

FINAL Initial Environmental Evaluation (IEE) of Eastern 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 (CPRRP/the Project) 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 (8) of 20 the subprojects
- > One for the eastern area of Efate, encompassing twelve (12) subprojects (this document)

Legislation and policy

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

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 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 differences in the existing environment between east and west Efate relate to climate, geology, hydrology, ecology, some socioeconomic characteristics including population density and traffic volume. Construction methodology (i.e., the possible need for a construction camp in the eastern area) is also a notable environmental difference. The table below summarises the existing environment in the vicinity of the twelve Subprojects proposed in eastern Efate.

ES1 – Summary of subproject existing environmental conditions

Subproject	Physical environment	Biological environment	Socio-economic environment
Onesua Storm Surge Repair	There are no major water crossings structures along this section. This location is exposed to the north east which is the main direction for large storms and cyclones. The geology is low lying beach sand on recent limestone. There is an area of thermal springs under the northern section of the road.	Coastal, beach environment with pine, coconut and <i>Pandanus</i> trees dominating.	There are no existing houses or other buildings in between coastline and the road. On inland side there are no buildings or other structures within 40 to 50 m from the road edge.
Sara Culvert	This culvert is located along the coast. The geology is low lying beach sand on recent uplifted limestone. The channel near the culvert is dominated by tidal flows with a small intermittent catchment of freshwater flows after rain. No flow of freshwater observed.	The vegetation is composed of coastal species – with coconut and other mature trees present adjacent to the culvert. The creek had a large amount of algal blooms downstream during the August and October site visits which are occasionally flushed by tidal action. This is probably due to stagnation from little or no saltwater flows.	The bridge is adjacent to a restaurant on the north east and private, fenced land on the southwest. There is a water well upstream used by the nearby villagers.
Epule Bridge	Epule crosses a river that is relatively large approximately 10-15 km in length and deep enough for the use of kayaks and canoes. The geology at the bridge is recent up- lifted limestone but further upstream the source is in the older limestone. Channel is dominated by tidal flows with very good water quality. There was no evidence of sedimentation in the channel.	The area is well vegetated both up and downstream of the bridge. The coastal side of the bridge is mostly cleared and grassy, however, as it is private land. Inland, there are planted gardens along the north by the residence and further upstream. The river supports a diverse ecosystem of endemic salt and estuarine fish and crustaceans such as eel fish and estuarine shrimp.	There is a residence to the northeast that rents out kayaks and does river tours. There is fenced off private land on either side of the bridge along the coast which is fenced using barbed wire.
Epau Culvert	The creek is wide but mostly shallow. Channel is dominated by tidal flows with a small catchment of permanent freshwater flows. Bank erosion is evident downstream and gabion walls	There is a large Banyan tree adjacent to the culvert, otherwise the immediate surroundings are fairly clear. There is likely habitat for endemic freshwater fish and crustaceans	There are a few houses along the bank upstream but the main village is about 300 m away.

Subproject	Physical environment	Biological environment	Socio-economic environment
	have been installed for a portion to prevent this		
Neslep Culvert	The culvert is located on the coast on a creek that widens near the mouth. Channel is dominated by tidal flows with a small catchment of permanent freshwater flows. There are small amounts of sediment building up which are sufficient to block the small pipe culverts.	Upstream vegetation is composed of tall grasses and weeds adjacent to the culvert and mature trees further up. Downstream, the vegetation is coastal with coconut and pine trees. Fallen trees remain. There is likely habitat for endemic freshwater fish and crustaceans	There are no nearby sensitive receivers.
Lamin Bridge	Lamin is approximately 100m from the coast. Channel is dominated by tidal flows with a small catchment of semi-permanent freshwater flows. There is little evidence of erosion and sedimentation	Vegetation upstream is dominated by coconut and banana trees with considerable weed infestation in the channel, while the vegetation downstream is more coastal. Lots of weed infestation in the channel itself. There is possible likely habitat for endemic freshwater fish and crustaceans but the stream is not permanently flowing freshwater	There are no nearby sensitive receivers.
Pangpang Bridge	The watercourse, Forari stream, is narrow and flowing freshwater. There is small area of alluvium underlain by recent limestone. There were no visible signs of sedimentation and deterioration of water quality. The river has a more extensive upland catchment and sources from volcanic geology and the area of a significant manganese deposit.	The area directly around the watercourse are heavily vegetated and relatively pristine. North of the bridge, near the village, the land has been cleared. There is likely habitat for endemic freshwater fish and crustaceans	The bridge is located near the junction to Pangpang village. There are huts at the northwest of the bridge
La Cressonniere Culvert	The watercourse is wide and shallow with a fast moving flow. There were recently completed/ongoing earthworks during the October site visit. The site is located on a steep geological boundary between the older raised reef limestone and the recent raised reef limestone.	The vegetation has been cleared around the culvert and vegetation is dominated by tall grasses and weeds; with palm and banana as well as some mature trees present further up and downstream. There are visible algal blooms which may be associated with cattle grazing facilities slightly upstream.	This watercourse is used for a tourist destination and benches have been provided in the downstream area for guests to sit with their feet in the water. The sudden change in geology is an interesting tourist and education location.
Eton Beach Culvert Bridge	Low coastal topography on recent up lifted limestone. The channel flows intermittently from a back dune estuary with	The environment is dominated by mangrove,	There is a tourist beach nearby that is run by

Subproject	Physical environment	Biological environment	Socio-economic environment
	brackish estuarine water supporting endemic estuarine saltwater fish and crustaceans.	<i>pandanus</i> and isolated canoe tree species.	the community for an entrance fee.
Eton Dry Creek Culvert	Low coastal topography on recent up lifted limestone. Windblown sand has damaged the existing bridge and approaches, No flow of either tidal or freshwater.	The environment is dominated by mangroves species to the west. On the east, it is white sand beach with very scattered <i>pandanus</i> and isolated tall canoe trees	There a tourist beach nearby that is run by the community for an entrance fee. Illegal sand clearing is a current land use problem
Rentapau Bridge	Geology is old limestone so channel is very stable with little obvious erosion and sedimentation. The river has an extensive upstream and is relatively large compared to the other eastern subprojects.	The area is well vegetated along the River. It is a highly modified environment with secondary vegetation including many weeds. Likely habitat bear the bridge for salt and estuarine species	There are residents south-west of the bridge, although the entrance is further down the road and is not visible from the bridge.
Pavement works 2 nd Lagoon to Rentapau	There are no major water crossings structures along this section.	The road is ~1.7km away from Emaotfer wetlands at its closest point. It is a highly modified environment with secondary vegetation including many weeds	The land use in the section is semi-rural, with residents and farmlands adjacent.

Proposed works

There are 12 subprojects on the east of the island that mostly require only minor works. Lamin is the only bridge that will require replacement (precast concrete semi/modular bridge). There were three options developed and then evaluated and selected for each of the subproject sites.

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, rechanneling works, road formation and pavement works and ancillary works for the eastern area, as summarised below:

- > New single span, concrete bridge at Lamin to replace existing bridge structure. Some concrete will need to be imported by truck but the volume is not substantial.
- > Coastal protection works at Onesua to reduce disaster risk and mitigate climate change impacts and repair the existing 1.4 km of road pavement damaged by TC Pam. Additional armour rock and gravel may need to be imported by truck (dependent on rock in situ) from nearby basalt quarry (if it is re-opened for use), which will generate some truck traffic.
- > Roadwork repairs at Neslep, and four very short minor road repair sections
- > Drainage and scour and environmental protection to Epule, Epau, Neslep and La Cressonniere
- > Desilting where necessary and some safety improvements at Epule, Sara, Neslep, Pangpang, Rentapau, Eton Beach, Eton Dry Creek

Detailed design drawings are issued separately.

Anticipated environmental impacts

Preconstruction impacts of the subprojects in the Eastern area are mainly limited to setting up work areas for each of the work sites as the focus of most sites is on repairs and clean up to existing facilities. The one preconstruction issue that may require the use of land outside the corridor is a possible accommodation construction camp site in the vicinity of Epau and Neslep. If the camp is necessary, this would need to be negotiated and agreed by the Village during the early contractor mobilisation stage.

In general terms, the construction impacts of the proposal present the majority of environmental risks for all of the three phases of the Project. However, the scale of construction in the eastern area is generally small, and very limited in scope. The subprojects are more widely scattered than in the west and the relative population density is significantly lower. Consequently, the risks associated with a majority of the subprojects were assessed as low even without mitigations. There were a number of exceptions to this general conclusion.

Impacts on hydrology and water quality and riverine ecology were assessed to be of moderate to high risk if unmitigated in the freshwater streams of Neslep, Epau subprojects. The reason for the higher risk assessment stems from the relatively well protected catchments of the two rivers. Even though the catchments are relatively small in area, these flow from steeper volcanic geology where modifications to the stream habitat were observed to be low. Some evidence of limited sedimentation was observed in in Neslep and Epau culverts. Design mitigations have been proposed to address these issues. A proposed baseline study of a sample of freshwater streams was not accepted by ADB and PWD. This would have formed the basis for a fish restocking and/or protection program for specific species in designated stream sections. As a result, the fish restocking is not currently proposed.

The other significant risk assessed, also in the Epau and Neslep area, is the issue of the operation of a materials storage area or construction camp, in an area near Neslep which was used for the MCA project yard facility. It should be emphasised that these risks assume the worst case scenario, i.e., that a camp would be preferred and established by the Contractor. Based on the MCA project experience, it is possible that no camp would be required, but it may be adopted by the successful tenderer. These risks were assessed as being moderate to high, particularly as there has been a significant increase in the population in the vicinity of the day-only camp used by MCA. The operation of the camp would expose the community to a variety of social risks including public health and safety and other labour issues resulting from an in-migrating workforce. There are also significant positive impacts of a construction camp operation involving increased local employment and indirect services such as supply of food and laundry services. This risk can be mitigated to acceptable levels by strict implementation a camp management sub-plan which would need to be prepared as part of the CEMP by the Contractor.

The operational impacts of well-designed facilities will be positive, provided that culvert and drain sediment maintenance is carried out into the future.

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.

The proposed design mitigations are shown in the table below.

ES2 – Proposed design mitigations

Subproject	Proposed Design Mitigation/ Management Program
Sara Culvert	Environmental enhancement with landscaping and stabilisation of side embankments with grasses and local tree and shrubs
Neslep Culvert	Environmental enhancement with landscaping and stabilisation of side embankments with grasses and local tree and shrubs
Epau and Neslep causeway/culverts	Construction of small in stream weir/sediment trap structures with adequate space for fish movement to reduce sedimentation in culvert flows and promote fish passage through the culverts
All freshwater streams including Epau, Neslep, Lamin, Pangpang, La Cressonniere (and	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

Subproject	Proposed Design Mitigation/ Management Program
Creek Ai and Morona in western Efate)	Technology and local freshwater fish aquaculture project in Mangaliliu, Onesua and Epau villages.

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 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 smaller freshwater streams in the eastern area including Forari (Pangpang Bridge), Neslep and Epau streams were also 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 1-13**. 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 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 identified in the scope of work in the Project Administration Manual (PAM). 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 twelve (12) subprojects located on the east of the island:

- > Onesua Storm Surge Repair
- > Sara Culvert
- > Epule Bridge
- > Epau Culvert
- > Neslep Culvert
- > Lamin Bridge
- > Pangpang Bridge
- > La Cressonniere Culvert
- > Eton Beach Culvert
- > Eton Dry Creek Culvert
- > Rentapau Bridge
- > 2nd Lagoon to Rentapau

^[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, Teuma-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 (2005)*

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

The Amendment Act establishes an Environmental Trust Fund, funded by penalties and bonds. This will be used to fund research, environmental rehabilitation, monitoring and analysis, management of community conservation areas, and as required for the protection and conservation of the environment.

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 Safeguards 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 (SDIRECTOR) requires borrowers to identify Project impacts and assess their significance; examine alternatives; and prepare, implement, and monitor environmental management plans. The SDIRECTOR 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.

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

2.2.2 Environmental Assessment and Review Framework

An Environmental Assessment and Review Framework (EARF) was completed for the Project. This document is required for projects, such as emergency projects or sector projects, where the types of activities to be undertaken and types of subprojects to be implemented are known in general terms but only a small number of subprojects might be identified during project appraisal. The frameworks set 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 12 subprojects on the east of Efate Island; as detailed in **Table 3-1** and **Figure 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 around Efate is in generally good condition. There are some areas near the coast, however, where the storm surge has damaged the pavement.

The crossings on the east 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 Onesua Storm Surge damage

The ring road through Onesua has been damaged by storm surges from TC Pam at several locations along a 1.4 km section of the road. At some locations, the road pavement has been washed out to almost half the width of the pavement, to about 400-500 mm depth.

The existing road pavement within the storm surge section varies between 30 and 100 m from the high tide coastline. The road surface level is only several metres higher than the water level on an essentially straight horizontal alignment and flat vertical alignment. The length of damaged road extends approximately 1.4 km and the existing sealed pavement width is varying 5.4 to 6.0 m. The erosion and scouring damage incurred by the pavement is scouring on the coastal side, with some sections of sealing lost. There are numerous large boulders (approx. 500-1000 mm diameter) located along the northern section of the damaged pavement area, presumably to dissipate wave energy and provide scouring protection.

The current conditions of the road pose a traffic hazard and the embankment and road pavement remain vulnerable to future storm surge.

3.1.6 Sara Culvert

Sara culvert is located about 70 m from the coastline and comprises five (5) 1000 mm diameter reinforced concrete pipe with concrete headwalls. The length of each pipe is 6.5 m and the clear width between the headwalls is 6.9m at the northern end and 6.4m at the southern end. The sealed pavement width is 5.4 m. The culvert is located on a curve in the two-lane road and no guardrail is provided at the site. There is no blockage of the pipes on the upstream side, however there are three (3) large tree trunks immediately upstream of the culvert.

3.1.7 Epule Bridge

Epule Bridge is a single-lane, single span “Standard” Bailey bridge comprising eleven (11) standard bays of 10 feet each giving it an overall length of 33.528 m (110 feet). The bridge has a TSR3 configuration (Triple Single Reinforced), two (2) transoms per bay, timber deck and has a clear width between panels of 3.3 m. No footway is provided on the bridge. It is understood that the bridge was erected in 2010 as part of the works for the construction of the Efate Ring Road when concern was expressed over the ability of the original bridge to carry heavy construction traffic loads. As a result, the Bailey bridge was built above the original bridge.

Local villagers report that the bridge was overtopped by floodwaters to a depth of about 1 m following TC Pam but receded after approximately one hour. The local villagers further report that the bridge is overtopped about twice a year.

It is noted that the original bridge collapsed in 2015 as a consequence of TC Pam and the partial remains of the centre pier and sections of steel beam are still visible above the waterline at the northern end.



Figure 3-2 Epule bridge

3.1.8 Epau Culvert

Epau culvert is a two-lane structure comprising eight 450 mm diameter reinforced concrete pipes with concrete headwalls and a concrete apron slab on the downstream side. This apron slab is damaged although still functional. At the time of the inspection, it was not possible to determine whether there is an upstream apron slab, due to siltation. The overall length of the structure is 25.7 m, including 3.5m long run-on (approach) slabs at both ends of the culvert. Reinforced concrete castellated kerbs are provided at the edges of the traffic lane across the structure and the clear carriageway width between kerbs is 4.9 m. The overall width of the structure is 6.0 m. The approach road on the eastern side is relatively straight but there is a sharp curve immediately prior to the approach to the structure from the western end.

There are no protection works on the upstream side however on the downstream side at the south-western end a gabion basket wall provides protection to the creek bank however local scour has occurred at the gabions and they are now undermined in places by up to about 0.5 m. Guardrails are provided at the southern approach only and on the western side this was observed to terminate about 4 m from the bank of

the creek. All pipes were found to be relatively free from debris blockage. The culvert is located approximately 300 m from the coastline.

3.1.9 Neslep Culvert

Neslep Culvert is a two-lane structure comprising six (or possibly seven – one obstructed) 700mm diameter reinforced concrete pipes with concrete headwalls. The overall length of the structure is 29.6 m which includes 4.75 m long run-on slabs at both ends of the culvert. Reinforced concrete castellated kerbs are provided toward the edges of the structure and the clear carriageway width between kerbs is 5.2 m, the overall width of the structure is 6.4 m. The approach road on the southern side is relatively straight but there is a sharp curve immediately prior to the approach to the structure from the northern end. Guardrail is provided on the northern approach on the east side only and this was observed to have substandard terminals.

Drainage on the deck surface of the structure is poor with a large area of ponding toward the north-west corner. There are no bank protection works. All pipes were substantially blocked by gravel/cobbles/small boulders. Due to the significant sediment deposition at the inlet, it is not known whether apron slabs are provided.

There is a large scour area on the southern side in the southbound lane adjacent to the run-on slab, at this location the road pavement has been washed-out. In addition, an area of significant scour has occurred adjacent to the road pavement exposed to a small coastal inlet, approximately 15 m south of the culvert. Gabion baskets that were supporting the pavement structure were undermined and collapsed during TC Pam. The culvert is located approximately 30 m from the coastline.

3.1.10 Lamin Bridge

Lamin Bridge is a single-span, single lane bridge comprising two (2) steel girders supporting a timber deck with an overall length of 11.6 m. The ends of the beams are cast into the concrete wall abutments. "I" 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.

Local villagers report that Lamin Bridge was affected by TC Pam with the bridge being overtopped by floodwaters to a depth of about 1 m, however, the floodwaters receded after a period of about 12 hours. Debris blockage was said to be a major contributor to the flooding as a result of the reduction in the waterway area under the bridge. The villagers stated that in a typical year without a major cyclone, the bridge does not get overtopped.

The bridge has no footway or traffic barriers. Timber kerbs are provided along both edges of the bridge. The clear width between the kerbs is 2.4 m. It crosses a narrow, steep sided channel with a depth from bed level to beam soffit of approximately 4.2 m. At the time of the inspection, debris was observed to be snagged on the upstream side of the bridge and it was noted that the creek was not flowing. There are no utilities fixed to the structure.



Figure 3-3 Lamin Bridge

The Vanuatu Impact Assessment Report prepared in April 2015 stated “Approach road was scoured at gabion wall protection and a wing wall was damaged. There was no impact on the bridge and its approaches due to Cyclone Pam.”

However, the presence of debris on the upstream side would suggest that high flows can be expected after intense rainfall events, such as would occur from a cyclone. The detailed design assessments have confirmed that flow rates of up to 7 m/s could be experienced in a 100 year ARI event.

The protective coating to the structural steel members has broken down and some large and significant areas of corrosion are evident. There is severe corrosion of the structural steel members. The presence of corrosion ultimately causes a loss of section and this reduces the load carrying capacity of the bridge.

In addition, there is no traffic barrier on the bridge, some of the timber kerbs are missing or have become dislodged, some of the transverse load bearing deck timbers are in an advanced state of decay and debris is trapped on the upstream side of the bridge. The trapped debris reduces the available waterway area further which ultimately causes flood levels to rise.

3.1.11 Pangpang Bridge

Pangpang Bridge is a single-span, two-lane bridge over Forari Stream, comprising four (4) rectangular concrete beams with a 12.0 m long reinforced concrete deck slab, 8.2 m kerb to kerb. It crosses a deep, steep sided channel with a depth from bed level to beam soffit of approximately 3.5 m. There are no traffic barriers on the bridge but castellated concrete kerbs are provided at both edges. The superstructure is supported on concrete wall abutments. Markings near the southern abutment indicate the bridge was built in 1964.

Local villagers report that Pangpang Bridge was overtopped by floodwaters to a depth of about 1 m as a result of TC Pam, however, the floodwaters receded during the night. The villagers stated that in a typical year without a major cyclone, Pangpang Bridge does not overtop.

No guardrail is provided on the bridge approaches or on the bridge and there is no footway. At the bridge site, the river is on a straight reach and there is negligible erosion of the banks. There also appears to be little or no scour at the abutments. There appear to be no utilities crossing the structure although this will need to be confirmed.



Figure 3-4 Pangpang 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.”

3.1.12 La Cressonniere Culvert

La Cressonniere Culvert is a single-lane vented ford structure over Edaw Creek, comprising twenty (20) 450 mm diameter reinforced concrete pipes with concrete headwalls. The overall length of the structure is 20.0 m. Continuous reinforced concrete kerbs are provided along the edges of the structure, provision for drainage of the deck surface is by scupper pipes through the concrete kerbs. The clear carriageway width between kerbs is 3.7 m and no footway is provided. The approach road on the southern side is straight and

level but there is a slight bend immediately north of the structure at the northern end which is also on a steep uphill grade. Guardrail is provided on the northern approach on the east side only. Drainage on the deck surface of the structure is poor with a large area of ponding at the southern end and a smaller area of ponding at the northern end on the downstream side. The culvert pipes were found to be relatively clear of debris but the creek width is restricted by extensive vegetation growth. The culvert is located approximately 1.2 km from the coastline and is non-tidal.

3.1.13 Eton Beach Culvert

Eton Beach Culvert is a two-lane structure comprising a twin-cell reinforced concrete box culvert with concrete wing walls and apron slabs. No footway is provided. Each culvert cell has a 3.0 m clear width and a clear height of 2.4 m. 750 mm high continuous reinforced concrete kerbs are provided along the edges of the structure and the clear carriageway width between kerbs is 6.5 m. The approach roads on both sides are straight and in good condition.

3.1.14 Eton Dry Creek Culvert

Eton Dry Creek Culvert is a twin-cell reinforced concrete box culvert with concrete wing walls. No footway is provided. Each cell has a clear width of 2.0 m. A concrete headwall supports steel traffic barrier posts that are severely corroded and currently has no rail attached on the downstream side. The clear carriageway width between kerbs is 8.6 m (seal width of 6.2 m).

Eton Dry Creek Culvert is located approximately 50 m from the coastline, immediately adjacent to a sandy beach. The approach roads on both sides are straight and in good condition but wind-blown sand has accumulated on the road surface and has approximately half-filled the culverts. Guardrail is provided on the approaches and across the structure, but it is badly damaged, heavily corroded and generally no longer serving its intended function. On the downstream side, gabion basket bank protection is present, however, the wires of the baskets are corroded and have broken in numerous places resulting in the rock fill material spilling out. On the upstream side there is a shallow depression approximately 30 m long by 10 m wide with rock boulders placed on the sides, forming a creek bed. There is a perceptible dry creek channel upstream.

3.1.15 Rentapau Bridge

Rentapau Bridge was constructed in 2004 and is a single-span, two-lane, galvanised steel single through-truss "Eastbridge" comprising three (3) standard 4 m length bays. A 0.8 m clear width galvanised steel separated cantilevered footway is provided on the downstream side and a utility pipe is attached to the outside edge of the footway structure. The bridge is supported on concrete wall type abutments. The clear width of the carriageway is 6.5 m, kerb to kerb. On the bridge, W-beam guardrails are fixed to the truss members (providing no effective protection for the truss); guardrail is also provided on the bridge approaches. The deck slab is orthotropic with concrete cast onto a steel trough profile sheet. Gabion mattresses provide protection to the west abutment slopes, and gabion baskets are used for protection at the east abutment.

According to local villagers the bridge was not overtopped following TC Pam.



Figure 3-5 Rentapau 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.” However, it is noted that there is damage to the gabion baskets at the toe of the abutments, some damage to the gabion mattresses on the abutment slope and the east abutment is locally undermined. It is possible that these damages could have occurred as a consequence of the cyclone,

The most significant issue at Rentapau Bridge is the alignment of the guardrails. It is noted that the guardrails do not align with the guardrail installed to the inside face of the truss on the bridge but are offset horizontally by about 750 mm. The face of the guardrail should be in-line with the face of the guardrails on the bridge to avoid the potential for vehicle impact damage to the ends of the bridge to reduce the risk of a vehicle collision with the end diagonal member of the truss structure.

3.1.16 Pavement works 2nd Lagoon to Rentapau

The pavement repair section is 10.84 km long. The western extent is approximately 1.0 km east of Teouma Bridge and it extends to approximately 0.8 km east of Rentapau Bridge. The existing sealed pavement width is 6.5 m and the formation width varies from 8.5 m to 11.5 m.

The existing road alignment is gentle and well-coordinated with the terrain. There are no bridges or major water crossing structures along this section; table drains (vegetated) are on both sides.

Blocked drains and general debris on the pavement was noted following TC Pam.

Due to aging, the bitumen seal has oxidised and the aggregate has differentially stripped out of the surface, particularly along wheel paths, exposing the base course. Surface repair works were carried out in the recent past, but the surface stripping continues. Continuous surface patching and isolated repair works are not a sustainable maintenance solution, given the condition of the seal. In several areas, vegetation has grown up to the edges of the sealed pavement and over grown along table drains, thus limiting the sight distance on the inside of curves and reducing the effectiveness of table drains in protecting the pavement edge from moving and seeping moisture.

A side road exists immediately east of Rentapau bridge, which is unsealed and on a long, steep slope. During rain events, sediment is washed down the side road, onto the Ring Road. This presents a road safety hazard, both with potential for aquaplaning during rain and loss of surface friction in both wet and dry conditions.

3.1.17 Subproject locations summary

Table 3-1 Location of subprojects




Subproject	Waterway	Location
Onesua Storm Surge Repair	N/A	Onesua is along the coast on the north-east of the island.
Sara Culvert	Intermittent fresh and tidal	Sara is located on the north east of the island approximately 60 km from Port Vila






Subproject	Waterway	Location
Epule Bridge	Epule River	Epule Bridge is located on the north east of the island, beside the entrance to Epule Village. It is roughly 500 m from the coast.
		
Epau Culvert	Unnamed creek	The culvert is ~227 m upstream from the coast and ~300 m from Epau Village
		
Neslep Culvert	Neslep River	The culvert is 70m from the coast

Subproject	Waterway	Location
Lamin Bridge	Unnamed creek	Lamin bridge is on the eastern side of the island, along the coast.
Pangpang Bridge	Forari Stream	The bridge is located in the village of Pangpang



Subproject	Waterway	Location
		
La Cressonniere Culvert	Edaw River	The culverts is ~1.2km upstream from the coast/mouth of the river
		
Eton Beach Culvert	Unnamed local creek	The culvert is located along Eton Beach, along the east coast of the island.
		

Subproject	Waterway	Location
Eton Dry Creek Culvert	Eton Dry Creek	The culvert is located along the east coast of the island, just south of Eton Beach.
 <p>A satellite image showing a coastal area. A road runs along the shoreline, and a culvert is marked with a yellow pin and labeled 'Eton Dry Creek Culvert'. The area is surrounded by dense green vegetation and a sandy beach. The ocean is visible to the right.</p>		
Rentapau Bridge	Rentapau River	This bridge is located on the south of the island, some 2 km from the coast.
 <p>A satellite image showing a river flowing through a dense forest. A bridge is marked with a yellow pin and labeled 'Rentapau Bridge'. The surrounding area is heavily wooded.</p>		
Pavement works 2 nd Lagoon to Rentapau	N/A	The western extent is approximately 1.0 km east of Teouma Bridge and it extends to approximately 0.8 km east of Rentapau Bridge.

Subproject	Waterway	Location
		

3.2 Project scope

There are 12 subprojects on the east of the island that mostly require only minor works. Lamin is the only bridge in eastern Efate that will require replacement (precast concrete semi-modular bridge).

The Project scope is best described in terms of the number of new bridges, new culverts, road formation and pavement works and ancillary works for the eastern area, as summarised below:

- > New single span, concrete bridge at Lamin to replace existing bridge structure. Some concrete will need to be imported by truck but the volume is not substantial
- > Coastal protection works at Onesua to reduce disaster risk and mitigate climate change impacts and repair the existing 1.4km of road pavement damaged by TC Pam. Armour rock and gravel will need to be imported by truck from nearby basalt quarry which will generate some heavy vehicle traffic
- > Roadwork repairs at Neslep, and four very short minor sections
- > Drainage and scour and environmental protection to Epau, Neslep and La Cressonniere
- > Safety improvements at Epule, Sara, Pangpang, Rentapau, Eton Beach, Eton Dry Creek
- > Wind protection with planting at Eton Dry Creek

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).

The detailed design was submitted as a separate deliverable.

3.2.1 Onesua Storm Surge (RD01)

Onesua was ranked as priority site No.8. This was on account of its importance to ring road connectivity, extent of damage sustained in TC Pam and vulnerability to future storm damage

Option B is recommended at this site. Option B is to provide a concrete “wave wall” adjacent to the pavement and protect this from storm surge with Elcorock® (or similar) shoreline protection to break up wave energy. The embankment would also be covered with sand/loose coral material and planting for a “natural” finish. Additional cross drainage culverts and reshaping of road side drains on the inland side of the road would provide adequate drainage in the case of infrequent inundation. As priority number 8, a series of interventions that adequately address the site objectives (protection of road pavement from storm surge and wave action) are warranted.

Key issues resolved during detailed design were:

- > Location of new cross-drainage
- > Ownership of beach front areas and use of naturally occurring materials in bank stabilisation

3.2.2 Sara culvert (CT05)

Sara was ranked as priority site No.10. This was on account of the extent of damage sustained in TC Pam, and its level of environmental degradation. 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 concrete repairs, safety improvements and a footway. As priority number 10, these works that adequately address the site objectives (road safety, scour protection) are warranted.

Key issues resolved during detailed design were:

- > Extent of utilities relocation and protection
- > Method of cracked pipe sealing

3.2.3 Epule Bridge (BR04)

Epule Bridge was ranked as priority site No.20. Due to the limited damage sustained in TC Pam. Given this, the “do-something” option (Option A) –bank protection repair (replace missing gabion rocks) and replace timber deck – was not considered acceptable.

Option B is recommended at this site. Option B is to complete Option A works and to install a cantilevered footway to the upstream side of the existing bridge. As priority number 20, these works that adequately address the site objectives (road and pedestrian safety, structure longevity) are warranted.

Option C, which would involve the construction of a new two-lane concrete bridge is not considered to be necessary or the expenditure warranted, in the context of the current Project scope and funding.

Key issues resolved during detailed design were:

- > Inclusion of access stairs to the river bank
- > Fixity of footway to the existing structure

3.2.4 Epau culvert (CT06)

Epau was ranked as priority site No.15. This was on account of its vulnerability to climate change and moderate traffic volume. Given this, the “do-something” option (Option A) – scour protection improvements (Elcorock® or similar) and improving road side drainage – was acceptable. Option A is recommended at this site. As priority number 15, these works that adequately address the site objectives (road and pedestrian safety, community access) are warranted.

Key issues to be resolved during detailed design are:

- > Extent and nature of community works
- > Inclusion of replacement approach slab in scope

3.2.5 Neslep culvert (CT07)

Neslep was ranked as priority site No.11. This was on account of the extent of damage sustained in TC Pam, the adequacy of the existing structure and its low traffic volumes. Given this, the “do-something” option (Option A) – remove deposition material from creek bed, repair damaged areas of road pavement and improve road side drainage outlets – was acceptable. Option A is recommended at this site. As priority number 11, these works that adequately address the site objectives (waterway capacity, connectivity security) are warranted.

Option B, which is to complete Option A works, and build an upstream weir structure to capture sediment, is not considered necessary.

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

Key issues resolved during detailed design were:

- > Source of sediment deposition

3.2.6 Lamin Bridge (BR05)

Lamin was ranked as priority site No.6. This was on account of its importance to ring road connectivity, lack of universal access provision and high future maintenance cost. Given this, the “do-something” option (Option A) – simply repairing it and leaving high ongoing maintenance costs and a substandard, non-universal access single lane bridge – was not considered acceptable.

Option B, a new single-span, single-lane concrete bridge, will reduce the frequency of maintenance, but does not address the road and pedestrian safety issues.

Option C, a new single-span, two-lane concrete bridge, is recommended at this site. As priority number 6, a new structure that adequately addresses the site objectives (safety, structure longevity) is warranted.

Key issues to be resolved during detailed design are:

- > Extent of approach road reconstruction

3.2.7 Pangpang Bridge (BR06)

Pangpang Bridge was ranked as priority site No.19. This was on account the limited damage sustained in TC Pam. Given this, the “do-something” option (Option A) – guardrail on the bridge and the approaches, minor concrete repairs – was acceptable. Option A is recommended at this site. As priority number 19, these works that adequately address the site objectives (road and pedestrian safety, structure longevity, community access) are warranted.

Comments received from PWD during review of the feasibility study resulted in elements from Options B and C being included in the agreed Option A; namely, construction of access stairs to river bank and the provision of a footway by correctly aligning the guardrails to the bridge.

Works excluded from the selected option include provision of an overlay to the concrete deck slab and improvement of the road drainage outlets.

Key issues resolved during detailed design were:

- > Location and extent of access stairs to the river bank to facilitate village laundry

Traffic barriers are warranted as there is a drop off from the bridge deck to the creek bed of approximately 3 m. Guardrails on the bridge approaches are deemed necessary particularly as there is a tight right-angled bend on the approach road at the northern end of the bridge where there is a heightened risk of vehicles veering off the road toward the steep bank. Guardrails will also provide protection to pedestrians from errant vehicles.

3.2.8 La Cressonniere culvert (CT08)

La Cressonniere was ranked as priority site No.18 due to the limited damage sustained in TC Pam. Given this, the “do-something” option (Option A) – clear overgrowth around culvert inlet, introduce plantings and scour repairs – was acceptable. Option A is recommended at this site. As priority number 18, these works that adequately address the site objectives (waterway capacity, connectivity security, road user amenity) are warranted.

Option B, which is to complete Option A works, with formalised parking areas and new footways, is not considered essential to the objectives of this Project.

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

Key issues resolved during detailed design were:

- > Extent and nature of nearby excavation and access works and whether this will affect the design

- > Suitable species to plant upstream to mitigate algal blooms due to upstream pollution sources associated with cattle grazing and feeding facilities

3.2.9 Eton Beach culvert (CT09)

Eton Beach was ranked as priority site No.16. This was on account of its lower importance to ring road connectivity and opportunity for gender-related improvements. Given this, the “do-something” option (Option A) – scour protection improvements (Elcorock® or similar) and replacing guardrail – was acceptable. Option A is recommended at this site. As priority number 16, these works that adequately address the site objectives (road and pedestrian safety, bank protection) are warranted.

Option B, which is to complete Option A works, with traffic calming and entry improvements, is not considered essential to the objectives of this Project.

Option C, which is to complete Option B works, plus extending concrete wing walls and improving road side drainage outlets, is not considered to be cost effective.

Key issues resolved during detailed design were:

- > Detail of guardrail connection to the culvert headwall

3.2.10 Eton Dry Creek culvert (CT10)

Eton Dry Creek was ranked as priority site No.14. This was on account of the extent of damage sustained in TC Pam and its proximity to the coast. Given this, the “do-something” option (Option A) was accepted – embankment protection (Elcorock® or similar) replace guardrail, remove excess sand from the culvert cells and around culvert and include some vegetative solutions to prevent sand accumulation. Option A is recommended at this site. As priority number 14, these works that adequately address the site objectives (sand deposition, embankment support) are warranted.

Option B, which is to complete Option A works, with a concrete barrier instead of W-beam guardrail, is not considered necessary.

Option C, which is to complete Option B, with extensive fore dune reconstruction and replanting is not considered to be affordable, given the priority of the site in the context of this Project.

Key issues resolved during detailed design were:

- > Extent of foredune planting and suitable tree, shrub and grass species
- > Land (beach) ownership

3.2.11 Rentapau Bridge (BR07)

Rentapau Bridge was ranked as priority site No.17. This was on account the limited damage sustained in TC Pam and the recent construction of the structure (2004) There is also an opportunity for gender-related improvements. Given this, the “do-something” option (Option A) – realign guardrails on bridge approaches and concrete path access to the water – was acceptable. Option A is recommended at this site. As priority number 17, these works that adequately address the site objectives (road and pedestrian safety, bank protection) are warranted.

Option B, which is to complete Option A works, with reconstruction of gabion bridge abutment scour protection, is not considered essential to the objectives of this Project.

Option C, which is to complete Option B works, plus sealing the adjacent side road to prevent silt washing onto the road, is not necessary, particularly given that the guardrail alignment is being improved to protect the bridge from errant vehicles.

Key issues resolved during detailed design were:

- > Extent of scour repair required to achieve adequate bank protection
- > Design of gender related improvements under the bridge

3.2.12 Pavement works 2nd Lagoon to Rentapau

Extensive surface patching will be carried out at this site, followed by a 7 mm single coat reseal. Summary of scope of works under this subproject are as follows:

- > Vegetation control and reinstate the table drains.
- > Regrade side roads for 10 m from the edge of the ring road, and provide single seal coat seal with 7 mm cover aggregate
- > Surface repair on existing seal pavement
- > Reseal whole section with 7 mm cover aggregates
- > Road furniture – reinstate line marking, speed humps and road signs

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**). 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. The site prioritisation is listed in the table below.

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 Lamin, where bridgeworks and river channelling are proposed, specific equipment and workforce requirements are estimated to be:

- > Pile driving rig
- > Excavation equipment (track mounted excavators, up to 35 tonne)
- > Mobile crane
- > Concrete delivery, pumping and formwork
- > The workforce is expected to peak at 30 workers

At the remainder of sites, specific equipment and workforce requirements are estimated to be:

- > Excavation equipment (track mounted excavators, up to 35 tonne)
- > Mobile crane (Epule only)
- > Concrete delivery, pumping and formwork
- > Road construction equipment, such as rollers, water cart, delivery truck and bitumen sealing trucks
- > 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 craning or piling within the controlled airspace radius of Bauerfield Airport, a permit may be required. This is not expected to affect any sites in eastern Efate (affects Mele and Klems Hill subproject sites only).

3.4.5 Construction camp requirements

A decision on the need for, and possible locations of, a construction camp has not yet been made, as it is subject to Contractor proposals. For the purposes of this IEE, it was assumed that a construction camp would be required for the eastern area, in order to assess a worst case scenario for the more remote sites. At this stage, an area used by the MCA project at Neslep has been identified as the most likely site and is discussed further for purposes of this analysis.

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, precast concrete modular type bridges, such as those proposed for Lamin, have maintenance inspection requirements due to the number of components and connections. However, there are no exposed steel components on the bridge and the connections are stainless steel and not prone to corrosion.

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, including Neslep and La Cressonniere, 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 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 1-1 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 – 2 nd Lagoon 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

Code	Site*	Weighted Score	Revised Rank
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 on the east of the island

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 Pangpang (in the eastern 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

4 Description of the environment in the Project area

The Project area includes the road corridor at each subproject location on the Efate ring road. The eastern area which is under consideration for this IEE, includes the areas east of a north-south line from 10 km east of Port Vila, to the northern coast of Efate (near Emua). This takes in the waterway catchments for the eastern area.



Figure 4-1 Map showing eastern area of Efate

4.2 Physical resources

4.2.1 Climate

Vanuatu experiences two (2) main seasons; the cold and dry season from May to October and the hot and wet season from November to April (Republic of Vanuatu, 2014).

Temperatures do not vary greatly throughout the year, given its geographical position near the equator. Air temperatures in Port Vila, on the western side of Efate, vary between an average of 23°C in August and 27°C in February. Monthly maximum, mean and minimum temperatures from 1992 to 2016 are illustrated in the Figure below. Temperatures are not collected on other areas of the island (Republic of Vanuatu, 2014).

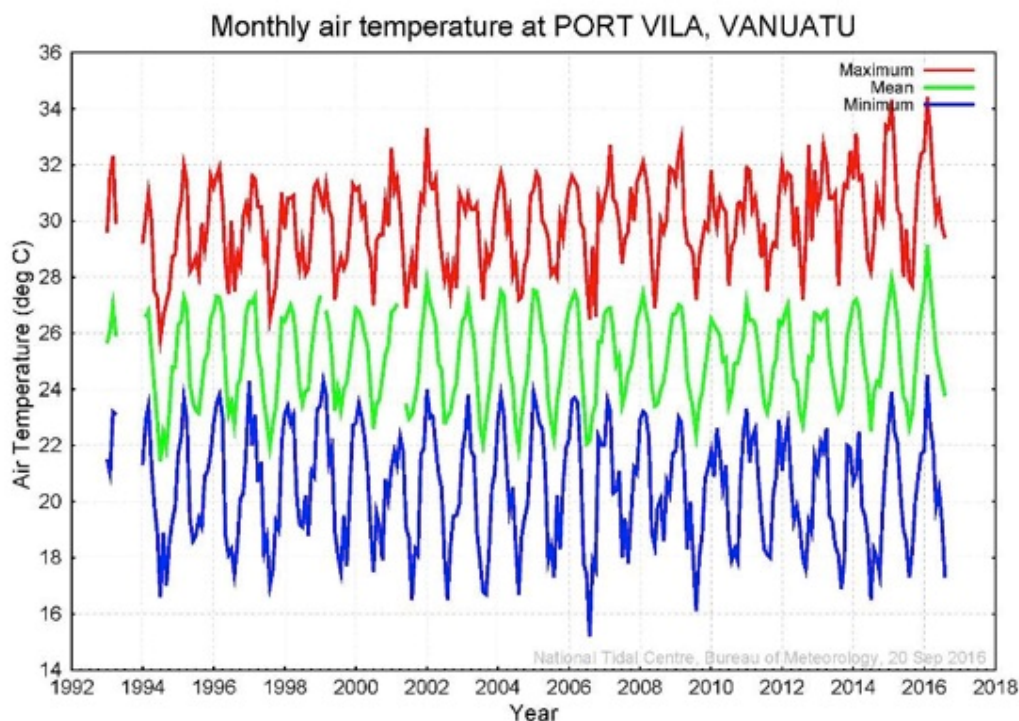


Figure 4-2 Monthly air temperatures in Port Vila, west Efate

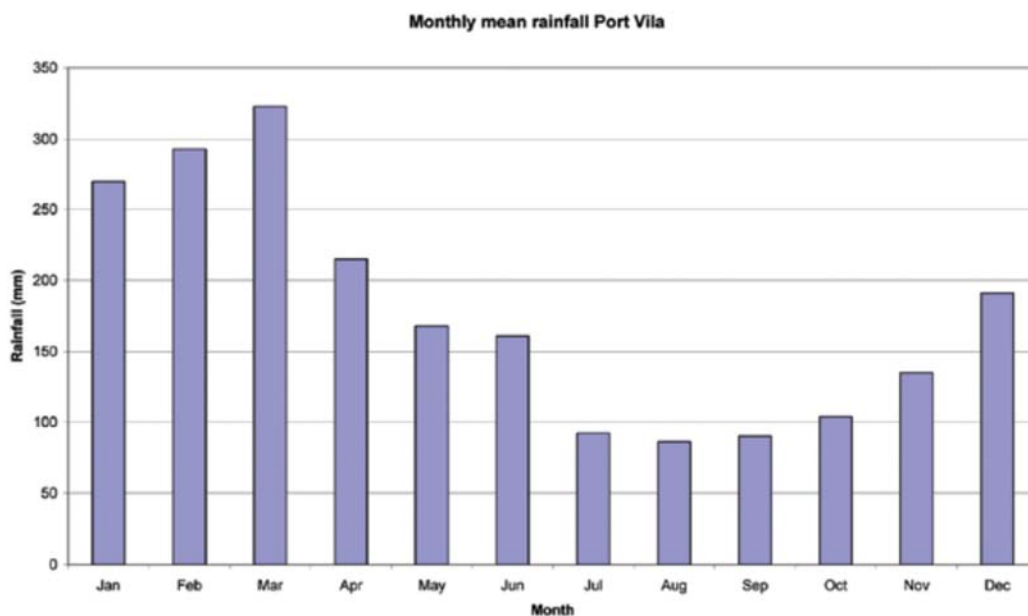
Rainfall distribution patterns across Vanuatu is determined by seasonal wind flow, topographic features (i.e. rain shadow effects) and the South Pacific Convergence Zone (SPCZ). During the wet (hot) season, rainfall is higher on the southeast, the windward side. On Efate, annual rainfall ranges from 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 1-2 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)

The eastern area subprojects are dominated by the recent uplifted limestone along the entire east coast. Le Cressonniere is located at the interface of the older harder limestone and the younger coastal limestone and explains the very steep cascade above and below the culvert. The Neslep river is the only subproject area that has a similar underlying geology to Creek Ai in the western area, with volcanic breccias and a small alluvial area near the coast but with significantly higher and less seasonal rainfall. Epau culvert is located entirely within the younger coastal limestone area. This would provide an interesting contrast to consider whether the different geology may partly explain the presence of different freshwater fish and invertebrates.

4.2.3 Hydrology

Freshwater 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

Efate has a large number of surface water sources, ranging from creeks to rivers and lakes. In the Eastern area most of the subprojects are located at creek and river crossings. Epau, Neslep, and Forari Stream (Pangpang Bridge) have permanent freshwater and Elu river (Lamin Bridge) is more influenced by tidal movement.

In its lower reaches near the bridge. Water quality in all the streams not flowing from catchments affected by grazing and livestock agriculture is excellent. La Cressonniere showed signs of high nitrogen loads with weed infestation and algae growth which is normally indicative of upstream pollution sources. The other subprojects which are water crossings – Eton Dry Creek, Eton Beach, Sara Culvert and Rentapau Bridge are all mainly influenced by tidal movements of seawater in the vicinity of the facilities.

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

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**).

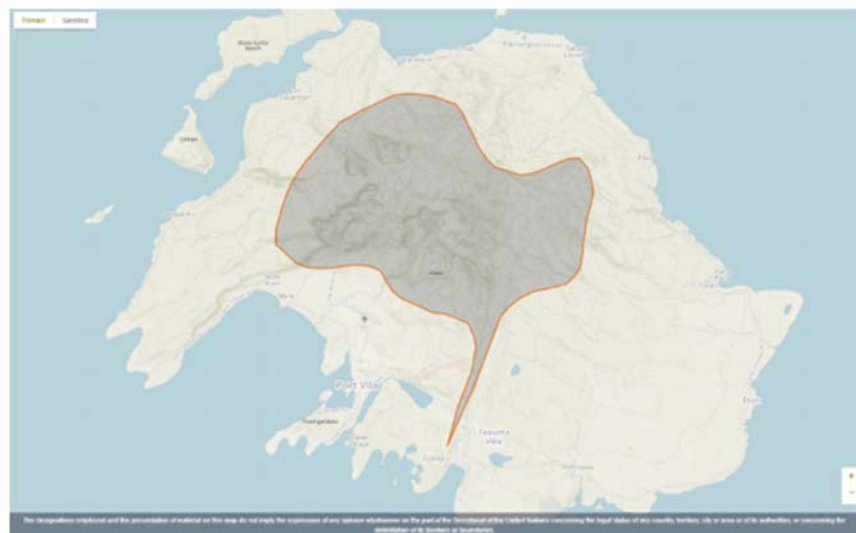


Figure 4-4 Central Efate forest conservation area

Vanuatu has eight (8) existing wetland sites (2009 Wetland Inventory), two (2) of which are on Efate Island: Duck Lake (Emaotul) and Emaotfer. Both are on the east of the island and neither are within close proximity to any of the subproject sites (Republic 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 eastern Efate are:

- > Important places
 - Mangroves on Efate, Malekula, Santo and Vanua Lava
 - Rivers on Maewo, Tanna, Vanua Lava and Efate
- > 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

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. There are no mangroves observed in eastern Efate.

4.3.2 Terrestrial flora and fauna/land cover

4.3.2.1 *Birds*

Vanuatu has 126 recorded bird species; including 11 endemics, 16 migrants and 8 introduced species. One endemic species is now extinct (Republic of Vanuatu, 2014). The endemic species are presented in the table below:

Table 1-2 Endemic bird species

Scientific name	Common name	Conservation status	Habitat
<i>Chamosyna 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>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 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 1-3 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: Republic of Vanuatu, 2014; IUCN RedList 2016

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 (see table below) (Republic of Vanuatu, 2014).

Table 1-4 Amphibians and Reptiles of Vanuatu

Scientific name	Common name	Status	Habitat/distribution
Amphibia			
<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.

Scientific name	Common name	Status	Habitat/distribution
			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 edification 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>Hemidactylus 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

Scientific name	Common name	Status	Habitat/distribution
			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 (Republic 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 (Government of Vanuatu, 2014).

Thirteen species of mangroves are found in Vanuatu, however, none have been identified at Project sites on eastern Efate.

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, four (4) endemic species were found (see table below) (Republic of Vanuatu, 2014).

Table 1-5 Endemic freshwater species

Scientific name	Common name	Conservation status	Habitat
<i>Sicyopterus aiensis</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). 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 and Cultural Resources

4.4.1 Overview of land use distribution

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.

The eastern area is dominated by scrubland which is typically weed infested in the north around the old American air base, to the north east corner. The area between Sara Culvert and Pangpang bridge form a narrow coastal strip with steep adjoining hills which are less modified and still support some forest. To the south of the Pangpang to Rentapau, the land use becomes dominated by extensive cattle grazing and coconut plantation. Tourism on the eastern side is limited to smaller family run businesses in contrast to the Western area which has resort based larger scale tourism.

4.4.2 Community profiles

A more detailed description of the communities (and impacts upon them) may be found in the Due Diligence Report on Social Safeguards.

4.4.2.1 *Takara and Onesua – Emau Area Council*

Takara village has 61 households with population of 354, consisting of 181 females and 173 males. Main economic activities include sale of agricultural products such as manioc, kumala, banana, cabbage. Fishing products and tourism related activities including a resort, geothermal pools and handicraft markets which provides employment to both men and women.

A number retail shops selling basic food stuff and items, an aid post, women's hall and community hall are located in the village. Bread from one of the main bakeries in Port Vila, Ah Pow Bakery, is delivered to the area daily. There is communal water supply. Electricity is being supplied by either solar panels, portable generators or battery operated lamps.

Takara is located on a part of Efate that is geo-active, evident at a number of hot springs. A project was proposed for a geothermal energy plant in the area. Feasibility studies were conducted, however progress has stalled due to land access and feasibility issues.

Christian affiliated denominations in the village include Presbyterian, Christian Outreach Centre and Seventh Day Adventists.

Within the Takara custom boundary, is the settlement at Onesua, approximately 800m south. It is known as the location of the Onesua Presbyterian College, a secondary boarding school of up to 400 students, 30 academic staff and 24 auxiliary staff (417 people, consisting of 203 females and 214 males). Students come

from all over Vanuatu and from various Christian denominations to study at the college, which accommodates Years 9 to 13. The college is located approximately 500 metres north of Sara.

College vehicles travel to and from Port Vila about 3 times a week, to attend to administrative matters as well as transporting staff and students. Public transport is also available to and from Port Vila, on a daily basis. The College is located on a former coconut plantation belonging to the people of Takara.

The College provides its own electricity, using diesel generators. Power is switched on 5.30am and switched off at 9.00pm. Water is supplied from an underground source, pumped and stored in tank reservoirs for supply to the College buildings. The College supplies its own local produce from its farm, such as manioc, kumala, rice and grapefruit. The College also rears its own cattle, pigs and chickens, for their own consumption. The College farm is located at Saratop, where a waterfall is also located. Within the College premises, there is a chapel, a canteen, dormitories, sports ground and basketball courts, a meeting hall, dining hall, classrooms and a clinic. It's close proximity to the sea results in fishing being a major source of food for students and staff and recreational swimming, fishing and diving. During weekends, students also swim at Epule River.

The Project site within this area is: Onesua pavement repair and coastal protection. The customary land ownership of Onesua is under dispute between Takara village (originally from Emau Island), Sara, and a family from Nguna Island.

4.4.2.2 Sara – Emau Area Council

Sara (65 km from Port Vila) is a small settlement under the jurisdiction of the Emau Area Council. It has a population of 40 people, of whom 23 are males and 17 are females. Its closest neighbouring settlements are Takara and Onesua to the north, under the same Area Council and Epule to the south (refer **Section 3.1.5**). Main economic activities include fishing and tourism related activities. Handicraft markets, local cafés and picnic spots are evident in the area. Some of the residents commute to work in Port Vila. This was made possible with the upgrade of the ring road in 2008-2010.

There is no health centre or aid post in Sara. Villagers either travel to Takara Aid Post or the Paunangisu Health Centre to access health services. There is no electricity supplied to the settlement. However, some individuals own solar panels which provide electricity for basic use.

The Project site within this area is: Sara culvert.

4.4.2.3 Epule – North Efate Area Council

Epule (about 62 km from Port Vila) is part of the North Efate Area Council and has a population of 317, of whom 150 are males and 167 are female. There are 55 households.

The main source of income is agriculture, with farmers, mainly women, taking their produce to the Port Vila central market for sale. Other activities include cattle farming, fishing and some tourism activities on the Epule River, which all members of the community are involved in. Some adults commute to Port Vila town for work, including in government agencies, commercial institutes, retail shops, private companies as well as resorts. The income from the above activities is used for basic needs and school fees.

Children either travel to Ekipe village to attend the Ekipe English-speaking primary school, or to attend the nearby Matarisu French-speaking primary school. The village has a health clinic but it is no longer in operation. Therefore, villagers either travel to Paunangisu Health Centre or to Port Vila, to access health services.

The village has access to communal water supply and also from water tanks storing rain water, mainly used for drinking purposes. Although the Epule River is easily accessible to the village, the village has no reticulate water supply system to supply water to households. The village is located on a tidal reach of the river. Most villagers bath and wash in the river. Students from the nearby secondary school frequently come to Epule River for recreational swimming.

There is no electricity supplied to the village. However, solar panels owned by individuals within the community primarily provide electricity for lighting.

Except for the Paramount Chief and the indigenous people of Epule, most of the villagers are originally from the Shepherd Islands, a group of islands lying between the larger islands of Epi and Efate, in Shefa

Province. They migrated to Epule in the 1960-70s as a result of good friendships and relationships that their descendants had with the paramount chief of Epule. The Chief invited his friends to Epule and gave them land to live on and farm. Over time, more Shepherds Islands families moved to Epule, who were also either given land or bought land to live on and grow crops.

There are locally and foreign owned restaurants within the vicinity of the village and tourist scenic tours are operated by the local community. Some villagers also own small retail shops which sell basic food and household items. There are also kava nakamals and kava bars in the area. Most of the kava that is being sold is not originally planted at Epule, but bought from markets in Port Vila, then prepared for sale.

The Project site within this area is: Epule bridge.

4.4.2.4 Pangpang – North East Efate Area Council

Pangpang (about 45 km from Port Vila) is part of the North East Efate Area Council and has a population of 145, of whom 75 are males and 70 are female.

Subsistence agriculture is the main source of income, with farmers growing root crops such as manioc, banana, kumala, taro and green vegetables to sell at the central market in Port Vila. Fruit is also sold at the market such as coconuts, oranges, mandarins, mangoes and pawpaw. Sale of crops and fruit assist in generating income to buy basic needs and school fees. TC Pam severely damaged much of these fruit trees, however they are slowly being restored. Both men and women are involved in planting and selling of their produce.

The villagers travel to Epau Aid Post for basic health services, however emergencies are referred to the Port Vila Central Hospital. There is currently no communal water supply system and no electricity supplied to the village. Some villagers own solar panels that provide electricity, mainly for lighting. Villagers use water from the adjacent Epau river and store rain water in polytanks.

There is one Project site at this location: Pangpang bridge.

4.4.3 Epau – North East Efate Area Council

Epau is part of the North East Efate Area Council, which includes Lamin village. The population is 381, of whom 201 are male and 180 are female. The number of households is 75.

The main sources of incomes are agriculture and fisheries. The community accesses the Port Vila central market where they can sell and buy food. The village market venue for trading and sales of garden produce was destroyed by TC Pam. Therefore, all produce, if not sold within the village or roadside markets, are transported to the central market in Port Vila, where women are usually the vendors. Women are also usually involved in selling cooked food in makeshift shelters with tables, along the roadside, often referred to as “20 Vatu Market”, or at kava bars. Men would usually gather the food or fish and the women would prepare and sell it.

There is a primary school within the village, however many children also travel to Port Vila to attend primary school. Those attending secondary schools in Port Vila either board at their respective schools or live with family members in town. An Aid Post within the village provides basic health services for the village and nearby settlements.

The majority of villagers live mainly in semi-permanent buildings. The people have access to the ring road and water supply. Electricity is supplied by solar panels. There was previously donor funding available for a Solar Panel project, however maintenance of the assets was a challenge for the community.

Epau, is located at almost the halfway point around the ring road, from Port Vila. This position has made it an ideal location used by government departments, NGOs and religious groups for hosting of meetings all year round.

The Project sites within this area are: Epau culvert, Neslep culvert and Lamin bridge.

4.4.3.1 Eton Village – North East Efate Area Council

Eton (about 20 km from Port Vila town) is located adjacent to the ring road. The population in 2009 was 516 people, of whom 262 are males and 254 are females. There are 99 households. The majority of the locals

work in the village as farmers, fishermen, guest house operators, local restaurant operators, Mama's market and kava bar operators, while a few commute to Port Vila for work.

The main source of income for most of the population is subsistence agriculture. Farmers sell crop produce such as manioc, banana, taro, kumala, cabbage, coconuts and fresh fruit and nuts at the central market in Port Vila. Fishing is also an activity used to generate income, however this is only on a very small scale. The community is also involved in tourism such as at Eton Beach, where picnic ground facilities and the beach can be hired by the public. Some families also operate private tourism activities, especially in commercialising their picnic and swimming areas.

There are four different Christian affiliated denominations within the village – Presbyterian, Seventh Day Adventist, Jehovah's Witnesses and Church of God. Villagers are devoted to their religious duties and responsibilities within the respective churches. The church has influence in the lives of the community members and the societal stability.

Eton has average access to basic amenities and services. An aid post is located within the community hall premises. At scheduled times, a registered nurse from the main health centre in North Efate or the Shefa Province Health office, will visit at the Aid Post. Nursing mothers from the village and nearby communities bring their babies for regular check-ups and vaccinations. In cases of emergency, sick persons are transported to the Port Vila Central Hospital via private or public transport available in the village.

Eton is not yet connected to the UNELCO electricity grid. Electricity is obtained by solar panels and the few portable generators. Battery operated lamps are also common in households.

There is a communal water supply available and water tanks are also used by most households for collecting rain water, especially for drinking purposes.

There are three Project sites within the Eton area: Eton Dry Creek culvert, Eton Beach culvert and La Cressonniere culvert.

4.4.3.2 *Rentapau – Eratap Area Council*

Rentapau is located 11 km east of Port Vila. It has a population of 346, of which 178 are males and 168 are females. Rentapau is part of the Eratap Area Council. There are 85 households. Rentapau is a settlement that is increasingly becoming more diverse in its composition. The original land owners are from Eton on the eastern side of the river and Eratap on the west. However, land was leased out and now non-indigenous people are occupying the land and residing in the area.

The main income generating activities are subsistence agriculture and fishing. Produce is sold in various Port Vila markets, shops and individual homes. Women are mostly involved in the sale of agricultural products while men and boys are involved in fishing activities for income sources. Some residents are also involved in public transportation (both buses and taxis) and small retail shops as well as kava bars.

Children attend schools in Teouma, approximately 4 km to the west.




There is electricity now available from UNELCO, but relatively few households are connected, with the majority still using solar or battery-powered lights. The residents source water for drinking and cooking from identified springs at the Rentapau river banks. Other water catchments are also used such as tanks and drums for rainwater storage purposely filled for cooking and drinking. The river is used mainly for washing and swimming.




The Project sites within this area are: Rentapau Bridge and part of 2nd Lagoon to Rentapau pavement works



4.5 Subproject-specific existing environment




While the above sections describe the existing environment for the Project area (Efate Island Ring Road and surrounds); the environmental conditions at each Subproject site on the east of the island are presented in the table below; and photos are provided beneath this.



Table 1-6 Subproject-specific existing environment



Sub project	Physical environment	Biological environment	Socio-economic environment
Onesua Storm Surge Repair	<p>There are no major water crossings structures along this section. This location is exposed to north east which is the main direction for storms and cyclones. The geology is low lying beach sand on recent limestone. There is an area of thermal springs under the northern section of the road.</p>	<p>Coastal, beach environment with pine, coconut and <i>Pandanus</i> trees dominating.</p>	<p>There are no existing houses or other buildings in between coastline and the road. On inland side there are no buildings or other structures within 40 to 50 m from the road edge.</p> 
Sara Culvert	<p>This culvert is located along the coast. The geology is low lying beach sand on recent up lifted limestone. The channel near the culvert is dominated by tidal flows with a small intermittent catchment of freshwater flows after rain.</p> 	<p>The vegetation is composed of coastal species – with coco nut and other mature trees present adjacent to the culvert. The creek had a large amount of algal blooms during the August and October site visits which are occasionally flushed by tidal action. This is probably due to stagnation of intermittent tidal saltwater flows.</p>	<p>The bridge is adjacent to a restaurant on the north east and private, fenced land on the southwest.</p>  <p>There is a water well upstream used by the nearby villagers.</p>

Sub project	Physical environment	Biological environment	Socio-economic environment
			
Epule Bridge	<p>Epule crosses a river that is relatively large approximately 10-15 km and deep enough for the use of kayaks and canoes. The geology at the bridge is recent up-lifted limestone but further upstream the source is in the older limestone.</p> <p>Channel is dominated by tidal flows with very good water quality. There was no evidence of sedimentation in the channel.</p>	<p>The area is well vegetated both up and downstream of the bridge. The coastal side of the bridge is mostly cleared and grassy, however, as it is private land. Inland, there are planted gardens along the north by the residence and further upstream.</p> <p>The river supports a diverse ecosystem of endemic fish and crustaceans such as eel fish and estuarine shrimp.</p>	<p>There is a residence to the northeast that rents out kayaks and does river tours. There is fenced off private land on either side of the bridge along the coast which is fenced using barbed wire.</p> 

Sub project	Physical environment	Biological environment	Socio-economic environment
Epau Culvert	<p>The creek is wide but mostly shallow. Channel is dominated by tidal flows with a small catchment of permanent freshwater flows.</p> <p>Bank erosion is evident downstream and gabion walls have been installed for a portion to prevent this</p>	<p>There is a large Banyan tree adjacent to the culvert, otherwise the immediate surroundings are fairly clear.</p> <p>There is likely habitat for endemic freshwater fish and crustaceans</p>	 <p>There are no nearby sensitive receivers. A few houses upstream along the stream but main village is about 300m</p>
Neslep Culvert	<p>The culvert is located on the coast on a creek that widens near the mouth. Channel is dominated by tidal flows with a small catchment of permanent freshwater flows. There are small amounts of sediment building up which are sufficient to block the small pipe culverts.</p>	<p>Upstream vegetation is composed of tall grasses and weeds adjacent to the culvert and mature trees further up.</p> <p>Downstream, the vegetation is coastal with coconut and pine trees. Fallen trees remain.</p> <p>There is likely habitat for endemic freshwater fish and crustaceans</p>	<p>There are no nearby sensitive receivers.</p> 
Lamin Bridge	<p>Lamin is ~100m from the coast. Channel is dominated by tidal flows with a small catchment of semi-permanent freshwater flows. There is little evidence of erosion and sedimentation.</p> <p>No freshwater flow observed</p>	<p>Vegetation upstream is dominated by coconut and banana trees with considerable weed infestation in the channel, while the vegetation downstream is more coastal. Lots of weed infestation in the channel itself.</p> <p>There is likely habitat for endemic freshwater fish and crustaceans</p>	<p>There are no nearby sensitive receivers.</p>

Sub project	Physical environment	Biological environment	Socio-economic environment
			
Pangpang Bridge	The watercourse Forari river is narrow and flowing. There is small area of alluvium underlain by recent limestone. There were no visible signs of sedimentation and deterioration of water quality. The river has a more extensive upland catchment and sources from volcanic geology and the area of a significant manganese deposit.	<p>The area directly around the watercourse are heavily vegetated and relatively pristine. North of the bridge, near the village, the land has been cleared.</p> <p>There is likely habitat for endemic freshwater fish and crustaceans</p> 	<p>The bridge is located near the junction to Pangpang village. There are huts at the northwest of the bridge</p> 
La Cressonniere Culvert	<p>The watercourse is wide and shallow with a fast moving flow.</p> <p>There were recently completed/ongoing earthworks during the October site visit. The site is located on a steep geological boundary between the older raised</p>	<p>The vegetation has been cleared around the culvert and vegetation is dominated by tall grasses and weeds; with palm and banana as well as some mature trees present further up and downstream. There are visible algal blooms which may be</p>	<p>This watercourse is used for a tourist destination and benches have been provided in the downstream area for guests to sit with their feet in the water. The sudden change in geology is an interesting tourist and education location.</p>

Sub project	Physical environment	Biological environment	Socio-economic environment
	reef limestone and the recent raised reef limestone.	associated with cattle grazing facilities slightly upstream.	
Eton Beach Culvert	Low Coastal topography on recent up lifted limestone. The channel flows from a back dune estuary with brackish water supporting endemic estuarine saltwater fish and crustaceans.	The environment is dominated by mangrove, pandanus and isolated canoe tree species.	There is a tourist beach nearby that is run by the community for an entrance fee. 
Eton Dry Creek Culvert	Low Coastal topography on recent up lifted limestone. Windblown sand has damaged the existing bridge and approaches,	The environment is dominated by mangroves species to the west. On the east, it is white sand beach with pandanus and isolated tall canoe trees	There a tourist beach nearby that is run by the community for an entrance fee. Illegal sand clearing is a current land use problem

Sub project	Physical environment	Biological environment	Socio-economic environment
			
Rentapau Bridge	<p>Geology is old limestone so channel is very stable with little obvious erosion and sedimentation. The river has an extensive upstream and is relatively large compared to the other eastern subprojects.</p>	<p>The area is well vegetated along the River. It is a highly modified environment with secondary vegetation including many weeds</p>	<p>There are residents south-west of the bridge, although the entrance is further down the road and is not visible from the bridge.</p> 

Sub project	Physical environment	Biological environment	Socio-economic environment
Pavement works 2 nd Lagoon to Rentapau	There are no major water crossings structures along this section.	The road is ~1.7km away from Emaotfer wetlands at its closest point. It is a highly modified environment with secondary vegetation including many weeds	The land use in the section is more urban, with residents and farmlands adjacent.



Figure 4-5 Onesua Storm Surge Repair existing environment



Figure 4-6 Sara Culvert existing environment



Figure 4-7 Epule Bridge existing environment



Figure 4-8 Epau Culvert existing environment



Figure 4-9 Neslep Culvert existing environment



Figure 4-10 Lamin Bridge existing environment



Figure 4-11 Pangpang Bridge existing environment



Figure 4-12 La Cressonniere Culvert existing environment

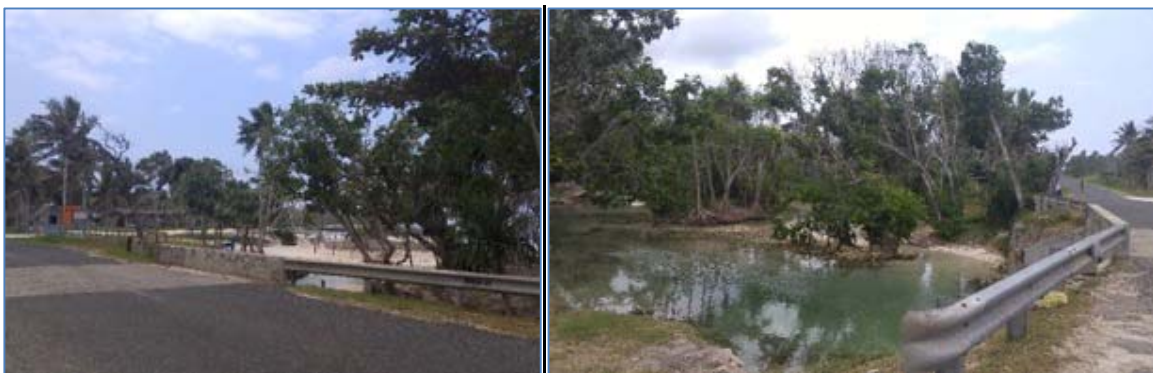


Figure 4-13 Eton Beach Culvert existing environment



Figure 4-14 Eton Dry Creek Culvert existing environment



Figure 4-15 Rentapau Bridge existing environment

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 eastern Efate is set out below.

5.2 Onesua road and coastal protection

5.2.1 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 30 on-site personnel
- > Preparation of a working area inside the corridor for site preparation works

5.2.1.1 *Physical environment*

Climate change and adaptation

The subproject will specifically carry out coastal protection works to reduce disaster risk and mitigate the effects of climate change as well as carry out 1.4 km of road repairs caused by cyclone damage.

It will not create any impacts on rainfall, unexpected groundwater depletion, or additional carbon emissions, which in turn could affect the risk of, or induce, climate change. Climate change measures to allow the stabilized slope has been integrated into the design. The main issue was to design the works so that the risk of future very high storm tidal surges affecting that section of the road in the future is minimised.

5.2.1.2 *Biological environment*

Vegetation removal during surveying, demarcation and clearance

There will be a need to remove grass and weeds where the coastal protection is being built. 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 more permanent storage yard for POL would be required in a separate location which will be the responsibility of the Contractor.

Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances.

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

5.2.1.3 *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.

5.2.2 Construction impacts

5.2.2.1 *Physical environment*

Construction involves the following activities:

- > Earthworks, excavation 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, drainage structures and geotextiles, guardrail components
- > Temporary stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Construction of the concrete wave wall
- > Repair and clearance of road side drains as required
- > Preparation and resealing of road surface
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)

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 section of the road is located on very sandy coastal soils and beach sand with recent underlying uplifted reef limestone geology with a distinct dry season. The risks of significant soil erosion and sedimentation were considered very low.

Water quality

Some silt runoff from imported material stockpile can be anticipated. There is potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality. The risk to water quality is considered low but routine 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)

5.2.2.2 Biological environment

Flora and fauna

The 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 works 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

5.2.2.3 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 is a Collage and some residences nearby. The pattern of intermittently generated noise for up to 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 College and nearby 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.

5.2.3 Operations impacts

5.2.3.1 *Physical environment*

Overall the area of the subproject is very limited but it has been targeted at the specific section of the road that was significantly affected by TC Pam. The operations phase will be directly positive and long term.

Other operational physical impacts are considered to be low, as traffic forecasts predict that traffic growth will be stable. However, if routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

5.2.3.2 *Biological environment*

Flora and fauna and protected areas

There are no protected areas in the limited subproject area and the operational risks of the project were considered to be low. Coastal vegetation outside the proposed repair works will not be affected by the subproject.

5.2.3.3 *Social environment*

Noise

Ambient traffic noise levels will not increase due to the stable traffic volume forecast.

5.3 Sara Culvert

5.3.1 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 10 on-site personnel
- > Preparation of a working area near the culvert inside the corridor for culvert preparation

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.

5.3.1.2 Biological environment

Vegetation removal during surveying, demarcation and clearance

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

The subproject culvert is located in a coastal intermittent drainage line that flows to the sea. Most of the time the stream does not flow freshwater except after rainfall periods so it is mainly affected by tidal flows.

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

- > Survey and construction workers will be informed in advance about the need environmental protection and the need to avoid vegetation clearance.

5.3.1.3 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.

5.3.2 Construction impacts

5.3.2.1 Physical environment

Construction involves the following activities:

- > Proposed works are limited to minor earthworks and any required excavations to rehabilitate and repair the existing culvert
- > 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 ensure smooth transition to culvert pavement
- > 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 guard rails repair and extension and new signage
- > Repair of gabions upstream and downstream with installation of new geotextile mattresses

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 on the coast in a small bay only metres from the sea and flow in the stream is mainly tidal. There was no evidence of significant sedimentation other than rocks and boulders resulting from the very high tidal surge during TC Pam which also affected the culvert gabions.

The risk of normal sedimentation and erosion and deposition from upstream is considered very low as the upstream catchment is very limited in area and the surrounding soil is coastal sand.

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

Standard mitigating measures would be necessary and 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

5.3.2.2 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

5.3.2.3 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 three 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

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

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > Nearby residents 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.

5.3.3 Operations impacts

5.3.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 inlets.

5.4 Epule Bridge

5.4.1 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 10 on-site personnel

- > Preparation of a working area near the bridge inside the corridor for bridge preparation and superstructure

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. Climate change measures were integrated in the design of the bridge with maximum flood levels taken into consideration.

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. 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

5.4.1.3 *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.

5.4.2 Construction impacts

5.4.2.1 *Physical environment*

Construction involves the following activities:

- > Replacing the timber planks on the existing bridge
- > Vegetation clearance and replanting with local shrubs and grasses on the north eastern approach of approximately 30 m
- > Repair of scour protection on the south western abutment
- > Construction of a cantilevered pedestrian footway to improve safety
- > Connection to road side drains as required
- > Transportation of construction materials bridge planks, plantings replacement scour protection
- > A temporary stockpile for top soil cleared for replanting area

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 Epule river mouth which is a large tidal river and presently stands approximately 10 m above the river. There is low potential risk for significant loss of topsoil as the area of disturbance is approximately 150 m².

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.
- > Embankments and in-stream/river activities to be monitored during construction for signs of scour and if necessary measures with armour rock and geotextile bags 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 sediment to be removed by private sector contractors.

Water quality

As noted above, the works are very limited and risk to water quality is considered very 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

5.4.2.2 *Biological environment*

Flora and fauna

Most bridge works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected except for clearance of approximately 150m² to be cleared of weeds and landscaped.

5.4.2.3 *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 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

Although the village and other nearby receptors are close, due to the nature of the activities, construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.4.3 Operations impacts

5.4.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 structure 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.

5.4.3.2 *Social environment*

Health and safety

The impact of the bridge will improve safety for pedestrians as there is no existing separate footway.

5.5 Epau 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 10 on-site personnel
- > Preparation of a working area near the culvert inside the corridor for culvert preparation
- > Possible use of land near the village for materials storage area

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.

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.

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

5.5.1.3 *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.

If storage area is required near the village there would need to be a negotiation with the Contractor in the early mobilisation phase.

5.5.2 Construction impacts

5.5.2.1 *Physical environment*

The subproject culvert crosses a small permanent freshwater stream known as the Epau river which flows to the sea approximately 70 metres away. Up to the culvert the river can be affected by storm surges from the sea but is not tide affected.

Construction involves the following activities:

- > Proposed works are limited to minor earthworks and any required excavations to rehabilitate the existing culvert
- > 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 ensure smooth transition to culvert pavement
- > 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 in the Elcorock bags
- > No traffic diversion will be required and all works will stay within the corridor
- > Safety improvement works such as guardrails repair and extension and new signage
- > Repair of scour protection with Elcorock bags upstream and downstream

- > Removal and replacement of in stream boulders to improve the natural weir built by local villagers
- > Repair and improve access for washing and laundry facilities

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 virtually on the coast only 70 m from the sea and flow in the stream is freshwater with a width of approximately 10 m.

There was some evidence of sedimentation on the upstream side of the culvert which will be cleared and used for scour protection.

A design mitigation will be place rocks and boulders up stream to improve the natural weir to minimise further sedimentation clogging the pipe culverts and improve fish and invertebrate passage.

Water quality

The existing water quality in the river was observed to be excellent as it is coming from a risk from a relatively limited but well vegetated clean catchment and annual rainfall in this section is much higher than further to the north of the eastern area. The scale and duration of the works proposed is limited so the risk to water quality is considered low.

Nonetheless, 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

5.5.2.2 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

Protected riverine flora and fauna ecosystems

The catchment area of the Neslep 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 either data deficient and one of least concern. However, there was one species listed as near threatened (i.e. the Creek Ai Goby) and it is possible that this species is also present in the Neslep river which possesses the same flow and channel characteristics to Creek Ai. 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 minimised. As the scale of the works is very limited the risk was considered low when unmitigated.

In order to further reduce risk the following measures will be necessary:

- > 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

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 on-road works 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 three months. The following mitigations will be required:

- > 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 project will improve pedestrian safety with improvements to guardrails, pedestrian lanes and warning signage.

There will be a moderate risk of impacts to community health and safety as a proposed storage area for the eastern subprojects was assumed to be in the vicinity of Neslep and Epau village based on information supplied by the contractor which was involved in the MCA project in 2008-2010. A day camp may also be required in the vicinity of the site.

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

- > 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

Although the village and other nearby receptors are close, due to the nature of the activities, construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.5.3 Operations impacts

5.5.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 structures 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 inlets.

5.6 Neslep Culvert

5.6.1 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 10 on-site personnel
- > Preparation of a working area near the culvert inside the corridor for culvert preparation

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.

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.

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.

5.6.2 Construction impacts

5.6.2.1 Physical environment

The subproject culvert crosses a small permanent freshwater stream known as Neslep river which flows to the sea approximately 20 m away. Up to the culvert, the waterway can be affected by storm surges from the sea but is not tide affected.

Construction involves the following activities:

- > Proposed works are limited to minor earthworks and any required excavations to rehabilitate the existing culvert
- > 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 ensure smooth transition to culvert pavement
- > 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 in the Elcorock bags
- > No traffic diversion will be required and all works will stay within the corridor
- > Safety improvement works such as guard rails repair and extension and new signage
- > Repair of scour protection with Elcorock bags upstream and downstream

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 on the coast only 20 m from the sea and flow in the stream is freshwater with a width of approximately 10 m.

There was some evidence of sedimentation on the upstream side of the culvert which will be cleared and used for scour protection. Rocks and boulders will be placed up stream to create a natural weir to minimise further sedimentation clogging the pipe culverts.

Water quality

The existing water quality in the river was observed to be excellent as it is coming from a relatively limited but well vegetated, clean catchment. Anecdotally, annual rainfall in this section is much higher than further to the north of the eastern area. The scale and duration of the works proposed is limited so the risk to water quality is considered low.

Nonetheless, standard mitigating measures to protect water quality would be necessary and 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. The contractor would pay for any non- land assets damaged by the construction works but this is very unlikely due to scale of the works.

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

Protected riverine flora and fauna ecosystems

The catchment area of the Neslep 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 either data deficient and one of least concern. However, there was one species listed as near threatened (i.e. the Creek Ai Goby) and it is possible that this species is also present in the Neslep river which possesses the same flow and channel characteristics to Creek Ai . 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 minimised. As the scale of the works is very limited the risk was considered low when unmitigated.

In order to further reduce risk the following measures will be necessary:

- > 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

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 three 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 project will improve pedestrian safety with improvements to guardrails, pedestrian lanes and warning signage.

There will be a moderate risk of impacts to community health and safety as a proposed storage area for the eastern subprojects was assumed to be in the vicinity of Neslep and Epau village based on information supplied by the contractor which was involved in the MCA project in 2008-2010. A day camp may also be required in the vicinity of the site.

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

- > 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

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk.

Any excessive noise which is unanticipated at this stage will still require routine mitigations including:

- > Nearby 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.

5.6.3 Operations impacts

5.6.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 structures 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 inlets.

5.7 Lamin 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
- > Presence of both foreign and local construction workers of up to 25 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 bridge 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.

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

- > If necessary and 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 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 will be no need for a temporary diversion near the bridge as there is already an alternative low crossing slightly further downstream near the sea.

5.7.2 Construction impacts

5.7.2.1 *Physical environment*

Construction involves the following activities:

- > Removal of the existing single span, steel beam, timber decked bridge
- > Placement of a new short span pre-fabricated concrete bridge
- > Earthworks downstream to reshape the channel to align better with new bridge
- > Improve up stream drainage
- > 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
- > Bored piling operation
- > Bridge approach reshaping and filling to ensure smooth transition to bridge pavement
- > Excavations and lining for connection to road side drains as required
- > Use of crane for a period of approximately two weeks to place the bridge or components
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)

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 100 m from the river mouth which is mainly affected by tidal movement and has intermittent flows of freshwater after rainfall. There was no evidence of sedimentation. There is low potential risk for significant loss of topsoil as the underlying soil is coastal sand. Also construction work is planned to be carried during the dry season.

The new bridge has been designed to improve intermittent tidal flows and very intermittent freshwater flood flows. Channel spoil being removed will be used in supporting the channel bank slopes in geotextile bags. This spoil will need to be stored temporarily in agreed location near the proposed bridge location until it can be used.

The risk of soil erosion and sedimentation is considered very low but if required 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 extraction and moving construction materials within a lay out area adjacent to the river. Silt runoff from the lay out area can be anticipated. There is potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality. The risk to water quality is 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

5.7.2.2 Biological environment

Flora and fauna

Most bridge works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected. The lay down work area for the bridge will require removal of road side secondary weed vegetation. The contractor will pay for any non-land assets damaged by the construction works.

Construction of site amenities 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 catchment area of the upstream is very limited and is dependent on intermittent tidal flows and freshwater movement downstream. It is located in a higher rainfall section of the Eastern area but the small catchment area does not maintain permanent flows. The life cycle of riverine fauna would be dependent on freshwater movement downstream.

The flow of the river will not need to be diverted to do the works so there is no potential to disrupt the normal life cycle of fish and invertebrate species which require movement both from the sea upstream and downstream from freshwater. As the scale of the works is very limited the risk was considered low even when unmitigated.

5.7.2.3 Social environment

Public access and local mobility

As discussed above there will be a need to use an existing temporary diversion on the downstream side of the bridge. Traffic volume is low so disruption will be minimal and will be in keeping with existing conditions. 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 six 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 this subproject.

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

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk. The piling for Lamin Bridge is expected to be bored piles, not driven piles.

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.

5.7.3 Operations impacts

5.7.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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.

5.8 Pangpang 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;
- > Presence of both foreign and local construction workers of up to 10 on-site personnel
- > Preparation of a small working area near the bridge inside the corridor to prepare equipment

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 bridge 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. A separate storage yard for POL would be required in a separate location which will be the responsibility of the Contractor.

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:

- > 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

5.8.1.3 *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 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.

5.8.2 Construction impacts

5.8.2.1 *Physical environment*

Construction is limited and involves the following activities:

- > 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
- > Drilling and forming and pouring concrete kerbs
- > Installing guardrails and handrails
- > Forming and pouring concrete footpaths
- > Establishment of site amenities (possibly to serve multiple sites) may be necessary (no accommodation camp)

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 types of vehicles and at night traffic becomes very sparse. The foreshore location and the prevailing south-easterly winds also ensure excellent air quality. Risk is considered low and the scale of works at the site is minor.

Soils, sedimentation and erosion

The works are very limited and involve only minor excavation for footpath construction. Risks are considered to be low.

Water Quality

As noted above, the works are very limited and risk to water quality is considered very 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

Bridge works will be carried out on the existing road alignment so risks are considered low and minimal impacts on vegetation are expected.

5.8.2.3 *Social environment*

Public access and local mobility

There may be a need to create a temporary stop go system for pedestrians and cars through the section while some of the works proceed. Traffic volume in the location is low during the day time so disruption and inconvenience will be minimised to specific periods. Access to villages along the subproject road will be maintained at all times.

The approximate time of construction will be up to two 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

There will be a low risk of impacts on community health and safety as the works are limited in nature and confined to the bridge site.

Noise

Although the village and other nearby receptors are close, due to the nature of the activities, construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.8.3 Operations impacts

5.8.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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.

5.8.3.2 Social environment

Health and Safety

The impact of the bridge will improve safety for pedestrians; guardrails and handrails will be provided, which are not existing.

5.9 Le Cressonniere Culvert

5.9.1 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 10 on-site personnel
- > Preparation of a working area near the culvert inside the corridor

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.

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.

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

5.9.1.3 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.

5.9.2 Construction impacts

5.9.2.1 Physical environment

The site is located on a steep geological boundary between the older raised reef limestone and the recent raised reef limestone. The subproject culvert crosses a small permanent freshwater fast flowing stream which drops down to coastal level approximately 200 m away and then the stream flows to the sea.

Construction involves the following activities:

- > Scour damage to be repaired and stabilised
- > Culvert pipes and vegetation to be cleared to restore flow
- > No traffic diversion will be required and all works will stay within the corridor

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 crosses a fast flowing freshwater stream with a width of approximately 10 m which cascades below the culvert due to the sudden change in geology and slope.

There was some evidence of minor sedimentation on the upstream side of the culvert which will be cleared and used for scour protection. The risks of soil erosion and sedimentation resulting from construction were considered low as works are very limited.

Water quality

The existing water quality in the river was observed to be clear but showed signs of significant algae and weed invasion. The invasive weeds in the water suggested a higher than normal nitrogen load in the upstream catchment which is common when used for cattle grazing. The scale and duration of the works proposed is limited so the risk of the construction leading to a decline in water quality is considered low.

Nonetheless, standard mitigating measures to protect water quality would be implemented and 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

5.9.2.2 Biological environment

Flora and fauna

Works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected. The contractor would pay for any non- land assets damaged by the construction works but this is very unlikely due to scale of the works.

Additional measures to be included in the project to ensure protection of flora and fauna within the subproject area include:

- > 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

5.9.2.3 Social environment

Public access and local mobility

There will be no need to close the road to complete the works.

Health and safety

There will be a low risk of impacts on community health and safety as the works are limited in nature and confined to the site.

Noise

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.9.3 Operations impacts

5.9.3.1 Physical environment

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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.

5.9.3.2 Biological environment

This site is an important tourist destination and educational destination. The presence of invasive weed species and build-up of algae is indicative of the upstream area being used for grazing of cattle and other

livestock. Clearing of the weeds and algae need to be part of routine maintenance. However, a more sustainable solution would be to use a catchment management approach and locate the sources of the high nitrogen load entering the stream. There may only be several sources which could be addressed with simple water quality treatment techniques. This is outside the current scope of the Project, but will be further discussed with DEPC to consider possible solutions.

5.10 Eton Beach Culvert

5.10.1 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 10 on-site personnel
- > Preparation of a working area near the culvert inside the corridor for culvert preparation

5.10.1.1 *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.

5.10.1.2 *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.

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

5.10.1.3 *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.

5.10.2 Construction impacts

5.10.2.1 *Physical environment*

The subproject culvert is located on a small coastal estuary with intermittent freshwater that flows to the sea and is occasionally affected by high tides and storm surges. Proposed works are very limited in scope.

Construction involves the following activities:

- > Proposed works are limited to required excavations to rehabilitate and repair the existing scour protection on either side of the culvert
- > Some scour protection on the downstream seaward side will be removed and used in situ
- > Stockpiling of small quantities of construction materials such as sand, gravel, cement
- > Culvert approach road reshaping and filling to ensure smooth transition to culvert pavement
- > Improve connections to road side drains as required

- > A temporary stockpile for any 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 guard rails repair and extension and better lane marking
- > Installation of new geotextile and Elcorock bags for scour protection

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 adjacent to the coast separating a small estuary only metres from the sea and flow in the stream is mainly freshwater. There was no evidence of significant sedimentation.

The risk of normal sedimentation and erosion and deposition from upstream is considered very low as the upstream catchment is very limited in area and the surrounding soil is coastal sand.

Water quality

Water quality was excellent coming from a relatively limited and clean estuary catchment. The risk to water quality was considered low due to the scope of the works.

Standard mitigating measures would still be necessary and 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

5.10.2.2 Biological environment

Flora and fauna

Most culvert works will be carried out on the existing road alignment, therefore minimal impacts on vegetation are expected. The contractor would pay for any non- land assets damaged by the construction works but this is very unlikely due to scale of the works.

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

Additional measures to be included in the project 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)
- > 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
- > 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

5.10.2.3 Social environment

Public access and local mobility

There may be a need to create a temporary stop go system for pedestrians and cars through the section while some of the works proceed. Traffic volume in the location is low during the day time so disruption and inconvenience will be minimised to specific periods. Access to villages along the subproject road will be maintained at all times.

The approximate time of construction will be up to two 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 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

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk. Nonetheless, the following mitigations will be required:

- > Any nearby residences 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.

5.10.3 Operations impacts

5.10.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 structures involves accumulation of debris during high tides and storm wave surge incidents and regular maintenance is considered essential to maintain flows under the culvert, reduce channel changes and reduce scour and erosion near the culvert supporting structures.

5.11 Eton Dry Creek Culvert

5.11.1 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

5.11.1.1 *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.

5.11.1.2 *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.

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

5.11.1.3 *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.

5.11.2 Construction impacts

5.11.2.1 *Physical environment*

The subproject culvert is located along a long open beach area with intermittent freshwater from storm events that flows to the sea and is occasionally affected by high tides and storm surges. Proposed works are designed to address the ongoing problem of windblown sand blocking the culvert and salt spray degrading the supporting structures of the culvert.

Construction involves the following activities:

- > Excavations to rehabilitate and repair the existing scour protection on either side of the culvert
- > Accumulated sand will be removed from the culvert which has virtually covered the entire opening

- > All gabion basket scour protection on the downstream seaward side will be removed and replaced with Elcorock to address the salt spray and abrasion issues
- > No traffic diversion will be required and all works will stay within the corridor
- > Safety improvement works such as guardrails repair and extension
- > Installation of new geotextile and Elcorock bags for scour protection

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 near foreshore location and the prevailing south-easterly winds also ensure excellent air quality. Wind blown sand is the main air quality issue.

Standard mitigation measures will still 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 (i.e. visible smoke) at the subproject site;
- > Damping down any exposed areas in the working area near the culvert under dry conditions

Soils, sedimentation and erosion

The dry culvert is located on the coast, separated by approximately 100 m of sand before the water line. There was no evidence of significant sedimentation other than sand.

The risk of normal sedimentation and erosion and deposition from upstream is considered very low as the upstream catchment is very limited in area and the surrounding soil is coastal sand.

Water quality

Normally the creek is dry so water quality issues normally associated with construction are not considered significant.

5.11.2.2 Biological environment

Flora and fauna

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

5.11.2.3 Social environment

Public access and local mobility

There may be a need to create a temporary stop go system for pedestrians and cars through the section while some of the works proceed. Traffic volume in the location is low during the day time so disruption and inconvenience will be minimised to specific periods. Access to villages along the subproject road will be maintained at all times.

The approximate time of construction will be up to two 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 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

Due to the nature of the activities and its sparsely populated location construction noise is considered to be a low risk. Nonetheless, the following mitigations will be required:

- > Any nearby residences 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.

5.11.3 Operations impacts

5.11.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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 structures involves accumulation of sand during dry periods or during high tides and storm wave surge incidents and regular maintenance is considered essential to maintain flows under the culvert, reduce channel changes and reduce scour and erosion near the culvert supporting structures.

5.12 Rentapau Bridge

5.12.1 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 small working area near the bridge inside the corridor to prepare equipment

5.12.1.1 *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.

5.12.1.2 *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 project area.

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

- > If necessary and 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 unnecessary felling of trees

5.12.1.3 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.

5.12.2 Construction impacts

5.12.2.1 Physical environment

Construction is limited and involves the following activities:

- > Removal and reconstruction of the guardrails on a new alignment to both sides of the bridge
- > 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
- > Improving access to the river with concrete stairs on the western side to facilitate washing and laundry by local villagers
- > Repair of existing scour protection with geotextile bags

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 types of vehicles and at night traffic becomes very sparse. The prevailing south-easterly winds also ensure excellent air quality. Risk is considered low.

Soils, sedimentation and erosion

The works are very limited, so risks are considered to be low.

Water quality

As noted above, the works are very limited and risk to water quality is considered very 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
- > A waste management sub-plan as part of the CEMP

5.12.2.2 Biological environment

Flora and Fauna

The bridge is well above the river and there are very limited areas of disturbance required which are already highly modified, including either weeds or introduced species. Works will be carried out on the existing road alignment so risks are considered low and minimal impacts on vegetation are expected.

5.12.2.3 Social environment

Public access and local mobility

There may be a need to create a temporary stop go system for pedestrians and cars through the section while some of the works proceed. Traffic volume in the location is low during the day time so disruption and

inconvenience will be minimised to specific periods. Access to villages along the subproject road will be maintained at all times.

The approximate time of construction will be up to two 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

There will be a low risk of impacts on community health and safety as the works are limited in nature and confined to the bridge site.

Noise

Although the village and other nearby receptors are close, due to the nature of the activities, construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.12.3 Operations impacts

5.12.3.1 *Physical environment*

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. 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.

5.12.3.2 Social environment

Health and safety

The impact of the bridge will improve safety for pedestrians as guardrails and waterway access will be improved.

5.13 Road Pavement Repairs – 2nd Lagoon to Rentapau

5.13.1 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 20 on-site personnel
- > Preparation of a working area near each of the three road sections.

5.13.1.1 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 to allow the stabilised slope has been integrated into the design. The main issue was any increases in the intensity and duration of severe storm and cyclonic conditions.

5.13.1.2 Biological environment

Vegetation removal during surveying, demarcation and clearance

There will be no need for removal of assets as the works will stay within the road corridor. There is adequate space shown in the concept design to stockpile materials and equipment and secure a working area within a perimeter fence.

5.13.1.3 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.

5.13.2 Construction impacts

5.13.2.1 Physical environment

Construction involves the following activities:

- > Bitumen patching repairs to damaged pavement
- > Stockpiling of construction materials such as sealing aggregate
- > Transportation of construction materials such as aggregates, bitumen and pre-coat
- > Trimming of vegetation to drains, including grading of high shoulders

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 sections of the road pavement to be replaced total 10.84 km. The topography is undulating to flat, thus the risk of soil erosion and sedimentation is considered low. Any areas where grading of high shoulders removes significant volumes of grassed vegetation, silt arrestors will be placed in the drains until the vegetation re-establishes. Frequent high intensity rainfall that can occur in this area so mitigations will need to be maintained and are included in the discussion on water quality, below.

Water quality

Some silt runoff from the lay out area can be anticipated. There is potential for spillages of POL and other chemical spillages and such runoff has the potential of degrading water quality. High intensity storms in the area 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:

- > 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
- > Stockpiles of materials will be located away from any drainage and bunded on each side with sandbags lined with silt mesh

5.13.2.2 Biological environment

Flora and fauna

Extraction of construction materials will be carried out from existing quarries so there are no vegetation impacts expected from opening quarries. The roadside vegetation of the area is highly modified and fauna are mainly domestic animals as the area is generally semi-rural on the fringe of Port Vila.

Additional routine measures to be included in the project 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

5.13.2.3 Social environment

Public access and local mobility

There may be a need to create a temporary stop go system for pedestrians and cars through the section while some of the works proceed. Traffic volume in the location is low during the day time so disruption and inconvenience will be minimised to specific periods. Access to villages along the subproject road will be maintained at all times.

The approximate time of construction will be up to two 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)

There will be a low risk of impacts on community health and safety as the works are limited in nature and confined to the bridge site.

Noise

Although the village and other nearby receptors are close, due to the nature of the activities, construction noise is considered to be a low risk. 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.

Nonetheless, the following mitigations will be required:

- > The nearby residences 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.

5.13.3 Operations impacts

5.13.3.1 Physical environment

Operational physical impacts are considered to be low as traffic forecasts predict that traffic growth will be stable. If routine and periodic maintenance works are carried out effectively by PWD and community contractors, existing infrastructure is expected to remain suitable.

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.

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. No subprojects in eastern Efate are located in, or adjacent to, protected areas or conservation areas except local community initiatives at Epau and Neslep. The final design will include environmental enhancements to address cyclone damage with design mitigations to build back better.

5.14 Summary pre-construction impacts

The significance of the pre-construction phase was assessed as being low risk for all subprojects except for the Epau and Neslep culvert. These two subprojects are in the vicinity of the construction storage area that was required for the previous MCA project. If a construction camp facility were required for this Project, there will be resulting impacts on land use and construction related social issues involved in gaining access to the land and building relationships with the local community.

Table 1-7 Significance of pre-construction impact

Subproject	Physical environment incl. Air Noise, Hydrology, Water Quality	Biological environment incl. Riverine and Terrestrial Ecology	Socio-economic environment incl. Land use and Socioeconomic
Onesua Roadworks	Low	Low	Low
Sara Culvert	Low	Low	Low
Epule Bridge	Low	Low	Low
Neslep Culvert	Low	Low	Moderate to High

Subproject	Physical environment incl. Air Noise, Hydrology, Water Quality	Biological environment incl. Riverine and Terrestrial Ecology	Socio-economic environment incl. Land use and Socioeconomic
Epau Culvert	Low	Low	Moderate to High
Lamin Bridge	Low	Low	Low
Pangpang Bridge	Low	Low	Low
La Cressonniere Culvert	Low	Low	Low
Eton Beach Bridge	Low	Low	Low
Eton Dry Creek Bridge	Low	Low	Low
Rentapau Bridge	Low	Low	Low
2 nd Lagoon to Rentapau Roadworks	Low	Low	Low

5.15 Summary construction impacts

In general terms, the construction impacts present the majority of environmental risks (compared to other two phases of the Project). However, the scale of construction in the eastern area is generally small, the subprojects are more widely distributed than in the west and the relative population density is significantly lower. Consequently, the risks associated with the subprojects were assessed as low, even without mitigations. There were a number of exceptions to this general conclusion.

Impacts on hydrology and water quality and riverine ecology were assessed to be moderate to if unmitigated in the freshwater streams of Neslep and Epau subprojects. The reason for the higher risk assessment stems from the relatively well protected catchments of the two rivers. Even though the catchments are relatively small in area, these flow from steep volcanic geology where modifications to the stream habitat were observed to be low. There was little evidence of significant sedimentation particularly in the Forari and river (i.e. Pangpang) but some evidence of sedimentation in Neslep and Epau culverts. 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. This work is being done with close coordination with the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biodiversity (MALFFB) which has just commenced a Freshwater Aquaculture Trials and Governance Project focused on the Tagabe Freshwater Aquaculture Centre and three local communities of Efate – Mangaliliu, Eton and Onesua. This project is also working closely with the Ministry of Climate Change which considers sustainable freshwater fisheries development as a suitable mitigation to address food and nutrition losses on the exposed areas of northern Efate.

The other significant risk assessed which is also in the area of Epau and Neslep is the issue of the operation of a construction camp which would seek to use a similar location to that of the MCA project. These risks were assessed as being moderate to high particularly as there has been a significant increase in the population in the vicinity of the previous camp area. The operation of the camp will expose the community to a variety of social risks including public health and safety and other labour issues resulting from an in-migrating workforce. There are also significant positive impacts of a construction camp operation involving increased local employment and indirect services such as supply of food and laundry services.

Table 1-8 Subproject specific construction impacts

Subproject	Physical environment incl. Air Noise, Hydrology, Water Quality	Biological environment incl. Riverine and Terrestrial Ecology	Socio-economic environment incl. Land use and Socioeconomic
Onesua Roadworks	Low	Low	Low
Sara Culvert	Low	Low	Low

Subproject	Physical environment incl. Air Noise, Hydrology, Water Quality	Biological environment incl. Riverine and Terrestrial Ecology	Socio-economic environment incl. Land use and Socioeconomic
Epule Bridge	Low	Low	Low
Neslep Culvert	Moderate to low	Moderate	Moderate to High
Epau Culvert	Moderate to low	Moderate	Moderate to High
Lamin Bridge	Low	Low	Low
Pangpang Bridge	Moderate to Low	Moderate to Low	Low
La Cressonniere Culvert	Low	Low	Low
Eton Beach Bridge	Low	Low	Low
Eton Dry Creek Bridge	Moderate	Low	Moderate to Low
Rentapau Bridge	Low	Low	Low
2 nd Lagoon to Rentapau Roadworks	Low	Low	Low

5.16 Summary operation impacts

The main risk associated with the operation of the new infrastructure is the need for monitoring of maintenance of sedimentation and vegetation for culverts and new road-side drainage using community based labour programs. The Public Works Department is the responsible authority. The issue of culvert clearance is particularly important for the movement of fish and invertebrate fauna in the streams of Neslep and Epau Culverts which have relatively protected un-modified catchments due to the proximity of steeper upland topography with longer stretches of freshwater. An on-going baseline study of species present will form the basis for a restocking and protection program in some designated stream sections.

Also for the eastern area low profile piped culverts at Epau and Neslep that do not have high traffic volumes, a design mitigation has been proposed to build small weirs/sediment traps with rock placements slightly upstream across the low portion of the channel to allow removal of sediment and maintain the flows in the culvert pipes. There would be open sections in the weir design to facilitate fish and crustacean passage.

5.17 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.

Raising the level of embankments and protection on the Onesua Road Section most exposed to cyclone wind and tidal flows

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 1-9 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 villages² 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

² 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 the PWD of the 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 (DSC)

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 organisation 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 are 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 recognized 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 1-10 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

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 1-11 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 eastern 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. The subprojects in eastern 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 1-12 Proposed design mitigations

Subproject	Proposed Design Mitigation/ Management Program
Sara Culvert	Environmental enhancement with landscaping and stabilisation of side embankments with grasses and local tree and shrubs
Neslep Culvert	Environmental enhancement with landscaping and stabilisation of side embankments with grasses and local tree and shrubs
Epau and Neslep causeway/culverts	Construction of small in stream weir/sediment trap structures with adequate space for fish movement to reduce sedimentation in culvert flows and promote fish passage through the culverts
All freshwater streams including Epau, Neslep, Lamin, Pangpang , La Cressonniere (and Creek Ai and Morona in western 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 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 Specific mitigations

The specific mitigations required for Epau and Neslep Culverts are set out below.

The catchment area of the Neslep 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 either data deficient and one of least concern. However, there was one species listed as near threatened (i.e. the Creek Ai Goby) and it is possible that this species is also present in the Neslep river which possesses the same flow and channel characteristics to Creek Ai. 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 minimised. As the scale of the works is very limited the risk was considered low when unmitigated.

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

- > 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

There will be a moderate risk of impacts to community health and safety as a proposed storage area for the eastern subprojects was assumed to be in the vicinity of Neslep and Epau village based on information supplied by the contractor which was involved in the MCA project in 2008-2010. A day camp may also be required in the vicinity of the site.

To further mitigate these 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:

7.7 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 1-13**.

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 1-13 Mitigation monitoring matrix

Project activities	Environmental Impact	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	> Minimise vegetation removal to immediate corridor of works	Contractor	DSC Project Manager/ Site Supervisor	Incl in Contract ESO Site supervisor + two field assistants	Area of vegetation; area of felled trees/vegetation removal	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 DECP and/or Safeguards Specialist
	Land Use Changes and Restrictions	> 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
Mobilization of Contractor, presence of construction workers, associations with local people	Social disruption	> 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 DECP 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 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 DECP and/or Safeguards Specialist
		> If Camp required Signage and security at camp i.e. prohibition on unauthorized 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 DECP and/or Safeguards Specialist
	Public/ Workforce Health	> A separate Safety, Security and Health sub-plan will be developed as part of the CEMP > Implementation of awareness and prevention program – contractor staff and in any nearby villages	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 DECP 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 DECP and/or Safeguards Specialist
All Activities Construction Phase									

Project activities	Environmental Impact	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
	Air Quality								
		> 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Noise Emissions								
		> Construction vehicle exhaust systems and noisy equipment will be maintained to minimise 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Water Quality								
		> 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 DECP 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 DECP and/or Safeguards Specialist

Project activities	Environmental Impact	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 minimise 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
		> Use of heavy machinery in smaller more sensitive freshwater aquatic environments to be minimised	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 DECP and/or Safeguards Specialist
		> Good design used in all construction activities to minimise 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 DECP 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 DECP and/or Safeguards Specialist
	Erosion and Sediment Control								
		> 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 DECP 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 DECP and/or Safeguards Specialist

Project activities	Environmental Impact	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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Land Use Changes								
		> 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist	
	Top Soil Protection								
		> 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Hazardous Materials Planning								
		> Detailed Emergency Response Plan (as part of CEMP) prepared by Contractor to cover hazardous materials/oil	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 DECP and/or Safeguards Specialist

Project activities	Environmental Impact	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
		storage, spills and accidents > A separate Solid and Liquid Waste Management sub-plan will be developed as part of the CEMP							
		> 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Incident Reporting Procedure								
		> 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Sensitive Ecosystems								
		> 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 DECP and/or Safeguards Specialist
		> 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 DECP and/or Safeguards Specialist

Project activities	Environmental Impact	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
		> 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Chance Find Procedure								
		> 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Traffic Management								
		> 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 DECP 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 DECP and/or Safeguards Specialist
		> Consultations and care taken to minimise 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 DECP and/or Safeguards Specialist

Project activities	Environmental Impact	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
		> 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP and/or Safeguards Specialist
	Workforce Safety								
		> 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 DECP 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 DECP 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 Project Manager	Random or Routine Audit by DECP and/or Safeguards Specialist
	Site Security and Camp Management								

Project activities	Environmental Impact	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
		> 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 DECP 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 DECP 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 DECP 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 DECP 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 DECP 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 minimise 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
- > Minimise 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 minimised
- > Good design used in all construction activities to minimise 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 minimise 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

Construction Camp

- > Preparation of a Camp Management Sub Plan
- > Location with nearby Villages marked
- > Site layout with all Infrastructure
- > Drainage System
- > Wastewater Management System
- > Solid Waste Management System
- > Standard for accommodation space based on Project work force

7.8 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 Appendix B below 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 eastern area will lead to a number of pre-construction construction and operational impacts. In general terms, the construction impacts of the proposal present the majority of environmental risks for all of the three phases of the project. However, the scale of construction in the eastern area is generally small, the subprojects are more widely scattered than in the west and the relative population density is significantly lower. Consequently, the risks associated with a majority of the subprojects were assessed as low even without mitigations. There were a number of exceptions to this general conclusion.

Impacts on hydrology and water quality and riverine ecology were assessed to be of moderate to high risk if unmitigated in the freshwater streams of Neslep, Epau and Pangpang subprojects. The reason for the higher risk assessment stems from the relatively well protected catchments of the three rivers. Even though the catchments are relatively low in area, these flow from steeper volcanic geology where modifications to the stream habitat were observed to be low. There was little evidence of significant sedimentation particularly in the Forari river (i.e., Pangpang) and some evidence of sedimentation in Neslep and Epau culverts. 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.

The other significant risk assessed which is also in the area of Epau and Neslep is the issue of the operation of a construction camp which would seek to use a similar location to that of the MCA project. These risks were assessed as being moderate to high particularly as there has been a significant increase in the population in the vicinity of the previous camp area. The operation of the camp will expose the community to a variety of social risks including public health and safety and other labour issues resulting from an in-migrating workforce. There are also significant positive impacts of a construction camp operation involving increased local employment and indirect services such as supply of food and laundry services.

A less significant risk is associated with the Eton Dry Creek Culvert, involving the continuing problem of windblown sand affecting the culvert structure and supporting structures. Anecdotally, there is also a significant on-going loss of sand in the fore-dune area due to alleged illegal use of the area for sand mining. A proposed design mitigation has been included to address the issue of this sand accumulating on the road.

The Project is not likely to cause significant environmental, social and/or custom impacts if adequately mitigated. The mitigation and management measures that are being implemented will ensure that the risk of pollution is minimised 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 : Onesua Roadworks O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre-Construction Phase							
Mobilization 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						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	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	No	Low
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Transport of 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 : Sara Culvert O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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							
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	O					
	Noise	O					
	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	O					
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	O					
	Riverine Ecology	O					
	Terrestrial Ecology	O					
	Socio	O					
Transport of 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 : Epule Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	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
	Land Use	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	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						
	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 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	Low

Subproject : Epau Culvert O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	Direct	Local	Temporary	Yes	Moderate
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate
	land use	—	Direct	Local	Temporary	Yes	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Moderate
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	Temporary	Yes	Low
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	—	Direct	Local	Temporary	Yes	Moderate to Low

	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate to Low
	Terrestrial Ecology	O					
	Socio	+	Direct	Local	Temporary	Yes	Low
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 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	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Moderate
	Hydrology/ Water	—	Direct	Local	Short term	Yes	Moderate
	Riverine Ecology	O					

	land use	=	Direct	Local	Short term	Yes	Low
	Socio	=	Direct	Local	Long Term	No	Moderate to High
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Neslep Culvert O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	Direct	Local	Temporary	Yes	Moderate
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate
	land use	—	Direct	Local	Temporary	Yes	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Moderate
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	Temporary	Yes	Low
	Noise	—	Direct	Local	Temporary	Yes	Low

	Hydrology/ Water	—	Direct	Local	Temporary	Yes	Moderate to Low
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate to Low
	Terrestrial Ecology	O					
	Socio	+	Direct	Local	Temporary	Yes	Low
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 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	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Moderate

	Hydrology/ Water	–	Direct	Local	Short term	Yes	Moderate
	Riverine Ecology	0					
	land use	–	Direct	Local	Short term	Yes	Low
	Socio	–	Direct	Local	Long Term	No	Moderate to High
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Lamin Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	Direct	Local	Temporary	Yes	Moderate
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate
	land use	—	Direct	Local	Temporary	Yes	Moderate
	Socio	+	Direct	Local	Temporary	Yes	Moderate
Construction Phase							
Bridge Construction includes Earthworks, piling, construction of abutments, deck placement with Crane	Air	—	Direct	Local	Temporary	Yes	Low
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	—	Direct	Local	Temporary	Yes	Moderate to Low
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate to Low
	Land Use	O					
	Socio	+	Direct	Local	Temporary	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						
	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 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	—	Direct	Local	Short term	Yes	Low
	Noise	—	Direct	Local	Short term	Yes	Moderate

	Hydrology/ Water	–	Direct	Local	Short term	Yes	Moderate
	Riverine Ecology	O					
	land use	–	Direct	Local	Short term	Yes	Low
	Socio	–	Direct	Local	Long Term	No	Moderate to High
Operational Phase							
Routine Maintenance Community Based		+	Direct	Local	Long Term	No	Moderate

Subproject : Pangpang Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	Direct	Local	Temporary	Yes	Low
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	—	Direct	Local	Temporary	Yes	Moderate to Low
	Riverine Ecology	—	Direct	Local	Temporary	Yes	Moderate to Low
	Land Use	O					
	Socio	+	Direct	Local	Temporary	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						
	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 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 : La Cressonniere Culvert O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	Temporary	Yes	Low
	Noise	—	Direct	Local	Temporary	Yes	Low
	Hydrology/ Water	—	Direct	Local	Temporary	Yes	Low

	Riverine Ecology	+	Direct	Local	Temporary	Yes	Moderate
	Terrestrial Ecology	O					
	Socio	+	Direct	Local	Temporary	Yes	Low
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 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 : Eton Beach Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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						
Construction Camp Development Near Village	Socio	+	Direct	Local	Temporary	Yes	Low
	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
	Noise	—	Direct	Local	Short Term	Yes	Low
	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
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						
	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 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	Low

Subproject : Eton Dry Creek Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	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
	Land Use	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	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						
	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 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	Low

Subproject : Rentapau Bridge O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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	—	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
	Land Use	+	Indirect	Local	Short Term	No	Low
	Socio	+	Direct	Local	Short Term	No	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						
	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 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	Low

Subproject : 2 nd Lagoon to Rentapau Roadworks O- Benign + Positive Impact - Negative Impact							
Activities	Environment Component	Type of Impact	Nature	Area	Duration	Reversibility	Significance
Pre- Construction Phase							
Mobilization 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						
	Noise						

	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Road Repair Remove old pavement, Place new base material, compact , resurface	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	No	Low
Safety Access Enhancements Safety signs, pedestrian bridge or lane, Gender Access	Air						
	Noise						
	Hydrology/ Water						
	Riverine Ecology						
	Terrestrial Ecology						
	Socio						
Transport of 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