity storms will help to reduce the concentration of any small amount of pollution that was discharged to the environment. The risk to water quality is considered low. Mitigating measures include:

- > The works to be carried out in the driest period of the year to reduce risk to water quality
- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP
- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.4.2.2 Biological environment

Flora and fauna

The works will be carried out on the up and downslopes of the affected section of the road on areas which have already been cleared by the Cyclone damage. As discussed above, there may be non-land assets across the upper slopes that will need to be removed. Apart from these trees and crops, the vegetation of the area is highly modified. Fauna is mainly domestic animals as the area is generally semi-rural on the fringe of Port Vila. Risks to native flora and fauna are considered low.

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

5.4.2.3 Social environment

Public access and local mobility

There will be a need to create a temporary contraflow traffic control system through the section while works proceed on alternate sides of the road. The traffic volume in the location is low to moderate during the day time so disruption and inconvenience will be minimal. Under normal traffic conditions, access to villages beyond the subproject and into Port Vila will be maintained at all times.

The approximate time of operation of the contraflow system will be up to four months. The following mitigations will be required:

- > Traffic controllers will be required to use traffic control when trucks or other machinery enter and leave the operational traffic lanes
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified
- > The Contractor will negotiate access with landowners, if access to land is required, beyond that which is planned and under negotiation in the MOU process

Health and safety

There will be a low risk of impacts on community health and safety as there is no proposed accommodation construction camp for the western subprojects.

Some of the risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies

- Fit kitchen facilities with grease traps to reduce odours and vermin infestation
- Provision of safe and clean facilities including sanitation and drinking water
- Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise levels

Construction noise will cause moderate to low disturbance to the neighbouring community within the immediate semi-rural area, due to the need for the temporary use of a pile boring machine (or possibly a pile driver). The pile driver has been used in the assessment below as a worst case scenario. The village of Melemaat is located approximately 300 metres downslope. The immediate vicinity of the road is uninhabited and there is one house further upslope which has no direct line of sight to the sources of noise.

Using an attenuation rate of 6 dBA per doubling of distance, the projected noise was found to be within the standard at the main village, using the accepted daytime level of 55 dBA for residential land use in the village.

Table 5-3 Noise attenuation at Klems Hill*

Distance from source (m)	15.24	30	61	122	244	488	975
Number of receptors	0	0	0	1	1	388	388+
Vibratory pile driver (dBA)	101	95	89	83	77	71	65
Concrete mixer truck (dBA)	79	73	67	61	55	49	43
Concrete pump truck (dBA)	81	75	69	63	57	51	45
Dump truck (dBA)	76	70	64	58	52	46	40
Excavator (dBA)	81	75	69	63	57	51	45

* Daytime (7am-10pm) maximum noise levels: Residential = 55 dBA; Commercial = 70 dBA

Source: U.S. Federal Highway Administration and IFC

The excessive noise of the pile driver will require mitigations, including:

- > Notification to all receptors. Contractor will prepare a schedule of operations that will be approved by village chiefs and the Engineer. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.4.3 Operations impacts

5.4.3.1 *Physical environment*

Although unrelated to the Project physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

5.4.3.2 *Biological environment*

Flora and fauna and protected areas

There are no protected areas in the subproject area. It is envisaged, the operation of the repaired road would not have any impact on any protected area.

5.4.3.3 *Social environment*

Noise

Ambient noise levels are assessed to be low against typical rural standard conditions.

5.5 Creek Ai Culvert

5.5.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the culvert and the designated area controlled by the Contractor
- > Presence of both foreign and local construction workers of up to 20 on site personnel
- > Preparation of a working area near the culvert inside the corridor for culvert preparation

5.5.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the culvert works with maximum flood levels taken into consideration.

5.5.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover. Plant species near the culvert are common in the designated subproject area.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Vegetation clearance during surveying and demarcation activities of trees along the river banks. There are no road side trees of significant height that will be affected
- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.5.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the bridge. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.5.2 Construction impacts

5.5.2.1 Physical environment

Construction involves the following activities:

- > Earthmoving for channel and bank excavations and stockpiling of materials for reuse in Elcorock® bags
- > Transportation of construction materials such as sand, gravel, cement, precast concrete elements and guardrail components
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Culvert approach road reshaping and filling to provide suitable vertical road geometry
- > Connections to road side drains as required
- > Use of a mobile crane for short period of a week, on two separate occasions, to place culvert components
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)
- > The work will be staged, but no traffic diversion into the waterway will be required

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Anecdotally, there is relatively low rainfall in this section of the western area during the dry season. However, dust generated will be a low risk as the area is very sparsely populated.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site

- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The culvert is located about 200 m from the Creek Ai waterway mouth and is located on a very small alluvial floodplain. There is low potential risk for significant soil loss, as the earthworks is planned to be carried during the dry season.

Sedimentation of the river has occurred and there was significant deposition observed on the upstream side of the culvert which may still be the result of the TC Pam, which caused severe scour in the upper catchment as shown in the before and after figures below (**Figure 5-2** and **5-3**). It may also be due to recent uncontrolled development works.

The risk of sedimentation and erosion caused by the construction is considered low but if required, soil erosion and sedimentation impacts will be mitigated by:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the Contractor causes damage to agricultural land upstream, productive land or gardens
- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion
- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed
- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors

Water quality

As noted above, the work will involve sediment extraction using excavators and trucks and moving construction materials within a laydown area adjacent to the waterway. Silt runoff from the material laydown area is anticipated. There is also potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality.

The risks to water quality are considered low if standard mitigating measures are in place. Mitigating measures include:

- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP

- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.5.2.2 Biological environment

Flora and fauna

The culvert works will be carried out within the existing road corridor and therefore minimal impacts on vegetation are expected. The work area and establishment of material stockpile areas and site amenities for the bridgeworks will require removal of secondary weed vegetation. To minimise clearance, facilities will be constructed in unused open space and, upon completion, will be revegetated back to pre-construction condition or better

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

Creek Ai is an unusual, small and steep catchment which has a distinct canyon shape about 4 km in length and approximately 0.5 km in width. The subproject itself is located within a small pocket of alluvium on the northern section of the creek which becomes volcanic pumice (breccia) further upstream and is the only one of the streams in the western area directly flowing out of volcanic material directly above the alluvial deposits adjacent to the coast. Flow in the creek was heavily affected by TC Pam, with very high and fast flood flows (refer **Figure 5-2** and **5-3**).

The normal flow of the creek has also been greatly altered by recent earthworks and reclamation along both sides of the creek, up and downstream. The lower section of the creek, where the existing culvert is located within 200 m of the sea and is occasionally affected by high tidal movements. Freshwater flows can become very low during the dry season as this section of the Western area is in a rain shadow area and theoretically receives lower rainfall than the east and south of Efate island.

The flow of the river will need to be laterally diverted in stages, in order construct the base slab and place box culverts. This has the potential to disrupt the habitats and normal movements of fish and invertebrate species which require movement both from the sea upstream and downstream from freshwater. The catchment area of the river upstream is limited but water quality is very good and the life cycle of riverine fauna would be dependent on freshwater movement downstream. The river is likely to support a range of species of fish and invertebrates. Information about the range and abundance of species in this river is presently limited. Of the five species of freshwater fish found in coastal rivers in Efate, three were listed as being data deficient and one was considered to be of least concern. However, there is one other species which was listed as near threatened (i.e., the Creek Ai Gobi (*Sicyopterus aiensis*)).

As the “Ai Creek Goby” (as it’s known) is a protected species and listed by the IUCN as near threatened, extra care will be needed to ensure that the effect of construction on the riverine fauna is minimised. The risk associated with this protected species was considered moderate to high when unmitigated.

The design of the culvert includes build back better principles, to both facilitate recovery from the effects of TC Pam and to enhance the sustainability of the near threatened species.



Figure 5-2 Before TC Pam, 2014



Figure 5-3 The day after TC Pam, 2015

In order to reduce risks, the following measures will be required or have already been implemented in the design:

- > The design is for large, multi-cell box culverts, which will significantly improve the flow characteristics of the stream compared to the existing piped culverts which were supported by a large concrete embankment which effectively was acting to dam the flow at low flows
- > The base slab of the box culverts will also feature a low flow channel to maximise flow depth during the distinct dry season in this area

- > A separate sub-plan on temporary river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys being undertaken are understood and implemented by the Engineer and Contractor
- > Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is currently being obtained from the DEPC biodiversity officer
- > Subject to the results of further sample studies on this stream and inputs from government agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with TC Pam
- > A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime

5.5.2.3 Social environment

Public access and local mobility

No diversion of traffic will be necessary as the volume of traffic through the subproject is low and the culvert will be built one half at a time, to maintain a minimum of one lane open at all times. The approximate time of construction will be up to six months. The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Permanent traffic control will be required to operate the single lane and traffic controllers will be used to control traffic when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified
- > The contractor will negotiate access with landowners if additional access outside the road corridor is required (considered unlikely)

Health and safety

The area is rural and there are two residences approximately 150 metres to the south and south west of the site. There are no nearby villages.

The risk to these residents is considered low, assuming that standard mitigation measures are used. There is no proposed accommodation construction camp for the western sub-projects. Some of these low risks and mitigation measures have been indirectly addressed above.

To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis

- Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
- Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
- Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
- Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
- Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
- Capture of wastewater to prevent discharge to local water bodies
- Fit kitchen facilities with grease traps to reduce odours and vermin infestation
- Provision of safe and clean facilities including sanitation and drinking water
- Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise

Construction noise from machinery and trucks is considered a low risk for the new culvert construction even though there are two residences nearby. The pattern of intermittently generated noise for up to six months and the scale of construction is not considered to be significant enough to generate noise complaints.

Nonetheless, the following mitigations will be required:

- > The two residences would be notified, at least one week in advance, of any sources of noise that may cause complaint
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.5.3 Operations impacts

5.5.3.1 *Physical environment*

Although unrelated to the Project, physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

5.5.3.2 Biological environment

Flora and fauna and protected areas

Creek Ai is a recognised protected catchment area and requires a long term management plan from the government to ensure sustainability of this unusual ecosystem. The longer term positive impacts of a possible endemic species fish restocking, would be the responsibility of Department of Fisheries. It is envisaged, that the operation of the new culvert will assist in promoting the sustainability objective as well as meeting the future transport needs of the community along the ring road in this area.

5.6 Havannah Culvert

5.6.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor
- > Presence of both foreign and local construction workers of up to 10 on site personnel
- > Preparation of a working area near the bridge inside the corridor for in channel works

5.6.1.1 Physical environment

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the works with maximum flood levels taken into consideration.

5.6.1.2 Biological environment

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

The subproject is located downstream of a very steep ephemeral catchment, which flows to Havannah Bay. Most of the time the stream does not flow.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.6.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the culvert. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.6.2 Construction impacts

5.6.2.1 *Physical environment*

Construction involves the following activities:

- > Minor earthworks for channel and bank excavations and stockpiling of materials
- > Transportation of construction materials such as sand, gravel, cement and guardrail components
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement;
- > Construction of concrete pavement and approach road reshaping and filling
- > Connection to road side drains as required
- > A temporary stockpile for deposited sediment spoil will be required but all spoil will be reused on site.
- > No traffic diversion will be required and all works will stay within the corridor
- > Safety improvement works such as guardrail replacement and extension
- > Construction of scour protection measures

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The culvert is located about 200 m from Havannah Bay and flow in the stream is intermittent. There was no evidence of significant sedimentation other than rocks and boulders resulting from the flooding during TC Pam, which also affected the culvert gabions.

The risk of normal sedimentation and erosion and deposition is considered low. To mitigate the impact of flooding, replacement of in stream boulders to reduce energy at the culvert outlet was designed.

Water quality

The risk to water quality is considered low as the flow is very intermittent and coming from a relatively limited and clean catchment

Mitigating measures include:

- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP

5.6.2.2 Biological environment

Flora and fauna

Most culvert works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected.

If required, extraction of construction materials will be carried out from existing quarries with no vegetation impacts expected.

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

5.6.2.3 Social environment

Public access and local mobility

No diversion of traffic will be necessary as the volume of traffic through the subproject is low and the culvert will be built one half at a time, to maintain a minimum of one lane open at all times. The approximate time of construction will be up to six months. The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Permanent traffic control will be required to operate the single lane and traffic controllers will be used to control traffic when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified

- > The contractor will negotiate access with landowners if additional access outside the road corridor is required (considered unlikely)

Health and safety

The area is rural and there are two residences approximately 150 metres to the south and south west of the site. There are no nearby villages.

The risk to these residents is considered low, assuming that standard mitigation measures are used. There is no proposed accommodation construction camp for the western sub-projects. Some of these low risks and mitigation measures have been indirectly addressed above.

To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation
 - Provision of safe and clean facilities including sanitation and drinking water
 - Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise

Construction noise will cause moderate to low disturbance to the neighbouring community within the immediate semi-rural area, resulting from the use of machinery such as dump trucks and excavators.

The pattern of intermittent generated noise for two months and the scale of construction is not considered to be significant enough to generate noise complaints. The tourist resort is surrounded by a solid brick wall which will serve to attenuate construction noise.

Nonetheless, the following mitigations will be required:

- > The tourist resort would be notified one week in advance, of any sources of noise that may cause complaint

- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.6.3 Operations impacts

5.6.3.1 *Physical environment*

Although unrelated to the Project, physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the culvert structure involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the culvert, reduce channel changes and reduce scour and erosion around the inlet.

5.7 Tanoliu Bridge

5.7.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor;
- > Additional land beside the bridge will be required for access to the bridge surrounds
- > Presence of both foreign and local construction workers of up to 30 on site personnel
- > Preparation of a working area near the bridge inside the corridor for bridge preparation and superstructure

5.7.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the bridgeworks with maximum flood levels taken into consideration.

5.7.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover. Plant species near the bridge are common in the designated subproject area.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Vegetation clearance during surveying and demarcation activities of trees along the river banks. There are no road side trees of significant height that will be affected
- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.7.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the bridge. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.7.2 Construction impacts

5.7.2.1 Physical environment

Construction involves the following activities:

- > Earthmoving for channel and bank excavations and stockpiling of materials for reuse in Elcorock® bags
- > Transportation of construction materials such as sand, gravel, cement and guardrail components
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Removal of sediments and re-channelling of the river immediately up and downstream of the bridge
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)
- > Improvements to pedestrian safety and access to the beach
- > Sand blasting and repainting of steel girders
- > Timber deck replacement with pre-fabricated concrete slabs

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring

- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The bridge is located across a narrow tidal channel approximately 20 m from the beach on Havannah Bay. The stream flows freshwater intermittently but is mainly influenced by high tide movements.

The risk of sedimentation and erosion caused by the construction is considered low but if required, soil erosion and sedimentation impacts will be mitigated by:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the Contractor causes damage to agricultural land upstream, productive land or gardens
- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion
- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed
- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors
- > Crane use to replace timber deck with prefabricated concrete sections

Water quality

As noted above, the work will involve grit blasting and painting of steel beams and moving construction materials within a laydown area adjacent to the waterway. Silt runoff from the lay out area can be anticipated. Sand blasting of the existing steel girders will generate grit and old paint. There is potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality. Mitigating measures include:

- > As the river is generally at very low flow during low tide, a drop blanket covering the work area under the bridge to collect the grit and old paint will be required during times when it is still possible to get access under the bridge.
- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP

- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.7.2.2 Biological environment

Flora and fauna

In this location minimal impacts on vegetation are expected. The bridgeworks will be carried out within the existing road corridor and therefore minimal impacts on vegetation are expected. The work area and establishment of material stockpile areas and site amenities for the bridgeworks will require removal of secondary weed vegetation. To minimise clearance, facilities will be constructed in unused open space and, upon completion, will be revegetated back to pre-construction condition or better

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

As the existing channel has very low flows under normal conditions, generally influenced only by tidal flows, the risks to in stream flora and fauna are considered low. The upstream area has been heavily modified by the village area and also showed evidence of some pollution caused by upstream users. There were mangroves observed in the upstream area further up from the village which indicates that the main flow is due to tidal saltwater flows. The general condition of the upstream was highly modified and there has been clearing of mangroves in this area for production of charcoal. The risk to protected species from the limited construction works was considered low even when unmitigated.

5.7.2.3 Social environment

Public access and local mobility

There is likely to be a need to close the bridge for approximately 48 hours to replace the deck. The area is semirural the normal traffic volume is low. However, a temporary diversion to maintain traffic flow may be necessary. Dependent on the location of the diversion, this may cause temporary negative impacts, including inconvenience, minor disruptions to traffic using the road, and on local access around the nearby village. It should be emphasised that access to villages along the subproject road will typically be maintained at all times.

The approximate time of operation of the diversion will be up to 48 hours. It is possible that no diversion will be put in place. If it is, the proposed route has not yet been determined, however, there is a local village road that could be used to direct traffic further to the east but directly pass more houses than when on the main ring road.

Health and safety

There will be a low risk of impacts on community health and safety as there is no proposed accommodation construction camp for the western subprojects.

Some of the risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation
 - Provision of safe and clean facilities including sanitation and drinking water
 - Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Using the diversion road through the village will cause a slight decrease in safety and will require specific mitigation. The following mitigations will be required:

- > Notification well in advance to the local villages and the general public about the upcoming closure
- > Signs and other appropriate safety features will be used to indicate construction works are being undertaken
- > In order to address this temporary impact, at least three traffic controllers will control traffic speed through the detour and if necessary stop traffic for any hazardous truck or other machinery movements
- > The diversion works would only take place on a weekend or non-school time
- > Agreed speed limits will be imposed and posted for all sections of the detour
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road

- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified
- > The Contractor will negotiate access with landowners if additional access is required for specific purposes

Noise levels

Construction noise will cause moderate disturbance to some of the neighbouring community within the immediate village area. As shown in **Table 5-4**, the immediate vicinity of the bridge is not used for any activities (i.e. up to 61 m). However, within 122 m there are 7 receptors which are mainly residences. Most of the village is within 250 metres of the bridge site. The noise will be mitigated by the prevailing south east breeze. However these receptors will be slightly affected by some of the normal machinery as shown in the table as the activity will exceed the daytime standard for residential receptors.

Using an attenuation rate of 6 dBA per doubling of distance, the projected noise was found to be within the standard at the main village, using the accepted daytime level of 55 dBA for residential land use in the village. All other noise sources were found to be at generally acceptable levels at the village.

Table 5-4 Noise attenuation at Tanoliu Bridge*

Distance from source (m)	15.24	30	61	122	244	488	975
Number of receptors	0	0	0	7	20	29	29+
Dump truck	76	70	64	58	52	46	40
Excavator	81	75	69	63	57	51	45

* Daytime (7am-10pm) maximum noise levels: Residential = 55 dBA; Commercial = 70 dBA

Source: U.S. Federal Highway Administration and IFC

The excessive noise of the machinery will require mitigations, including:

- > Notification to all receptors. Contractor will prepare a schedule of operations that will be approved by village chiefs and the Engineer. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

There will also be a temporary increase in noise for houses along the diversion road. This impact will be mitigated by the proposed measures set out above under **Safety impact**.

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can un-earth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not re-commence until the authorities have signed-off that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

5.7.3 Operations impacts

5.7.3.1 *Physical environment*

Although unrelated to the Project physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

5.7.3.2 *Biological environment*

Flora and fauna and protected areas

There are no protected areas in the subproject area. It is envisaged, the operation of the bridge would not have any impact on any protected area.

5.7.3.3 *Social environment*

Noise levels

Ambient noise levels are assessed to be low against typical rural standard conditions.

5.8 Marona Bridge

5.8.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor;
- > Additional land beside the bridge will be required for access to the bridge surrounds
- > Presence of both foreign and local construction workers of up to 30 on site personnel
- > Preparation of a working area near the bridge inside the corridor for bridge preparation and superstructure

5.8.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the bridgeworks with maximum flood levels taken into consideration.

5.8.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. There is no vegetation that has any conservation significance nor is it representative of the original vegetative cover. Plant species near the bridge are common in the designated subproject area.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Vegetation clearance during surveying and demarcation activities of trees along the river banks. There are no road side trees of significant height that will be affected
- > Construction workers will be informed about general environmental protection and the need to avoid unnecessary felling of trees

5.8.1.3 Social environment

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the bridge. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.8.2 Construction impacts

5.8.2.1 Physical environment

Construction involves the following activities:

- > Earthworks, excavation and stockpiling of materials for reuse
- > Transportation of construction materials such as sand, gravel, cement and guardrail components
- > Receipt of concrete by truck from existing batching plants in the Port Vila area
- > Stockpiling of construction materials such as sand, gravel, cement
- > Bridge approach reshaping and filling
- > Piling works which will require pile driving for approximately 3-4 weeks
- > Connection to road side drains as required
- > Possible use of crane for short period of several days to place bridge or components
- > Construction of a day camp to serve multiple sites may be necessary but no accommodation camp will be required.
- > A temporary stockpile for deposited sediment spoil will be required

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The bridge is located about 800 m from the Marona river mouth which is part of an alluvial floodplain. There is some evidence of sedimentation occurring in the channel, either due to the enduring impact of TC Pam, which caused severe scour, or due to upstream clearance of land and grazing land use. There is low potential risk for significant loss of topsoil and the alluvial sub soil from the construction work as it is planned to be carried during the dry season.

Sedimentation of the river has occurred and there is significant deposition on the upstream side of the bridge/culvert. A much higher bridge has been designed to improve flows and all of the spoil being removed will be used in supporting the new bridge abutments in geotextile bags. This spoil will need to be stored temporarily in agreed location near the proposed bridge location

The risk of further sedimentation and erosion and deposition is considered low but if required soil erosion and sedimentation impacts will be mitigated by:

- > The Contractor being solely responsible for repairing the damage and/or paying damages if the Contractor causes damage to agricultural land upstream, productive land or gardens
- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion
- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed
- > Random and uncontrolled tipping of spoil, or any material, will not be permitted, with all spoil to be removed by the Contractors

Water quality

As noted above, the work will involve pile driving, filling, extraction and moving construction materials within a laydown area adjacent to the river. Silt runoff from the lay out area can be anticipated. There is potential for spillage of POL and other chemical spillages and such runoff has the potential of degrading water quality. The risk to water quality are considered low. Mitigating measures include:

- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material

- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP
- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.8.2.2 Biological environment

Flora and fauna

The bridgeworks will be carried out within the existing road corridor and therefore minimal impacts on vegetation are expected. The work area and establishment of material stockpile areas and site amenities for the bridgeworks will require removal of secondary weed vegetation. To minimise clearance, facilities will be constructed in unused open space and, upon completion, will be revegetated back to pre-construction condition or better

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- > Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection
- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

The catchment area of the Marona river is limited and is dependent on tidal and freshwater movement downstream. It is located in a rain shadow area so anecdotally, its climate is drier and hotter than the Port Vila area subprojects. It is also within a similar geophysical environment to Creek Ai but does not share its underlying geology.

There will be times during construction that the flow of the river will need to be diverted for the bridge works which, has the potential to disrupt the normal life cycle of fish and invertebrate species which require movement both from the sea upstream and downstream from freshwater. The river is likely to support a range of species of saltwater fish (egg eel fish) and invertebrates (saltwater prawns) and also freshwater species. Information about the range and abundance of species in the river is presently limited. Of the five species of freshwater fish found in coastal rivers in Efate three were listed as being data deficient and one was considered to be of least concern. However, there is one other species which was listed as near threatened (i.e. the Creek Ai Gobi)

Given the proximity to Creek Ai, it is possible that this species may also be present in the Marona river. As this species is considered and listed by the IUCN as near threatened extra care will be needed to ensure that

the effect of construction on the riverine fauna is minimized. The risk to protected species was considered moderate to when unmitigated.

In order to reduce risks, the following mitigating measures will be necessary:

- > A separate sub-plan on temporary river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys being undertaken are understood and implemented by the Engineer and Contractor
- > Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is currently being obtained from the DEPC biodiversity officer
- > Subject to the results of further sample studies on this stream and inputs from government agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with TC Pam
- > A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime

5.8.2.3 Social environment

Public access and local mobility

As discussed above there will be a need to create a temporary diversion on the downstream side of the bridge. Traffic volume is low so disruption will be much less than in the southern bridges of Prima and Mele. It should be emphasized that under normal traffic conditions access to villages along the subproject road will be maintained at all times.

The approximate time of operation of the diversion will be up to four months. The Contractor will make a decision, but the detour will be built at low level and a temporary pipe culvert will be used as a causeway.

The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Traffic controllers will be required to use traffic control when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified
- > The traffic diversion road will be kept free of debris, spoil, and any other material at all times
- > The contractor will negotiate access with landowners if additional access outside the road corridor is required but is considered unlikely.

Health and safety

There will be a low risk of impacts on community health and safety as there is no proposed accommodation construction camp for the western subprojects.

Some of the risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers

- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation
 - Provision of safe and clean facilities including sanitation and drinking water
 - Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise levels

Construction noise will cause moderate disturbance to the neighbouring communities due to the need for the temporary use of a pile driver. The village of Ulei is located to the south west and another village 1.3 km to the east. Within 550 m of the bridge there are five isolated dwellings.

Using an attenuation rate of 6 dBA per doubling of distance, the projected noise was found to be within the standard at the main village, using the accepted daytime level of 55 dBA for residential land use in the village. All other noise sources exceeded the standard at the commercial premises, however, were found to be at acceptable levels at the village.

Table 5-5 Noise attenuation at Marona Bridge*

Distance from source (m)	15.24	30	61	122	244	488	975
Number of receptors	0	0	0	0	0	5	9
Vibratory pile driver (dBA)	101	95	89	83	77	71	65
Concrete mixer truck (dBA)	79	73	67	61	55	49	43
Concrete pump truck (dBA)	81	75	69	63	57	51	45
Dump truck (dBA)	76	70	64	58	52	46	40
Excavator (dBA)	81	75	69	63	57	51	45

* Daytime (7am-10pm) maximum noise levels: Residential = 55 dBA; Commercial = 70 dBA
Source: U.S. Federal Highway Administration and IFC

The excessive noise of the machinery will require mitigations, including:

- > Notification to all receptors. Contractor will prepare a schedule of operations that will be approved by village chiefs and the Engineer. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can un-earth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall not re-commence until the authorities have signed-off that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.8.3 Operations impacts

5.8.3.1 *Physical environment*

Although unrelated to the Project physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

Sedimentation in the channel occurs from natural effects and human activities. As the upstream catchment is in an urban floodplain, sedimentation within the channel is an ongoing long term impact at Prima. Mitigation of this issue requires strict control of building and land use within the Municipality of Port Vila requiring implementation and enforcement of a land use control plan.

5.8.3.2 *Biological environment*

Flora and fauna and protected areas

There are no protected areas in the subproject area. It is envisaged, the operation of the bridge would not have any impact on any protected area. The longer term impacts of restocking of the river with endemic species would be the responsibility of Department of Fisheries.

5.9 Malatia Culvert

5.9.1 Pre-construction impacts

Pre-construction impacts are limited to the following activities:

- > Identification and demarcation of the bridge and the designated area controlled by the contractor;
- > Presence of both foreign and local construction workers of up to 30 on site personnel
- > Preparation of a working area near the bridge inside the corridor for in channel works

5.9.1.1 *Physical environment*

Climate change and adaptation

The subproject will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures were integrated in the design of the bridgeworks with maximum flood levels taken into consideration.

5.9.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of any non-land assets including trees and crops as little road space is affected. There will be a need to remove grass and weeds. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence. A separate storage yard for POL would be required in a separate location which will be the responsibility of the Contractor.

The culvert is located in a tidal wetland area with significant mangrove plant species present alongside both banks of the waterway. The wetland mangrove area was once much larger and is now undergoing significant development pressure to be further depleted. The viable area of mangrove which is surviving was calculated to be approximately six hectares, although this area is interspersed with coconut plantation. Mangroves are considered to be at risk within the entire area of Efate.

There will be mitigating measures included in the CEMP to ensure minimisation of impacts from vegetation removal which include:

- > Any removal of mangroves would require approval of the Engineer
- > Any mangrove near the work area would need to be protected with surrounding barriers and signage
- > Survey and construction workers will be informed about general environmental protection and the need to avoid vegetation clearance

5.9.1.3 *Social environment*

Restrictions on use of land

It is normal practice for PWD contractors to pay construction damage for crops and trees (or structures) if affected by road and bridge works and there is a standard contract clause for the Contractor to pay damages for such an occurrence.

There is no requirement to realign the bridge. If it were necessary, land owners would be notified and the changed scope of work and need for land a temporary traffic detour would be included in the details of a revised MOU.

5.9.2 Construction impacts

5.9.2.1 *Physical environment*

Construction involves the following activities:

- > Earthworks, excavations and stockpiling of materials for reuse
- > Transportation of construction materials such as sand, gravel, cement and guardrail components
- > Receipt of concrete by truck from existing batching plants in the Port Vila area

- > Stockpiling of construction materials such as sand, gravel, cement
- > Removal of older deteriorated concrete to an agreed disposal location subject to landowner agreement
- > Approach road reshaping and filling
- > Connection to road side drains as required
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)
- > A temporary stockpile for deposited sediment spoil will be required but all spoil will be reused on site
- > No traffic diversion will be required and all works will stay within the corridor
- > Construction of an additional culvert approximately 70 metres to the west of the existing culvert to further promote tidal flow into the area of mangroves further upstream has been already included as a design mitigation

Air quality

The quality of air within the subproject area is very good and typical of a semi-rural setting. During the day, the main sources of pollution are from traffic exhaust from all vehicle types. At night traffic becomes very infrequent. The proximity of the site to the coast and the prevailing south-easterly winds also regulate air quality. Due to the tropical (high) rainfall throughout the year, dust generated by traffic is minimal.

During the construction phase the key activities that might have impacts on air quality are the machines used for excavation and vehicles transporting materials on site. Some sulphur dioxide (SO₂) and nitrogen oxide (NO) gases will be generated by these construction vehicles.

Standard mitigation measures will be implemented and include:

- > Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring
- > Prohibition of the use of equipment and machinery that causes excessive pollution (e.g., visible smoke) at the subproject site
- > Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. Material stockpiles being located in sheltered areas and covered with tarpaulins or other such suitable covering to prevent material becoming airborne
- > Damping down any exposed areas in the working area near the bridge under dry conditions
- > Periodic qualitative air quality monitoring (by observation rather than testing) based on site weather conditions

Soils, sedimentation and erosion

The culvert is located about 80 m from the river mouth which is part of a small floodplain and is heavily influenced by tidal flows rather than freshwater from the immediate catchment, so it is considered that there is low potential risk for significant loss of topsoil and any alluvial subsoil, as the material is mainly made up of saltwater tidal mud flat silt.

There was no evidence of significant sedimentation in tidal river.

The risk of sedimentation and erosion caused by the construction is considered low but if required, soil erosion and sedimentation impacts will be mitigated by:

- > The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Geotextile sand-filled bags will be used around bridge abutments to mitigate scouring and erosion

- > Embankments and in-stream/river activities will be monitored during construction for potential erosion and, if necessary, prevention or permanent measures would be placed as soon as possible
- > Slope areas needed for access will be revegetated with fast growing species, or other plants in consultation with the land owners and village chiefs, as quickly as possible after work in the slope areas has been completed

Water quality

As noted above, the work will involve sediment extraction using excavators and trucks and moving construction materials within a laydown area adjacent to the waterway. Silt runoff from the material laydown area is anticipated. There is also potential for spillages of petrol, oil and lubricants (POL) and other chemical spillages and such runoff has the potential of degrading water quality.

The risk to water quality are considered low. Mitigating measures include:

- > Separate, bunded area for storage of POL. The contractor will be required to store chemicals in a secure yard and/or /compound away from the waterway, with a concrete floor, bund wall and weatherproof roof. Only daily storage in the laydown area will be allowed during use of products. Used oils and chemicals will be transported to approved, designated waste disposal site for hazardous material
- > Sediment control measures including, sedimentation ponds, bunds and silt fences around the work areas whenever required to contain plumes of disturbed water from getting into water bodies. The site will be secured each day with sediment controls in place.
- > A waste management sub-plan as part of the CEMP
- > Material stockpiles (laydown areas) must be located outside the 1:1 year ARI flood zone (i.e. the annual flood zone)

5.9.2.2 Biological environment

Flora and fauna

Most culvert works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected. Any laydown work area for the culvert will require removal of road side secondary weed vegetation away from fringing mangrove areas.

Construction of day camps may require some level of vegetation clearance and cause minor impacts. To minimise clearance, day camps will be constructed in unused open space. Upon completion of construction works, day camps will be revegetated at least back to original condition.

Supply of construction materials will be carried out from quarries with valid permits with no additional vegetation impacts expected. Additional measures to be included to ensure protection of flora and fauna within the subproject area include:

- Approval by the Engineer for all sites for material stockpile areas and site amenities. These will not be permitted in any ecologically important sites or areas valuable for conservation (of which there are none near the subproject site)
- > Minimise vegetation clearance during construction activities, especially of any small, endemic trees along the river banks and road side
- > Stockpile vegetative cover and top soil cleared from the roadside for use in slope protection and re-vegetation works. Contractors will be responsible for re-vegetation in areas for their facilities
- > Provision of adequate knowledge of fauna to construction workers. This is to be undertaken by the Contractor, in accordance with the contract documents and technical specifications. These documents expressly prohibit the poaching of fauna and make the Contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached, fauna
- > The Contractor will be responsible for supplying appropriate and adequate cooking fuel in site amenities to prevent any possible fuel-wood collection

- > The Contractor will be responsible for informing construction workers about general environmental protection and safety at weekly toolbox meetings, including the need to avoid unnecessary felling of trees wherever possible

Protected riverine flora and fauna ecosystems

The mangrove area has been significantly modified by past development of agriculture, exploitation for charcoal production and marina development. There is a current sub-division plan which would increase the area of the existing marina development, approximately four hundred metres to the north west. It is unclear exactly where the next stage of the development is located. Previous work completed and observed in the satellite imagery suggests it will take up all of the intervening area between the river and the existing marina.

The lower section of the Creek where the existing culvert is located within 80 metres of Undine Bay and is mainly affected by tidal movements. Freshwater flows can become very low during the dry season as this section of the Western area is in a rain shadow area and has significantly lower rainfall than the east and south of Efate island. The wetland area would support a range of saltwater species of fish and other invertebrates which require the brackish backwater as part of their life cycle.

Tidal flows will not be significantly affected by the works and any works requiring access to the river will be carried out at low tide. The risk of the culvert works to riverine fauna is considered low even when unmitigated.

However due to the current state of remaining mangroves in Efate, the project plans to carry out the following mitigation measures to enhance the current mangrove ecosystem.

- > The design of the culvert has adopted the build back better principle to both facilitate recovery from the effects of TC Pam and enhance the sustainability of the mangrove wetland
- > The design of the culverts will significantly improve the flow characteristics of the river compared to the existing piped culverts which are supported by a large concrete embankment which appear to be settling into the silty tidal sediments
- > A new culvert will be built further to the west to promote circulation of high tides to the backwater areas
- > Any works with the potential to affect river flow will be timed at periods of low tide and also will avoid any endemic fish and invertebrate fauna spawning seasons.
- > A mangrove replanting area on the north side of the current road (i.e. between the road and Undine Bay) will be established with species subject to recommendation by DEPC and landowner agreement
- > A dedicated road side rest area with a community education display pointing to the features and explaining the importance of the ecosystem to the Havannah Bay fishery to be operated and maintained by the local landowners or their agreed representatives operating a concession.

5.9.2.3 Social environment

Public access and local mobility

No diversion of traffic will be necessary as the volume of traffic through the subproject is low. A one lane operation will be required and will be open at all times.

The approximate time of construction will be up to three months. The following mitigations will be required:

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Traffic controllers will be required to use traffic control when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified

Health and safety

The area is rural and the immediate area has no residences. There will be a low risk of impacts on community health and safety due to low traffic volumes. Also there is no proposed accommodation construction camp for the western sub-projects.

Some of these low risks and mitigation measures have been indirectly addressed above. To further mitigate these low risks, the Contractor will be required to:

- > Provide adequate knowledge to construction workers on work safety issues and facilities management. Even though there is no plan to use a construction camp for temporary accommodation, the Contractor will conduct an STI and HIV/AIDS awareness program for the construction force and nearby villagers
- > Develop a Safety, Security and Health sub-plan and Solid and Liquid Waste Management sub-plan as part of the CEMP. This document will address both community and workforce issues and include a layout and design of Contractor facilities. The sub-plans will cover typical issues such as:
 - Septic tanks and solid waste receptacles to be set up at facilities. These will be required to be regularly cleared by the Contractor to prevent outbreak of diseases
 - Solid waste and septage to be transferred to nominated waste disposal sites on a frequent basis
 - Adequate signage and security are to be provided at the construction sites for prevention of unauthorised persons (including children) entering the construction sites.
 - Provision for adequate protection to the general public in the vicinity of the work site, including advanced notice of commencement of works, installing safety barriers and signage or marking of the work areas will be carried out
 - Provide an Environmental Safety Officer (ESO) and Community Liaison Officer (CLO) to address health and safety concerns and liaise with villagers
 - Provision of adequate health care facilities including first aid, at the site. The Contractor will train construction workers in basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work
 - Provision of personal protective equipment, such as safety boots, reflective vests, hard hats, gloves, protective clothing and goggles
 - Capture of wastewater to prevent discharge to local water bodies
 - Fit kitchen facilities with grease traps to reduce odours and vermin infestation
 - Provision of safe and clean facilities including sanitation and drinking water
 - Store all POL inside a bunded enclosure and away from the frequent (annual) flood zone

Noise levels

Construction noise from machinery and trucks is considered a low risk for the new culvert construction. The pattern of intermittent generated noise for three months and the scale of construction is not considered to be significant enough to generate noise complaints.

Nonetheless, the following mitigations will be required:

- > The closest village (Siviri) would be kept informed of any sources of noise that may cause complaint at least one week in advance
- > An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The need and requirements for the GRM is established in the CCP and is detailed in the social safeguards DDR

Accidental discovery of archaeological resources

Although highly unlikely, any site clearance, digging and excavation activities undertaken during pre-construction and construction can unearth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum of Vanuatu) will be informed. Activities shall

not recommence until the authorities have agreed that the site/resources have been dealt with appropriately and that work may continue.

Other social impacts

The CLO will establish the communications protocol between the Contractor and community in accordance with the Project CCP. The Contractor will have a dedicated member of their staff to be the liaison between the village chief and elders and the Contractor.

Should construction workers be permitted to go into villages for any reason, the Contractor will be responsible for their behaviour. In the event that there are complaints about the behaviour or conduct of construction workers, complaints will be dealt with using the GRM procedure.

5.9.3 Operations impacts

5.9.3.1 Physical environment

Although unrelated to the Project physical impacts during the operational phase are likely, as traffic forecasts predict that traffic growth will be moderate. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

The risk of impacts on the bridge structures involves accumulation of debris from the frequent flooding incidents and regular maintenance is considered essential to maintain flows under the bridge, reduce channel changes and reduce scour and erosion around the abutments.

Long term changes in river channel morphology can occur and require regular monitoring at bridges subject to frequent flooding, such as Prima. Regular monitoring and maintenance is the responsibility of PWD, who works with communities to undertake desilting of bridges, pothole patching, vegetation control and removal of debris.

5.9.3.2 Biological environment

Flora and fauna and protected areas

Mangroves are recognised as being under threat from development in Efate. A management and business plan prepared by the government the area and surrounding mangrove wetland would help to ensure sustainability of this ecosystem. It is envisaged, that the operation of the new design of the culvert will assist in promoting the sustainability objective as well as meeting the future transport needs of the community along the ring road in this area.

5.10 Climate change effects and adaptation requirements

The effects of climate change are described in detail in Section 10 of the feasibility study report. The relevant hazards presented by a changing climate are predicted (with a high level of confidence) to increase sea levels and increase the intensity of storms. To mitigate the impact of these risks, were they to eventuate, several design mitigation measures have been taken.

In keeping with the recommendations of CSIRO/BOM reports of 2011 and 2014 and short interpretive inputs from CSIRO experts, rainfall intensities were increased by 10% for hydrology assessments. Some uncertainty exists in this projection because the rainfall data doesn't show an upward trend. This has the effect of increasing the calculated flow rate at the sites in the design storm, leading to greater waterway capacity through/under structures, to cater for the predicted greater flow volume that would result from more intense storms.

The technical aspects of climate change adaptation, relating to BBB or disaster risk management are described in more detail in other sections of the Feasibility Study Report.

However, adaptation to climate change also includes some non-engineering, community elements. Community adaptation to climate change will involve activities at different subproject sites. These have an overlap with some gender, environment and community elements below too. The initiatives include:

- > Reinforcing the resilience of ecosystems with rehabilitation and replanting of native species

- > Addressing degree of salination and mangrove ecosystem habitat for fish and invertebrates by increasing the cross sectional area of culverts and replacing older pipe culverts with bridges where possible.
- > Enhancing awareness and participation of communities of the impacts of climate change, highlighting the various other adaptation programs of government, NGOs and donors, that are current or planned
- > Capacity building with the provision of a new climate change information and training module for PWD contractors, which they receive upon contract award. This Module 7 will accompany Modules 1-6 of the information and training procedure which PWD already operates

6 Information disclosure, consultation and participation

6.1 National, provincial and community consultation

Following the process and procedures established in the Project Community Consultation Plan (CCP), consultations with government agencies and civil society including communities including women's groups, chiefs, businesses operators were conducted. These consultations with communities and stakeholders on the Efate Ring Road were undertaken during the feasibility study stage, from August to mid-October 2016. The purpose of community consultations at this stage are to:

- > Foster partnerships with beneficiary and stakeholder communities
- > Share information on the proposed project and its components and activities
- > Communicate with stakeholders that their co-operation (and possible participation) in Project activities including surveys, site investigations, planning, feasibility and design, construction, monitoring, and maintenance is valued
- > To develop and inform the site options analysis, to influence the recommendation of an overall Project scope

6.2 Consultations

Towards the above objectives, the following consultations were conducted:

Table 6-1 Consultation

Date	Groups	Participants	Response
July 2016 – ongoing	PWD/MIPU	At least 10 staff and officers	Supportive of the Project
July 2016 - ongoing	Ministry for Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management Department of Environmental Protection and Conservation National Disaster Management Office Department of Fisheries Department of Forestry Department of Biosecurity Department of Agriculture Department of Geology, Mines and Water Resources Department of Lands Department of Women's Affairs Ministry of Health Shefa Provincial Government	At least 15 officers	Supportive of the Project
July - September 2016	Chamber of Commerce Vanuatu National Council of Women	7 officers	Supportive of the Project

Date	Groups	Participants	Response
	Vaturisu Executive Council (Efate Chiefs) international non-government organisations (Save the Children, Red Cross)		Recommended continued involvement particularly the women and chiefs consulted
8 and 10 August 2016	Two area-level village consultations (Epau and Mele) for all 13 project villages along the ring road area	92 people	Concerned about lack/poor public safety features e.g., lack of footways at structures; requested improvement of washing areas in some sites
29 August to 1 September 2016	Community level consultations (14 villages)	253 people	
29 September 2016	Malvatumauri Chiefs (Efate Council of Chiefs) briefing	48 people	
	Sub-Total	392 communities 33 government/NGO	
	Total Consulted People	425	

- > At least 392 community members and leaders (including 109 (28%) women) representing the 20 project sites, drawn from 14 villages³ on the Efate Ring Road, were consulted from August 8 to 29 September 2016. Also 33 government and non-government representatives were also consulted during the feasibility study stage.
- > At the area-level village consultations, communities were introduced to the proposed project including objectives, scope of works and land requirements. Following this high level consultation, smaller teams of specialists including the technical, social and environmental safeguards team, and survey teams returned multiple times to visit the site and consult with the chiefs, landowners, or communities as a whole, including the formal consultations conducted from 29 August to 1 September.

6.3 Key information gathered

Information collected from the consultations included:

- > Height and nature of flooding on the structure during TC Pam
- > Frequency and severity of flooding during a normal year
- > Incidence of debris building up against structure
- > Impact to the communities, including whether basic supplies for the village are cut off
- > Recommended areas near the road for improvement e.g. bridge or culvert to be protected or improved? (washing, fishing, gathering areas, cultural)
- > Recommended facilities to be improved

³ Villages of Eton, Pangpang, Epau, Epule, Siviri, Tanoliu, Mangaliliu, Mele, Tamate, Rentapau, Sara, Takara, Emua, and Lelepa

- > Suggested safety improvements for the structures
- > Suggested best way for temporary access during construction
- > Involvement of community during construction and maintenance
- > Perceived potential benefits to the community of the project (including for the elderly, women, children, disabled)
- > Perceived failure to deliver on commitment by PWD to provide maintenance contracts to communities through chiefs
- > Chief's feedback on signing of a long term MOU with the landowners including questions on compensation to landowners
- > Chief's opinion regarding the participatory and grievance redress mechanism through establishment of a community liaison committee
- > Various other non-project-related issues for communication back to PWD

The above information was used as input to the technical design, procurement, and operational stages.

6.3.1 Land ownership

All sites are on customary lands, some with existing leases. These leases are still being confirmed with the Department of Lands' survey section, pending updating of their land records after submission of As-Built Design document by PWD. There is a more complete description of these issues in the Due Diligence Report (DDR) on Social Safeguards.

To better understand the ownership of the river crossings and road development and the impacts which may be caused if land owners, claimants or operators of existing facilities interfere with the repair or replacement of the infrastructure, formal agreements (Memoranda of Understanding (MOUs)) are sought between MIPU, landowners, claimants, or their representatives. The MOUs are to allow long term access to sites, to carry out further investigations or studies, and for construction, maintenance, or future upgrades of infrastructure. These MOUs are regarded as formal documents respected by all signatory parties, and as evidence of support for the Project by relevant land stakeholders. Independent witness representatives acting as third party validators (TPV) will be chosen to witness the agreement process and the signing of each MOU. These will be people such church leaders or non-government organisation leaders respected in the communities and perceived to be without vested interests in the Project.

The MOU template to be used by this project is similar to the one used under previous ADB projects in Vanuatu. This was approved and endorsed by Department of Lands and the State Law Office for those projects. This approval also stated that the MOU template is acceptable as an evidence of consent from landowners and maybe used, if necessary, for the approval of Foreshore Development Permit for the relevant sites. The MOU consultation process is planned for completion prior to the procurement process commencing in January 2017.

6.4 Disclosure

Disclosure of this IEE will formally apprise the communities of the mechanism for GRM. It will be used as a starting point for open and meaningful communications with communities and landowners. Disclosure will take place when the EMP is finalised, following detailed design.

As described in the CCP, the DDR, and in particular the establishment of the GRM, will require face-to-face meetings with landowners and leaseholders and public disclosure of the GRM through community meetings for all Project communities. Also, signage with the Project name, contact person, and contact number for inquiries and complaints will be erected in public view for each of the Project sites. Moreover, a leaflet summarising the GRM will be disclosed on community notice boards, government and ADB websites.

7 Environmental Management Plan

The environmental management plan (EMP) is the guiding document to provide direction to the implementation of the environmental safeguards component of the Project. The EMP included in this IEE will be updated during detailed design to reflect the more detailed and accurate information going forward. The updating of the EMP will also integrate the additional baseline information obtained during the stream flora and fauna studies to be undertaken in the next month. The EMP section and any additional provisions will be included in the bidding documents to which the contractor will respond.

The mitigation and management principles set out in the EMP establish the requirements and provisions each of the Contractors must follow when they prepare subproject site-specific contractor's environmental management plans (CEMP's), which will set out the construction methodology (including site specific plans at each site showing laydown areas, extent of works, stockpiles, location of silt/sediment curtains, coastal protection, trees/vegetation to be protected, etc.) they will adopt to meet the mitigation requirements and reduce risk to acceptable levels, sites for obtaining materials and will be implemented in accordance with the relevant provisions of the Contract and any conditions placed on the environmental permit by the DEPC. Given that works not associated with the project are being undertaken at some sites, the contractor will be required to update the baseline as required to reflect actual conditions at the sites at the time of CEMP preparation.

The IEE includes the EMP that will be elaborated by the Contractor as the basis for the preparation of their site specific CEMPs. The EMP outlines the activities, impacts mitigations, costs and responsibilities basic management principles, the proposed design mitigations to ensure inclusion in the bidding documents, standard construction mitigation measures, monitoring and a proposed institutional arrangement for further implementation of environmental management during the construction phase.

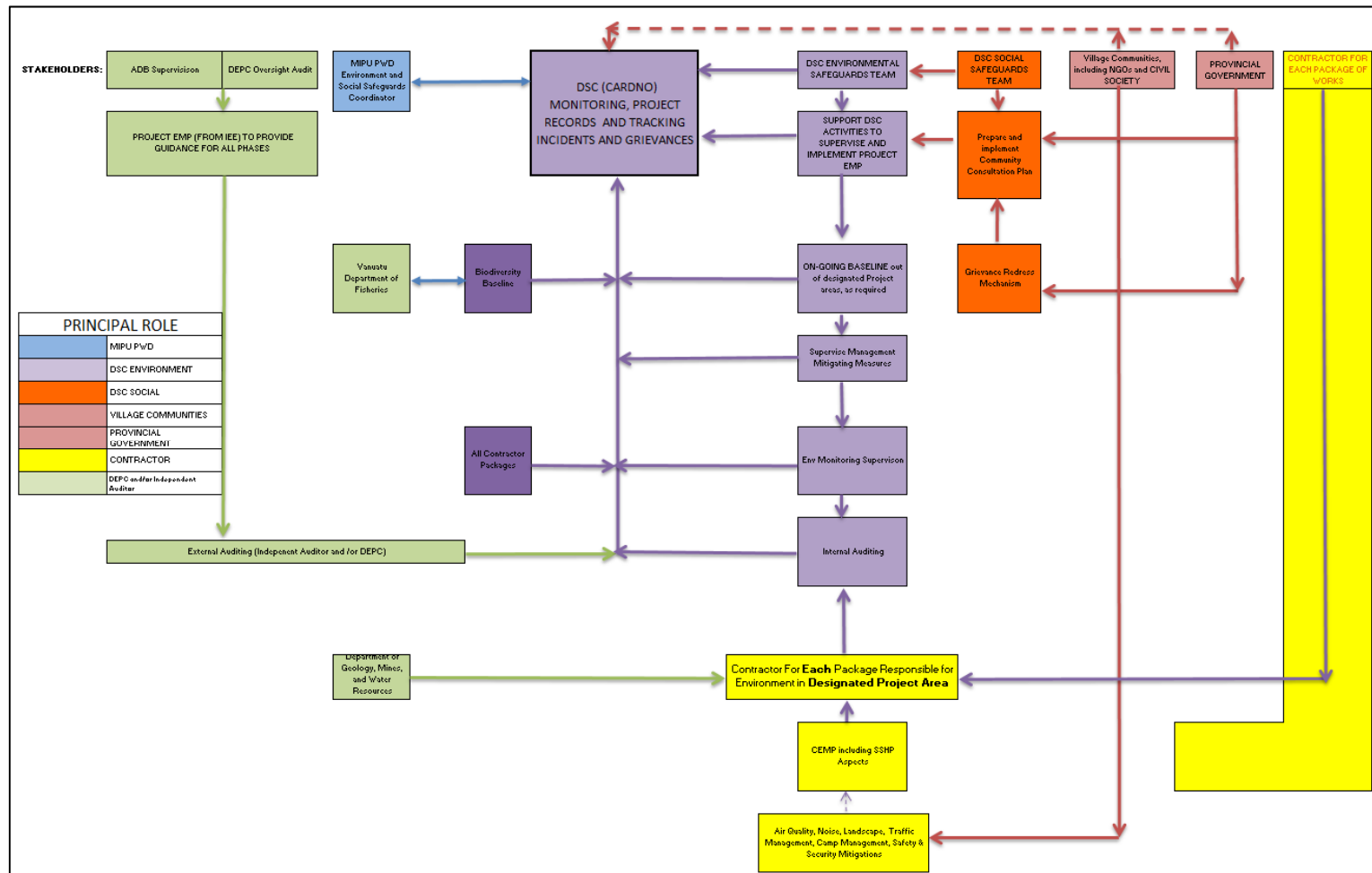
The EMP details the implementation arrangements and the roles and responsibilities of each the main stakeholders, then goes onto discuss capacity building requirements to support the implementation, a grievance redress mechanism for community feedback and complaints.

7.1 Implementation arrangements

The key stakeholders in the implementation of environmental safeguards are as follows:

- > The proponent is PWD of MIPU
- > The safeguard operations within PWD, made up of PWD Staff (Environmental and Social Affairs Coordinator), supported by the DSC safeguards team
- > The Contractor(s)
- > Shefa Provincial Council
- > The affected village communities
- > The DEPC
- > ADB

The proposed implementation arrangements are shown in the figure below.



7.2 Institutional roles and responsibilities

The role and responsibilities of the main stakeholders are set out in the table below and described in the text below. As shown in the table, the responsibility for preparation and implementation of the CEMP is the Contractor. The supervision, quality control and enforcement of contract provisions is the responsibility of the DSC project manager (Engineer to the Contract) and the Resident Engineer. A daily and/or weekly checklist will be required by the Contractor and a monthly report by the Contractor will incorporate these checklists, any issues relating to routine compliance and reporting of any incidents / complaints that have occurred and the progress of their resolution.

7.2.1 Ministry of Climate Change, Meteorology and Geo-hazards, Environment, Energy, and Disaster Management

The Department of Environment Protection and Conservation (DEPC) is responsible under the EPC Act (2010) to administer the Act which includes approval of environmental assessments. Since 2013 it has been part of the MCC. The MCC comprises four separate units or departments: Vanuatu Meteorology and Geo-Hazards Department; National Disaster Management Office; Department of Energy; and DEPC. The DEPC is legally responsible for monitoring of implementation of the Management Planning

The EIA Regulation 2011 sets out requirements for management planning and the document is referred to as the Environmental Management and Monitoring Plan (EMMP), which under the Regulations must: (i) describe, in respect of the project, proposal or development activity, the environmental protection measures that will be put in place by the project proponent if approval is given for the project, proposal or development activity; (ii) include an environmental monitoring and surveillance program of action; and (iii) provide for an environmental monitoring manager to be appointed by the project proponent, in consultation with the DEPC, to verify that the EMMP and protection measures are being fulfilled and adverse impacts of the project, proposal or development activity are documented.

7.2.2 Ministry of Infrastructure and Public Utilities

The Ministry of Infrastructure and Public Utilities (MIPU) is the key government agency responsible for infrastructure development and the management of public works. MIPU comprises four divisions one of which is the Public Works Department (PWD). MIPU, through PWD, administers infrastructure development projects and infrastructure maintenance.

As the PWD is one of the few central government departments with line staff in the provinces (where DEPC has no operational staff) it would be useful to improve understanding of environmental safeguards for PWD staff and contractors in the provinces.

7.2.3 Design and Supervision Consultant

Cardno is the design and supervision consultant (DSC) for the Project, supporting the Public Works Department (PWD) of the Ministry of Infrastructure and Public Utilities (MIPU) in detailed design preparation, construction supervision and monitoring and evaluation. The DSC specifically provides design and construction services for the following Project outputs:

- > Reconstruction of roads and bridges
- > Reconstruction of Klems Hill landslide-affected structures and improvement of drainage
- > Implementation of social and environmental safeguards, and where applicable, gender mainstreaming
- > Updating the EMP based on detailed design and baseline studies and environmental permit conditions from DEPC; integrating updated EMP in the tender dox; assisting with bid evaluation regarding EMP aspects proposed by bidders; orientation and support on contract award prior to contractor preparing the CEMP; review and clearance of contractors EMP; inducting contractor to site, post CEMP approval; monitoring and auditing, reporting

Construction supervision of safeguards is the responsibility of the DSC which has an overall resident engineer responsible for supervision of quality control, performance including implementation and

enforcement of safeguards and review of monthly reports and follow up. The role of the DSC safeguards team is to provide input to the project manager but its principal role with the DEPC is quality assurance and auditing, in order to ensure that the agreed procedures are in place and being operated in a satisfactory matter and in accordance with the contract provisions.

7.2.4 Contractor

The civil works contractor(s) will be responsible for preparing the CEMP during the mobilisation phase of construction after contract award. The DSC environmental safeguards specialist will approve the CEMP before any construction work commences. The contractor will undertake its own monitoring and prepare an environmental section of the monthly report to the DPSC. The contractor is responsible for implementing all environmental, health and safety actions included in the CEMP and relevant clauses in the bidding documents. The contractor is required to assign an environmental safety officer (ESO) whose responsibilities will include:

- > Coordinating with the DSC during preparation and approval of the CEMP
- > Ensuring that the contractor engages a suitable organization to undertake STIs/HIV/AIDS briefings and awareness raising amongst the contractor's employees and neighbouring communities follow-up upon request
- > Coordinating with PWD in respect of community consultation
- > Participating in monitoring and coordinating with DSC to ensure that environmental management activities are reported as required
- > Ensuring that the contractor does not commence construction activities until requisite approvals have been received from DEPC and/or other Government permitting agencies such as the Ministry of Internal Affairs, office of Physical Planning and Department of Mining responsible for quarries
- > Coordinating and communicating with the contractor's Community Liaison Officer (CLO), as required, to facilitate consultation with the affected villages, various stakeholders, and ensuring smooth implementation of the subproject

The contractor and PWD, through the DSC, will be responsible for environmental monitoring during construction and post-construction. The DSC will also be responsible for verifying the monitoring undertaken by the contractor through audits and spot-checks. The outcomes of the monitoring will be included in the overall safeguards monitoring progress reports to be submitted to DEPC. These will also be consolidated and submitted to ADB for review on a designated time period as required.

7.2.5 PWD Operations and communities

PWD Operations is responsible for the administration and maintenance of all infrastructure and will be responsible for these activities during operations. Routine maintenance operations is normally carried out by nearby communities under contract to PWD. Village leaders and organisations will assist in arranging meetings, facilitating consultation and providing information about affected communities and environmental impacts of construction. Documentation of issues that arise is an integral part of the internal monitoring report prepared by the Contractor.

The consultation process was set out and agreed with PWD for the preparation of the CCP. If issues arise during construction the local communities can provide input and advice to the Contractor's CLO or use the GRM for issues and grievances which have not been satisfactorily resolved.

7.2.6 ADB

Due diligence. ADB's safeguard due diligence emphasises planning, environmental and social impact assessments and safeguard documentation. Through such due diligence and review, ADB will confirm (i) that all key potential social and environmental impacts and risks of a project are identified; (ii) that effective measures to avoid, minimise, mitigate, or compensate for the adverse impacts are incorporated into the safeguard plans and project design; (iii) that the borrower/client understands ADB's safeguard policy principles and requirements and has the necessary commitment and capacity to manage the risks adequately; (iv) that, as required, the role of third parties is appropriately defined in the safeguard plans; and (v) that consultations with affected people are conducted in accordance with ADB's requirements.

Health and safety. The project will be required to provide workers with a safe and healthy working environment, taking into account inherent risks, any hazards in the work areas, including physical, chemical, biological, and radiological hazards. The SPS also requires that the government, through the implementing agency, will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work.

The ADB ensures that the project adheres to international good practice, as reflected in internationally recognised standards such as the World Bank Group's Environmental Health and Safety Guidelines.

Monitoring and Reporting. Both government and ADB have their own separate monitoring responsibilities. The extent of monitoring activities, including their scope and periodicity, will be commensurate with the project's risks and impacts. Governments, through the implementing agency, are required to implement safeguard measures and relevant safeguard plans, as provided in the legal agreements, and to submit periodic monitoring reports on their implementation performance. Monitoring and supervising of social and environmental safeguards is integrated into the project performance management system. ADB will monitor projects on an ongoing basis until a project completion report is issued.

Table 7-1 Roles and responsibilities of key stakeholders for CEMP implementation

Stakeholder	Main Role in Implementation of the EMP (EMMP)	Responsibilities						
		Decision maker, Policy Advice and Intergovernmental and Inter-Ministerial Co-ordination on Safeguards	Preparation of CEMP	Implementation of Mitigations and/or Management Programs in CEMP	Daily/Weekly Checklists and Monthly Reporting	Supervision/ Quality Control/ Enforcement	Consultation, Advice, Complaint, Feedback	Audit Quality Assurance
PWD	Proponent /Owner	Responsible for overall project implementation					Responsible for resolution of comments and grievances	Input
DSC Project Manager/Site Supervisor	Project Management, Supervision, Contract Management	Support PWD at meetings	Supervision and coordination of Quality control	Supervision and coordination of Quality control	Responsible For Supervision and coordination of Quality control	Responsible For Supervision and coordination of Quality control	Coordination	Support Implementation of QA Audit by DEPC Delegated authority to enforce if DEPC constrained by budget or personnel
DSC Safeguards Team	Support to Project Manager	Support PWD at meetings	Coordination of preparation and approval of document	Responsible for Implementation	Responsible for preparation	Input and Support	Preparation of feedback on comments and GRM	Implementation of QA Audit Delegated authority to enforce if DEPC constrained by budget or personnel
Contractor	Construction	Provides technical support at meetings on request	Responsible for Preparation	Responsible for Implementation	Responsible for preparation			Provides requested information from site visits
Provincial Government	Consultation and advice	Input to Technical meetings	Inputs to regular consultation	Inputs to regular consultation	Inputs to regular consultation	Monitors contractor performance	Facilitation of feedback to communities	Input

Stakeholder	Main Role in Implementation of the EMP (EMMP)	Responsibilities						
		Decision maker, Policy Advice and Intergovernmental and Inter-Ministerial Co-ordination on Safeguards	Preparation of CEMP	Implementation of Mitigations and/or Management Programs in CEMP	Daily/Weekly Checklists and Monthly Reporting	Supervision/ Quality Control/ Enforcement	Consultation, Advice, Complaint, Feedback	Audit Quality Assurance
Village Communities	Consultation and advice	Provide Advice through CCP process	Inputs to regular consultation	Inputs to regular consultation	Inputs to regular consultation	Monitors contractor performance	Prepares comments and/or grievances	Input
DEPC	Monitoring of Compliance	Responsible for Safeguards Implementation Approve PEA and EMMP Provide Advice to DPW	Review of CEMP	Monitoring of Implementation	Monitoring of Implementation	Monitoring of Implementation	Monitoring of Implementation	Responsible for review and enforcement of EMMP provisions
ADB	Due Diligence and Monitoring of Safeguard Monitoring Reports	Review of PEA and EMMP	Review of CEMP	Monitoring of Implementation	Monitoring of Implementation	Monitoring of Implementation	Monitoring of Implementation	Monitoring of Implementation

Source: Environment Safeguards Specialist, DSC,2016

7.3 Capacity building requirements

Capacity building has been discussed briefly with the PWD and will be confirmed as part of the final design phase.

PWD has recently developed a social safeguards framework (SSF) through the Vanuatu Transport Sector Support Program (VTSSP). The VTSSP is financed by the Department of Foreign Affairs and Trade (DFAT) of the Government of Australia and is now in its second phase. The VTSSP includes support for social safeguards and other institutional strengthening within MIPU such as human resource management and procurement.

The SSF for VTSSP is currently being implemented by PWD. Implementation includes capacity development and training for PWD staff and local contractors in the provinces and was developed partly in response to challenges face in the first phase of the program. MIPU and PWD intend to apply the SSF to other infrastructure projects and PWD work programs over time however currently the focus is on the VTSSP. Environment is included in the SSF however understanding and capacity for environmental elements is relatively weak. The current emphasis is largely on social safeguards with only one out of the seven elements of the SSF being environment.

As the PWD is one of the few central government departments with line staff in the provinces (where DEPC has no operational staff) it was considered to be useful to improve understanding of environmental safeguards for PWD staff and contractors in the provinces.

A recent step towards strengthening CSS implementation is the PWD appointment of a Senior Safeguards Officer and also an Environmental Safeguards Officer. These are new appointments and these officers will be involved with this TA and the DEPC as it is progressively implemented in those areas of PWD work outside the VTSSP.

7.4 Grievance Redress Mechanism

An integral part the EMP structure is the GRM and will be responded to by the contractor in the CEMP. The GRM is for the project overall and is also included in the DDR and makes up an important component of the CCP.

During the course of the project, it is possible that people may have concerns with the project's environmental performance including the implementation of an agreed MOU. Issues may occur during construction and again during operation. Any concerns will need to be addressed quickly and transparently, and without retribution to the affected person (AP).

The following process will be used to address concerns quickly and transparently at Project level, based on the existing system for dispute resolution.

- > Any AP may discuss their complaint with the Chief in their village. The AP or both AP and Chief take the complaint to PWD (formally, the Director)
- > PWD will record all complaints (date, details of complainant/grievance, attempts to resolve the complaint, and outcomes) and will have a maximum of one week to resolve the complaint and convey a decision to the AP
- > If the complaint of the AP is dismissed, the AP will be informed of their rights in taking it to the next step. A copy of the decision is to be sent to next level of authority
- > Should the AP not be satisfied with decision of PWD, depending on the nature of the complaint, the AP may take the complaint to the MLNR, who will appoint a representative to review the complaint in the case of alienated land or to a custom land officer (under the Custom Land Management Act) for customary land. The MLNR will have two weeks to make a determination. The determination by nakamal or custom area land tribunal will follow the timelines established in the Custom Land Management Act
- > If a satisfactory conclusion cannot be obtained through this process (or at any time), the AP can take the matter to the courts (nakamal, custom area land tribunal, Island Court or Supreme Court). This will be at the APs cost but if the court shows that the government ministries have been negligent in making their determination, the AP will be able to seek costs

Through public consultations, APs will be informed that they have a right to complaint/grievance resolution. The record of the grievance redress mechanism will be the subject of monitoring.

During construction/implementation, a grievance register will be held at each Project site office, maintained by the site manager and monitored by the Project safeguards team. All complaints arriving at a site office are to be entered in a Register (by, date, name, contact address and reason for the complaint) that is kept at site. A duplicate copy of the entry is given to the AP for their record at the time of registering the complaint. The Register will show who was directed to deal with the complaint and the date when this was made together with the date when the AP was informed of the decision and how the decision was conveyed to the AP.

The Register is then signed off and dated by the person who is responsible for the decision. The Register is to be kept at the front desk of the site office and is a public document. The duplicate copy given to the AP will also show the procedure that will be followed in assessing the complaint, together with a statement affirming the rights of the AP to make a complaint. For anybody making a complaint no costs will be charged to the AP.

In the event that grievances cannot be resolved at the local level, MIPU and MLNR will hold the compensation amounts in escrow or trust account. Compensation will be paid in full upon final resolution of the case in the courts or other forum, in accordance with the entitlements of the AP.

Table 7-2 Procedures for resolving grievances

Step	Process	Duration
1	Displaced Person (AP)/Affected Person (AP) takes grievance to the village chief/ then with village chief to PWD. This could be done after initial notification of grievance at Contractor's site office, or through the DSC (Resident Engineer)	Any time
2	PWD reviews issue, and in consultation with contractor (if appropriate), then records a solution to the problem.	1 week
3	PWD reports back to AP and gets clearance from complainant.	1 week
If unresolved		
4	AP take grievance to relevant government agency for resolution (MLNR)	Decision within 1 week
5	AP refers matter to public solicitor's office	2 weeks
6	National agency refers to an internal committee	4 weeks
7	National agency through reports back to relevant government agency/AP	1 week
If unresolved or if at any stage and AP is not satisfied with progress		
AP can take the matter to appropriate court.		As per judicial system

7.5 Environmental mitigation and monitoring

7.5.1 Mitigation

Section 5 described the potential impacts and risks of the eight subprojects in the western area for all three phases of the project and also specified mitigating measures for some of the subprojects which are considered to have higher risks due to the more sensitive existing environment surrounding the subproject.

This section includes a discussion of agreed design mitigations that have been included into the design of the subprojects considered to require mitigation to address both cyclone damage. Mitigations were also required for the moderate to high risks assessed for the impact of the construction phase on the subproject, which is concluded to lead to the majority of more significant risks if unmitigated.

However, due to the localised nature of activities, the scale and duration of construction required and the relatively low population density in the vicinity of most subprojects, the impacts were generally assessed as

being of low significance without mitigation. A minority of subprojects showed moderate to high direct or indirect impacts without mitigation or management intervention.

It should be emphasised that for most Subprojects the works will focus on reconstruction within existing corridors which were generally found to be highly modified due to the past operation of the ring road. For most subprojects, the road corridor does not traverse stream sections which include critical or natural habitats. With the exception of Creek Ai and Malatia, subprojects in western Efate are not located in, or adjacent to, protected areas or conservation areas. The final design will include environmental enhancements to address cyclone damage with design mitigations to build back better.

Table 7-3 Proposed design mitigations

Subproject	Proposed Design Mitigation/ Management Program
Malatia Culvert involving repair and enhancement of existing and new culvert construction in wetland mangrove environment	The culvert will be replaced with open box design and an additional culvert further to the north to maximise the tidal flow into the wetland. A roadside attraction point will be sought from within the local community to improve public awareness of the importance of mangrove ecosystems. This location is one of the biggest areas of mangrove (even though heavily modified on its boundaries on the island of Efate
Creek Ai Culvert involving the need for protection and management of freshwater fish and invertebrates	The culvert will be replaced with much larger open box design to reduce sedimentation associated with the older pipe designs and will promote fish and crustacean passage both upstream and downstream. Low flow flute design will be included at the lowest level within each box.
Morona Bridge involving the need for protection and management of freshwater fish and invertebrates	A new higher level bridge will replace the current half bridge half piped culvert design which will substantially improve conditions for fish and crustacean passage both upstream and downstream.
All freshwater streams including Creek Ai and Morona (and Epau, Neslep, Lamin, Pangpang, La Cressonniere in eastern Efate)	A baseline biodiversity study of freshwater fish and invertebrates was proposed to be conducted in selected subprojects to promote selective restocking programs (timing and sites for study TBC). The results of the study will be completed before the construction program commences so it will also facilitate the design of further mitigations to mitigate construction impact and also to design restocking and/or a conservation program upstream of facilities on priority streams. This work would be carried in close coordination with a new project being carried out for the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biodiversity by the Queensland Institute of Technology and local freshwater fish aquaculture project in Mangaliliu, Onesua and Epau villages

The specific mitigations required for Creek Ai , Morona Malatia Culverts are set out below. In order to reduce risk, the following measures will be required or have already been implemented in the design:

- > Creek Ai:
 - The design is for large, multi-cell box culverts, which will significantly improve the flow characteristics of the stream compared to the existing piped culverts which were supported by a large concrete embankment which effectively was acting to dam the flow at low flows
 - The base slab of the box culverts will also feature a low flow channel to maximise flow depth during the distinct dry season in this area
 - A separate sub-plan on temporary river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys being undertaken are understood and implemented by the Engineer and Contractor

- Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons. This information is currently being obtained from the DEPC biodiversity officer
 - Subject to the results of further sample studies on this stream and inputs from government agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with TC Pam
 - A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime
- > Marona:
- A separate sub-plan on river diversion will be prepared as part of the CEMP in order to ensure that the recommendations of the sample surveys are understood and implemented by the Supervising Engineer and Contractor
 - Any works with the potential to divert river flow will be timed at periods of low flow and also to avoid any endemic fish and invertebrate fauna spawning seasons
 - Subject to the results of further sample studies on this stream and inputs from GOV agencies, restocking with certain species may be carried out by the Contractor using the building back better (BBB) principle and to help the river to overcome the effects of the very high flood flows associated with Cyclone Pam
 - A quality assurance audit of Contractor practices will be carried out by the DEPC biodiversity officer and/or their independent representative before site works affecting the current flow regime
- > Malatia:
- The design for the site incorporates the build back better principle to facilitate recovery from the effects of TC Pam and enhance the sustainability of the mangrove wetland
 - The inclusion of relief culverts to convey flows above the existing piped culverts will improve the flow characteristics of the waterway. The existing pipes are large but typically flow more than half full with estuarine flow
 - An additional relief culvert will be built further to the west, to allow circulation of high tides to the backwater areas
 - Any works with the potential to affect river flow will be timed at periods of low tide and also will avoid any endemic fish and invertebrate fauna spawning seasons
 - A mangrove replanting area on the north side of the road (i.e., between the road and Undine Bay) will be established, with species subject to recommendation by DEPC and landowner agreement
 - Dialogue with landowners will include discussion of a dedicated road side rest area with a community education display, identifying the features and explaining the importance of the ecosystem to the local fisheries. It could be operated and maintained by the local landowners or their agreed representatives operating a concession

There are site specific noise mitigations required for Mele Bridge, Klems Hill landslip and Marona Bridge, due to the need for the use of pile driving equipment. The noise impact analysis predicted that Mele, Melemaat would be subject to excessive noise.

The excessive noise of the pile driver will require mitigations including:

- > Notification to all receptors and the Contractor will prepare a schedule of operations that will be approved by village chiefs. The construction schedule will identify days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used
- > Restricting the hours of operation to agreed times

- > Requirements in the CEMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken
- > Noise incurred by construction workers from construction machine is a workplace health and safety hazard. Workers will be provided with noise abatement personal protective equipment as may be required
- > Complaints regarding noise will be dealt with in accordance with the community consultation plan (CCP) which includes the grievance redress mechanism (GRM)

The need for temporary traffic diversions outside of the nominal road corridor was assessed as being of moderate significance for health and safety as there is a relatively high population density with potential for nuisance and land use impacts. Road diversions will also be necessary in a number of subprojects including Mele, Morona and possibly Tanoliu Bridge. In order to address health and safety the following specific mitigations will be required.

- > Construction will be timed during the dry season so that local flash flood risk is reduced
- > Traffic controllers will be required to use traffic control when trucks enter and leave the road
- > After working hours, the traffic volume is low and any hazards will be appropriately protected
- > Designated construction zones will be marked and/or fenced with Keep Out and safety information signage and advance warning signs placed on the road
- > Provincial authorities, the community and schools will be notified in advance of the schedule and duration of operation (refer Project CCP)
- > Disposal sites and haul routes to existing concrete batching plants and quarries will be identified

The need to carry out river channelling to increase channel cross sectional area and reduce sedimentation means that construction access to the waterway is also necessary for both Prima and Mele bridges. This will result in short term hydrology and water quality issues and potential for impacts on freshwater fish and crustaceans.

There are further routine mitigations listed under each subproject to provide additional guidance to the Contractor when they prepare the CEMP. The project EARF also stipulates some design criteria for run-off management design as follows:

- > Roadside storm-water drainage will include the following recommendations:
 - Cross drainage using culverts will be carefully evaluated to ensure that systems do not fail from excessive discharge
 - Where the road traverses ridges, side drains (off-takes) are required to direct storm water flows away from the road. These are to be established at 2 m vertical intervals (VI) where bare earth channels will be maintained. If a 2 m VI cannot be achieved, then consideration will need to be given to vegetated channels with a VI of 4 m or otherwise armoured with concrete or half round steel pipes.
 - Where cross drains are required stable outlets will be provided that can carry the runoff safely to the disposal area. Culverts and drains must not be allowed to terminate above a disposal area without considering the possible effects on the stability of the discharge area
 - All pipe and box culverts must have flared level outlets and be provided with a vertical cut-off wall at the end of the apron that extends at least 0.35m below the apron to avoid the apron being undercut
 - All culverts are to discharge to safe (non-eroding) areas

7.5.2 Monitoring

The CEMP for each package will detail the contents of the monthly environmental report which at a minimum will include:

- > Routine non-compliances
- > Reporting status for each level of non-compliance and proposed contract enforcement
- > Incident and complaint classification with required reporting time-frames and status of resolution
- > Reporting of the results of regular community update / progress meetings including use of local labour (gender disaggregated)

7.6 Pre-construction and construction mitigation principles

This section highlights the routine mitigation measures that will form the basis for each CEMP and each measure will require monitoring and supervision. The proposed mitigations for the pre-construction and construction phase are set out in **Table 7-4**.

The table outlines the management and mitigation principles and guidance for the Contractor responsible for each Contract package to prepare a CEMP. It also provides guidance on the necessary monitoring program that will be required to ensure compliance with EPC Act and ADB requirements during implementation of the subprojects.

Table 7-4 Mitigation monitoring matrix

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
Pre- Construction Phase									
Pre- Construction Survey	Vegetation Clearance (Physical)	> Minimise vegetation removal to immediate corridor of works > Identify/mark out mature or special trees and areas of vegetation to be protected	Contractor	DSC Project Manager/ Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Area of vegetation; area of felled trees/vegetation removal Drawing/plan identifying trees and/or vegetation marked for protection	Visual inspection with Photos before, during and after	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Land Use Changes and Restrictions (Social)	> MOU negotiation with landowning units	Contractor/ DSC and Village Elders	Customary Land Management Office (CLMO) for Custom Land and Lands Department for Leases	Incl in Contract ESO Site supervisor + two field assistants	Grievances from communities and Agreed Resolution	Third Party Verification	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> During consultation communities confirm they are willing to cooperate with a MOU to be agreed and signed	Contractor/ DSC and Village Elders	Customary Land Management Office (CLMO) for Custom Land and Lands Department for Leases	Incl in Contract ESO Site supervisor + two field assistants	MOU signed	Third Party Verification	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Non-land assets damaged to be compensated(e.g. trees, crops, yards, sheds and fences)	Contractor DSC	DSC MIPU MPW and Finance	Incl in Contract ESO Site supervisor + two field assistants	Compensation for any Damage foreseen for mobilisation and facilities	Compensation Paid before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
Mobilisation of Contractor, presence of construction workers, associations with local people	Social disruption (Social)	> Village protocols discussed; worker awareness as part of mobilisation	Contractor / DSC	MIPU Province Village Elders	Incl in Contract ESO Site supervisor + two field assistants	Complaints of incidents between workers and villagers;	Complaints of incidents between workers and villagers;	Contractor/ DSC MIPU MPW Coordinator	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Contractor prepares, and submits for clearance, CEMP which identifies protocols and construction work force elements. A separate Safety, Security and Health sub-plan will be developed as part of the CEMP: If Camp required Contractor to ensure workers actions outside camp/site are controlled and village rules, code of conduct observed	Contractor	MIPU Province Village Elders	Incl in Contract ESO Site supervisor + two field assistants	Complaints of incidents between workers and villagers;	Complaints of incidents between workers and villagers;	Contractor/ DSC MIPU MPW Coordinator	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> If Camp required Signage and security at camp i.e. prohibition on unauthorised people (esp. children) entering camp	Contractor DSC	MIPU Province Village Elders	Incl in Contract ESO Site supervisor + two field assistants	Number and effectiveness of signs	Signage Installed before Construction commences	Contractor Photo record and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Public/ Workforce Health (Social)	A separate Safety, Security and Health sub-plan will be developed as part of the CEMP	Contractor	MIPU PWD and MOH	Incl in Contract ESO Site supervisor + two field assistants	STI/HIV/AIDS prevalence	Prior to construction - check contractor records, consultation with employees, Coordination with MOH	Contractor relevant Communications in Monthly Report with MOH to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Follow Up Evaluation before Construction Commences	Contractor	MOH	Incl in Contract ESO Site supervisor + two field assistants	Increased awareness about transmission and prevention	Randomised Evaluation Survey	Evaluation Survey Results	Random or Routine Audit by DEPC and/or Safeguards Specialist
All Activities - Construction Phase									
	Air Quality (Physical)								

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> Prohibition of use of equipment that causes excessive pollution (e.g. generates smoke)	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visible Smoke or other Vehicle Emission	Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Vehicles transporting dust-producing material not overloaded, provided with tail-boards and side-boards, and adequately covered	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visible Dust	Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Material stockpiles located in sheltered areas and to be covered	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visible Dust	Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Damping down of access road during the dry season	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visible Dust	Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Noise Emissions (Social)								
		> Construction vehicle exhaust systems and noisy equipment will be maintained to minimize noise	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Noise in DbA using hand held monitor at Standard Distance	Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Contractor will develop a schedule of operations with village chiefs and DSC to identify days of no work and hours for certain activities	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Schedule Delivered copy in MR	Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Agreed with Village officials by Letter	before start of Construction	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Agree on non-routine notice protocol with village leaders	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Agreed with Village officials by Letter	before start of Construction	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Water Quality (Physical)								
		> Construction works in areas of rivers, especially riverbanks, streams and the coast to be undertaken with extreme care > A separate river diversion sub-plan will be developed as part of the CEMP	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Daily Start and Finish at site	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Use of silt control devices and sediment traps/fences during bridge and culvert works and extraction activities with regular cleaning and maintenance.	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Daily Start and Finish at site	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> Temporary structures to minimize any reduction of river and stream flows	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Daily Start and Finish at site	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Temporary structures removed on completion of works and riverbed restored	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Daily Start and Finish at site	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Side slopes of embankments designed to reflect soil strength	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Verify design	Implementation completed	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> River training and scour protection as needed	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Verify design	Implementation completed	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Minimise size and duration of cleared areas and undertake progressive re-vegetation of cleared/work areas	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Avoid clearing activities during rainy season where possible	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Natural water flows in streams and rivers will not be interfered to the extent possible	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Use of heavy machinery in smaller more sensitive freshwater aquatic environments to be minimized	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Good design used in all construction activities to minimize need for changes to natural gradients	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> No discharges of POL to rivers and surface waters.	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Erosion and Sediment Control (Physical)								
		> Stockpile of suitable material always available and used in event of bank or channel erosion	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Gabion baskets or rock rip-rap to be used for embankments when suitable	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> No dumping of spoil in streams and rivers.	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Spoils and stockpiles will not be located near or on slopes or within flood zone of rivers and streams	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Placement of diversion ditches around stockpiles	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Abstraction from, or pollution of, water resources and coastal waters not permitted	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Land Use Changes (Social)								
		> Existing quarries will be used wherever possible and appropriate	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Letter	Verify before Construction Commences	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Extraction from ecologically sensitive areas (inter-tidal, swamp, or mangrove areas) or productive land is not permitted	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Verify	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist	
		> Sites for Spoil Placement to be identified in consultation with MIPU DPW, land owners and communities	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants		Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist	
	Top Soil Protection (Physical)								
		> Topsoil is preserved in designated storage areas and reused as soon as possible to promote and stabilise endemic species	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Endemic Species to be preferred unless there are technical reasons for using introduced species	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Letter	Verify before Construction Commences	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> After completion of works all areas edging streams to be restored to original condition as quickly as possible with suitable mix of trees and shrubs to promote stabilisation of soils	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Visual Inspection with Photo date	Verify within two weeks on work completion	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Hazardous Materials Planning (Physical)								

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> Detailed Emergency Response Plan (as part of CEMP) prepared by Contractor to cover hazardous materials/oil storage, spills and accidents > A separate Solid and Liquid Waste Management sub-plan will be developed as part of the CEMP	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Report	Report Completed before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Chemicals will be stored in secure containers.	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safe Storage practice	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Chemicals stored in bunded area or compound with concrete floor and weatherproof roof	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safe Storage practice	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Spills will be cleaned up as per emergency response plan	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safe Storage practice	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Signage for no go smoking zones	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Signage	Photo Verification	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Provide training workers on ERP procedures and equipment e.g. extinguishers	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	ERP training	Verify Monthly with weekly Tool Box follow up	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Incident Reporting Procedure (Social)								
		> Incident level to be classified by Type in CEMP	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Incident Tracking Procedures	Plan in Place before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Level 1 All human or significant widespread pollution with 24 Hours with Senior DSC and MIPU MPW Management Notified	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Incident Tracking Procedures	Plan in Place before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Incident recorded and Resolution closely Monitored	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Incident Tracking Procedures	Plan in Place before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Sensitive Ecosystems (Biological)								
		> Mangroves not to be felled, removed or damaged	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Loss of natural habitat	Plan in Place before Commencement	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> Vegetation clearance to be kept to minimum, avoid felling of road-side trees wherever possible	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Vegetation Clearance	Photo before after	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Contractor responsible for information and sanctions regarding harm to wildlife and felling of trees (not requiring to be cleared)	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Vegetation Clearance	Contract Clause on Damage and sanctions	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Camp, equipment and stockpiles not to be located in ecologically important or sensitive areas	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Camp /Yard Location	Verify before Commencement of Camp Yard Construction	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Water depth to be maintained at bridges and culverts to allow migrating species to move up and down rivers	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Water Depth	Measurement before commencement and photo Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Progressive re-vegetation to be carried out in all areas disturbed by the project with fast-growing, native species if practicable	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Restoration of Habitat	Verify with Photo record of Installed landscaping in accordance with spec	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Chance Find Procedure (Social)								
		> Site will be properly demarcated collaboratively with the local community at the start of the construction.	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Chance Find of Artefacts or Site of Cultural Importance	Immediate stop work Level 1 incident Procedure	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Cease activity immediately if artefacts uncovered	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Chance Find of Artefacts or Site of Cultural Importance	Immediate stop work Level 1 incident Procedure	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Inform National Museum	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Chance Find of Artefacts or Site of Cultural Importance	Immediate stop work Level 1 incident Procedure	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Undertake all actions required by above	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Chance Find of Artefacts or Site of Cultural Importance	Immediate stop work Level 1 incident Procedure	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Traffic Management (Social)								
		> Traffic management plan to be prepared by Contractor	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Notify villages in advance of schedule and duration of works	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
		> Consultations and care taken to minimize disruptions to access	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Install temporary access to affected properties where required	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Spoil disposal sites and haulage routes identified in consultation with the local communities	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Safety Control and Signage to be used in vicinity of works	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Access through people's land will be negotiated with landowners and restored after works completed	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Safe access across work sites provided for the public	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Community awareness ascertain village concerns regarding traffic management matters (e.g. to determine if they need speed bumps in villages which are close to the road)	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Plan in Place before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Traffic Control Procedures in place at all work sites with warning at agreed distances with Stop/Go Monitor in place with radio if more than one	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Traffic Control	Photo Record Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
	Workforce Safety (Social)								
		> A separate Safety, Security and Health sub-plan will be developed as part of the CEMP > Provide workers with noise abatement equipment (ear-muffs etc.)	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safety Clothing and equipment	Photo Record Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> All workers provided with suitable protective head, eyes, reflective clothing and footwear	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safety Clothing and equipment	Photo Record Daily	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Weekly toolbox sessions on Safety in the workplace	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Safety Clothing and equipment	Photo Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC	Random or Routine Audit by DEPC and/or Safeguards Specialist

Project activities	Environmental Impact (Physical, Biological or Social)	Mitigation Principles to be included in CEMP	Mitigation Responsibility	Supervision Quality Control Responsibility	Mitigation Budget Required For Environmental Staff and Field Equipment	Parameter to be monitored	Frequency and means of verification	Monitoring Responsibility	Audit Quality Assurance
								Project Manager	
	Site Security and Camp Management (Social)								
		> A separate Safety, Security and Health sub-plan will be developed as part of the CEMP > All work sites to be secure with workforce identification system	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Site Security	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Designated locked yards for machinery and POL storage	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Site Security	Verify Weekly	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Construction camp authorized access control	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Camp Management	Plan before Commencement as part of CEMP	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Contractor to supply energy source to avoid use of local timber or felling of trees	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Camp Management	Verify Installation before Occupation	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist
		> Contractor installs package wastewater treatment plant and grease trap system with agreed effluent strategy	Contractor	DSC Project Manager/Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Camp Management	Verify Installation before Occupation	Contractor Daily Record Checklist and relevant Communications in Monthly Report to DSC Project Manager	Random or Routine Audit by DEPC and/or Safeguards Specialist

The elements of the environment and a summary of the mitigation measure for each are:

Air Quality

- > Prohibition of use of equipment that causes excessive pollution (e.g. generates smoke)
- > Vehicles transporting dust-producing material not overloaded, provided with tail-boards and side-boards, and adequately covered
- > Material stockpiles located in sheltered areas and to be covered
- > Damping down of access road during the dry season

Noise

- > Construction vehicle exhaust systems and noisy equipment will be maintained to minimize noise
- > Contractor will develop a schedule of operations with village chiefs and PWD to identify days of no work and hours for certain activities
- > Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am
- > Agree works schedule with village leaders
- > Provide workers with noise abatement equipment (ear-muffs etc.)

Water Quality

- > Construction works in areas of rivers, especially riverbanks, streams and the coast to be undertaken with extreme care
- > Use of silt control devices and sediment traps/fences during bridge works and extraction activities with regular cleaning and maintenance.
- > Temporary structures to minimise any reduction of river and stream flows
- > Temporary structures removed on completion of works and riverbed restored
- > Side slopes of embankments designed to reflect soil strength
- > River training and scour protection as needed
- > Minimize size and duration of cleared areas and undertake progressive re-vegetation of cleared/work areas
- > Avoid clearing activities during rainy season where possible
- > Natural water flows in streams and rivers will not be interfered to the extent possible
- > Use of heavy machinery in smaller more sensitive freshwater aquatic environments to be minimized
- > Good design used in all construction activities to minimize need for changes to natural gradients
- > No discharges of POL to rivers and surface waters.
- > Alternative / upstream water sources must be arranged for rivers currently used by communities for water supply

Erosion and Sediment Control

- > Stockpile of suitable material always available and used in event of bank or channel erosion
- > Gabion baskets or rock rip-rap to be used for embankments when suitable
- > No dumping of spoil in streams and rivers.
- > Spoils and stockpiles will not be located near or on slopes or within flood zone of rivers and streams
- > Placement of diversion ditches around stockpiles
- > Abstraction from, or pollution of, water resources and coastal waters not permitted

Land Use and Permit Control

- > Existing quarries will be used wherever possible and appropriate

- > Extraction from ecologically sensitive areas (inter-tidal, swamp, or mangrove areas) or productive land is not permitted
- > Sites to be identified in consultation with PWD, land owners and communities
- > Preparation and implementation of extraction plan (with limits to volumes extracted from any one source) in accordance with guidelines
- > Extraction from rivers will be identified by consultation with PWD, Chiefs and communities and according to approved extraction plan
- > All extractions sites to be rehabilitated after use

Top Soil Protection

- > Topsoil is preserved in designated storage areas and reused as soon as possible to promote and stabilise endemic species
- > Endemic species to be preferred unless there are technical reasons for using introduced species
- > After completion of works all areas edging streams to be restored to original condition as quickly as possible with suitable mix of trees and shrubs to promote stabilisation of soils

Hazardous Materials Planning

- > Detailed Emergency Response Plan (as part of CEMP) prepared by Contractor to cover hazardous materials/oil storage, spills and accidents
- > Chemicals will be stored in secure containers away from the coast, surface waters or rivers
- > Chemicals stored in area or compound with concrete floor and weatherproof roof
- > Spills will be cleaned up as per emergency response plan
- > Prohibit smoking close to fuel storage areas
- > Signs of no go smoking zones
- > Training workers on planning and implementation

Incident/ Complaint Reporting Procedure

- > Accidents reported to police and PWD within 24 hours Level 1
- > Level Classification to be agreed with PWD

Sensitive Ecosystems

- > Mangroves not to be felled, removed or damaged
- > Vegetation clearance to be kept to minimum, avoid felling of road-side trees wherever possible
- > Contractor responsible for information and sanctions regarding harm to wildlife and felling of trees (not requiring to be cleared)
- > Camp, equipment and stockpiles not to be located in ecologically important or sensitive areas
- > Water depth to be maintained at crossings and culverts to allow migrating species to move up and down rivers
- > Progressive re-vegetation to be carried out in all areas disturbed by the project with fast-growing, native species
- > Contractor to supply sufficient cooking fuel to avoid use of local timber or felling of trees

Chance Find Procedure

- > Site will be properly demarcated collaboratively with the local community at the start of the construction.
- > Cease activity immediately if artefacts uncovered
- > Inform National Museum
- > Undertake all actions required by above

Traffic Management

- > Traffic management plan to be prepared by Contractor
- > Notify villages in advance of schedule and duration of works
- > Consultations and care taken to minimize disruptions to access
- > Install temporary access to affected properties where required
- > Spoil disposal sites and haulage routes identified in consultation with the local communities
- > Safety Control and signage to be used in vicinity of works
- > Access through people's land will be negotiated with landowners and restored after works completed
- > Safe access across work sites provided for the public
- > Community awareness ascertain village concerns regarding traffic management matters (e.g. to determine if they need speed bumps in villages which are close to the road)

Workforce Safety

- > Provide workers with noise abatement equipment (ear-muffs etc.)
- > All workers provided with suitable protective head, eyes, reflective clothing and footwear
- > Weekly toolbox sessions on Safety in the workplace

Site Security

- > All work sites to be secure with workforce identification system
- > Designated locked yards for machinery and POL storage
- > Construction camp authorized access control

7.7 Environment monitoring and reporting

Monitoring is a component of impact assessment to reduce uncertainty about routine and unanticipated impacts such as spill incidents, to ensure mitigation measures are working and to reassure the public on the progress of the development. Progressive monitoring must accompany various stages of the subproject activities (Preconstruction, construction and operational phase).

The Environmental monitoring plan is based on the potential impacts, significance of the impacts and mitigation approaches identified during the scoping and feasibility study. It is comprised of parameters to be monitored, frequency of collection, responsible authorities and cost estimate as per impact. The Contractor will be required to prepare a detailed environment monitoring plan based on the guidance set out in final revised EMP and outlined in **Table 7-4** above and which becomes part of the contract documents.

Supervision is the responsibility of the DSC, responsible for monitoring compliance, review contractors monthly monitoring report and proposing ways to improve or strengthen mitigation approaches.

The DSC is required to:

- > Review contractors monitoring plan based on specifications in the contract documents approve when requirements are met;
- > Co-ordinate compliance monitoring programs

The Contractor is required to:

- > Produce a detail monitoring plan and submit to DSC for review
- > Implement all mitigations required under the contract document and contractor's CEMP
- > Produce a monthly environment monitoring report to DSC; and submit quarterly monitoring reports with the DEPC and ADB

8 Conclusion and recommendations

The subprojects in the western area will lead to a number of pre-construction construction and operational impacts. In general, the western areas have higher population densities and existing traffic volumes, which generates more potential for significant environmental risk. In some of the smaller more remote subprojects to the north, there is potential for more significant impacts even though the actual area in the vicinity of the constructed is a heavily modified environment.

Impacts on hydrology and water quality and riverine ecology were assessed to be of moderate to high risk if unmitigated in the freshwater streams for the Creek Ai Culvert and Marona River Bridge subprojects and the tidal wetland area in the vicinity of Malatia subproject. Design mitigations have been proposed to address these issues. An on-going baseline study of a sample of freshwater streams will be completed before construction commences and will form the basis for a restocking and protection program for specific species in designated stream sections to further reduce risk.

The issue of the need for temporary traffic diversions of the road off the corridor in the cases of Prima, Mele, Tanoliu and Marona bridges to enable bridge construction were assessed as being of moderate significance for most elements of the environment, as there is a higher population density with potential for nuisance and land use impacts. Construction of these bridges will require the use of pile driving equipment, although, the period of high noise levels is not expected to last for more than 3-4 weeks. With construction mitigations in place including community consultation, muffling the equipment at source and strictly control the hours of operation, the risks can be lowered to acceptable levels. The need to carry out river channelling to increase channel cross sectional area and reduce sedimentation and weed growth means access to the river is also necessary, leading to short term hydraulic and water quality issues and potential impacts on freshwater fish and crustaceans.

The Project is not likely to cause significant environmental, social and/or custom impacts. The mitigation and management measures that are being implemented will ensure that the risk of pollution is minimized as part of the works. Further, the Project will have a positive impact on coastal erosion for some subprojects due to stabilisation or embankment construction.

With the proposed design mitigation measures included and implementation of a CEMP with site specific and routine construction mitigation measures, the identified risks can be lowered to an acceptable level to satisfy ADB SPS requirements. As a result, an EIA is not considered necessary, but this will be a matter for determination by the Director, DEPC.

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Appendix A – Impact identification and assessment matrices

Subproject : Prima Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use						
	Socio						
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air	—	Direct	Local	Short Term	Yes	Low to Moderate
	Noise	—	Direct	Local	Short Term	Yes	Moderate to High
	Hydrology/ Water	+	Direct	Local	Short Term	No	Low
	Riverine Ecology	+	Indirect	Local	Short Term	No	Low
	Land Use	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	Low
River Channelling Spoil Removal	Air	—	Direct	Local	Short Term	Yes	Moderate
	Noise	—	Direct	Local	Short Term	Yes	Moderate
	Hydrology/ Water	+	Direct	Local	Long Term	No	Moderate
	Riverine Ecology	—	Direct	Local	Long Term	Yes	Moderate
	Land Use	—	Direct	Local	Short Term	Yes	Moderate
	Socio	+	Direct	Local	Short Term	No	Moderate
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Prima Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	=	Direct	Local	Short Term	Yes	Low
	Noise	=	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	=	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	=	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	=	Direct	Local	Short term	Yes	Low to Moderate
	Noise	=	Direct	Local	Short term	Yes	Low to Moderate
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio						
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Mele Bridge Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use	—	Direct	Local	Temporary	Yes	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air	—	Direct	Local	Short Term	Yes	Low to Moderate
	Noise	—	Direct	Local	Short Term	Yes	Moderate to High
	Hydrology/ Water	+	Direct	Local	Short Term	No	Low
	Riverine Ecology	+	Indirect	Local	Short Term	No	Low
	Land Use	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	Low
River Channelling Spoil Removal	Air	—	Direct	Local	Short Term	Yes	Moderate
	Noise	—	Direct	Local	Short Term	Yes	Moderate
	Hydrology/ Water	+	Direct	Local	Long Term	No	Moderate
	Riverine Ecology	—	Direct	Local	Long Term	No	Moderate
	Land Use	—	Direct	Local	Short Term	Yes	Moderate
	Socio	+	Direct	Local	Short Term	No	Moderate
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Mele Bridge Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Moderate to High
	Noise	—	Direct	Local	Short term	Yes	Moderate
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio						
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate to High

Subproject : Klems Hill Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use	—	Direct	Local	Short Term	No	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Slope stabilisation includes Earthworks, Drainage Improvements	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Moderate
	Hydrology/ Water	—	Direct	Local	Short Term	No	Moderate
	Riverine Ecology	O					
	Land Use	—	Direct	Local	Short Term	No	Moderate
	Socio	+	Indirect	Local	Short Term	No	Low
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Land Use						
	Socio						
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air						
	Noise						
	Hydrology/ Water						

Subproject : Klems Hill Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Transport of concrete, borrow material from quarry and spoil removal	Air	–	Direct	Local	Short term	Yes	Low
	Noise	–	Direct	Local	Short term	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land Use	O					
	Socio	+	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Provincial and Community Based		+	Direct	Local	Long Term	No	Moderate to High

Subproject : Creek Ai Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use						
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Land Use						
	Socio						
Culvert Re- Construction includes Earthworks, abutments, laying box culvert , surfacing	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Long Term	No	Moderate
	Riverine Ecology	—	Direct	Local	Long Term	No	High
	Land Use	O					
	Socio	+	Direct	Local	Short Term	Yes	Low
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Creek Ai Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance/Risk
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane,	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	—	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Havannah Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use						
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Land Use						
	Socio						
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	+	Direct	Local	Short Term	No	Low
	Riverine Ecology	+	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	Low
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Havannah Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	—	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Marona Bridge Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use						
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	land use	O					
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Long Term	No	Moderate
	Riverine Ecology	—	Direct	Local	Long Term	No	High
	Land Use	+	Direct	Local	Short Term	No	Low
	Socio	—	Direct	Local	Short Term	Yes	Low
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Marona Bridge Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	—	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Malatia Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use						
	Socio	+	Direct	Local	Temporary	Yes	Low
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Land Use						
	Socio						
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Long Term	No	Moderate
	Riverine Ecology	—	Direct	Local	Long Term	No	High
	Terrestrial Ecology	+	Direct	Local	Short Term	No	Moderate to High
	Socio	—	Direct	Local	Short Term	Yes	Low
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						

Subproject : Malatia Culvert Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	—	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Tanoliu Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilisation Equipment and Machinery Yard and Storage Area For POL	Air	O					
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Land use	—	Direct	Local	Temporary	Yes	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Moderate
Construction Camp Development Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane, pile driving	Air	—	Direct	Local	Short Term	Yes	Moderate
	Noise	—	Direct	Local	Short Term	Yes	Moderate to High
	Hydrology/ Water	—	Direct	Local	Short Term	No	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Land use	—	Indirect	Local	Short Term	No	Moderate
	Socio	+	Direct	Local	Short Term	No	Moderate
Culvert Construction includes Earthworks, abutments, laying box culvert , surfacing	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	Air						
	Noise						
	Hydrology/ Water						

Subproject : Tanoliu Type of Impact O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air	—	Direct	Local	Short Term	Yes	Low
	Noise	—	Direct	Local	Short Term	Yes	Low
	Hydrology/ Water	—	Direct	Local	Short Term	Yes	Low
	Riverine Ecology	—	Indirect	Local	Short Term	No	Low
	Terrestrial Ecology	+	Indirect	Local	Short Term	No	Low
	Socio	O					
Transport of concrete, borrow material from quarry and spoil removal	Air	—	Direct	Local	Short term	Yes	Moderate
	Noise	—	Direct	Local	Short term	Yes	Moderate
	Hydrology/ Water	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	+	Direct	Local	Short term	Yes	Low
Construction Camp Operation Near Village	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	land use						
	Socio						
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate