Environmental Assessment Document

Document Stage: Draft
Project Number: 40173
June 2013

Papua New Guinea: Highlands Region Road Improvement Investment Program

Ialibu – Kagua Road, Southern Highlands Province

Initial Environmental Examination

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ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected people
BCD	Bid and contract documentation
BOQ	Bill of Quantities
CEMP	Construction Environmental Management Plan
CSC	Construction Supervision Consultant
DBST	Double bitumen surface treatment
DC	Design Consultant
DEC	Department of Environment and Conservation
DLPP	Department of Lands and Physical Planning
DOW	Department of Works
EA	Executing Agency
EARF	Environmental Assessment and Review Framework
EMP	Environmental Management Plan
EMU	Environmental Management Unit (in DOW's PIU)
EO	Environmental Officer (in DOW's EMU)
EP	Environmental Permit
EHSO	Environmental, Health and Safety Officer (contractor)
EPAR	Environmental (Prescribed Activities) Regulation 2002
GoPNG	Government of Papua New Guinea
GRM	Grievance and Redress Mechanism
HRMG	Highlands Region Maintenance Group
HRRIIP	Highlands Region Roads Improvement Investment Program
IA	Implementing Agency
IES	International Environmental Specialist (in CSC)
IEE	Initial Environmental Examination
LLG	Local-Level Government
MFF	Multi-Tranche Financing Facility
NGO	Non-governmental organization
NRA	National Roads Authority
PFR	Periodic Financing Request
PIU	Project Implementation Unit (in DOW)
PNG	Papua New Guinea
QPR	Quarterly Progress Report
RE	Resident Engineer
SPS	Safeguard Policy Statement
SEC	Secretary of Environment and Conservation
RP	Resettlement Plan

CURRENCY EQUIVALENTS

(as of 29 April 2013)
Currency Unit – Kina (K)
K1.00 = $0.44
$1.00 = K2.28

EXECUTIVE SUMMARY

The Government of Papua New Guinea (GoPNG) has requested assistance from Asian Development Bank (ADB) in financing the Highlands Region Road Improvement Investment Program (HRRIIP) through a Multi-tranche Financing Facility (MFF). The HRRIIP is focused on improving the Highlands Region Core Network (HRCN) in the Highland Provinces of Enga, Southern Highlands, Western Highlands, Eastern Highlands, Simbu, Jiwaka and Hela. Project 1 implemented improvements of two road sections and Project 2 proposes to upgrade and rehabilitate three sections of the HCRN.

The environmental regulations of GoPNG are found in the Environment Act 2000. The Environment (Prescribed Activities) Regulation (EPAR) 2002 categorizes designated projects that need environmental assessment as “Prescribed Activities” in two schedules according to the anticipated potential environmental impact. Projects that are likely to have significant adverse environmental impact (Level 2 and Level 3) are required to obtain an Environmental Permit (EP) from the Department of Environment and Conservation (DEC) following environmental assessment. In addition to GoPNG requirements, the HRRIIP must comply with ADB’s Safeguard Policy Statement (SPS) 2009. An environmental assessment and review framework (EARF) has been prepared to guide the implementation of, and compliance with, environmental safeguards during Project 2. According to the SPS and understanding of impacts created and mitigated in Project 1, the sub-project is classified as Category B because the potential adverse environmental impacts are site-specific, few if any of them are irreversible, and mitigation measures can be designed readily.

This initial environmental examination (IEE) covers the 32 km long section of Ialibu to Kagua Road in Southern Highlands Province as one subproject in Project 2. The works proposed for Ialibu to Kagua Road such as earthworks, establishment and operation of quarry site and extraction of materials, minor civil works and discharge of waste-water are Level 2 activities under the EPAR and may require an EP depending on the duration and scale of those activities.

The Ialibu-Kagua Road is in poor condition and travel is very slow, so that access to Ialibu and beyond is costly in money and time. Access from Ialibu is ultimately either to Mendi, the Provincial Administrative center, or Mt Hagen. Travel time to both centers from Kagua is about half a day and Public Motor Vehicle (PMV) fares are very high being about five kina. The subproject road could provide a fast, low cost access between Kagua and Ialibu which itself will grow in significance as a sub-regional center as the whole road network is improved. The upgraded road would reduce costs for the local and the provincial levels of economy and allow cash economy production to expand.

Works proposed include upgrading the road to double bitumen surface treatment, with a 6.0m carriageway and 1.0m shoulders, selectively sealed where necessary. Provision is also made to improve drainage through installation of lined drains where necessary. The rehabilitation and upgrading of the Ialibu to Kagua road is estimated at Kina 61,013,495.. The construction period is expected to be 24 months.

As required by the ADB’s SPS and Public Communications Policy 2011, public consultations were undertaken during the preparation of this IEE and social safeguards documents. The main purpose of the consultations were to present the proposed sub-project, illicit issues and concerns that the people, stakeholders, and concerned parties in the impact area may have, and provide a mechanism for addressing those concerns and issues as far as possible.

The Project's communications and consultation plan will ensure that regular dialogue during all phases of project implementation is undertaken with stakeholders and communities. Through the Project's grievance redress mechanism (GRM), the project office on site will receive and document issues and concerns that stakeholders may have relative to the project and its implementation. Resolution of these issues and concerns will be undertaken expeditiously and according to the procedures of the GRM. The complaints/issues registry maintained at the site project office and by the contractor will be subject to monitoring.

The findings of the IEE are that the environmental impacts of the proposed rehabilitation of the Mendi to Tambul Road will be minor and manageable if the mitigation measures established in the environmental management plan (EMP) are implemented thoroughly. The IEE also sets out the requirements for monitoring and reporting of the monitoring.

During the construction phase, construction supervision consultant (CSC) which will include an international environmental specialist (IES) will support the project implementation unit (PIU) in DOW. In consultation with the Environmental Management Unit – Department of Works (EMU-DoW) it has been agreed that the EMU-DoW take the main responsibility for the overall management, monitoring and reporting on implementation of the EMP for Project 2. Two staff including environment officer (EO) and social safeguards officer will expand the existing EMU. The staff will be funded under the Project for three years, after which time the DOW will cover costs as part of its annual operating budget. The IES in the CSC team will provide concentrated training to the EMU and awareness raising of DOW staff in year 1 and year 2 of Project 2 implementation, reducing to shorter inputs in year 3 and year 4.

The PIU with the assistance of the IES and EO will be tasked with: (i) strengthening the environmental management of the Project during contract process, construction, and implementation; (ii) providing induction training to contractors prior to preparation and submission of the CEMP for each subproject; (iii) providing assistance for review and clearance of the CEMPs; (iv) monitoring compliance with the approved CEMP of each subproject; and (v) preparing reports on environmental safeguards activities as required by the EMP.

This IEE concludes that there are no significant environmental impacts likely to result from the proposed works, implementation of the EMP will ensure that anticipated impacts will be mitigated and managed, and the capacity of DOW for environmental management will be improved.

I. INTRODUCTION

A. Background to HRRIIP and Project 2

1. The Highlands Region of Papua New Guinea (PNG), comprising the Provinces of Western Highlands, Southern Highlands, Eastern Highlands, Enga, Jiwaka and Chimbu, is a major contributor to the PNG economy through its agricultural production and mineral resources. A well-maintained road network is essential to facilitate the movement of goods and people. The Government of PNG (GoPNG) has made significant investment in improving the road network but a lack of maintenance has resulted in deterioration of the roads such that the Highlands Core Road Network (HCRN) is now in poor condition.

2. In order to address the deterioration of the HCRN there is a clear need to: (i) implement a program of regular maintenance on all HCRN roads that are in good condition; and (ii) improve those roads that are in poor condition and ensure that maintenance begins on these roads as soon as the improvement works are completed.

3. The GoPNG has negotiated a Multi-tranche Financing Facility (MFF) with the Asian Development Bank (ADB) to implement the Highlands Region Road Improvement Investment Program (HRRIIP). The HRRIIP will include projects to improve the HCRN, the preparation of long-term maintenance contracts for the HCRN, and develop the capacity development of road agencies. Project 1 has included improvement to two road sections and Project 2 proposes to upgrade three road sections comprising 118.9 km of the HCRN. The Department of Works (DOW) is the executing agency (EA) and the implementing agencies (IA) including Highlands Road Maintenance Group (HRMG) for road improvements and National Roads Authority (NRA) for road maintenance.

4. The overall objective of the HRRIIP is firstly to improve the deteriorated sections of the HCRN and to establish sustainable maintenance programs for the HCRN, and secondly to strengthen the capacity of the DOW and NRA to manage these programs.

5. The establishment of a sustainable transport system will provide a basis for increased economic and social development in the Highlands Region through improved access to ports, markets and livelihood opportunities together with reduced travel times and transport costs. The HRRIIP will support GoPNG's Development Strategic Plan 2010-2030 and the National Transport Development Plan.

6. The HRRIIP will establish a sustainable maintenance program for the HRCN through the implementation of the following:

i. The improvement of 1,400Km of the HRCN to be funded through the four tranches under the MFF and to be implemented under contracts which will include the provision for 10 years of maintenance of the roads upon completion of the improvement works;

ii. Long term maintenance contracts for 1,100Km of the HRCN which are considered to be in a maintainable condition; and

iii. Capacity building and institutional strengthening of DOW, HRMG and NRA to ensure the future success and sustainability of the Program.

7. An environmental assessment has been undertaken of the proposed works for upgrading and rehabilitating a 32 km long section of the Ialibu – Kagua Road to comply with the requirements of GoPNG's Environment Act and ADB's Safeguard Policy Statement (SPS) 2009. This initial environmental examination (IEE) presents the environmental assessment for the upgrading and rehabilitation of the existing Ialibu to Kagua Road.

8. The upgrading and rehabilitation of Ialibu to Kagua Road is not a Level 3 of the "Prescribed Activities". However, certain project activities commonly associated with upgrading, improvement works such as earthworks, establish and operation of quarries, and materials extraction, minor civil works and discharge of wastewater are Level 2 activities that may require an environmental permit (EP) depending on the duration and scale of those activities. The Environment Management Unit (EMU) of DoW will review the IEE with regard to its Code of Practice for Environmental Assessment of Roads and Bridges and make the necessary notifications to Department of Environment and Conservation (DEC) (under Section 48 of Environment Act 2000) for determination on the need for an EP.

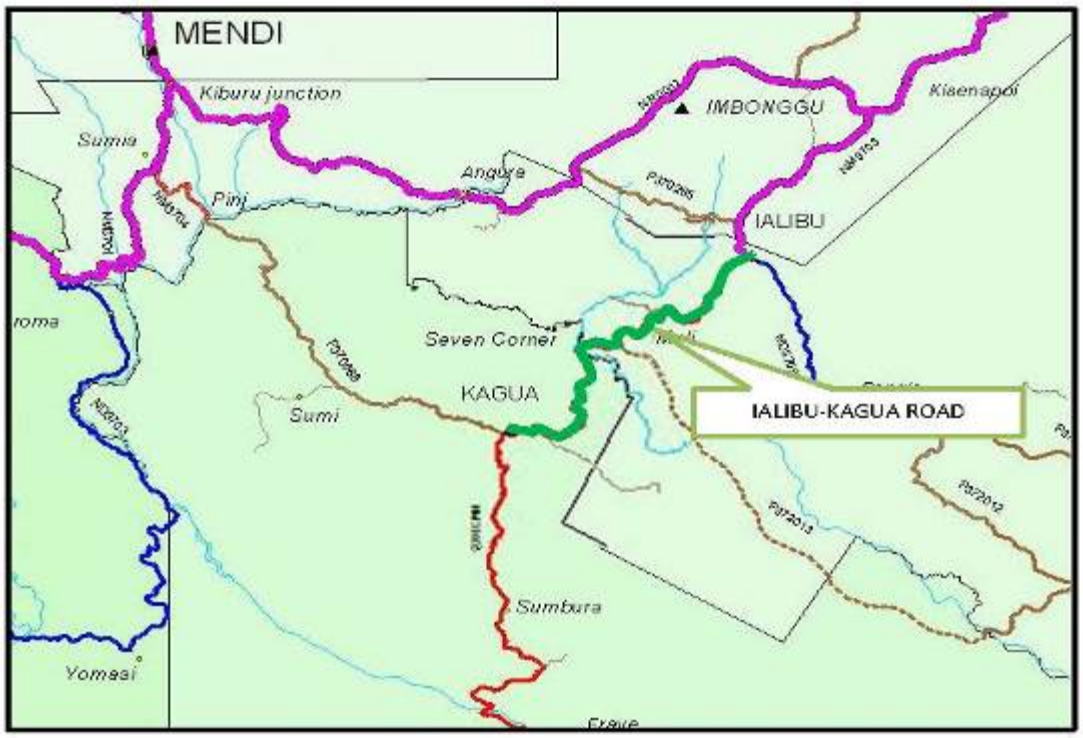
B. Overview

9. The creation and sustainable support to economic growth requires a good road network. A well-maintained transport infrastructure is a critical requirement for the efficient flow of consumer goods and services to and from villages and communities. This would ensure that vital connectivity between production areas and markets are existent which would make transport between centers fast, efficient and cost effective.

10. The majority of the population of PNG (85% of the total population as per the latest census of 2011) is in the highly dispersed and culturally diverse rural areas characterized by very rugged topography, swamps, and water bodies, which constrain the development of a national road transport and have resulted in a fragmented road network. Consequently, improvement of the transport service delivery, providing improved economic, and income opportunities are a priority undertaking of the GoPNG. The improvement of the existing rural road networks will result to the establishment of new markets, improve agricultural production, facilitate supply and market chain linkages with post-harvest and downstream processing facilities and export markets and more importantly, improve access to and expand education and health services. These initiatives are expected to create a significant increase in income and improvement in standard of living.

11. The subproject - Ialibu to Kagua Road - is located in Ialibu Pangia district serves a rural population of 28,000 with about 7,700 living directly along the road and a further 20,000 people in catchments around the road and in the Laro River and Kagua River valleys. These districts are served by a network of paths and by a spine road of secondary road standard along the Kagua valley. Until 1999 this route provided a more direct route between Kagua and Mendi via Sumia by a footbridge crossing of the Angura River. PMVs provided a service to each side of the river. Another narrow earth road links Erave 40 km to the south of Kagua. Figure 1 shows the location of the existing Ialibu to Kagua Road.

Figure 1 - Location of the Ialibu to Kagua Road



12. The existing Ialibu to Kagua Road is in poor condition and travel is very slow, such that access to Ialibu and beyond is costly in money and time. Access from Ialibu is either through Mendi, the Provincial Administrative center, or Mt. Hagen. Travel time to both centers from Kagua takes about half a day and PMV fares are very high being about Kina 5. The subproject road could provide a fast, low cost access between Kagua and Ialibu which itself will grow in significance as a sub-regional center as the whole road network is improved. The upgraded road would reduce costs for the local and the provincial levels of economy and allow cash economy production to expand.

C. Report Structure

13. The IEE is based on primary and secondary sources of information. During the field studies the existing roadway and immediate environment, including watercourses, were inspected. Public consultations with government stakeholders and communities adjacent to the road were undertaken as part of the IEE process to determine community attitudes to the development and obtain relevant information.

14. The report structure follows the format outlined in Appendix 1 of the SPS. The IEE consists of eleven sections including the executive summary and this introduction. The following sections include; policy, legal and administrative framework; description of the sub-project; description of the environment; anticipated environmental impacts and mitigation measures; information disclosure, consultation, and participation; grievance redress mechanism; environmental management plan; and conclusions and recommendations. There are a series of annexes at the end of the report.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Papua New Guinea Environmental Laws and Regulations

15. In PNG the Environment Act 2000 and Environment (Prescribed Activities) Regulation 2002 (EPAR) address environmental impact assessment and management. The Environment Act provides for the sustainable management of the biological and physical components of the land, air and water resources of the country. DEC administers both the Act and the EPAR.

16. DEC has published the Guideline for Conduct of Environmental Impact Assessment and Preparation of an Environmental Impact Statement (2004) which provides guidance on fulfilling the requirements of the EPAR.

17. The EPAR categorizes projects as "Prescribed Activities" in two schedules according to the anticipated potential environmental impact. Schedule 1 consists of Level 2 activities that are subdivided into two categories (Category A and B). Category B has 13 sub-categories with sub-category 12 addressing Infrastructure Development. While item 12.5 includes construction of new national roads, there is no specific activity covering the upgrading or rehabilitation of existing roads. However, a number of activities associated with upgrading of existing roads such as quarrying, extraction of gravel etc. may require EPs from DEC.

18. The DEC, as the GoPNG environmental management agency, operates under the mission statement: To ensure PNG's natural resources are managed to sustain environmental quality, human well-being and support improved standards of living (DEC Corporate Plan (2009-2012). The DEC consists of three divisions: Environment Protection responsible for environmental approvals; Sustainable Environment Management; and Policy Coordination and Evaluation. The DEC has issued several guidelines including Guideline for submission of an application for an environmental permit to discharge waste (GL-Env/03/2004) which covers: noise discharges (IB-ENV/03/2004); air discharges (IB-ENV/02/2004); and water and land discharges (IB-ENV/04/2004).

19. DEC operates at the national level from its office based in Port Moresby. It does not have offices and staff in the provinces. All environmental approvals are done in the central office in Port Moresby. As part of the GoPNG decentralization policy, DEC has to work in close consultation with the provincial governments through the respective provincial administrations to ensure implementation of environmental legislation at the provincial level. Certain environmental management and monitoring functions are delegated to provincial administrations on an "if and when" they have the resources and capacity basis to conduct these activities.

B. The Department of Works

20. Under a World Bank project the DoW was required to form an Environmental Management Unit (EMU) which is located within the Contract's Management Division. The EMU comprises a Manager and two monitoring staff and supports the PIU in terms of environmental management for projects.

21. The DoW has published two documents related to environmental assessment these are:

i. Environmental Impact Assessment Guidelines for Roads and Bridges, also referred to as the Code of Practice) which establishes the need for assessment, the methodology for preparing assessments and compiling the EMP. The Code of Practice is extensive and among other EMP requirements requires the contractor to prepare a CEMP, arrange HIV/AIDS awareness programs and prepare Quarry

Management Plans. The EMU is required to clear assessment and EMP documents submitted; and

ii. Environmental Appraisal Report - Suggested Outline establishes the contents of assessments and serves as a quick reference guide for verifying the reports contents.

C. Other Relevant Legislation

22. The following legislation will also apply to the project:

- The Employment Act 1978 is an act relating to the employment of nationals and non-citizens. The act covers recruitment, conditions of employment as well as health and safety aspects and is administered by the Department of Labor and Employment. Conditions of this act are relevant to the health and safety of workers employed during construction and are reflected in the IEE;
- The Forestry Act 1991 has the objective to manage, develop and protect PNG forest resources and environment in such a way as to conserve and renew them as an asset for succeeding generations;
- The National Cultural Property Preservation Act 1965 covers the preservation and protection of objects of cultural or historical importance. This act is administered by the National Museum and Art Gallery. Should “chance finds” be made during construction this act will be triggered, provisions for this have been made in the EMP;
- The Public Health Act 1978 protects the general public by regulating and controlling the unplanned disposal of any environmental contaminants such as domestic or industrial waste and/or refuse that will have some kind of impact on the lives of people. The act regulates the proper and planned establishment of waste disposal points such as rubbish dumps and landfills so that such establishments are seen to be causing minimal inconvenience to people’s lives. The act also covers all the activities that pose risks and potential risks, and inconveniences to the usage of the environment surrounding the area of activity. As the subproject will affect the lives of people, especially the local community downstream, this act is applicable and has been taken into consideration while undertaking the IEE;
- Drinking water quality standards for raw (untreated) water are contained in the Public Health Drinking Water Quality Standards 1984 while the standards for aquatic life protection are listed in the Environment (Water Quality Criteria) Regulation 2002. Ranges of criteria are given for several parameters including turbidity, which should not exceed 25 NTU. Since many of the water courses in PNG are naturally quite turbid this standard appears to be unrealistic as it is close to drinking water standard. Therefore, the pre-project turbidity in the watercourse is suggested as the standard for assessing turbidity during construction.

23. Other related legislation administered by DEC includes; the Fauna Protection and Control Act (1966) the Conservation Areas Act (1978), the International Fauna and Flora Trade Act (1978), the Crocodile Trade Protection Act (1978) and the National Parks Act (1984).

24. PNG is a signatory to a number of international agreements (treaties and conventions). These are listed in Annex A.

D. Asian Development Bank Safeguard Requirements

25. In addition to complying with country safeguards Project 2 will also need to comply with ADB's SPS (2009) which sets out the policies and principles for protecting the environment and people by wherever possible avoiding impacts and mitigating and/or compensating for impacts that cannot be avoided. ADB's SPS is a policy document in respect of safeguards and avoiding, minimizing or mitigating adverse impacts on people and the environment. For projects with a number of components or subprojects, SPS requires the preparation of safeguards (environment and resettlement frameworks). An EARF has been prepared for Project 2, setting out the procedures for complying with the principles and requirements of SPS.

26. The EARF: (i) reflects the policy objectives and relevant policy principles and safeguard requirements governing preparation and implementation of projects and/or components; (ii) explains the general anticipated impacts of the project and/or components; (iii) specifies the requirements that will be followed for subproject screening and categorization, assessment, and planning, information disclosure, meaningful consultation, and grievance redress mechanism; (iv) describes implementation procedures, including budgets, institutional arrangements, and capacity development requirements; (v) specifies monitoring and reporting requirements; and (vi) specifies the responsibilities and authorities of the borrower/client, ADB, and relevant government agencies in relation to the preparation, submission, review, and clearance of safeguard documents, and monitoring and supervision.

27. If gaps exist between ADB's requirements and country laws, or where gaps in borrower's capacity are apparent, the safeguard frameworks should include the details of the specific gap-filling requirements to ensure that policy principles and safeguard requirements are achieved. The EARF prepared for Project 2 also sets out the capacity building measures that will be implemented during the Project.

28. Under the SPS, the subproject is classified Category B because the potential adverse environmental impacts are site-specific, few if any of them are irreversible, and mitigation measures can be designed readily. The appropriate level of environmental assessment for environment category B is an IEE.

29. The objectives of this IEE are to: (i) identify and describe the existing environmental conditions in the project area including the identification of environmentally sensitive areas; (ii) assess the proposed works and activities to identify their potential impacts, evaluate the impacts, and determine their significance; and (iii) propose appropriate mitigation measures that can be incorporated into the proposed activities to minimize any adverse impacts, ensure that residual impacts are acceptable and establish the requirements for monitoring of the subproject.

III. DESCRIPTION OF THE SUB-PROJECT

A. Technical Description of Sub-project

30. The existing Ialibu to Kagua road is approximately 32 kilometers in length and commences at Ialibu Station proceeding southwest from the Ialibu/Pangia Junction to Kagua Station. The existing road serves very highly populated areas namely, Ialibu/Pangia and Kagua/Erave districts in the Southern Highlands Province. The road was constructed in the early 1970s and has a reasonable alignment despite some tight horizontal curves and existing gravel pavement. The road is a predominantly limestone pavement and gravel placed on steep grades. Due to poor drainage several sections of the pavement that have failed.

31. The road traverses flat to rolling topography with generally secondary growth and grassland. Most part of the road is wide and within the absolute maximum gradient and will conform to the proposed design width, grades and design speed. Steep gradients are located seven corners area from KM 18 + 500 to KM 19 + 300. The gradient of this section of the roadway would range from 13% to 18%.

32. With due consideration of the worst gradient section, the road alignment would be retained as it is because it will be environmentally unacceptable because the realignment would necessitate extensive clearing and earthworks. Moreover, realigning the said section would increase the cost of the rehabilitations works would make the development. Other design parameters, terms and references useful for the geometric design is mentioned below.

- Terrain Category = Flat and Rolling (less than 10% cross slope)
- Traffic Category = Medium (100 – 200 v.p.d)
- Design Speed = 60kph
- Horizontal Radius = 115m
- Sealed Width = 6.0m
- Formation Width = 8.0m
- Maximum Grade = 9%

33. The current alignment is a single vehicular road with limestone basement. The existing road comprises an unsealed granular pavement of variable thickness above silty clay subgrade soils. Localized but small potholes and water-logged sections were observed along the roadway due to inadequate drainage structures.

B. Proposed Works

34. Works to upgrade include double bitumen seal treatment, with a 6.0m carriageway and 1.0m shoulders, selectively sealed where necessary. This will give better water proofing to the pavement and a slightly more robust surfacing. The first coat should have a sealing chip of 19mm while the second coat should have a 13mm sealing chip. Provision is also made for lined drains where necessary.

35. The proposed horizontal and vertical alignment will be virtually identical to the existing alignment, minimizing the need for earthworks. The road profile is designed to increase the road pavement thickness ranging from 400 m to 600 meters above the existing surface with adequate drainage systems. Few critical locations would require fill more than 700mm but less than 1000mm.

36. The curves in the existing roadway are within the required standards with very few sections having tight radius of 10 to 25 meters specifically at chainage Km 18+500 to Km 19+300. The minimum curve radius through the entire road length is 10 meters. Super elevations for the curves will be calculated to meet the requirements of safety and comfortable travel. Calculated average values are applied to certain range of radius and some curve cross-falls. Appropriate road signs erected to address traffic management and safety.

37. There are six bridges along the existing Ialibu to Kagua Road, five of which are of Bailey Type construction with timber decking and one (Yalo Bridge) is a concrete deck structure on steel beam. The Bridges are generally, except for the timber decking, in acceptable condition. Five of the six bridges have been improved under the Bridge Replacement and Upgrading Project by refurbishing the existing Bailey bridges, while the Yalo Bridge requires maintenance. Table 1 shows details of the six bridges and the proposed remedial works.

Table 1 - Bridge Details of the Ialibu to Kagua Road

Name	Chainage	Existing Type	Proposed works
Lineger Bridge	2 + 800	12 Bay DSR Standard Bailey	Install new steel deck
Kuni Bridge	10 + 400	6 Bay DS Standard Bailey	Install new steel deck
Yalo Bridge	17 + 000	1 Lane Concrete Deck Steel Beam	Maintenance
Puti Bridge	17 + 300	5 Bay SS standard Bailey	Install new steel deck
Alipina Bridge	17 + 600	4 Bay SS standard Bailey	Install new steel deck
Kagua Bridge	31 + 000	8 Bay DS Standard Bailey	Install new steel deck

Source: Renardet SA; HRRIIP Project 2 Bridge Inventory 2011

38. As per the inventory conducted, there are 65 existing culverts along the existing Ialibu to Kagua Road. The subproject will replace 55 of the existing culverts while the remaining 10 culverts will be retained. In addition, another 51 new culverts will be installed to provide proper drainage. The rehabilitation and upgrading of the Ialibu to Kagua Road would approximately take 24 months and would involve the following activities:

- Transport, handling and storage of construction materials and machinery to site;
- Preparation of contractor's camp and work sites;
- Establishment of ancillary facilities, i.e. identification and establishment of suitable material sources/quarries, batching, crushing and asphalt plants;
- Clearing and grubbing (shoulders and drainage);
- Excavate defective sections and improve side drains as required;
- Excavation and/or filling to widen the existing road bench
- Culvert removal, installation, extension and/ or replacement;
- Construct masonry retaining walls
- Construction of gabion protection works
- Rehabilitate bridges which may include installation of new steel decks if necessary, removing rust and repainting
- Backfill and compact as required;
- Layout sub-base and base materials;
- Install road furniture required (guardrails, pavement markings, etc.); and
- Pave roadway.

39. The upgrading and rehabilitation works for the Ialibu to Kagua Road would require 226 people of which 95 unskilled workers will be sourced from the local communities in the area. Various machinery and heavy equipment will be required in the rehabilitation and upgrading works. This would range from 4WD vehicles to bulldozers. Annex B presents the manpower complement and machinery and equipment required for the works

40. The works require materials including fuel, lubricants, paint, bitumen, cement, aggregates, cement, sand, timber, geotextile, drainage pipes and culverts. All materials will be sourced from approved suppliers. Workers, including local women, will make gabions using local materials for embankment and bridge pier protection.

41. The rehabilitation and upgrading of the Ilaibu to Kagua road is estimated at Kina 61,013,495.57. The construction period is expected to be 24 months. Table 2 presents the summary of the Bill of Quantities for the works of the proposed sub-project.

Table 2 - Summary Bill of Quantities for Rehabilitation of Ialibu to Kagua Road

Bill	Description of Item	Amount (Kina)
1.0	GENERAL	1,270,593.56
2.0	ESTABLISHMENT	9,027,351.72
3.0	CLEARING AND GRUBBING AND STRIPPING OF TOP SOIL	391,478.73
4.0	EARTHWORKS	2,900,147.67
5.0	BASE AND SUB-BASE	20,669,386.10
6.0	BITUMINOUS SURFACE COURSES	6,737,122.52
7.0	DRAINAGE	8,740,812.48
8.0	ROAD FURNITURE AND MARKINGS	3,572,206.15
9.0	MASONRY FOR STRUCTURE	529,214.92
17.0	MISCELLANEOUS BRIDGEWORKS ITEMS	600,000.00
18.0	RIVER TRAINING AND BANK PROTECTION	452,145.75
SUB TOTAL OF BILLS		**54,890,459.61**
Provisional Sum for Daywork		633,990.00
TOTAL OF BILLS AND DAYWORKS		**55,524,449.61**
Add 10% of SUBTOTAL OF BILLS as Provisional Sum for Contingencies		5,489,045.96
TOTAL CARRIED FORWARD TO GRAND SUMMARY		**61,013,495.57**

Source: Renardet SA; HRRIIP Project 2 - Detailed Design and Tender Documents 2012

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1. Soils and Topography

42. The Ialibu-Kagua Road section is located in the broad, mountainous core of PNG known as the Highlands Region, and which consists of numerous, sometimes large valleys at 1,100m to 1,800m above sea level (masl) with intervening ranges of hills and mountains (often steep and rugged) rising in many places to 3,000masl. The highest peak is Mt Wilhelm at about 4,550masl. The sub-project traverses the districts of Ialibu-Pangia and Kagua-Erave in the Southern Highlands Province.

43. Southern Highlands occupies 25 700 km^2 in the central west of PNG. It is one of the larger provinces in the country and covers a diverse range of environments. The Central Range, Lagaip Valley and extensive volcanic hills, plains and swamps of the Tagari Valley dominate the northwest. The central north covers the Wage, Nembi, Lai, Erave and Mendi valleys and the extinct volcano, Mt Giluwe. The northeast covers the plains and swamps of the Iaro and Poru valleys, Mt Ialibu and the Tua Valley. The south of the province covers vast limestone plateaux, the Hegigio, Mubi and Digimu valleys and Lake Kutubu. Mt. Bosavi, a dormant volcano, dominates the southwest. Altitude varies from 100 m in the lower Hegigio Valley, to over 4300m on Mt Giluwe. Most people live within an altitudinal range of 1200–2400 meters.

44. The upper altitudinal limit of agriculture is around 2500 meters. Average annual rainfall varies from 2200mm in the central northern valleys, to over 4500mm in the south. The eight districts in Southern Highlands are Ialibu-Pangia, Imbonggu, Kagua-Erave, Komo-Margarima, Koroba-Lake Kopiago, Mendi, Nipa-Kutubu and Tari. Figure 2 presents the land occupation map of the province.

45. Ialibu-Pangia District covers the Iaro, Poru, upper Kagua, Kaugel and Tua valleys. The Poru Basin, Poru Plateau and Mt. Ialibu dominate the centre of the district. Average annual rainfall ranges between 3200 and 4000 millimeters. Altitude varies from 400m at the junction of the Tua and Iaro rivers, to over 3700m on Mt Ialibu. Most people live between 1200 and 2400 meters. Kagua-Erave District covers the Valkaru Range and the Kagua, Sugu and Erave valleys. The southern half of the district is dominated by limestone plateau and valleys, and is largely unoccupied. Average annual rainfall ranges from 3000mm to over 4000mm, increasing from north to south. Altitude varies from 400m at the junction of the Erave and Purari rivers, to over 2000m on the Valkaru Range. Most people live between 1100 and 1800 meters.

46. The Highlands hills and mountain ranges are formed mainly on a wide range of sedimentary rock types of Mesozoic and Tertiary age. These rocks are predominantly fine grained mudstones and shale with some coarser poorly sorted sandstone. Massive limestone and quartzite also occur. There are several large andesitic volcanoes of late Tertiary and Quaternary age and the thick ash and lahar (i.e. debris avalanche) deposits produced by this mantle, the floors of the major highland valleys and their adjacent foot-slopes. The soils formed on these volcanic deposits are highly suitable for cultivation and much of both the subsistence and cash cropping agriculture (especially coffee and vegetables) in the highlands.

47. Papua New Guinea lies in the collision zone between two major tectonic ‘Plates’, i.e. the Pacific and the Australian Plate, which is associated with earthquakes and volcanic activities. Overall, seismic activity in PNG is mostly evidenced by landslides and subsidence and to a lesser extent changes in water courses. In the Highlands regions, there is no record of volcanic activity or recent large scale devastation due to earthquakes. Smaller earthquakes, combined with heavy rainfall, are responsible for many deteriorated sections of all the national and rural roads.

2. Climate

48. The subproject area is characterized by all year round warm to very warms days (temperatures in the mid to high 20s °C) and cool to warm nights (10s to low 20s °C). The subproject area is characterized by all year round warm to very warms days (temperatures in the mid to high 20s °C) and cool to warm nights (10s to low 20s °C).

49. Average annual rainfall varies from 2200mm in the central northern valleys, to over 4500mm in the south. Table 3 provides rainfall data for Southern Highland Province.

50. The Northwest winds are predominant during the (monsoon) season, mostly between November and March. April and May are transitional months where the wind starts to shift to southerly. The southeasterly in contrast are dominant from months June to August with September and October being transitional months when wind is variable.

Table 3 - Average Monthly and Annual Rainfall, 1998-2002, Erave Agro-Met Station

STATION NO: 70001 200188
NAME: ERAVE P P (MD25) (COMPOSITE)
LATITUDE: 06 39 SOUTH
LONGITUDE: 143 57 EAST
ELEVATION: 1,091 METERS
UNIT: MILLIMETERS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1998	237.0	184.4	153.6	124.6	299.8	291.8	179.6	814.8	408.6	420.8	574.4	543.6	4233.0
1999	297.8	666.8	1158.0	809.8	363.8	412.0	584.0	1183.0	322.6	217.6	694.4	461.6	7171.4
2000	333.8	524.2	647.8	382.8	501.0	521.8	509.8	206.6	619.4	342.0	238.8	328.8	5156.8
2001	738.4	279.4	522.6	499.2	226.6	156.4	332.6	397.0	211.2	111.2	381.2	260.6	4116.4
2002	387.6	185.8	478.8	261.0	288.8	424.0	272.0	716.4	0.0	12.8	146.2	34.6	3208.0
RAINFALL SUMMARY FOR PERIOD 1998 TO 2002, USING ALL AVAILABLE DATA													
TOTAL	1994.6	1840.6	2960.8	2077.4	1680.0	1806.0	1878.0	3317.8	1561.8	1104.4	2035.0	1629.2	23885.6
HIGHEST	738.4	666.8	1158.0	809.8	501.0	521.8	584.0	1183.0	619.4	420.8	694.4	543.6	7171.4
LOWEST	237.0	184.4	153.6	124.6	226.6	156.4	179.6	206.6	0.0	12.8	146.2	34.6	3208.0
YEARS	5	5	5	5	5	5	5	5	5	5	5	5	5

Source: National Weather Service, Jacksons Airport, Port Moresb

3. Climate Change

51. Climate change is predicted to affect several climate attributes that influence the function, use and integrity of navigational infrastructure, including temperature, ocean acidification, sea level, and sea temperature. The International Panel on Climate Change's (IPCC)[1] projects that for the Pacific region, anthropogenic climate change will cause: (i) sea levels and sea water temperature to rise, contributing to greater incidence of coastal flooding; and (ii) increased cyclone intensity, with Category 4 and 5 cyclones more common, although with lower frequency.

52. Globally, emissions are tracking at the upper emissions scenarios. "A2" Modeling refers to the schedule of emissions scenarios developed by the IPCC for its Special Report on Emissions Scenarios (SRES). Under A2 modeling (high emissions scenarios), air temperature is projected to increase more than 2.5°C, with sea level rise of 0.20m – 0.60m by 2090 (not accounting for ice sheet dynamics).[2]

53. **Climate change in PNG**. The Pacific Climate Futures project has projected minimum temperature increases of 1.1°C by mid-century for PNG.[3] The location of PNG near the Equator and its landforms contribute to high levels of variation in climate among various regions of the country. This climate variation means that accurate assessments of potential climate change impacts in PNG require regional context. However, at the national level, recent studies indicate that PNG's climate is indeed changing. For example:

- Annual and seasonal ocean and land surface temperatures have increased by 0.6°C to 1.0°C since 1910;
- Since the 1970s, decadal average temperature has increased by 0.3°C to 0.5°C.
- Significant increases have been observed in the annual number of hot days and warm nights, with significant decreases in the annual number of cool days and cold nights.

54. The Pacific Climate Futures program has been preparing regionalized climate change projections for application at the national scale. Dynamic downscaling of Global Circulation Models (GCMs) to 60km and 8km grids undertaken for PNG provide summarized in Table 4. Given that the expected design life of the road improvements anticipated for this program is 20-30 years, these projections consider 2030 and 2055 timeframes only.

Table 4 - Climate Change Projections for PNG for the A1B scenario

Climatic variable	2030 projections (annual averages)	2055 projections (annual averages)
Surface air temperature (°C)	+0.8°C	+1.45°C
Total rainfall (%)	+1.2%	+8.8%
Humidity (%)	+0.1%	+0.15%
Sea surface temperature (°C)[i]	+0.7 ±0.4	+1.3 ±0.5
Mean sea level (cm)	+10 (5-14)	+20 (9-30)

Source: Pacific Climate Futures Program; Climate Futures Exploration Tool (February 2012).

Note: Ensemble mean data for 2030 and 2055 projections for A1B (medium emissions scenario).

[1] International Panel on Climate Change: Climate Change – Fourth Assessment Report: Synthesis Report (2007)
[2] IPCC Working Group I: The Scientific Basis. http://www.ipcc.ch/ipccreports/tar/wg1/029.htm
[3] Pacific Climate Change Program: Climate Change in the Pacific: Scientific Assessment and New Research, CSIRO (2011)

55. **Climate change parameters considered.** This IEE specifically considers climate change projections for climatic variables relevant to vulnerability of road and bridge infrastructure in PNG including changes (increases) in rainfall and intensity and frequency of cyclones. The assessment considers the design and effective life of improvements over the coming 20-30 years. An increase in precipitation would increase the risk of the following: (i) landslides and the erosion of slopes; (ii) overtopping of bridges or damage to bridge substructure; (iii) overtopping/wash out of culverts; and (iv) scouring of drains and road shoulders.

56. Each of these aspects has been considered in the design process and due allowance made in the proposed works to minimize the potential risks due to rainfall events through the provision of a coherent drainage system and stable slopes as discussed in the following:

- Slopes have been designed to appropriate angles for the soil types encountered with benches and bench drains where necessitated by the height of the slope
- None of the bridges have been reported as being overtopped and site observations confirm that there appears to be adequate flood clearance at the existing bridges. Minor repairs will be required.
- Based on the inventory off the existing culverts and observations of natural watercourses, replacement and additional culverts are provided to cater for the anticipated flows with an allowance for an increase in flow and some sedimentation in determining culvert diameters. To ensure smooth flow conditions and to minimize any risks of scour particular attention was given to the treatment of culvert inlet and outlet works.

57. Roadside drains are designed to cater for the anticipated run-off from the carriageway and adjacent slopes. Lined drains will be provided where the longitudinal gradient exceeds 3% or where the soil is considered susceptible to erosion. To prevent scour sealing of the carriageway will be extended to the shoulders at steep longitudinal gradients.

4. Water Resources

58. Extensive rivers and perennial streams are found throughout the country, with an estimated cumulative flow rate of 5,000 cu m/sec annually. Total surface waters cover some 64,341 sq km. Surface water flows recharge extensive groundwater aquifers (such as sandstones and limestone are common) on the PNG mainland.

59. The Highlands Region is traversed by many fast flowing rivers and creeks, which form the upper-watersheds for the biggest rivers in the PNG (the Ramu, the Sepik, the Strickland, the Fly, and the Purari). Nearly all the rivers and creeks in the Highlands region are permanent, discharging all year around. River flows in the Highlands area are the highest from December to April. During heavy rainfall, bridges and culverts are frequently washed out, cutting off roads and villages. Most of the rivers and creeks are free from industrial pollutants as there are no established industries along the rivers and their tributaries.

60. Flow regimes in the main rivers of the subproject area are dominated by surface runoff, and many rivers have flow rates that increase sharply in response to regional rainfall. A large part of the base flow in the watercourses in the karsts landscape is groundwater inflow from subterranean streams. Most of the rivers and creeks are free from industrial pollutants as there are no established industries along the rivers and their tributaries. However, many of these rivers waterways carry high sediment loads, depositing large quantities of gravels and sands in the lower areas.

5. Air Quality

61. Air quality in the Highlands Region is generally good. There are no industries producing discharges which result in atmospheric pollution and pollution from vehicular exhaust emissions are not significant given the low levels of traffic and absence of any traffic congestion. The only detrimental effect on air quality is the dust arising from the passage of vehicles over unsealed roads when the roads are dry. This is an intermittent problem with a minor effect over a limited area of 5 to 10 meters either side of the road.

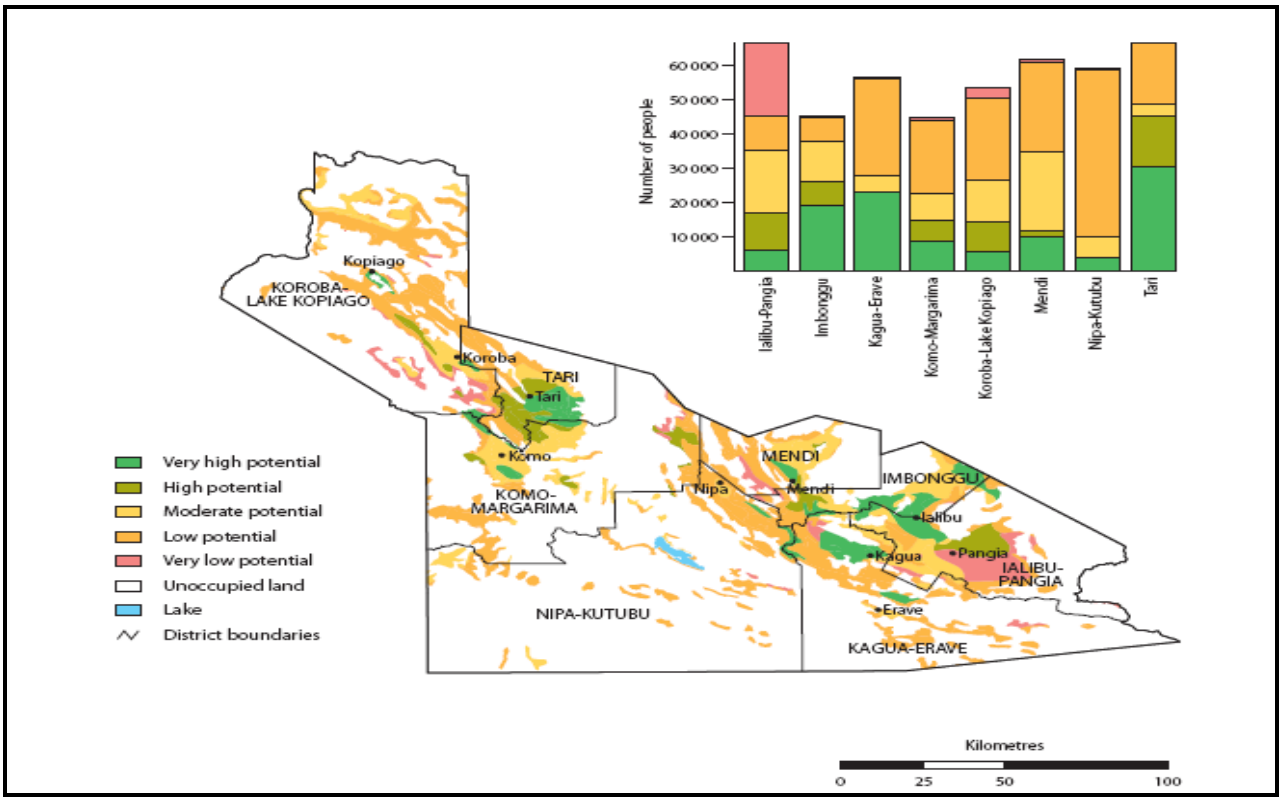
B. Biological Environment

1. Land Use and Vegetation

62. Intensive land improvement practices such as drainage, composting and mounding have improved much of the flatter land around Tari, Ialibu, Kagua and Pangia such that it now has high to very high land potential. There is moderate land potential in the Lagaip, Tagari, Mendi and Iaro valleys due to frequent cloud cover, steep slopes and low temperatures at higher altitudes. The remaining areas of the province have very low to low potential because of combinations of steep slopes, poor soils, high rainfall, flooding, low temperatures, frost and frequent cloud cover.

63. Land potential decreases in areas where practices such as mounding and composting are used on steep slopes, resulting in increased soil erosion. Figure 2 presents the land potential map of the Southern Highlands Province.

Figure 2 - Land Potential Map of Southern Highlands Province



Source: PNG Rural Development Handbook, 2001

64. The land potential in the Iaro, Andawe and Kaugel valleys in Ialibu-Pangia District is very high. Soils, slope and rainfall are ideal for the production of many crops, however low temperatures slow plant growth. The Poru Basin has high potential with high rainfall and frequent cloud cover. The flatter parts of the Iaro and upper Kagua valleys have moderate potential and have frequent cloud cover and high rainfall, while the fringe areas have low potential due to the additional constraints of steep slopes and low temperatures. Most of the Poru Plateau has very low potential due to steep slopes, high rainfall, frequent cloud cover and low temperatures.

65. The land potential in the flatter parts of the Kagua, Sugu and upper Erave valleys is very high. Soils, slope and temperature are ideal for the production of many crops, but there are minor constraints of high rainfall and frequent cloud cover. Intensive land improvement practices maintain production. On the lower northern slopes of the Valkaru Range, land potential is moderate caused by frequent cloud cover and low temperatures. The steeper land in the Kagua, Erave and Sugu valleys has low potential due to high rainfall, frequent cloud cover, poor soils and steep slopes.

2. Forest Resources

66. Forests provide the basis of livelihood and cultural life to the 85% of Papua New Guineans who live in rural communities. Seventy eight percent of PNG's 462,800 sq km of land is still under natural forest which is the world third largest block of tropical forest. Before independence the country had an estimated 33 million hectares of natural forest, however, since independence, this has been reduced to about 29 million hectares.

67. There are no forests concessions in any of the areas which are directly accessible from the roads currently under consideration for rehabilitation and upgrading by the DoW. Some logging do occur in the Highlands region, but it has been reported that this is only small-scale production of timber for local construction purposes. Such logging is unlikely to increase if the road is improved.

68. The existing Ialibu to Kagua Road is not located within a forest area. As can be seen from the Forest Resources Map of the Southern Highlands Province, land-use of the area where the sub-project is situated has been unchanged since 1975.

3. Biodiversity and Wildlife Management Areas

69. Papua New Guinea has a total land area of 46.2 million hectares, of which about 36 million ha, or roughly 78% of total land area, is still covered by closed natural forest. This constitutes one of the most complex, species-rich significant tropical rainforest wildernesses remaining in the world. Although this biodiversity has not been extensively surveyed, the current scientific estimates are that 5% to 7% of the world's biodiversity is found in PNG. Terrestrial biodiversity includes 304 mammal species, 15,000-20,000 plant species, 1,500 tree species, and 733 bird species. This includes many unique species not found anywhere else on earth. Best known birds include the birds of paradise (90% of the world's total species), bowerbirds, mound builders, and cassowaries. Many of PNG's mammals are marsupials, and include the tree kangaroo, cuscus, and possum. PNG's reptiles include an endemic freshwater crocodile and the world's longest lizard. Outstanding PNG insects abound such as the world's largest butterfly, Queen Alexandria's Birdwing.

70. The vegetation along the road corridor is by: (i) introduced and native pitpits, (ii) coffee trees, (iii) flower gardens, and (iv) shrubs and grasses. There are no significant flora existing along the road corridor as the roadway and adjacent development has been in existence since the early 1970s. The dominant vegetation along the footprint of the roadway are pitpits and cow grasses.

71. Within the broader vicinity of the project, the Siwi – Utame Wildlife Management Area (WMA) is situated on the slopes of Mount Giluwe in Ialibu District. At its closest point, the WMA is some 35 kms from the project road. The proposed works will result in the clearance of the existing vegetation for 3 to 4 meters either side of the existing formation width. Within this clearance area site inspection has not noted the presence of any significant wildlife or wildlife habitats.

72. Availability of literature on aquatic fauna of the project area is scarce. Therefore, species composition of aquatic fauna in the rivers and creeks of the project area is unknown. However, communities report that local aquatic systems host little aquatic fauna. In the Highlands it is mainly due to the steep topography and fast flowing river systems which are hostile for habitation of aquatic fauna. Many rivers are highly turbid and subject to flooding and high sediment loads most times of the year.

73. In slower flowing creeks, local people plant and harvest some local fresh water-based vegetables. In the highland region casuarina trees and Imperata cylindrica become established along with other colonizing species on disturbed creek beds and banks. Often disturbance is the result of flooding.

C. Socio-Economic Environment

1. Population and Demographics

74. The population of the Highlands Region as per the preliminary figures of the 2011 Census is 3,001,598. This is 42.5% of the total population of the country placed at 7,059,653 for the same census. The growth rate (2000-2011) of the Highlands Region is 3.8% compared to that of PNG which is only 2.8%.

75. The Southern Highlands Province has an approximate population of 515,511 with 94,987 households. The area more specifically benefiting from the road section mainly includes the Ialibu-Pangia and Kagua-Erave Districts, with a total population of 143,072 (Ialibu-Pangia – 59,507 and Kagua-Rave – 83,565 Census 2011).

76. Table 5 below shows the population of the Highlands Region by Province while Table 6 presents the population and demography of the Southern Highlands. Figure 3 shows the settlement map of the Southern Province.

Table 5 - Population Count and Growth

AREA	TOTAL POPULATION		GROWTH RATE (%) 2000-2011
	HOUSEHOLDS	PERSONS	
Papua New Guinea	**1,424,835**	**7,059,653**	**2.8**
Highlands Region	**606,081**	**3,001,598**	**3.8**
Southern Highlands	94,987	515,511	3.2
Hela	65,309	352,698	5.8
Enga	85,012	452,596	3.9
Western Highlands	116,476	352,934	3.0
Jiwaka	30,984	341,928	5.5
Chimbu	79,888	403,772	4.0
Eastern Highlands	133,425	582,159	2.7

Source: GoPNG – 2011 Census Preliminary Results (2012)

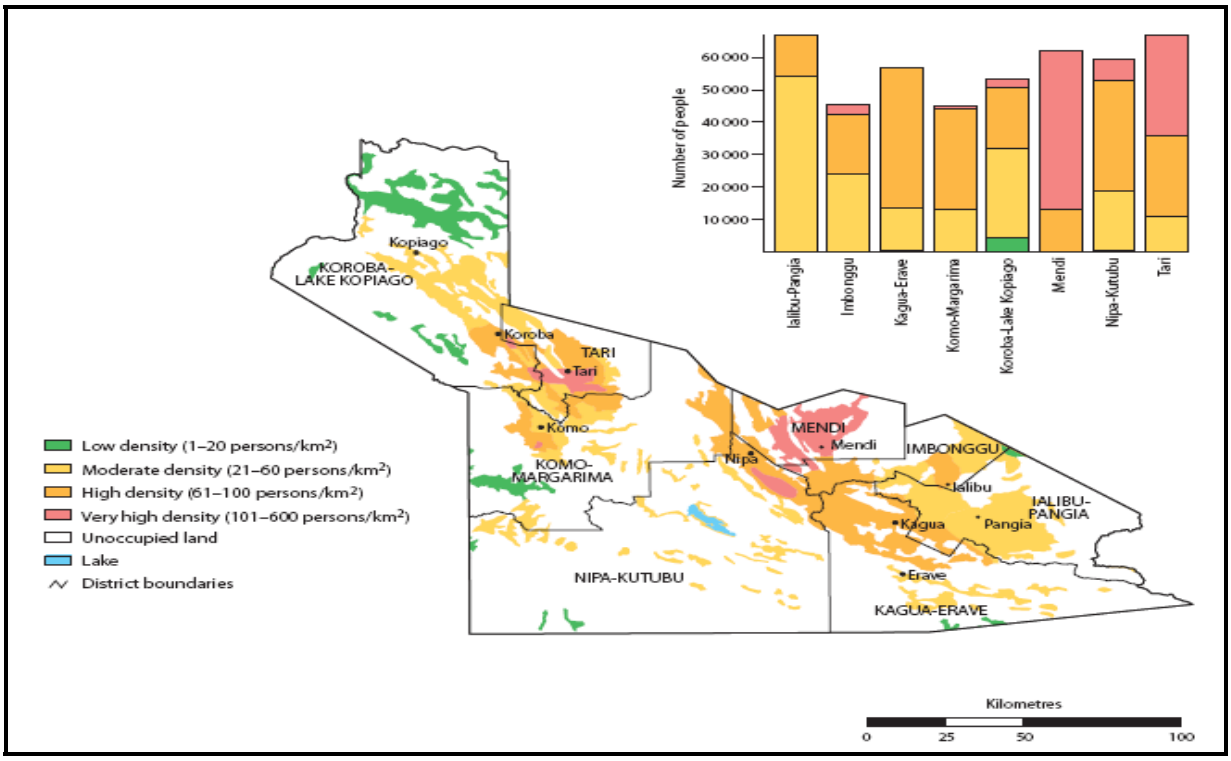
Table 6 - Population and Demography of the Southern Highlands Province

Proportion on PNG Population	7.30%
Average Annual growth rate since 2000	3.20%
Sex Ratio	106 males per 100 females
Population Density	110.7 persons/km^2
Average Household Size	5.4 persons
Highest population	Nipa/Kutubu District (29.9%)

AREA	Households	Persons	Males	Females
SOUTHERN HIGHLANDS PROVINCE	**94,987**	**515,511**	**265,596**	**249,915**
IALIBU/PANGIA	12,341	59,507	30,802	28,705
East Pangia Rural	3,100	14,622	7,453	7,169
Ialibu Urban	1,336	6,283	3,106	3,177
Kewabi Rural	3,429	16,742	8,705	8,037
Wiru Rural	4,476	21,860	11,538	10,322
IMBONGGU	13,314	68437	34822	33615
Ialibu Basin Rural	4,095	18,427	9,163	9,264
Imbongu Rural	3,870	20,251	10,348	9,903
Lower Mendi Rural	5,349	29,759	15,311	14,448
KAGUA/ERAVE	15,448	83,565	43,931	39,634
Erave Rural	3,320	17,239	8,929	8,310
Kagua Rural	5,031	25,505	13,251	12,254
Kuare Rural	3,174	16,567	8,917	7,650
Aiya Rural	3,923	24,254	12,834	11,420
MENDI/MUNIHU	25,752	150,016	77,436	72,580
Karints Rural	5,521	31,576	16,165	15,411
Lai Valley Rural	9,028	52,839	27,337	25,502
Mendi Urban	3,379	17,266	9,009	8,257
Upper Mendi Rural	7,824	48,335	24,925	23,410
NIPA/KUTUBU	28,132	153,986	78,605	75,381
Lake Kutubu Rural	2,653	14,249	7,287	6,962
Mt.Bosavi Rural	2,296	12,831	6,923	5,908
Nembi Plateu Rural	5,867	32541	16483	16,058
Nipa Rural	9,616	58,727	28,696	29,031
Poroma Rural	7,700	35,638	18,216	17,422

Source: GoPNG – 2011 Census Preliminary Results (2012)

Figure 3 - Settlement Map of Southern Highlands Province



Source: PNG Rural Development Handbook, 2001

2. Health Facilities

77. Malaria is among the top cause of morbidity and mortality in the country. Malaria epidemics in the highlands of PNG are becoming a regular occurrence. In the Highlands where there used to be 'no malaria or low epidemic outbreak', WHO (2006) recorded 4,986 malaria cases in Western Highlands Province in 2005, compared to 638 cases in 2000. Child and mother mortality is also prevalent. Waterborne diseases and minor airborne viral infections are frequent irritation in the communities. In some remote areas the main problems in the delivery of health services include inadequate medical supplies, lack of aid-post or medical orderlies, difficulty in staff retention, and inadequate levels of immunization and infectious disease control. Infant mortality and malnutrition are also of significant issues.

78. Mortality rate in Southern Highlands is 84/1000 for under five year olds and 61/1000 for under one year olds. Life expectancy is 53.8 years for males and 56.7 years for females. There are 158 aid posts and 56 health centers in Southern Highlands with 5 health centers in Ialibu and seven in Kagua and 16 aid posts in Ialiabu and 21 aid posts in Kagua. In terms of access to facilities, the average provincial population per health center is 9,755 and per aid post is 3,457.

3. Educational Facilities

79. Provincial education is managed independently from the Department of Education except for matters related to national standards and curriculum. Provincial education branches oversee education services. Shortage of supplies and trained teachers and high staff turnover in rural areas are of concern.

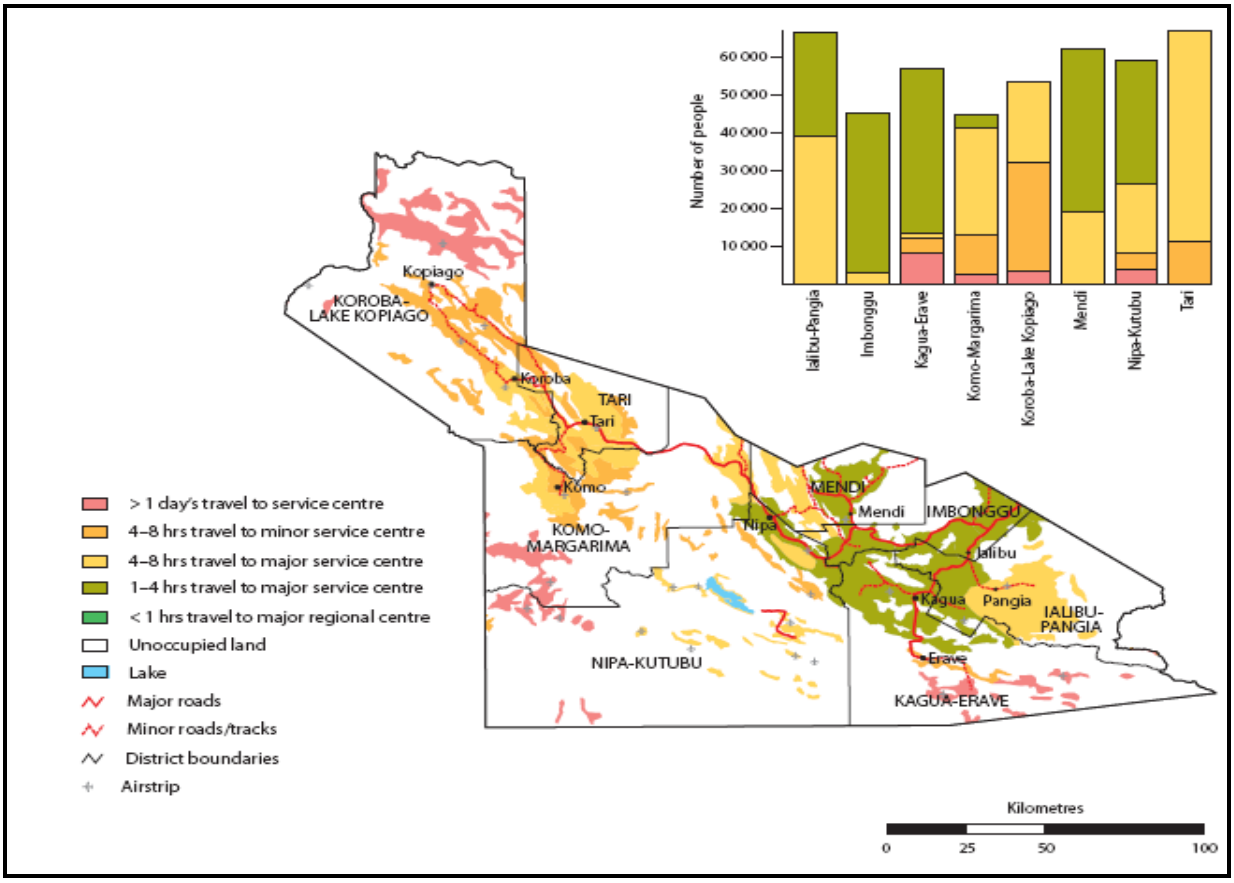
80. The literacy rate in the Southern Highlands Province is 36.5%; with the males at 40.6% and the females at only 32.2% as compared to 45.7% (Total); 51.5% (Males); 39.8% (Females) for Ialibu-Pangia District and 32.7% (Total); 37.5% (Males); 27.9% (Females) for Kagua-Erave District. Table 7 presents the type and number of schools for the Southern Highlands Province and the districts of Ialibu-Pangia and Kagua-Erave. Figure 4 shows access to services in the Southern Highlands Province.

Table 7 - Type and Number of Schools

TYPE	NUMBER		
	S H Province	Ialibu	Kagua
Elementary	529	87	77
Community	61	4	12
Primary	166	21	26
Provincial High	12	1	4
Secondary	5	0	0
Vocational	7	2	1

Source: PNG Rural Development Handbook, 2001

Figure 4 - Access to Services Map of the Southern Highlands Province



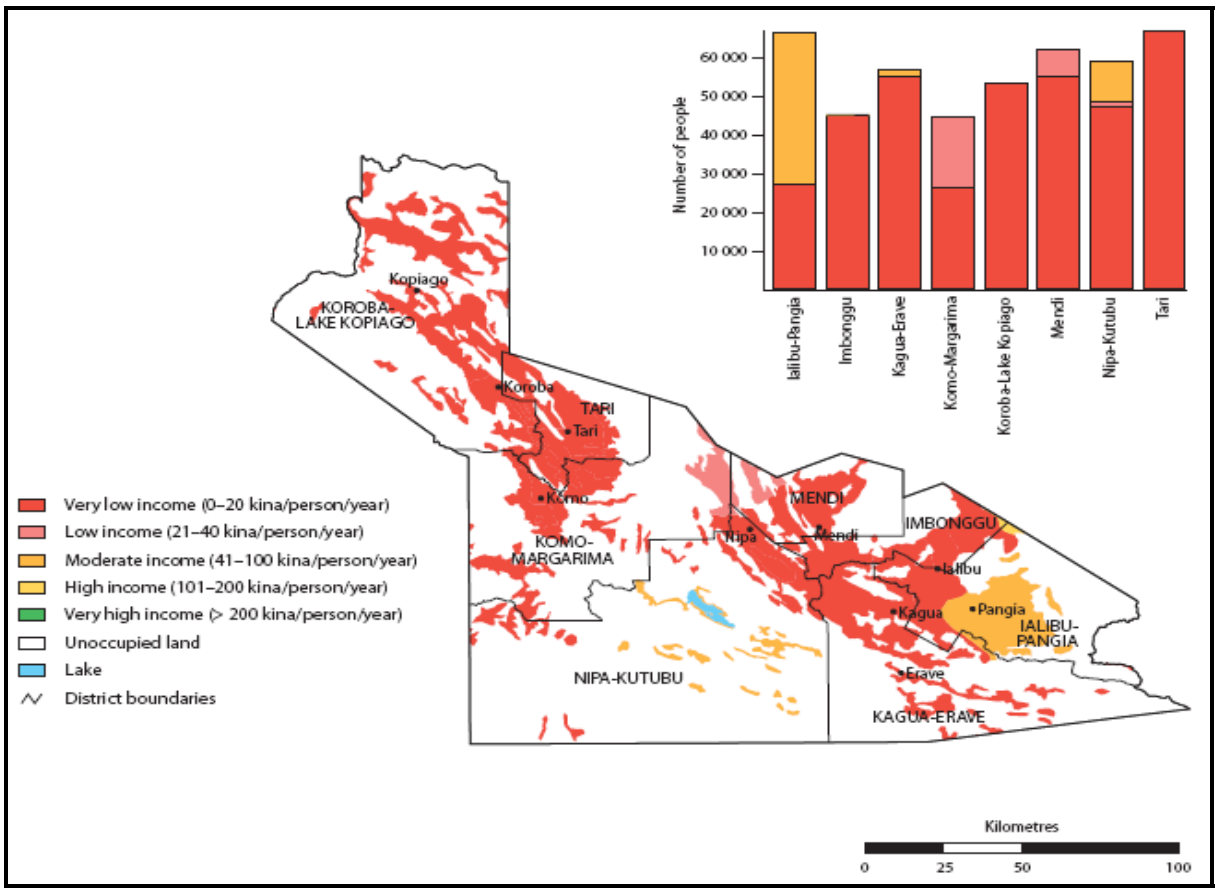
Source: PNG Rural Development Handbook, 2001

4. Income Sources

81. Incomes in the province are very low to low, although some people receive relatively large amounts of money from oil and gas projects. Agriculture provides the main source of cash income through sales of coffee, fresh food and firewood. Most of the coffee is grown east of Nipa. People in the high altitude areas of the upper Wage and Lai valleys sell minor amounts of potato, fresh food and firewood. Royalties and wage employment from the Kutubu, Erave and Hides oil and gas operations are the only sources of non-agricultural income. This income is very high, but only benefits people living close to the operations.

82. A major electricity supply line runs across the Tari Basin, from the Hides gas field near Komo, to the Porgera goldmine in Enga province. Small amounts of money are earned from land rent and maintenance work along the line. Incomes are moderate in the Poru Plateau and Poru Basin in the District of Ialibu-Pangia and are derived from minor sales of coffee, fresh food and cattle. People in the rest of the district earn very low incomes from minor sales of coffee and fresh food. Incomes are very low in the entire district of Kagua-Erave and are derived from minor sales of coffee and fresh food. Some communities near Erave receive high incomes from oil royalties. Figure 5 shows the income levels in Southern Highlands Province.

Figure 5 - Income Levels in Southern Highlands Province



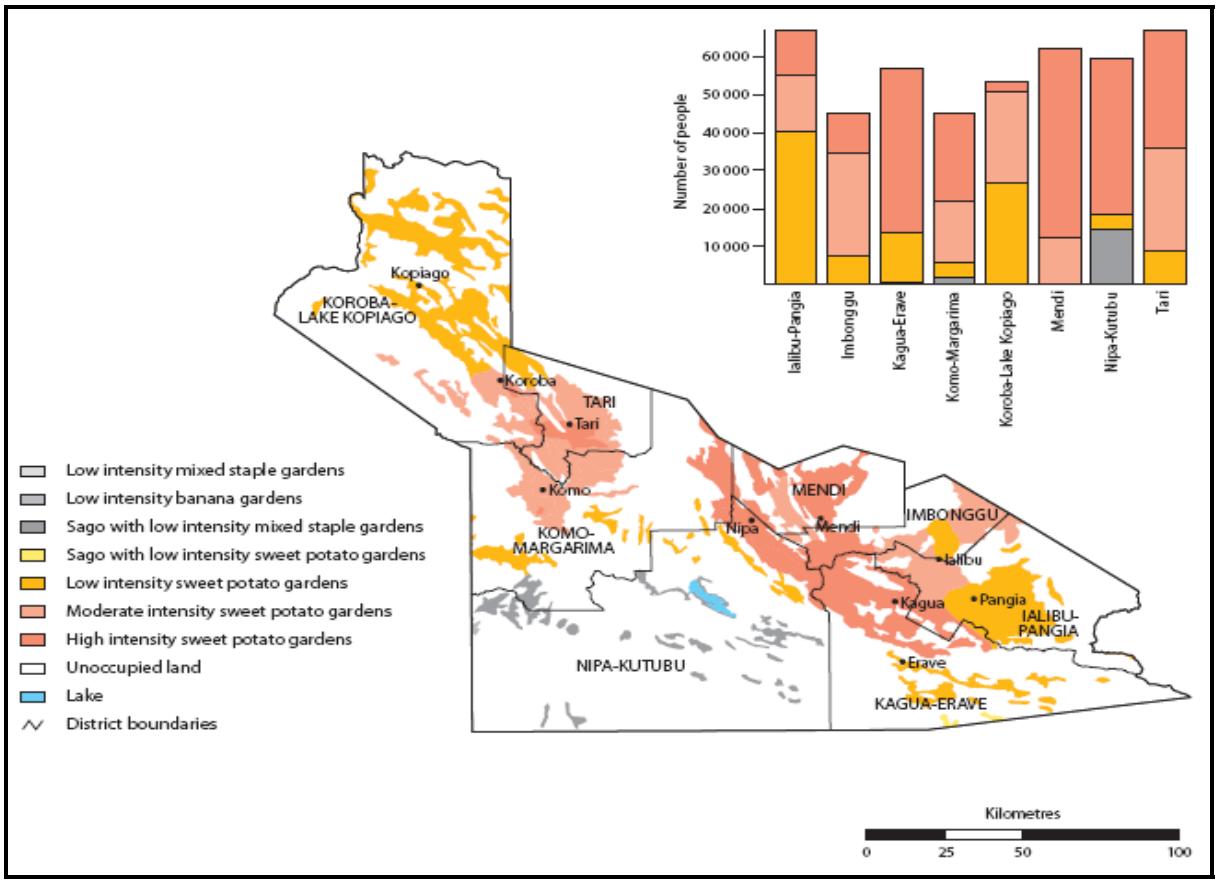
Source: PNG Rural Development Handbook, 2001

5. Agricultural Development

83. Agriculture in the Tagari Valley around Tari and the Wage, Nembi, Mendi, Kagua and Erave valleys in the Southern Highlands Province is characterised by high intensity sweet potato production. Supplementary crops include banana and taro at lower altitudes, and potato at higher altitudes. Cultivation is continuous around Tari, while in other valleys people make more than 20 consecutive plantings before a fallow period of 1-4 years. Production is maintained through the use of drainage, composting, mounding and bedding. People in the Tagari, Lai and Iaro valleys use similar practices to cultivate moderate intensity sweet potato gardens. In the far south and southwest, people rely on sago production is supplemented by low intensity mixed staple gardens. Agriculture in the remaining areas of the province is characterized by low intensity sweet potato cultivation (Figure 6).

84. Agriculture in the upper Kagua Valley of the Ialibu-Pangia District is dominated by high intensity sweet potato cultivation. People make 2-4 plantings before a fallow period of 1-4 years. Production is maintained through the use of composting, tillage, drainage and bedding. People in the upper Iaro and Kaugel valleys cultivate moderate intensity sweet potato gardens and use composting and mounding. Those on the Poru Plateau and in Poru Basin make low intensity sweet potato gardens. Agriculture in the upper Erave, Kagua and Sugu valleys is dominated by high intensity sweet potato cultivation. There are 2-4 consecutive plantings before a fallow period of 1-4 years.

Figure 6 - Subsistence Agricultural Map of the Southern Highlands Province



Source: PNG Rural Development Handbook, 2001

6. Mineral and Petroleum Resources

85. Mineral resources in PNG include copper, gold, nickel, zinc, cobalt, chromite, manganese and silver. PNG is currently ranked as the 11th largest gold producer in the world and 13th in terms of copper production (World Bank 2002). All of the mining activities since 1970 have produced approximately 2,000 metric tons of gold, almost 2,000 metric tons of sliver and over five million metric tons of copper. There are still huge deposits of undeveloped mineral resources spread across the country. Current world prices have sparked a new wave of prospecting. Significant oil and natural gas deposits are found in PNG, with the petroleum sector contributing around 9% to GDP. In 1991, the Hides project started generating gas for electricity for the Porgera gold mine.

86. Commercial oil started flowing from the Kutubu field in 1992 and from the Gobe field in 1998. A development license was issued for the Moran field in 2001. Further exploration has identified numerous basins that hold petroleum deposits. The country's first oil refinery started operating in Port Moresby in 2005. A pipeline is being planned that would deliver natural gas from the PNG Highlands to Queensland, Australia. The mining and petroleum sectors as a whole contributed around 21% of estimated GDP in 2003, and accounted for some Kina 4.8 billion (approximately US$1.5 billion) of exports (74% of all natural resources exports). In terms of employment, the mining sector employs 5% of the total workforce in PNG.

7. Industrial Development

87. There are no major industries in the Highlands regions. In general, the Papua New Guinea economy is highly dependent on imports for manufactured goods. The small domestic market, relatively high wages, and high transport costs are constraints to industrial development.

8. Transportation

88. Southern Highlands is at the south-western end of the Highlands Highway, which runs through Mendi, Nipa, Tari and ends at Koroba. Good roads connect Tari with Kopiago in the north, and the Hides gas field in the south. There is also a good road connecting the highway, via Poroma, to the Lake Kutubu oil and gas fields in the south. Most roads are of reasonable quality due to an abundance of limestone suitable for road building materials. Criminal activity and ethnic conflicts restrict travel along the highway, especially between Mendi and Tari. People in the central northern valleys require less than four hours' travel to reach Mendi or Mt Hagen. People in the Tagari, Wage, Lai and Poru valleys require between 4-8 hours' travel to reach the nearest service centre, while those in the Lagaip and lower Erave valleys and on the northern slopes of Mt Bosavi require more than one day's travel.

89. People in the upper Iaro, Kagua and Kaugel valleys of Ialibu-Pangia district require less than four hours' travel to reach Mendi or Mt Hagen, while those in the Poru Plateau and Poru Basin require 4-8 hours' travel. A good condition road between the Highlands Highway and Ialibu extends through Iaro Valley to Kagua and Erave. There is also a network of minor roads in the Poru Plateau and Poru Basin. People in the upper Erave, Kagua and Sugu valleys of Kagua-Erave district require less than four hours' travel to reach Mendi, while those around Erave Station require 4-8 hours' travel. People in the lower Erave Valley are very remote and require over one day's travel to reach the nearest service centre. There is a road from Erave through the Kagua Valley that connects to Ialibu and the Highlands Highway.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

90. The rehabilitation and upgrading of the Ialibu to Kagua Road will have few and limited adverse impacts. These impacts will be mainly occur during the construction phase. Construction will create a range of expected minor impacts which can be readily addressed by conditions imposed in the environmental management plan (EMP). Improvements that may be affected, such as gardens and fences, will be compensated based on existing procedures of the GoPNG and SPS as per the subproject's resettlement plan (RP). There will be no cultural or heritage sites that will be affected nor will any primary forest be cleared. The water quality of the water courses will not be affected as bridgeworks would only be re-decking and repainting and would be confined to the bridge.

91. The rehabilitation and upgrading works for the Ilaibu to Kagua Road will be undertaken over a 24 month period. Construction will cause a range of minor impacts in terms of noise, dust, employment opportunities and waste disposal. Construction will create some short-term employment opportunities that will benefit the local communities.

92. Construction impacts are of a general nature and as these are applicable to most projects these will be discussed in the EMP section. The activities are presented in terms of their impacts on the physical, biological and socio-economic environments. For each of these categories the impacts are discussed in terms of their decreasing order of magnitude.

A. Pre-Construction Phase

93. Land clearance. This activity will be coordinated with activities undertaken for the RP. During the detailed design and construction works, detailed land surveys will be undertaken to clarify the land status, detailed ownerships, and a resettlement plan will be prepared to address land acquisition and compensation. Measures to minimize the social impacts include: (i) Identify land acquisition needed, trees and plant or other items to be affected by reconstruction and rehabilitation, and compensation requirements as per the RP; and (ii) projected impacts and proposed measures implemented as per the approved RP.

94. This project will provide an opportunity to formalize and transfer land ownership of the corridor to the GoPNG. The RP will address land acquisition and compensation. All land acquisition and compensation payments must be completed before construction commences. The GoPNG Department of Lands which has this responsibility has already been informed and has accompanied the inspection teams to the field and has commenced preliminary discussions with the customary landowners. There do not appear to be any issues provided payment is made for the land. Land acquisition will need to be completed as soon as possible so as not to delay the implementation of the project. Implementation of the RP will be the responsibility of the Lands Department which will be directed to commence this by DoW. Determination of compensation requirements will be the responsibility of the Department of Lands, arranged by DoW.

95. Climate change requirements in the design. In the Highlands Region of PNG, where the project roads are located, rainfall and the potential effects of increased intensities on the sustainability of the roads would clearly be the dominant factor to be considered. An increase in precipitation would increase the risk of the following: (i) landslides and the erosion of slopes; (ii) overtopping of bridges or damage to bridge substructure; (iii) overtopping/wash out of culverts; and (iv) scouring of drains and road shoulders.

96. Each of these aspects has been considered in the design process and due allowance made in the proposed works to minimize the potential risks due to rainfall events through the provision of a coherent drainage system and stable slopes.

97. As mitigation (i) slopes have been designed to appropriate angles for the soil types encountered with benches and bench drains where necessitated by the height of the slope; (ii) none of the bridges have been reported as being overtopped and site observations confirm that there appears to be adequate flood clearance at the existing bridges; (iii) minor repairs of bridges will be undertaken when necessary; (iv) based on the inventory of the existing culverts and observations of natural watercourses, replacement and additional culverts have been provided to cater for the anticipated flows with an allowance for an increase in flow and some sedimentation in determining culvert diameters with particular attention to the treatment of culvert inlet and outlet works to ensure smooth flow conditions and to minimize any risks of scour; and (v) roadside drains have been designed to cater for the anticipated run-off from the carriageway and adjacent slopes with lined drains provided where the longitudinal gradient exceeds 3% or where the soil is considered susceptible to erosion; and (vi) sealing of the carriageway will be extended to the shoulders where the is a steep longitudinal gradient or high super-elevation or a combination of both to protect the shoulders from scour.

98. Review EMP, extract construction section of the EMP and attach to the bid and contract documentation (BCD). Experience shows that inadequate application of the EMP by the contractor may occur due to weak linkages of the EMP with the contract document. The EMP is a part of the work program and as such it must be addressed by the contractor and carried out as required. If the EMP is not satisfactorily addressed then the environmental safeguards and project sustainability will be compromised.

99. While a brief outline of the requirements is shown below preparation of BCD is a specialized task and needs to be carried out by a person skilled in BCD preparation. In the BCD section “Special Conditions of Contract” list the following will be organized; (i) prior to the tender being called the EMP will be revised and updated and (ii) the construction section of the EMP will be extracted and will be attached to the Bid and Contract Documents in section; Part II - Requirements; Section 6 - Employer’s Requirements. (iii) in Part 1 the Price Schedule 4 - Bill of Quantities this must include reference to particular requirements e.g. Preparation of contractor’s EMP (CEMP) including procedures and safeguards, as per Specification Clause x.x. which requires the bidder to specify the cost of the item within the Price Schedule. (iv) in the BCD section “Special Conditions of Contract” list the construction section of the EMP as forming part of the BCD.

100. Inclusion of Appendix 5 - Prohibited Investment Activities List - in BCD. During the implementation of the subproject, environmental degradation and values may be lost due to the utilization of the banned materials and engaging in illegal activities that is detrimental to the environment. It will be necessary to include in the BCD reference to Appendix 5 - Prohibited Investment Activities List of the SPS, especially item (ii) - production or trade in any product or activity deemed illegal under host country laws and regulations or international conventions and agreements or subject to international phase outs or bans, such as (a) pharmaceuticals, pesticides, and herbicides (b) ozone-depleting substances, (c) polychlorinated biphenyls and other hazardous chemicals etc.

101. Bid evaluation and selection of contractor. Selection of competent contractor will ensure that the environmental integrity of the subproject is maintained. Moreover, the contractor will be required to provide a short statement to be attached to the Bid in the section “Special Conditions of Contract” - that confirms the following:

- That the construction section of the EMP conditions has been costed into the bid price;

- The contractor is to provide prior experience of satisfactorily implementing EMP;
- The contractor is required to provide the name, details of qualifications and experience of the person on the contractor's team who will be responsible for the environmental compliance requirements of the EMP. During bid evaluation these strengths will be evaluated and will be awarded 10% of the bid in the selection of the contractor. Should the contractor not provide these details, the bid will be judged to be non-compliant and the bid rejected.

102. Provision of relevant training to contractor. As experienced in the implementation of the two road packages (Laigam to Porgera and Mendi to Kandep Roads) in Project 1, the contractor is having difficulties, at the minimum, in complying with the safeguards requirements of the Bank and the National Environmental regulations of the GoPNG. This resulted in non-satisfactory implementation of measures embodied in the EMP. As mitigation for this impact, the contractor will receive basic training on the preparation of a CEMP and the tenets of the SPS of and governing environmental regulations of the GoPNG. The training will be provided by the IES and EO in coordination with EMU-Manager who is well-experienced in provision of training.

103. Contractor prepares CEMP. Before commencing work the contractor will be required to prepare a construction EMP (CEMP) that addresses the conditions of the construction EMP that has been attached to the BCD. The CEMP will amplify how the contractor will address the activities in the construction section of the EMP. The contractor prepares the CEMP that establishes the contractor's management and compliance requirements with the construction section of the EMP.

104. Induction of contractor to site. Following the selection of the contractor and the approval of the CEMP, the contractor together with the person on the contractor's staff who will be responsible for supervising the CEMP and all the concerned staff of the contractor will meet the PIU-EO and the supervision consultants on-site where the CEMP conditions will be confirmed with the contractor. The contractor and his staff will also be made cognizant of the GRM and the requirements and protocol for addressing complaints, issues and concerns raised by the APs and stakeholders during the implementation of the subproject All the staff of the contractor are to be made aware of the safeguards requirements and their obligations as stipulated in the CEMP.

B. Construction Phase

1. Impacts on the Physical Environment

105. Preparation of site and establishment of contractor's facilities. This applies to all of the contractor's facilities, offices, worker camps, storage areas, workshops, quarries, concrete batching areas etc. The establishment of the requisite facilities of the contractor will result to various adverse impacts to the environment. These are, however, minimal and temporal in nature and will be mitigated through measures established in the EMP. The identified impacts are as follows:

- Clearing and grubbing activities for the establishment of the required facilities, quarries, camps and offices will result in loss of vegetation which may further result in soil erosion and increased sedimentation of nearby water bodies;
- An acute increase in ambient levels of noise will be experienced as a result of the operation of the heavy equipment, operation of the batching and asphalt plants and increased vehicular and human traffic in the area;

- An acute increase in suspended particulate matter may occur because of the removal of covering vegetation and the increase human and vehicular traffic in the area;
- Acute increased levels of SO_2 and NO_2 as a result of the operation of the various heavy equipment, vehicles and the operation of the batching and asphalt plants;
- Contamination of water bodies and the aquifer may also result due to the generation of solid and domestic waste from camps and offices;
- Contamination of nearby water courses may result from accidental spills and improper storage of fuel and lubricants and construction materials;
- The generation of solid and domestic waste which may cause contamination of the nearby water courses and aquifer is a potential impact of this activity.

106. As mitigation for the projected impacts of the activity, the following are to be established:

i. The location and development of contractor's facilities are to be approved prior to establishment.
ii. The camps and offices are to be provided with the necessary sanitary facilities such as toilets and bathrooms;
iii. The camps, offices, and ancillary facilities should not interfere with the welfare of surrounding communities in terms of noise, dust, noxious gases and vibration from construction activities and their social well-being from their proximity to contractor's facilities;
iv. The areal extent of the contractor's facilities are to be limited to reduce unnecessary clearing of vegetation,
v. Sanitary waste and grey water is not to be released untreated into surface water systems.
vi. Solid waste from the camps will be properly collected and disposed in the approved disposal sites.
vii. Septic tanks are to be constructed to address the domestic waste that will be generated from the camps and contractor's offices;
viii. Proper drainage facilities are to be established in the camps and facilities to mitigate contamination of the nearby water courses and aquifers
ix. Sites are to be properly drained. Paved areas, including vehicle parking areas, workshops and fuel storage areas are to drain to an oil and water separator.
x. Machineries and equipment are to maintained in good working conditions at all times.
xi. Requisite air pollution control devices are to be installed in the ancillary facilities, i.e. batching and asphalt plants and mufflers are to be installed in all vehicles.
xii. Fuel storage areas are not to be located within 20m of a water course.
xiii. Workers involved in the utilization of fuel and lubricants are to be properly trained in the handling, storage and dispensing of such materials.
xiv. An emergency contingency plan will be prepared to address accidental spills and the occurrence of fire in the facilities.
xv. The contractor's facilities are to be contained within an adequate security fence.
xvi. Concrete and Asphalt batching areas are to be provided with bunds to control movement of runoff to waterways.

107. Preparation of site; excavation, removal and disposal of incompetent materials. This applies to all cleared sites where excavation will be undertaken. This activity may inadvertently result negative impacts such as those listed below. The projected impacts are temporary in duration and low in magnitude.

- Lowered water quality from eroded material;
- Loss of visual amenity from poorly located and finished dumpsites;
- Soil erosion and sedimentation of water courses as a result of the removal of the topsoil and from improper disposition of the spoils;
- Increased levels of particulate matter as a result of the excavation works and dumping of materials which is projected to be particularly problematic during the dry periods;
- Loss of vegetation as a result of the excavation works;
- Loss of faunal habitats resulting from the removal of vegetative cover;

108. The contractor is to arrange and is responsible for the mitigating measures listed below:

i. Limit the areas to excavated to those that can be effectively managed and protected.
ii. Topsoil is removed and stored in separate heaps that are located in stable areas for later re-use for site rehabilitation.
iii. Excavated material is sorted and stored as either competent (able to be reused) and incompetent (to be disposed of) materials.
iv. Materials are not to be disposed/stockpiled less than 20 meters from water courses.
v. Side casting of materials are not to be undertaken especially during the wet season.
vi. At completion of work dumping areas to be re-top-soiled and re-vegetated.

109. Utilization of quarry and material fill sites. The DoW maintains several approved quarries and sites for fill material in the highlands region. The choice of quarry or fill material sites depends upon the requirements of the contractor and the location of the work areas. The contractor may opt to utilize existing quarry and fill material sites, however, he may also decide to open new ones. If already opened sites are to be used by the contractor, he is to follow established procedures for these sites. Should the contractor decide to open a new quarry or a fill material site the contractor will first need to discuss the requirement with the PIU and prepare necessary documentation as required by the DEC. The extraction of materials from quarry and fill sites may result to various adverse impacts such as

- Impairment of water quality from uncontrolled runoff from the quarry and material fill sites;
- Loss of soil resources as a result of the removal of the top soil;
- Loss of aesthetics as a result of the alteration of the natural topography of the area;
- Loss of vegetative cover as a result of the removal of the topsoil and overburden;
- Disturbance to settlement areas along the haul roads during transport of materials from quarry site to work areas;
- Ponding and accumulation of stagnant water in borrow pits and quarry areas;
- Disruption in the hydrology of the water courses as a result of excavation of river beds;
- Quarry sites and material sources areas are not to be located in wildlife management areas, forest areas or game sanctuaries; This impact is irrelevant as the road itself is not located in any of the above mentioned areas.

110. The contractor, should he decide to open a new materials source/quarry will need to establish the following mitigating measures to minimize or if at all possible, eliminate the attendant adverse environmental impacts.

i. The contractor will prepare a quarry management plan that meets the requirements of the DoW Code of Practice, which will include payment of a royalty to the landowners to extract materials from the site and closure of the site.
ii. Balance cut and fill requirements to minimize impacts from extraction of aggregates;
iii. Topsoil and overburden are to be stockpiled near the site and covered with tarpaulin fenced off for safety and security considerations and later reused to re-contour borrow pits after completion of works.
iv. Adequate drainage shall be provided in the material source/quarry areas to prevent the accumulation of stagnant water during the operation;
v. Should stagnant water accumulate, the borrow pits shall immediately be de-watered to prevent the creation of mosquito breeding grounds;
vi. Material sources and quarry areas shall preferably located near the alignment to minimize hauling distance and time and disturbance to settlement areas along the haul roads;
vii. Damages to access roads, garden plots, and other property resulting from the operation of the quarry and material sources sites and transport of materials are to be reinstated after completion of works;
viii. Existing quarry and material sources areas are to be restored before a new site is opened.

111. Working over watercourses. This is in the context of the maintenance and rehabilitation works that will be undertaken for the six bridges within the existing Ialibu to Kagua Road. The works would only involve the replacement of the decking and removal of rust and repainting of the Lineger; Kuni, Puti, Alipina, and Kagua Bridges and the removal of rust and repainting of Yalo Bridge. All activities will be undertaken and concentrated on the bridge itself (above the watercourse) and will not require working in or alongside the channels. There will be minimal or no impact to the channels that will accrue from the works that will be undertaken on the bridges.

112. The water quality and the aquatic life of the watercourses will be not affected by the above developments. Nevertheless, the water quality parameters as established by the Environment Act of 2000, specifically Table 1 – Water Quality Criteria for Aquatic Life Protection and the baseline measurements that will be undertaken prior to commencement of the works shall be taken into consideration. If the water quality of the watercourses elevates to unacceptable levels, the contractor is to schedule work to provide periods where the watercourse are not disturbed. The contractor's Community Liaison officer of the contractor will advise the communities when the conditions return for suitable use. The identified impacts for this activity is as follows:

- Contamination of the water course from accidental spills of materials. This impact is very insignificant as the works on the bridges will mainly involve removal of rust, repainting and replacement of decking in some bridges. The volume of materials to be utilized in the works, such as paint does not pose a risk to contamination of the water course
- Increased turbidity as a result of the disturbance of the channel. This is irrelevant in the context of the proposed bridge works. As stated in the previous section, all works will be concentrated on the bridge above the watercourse and no works will be undertaken in, alongside or adjacent to the channel.

- Disruption of the hydrology and hydraulic characteristics of the channel as a result of laying of gabions and other river protection works and river training works. This is also an irrelevant impact as works will only be limited to removal of rust, repainting and in some bridges, replacement of missing decking which will all be done on the bridge itself above the watercourse and not in, alongside or adjacent to the channel;
- Scouring of the riverbed as a result of works on the foundation of the structure. This is another irrelevant impact as the proposed works will only involve removal of rust, repainting and in some bridges, replacement of missing decking;
- Increased noise levels and vibration as a result of pile driving activities. There will be no pile driving activities that will be undertaken as bridge works are limited to removal of rust, repainting and in some bridges, replacement of missing decking. This is irrelevant in the context of the proposed subproject;
- Depletion of aquatic life due to the proposed development. The aquatic life will not be affected by the development as the proposed works are limited to minor repair and maintenance on the bridge itself above the watercourse and would not in any way adversely impact the aquatic life in the channel.

113. The contractor will be responsible for ensuring that the water quality of the watercourses does not reach unacceptable levels and cause concerns from downstream users. The following mitigating measures are to be established to minimize the projected adverse impact of the activity.

i. Plan works to be carried out over the channels only for dry season;
ii. Plan operations to avoid creating downstream turbidity;
iii. Tarpaulin will be laid-out under the structure to prevent materials from falling into the watercourses.
iv. No fuel, oil or lubricants to be spilled or released from equipment working over the watercourses;
v. There will no refueling of equipment or vehicles while working over the watercourses;
vi. Work will be halted if background water quality elevates to levels above the limits prescribed by the Water Quality Criteria for Aquatic Life Protection or complaints are received from downstream users;
vii. If the water quality of the watercourses elevates to unacceptable levels, the contractor is to schedule work to provide periods where the watercourse are not disturbed. The Community Liaison officer of the contractor will advise the communities when the conditions return for suitable use.

114. Waste materials from the removal of bridge or bridge components. This is an impact which is irrelevant to the subproject as the bridge works will not entail the removal and replacement of the bridge but will merely involve minor maintenance and in some cases replacement of the missing decking.

115. Waste materials from the removal of existing seal/sheeting. This is another impact that is irrelevant to the subproject as the whole length of the existing Ialibu to Kagua road does not have any seal or pavement.

116. Noise and Vibration: this applies to all machinery, vehicles and construction sites where noise and vibration may affect susceptible receptors. The improvement/rehabilitation works would inadvertently result to increased noise levels in the area. Among the impacts identified are the following:

- During the works, the operation of heavy equipment and various construction machinery are primary noise generators. It is projected that noise levels could reach from 65 to 80 dB (A) at peak times.
- Poor maintenance of equipment may cause very high noise levels. Faulty or damaged mufflers, loose engine parts, rattling screws, bolts, or metal plates all contribute to increasing the noise level of a machine as well as careless or improper handling and operation of equipment.
- Poor loading, unloading, excavation and hauling techniques may lead to increased noise levels.

117. The contractor will be responsible for ensuring that noise and vibration does not affect the surrounding communities. While it is unlikely that noise and vibration will be an issue due to the distance between the activities and the communities the contractor must be prepared to curtail work to daylight hours should the community find that any nighttime operations become a nuisance. Suggested measures to achieve this objective will also include:

i. Ambient noise levels should not exceed 45dBA at the boundaries of the residential areas.
ii. Temporary construction facilities such as labor camps, vehicle maintenance workshop and earth moving equipment will be located at least 1 km away from settlements and other sensitive areas as far as possible.
iii. Noise sources such as stone crushers, vehicles movements and stone quarry will be re-located to less sensitive areas and at least 1 km away to take advantage of distance and shielding.
iv. Opportunity will be explored to take advantage of the natural topography as a noise buffer such as behind the ridge that break the line of sight between the source of noise and the receptors during facility design.
v. Silencers will be installed in construction equipment and machinery and maintained properly at all times.
vi. Equipment and machinery with lower sound levels will be selected for the use.
vii. Protection devices such as ear plugs/ or ear muffs will be provided to the workers during period of operating high noise generating machines.
viii. Noise levels will be regularly measured to ensure the effectiveness of mitigation measures.
ix. Construction activities will be carried out between 5 am to 8 pm only to avoid disturbance to nearby communities at night. Only in extreme instances will work beyond these hours be allowed.
x. Noise barriers such as earth mounds or walls of wood, metal that form a solid obstacle between the road and roadside community will be used, especially in the schools and hospitals.
xi. Proper information and notification of the concerned local government unit will be conducted to prevent disturbance and nuisance to nearby settlement areas.

118. Air Quality. The potential sources of air pollution during the construction stage include: dust from earth works; emissions from the operation of construction equipment and machines; fugitive emissions from vehicles plying the road; fugitive emissions during the transport of construction materials; air pollution other than dust arise from combustion of hydrocarbons particularly from the hot mix plants, and localised increased traffic congestion in work areas. Most of the emissions will be in the form of coarse particulate matter and will settle down in close vicinity of construction site. Hot mix plant will generate carbon monoxide (CO), un-burnt hydrocarbon, sulphur di-oxide, particulate matters, and nitrogen oxides (NOx) emissions. The impacts will be minor, local, short-term, direct and reversible. The following are the identified projected impacts on the air quality of the receiving environment:

- Acute increase in levels of Total Suspended Particulate Matter, SOx, NOx and CO;
- Increase in incidences of upper respiratory diseases due to elevated levels of pollutants in the works areas and nearby settlement areas;
- Increased incidences of accidents due to low visibility during dusty conditions in the work areas;
- Nuisance to residents near haul roads due to increased traffic in the area.

119. The following mitigating measures are to be established by the contractor during the implementation of the works:

i. Water sprinkling, water fogging, broom sweeping will be carried out in dust prone locations, unpaved haulage roads, earthworks, stockpiles including asphalt mixing plant areas.
ii. Open burning of solid wastes (plastic, paper, organic matters) will be prohibited.
iii. Use of dust control methods (such as covers, water suppression paved or unpaved road surfaces, or increase moisture content for open materials storage piles) will be practiced.
iv. A regular vehicle maintenance and repair program will be implemented.
v. Masks and personal protective equipment (PPE) will be provided to the construction workers to minimize inhalation of respirable suspended particulate matters.
vi. Mixing plants and asphalt (hot mix) plants including crushers and the batching plants will be located at least 1 km downwind from the nearest settlement only after receiving permission from the Supervision Consultant. Hot mix plant will be fitted with stack /chimney of adequate height as prescribed by Supervision Consultant to ensure enough dispersion of exit gases.
vii. Bitumen emulsion and bitumen heaters will be used to the extent feasible.
viii. LPG or kerosene will be used as fuel source in construction camps instead of wood. Tree cutting for fuel wood will be restricted.
ix. Diesel generating sets will be fitted with adequate stack height.
x. Diesel with low sulphur will be used in diesel generator sets as well as other machineries.
xi. Air quality will be monitored during construction stage and if monitored parameters are above the prescribed limit, suitable control measures will be applied.

120. Prevention of soil erosion on construction site. The contractor will be responsible for ensuring that the erosion is contained by appropriate soil conservation protection methods. The implementation of the subproject may result to the following:

- Loss of soil resources

- Decreased water quality of water courses affected;
- Eroded soil interfering with construction activities;
- Sedimentation of nearby watercourses and channels.

121. These impacts are transient, short-term and insignificant. The following measures are recommended to be undertaken to mitigate potential soil erosion in the work sites. This will be the responsibility of the contractor.

i. Limit the extent of excavation to reduce soil erosion potential.
ii. Install control structures or soil conservation protection methodology is to be applied to susceptible areas to avoid storm water runoff carrying eroded materials either, off-site to susceptible areas or, else onto already finished work areas.
iii. Schedule construction so that large areas of soil are not laid bare during wet seasons, and avoid excavating areas and operating machinery in wet ground conditions.
iv. When needed (particularly work area abutted with watercourses/bodies), contain construction areas using a bund or trench, installation of sediment traps or isolate them from other surface run-off, and clean and rehabilitate them when construction is complete.
v. Excavated areas are to be re-vegetated as soon as possible at the completion of the work site.

122. Storage and handling of other construction materials, fuel and lubricants. Construction materials that will be utilized for the works will include sand, gravel and cement for concrete manufacture, reinforcing rods and steel mesh, wood and other construction materials, fuel and lubricants and paint and thinners. Impacts of this activity are as follows:

- Improper handling of these materials may result to pollution of the surrounding areas.
- Nearby water bodies and aquifers may be contaminated by the stored materials if improperly handled.
- Contamination of the soil may occur as a result of this activity.
- Noxious gases and fumes may be released if the materials are not properly stored.

123. This impacts, however, can be readily mitigated. Areas will need to be prepared for storing these materials to prevent deterioration of materials. The contractor is responsible for this with the Resident Engineer (RE), EO and IES responsible for the supervision and monitoring of the contractor. Suggested measures are the following:

i. Fuel and oil will need to be stored in dedicated areas, security fenced and provided with oil and water separators with fuel hoses and shut off valves locked and at least 20m away from the water courses/bodies. Where >5000 liters of fuel is stored on site, the fuel must be stored in sealed tanks that are provided with a concrete base that is bunded to hold 110% of the tank capacity.
ii. All workshops with significant activities should be provided with oil and water separators.
iii. Vehicles and machinery are not to be refueled within 20m of the nearest water course/body.
iv. The contractor must prepare a Fuel Handling Procedure and trained personnel who are competent in fuel handling procedures.

v. The contractor will prepare an Accidental Spill Reaction Procedure to address accidental spills.

vi. If water soluble bitumen is to be utilized, such material is not to be applied immediately prior to the occurrence of rain

vii. Any major spill is to be reported to DoW and DEC.

viii. All waste oil, oil and fuel filters are to be collected and disposed of in safe and secure disposal facilities.

ix. At the closure of the site, all contaminated soil is to be excavated, removed and replaced with fresh topsoil.

124. Use of hazardous materials. The use of hazardous substances can cause significant impacts if uncontrolled or if waste is not disposed correctly. Care will need to be taken should any hazardous chemical (HAZCHEM) materials be required during construction. It is recommended that the contractor use the HAZCHEM system, which is based on the UN classification system. The contractor will be required to prepare a list of all materials that are proposed to be brought to site together with their HAZCHEM rating. The PIU is to verify the HAZCHEM rating and approve the use of any HAZCHEM rated chemicals. Among the impacts identified for this activity are the following:

- Contamination of the soil and nearby watercourses may result from the utilization of hazardous materials.
- Improper handling, storage or utilization of hazardous materials poses a significant health risk to the workers and residents of nearby settlement areas;
- Damage to vegetation and crops may occur as a result of contamination from the hazardous materials.

125. As mitigating measures, the contractor is to establish the following:

i. Ensure that safe storage of fuel, other hazardous substances.

ii. Hydrocarbon, toxic material and explosives (if required) will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination.

iii. Equipment/vehicle maintenance and re-fuelling areas will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas shall be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency;

iv. Fuel and other hazardous substances shall be stored in areas provided with roof, impervious flooring and bund/containment wall to protect these from the elements and to readily contain spilled fuel/lubricant;

v. Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations;

vi. Ensure all storage containers are in good condition with proper labeling;

vii. Regularly check containers for leakage and undertake necessary repair or replacement;

viii. Store hazardous materials above flood level;

ix. Discharge of oil contaminated water shall be prohibited;

x. Used oil and other residual toxic and hazardous materials shall not be poured on the ground;

xi. Used oil and other residual toxic and hazardous materials shall be disposed of in an authorized facility off-site;

xii. Adequate precautions will be taken to prevent oil/lubricant/hydrocarbon contamination of river channels;

xiii. Ensure availability of spill clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored;

xiv. Spillage, if any, will be immediately cleared with utmost caution to leave no traces;

xv. Spillage waste will be disposed at approved disposal sites;

xvi. All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulation;

xvii. The contractor will be required to display safety information in all work areas and to train workers in the safe use of these materials, including the provision of protective equipment for handling these substances.

xviii. The contractors shall identify named personnel in-charge of storage sites for hazardous materials and ensure they are properly trained to control access to these areas and entry will be allowed only under authorization.

126. Conduct of Prohibited Activities. The contractor is to be aware of the activities shown in Appendix 5 of the of the ADB's SPS, Prohibited Investment Activities List. Any of the listed activities are prohibited. The IES and EO are to verify that the contractor is aware of the Appendix 5 requirements and that none of these activities will be sanctioned during construction.

127. Disposal of site waste. During the implementation of the works, solid waste such as steel and timber off-cuts, sand and gravel, cement bags will be generated. If not properly collected and disposed, these materials may cause adverse impacts to the surrounding areas. The following are the identified impacts of this activity:

- Contamination of the land where the solid waste is deposited;
- Decrease in water quality of nearby water courses and affected aquifers;
- The stockpile of solid waste may create habitation for rodents, pest and vermin which may present a health risk to workers and residents of nearby communities;
- Reduced aesthetics as the heaps of solid waste in the area will be an eyesore;

128. As mitigation, the contractor will establish the following measures listed below.

i. All solid waste that will be generated during the construction works are to be collected and sorted and properly disposed in approved facilities;

ii. The contractor will maximize the utilization of materials to minimize generation of waste;

iii. It shall be endeavored that used wood and timber be reused for formworks and other appropriate works;

iv. Recovery of materials will be encouraged, however if these cannot be recovered for scrap value these materials are to be taken to an approved landfill sites for final disposition.

129. Clearance and rehabilitation of construction sites and removal of contractor's facilities. During the implementation of the works temporary facilities such as camps, offices and facilities will have been constructed. The impacts of this activity includes the following:

- Reduction of the aesthetics of the receiving environment;
- Soil contamination from residual and excess materials stockpiled in the area;
- Elevated levels of pollutants in the nearby water courses and aquifer;
- Creation of habitat for mosquitoes, pests, vermin and stray animals as a result of the stockpiling of solid waste.

130. After all the works are completed, it is the contractor's responsibility to address site cleanup and restoration. The mitigating measures to address this concern are the following:

i. It shall be endeavored that all waste materials, machinery and any contaminated soil are removed from the site and properly disposed inn approved disposal areas.
ii. All construction sites and work areas are to be rehabilitated and restored so that these can be returned as close as possible to their previous use.
iii. Stabilization and landscaping of all of the construction sites to re-establish site drainage are to be undertaken as soon as works are completed.
iv. Any borrow pits or quarries that were operated by the contractor are to be reshaped and closed.
v. Any contaminated soil must be removed from fuel and oil storage areas and the site re-vegetated.
vi. No waste is to remain behind after work is completed that will not naturally and safely decompose.
vii. Should waste not be removed, DoW is entitled to withhold payment and arrange the clean-up and deduct the cost of the clean-up from the final payment amount less an additional 10% for arranging the task.

2. Impacts on the Biological Environment

131. The impacts on the biological environment due to the rehabilitation and upgrading of the Ialibu to Kagua Road is projected to be minimal as the works will be undertaken in an existing roadway and already disturbed area. Clearing and grubbing will only be undertaken for the temporary facilities and will be limited to the required areas only. Removal of vegetation along the shoulders and additional areas required may be necessary but this also will be kept to the minimum. Re-vegetation of cleared areas will be undertaken as part of the restoration works.

132. Clearing of sites and removal and disposal of vegetation. This applies to the existing carriageway, shoulders, drainage and the contractor's site facilities. It is projected that the implementation of the subproject activity will result to negative impacts on the receiving environment. These are listed below:

- The clearing and grubbing activities will result to loss of vegetative cover;
- Removal of the vegetation will result to soil erosion;
- Sedimentation of nearby watercourses as a result of the subsequent erosion of the areas;
- Increased levels of particulate matter, especially during the dry periods, as a result of the removal of the vegetative cover;
- The removal of the vegetation will generate organic material for composting which could be utilized to fertilize the garden plots in the area;

133. To minimize the adverse impact of this activity, the contractor is to arrange and is responsible for the activities listed below.

i. Wherever possible limit area to be cleared and avoid excessive machine disturbance of the topsoil as this is required to be removed and stored
ii. Areas of significant vegetation within the cleared area have been identified and have been shown to machinery operators.
iii. The area to be cleared is defined by a clearly established boundary.
iv. 10 m wide buffer zones are to be established around watercourses and no clearing is permitted within this area.
v. Machinery operators must be shown the boundaries of areas to be cleared.
vi. Cleared material is to be pushed into manageable stockpiles according to disposal or re-use requirements.
vii. Waste vegetation should be made available to villagers as fuel wood
viii. If the material is an impediment to workers it may need to be burnt to clear the area. Wherever possible limit burning and if this is to be done ensure that the wood is dry so as allow a hot clean burn that produces little smoke.

134. Loss of forest cover. This impact is irrelevant to the subproject as the existing Ialabu to Kagua Road is not located within a forested area.

135. Disturbance to Wildlife Management Areas (WMA). This impact is also irrelevant in the context of the subproject as the existing roadway is not within a WMA, Forest Reserve or Floral/Fauna Sanctuary.

136. Loss of faunal habitats. This is an impact which is irrelevant to the subproject. There are no significant faunal communities existing in the existing roadway. Moreover the vegetation that may be cleared are some vegetable gardens and cow grasses which is the predominant vegetation in the length of the roadway.

137. Loss of faunal communities. There are no significant faunal communities existing in the area of the roadway. In this context, this impact is irrelevant to the subproject.

138. Control of invasive species. Invasive species have the ability to out compete local vegetation and the introduction of these into new areas is to be avoided. The primary impact of this concern is the loss of indigenous vegetation. This may result to a permanent and irreversible impact unless properly mitigated. Prior to the contractor mobilizing the IES and EO will arrange to review the site and determine whether there is or is not any infestations of invasive species in the area. The IES and EO are to determine where the contractor's machinery was last used and whether the area is infested with any invasive species. Depending on the state of any infestation at the construction site the RE will advise the contractor whether or not machinery must be cleaned before moving to the site. As mitigation for this impact, the contractor is to establish the following measures:

i. Any potential seed sources such as earth and organic material that may be attached to machinery will be removed and disposed appropriately.
ii. During replanting/re-vegetation works, new alien plant species (i.e., species not currently established in the region of the project) shall not be used. Only endemic species of vegetation are to be utilized for this purpose;
iii. The contractor, PIU will be required to observe for any infestations.
iv. Should infestations occur on construction sites that are due or are not due to the contractor's activities the contractor will be required to control the infestation.

139. Control and avoidance of the introduction of invasive species is the contractor's responsibility and this extends to any sub-contractors.

3. Impacts on the Socio-economic and Cultural Environment

140. The project will create better access to town centers especially on the middle section of the road where access is problematic. An all-weather road would mean continuous access during rainy season and would improve household income (Manus 2009) because households are able to transport their agricultural produce easier and faster to the markets because of improved road conditions. The residents of the impact area of the Ialibu to Kagua road would have better opportunities because of easier and faster travel time. The proposed development will also improve the health and education services in both Ialibu and Kagua Districts.

141. Public access to the site. this applies to the contractor's site and work areas. This impact is insignificant and short-term in duration. Impacts identified for this concern are the following:

- Unrestricted access to the work sites and contractor's facilities may present security concerns.
- Increased risk of accidents as a result of unhampered access of unauthorized persons into the work areas and facilities

142. The IES and EO will be responsible for the supervision and monitoring of the contractor. As mitigation for this impact, the following will be established by the contractor:

i. Access to the contractor's facilities will be controlled.
ii. A security fence will be installed around the facilities.
iii. Visitors will be required to report to a check point before being allowed to enter the site.
iv. Work areas will be demarcated by barrier tape and signs erected as required to warn people that there is no right of entry to these areas.

143. Community safety from increased vehicle movements. This applies to all vehicles and in particular haul trucks that have to pass through villages. Increased vehicular traffic is an impact of the proposed development. This presents itself as a safety issue to the communities near the work sites where the vehicles will be passing through. The contractor is to ensure that all vehicles that may be required to pass through villages are operated and transport equipment and materials safely without endangering these communities. The contractor is to immediately remove any drivers that ignore any of the community safety requirements. This will be the responsibility of the contractor. The IES and EO will responsible for the supervision and monitoring of the contractor. The contractor is to ensure:

i. That trucks and other vehicles are maintained in a safe operating condition,
ii. All drivers and machinery operators act responsibly,
iii. All loads are to be secured and all loads with fugitive materials (e.g. excavated soil and sand) are to be covered with tarpaulins,

144. Workplace health and safety. The contractor is expected to employ workplace health and safety protocols and is covered by the Employment Act (1978). The main workplace impacts are the following:

- Hazards from operating and using machinery. Direct hazards to the machine operators and to workers working in the vicinity of the machine;
- Hazards to workers exposed from heavy materials being lifted by cranes;
- Refueling hazards;
- Exposure to HAZCHEM materials;

- Traffic accident hazards.

145. Before commencing work in any of these activities (and in any other areas that the contractor identifies), the contractor will be required to prepare a brief work statement that identifies hazards that apply at a particular site. An outline of the approved work procedure and details of protective safety equipment to be used by any person entering the specified work area and an Emergency Response Procedure (ERP) as part of the CEMP to address serious accidents and nominate a person who is to be immediately contacted should an accident occur should also be included in the CEMP. A copy of the CEMP-ERP and the person to contact in case of an emergency is to be posted at the site where it is visible to all workers. Before commencing work, the contractor is required to discuss the ERP requirements with the workers. As part of the CEMP, the ERP is to be submitted to the PIU/EMU-DoW for approval at least one week prior to work commencing on the site. The contractor will be required to keep a Record of Accidents and Incidents (including time lost from accidents and incidents).

146. This will be forwarded each month to DoW as part of the contractor's monthly reporting. The IES and EO will inspect and approve the adequacy of these arrangements. Measures to comply with this include:

i. Erect warning signs and barriers around work areas
ii. No drugs or alcohol allowed on-site
iii. Noise and dust to be controlled
iv. All workers provided with safety equipment appropriate for the task in which they are employed
v. Potable water, chemical toilet, changing place with clothes storage, and washing and showering facilities
vi. Work Statements prepared for each activity
vii. Prior to entering site for first time workers to be inducted to site and site hazards explained together with explanation of work site safety procedures
viii. Medical and first aid facilities provided together with a person qualified in first aid

147. Location of camps and employment of local labor. A construction site such as this may employ over 200 persons some of who may need to be located on-site. Impacts of this concern are listed below:

- There is a potential for conflict to develop with local communities should they be marginalized by the introduction of outside workers who then enjoy an enhanced economic status in comparison to the local communities.
- The risk of contracting and spreading of HIV and STI's is also a projected impact of the proposed development.

148. As mitigation for the identified impacts, the contractor is to establish the following measures listed below.

i. Workers from the local communities will be offered preferential employment as unskilled labor.
ii. Workers will also be required to undergo regular check-up to minimize the risk of contracting and spreading of HIV and STI's.
iii. Camps will be sited a good distance away from nearby settlement areas to avoid social conflicts.

149. Provision of adequate living conditions within campsite. The impacts that may accrue as a result of this activity are the following:

- Poor health of workers;
- Loss of worker productivity may result from the absence of appropriate living conditions within the project area.

150. As mitigation for the abovementioned impacts, the contractor will establish the following measures:

i. Workers will be provided with adequate housing, sanitation and recreational facilities.
ii. The contractor will provide acceptable camp facilities with potable water, sanitation and washing facilities, kitchen and adequate cooking facilities, nutritionally adequate food rations and recreational facilities to either meet requirements of the Employment Act (1978) or an acceptable international standard whichever is the higher.

151. Camp water heating and cooking - use of fuel wood. To avoid sudden and unsustainable loss of any resources to the detriment of surrounding communities, the contractor will be required to implement the following.

i. Provision of gas and kerosene for water heating and cooking;
ii. Locate camp away from significant forest areas, and limit collection and use of fuel-wood; and
iii. Contractor will impose sanctions on any workers collecting timber or non-timber resources.

152. Hunting and sale of wildlife. To avoid sudden and unsustainable loss of any wildlife resources the contractor will be required to address the issues listed below. This will be the responsibility of the contractor. Mitigation measure include:

i. Labor employment agreement enforced by contractor that bans hunting and trading in wildlife by workers;
ii. Contractor is to provide nutritionally adequate camp rations;
iii. Contractor will impose sanctions on any workers hunting or catching wildlife.

153. Chance discovery of archaeological and cultural sites. Archaeological and cultural sites are protected under the National Cultural Property Preservation Act. While there are no known archaeological or cultural sites within the project boundaries, during works it is possible that "chance discoveries" may be made. The contractor will be responsible for these finds and is to immediately stop work where the discovery has been made and advise the RE and implement the "chance find" measures included in the CEMP. The DoW will arrange to have the site evaluated. Depending on the evaluation of the discovery, the contractor will be advised whether it is possible to resume work on the site. This will be the responsibility of the contractor.

C. Operation Phase

1. Impacts on the Physical Environment

154. During the operation of the rehabilitated roadway, the main issues will be the (i) Disposal of waste materials from the maintenance works such as removed asphalt from patching and re-sealing activities of the roadway and paint tins and solvents from the re-painting of the bridges; (ii) Noise and emission levels; and (iii) Public Safety.

155. Infrastructure Maintenance: Routine maintenance will be undertaken at regular basis. Seasonal maintenance will be undertaken as necessary, such flood repairs, emergency maintenance to reinstate structures after major failures, and the regular upkeep of safety features. Major maintenance that will include major repairs is typically scheduled over periods of several years.

156. The maintenance works will generate solid waste that has to be managed properly and disposed appropriately. Disposal of removed asphalt from road maintenance, paint tins and solvents from bridge maintenance. During the maintenance on the roadway, asphalt from removed and replaced the roadway re-sealed. This will be undertaken as required. During the maintenance of the bridges which will be done every 5 years, small quantities of paint and solvents may be needed for the works. All removed asphalt, paint tins and solvents are to be collected and disposed in an approved disposal facility. To mitigate this impact, all waste that will be generated will be collected and disposed in approved disposal sites. The work areas during the maintenance works will be kept free of waste materials. DoW will be responsible for the implementation of this procedure.

157. Noise and emissions control. Noise and emission levels may increase as a result of the development. However, considering the low traffic volume, noise and increased levels of emissions cannot be considered a major concern in the area. However, when the amount of heavy traffic increases, provision of noise/dust fence barriers (using traditional material such as coconut leaves mat) commonly used in the area might be considered. Regular monitoring of levels will also be undertaken for the first year of operation. This will be the responsibility of DoW in coordination with the DEC.

2. Impacts on the Socio-Economic and Cultural Environment

158. Public Safety. Safety of the public, especially in built-up areas may be compromised with the upgraded roadway. Measures to mitigate this impact will include the following: (i) Measures to slow traffic (e.g. speed bumps) at selected sites such as schools, markets, and densely populated areas; (ii) Provision of off-road let down stops for vehicles; and (iii) Proper road signage and pavement markings, particularly accident-prone spots. DoW will be responsible for this activity.

VI. ANALYSIS OF ALTERNATIVES

159. With the Project Alternative. Currently, access to marketplaces, jobs, education, health care etc., is hampered by the poor conditions of the road, which is a result of a lack of road and bridge maintenance. Transport is more costly and more time consuming than it would be with a properly maintained road network, and in many parts of the Highlands region some road connections have ceased to exist as the roads are no longer passable. Tthe subproject is expected to have the following benefits:

i. Road User Savings: Savings in Vehicle Operating Costs are the major category of benefits and are the difference between the costs of operating vehicles on the sub-project road with the proposed improvement compared with the base case of the existing condition.
ii. Generated Traffic Benefits: Reductions in vehicle operating costs and travel times will result in more trips being taken, particularly by PMVs, trade, and service

vehicles. These benefits from generated traffic are expected to arise as a result of increased economic and trip activity catalyzed by reduced transport costs.

iii. Exogenous Benefits and Costs: In addition to benefits in vehicle operating cost savings, some limited additional benefits could arise as a result of additional net value added to the economy through additional marketing of vegetables and coffee. Accessibility is currently constrained by the deteriorating condition of the existing road.

iv. Diverted Traffic Benefits: Benefits from diversion of existing traffic on to the upgraded road will be minimal, as the road is the only significant link road serving the population in the area.

v. Health Benefits: Improvements in health and personal lifestyle will occur as a consequence of the reduction of dust nuisance.

160. Without the Project Alternative. As shown in the sections above, the subproject will be a definite improvement in connectivity for the local communities. Not implementing the subproject will delay the development opportunities and social benefits for the concerned communities using the Ialibu-Kagua road section.

161. Technical Alternatives. Two technical alternatives were analyzed using the RAMS/HDM-4 system: a '*Base option*' (minimal maintenance of the existing road) and '*rehabilitation*' of the proposed road section. The assessment of the alternatives shows that for the Ialibu-Kagua road section, rehabilitation is the preferred technical alternative.

162. Alternative Alignments. To avoid steep slopes and sharp curved, it could be considered to realign selected sections of the road and construct new road sections. However, this alternative is not preferable because of significant environmental and social impacts. It has been agreed that possible land disputes and destruction of private/community property should be kept to the absolute minimum.

VII. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

163. As required by the ADB's environmental and social safeguard requirements and Public Communications Policy, public consultations need to be undertaken for projects of this nature. The primary purpose of the consultations is to present the proposed development, illicit issues and concerns that the people, stakeholders, and concerned parties in the impact area may have relevant to the proposed development.

164. Community consultations were held during site visits and data collection in July 2011. The purpose of the consultations was to inform the public about implementation of the HRRIIP and the specific subproject and get the opinions, concerns and issues of the stakeholders for consideration in the design of subproject. The project team presented and defined to the participants the scope as well as explained the need for the rehabilitation of the Ialibu to Kagua Road. The project team also explained the environmental and social impacts and the requisite mitigating measures to be established during the implementation of the sub-project.

165. After the presentation, issues and concerns of the stakeholders and participants were elicited, discussed and noted, for further inclusion in design of the subproject. The stakeholders were largely comprised of the concerned and affected people, Provincial and Local Government Officials, Village Leaders, Youth and Women. Annex C presents the photographs and attendance sheets of the consultations.

A. Results of Consultations

1. Community Consultation and Participation

166. Meetings and consultations were held between 08 to 20 July 2011 with communities along the length of existing Ialabu and Kagua Road. The date and locations of public consultations are shown in Table 8. As shown in the table, a total of six community consultations were held between Ialibu/Pangia and Kagua/Erave Districts. Villages covered were Yameyame, Karanas, Yarena/Muli station (combined three villages), Wara Yalo (Wara Yalo Bridge), Iniarere, Pawaabi concluding at the Kagua station.

Table 8 – Locations and Participants of Consultations

Date	Location	No. of participants		
		Male	Female	Total
19.07.11	Yameyame	48	10	58
19.07.11	Kanda	13	1	14
19.07.11	Yarana/Muli	19	8	29
20.07.11	Wara Yalo	24	3	27
20.07.11	Inalere	17	6	23
20.07.11	Rokoma	18	7	25
Total		139	37	176

167. A total of 176 people participated in the meetings. The meetings involved an average of 50 participants including women (25%), Youth Leaders (25%) and elders (10%). Most of the participants were farmers and community leaders some employed as public servants. Majority of the stakeholders expressed the need for the upgrading and rehabilitation of the Ialibu to Kagua road.

2. Process and Results

168. Formal consultations were held at the Ialibu/Pangia and Kagua/Erave District Offices on 08 July 2011. The District Administrators were present during the meetings including village leaders representing villages along the sub-project road, the youth, stakeholders, local officials and women. The first meeting with the District Administrator of Ialibu/Pangia was held at the Mt. Hagen Works Office on 08 July 2011. The District Administrator Mr. Pius Puk was present with the District Treasurer Mr. Raphael Yola. The district office provided local community leaders who assisted the National Consultants by sharing local knowledge on tribal relationships particularly on roads and other public utilities.

169. The Kagua/Erave district people need to connect with the Ialibu/Pangia district through an improved and rehabilitated road network in order to access much needed services. Leaders expressed that the main hindrance to the development of the Kagua/Erave district was because of the condition of the road. The improved road will result to better socio-economic conditions. Land issues were raised however, people have realized that the improvement of the road is of greater importance than the land and the leaders agreed to identify and resolve land issues before the project is implemented.

170. Short-term benefits identified by participants included community participation through employment and skills training, whilst in the long term an improved road would generally raise their living standards. Environmental issues involving dust and noise were minimal and the participants agreed the road rehabilitation would be of a far greater benefit to the people.

171. Table 9 below presents the summary of the issues raised during the public consultations and the response of the national consultants of the Project.

Table 9 - Issues raised during the Public Consultations

Issues raised during Consultation	Response of the Team
Outstanding compensation payment(s) for affected for Ialibu to Pangia Road.	Tasked to the local leaders, current provincial and national leaders to address.
Will affected persons (AP's) be properly compensated?	Yes. The project will conduct a thorough Census survey of losses including land investigation and AP's will be paid by the GoPNG through DOW before the road construction
Will women or Youths be Employed?	Yes the project intends for both men and women to be employed during the road construction. This would be tasked to the contractor(s) as part of the contractual agreement.
Environmental damage caused during construction?	Environmental damage of dust and noise will be minimal and only during the time of construction.
Will the road be maintained? Who is responsible to maintain the road?	The project will include a maintenance contract to ensure that the rehabilitated road will be kept in passable condition throughout its design life. This will create local employment and small business opportunities on a long-term.

B. Ongoing Consultations and Disclosure

172. Public consultations will be conducted as the sub-project proceeds to explain the various processes that the sub-project will proceed through. A structured approach will be developed for additional public consultation that will focus more on awareness so that communities are informed of the project's plans, leading them through the compensation procedures and creating awareness concerning opportunities that the sub-project may present in terms of employment and marketing of produce to the contractor and workers. These meetings will also discuss the social risks of the construction phase with regard to the location of workers and HIV/AIDS infection that may be carried into their communities.

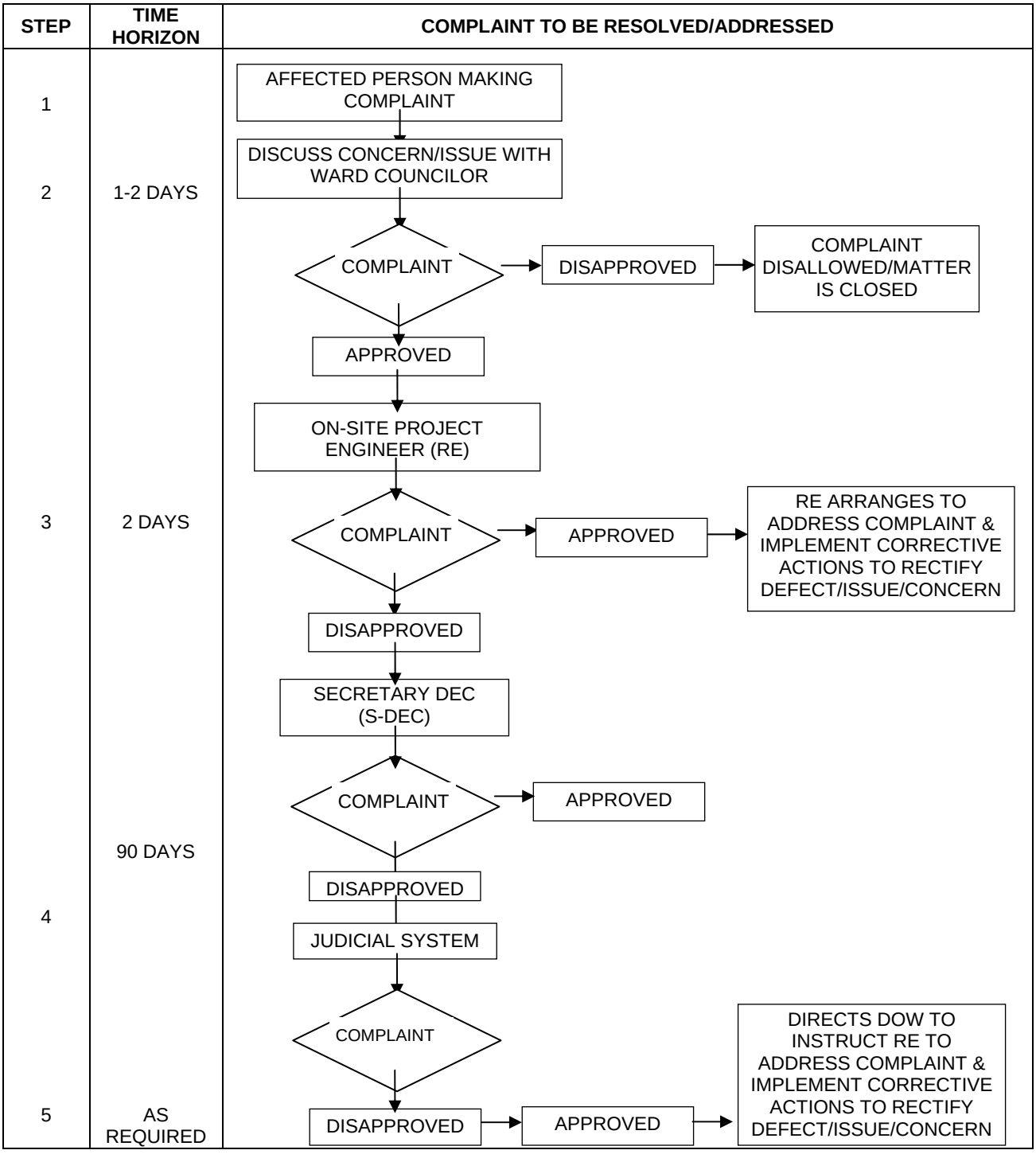
173. The ADB will arrange for the IEE to be posted on the website of the ADB. Following approval of the IEE, a copy of the approval and the IEE document will be sent to all relevant local government offices. DoW will arrange for the IEEs to be posted on their website and copies will be made available to the public. Information regarding the rehabilitation of the Ialabu to Kagua Road and the proposed environmental management measures will be posted at suitable locations in the subproject area.

VIII. GRIEVANCE REDRESS MECHANISM

174. During the course of the subproject and Project 2 it is possible that people will have, concerns with the project's environmental performance including the implementation of the EMP. Issues may occur during construction and again during operation. Any concerns will need to be addressed quickly and transparently, and without retribution to the AP. A grievance redress mechanism (GRM) has been established based on existing frameworks.

175. The following process is to be used and commences with an attempt to sort out the problem directly at sub-project level. If this cannot be resolved then the grievance moves to the resolution process outlined in Section 87 of the Environment Act 2000. This procedure is for addressing environmental issues. Any grievances dealing with land and compensation issues are to be directed to the Department of Lands (DoL) who has established procedures for dealing with these issues. The process is also shown as a flow chart in Figure 7.

Figure 7 - Flowchart Outlining Grievance Review Mechanism



A. During Construction

- Most complaints arising during construction are expected to be minor complaints concerning dust or noise that should be able to be resolved quite easily and acted upon immediately at the sub-project level by the Resident Engineer (RE). Where the complaint is of a more serious nature the RE has up to two days to resolve the compliant.
- Affected people (AP) are initially to discuss their complaint directly with the Ward Councillor in their village. If the Ward Councillor supports the complaint both persons take the complaint to the RE who will review the complaint within two days. All complaints arriving at the site office are to be entered in a register that is kept at site by; date, name, contact address and reason for the complaint. 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 has been 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 by the person who is responsible for the decision and dated. 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. 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 the PIU.
- Should the AP not be satisfied, the AP may take the complaint to the Secretary of the Environment and Conservation (SEC) and continue the grievance in accordance with Section 87 of the Environment Act 2000 - procedure for dealing with compensation claims for environmental impacts. The procedure is set out as follows:
    - The AP meets with EP holder to formally register concern over impact and seek redress. A copy of the alleged impact is submitted to SEC.
    - EP holder has to determine whether the impact has occurred due to its activities.
    - If EP holder accepts responsibility for the impact, it can negotiate a mutually acceptable settlement with AP within 90 days.
    - If EP holder rejects responsibility for the impact, AP can request DEC to carry out a verification investigation.
    - If SEC confirms that the impact has occurred, he/she will advise the EP holder and AP to negotiate a settlement within 90 days.
    - If a negotiated settlement is not reached, the EP holder or AP can request SEC to formulate a determination. Once this request is made, SEC will have 90 days to reach a determination. If either party is dissatisfied with the determination, they can appeal to the National Court.
    - Should the AP not be satisfied with the ruling of the SEC, the AP may at their discretion take the grievance to the PNG judicial system. This will be

at the AP's cost but if the court shows that the SEC or the administration have been negligent in making their determination the AP will be able to seek costs.

- All of the foregoing steps will be recorded in an inventory/register and included in Monthly Reports and will be subject to monitoring.

B. During Operation

176. The same procedure is followed except that the complaint is now directed to the National Roads Authority who will be responsible for making the improved road to rectify. During operation the same conditions apply; i.e. there are no fees attached to the AP for making a complaint, the complainant is free to make the complaint which will be treated in a transparent manner and the AP will not be subject to retribution for making the complaint.

IX. ENVIRONMENTAL MANAGEMENT PLAN

177. The EMP is a tool setting out the ways environmental issues will be addressed with regard to the sequence of activities, i.e. pre-construction, construction, and operation. Following requirements of SPS the EMP has the following components: (i) institutional arrangements for the implementation of the environmental safeguards requirements; (ii) environmental monitoring requirements; and the (iii) mitigation measures (EMP matrix) required to address the impacts of the sub-project.

A. Institutional Arrangements

178. The environmental safeguards and management system for Project 2 consists of:

i. An existing EMU within the DoW which will be responsible for the overall management, monitoring and reporting on application of environmental safeguards;
ii. The PIU which will be supported by the Environmental Officer (EO), delegated from the EMU who will provide advice and assistance to the construction supervision consultant (CSC) in the implementation and monitoring of the EMP;
iii. The CSC will include an international environmental specialist (IES) who will be responsible for supporting the EO and providing training and capacity building as required; and
iv. The contractor which will appoint two staff members as Environmental and Health and Safety Officer (EHSO) and a Community Liaison Officer (CLO) who will be responsible for implementing the EMP and facilitating and managing the GRM on behalf of the contractor. Terms of reference for these two positions are provided in Annex D.

179. The overall HRRIIP will have oversight by a steering committee. The DoW's PIU will be responsible for daily management and implementation of the subprojects under Project 2. The DoW will recruit the CSC which will support the PIU in subproject implementation and have the overall responsibility of supervising, monitoring and reporting EMP implementation. Table 10 sets out the responsibilities of each organization involved in Project and subproject implementation.

Table 10 - Institutional Responsibilities for Environmental Safeguards

Organization	Implementation Responsibilities
DoW through the EMU-DoW EO with assistance from the IES	Prior to the commencement of civil works the EMU-DoW will: ▪ Submit any of the environmental assessments required for regulatory approval of the DEC and obtain approval, e.g., environmental clearance, environmental permit or permits from other statutory authorities as required by the Government. ▪ Ensure that all regulatory clearances for the subproject that are obtained from the relevant Government authorities are submitted promptly to ADB. ▪ Ensure that the required mitigation measures during construction, the IEE and the EMP are included in the bidding document of the subproject and that all bidding contractors have access to the environmental assessments and EMP. ▪ Ensure that the EMP and all required mitigation measures during construction, including conditions stipulated in the DEC's clearance or environmental permit, are included in BCD with requirements to update the EMP in response to any unexpected impacts and that all selected contractors have agreed the to implement the full suite of environmental mitigation measures prescribed in the EMP. ▪ Receive environmental safeguard clearance on subproject(s). ▪ Provide training to contractor prior to preparation of CEMP, safeguards requirements of ADB and regulatory requirements of DEC. ▪ Review and clear the contractors CEMP for each subproject During the implementation of civil works the EMU-DoW will: ▪ Ensure that a CEMP including all proposed mitigation measures and monitoring programs and relevant provisions of the environmental assessments is updated as required, and is properly implemented by the contractors; ▪ Provide training as required to DoW and HRMG's unit in Mt Hagen; ▪ Monitor the implementation of CEMP and submit the monitoring reports to DoW and ADB. ▪ In case unpredicted environmental impacts occur during project implementation, inform ADB, review the CEMP with the contractor, and implement alternative environmental mitigation program. In case a subproject changes in scope, inform ADB and reconfirm the environmental classification, determine whether a supplementary IEE is required, and carry out the study including the requirement for information disclosure and public consultation; ▪ Submit the requisite reports on progress with social and environmental compliance and implementing the CEMP as required by the DEC/ADB; ▪ Ensure that ADB be given access to undertake environmental due diligence for all subprojects. However, the EMU-DoW will have the main responsibility for undertaking environmental due diligence and monitoring of all the subprojects. The due diligence report as well as monitoring reports on CEMP implementation, as required, will be systematically prepared and be made available to the public, if requested
ADB	▪ Provide technical guidance to the DoW/EMU as needed. ▪ Reviewing regular and quarterly monitoring reports and disclosing the environmental assessments and monitoring reports including uploading to the ADB website. ▪ Review and clear subproject IEEs. ▪ Monitor the EMP implementation, as required, and conduct due diligence as part of Project reviews. ▪ Provide assistance to DoW/EMU, if required, in carrying out its responsibilities and for building capacity for safeguard compliance

Organization	Implementation Responsibilities
ADB (continued)	▪ Ensure that the DoW/EMU will conduct the required consultations with project affected groups and local NGOs, and that the DoW/EMU as project sponsor disclose relevant environment information on the project's environmental issues in an appropriate form, manner, and language(s) accessible to those being consulted. Such information disclosure with affected. people will be guided by the Public Communication Policy (2011)
Contractors	▪ Participate in training delivered by DoW and based on site specific conditions, prepare Contractor's Environmental Management Plan (CEMP) for each site ▪ Implement and report on CEMP as part of the rehabilitation and upgrading works ▪ Maintain site diary of daily and weekly inspections and activities of EHSO ▪ Prepare monthly CEMP report as part of progress reports and submit to EMU-DoW. The report will also include the Monthly Accident Report and measures undertaken to address any non-compliance issues identified by the EMU-DoW or DEC. This will include any grievances made and actions taken to resolve the grievance
DEC	▪ Administration and enforcement of the Environment Act 2000 and its regulations as it pertains to the project Identify whether EPs (with or without conditions) required for any identified site ▪ Review IEE and other documentation required ▪ Administer Contractor Waste Disposal permit applications and performance

180. The DoW's EMU will be responsible for coordinating implementation of the EARF and EMP. This will include, but not be limited to; (i) ensuring that the EARF procedures are strictly adhered to and that preparation of environmental assessments will be carried out in a timely and adequate manner, and (ii) environmental monitoring and institutional requirements will be fully met while meaningful public consultations are carried out satisfactorily. DoW will submit the categorization, environmental assessments, and monitoring reports to ADB for review in a timely manner. Two staff, one of which will be the EO, will expand the existing EMU. During implementation the EO will be supported by the IES and receive training to build longer term capacity in DoW for environmental management. The primary environmental management tasks will be to provide environmental safeguards training to DoW staff and the contractor and strengthen the environmental management of the Project. The EMU will also provide support and training to the HRMG's unit based in Mt Hagen.

181. The EO and IES will be tasked to (i) strengthen the environmental management of the Project during contract process, construction, and implementation, (ii) ensure that EMP requirements are integrated into BCD, submit documentation to DEC and obtain EPs as advised by DEC; (iii) provide induction training to contractors prior to preparation and submission of the CEMP; (iv) provide assistance for review and clearance of the CEMP; (v) monitor compliance with the approved CEMP; (vi) prepare reports on environmental safeguards activities as required; and (vii) supervise and guide the environmental assessment process for subprojects to be implemented in the subsequent tranches as part of the PFR.

182. The DEC is responsible for the administration and enforcement of the Environment Act 2000 and its regulations. The DEC will make a determination of the requirements for EP application for subproject activities. DEC may be involved in subproject monitoring as budget and time allows. Copies of the IEE will be sent by the PIU to the DEC for its information.

183. The ADB will be responsible for the following tasks; (i) implementation of the Project Administration Manual which governs all aspects of Project implementation including safeguards; (ii) review and clearance of the IEEs produced under Project 2; (iii) evaluation of the quarterly progress reports (QPR) and safeguards monitoring reports submitted by the CSC to DoW and ADB; (iv) providing advice and support on safeguards application as require; and (v) conduct of review missions including site inspections as required.

B. Environmental Monitoring and Reporting

184. Monitoring requirements are set out in detail (by parameter) in the EMP and summarized in Table 11. At the start of the project and before monitoring begins the EO with the assistance of the IES will review the monitoring activities and update the monitoring requirements to conform with any changes that have been made to the subproject design and activities. The monitoring program will be conducted on two levels (i) compliance monitoring and (ii) baseline and conduct of monitoring to determine the extent of variations and changes in the levels of pollutants in the environment and other parameters and indicators considering the implementation or operation of the project.

185. The EMU-DoW will have overall responsibility for the management, monitoring and reporting for the implementation of the EMPs for Project 2 and will be supported by the CSC. The existing EMU will be expanded to include an EO (and Social Officer) who will receive training and capacity building from the Manager-EMU and IES assigned to the CSC. The EO will be responsible for liaising with the contractor and providing training, advice and assistance in the preparation of the CEMP and its implementation as well as assisting the EO in monitoring and reporting on implementation.

186. Monitoring will relate to compliance with construction contracts (including EMP measures and provisions), the state and health of the nearby environmental resources, and the effectiveness of mitigation measures and complaints. The EMU-DoW will be the primary entity responsible for reporting progress of Project 2 to DoW and ADB. Monitoring will include review of contractor's monthly reports that will cover progress of CEMP implementation and compliance (including general good practice). A section on safeguards activities and compliance with the CEMP for each subproject will also be included in QPR prepared for DoW and ADB.

50. The reporting will be as per the following schedule:

- A monthly report prepared during construction by the contractor reporting on progress of CEMP activities, issues and corrective actions. This will be based on the site diary maintained by the EHSO and compile notes of daily and weekly inspections;
- A report prepared every three months (the QPR) prepared by CSC. The QPR will include a section on safeguards activities and CEMP compliance for each subproject and will summarize the monthly reports submitted by the contractor and any actions or citations made by the Resident Engineer (RE);
- A semi-annual safeguards monitoring report (prepared every six months) by the PIU, submitted to DoW and ADB and disclosed; and
- The project completion report will include a section on safeguards implementation and make recommendations as required for modifications to the processes set out in the EARF and EMP procedures based on the review undertaken at the end of the project. The safeguards section will be prepared by the DoW-EMU (EO) and CSC three months prior to the end of Project 2.

187. During operation monitoring will be carried out by the DoW, in coordination with the DEC.

Table 11 – Summary of Monitoring Requirements

No.	Environmental Monitoring Tasks	Implementation Responsibility	Implementation Schedule
1	**Design Phase**		
1.1	Disclosure of subprojects to DEC and monitor permitting	DoW-EMU (EO) and CSC	Prior to construction
1.2	Audit project bidding documents to ensure IEE and EMP included in bids and environmental criteria are included in evaluation	DoW-EMU (EO) and CSC, ADB	Prior to issue of bidding documents
2	**Construction Phase**		
2.1	Training and briefing of contractor's management, site agents with regards to all IEE and EMP requirements	DoW-EMU (EO) and CSC Contractor	First training prior to preparation of CEMP and commencement of each contract and refresher courses at yearly intervals throughout construction period
2.2	Monitor the performance of environmental training by contractor and briefings and of the environmental awareness of Contractors staff, tool box talks and & refresher courses. Contractor to report on CEMP implementation in Monthly Reports	DoW-EMU (EO) and CSC Contractor	Ongoing, prior to and during implementation of works and operation
2.3	Regular (monthly) monitoring and reporting (quarterly) of contractor's compliance with CEMP and statutory environmental requirements	DoW-EMU (EO) and CSC	Continuous throughout construction period
2.4	Regular (monthly) monitoring and reporting (quarterly) of complaints and responses or environmental mitigation measures	DoW-EMU (EO) and CSC	Continuous throughout construction period
2.5	Monitor adjustments to the CEMP for unexpected impacts and the thorough implementation of detailed CEMP	DoW-EMU (EO) and CSC	During all phases of the subprojects
2.6	Commissioning phase monitoring of road maintenance and facilities versus environmental contractual performance criteria. Check EP compliance	DoW-EMU (EO) and CSC	At commissioning
3	**Operation and Maintenance Phase**		
3.1	Observations during routine maintenance inspections of facilities. Inspections will include monitoring implementation of operational mitigation measures versus environmental criteria specified in EMP for operational impacts	DoW-EMU (EO) and CSC	As per HRMG inspection schedules
3.2	Post construction monitoring of water quality at any sites where complaints about air/noise/water quality from works were justified in construction phase	DoW-EMU (EO) and CSC	Monthly up to 3 months after completion of construction or until air/noise, water quality meets baseline conditions
3.3	Monitoring survival of trees / shrubs and grass in bioengineered slopes (e.g. at landslides, also transplanted / compensatory planted trees)	DoW-EMU (EO) and CSC	During the first three years after installation or rehabilitation

C. EMP and Monitoring Matrix

188. The EMP (including monitoring) for the upgrading and rehabilitation of the Ialabu to Kagua Road is presented in Table 13. The budget for the EMP is estimated at US$500,000 as shown in Table 12, and the estimated costs of monitoring (US$ 310,300) are shown in Table 14. Costs were calculated based on prevailing prices and in consultation with the cost/quantity engineer and is incorporated in the BOQ for the subproject. As part of construction, the contractor will be responsible for provision of a number of mitigation measures as shown in the EMP the purchase of the requisite environmental monitoring equipment and the laboratory analysis of the samples where required.

Table 12 - Estimated Cost for the Environmental Management Plan

ITEM	COST (US$)
Pre-Construction	45,000.00
Construction	355,000.00
Operation	100,000.00
TOTAL	**500,000.00**

X. CONCLUSION AND RECOMMENDATION

189. The subproject is a component of Project under a program to improve the core road network of the Highlands region. The subproject will rehabilitate and upgrade the existing Ialibu to Kagua Road and enhance connectivity between the rural areas in the Districts of Ialibu-Pangia and Kagua-Erave. This will result in substantial improvement in living conditions in the areas where access was hindered by bad road conditions. The connectivity between the two districts in the Southern Highlands Province will be improved, allowing for unimpeded flow of goods and services.

190. The IEE has reviewed the environmental impacts associated with the sub-project and has developed a comprehensive EMP to address these activities. There are few impacts associated with the project. The Ialabu to Kagua Road is an existing roadway and the immediate environment is already disturbed. No significant flora or fauna will be affected by the project, and the road does not traverse any biodiversity conservation areas or areas of significant habitat that require further study or evaluation. The beneficiaries of the proposed development will be the communities of Ialabu and Kagua districts and intermediate villages which have been consulted and support the subproject.

191. The IEE concludes that adverse environmental impacts arising from the rehabilitation and upgrading of the Ialabu to Kagua Road can be minimized to insignificant levels. The subproject is classified as a Category B project as the impacts are site-specific, few, if any, are irreversible and most impacts can be readily mitigated by the measures set out in the EMP. Compliance with the EMP will be monitored and reported.

Table 13 - EMP and Environmental Monitoring Matrix for Ialibu to Kagua Road

MITIGATION MEASURES				MONITORING	
potential ental impact	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
action with the nies access to	RP/Due Diligence Report	DoW and Lands Department	As per RP	As per RP	PIU-EO
quency is ctures are e will be an early uctures.	Determine hydraulic capacity: i. DoW procedure ii. Climate change procedure	DC and PIU-EO	Part of detailed design – Project 2	Once at the design stage	PIU-EO
vironmental project	EMP from approved IEE to be UPDATED before extraction and integration as construction conditions to BCD. EMP re-issued before construction commences. EMP construction conditions included in BCD in Part II – Requirements; Section 6 – Employers Requirements. List approved IEE EMP in construction section as Special Conditions of Contract	DC and PIU-EO	Project cost	Once during design stage	PIU-EO, IES Verified by DoW and ADB
mental values of banned dertaking of ties	Appendix 5 to be included verbatim as a requirement under "Special Conditions of Contract" within the BCD	DC and PIU-EO	Project cost	One during preparation of BCD	PIU-EO/IES ADB
mpetent nsure that the ntegrity of the aintained	EO/IES to be part of evaluation panel to evaluate bids for environmental competence of contractor	PIU and PIU-EO	Project cost	Once during bidding process	PIU-EO/IES
rstanding of proves capacity oject	EIO and IES to undertake workshops and seminars throughout project implementation	EO and IES	Project cost	As required throughout Project 2	Verified by DoW and ADB
ation of the EMP ronmental values	Provision of training to contractor to improve awareness and safeguards application	EO and IES EMU-Manager	Project Cost	After awarding of contract; As required by contractor	PIU-EO
onmental ub-project	Contractor prepares CEMP that establishes the contractor's management and compliance requirements with the construction section EMP.	Contractor	Included in contract price	Once; CEMP prepared and approved	PIU-EO/IES
environmental ing that rstands and CEMP conditions	CEMP conditions are confirmed with the contractor at an on-site meeting. When the PIU considers that the contractor is competent to comply with the CEMP the RE is advised that the contractor can mobilize.	PIU-EO/IES	Project cost	Once; verify that induction has been carried out and contractor is competent to implement CEMP	PIU-EO/IES
er quality from ; l amenity from nd finished	i. Limit the areas to be excavated to those that can be effectively managed and protected. ii. Topsoil removed and stored in separate heaps that are located in stable	Contractor	Included in contract price	Weekly or as required until site has been established. Verify that clearance and excavation has met mitigation requirements	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
	sedimentation of water courses as a result of the removal of the topsoil and from improper disposition of the spoils; d. Increased levels of particulate matter as a result of the excavation works and dumping of materials which is projected to be particularly problematic during the dry periods; e. Loss of vegetation as a result of the excavation works;	iii. Excavated material is sorted and stored as either competent (able to be reused) and incompetent (to be disposed of) materials. iv. Materials are not to be disposed/stockpiled less than 20 meters from water courses. v. Side casting of materials are not to be undertaken especially during the wet season. vi. At completion of work dumping areas to be re-top-soiled and re-vegetated.				
Preparation of site and establishment of contractor's facilities (camps, offices, quarries, concrete batching areas etc).	a. Clearing and grubbing activities for the establishment of the required facilities, quarries, camps and offices will result in loss of vegetation which may further result in soil erosion and increased sedimentation of nearby water bodies; b. An acute increase in ambient levels of noise will be experienced as a result of the operation of the heavy equipment, operation of the batching and asphalt plants and increased vehicular and human traffic in the area; c. An acute increase in suspended particulate matter may occur because of the removal of covering vegetation and the increase human and vehicular traffic in the area; d. Acute increased levels of SO_2 and NO_2 as a result of the operation of the various heavy equipment, vehicles and the operation of the Batching and Asphalt Plants; e. Contamination of water bodies and the aquifer may also result due to the generation of solid and domestic waste from camps and offices; f. Contamination of nearby water courses may result from accidental spills and improper storage of fuel and lubricants and construction materials; g. The generation of solid and domestic waste which may cause contamination of the nearby water courses and	i. The location and development of contractor's facilities are to be approved prior to establishment. ii. The camps and offices are to be provided with the necessary sanitary facilities such as toilets and bathrooms; iii. The camps, offices, and ancillary facilities should not interfere with the welfare of surrounding communities in terms of noise, dust, noxious gases and vibration from construction activities and their social well-being from their proximity to contractor's facilities; iv. The areal extent of the contractor's facilities are to be limited to reduce unnecessary clearing of vegetation, v. Sanitary waste and grey water is not to be released untreated into surface water systems. vi. Solid waste from the camps will be properly collected and disposed in the approved disposal sites. vii. Septic tanks are to be constructed to address the domestic waste that will be generated from the camps and contractor's offices; viii. Proper drainage facilities are to be established in the camps and facilities to mitigate contamination of the nearby water courses and aquifers; ix. Sites are to be properly drained. Paved areas, including vehicle parking areas, workshops and fuel storage areas are to drain to an oil and water separator; x. Machineries and equipment are to maintained in good working conditions at all times. xi. Requisite air pollution control devices are to be installed in the Ancillary facilities, i.e. Batching and Asphalt Plants and mufflers are to be installed in all vehicles.	Contractor	Included in contract price	At start of site establishment, then as required.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
	aquifer is a potential impact of this activity.	xii. Fuel storage areas are not to be located within 20m of a water course. xiii. Workers involved in the utilization of fuel and lubricants are to be properly trained in the handling, storage and dispensing of such materials. xiv. An emergency contingency plan will be prepared to address accidental spills and the occurrence of fire in the facilities. xv. The contractor's facilities are to be contained within an adequate security fence. xvi. Concrete and Asphalt batching areas are to be provided with bunds to control movement of runoff to waterways.				
Opening quarry and material fill sites	a. Impairment of water quality from uncontrolled runoff from the quarry and material fill sites; b. Loss of soil resources as a result of the removal of the top soil; Loss of aesthetics as a result of the alteration of the natural topography of the area; c. Loss of vegetative cover as a result of the removal of the topsoil and overburden; d. Disturbance to settlement areas along the haul roads during transport of materials from quarry site to work areas; e. Ponding and accumulation of stagnant water in borrow pits and quarry areas; f. Disruption in the hydrology of the water courses as a result of excavation of river beds; g. Quarry sites and material sources areas are not to be located in wildlife management areas, forest areas or game sanctuaries; This impact is irrelevant as the road itself is not located in any of the above mentioned areas.	i. The contractor will prepare a Quarry Management Plan that meets the requirements of the DoW Code of Practice, which will include payment of a royalty to the landowners to extract materials from the site and closure of the site. ii. Balance cut and fill requirements to minimize impacts from extraction of aggregates; iii. Topsoil and overburden are to be stockpiled near the site and covered with tarpaulin fenced off for safety and security considerations and later reused to re-contour borrow pits after completion of works. iv. Adequate drainage shall be provided in the material source/quarry areas to prevent the accumulation of stagnant water during the operation; v. Should stagnant water accumulate, the borrow pits shall immediately be de-watered to prevent the creation of mosquito breeding grounds; vi. Material sources and quarry areas shall preferably located near the alignment to minimize hauling distance and time and disturbance to settlement areas along the haul roads; vii. Damages to access roads, garden plots, and other property resulting from the operation of the quarry and material sources sites and transport of materials are to be reinstated after completion of works; viii. Existing quarry and material sources areas are to be restored before a new site is opened.	Contractor	Included in contract price	Weekly or as required until site has been established. Verify that quarry and materials fill sites meet mitigation requirements.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
Working over watercourses	a. Contamination of the water course from accidental spills of materials. This impact is very insignificant as the works on the bridges will mainly involve removal of rust, repainting and replacement of decking in some bridges. The volume of materials to be utilized in the works, such as paint does not pose a risk to contamination of the water course b. Increased turbidity as a result of the disturbance of the channel. This is irrelevant in the context of the proposed bridge works. As stated in the previous section, all works will be concentrated on the bridge above the watercourse and no works will be undertaken in, alongside or adjacent to the channel. c. Disruption of the hydrology and hydraulic characteristics of the channel as a result of laying of gabions and other river protection works and river training works. This is also an irrelevant impact as works will only be limited to removal of rust, repainting and in some bridges, replacement of missing decking which will all be done on the bridge itself above the watercourse and not in, alongside or adjacent to the channel; d. Scouring of the riverbed as a result of works on the foundation of the structure. This is another irrelevant impact as the proposed works will only involve removal of rust, repainting and in some bridges, replacement of missing decking; e. Increased noise levels and vibration as a result of pile driving activities. There will be no pile driving activities that will be undertaken as bridge works are limited to removal of rust, repainting and in some bridges, replacement of missing decking.	i. Plan works to be carried out over the channels only for dry season; ii. Plan operations to avoid creating downstream turbidity; iii. Tarpaulin will be laid-out under the structure to prevent materials from falling into the watercourses. iv. No fuel, oil or lubricants to be spilled or released from equipment working over the watercourses; v. There will no refueling of equipment or vehicles while working over the watercourses; vi. Work will be halted if background water quality elevates to levels above the limits prescribed by the Water Quality Criteria for Aquatic Life Protection or complaints are received from downstream users; vii. If the water quality of the watercourses elevates to unacceptable levels, the contractor is to schedule work to provide periods where the watercourse are not disturbed. The Community Liaison officer of the contractor will advise the communities when the conditions return for suitable use	Contractor	Included in contract price	During conduct of rehabilitation works and when necessary	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
	This is irrelevant in the context of the proposed subproject; f. Depletion of aquatic life due to the proposed development. The aquatic life will not be affected by the development as the proposed works are limited to minor repair and maintenance on the bridge itself above the watercourse and would not in any way adversely impact the aquatic life in the channel.					
Noise and vibration	a. During the works, the operation of heavy equipment and various construction machinery are primary noise generators. It is projected that noise levels could reach from 65 to 80 dB (A) at peak times. ii. Poor maintenance of equipment may cause very high noise levels. Faulty or damaged mufflers, loose engine parts, rattling screws, bolts, or metal plates all contribute to increasing the noise level of a machine as well as careless or improper handling and operation of equipment. iii. Poor loading, unloading, excavation and hauling techniques may lead to increased noise levels.	i. It shall be ensured that ambient noise levels should not exceed 45dBA at the boundaries of the residential areas. ii. Temporary construction facilities such as labor camps, vehicle maintenance workshop and earth moving equipment will be located at least 1 km away from settlements and other sensitive areas as far as possible. iii. Noise sources such as stone crushers, vehicles movements and stone quarry will be re-located to less sensitive areas and at least 1 km away to take advantage of distance and shielding. iv. Opportunity will be explored to take advantage of the natural topography as a noise buffer such as behind the ridge that break the line of sight between the source of noise and the receptors during facility design. v. Silencers will be installed in construction equipment and machinery and maintained properly at all times. vi. Equipment and machinery with lower sound levels will be selected for the use. vii. Protection devices such as ear plugs/ or ear muffs will be provided to the workers during period of operating high noise generating machines. viii. Noise levels will be regularly measured to ensure the effectiveness of mitigation measures. ix. Construction activities will be carried out between 5 am to 8 pm only to avoid disturbance to nearby communities at night. Only in extreme instances will work beyond these hours be allowed. x. Noise barriers such as earth mounds or walls of wood, metal that form a solid obstacle between the road and roadside community will be used, especially in the schools and hospitals.	Contractor - CLO	Included in contract price	At start of noisy activities then as required. Community complaints. 45 dBA measured at workplace boundary. GRM and complaints register	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		xi. Proper information and notification of the concerned local government unit will be conducted to prevent disturbance and nuisance to nearby settlement areas.				
Air Quality	a. Acute increase in levels of Total Suspended Particulate Matter, SOx, NOx and CO; b. Increase in incidences of upper respiratory diseases due to elevated levels of pollutants in the works areas and nearby settlement areas; c. Increased incidences of accidents due to low visibility during dusty conditions in the work areas; d. Nuisance to residents near haul roads due to increased traffic in the area	i. Water sprinkling, water fogging, broom sweeping will be carried out in dust prone locations, unpaved haulage roads, earthworks, stockpiles including asphalt mixing plant areas. ii. Open burning of solid wastes (plastic, paper, organic matters) will be prohibited. iii. Use of dust control methods (such as covers, water suppression paved or unpaved road surfaces, or increase moisture content for open materials storage piles) will be practiced. iv. A regular vehicle maintenance and repair program will be implemented. v. Masks and personal protective equipment (PPE) will be provided to the construction workers to minimize inhalation of respirable suspended particulate matters. vi. Mixing plants and asphalt (hot mix) plants including crushers and the batching plants will be located at least 1 km downwind from the nearest settlement only after receiving permission from the Supervision Consultant. Hot mix plant will be fitted with stack /chimney of adequate height as prescribed by Supervision Consultant to ensure enough dispersion of exit gases. vii. Bitumen emulsion and bitumen heaters will be used to the extent feasible. viii. LPG or kerosene will be used as fuel source in construction camps instead of wood. Tree cutting for fuel wood will be restricted. ix. Diesel Generating (DG) sets will be fitted with adequate stack height x. Diesel with low sulphur containing will be used in DG sets as well as other machineries. xi. Air quality monitored during construction stage and if monitored parameters are above the prescribed limit, suitable control measures applied	Contractor - CLO	Included in contract price	i. As determined by wind and site conditions. ii. Complaints from communities (GRM and records)	Contractor, PIU-EO/IES to verify
Earthworks, cut and fill and embankments	a. Loss of soil resources b. Sedimentation - decreased water quality of water courses	i. Limit the extent of excavation to reduce soil erosion potential. i. Install control structures or soil	Contractor, EO and IES (PIU) will advise on re-vegetation	Included in contract price	Monthly and then as required. Sites are stable.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
	affected; c. Eroded soil interfering with construction activities; d. Increased turbidity in nearby watercourses and channels.	conservation protection methodology is to be applied to susceptible areas to avoid storm water runoff carrying eroded materials either, off-site to susceptible areas or, else onto already finished work areas. iii. Schedule construction so that large areas of soil are not laid bare during wet seasons, and avoid excavating areas and operating machinery in wet ground conditions. iv. When needed (particularly work area abutted with watercourses/bodies), contain construction areas using a bund or trench, installation of sediment traps or isolate them from other surface run-off, and clean and rehabilitate them when construction is complete. v. Excavated areas are to be re-vegetated as soon as possible at the completion of the work site.	requirements			
Storage and handling of fuel, lubricants and bitumen.	a. Improper handling of these materials may result to pollution of the surrounding areas. b. Nearby water bodies and aquifers may be contaminated by the stored materials if improperly handled. c. Contamination of the soil may occur as a result of this activity. d. Noxious gases and fumes may be released if the materials are not properly stored.	i. Fuel and oil will need to be stored in dedicated areas, security fenced and provided with oil and water separators with fuel hoses and shut off valves locked and at least 20m away from the water courses/bodies. Where >5000 liters of fuel is stored on site, the fuel must be stored in sealed tanks that are provided with a concrete base that is bunded to hold 110% of the tank capacity. ii. All workshops with significant activities should be provided with oil and water separators. iii. Vehicles and machinery are not to be refueled within 20m of the nearest water course/body. iv. The contractor must prepare a Fuel Handling Procedure and trained personnel who are competent in fuel handling procedures. v. The contractor will prepare an Accidental Spill Reaction Procedure to address accidental spills. vi. If water soluble bitumen is to be utilized, such material is not to be applied immediately prior to the occurrence of rain vii. Any major spill is to be reported to DoW and DEC. viii. All waste oil, oil and fuel filters are to be collected and disposed of in safe and secure disposal facilities.	Contractor	Included in contract price	Initially once to approve storage and handling procedures then as required. Verify that storage and handling of construction materials, fuel and lubricants meet these requirements.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		ix. At the closure of the site, all contaminated soil is to be excavated, removed and replaced with fresh topsoil.				
i. Use of hazardous materials	a. Contamination of the soil and nearby water courses may result from the utilization of hazardous materials. b. Improper handling, storage or utilization of hazardous materials poses a significant health risk to the workers and residents of nearby settlement areas; c. Damage to vegetation and crops may occur as a result of contamination from the hazardous materials;	i. Ensure that safe storage of fuel, other hazardous substances. ii. Hydrocarbon, toxic material and explosives (if required) will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination. iii. Equipment/vehicle maintenance and re-fuelling areas will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas shall be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; iv. Fuel and other hazardous substances shall be stored in areas provided with roof, impervious flooring and bund/containment wall to protect these from the elements and to readily contain spilled fuel/lubricant; v. Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations; vi. Ensure all storage containers are in good condition with proper labeling; Regularly check containers for leakage and undertake necessary repair or replacement; viii. Store hazardous materials above flood level; ix. Discharge of oil contaminated water shall be prohibited; x. Used oil and other residual toxic and hazardous materials shall not be poured on the ground; xi. Used oil and other residual toxic and hazardous materials shall be disposed of in an authorized facility off-site; xii. Adequate precautions will be taken to prevent oil/lubricant/hydrocarbon contamination of river channels; xiii. Ensure availability of spill clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored;	Contractor	Included in contract price	At start of work and whenever any hazardous compounds are to be brought to site. No Appendix 5 activities initiated	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		xiv. Spillage, if any, will be immediately cleared with utmost caution to leave no traces; xv. Spillage waste will be disposed at approved disposal sites; xvi. All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulation; xvii. The contractor will be required to display Material Safety Data Sheets (MSDS) in all work areas and to train workers in the safe use of these materials, including the provision of protective equipment for handling these substances. xviii. The contractor shall designate properly trained staff in-charge of storage sites for hazardous materials. Entry will be allowed only under authorization.				
Conduct of prohibited activities (Appendix 5)	Health dangers to workers and environment	Contractor to abide by prohibited activities as listed in Appendix 5 of the SPS.	Contractor	NA	As required, spot checks	Contractor, PIU-EO/IES to verify
Disposal of site waste	a. Contamination of the land where the solid waste is deposited; b. Decrease in water quality of nearby water courses and affected aquifers; c. The stockpile of solid waste may create habitation for rodents, pest and vermin which may present a health risk to workers and residents of nearby communities; d. Reduced aesthetics as the heaps of solid waste in the area will be an eyesore;	i. All solid waste that will be generated during the construction works are to be collected and sorted and properly disposed in approved facilities; ii. The contractor will maximize the utilization of materials to minimize generation of waste; iii. It shall be endeavored that used wood and timber be reused for formworks and other appropriate works; iv. Recovery of materials will be encouraged, however if these cannot be recovered for scrap value these materials are to be taken to an approved landfill sites for final disposition.	Contractor	Included in contract price	Spot checks and weekly inspections. Waste being collected and disposed of to meet requirements.	Contractor, PIU-EO/IES to verify
Clearance and rehabilitation of construction sites and removal of contractor's facilities.	a. Reduction of the aesthetics of the receiving environment; b. Soil contamination from residual and excess materials stockpiled in the area; c. Elevated levels of pollutants in the nearby water courses and aquifer; d. Creation of habitat for mosquitoes, pests, vermin and stray animals as a result of the stockpiling of solid waste.	i. It shall be endeavored that all waste materials, machinery and any contaminated soil are removed from the site and properly disposed inn approved disposal areas. ii. All construction sites and work areas are to be rehabilitated and restored so that these can be returned as close as possible to their previous use. iii. Stabilization and landscaping of all of the construction sites to re-establish site drainage are to be undertaken as soon as works are completed. iv. Any borrow pits or quarries operated	Contractor	Included in contract price	At completion of construction. Site has been cleared of materials, rehabilitated and returned to original state.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		by the contractor are to be re-shaped and closed. v. Any contaminated soil removed from fuel and oil storage areas and the site re-vegetated. vi. No waste is to remain behind after work is completed that will not naturally and safely decompose. vii. Should waste not be removed, DoW is entitled to withhold payment and arrange the clean-up and deduct the cost of the clean-up from the final payment amount less an additional 10% for arranging the task.				
Preparation of site, clearing of work areas, removal and disposal of vegetation	a. The clearing and grubbing activities will result to loss of vegetative cover; b. Removal of the vegetation will result to soil erosion; c. Sedimentation of nearby watercourses as a result of the subsequent erosion of the areas; d. Increased levels of particulate matter, especially during the dry periods, as a result of the removal of the vegetative cover; e. The removal of the vegetation will generate organic material for composting which could be utilized to fertilize the garden plots in the area;	i. Wherever possible limit area to be cleared and avoid excessive machine disturbance of the topsoil as this is required to be removed and stored ii. Areas of significant vegetation within the cleared area identified and shown to machinery operators. iii. The area to be cleared is defined by a clearly established boundary. iv. 10 m wide buffer zones are to be established around watercourses and no clearing is permitted within this area. v. Machinery operators must be shown the boundaries of areas to be cleared. vi. Cleared material is to be pushed into manageable stockpiles according to disposal or re-use requirements. vii. Waste vegetation should be made available to villagers as fuel wood If the material is an impediment to workers it may need to be burnt to clear the area. Wherever possible limit burning and if this is to be done ensure that the wood is dry so as allow a hot clean burn that produces little smoke.	Contractor	Included in contract price	Weekly or as required until site has been established. Verify that contractor's facilities meet mitigation requirements.	Contractor, PIU-EO/IES to verify
Control of invasive species	Loss of indigenous vegetation	a. Any potential seed sources such as earth and organic material that may be attached to machinery will be removed and disposed appropriately. b. During replanting/re-vegetation works, new alien plant species (i.e., species not currently established in the region of the project) shall not be used. Only endemic species of vegetation are to be utilized for this purpose; c. The contractor, PIU-EO and SC-EO will be required to observe for any infestations. d. Should infestations occur on construction sites that are due or are not	Contractor	Included in contract price	Monthly during wet season or as required until site has been cleared of introduced invasive species. Verify that contractor has washed down machinery	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		due to the contractor's activities the contractor will be required to control the infestation				
Public access to site	a. Unrestricted access to the work sites and contractor's facilities may present security concerns. b. Increased risk of accidents as a result of unhampered access of unauthorized persons into the work areas and facilities.	i. Access to the contractor's facilities will be controlled. ii. A security fence will be installed around the facilities. iii. Visitors will be required to report to a check point before being allowed to enter the site. iv. Work areas will be demarcated by barrier tape and signs erected as required to warn people that there is no right of entry to these areas	Contractor	Included in contract price	Weekly. Accident reports involving community.	Contractor, PIU-EO/IES to verify
Community Safety from increased vehicle movements	Accidents to surrounding communities from vehicles transiting villages.	a. That trucks and other vehicles are maintained in a safe operating condition, b. All drivers and machinery operators act responsibly, c. All loads are to be secured and all loads with fugitive materials (e.g. excavated soil and sand) are to be covered with tarpaulins,	Contractor	Included in contract price	Weekly. Accident reports. Community complaints	Contractor, PIU-EO/IES to verify
Workplace health and safety	a. Hazards from operating and using machinery. Direct hazards to the machine operators and to workers working in the vicinity of the machine; b. Hazards to workers exposed from heavy materials being lifted by cranes; c. Refueling hazards; d. Exposure to HAZCHEM materials; e. Traffic accident hazards.	Workers to be provided with safe working environment including: i. Erect warning signs and barriers around work areas ii. No drugs or alcohol allowed on-site iii. Noise and dust to be controlled. iv. All workers provided with safety equipment appropriate for the task in which they are employed. v. To be supplied on-site for workers: Potable water, chemical toilet, changing place with clothes storage, and washing and showering facilities. vi. Work Statements prepared for each activity vii. Prior to entering site for first time workers to be inducted to site and site hazards explained together with explanation of work site safety procedures. viii. . Medical and first aid facilities provided together with a person qualified in first aid.	Contractor	Included in contract price	Spot checks and weekly inspections. Accident record.	Contractor, PIU-EO/IES to verify
Worker issues (i): Location of camps and employment of local labor	a. There is a potential for conflict to develop with local communities should they be marginalized by the introduction of outside workers who then enjoy an enhanced economic status in comparison to the local communities. b. The risk of contracting and	i. Workers from the local communities will be preferentially offered employment as unskilled labor. ii. Workers will also be required to undergo regular check-up to minimize the risk of contracting and spreading of HIV and STI's. iii. Camps will be sited a good distance away from nearby settlement areas to	Contractor	Included in contract price	Monthly checking of employment records. ii. Grievance records from surrounding communities.	Contractor, PIU-EO/IES to verify

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
	spreading of HIV and STI's is also a projected impact of the proposed development.	avoid social conflicts.				
Worker issues (ii): provision of adequate living conditions within campsite.	a. Poor health of workers; b. Loss of worker productivity may result from the absence of appropriate living conditions within the project area.	i. Workers will be provided with adequate housing, sanitation and recreational facilities. ii. The contractor will provide acceptable camp facilities with potable water, sanitation and washing facilities, kitchen and adequate cooking facilities, nutritionally adequate food rations and recreational facilities to either meet requirements of the Employment Act (1978) or an acceptable international standard whichever is the higher.	Contractor	Included in contract price	i. Monthly checking of first aid records. ii. Complaints from workers.	Contractor, PIU-EO/IES to verify
Worker issues (iii): Camp water heating and cooking. Use of wood for fuel.	i. Unsustainable removal of forest resources to detriment of surrounding communities. ii. Disturbance to forests, wildlife, and biodiversity	i. The contractor will provide gas and kerosene for water heating and cooking. ii. Locate camp away from significant forest areas, and: limit collection and use of fuel wood; iii. Sanctions imposed on workers not complying	Contractor	Included in contract price	Monthly verify i. camp cooking facilities. ii. access to forests for fuel wood.	Contractor, PIU-EO/IES to verify
Worker issues (iv): Hunting and sale of wildlife by workers	i. Loss of wildlife and ii. Effect on biodiversity	i. Labor employment agreement enforced by contractor that bans hunting and trading in wildlife by workers. ii. contractor is to provide nutritionally adequate camp rations; iii. Sanctions imposed on workers not complying	Contractor	Included in contract price	Monthly Verify prosecution and dismissal of employees for wildlife infringements.	Contractor, PIU-EO/IES to verify
Worker issues (v): Clearing land for gardens	i. Cause of social conflict with surrounding communities.	i. Approval to clear land must be obtained from traditional owner. ii. No approval will be given to clear forest land. iii. contractor to provide adequate and nutritionally balanced rations.	Contractor	Included in contract price	Monthly Complaints from communities	Contractor, PIU-EO/IES to verify
Chance discovery of archaeological and cultural sites	Loss of cultural values	No known sites. Chance discoveries are to be notified to the RE who will advise the EO. EO to advise contractor on chance find procedures	Contractor EO/IES, National Museam	Included in contract price	Yearly. Notification of chance discoveries	Contractor, PIU-EO/IES to verify
OPERATION STAGE						
Infrastructure Maintenance	Lowering of soil and water quality.	i. All maintenance waste collected ii. Site kept tidy and no waste allowed to accumulate in yard or sites	DoW	DoW operating cost	During conduct of maintenance works	PIU-EO
Noise and emissions Control	Increase levels of noise and emission	Not a major concern due to low volume. If traffic increases significantly, provision of noise/dust fence barriers at selected locations (school and hospital). If required quarterly measurements to be undertaken.	DoW/DEC	DoW operating cost	TBC	PIU-EO
Public Safety	Safety issues from increased traffic	1. Traffic calming measures (e.g. speed bumps) at selected sites i.e.schools, markets, and densely populated areas. 2. Provision of off-road let down stops for vehicles	DoW/DEC	DoW operating cost	Duration of operation	PIU-EO

MITIGATION MEASURES					MONITORING	
Activity	**Issue/potential environmental impact**	**Proposed mitigation measures**	**Implementing responsibility**	**Mitigation cost**	**Frequency and means of monitoring**	**Monitoring responsibility**
		3. Proper road signage and pavement markings, particularly accident-prone spots				

DoW = Department of Works; PIU = Project Implementation Unit; EO = Environmental Officer (part of EMU and attached to PIU for Project 2); CSC = Construction Supervision Consultant; RE = Resident Engineer (of CSC); IES = international environmental specialist (part of CSC); DEC = Department of Environment and Conservation

Note: Contractor to undertake daily and weekly inspections and maintain site diary. Monthly Reports to cover CEMP implementation and activities of EHSO.

Table 14 - Estimated Cost for the Environmental Monitoring Plan

Item	Stations	FREQUENCY			COST (US$)	
Equipment		**Pre-construction**	**Construction**	**Operation**	**Unit Cost**	**Total Cost**
Water Quality (Portable Sampler)		1.00	0.00	0.00	3,500.00	3,500.00
Air Quality						
3 Gas Analyzer		1.00	0.00	0.00	5,000.00	5,000.00
PM 10 Sampler		1.00	0.00	0.00	4,000.00	4,000.00
Ambient Noise (Portable Noise Meter)		1.00	0.00	0.00	2,000.00	2,000.00
Sub Total A						**14,500.00**
Regular Monitoring/Field Sampling		**Pre-construction**	**Construction**	**Operation**	**Unit Cost**	**Total Cost**
Water Quality	6.00	1.00	24.00	4.00	300.00	52,200.00
Air Quality	8.00	1.00	24.00	4.00	200.00	46,400.00
Noise	8.00	1.00	24.00	4.00	100.00	23,200.00
Sub Total B						**121,800.00**
Laboratory Analysis of Samples		**Pre-construction**	**Construction**	**Operation**	**Unit Cost**	**Total Cost**
Water Quality	6.00	1.00	24.00	4.00	600.00	104,400.00
Air Quality	8.00	1.00	24.00	4.00	300.00	69,600.00
Noise	8.00	1.00	24.00	4.00	0.00	0.00
Sub Total C						**174,000.00**
GRAND TOTAL						**310,300.00**

ANNEXES

ANNEX A: LIST OF INTERNATIONAL TREATIES AND AGREEMENTS TO WHICH PNG IS A SIGNATORY

ANNEX B: WORKER COMPLEMENT AND MACHINERY AND EQUIPMENTS

ANNEX C: PHOTO DOCUMENTATION AND PARTICIPATION LISTS OF CONSULTATIONS

ANNEX D: TERMS OF REFERENCE FOR CONTRACTOR'S STAFF ENVIRONMENT, HEALTH AND SAFETY OFFICER (EHSO) AND COMMUNITY LIAISON OFFICER (CLO)

ANNEX A: LIST OF INTERNATIONAL TREATIES AND AGREEMENTS TO WHICH PNG IS A SIGNATORY

- International Convention on Biological Diversity, Rio de Janeiro 1992
- International Plant Protection Convention, Rome 1951
- International Convention for the Prevention of Pollution of the Sea by Oil, London 1954
- Plant Protection Agreement for the South East Asia and Pacific Region, Rome 1956
- International Convention on Civil Liability for Oil Pollution Damage, Brussels 1969
- RAMSAR Convention on Wetlands of International Importance, especially waterfowl habitat 1971
- International Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, London, Mexico City, Moscow 1972
- Convention on the World Cultural Heritage and Natural Heritage, 1972
- International Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington 1973 (CITES Treaty).
- International Convention on the Conservation of Migratory Species of Wild fauna and Flora, 1973
- International Convention on the Conservation of Nature in the South Pacific, Apia 1976
- International Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques, New York 1976
- United Nations Convention on the Law of the Sea, Montego Bay 1982 International Convention for the Protection of the Natural Resources and Environment of the South Pacific, 1986 (SPREP Convention)

ANNEX B: WORKER COMPLEMENT AND MACHINERY AND EQUIPMENTS

Manpower Complement for the Rehabilitation of the Ialibu to Kagua Road

WORKER	NUMBER
PROFESSIONALS	**34**
Project Manager	1
Deputy Project Manager	2
Project Engineer	1
Deputy Project Engineer/Lab Manager	1
Equipment Manager	1
Civil Engineer	2
Pavement Engineer	1
Materials/Quality Assurance/Quality Control Engineer	1
Surveyor	2
Survey Assistant	4
Quality Assurance/Quality Control Assistant	4
Administration Manager	1
Budget and Contract Manager	1
Accountant	1
Book Keeper	1
Administration Assistant	2
Secretary	1
Staff Officer	2
Environmental Officer	1
Public Liaison Officer	2
Compensation Officer	1
HIV Trainer	1
SKILLED	**77**
Supervisor	5
Foremen	11
Equipment Operators	12
Carpenter	10
Mechanic	8
Storemen	4
Laboratory Technicians	9
Drivers	15
Cook	4
UNSKILLED	**115**
Laborers	90
Security Guard	10
Cleaner	5
TOTAL	**226**

Machinery Required for the Rehabilitation of the Ialabu – Kagua Road

MACHINERY	NUMBER
Bulldozer D9	1
Bulldozer D6	2
Excavator	3
Front End Loader	4
Grader	2
Vibratory Roller	2
Tip Truck	8
Flat Bed Truck	1
Low Loader	1
Crane 40 Ton	1
Welding Machine	2
Mechanical Workshop	1
Testing Laboratory	1
Survey Equipment	3
Fuel Truck	2
Scaffolding	1
Compressor	2
Rock Drills	1
Spray Painters	2
Bitumen Truck	1
Water Truck	2
Bitumen Kettles	1
Demountable Buildings	3
Camp Buildings	1
Gravel Screening Plant	1
Crushing Plant	2
Concrete Mixer Large	2
Concrete Mixer Small	2
4WD Vehicles	8
TOTAL	**63**

ANNEX C: PHOTO DOCUMENTATION AND PARTICIPATION LSISTS OF PUBLIC CONSULTATIONS

PHOTOGRAPHS OF PUBLIC CONSULTATIONS

Group at Kepik Karanas

Gathering at Yalo Bridge

Gathering at Rokoma Village

Gathering at Inalere Village

PARTICIPATION LISTS

19 July 2011, Ialibu Junction - WaraYalo Bridge - Yameyame Village

	Name	Gender	Designation
1	Dicksin Makal	M	Census Officer
2	MichealTaisa	M	Subsistence farmer
3	Luke Yoke	M	Chicken farmer
4	Mark Oru	M	Truck driver
5	Potes Makire	M	Peace & Good Order committee coordinator
6	Michael Dura	M	Community leader
7	MakalWarea	M	Teacher
8	Rumi Kepiya	M	Drugbody (takes drugs/deal drugs)
9	Demo Bombea	M	Subsistence farmer
10	Nakanol Guli	M	Community elder
11	Rangula Akena	M	Community Leader
12	Aly Akena	M	Community Leader
13	TelekPhlip	M	Subsistence farmer
14	Junior Beri	M	Student
15	Kalu Koii	M	Rugby player
16	Siem Yana	M	Chicken farmer
17	James Yoke	M	Betel nut seller
18	Christopher Oru	M	Student
19	Louise Kopu	M	Pastor
20	Moses Repo	M	Mechanic
21	Mathew Lubirindi	M	Business man
22	Koke Rama	M	Subsistence farmer
23	Maiya Philip	M	Tyre service hand
24	Joas Rungula	M	Student
25	Issac Henry	M	Student
26	Peter Bokolu	M	Community elder
27	Winterford Gabriel	M	Student
28	Winterford Danny	M	Student
29	Ako Jenny	M	Visiting in-law
30	Eka Alu	M	Student
31	Tony Boss	M	Village youth
32	Daniel Nakanol	M	Councillor
33	Lopeke Lembo	F	Village old lady
34	Kunjaye Yake	M	Village elder
35	Tani Nathan	M	Truck driver
36	Emmi Miachael	F	Housewife
37	Tutus Micheal	M	Student
38	NopiyeTani	F	Housewife
39	Lapu yame Losimi	F	Housewife
40	Talazen Micheal	F	Baby sitter
41	John Yoke	M	Village youth
42	Desma Roy	M	Student
43	Priscilla Makal	F	Village young lady
44	Pulupeli Wambu	F	Village old Lady
45	Toro Warea	M	Papa
46	Ligory Maiyo	M	Student
47	Apea Makal	M	Student
48	Quilma Maiyo	F	Student
49	Grace Philip	F	Subsistence farmer
50	Gibson Mark	M	Student
51	Iso Taisa	M	Student
52	Wanpis Taisa	M	Rugby Player
53	Tupis Taisa	M	Betel nut seller

	Name	Gender	Designation
54	Peter Pawiya	M	Subsistence farmer
55	Gloria Peter	F	Farmer
56	Bill Peter	M	Farmer
57	Ipat Nande	M	Census Officer
58	Wepo John	M	LLG Councillor

19 July 2011, Ialibu Junction - WaraYalo Bridge, Kanda Village

	Name	Gender	Designation
1	Nagapu Puluma	M	Sub-Farmer
2	Kita Busu	M	Sub-Farmer
3	Aglus Mana	M	Sub-Farmer
4	Amon Waria	M	Sub-Farmer
5	Max Yama	M	Sub-Farmer
6	Rose Anton	M	Teacher
7	Erimanda Kurupu	F	Housewife
8	Benjamin Yarepeya	M	Student
9	Stephen Rambuli	M	student
10	Koni Molo	M	Youth leader
11	Mark Busu	M	Church leader
12	Patama Mark	M	Housewife
13	Luk Rambuai	M	Student
14	MankelIsopu	M	Student

19 July 2011, Ialibu Junction - WaraYalo Bridge, Yarana Village

	Name	Gender	Designation
1	Andawe Payambo	M	LLG councillor
2	Mala Pombo	M	Village court magistrate
3	Duku Kalipa	M	Village court magistrate
4	Issac Samba	M	Community leader
5	Wamo Pasalo	M	Sub- Farmer
6	Walea Yatu	M	Sub- Farmer
7	Emos Pasalo	M	Pastor
8	Philipi Kunipa	M	Youth leader
9	Palua Yamba	M	Sub- Farmer
10	Kaipu Kasu	M	Sub- Farmer
11	Paul Angima	M	Sub- Farmer
12	John Palua	M	Student
13	Lyneeth Jacob	M	Housewife
14	Yawame Turi	M	Housewife
15	David Pulua	M	Student
16	Roselyne Moke	F	Housewife
17	Grace Sula	F	Housewife
18	Murina Yama	M	Sub-Farmer
19	Waruame Opim	F	Housewife
20	Nebunu Diwa	F	Housewife
21	Rana Romo	M	Youth
22	Thomas Nalopa	M	Youth
23	Waru Palarua	M	Sub-Farmer
24	Kokena Lora	F	Housewife
25	Nakiame Turi	F	Housewife
26	Miriem Ansawe	F	Housewife
27	Lynneth Diwa	F	Youth
28	Lina Yandawai	M	Youth
29	Peter Marali	M	Sub-Farmer

20 July 2011, WaraYalo Bridge to Kagua Station, Warayalo Village

	Name	Gender	Designation
1	Tobias Simon	M	Student
2	Martin Mura	M	LLG Council
3	Gabriel Adina	M	Police
4	Luke Sumi	M	Chief leader
5	Justice Markus	M	Student
6	Esimail Lawrance	M	Student
7	Danyy Yapera	M	Sub-farmer
8	Gabriel William	M	Sub-farmer
9	Alex Molo	M	Sub-farmer
10	Elvis Eno	M	Sub-farmer
11	PetrosYapa	M	Teacher
12	Paul Palaru	M	Teacher
13	Philip Pina	M	Sub-farmer
14	Peter Puki	M	Sub-farmer
15	Enn Wapa	M	Coffee buyer
16	Domenic Lugera	M	Substitute elementary teacher
17	Seni Puke	M	Sub- farmer
18	Turri Nondo	M	Village court magistrate
19	Alphonse Kurupena	M	Sub-farmer
20	Losline Lawrance	F	Housewife
21	Smith Nande	M	Student
22	Raymond Kolowe	M	Sub-Farmer
23	Yabanu Nande	F	Housewife
24	Epo Lousise	F	Sub-farmer
25	Rox Loke	M	Sub-farmer
26	Nomi Nondo	M	Student
27	Benjamin Yarepea	M	Student

20 July 2011, WaraYalo Bridge to Kagua Station, Inalere Village

	Name	Gender	Designation
1	Samson Siimon	M	Student
2	Alex Tapa	M	Auxillary Police
3	Solomon Karo	M	Auxillary Police
4	Robin Rika	M	Peace Officer /Magistrate
5	Sep Warea	M	Sub-farmer
6	IpaRopo	M	Sub-farmer
7	James Mondo	M	Sub-farmer
8	Mathew Mealo	M	Village councillor
9	Telex Tapa	M	Sub-farmer/store keeper
10	Michael Kulumbu	M	Sub-farmer
11	Inolka Kiala	M	Sub-farmer
12	Aru Ula	M	Sub-farmer
13	Simon Mari	M	Sub-farmer
14	Sunny Karo	M	Student
15	Remono Alex	M	Housewife
16	Rachel Sk	F	Housewife
17	Mata Yandi	F	Pastor
18	SK Waiya	M	APOAidpost
19	Merian Marley	F	Housewife
20	Kaga Siimon	F	Housewife
21	Lapex Waladi	F	Store keeper
22	Perea Marire	M	Magistrate
23	MaruYandula	M	Student

20 July 2011, WaraYalo Bridge to Kagua Station, Rokoma Village

	Name	Gender	Designation
1	Luti Rogoma	F	Sub-farmer
2	Docas Wagapo	F	Sub-farmer
3	Serah Lope	F	Sub- farmer
4	Cathy R	F	Elementary teacher
5	Jonah Rosa	F	Sub- farmer
6	Rulki Wasape	M	LLG Councillor
7	Stanley Ropopa	M	Sub-farmer
8	Issac Luther	M	Student
9	Noel Noyo	M	Driver
10	Yana Papo	M	Sub-farmer
11	Carmilus Madali	M	Student
12	PariLombo	M	Secondary school teacher
13	Elijah Lissaa	M	District Health Manager
14	Mrs Charles Luther	M	Ex MP and area leader
15	Wesley Repo	F	Sub-farmer
16	Children under 5 yrs x11		
17	Mirupasi Koke	M	Sub-farmer
18	Tano Paupo	M	Sub-farmer
19	Lioel Luta	M	Driver
20	Mr Paulus Kadepiak	M	Sub-farmer
21	Mr Rodney Yako	M	Sub-farmer
22	Mr Bata Rawae	M	Sub-farmer
23	Mr RimbuRawa	M	Sub-farmer
24	Mrs Polin Yana	F	Sub-farmer
25	Mr Issac Charles	M	Sub-farmer

ANNEX D: TERMS OF REFERENCE FOR CONTRACTOR'S STAFF ENVIRONMENT, HEALTH AND SAFETY OFFICER (EHSO) AND COMMUNITY LIAISON OFFICER (CLO)

I. CONTRACTOR'S STAFF

The contractor is to appoint two staff as fulltime positions; environmental, health and safety officer and community liaison officer. These staff will be located at the construction site.

A. Environmental and Health and Safety Officer

The environmental, health and safety officer (EHSO) will be responsible for the contractor's staff complying with (i) the construction environmental management plan (CEMP) and (ii) health and safety requirements; and (iii) prevailing laws of Papua New Guinea and Asian Development Bank's Safeguard Policy Statement. The EHSO will have suitable qualifications and be experienced in both of these areas. The EHSO will report to the contractor's Site Engineer and will be responsible for the following:

i. Based on the EMP in the approved IEE, conditions and requirements set out in the bid and contract documentation, and construction methods to be employed by the contractor, prepare the construction environmental management plan (CEMP) and support to Department of Works (DOW) for approval;

ii. Ensuring the contractor and any sub-contractors comply with the CEMP requirements;

iii. Preparation of Emergency Response Procedure (ERP) as a specific section or part of the CEMP to be submitted to the DOW one week before work begins on site.

iv. Induction and training of contractor's personnel and any sub-contractors in CEMP provisions and ERP;

v. Monitoring of contractor's works and implementation of the CEMP and taking correction action as required to address issues arising;

vi. Preparation of summary of CEMP provisions as a 'work statement' before a new activity commences. Work statements will be delivered to workers at site and regular meetings;

vii. Issuing of safety gear and personal protective equipment (PPE);

viii. Induction of workers and visitors to site;

ix. Liaising with the DOW's Environmental Officer (EO) and the Project's international environmental specialist (IES) as required on all environmental and health and safety issues.

x. Maintaining a site diary compiling notes of daily and weekly inspections and other activities including provisions of training to workers

xi. Preparing a monthly environmental, health and safety report and submitting the report to the Site Engineer, based on the site diary. The environmental, health and safety report will be incorporated into the contractor's Monthly Report submitted to DOW and PIU.

B. Community Liaison Officer (CLO)

The CLO will be appointed by the contractor and will be responsible for ensuring that good community relationships are developed between the contractor and the affected communities. The CLO reports to the SE and will be responsible for the following:

i. Preparation of a community liaison program that encapsulates the requirements of the IEE, the Gov PNG and the DoW requirements.

ii. Before the contractor commences work the CLO will arrange meetings with the affected communities and explain the work program to them including its hazards and benefits in terms of recruiting workers.

iii. Establishment of the HIV/AIDS program with the Ministry of Health. Implement the Resettlement Plan with the assistance of the Department of Lands (DoL)