

# **Republic of Burundi**

## **Ministry of Transport, Public Works, and Equipment**

### **Burundian Roads Office**

## **Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rutunga – Rumonge Road (78km) Section in Bujumbura City, Bujumbura Rural, and Rumonge Provinces**

**Name of the Project:**

Multinational: Tanzania/ Burundi: Nyakanazi –  
Kasulu – Manyovu/ Rumonge – Rutunga –  
Bujumbura Road - Consultancy Services for Review  
of the Feasibility Studies and Detailed Designs  
Bujumbura City, Bujumbura Rural, and Rumonge  
Provinces

**Project Location:**

**Submitted to:**

Minister for Water, Environment, and Urban  
Planning (Ministère de l'Eau, de l'Environnement,  
de l'Aménagement du Territoire et de l'Urbanisme -  
MEEATU)

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## LIST ABBREVIATIONS

AC:	Asphalt Concrete
ACD:	Allergic Contact Dermatitis
AI:	Area of Influence
ASL:	Above Sea Level
CBD:	Convention on Biological Diversity
CoI:	Corridor of Impact
CRR:	Crushed Rock
DIZ:	Direct Impact Zone
DRC:	Democratic Republic of Congo
DP:	Domestic Point
EAC:	East African Community
ESIA:	Environmental and Social Impact Assessment
ESMP:	Environmental and Social Management Plan
ERP:	Emergency Response Plan
ERT:	Emergency Response Team
ESS	Environmental and Social Specialist
GS:	Galvanised Steel
GHGs:	Green House Gases
HIV/AIDS:	Human Infected Virus/Acquired Immunity Deficiency Syndrome
H & S:	Health and Safety
ICD:	Irritant Contact Dermatitis
LHS:	Left Hand Side
MEEATU	Ministère de l'Eau, de l'Environnement, de l'Aménagement du Territoire et de l'Urbanisme
NIOSH:	National Institute for Occupational Safety and Health
NO <sub>2</sub> :	Nitrogen Dioxide
OBPE:	Office Burundais pour la Protection de l'Environnement
OdR:	Office des Routes
OSBP:	One Stop Border Post
OPC:	Ordinary Portland Cement
PEL:	Permissible Exposure Limit
PLHAs:	People Living with HIV & AIDs
PTR:	Pneumatic Tired Roller

uPVC:	unplasticized Poly Vinyl Chloride
UV-B	Ultra Violet B
REGIDESO:	La Régie de Production et de Distribution d'Eau et d'Electricité
RHS:	Right Hand Side
SETEMU:	“Services Techniques Municipaux”
SO <sub>2</sub> :	Sulphur Dioxide
STIs:	Sexually Transmitted Infections
SSEMP:	Site Specific Environmental and Social Management Plan
SSHSMF:	Site Specific Health and Safety Management Plan
TSS:	Total Suspended Solids
UNESCO:	United Nations Education, Scientific and Cultural Organization
URTI:	Upper Respiratory Tract Infection
WHO-GPA:	World Health Organization Global Programme on AIDS

## **SECTION 1: INTRODUCTION**

### **1.1 BACKGROUND INFORMATION**

The Government of the Republic of Burundi intends to rehabilitate the existing bituminous Bujumbura – Rutunga – Rumonge road (78km) section to conform to East African Community standards. The project is being financed by African Development Bank (AfDB) through East Africa Community (EAC).

The project is being implemented by EAC through Burundian Office of Roads (Office des Routes – OdR). OdR, under the Ministry of Transport, Public Works, and Equipment is the roads authority of Burundi which was created by Decree No. 100/118 of 27 October 2001 as part of the restructuring of the former General Directorate of Roads. It is responsible for the construction and maintenance of the whole road network in Burundi including national roads and district roads.

EGIS International has been commissioned by EAC to carry out Feasibility Study, Environmental and Social Impact Assessment (ESIA), and Review of Detailed Engineering Design for the proposed rehabilitation of Bujumbura – Rutunga – Rumonge (Mutambara) road (78km) section.

This document presents Environmental and Social Impact Assessment (ESIA) of the proposed road rehabilitation of the road based on its feasibility study.

### **1.2 OBJECTIVES OF THE STUDY**

The objective of the project is was to determine the technical feasibility and economic viability of improving the Rumonge – Rutunga – Bujumbura road section. The objective of the ESIA study was to incorporate environmental and social considerations into design of the road. The main objective of the ESIA was to predict and forestall potential environmental and social impacts and propose mitigation measures to lessen any impacts to the environment and indigenous people in project's area of influence that may arise from the road upgrading. This is to ensure that the project delivers minimum disruption to the environment and surrounding communities.

Specifically, the objectives of this study were:

- To establish physical, biological, socio-economic conditions of the project area
- To predict any adverse (negative) and/or beneficial (positive) environmental and social impacts associated with the road upgrading.
- To propose appropriate mitigation measures and recommend ways in which proposed mitigation measures could be incorporated into the designs.
- To provide cost estimates required to cover the proposed mitigation measures
- To provide environmental and social management and monitoring plans



## **1.3 APPROACH AND METHODOLOGY**

### **1.3.1 Approach**

The ESIA has been carried out in accordance with Law N° 1/010 of 30<sup>th</sup> June 20000 on the Code of Environment and Article 4 and Annex I of Decree N° 100/22 of 7<sup>th</sup> October 2010 on the Procedure for Environmental Impact Assessment.

In accordance with Article 34 of Law N° 1/010 of 30<sup>th</sup> June 20000 on the Code of Environment and Article 4 and Annex I of Decree N° 100/22 of 7<sup>th</sup> October 2010 on the Procedure for Environmental Impact Assessment, the proposed project requires an Environmental Impact Assessment. The project is classified under item 1: Works of construction of public works or infrastructures such as roads, dams, dykes, pants and airports.

The Environmental Experts approach in the study has been to divide the project's area into Direct Impact Zone (DIZ) and the Area of Influence (AI). The Direct Impact Zone is the area that will be immediately and directly affected by the actions undertaken during the road rehabilitation construction phase and post-construction phase of the project. This area includes the site itself, underneath crust and marginal zones up to 100m on both sides of the centreline of the road. It also includes earmarked naturally occurring material borrow areas (borrow pits, quarries, sand borrow areas, contractors campsite, and equipment /materials storage areas. The 100m has been chosen to accommodate/give allowance for establishment of material borrow areas, contractor's campsites or materials storage yard close to the road alignment.

The DIZ was determined on the basis of the following factors:

- The distance of travel of noise, dust, vibrations and exhaust fumes from construction plants and machinery from the site boundary
- Marginal zones and developments from the site within 100m as it is within this distance that impacts are likely to be felt

The AI is the area beyond the DIZ where most of the environmental impacts will be induced or influenced by the project activities. It is not subject to direct contact with the site, but is directly or indirectly affected by the presence of the proposed road. Areas around sources of naturally-occurring construction materials are also considered as areas of influence. Collines that are linked to the project road through Collines roads are also considered to be the areas of influence.

### **1.3.2 Methodology**

The Consultant's first approach in this study was to consult the Burundian Office for Environment Protection (Office Burundais pour la Protection de l'Environnement - OBPE) under the Directorate of Environment and Climate Change, Ministry of Water, Environment, and Urban Planning (Ministère de l'Eau, de l'Environnement, de l'Aménagement du Territoire et de l'Urbanisme - MEEATU)

The purpose of the consultation was to introduce the proposed project and obtain general Terms of Reference for conducting EIA in accordance with the requirements of Article 3 of Ministerial Decision No. 770/083 of 9<sup>th</sup> January 2013 on the Procedure for Conducting Scoping.

The consultation with OBPE was then followed by scoping exercise. The scoping exercise was done in accordance with Article 4 of Ministerial Decision No. 770/083 of 9<sup>th</sup> January 2013 on the Procedure for Conducting Scoping. Scoping is a process in the EIA which identifies issues that are likely to be of most importance during the EIA and eliminates those that are of

little concern in order to focus the EIA study on the significant effects and so ensure that time and money are not wasted on unnecessary investigations.

The scoping exercise enables the EIA experts to refine and customised the draft Terms of Reference that were obtained from OBPE, to comply with the proposed road project.

The refined Terms of Reference were reviewed by OBPE and found to be adequate. The Terms of Reference were approved by OBPE on 2<sup>nd</sup> February 2018. The approved Terms of Reference and approval letter from OBPE are attached as appendix IV. The scoping process was followed by detailed EIA study which involved desk work and field surveys.

In order to identify and understand the environmental and social issues adequately, the EIA experts used different methods in collecting qualitative and quantitative data. This included reviewing some literatures, site observation, public consultation meetings, and face to face interviews with key informants as described hereupon.

#### **1.3.2.1 Deskwork**

During the EIA study, a number of relevant documents were collected and detailed reviews of important secondary data were carried out. The documents review included the following: Socio-economic profile reports, policies related to environment and socio-economic, legislations, international conventions, and guidelines, geometric design reports and drawings, materials report, hydraulic and hydrological report, and economic evaluation of the project. During the desk review, important information was collected on project background, objectives, and design of the proposed project. This gave the experts additional information about the project and the scope of work. Information obtained from desk review further contributed to the improvement of data collection tools.

#### **1.3.2 2 Consultation**

The study was conducted in a participatory and consultative manner in order to gather compressive information appropriate to the study.

#### **Face Interviews with key informants**

Interviews were conducted with relevant local government officials as well as governmental and non-governmental institutions that are interested or likely to be affected by the road upgrading. The interviews were aimed at gathering additional information with regard to current environmental and social profile as well as concerns related to possible impacts of the proposed road upgrading. The outputs of the interviews were identification of additional issues and impacts, which should be considered in the EIA study.

#### **Public Consultation**

The experts conducted consultative meetings in sampled collines. The public meetings were attended by women, youth, old people, as well as children. The output of the meetings was identification of additional key issues pertaining to the road project including perceptions, knowledge, and attitudes of these communities.

#### **1.3.2.3 Field Survey**

The stakeholders' consultations were followed by project field visit, the purpose of which was to obtain detailed information about the project area to compliment information gathered during the interviews and meetings with stakeholders.

During the site visit, the ESIA experts took advantage of the knowledge of the local people to gather specific knowledge about the project site, such as presence and location of burial and cultural, and archaeological sites, concealed public services/utilities etc., that are likely to be affected by the road project.

#### **1.3.2.4 Tools Used**

During the study, the experts used the following tools:

- Global Positioning System (GPS) instrument for locating features of significant environmental and social interests that were encountered along the project road corridor.
- ExpertGPS 6.0 software for downloading data from GPS instrument and reformatting downloaded data to ArcGIS compatible format

### **1.4 REPORT STRUCTURE**

This report is divided into eleven Chapters, of which Section 1 introduces the report, followed by discussion of Policies, Legislation, and Institutional Frameworks that are relevant to the project in Section 2. Section 3 describes the project, including its justification. Section 3 is followed by baseline information in Section 4, whereby the existing environmental and social conditions of the project area are discussed in detail. Section 5 presents and analyses feasible alternatives that were considered to reach of the objective of the road project.

Although mitigation measures have been proposed to mitigate potential adverse impacts that would be caused by the project, not all the impacts can be fully mitigated. Residual effects will be therefore some residual effects that may arise as a consequence of the project after implementation of the mitigation measures. Section 8 discusses such residual effects and measures to management such residual effects.

Plans to manage and monitor proper implementation of the proposed mitigation measures are presented in 9.

During the ESIA study, a number of stakeholders were consulted to obtain views and opinions which should be considered in the preparation of this report. The synthesis of the views and opinions are presented in Chapter 10.

Finally Section 11 gives a conclusion and recommendations on the proposed project. The remaining part of the report presents a list of appendices, which consists of maps, photos, list of stakeholder that were consulted, including minutes of consultative meetings and Terms of Reference.

## **SECTION 2: POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK**

### **2.1 POLICIES**

#### **2.1.1 National Water Policy of 2009**

Water is essential for the existence of man and all living beings. In a country like Burundi where the economy is largely based on agricultural resources, which account for 56% of Gross Domestic Product, and where Agriculture<sup>1</sup> occupies about 90% of the active population, any degradation of water resources can have severe consequences on food supply of the population.

High population growth (3% per annum) is putting increasing pressure on natural resources, with consequent degradation of the soil, deterioration of the quality of water resources, the proliferation of water-borne diseases and the decline of water resources.

The development of the National policy on water was inspired by legislation (Basic Law) of the Republic of Burundi and internationally recognized general principles to which Burundi has signed, including the principles of Dublin (1992) for integrated water resources management, the Millennium Goals for Development, the targets of the World Summit on Sustainable Development, and the vision and goal of New Partnership for Africa's Development.

The overall objective of this policy is to ensure sustainable coverage of water needs for all users by a harmonious development of national water resources. The following are specific objectives of the policy that are relevant to this project:

- To improve basic sanitation infrastructure
- To improve the behaviour of the population in relation to good water management practices and sanitation
- To prevent damage and mitigate climate disasters
- To protect water resources against degradation

#### Relevance to the Project

The road project could result into degradation of water sources if not carried properly. During construction the Contractor will be required to ensure construction activities do not cause pollution of water source.

#### **2.1.2 Economic Policy**

Burundi has been involved, for more than 20 years, in economic reforms with the help of the Bretton Woods institutions. However, the positive results which were becoming more and more significant were harmed by the 1993 crisis. Although the crisis persisted, the economic reforms were carried on with the help from World Bank, and few other partners through a minimum humanitarian assistance.

#### **2.1.3 Legal and Institutional Policy of Affairs**

To attract both national and direct foreign investments, Burundi has reviewed its code of investments in most of its main core. The procedures of enterprise approval as a priority enterprise have been simplified. Furthermore, some measures of the investment code have been reviewed in relation to of evolution of the foreign exchange policy change which has been

simplified. Also the concern of simplifying the approval and adaptation procedures, to the new exchange policy that has motivated the promulgation of the law n°1/15 of 31 July 2000. The law that modifying the statutory order n°1/30 of 31 august 1992 related to the creation of a Free Trade Area Regime in Burundi.

### **2.1.4 Trade Policy**

Burundi has adopted the trade liberalization policy especially by abolishing quantitative restrictions to imports, by instituting freedom of fixing prices, by observing the right to negotiate with the private sector, the price structure of a very limited number of strategic products for the national economy with respect of World Trade Organization and Common Market for Eastern and Southern Africa rules and regulations. This is specifically the case for oil products and sugar.

### **2.1.5 Privatization Policy**

Since 1986, the government has adopted a program of disengagement in public investment in order to give advantage of private initiatives. The program continues with the enterprises that remain. These are generally considered as investments with big capitals and therefore difficult to privatize because of the internal weak savings. However, it seems that the services sector is easier to privatize than the industrial sector. This probably is because of its profitability which is much higher and without competition. The Inter-ministerial Committee of Privatization and Service in charge of Public enterprises have already established a program of disengagement of the State from all sectors.

### **2.1.6 Child Labour Policy**

Children in Burundi work primarily in agriculture, livestock keeping, fishing, and in informal sector. A research project in Burundi has found that children in rural areas are more likely to work exclusively and not attending school than those in urban areas. In urban areas, a large number of street children are involved in activities such as hawking goods or working as porters, which may involve carrying heavy loads. Children also work long hours as domestic servants, and some have reported not being paid wages owed. There have also been reports that children are victims of commercial sexual exploitation.

Children in Burundi are trafficked internally for the purposes of domestic service, and commercial sexual exploitation. Children are also reportedly trafficked from Burundi to Uganda for commercial sexual exploitation and work in agriculture.

#### **2.1.6.1 Child Labour Laws and Enforcement**

The minimum age for employment in Burundi is 16 years. Children 12 to 16 years are permitted to engage in light work or apprenticeships that do not jeopardize their health, development, or ability to attend and benefit from school. Children of less than 16 years may work a maximum of 6 hours per day, must have rest periods of at least 12 hours between work sessions, and, as with all children, are prohibited from working at night. The law allows for medical examinations to determine whether a child's work causes undue physical stress. Employers found in violation of these work provisions of young persons are subject to fines and, for repeat offenses, closure of the place of employment.

The constitution prohibits slavery in all forms, and the labour code prohibits forced labour, except in special circumstances such as military service, civic obligations in the public interest, or as a result of a judicial decision. Inciting, exploiting, or facilitating prostitution of persons less

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than 21 years are subject to fines and imprisonment of up to 10 years. Offenses against the decency of a child are punishable by prison terms of 5 to 15 years. The law does not specifically prohibit trafficking; however, traffickers can be prosecuted under laws against assault, fraud, kidnapping, rape, prostitution, and slavery, and they may face up to 20 years in prison. The constitution specifically prohibits using children directly in armed conflicts. Nonetheless, by law the minimum age for military recruitment is 16 years, although the Government reports that in practice it does not recruit those less than 18 years.

The Ministry of Labour is responsible for enforcing child labour laws. According to USDOS, enforcement is carried out only in response to the filing of complaints. This practice is due, at least in part, due to a lack of labour inspectors. In 2008, there were only 12 labour inspectors, none of them was specifically assigned to child labour, and no child labour investigations were conducted.

#### **2.1.6.2 Current Government Policies and Programs to Eliminate the Worst Forms of Child Labour**

In 2008, the Government of Burundi continued to assist former child soldiers and street children. Burundi's National Demobilization, Reinsertion, and Reintegration Program continued activities that demobilize child soldiers and prevent recruitment of ex-combatant child soldiers. These activities were originally funded under a World Bank umbrella grant; since June 2006, the Government and UNICEF have continued to provide support so these children may receive education and vocational training. The government has also helped to provide income-generating projects for former child soldiers

#### **2.1.7 Education Policy**

The government is currently developed a concerted education sector policy with the assistance of development partners. This policy consists of instituting major reforms to ensure sustainable development of the education sector and establish necessary conditions for its recovery. The objectives of this policy are to:

- Raise enrolment ratios at all levels of education
- Raise the enrolment ratio of girls
- Reduce illiteracy; and
- Eliminate regional disparities.

To reach these objectives, strategies planned by the government will focus on the following:

- Build, rehabilitate, and expand education infrastructure, placing a priority on the most underprivileged regions;
- Upgrade the capacities of the education system by training trainers and teachers of sufficient quality and in sufficient numbers;
- Make appropriate educational equipment and teaching aids available to both public and private institutions at all levels of training;
- Enhance the status of teachers
- Reinforce education planning entities and improve the school map
- Develop a national policy on vocational education in order to integrate youth currently outside the school system
- Promote private education



- Mobilize financing; and
- Match training to employment so as to meet the country's socio-economic development needs.

### **2.1.8 African Development Bank Groups Policy on the Environment Policy, 2004**

The overall objectives of the policy are to improve the quality of life of the people of Africa by supporting an environmentally sustainable development and, preserve and enhance ecological capital and life-support systems across the continent of Africa.

The policy was developed to assess environmental constraints and opportunities that affect development objectives. It acknowledges the significant progress made in the implementation of Agenda 21 adopted at the 1992 Rio Earth Summit, the ratification of a large number of environmental conventions, agreements, and protocols and the growing use of Millennium Development Goals (MDGs) as a measure of development.

The policy recognizes the considerable constraints facing Africa, including growing poverty, and disparity in wealth distribution both nationally and regionally. A new threat of HIV/AIDS is recognized as a contributing factor to development crisis, and therefore recognizing the need to integrate social and environmental concerns into economic development policies to reduce the negative externalities, while enhancing the positive ones.

Some of the principles that have guided the development of the policy include the recognition that:

- A strong and diversified economy constitutes a just means to enhance the capacity for environmental protection;
- Environmental management tools, like environmental assessments, shall be used as a sustainability assurance rather than impact mitigation mechanism;
- Community involvement, in particular the most marginalized and vulnerable groups, including women and children, on decisions that affect them shall have to be provided for; and
- Governance structures and institutions which are more responsive to the needs and priorities of affected communities in general, and poor people and vulnerable groups in particular, shall be encouraged.

In implementing the policy, the Bank will use a set of approaches:

- Mainstream environmental sustainability considerations in all Bank's operations
- Strengthen existing environmental assessment procedures and develop new environmental management tools;
- Clearly demarcate internal responsibility in implementation;
- Improve public consultation and information disclosure mechanisms;
- Build partnerships to address environmental issues, harmonize policies, and disseminate environmental information; and
- Improve monitoring and evaluation of operations. In particular, the Environmental and Social

#### Relevance to the Project

The policy addresses main challenges like;

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- The need for environmental interventions to reduce poverty
  - The need to maintain regional and global life support systems
  - The need to work in partnership with others
  - The need to further strengthen the processes and procedures for addressing environmental concerns in AfDB's own operations

### **2.1.9 African Development Banks Involuntary Resettlement, 2003**

The Bank's involuntary resettlement policy is set within the framework of the commitment "to promote environmental and social mainstreaming as a means of fostering poverty reduction, economic development, and social well-being". The policy covers involuntary displacement and resettlement of people "when a project results in relocation or loss of shelter by the persons residing in the project area, assets being lost or livelihoods being affected".

The primary goal of the involuntary resettlement policy is "to ensure that when people must be displaced they are treated equitably, and that they share in the benefits of the project that involves their resettlement. The objectives of the policy are to ensure that the disruption of the livelihood of people in the Project's area is minimised, ensure that the displaced people receive resettlement assistance so as to improve their living standards and set up a mechanism for monitoring the performance of the resettlement programs. Most importantly, the Resettlement Action Plan (RAP) should be prepared and based on a development approach that addresses issues of the livelihood and living standards of the displaced people as well as compensation for loss of assets, using a participatory approach at all stages of project design and implementation.

According to the policy, where the number of Project Affected Person (PAPs) – people who would need to be displaced with a loss of assets, or access to assets or reduction in their livelihood exceeds 200, then a full replacement plan will be required as a supplement document to the Environmental and Social Impact Assessment (ESIA).

#### Relevance to the Project

- The number of PAPs in this project is likely to exceed 200
- Apart from this ESIA report, a full Resettlement Action Plan (RAP) will be conducted during detailed design of the road

## **2.2 LEGAL FRAMEWORK - ACTS**

### **2.2.1 Law N° 1/010 of 30<sup>th</sup> June 20000 on the Code of Environment**

This Law sets basic rules to protect and management the environment against all forms of degradation, in order to safeguard and enhance the rational use of natural resources, to fight against different forms of pollution and nuisances and thus improve the living conditions of the human person, and respect for the balance of ecosystems.

The law stipulates that the protection and improving the environment are part of the National Strategy for the Environment in Burundi (*Stratégie Nationale pour l'environnement au Burundi*). The law requires that policies, strategies, and plans economic sector that are established at the national level must incorporate issues of environment and sustainable development in their objectives using identified action plans within this framework.

The following articles of the law are also relevant to this project:

#### **Article 4**



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Specifies that the environment and natural resources must be conserved, maintained, and activities and phenomena that could degrade the environment and cause harm to human health and ecological balance must be prevented or limited. Damage to the environment must be repaired or compensated made for damage suffered.

Relevance to the Project

During construction the Contractor shall as much as possible conserve, maintain to prevent damages to the environment.

**Article 21:**

In order to minimize or eliminate short, medium and long term impacts on the environment, development initiative, referred to in Article 22, the tender documents must necessarily include an environmental impact assessment component.

Relevance to the Project

This ESIA has been conducted to comply with the requirement of this article

**Article 22:**

The section requires that any developer whose development initiative; due to its size and nature of activities is likely to have adverse environment impact, must prepare and submit environmental impact assessment to the Administration of the Environment. The impact assessment shall assess direct and indirect impacts of the project on the ecological balance, the environment and quality of life of the population.

Relevance to the Project

This ESIA has been conducted to comply with the requirement of this article

**Article 23:**

The section specifies that the impact study must include the following headings:

- Analysis of the initial state of the site and its environment
- Evaluation of the foreseeable consequences of the implementation of the project on its natural and human environment
- The statement and description of the measures envisaged by the petitioner to eliminate, reduce and, if possible, offset the damaging consequences of the project on the environment and the estimation of the corresponding expenditure
- The presentation of other possible alternative solutions and reasons for favouring the presented solution

Relevance: The ESIA report has included all such information

**Article 34**

The section specifies that public works and infrastructure, such as roads, dams, dikes, bridges, and airports are NOT exempted for carrying out environmental impact assessment for projects that are likely to have adverse impacts.

Relevance to the Project

This ESIA has been conducted to comply with the requirement of this article

**Article 60**

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The section forbids emitting into the air releases that are likely to generate air pollution beyond the limits to be set by regulation.

Relevance to the Project

The Contractor shall as much as practical prevent pollution of air and implement measures to minimize air pollution resulting from his construction activities.

**Article 70**

The section requires protection of public and private forests from any form of degradation or destruction resulting from such abusive clearing, pollution, burning, over-farming or grazing, disease or the introduction of inappropriate species

Relevance to the Project

During construction of the road, the Contractor shall as much as possible avoid unnecessary clearing of trees along the road.

**Article 71**

The section forbids any clearing of forests and woodlots that are protected without prior authorization of the administration of the Environment, under the terms and conditions established by the Forest Code and by its application texts. The authorization is subject to the completion of an impact study

Relevance to the Project

OdR shall seek permission of OBPE before commencing widening of the road section that traverses Nkayamba Natural Forest Reserve. This ESIA is being conducted to comply with the requirement by the law to conduct impact assessment.

**Article 75**

The section stipulates that any natural environment which is conserved against degradation or modification by any human intervention is classified as protected areas as national park or nature reserve as provided by the law governing this matter.

Relevance to the Project

The road traverses one forest reserve namely Nkayamba Natural Forest Reserve. The Contractor shall take heed to ensure that damages to the forest reserved in minimized.

**Article 105**

Any natural or legal person, public or private, owner or operator of any facility is required to take all necessary measures to fight against environmental pollution that are likely to be caused by the installation, in accordance with requirements of this code and its application texts.

Relevance to the Project

Measures have been proposed to prevent and minimize environmental pollution. The supervising consultant shall ensure that the proposed mitigation measures are implemented by the Contractor.

**Article 120**

Requires that wastes from a facility be properly treated to eliminate or reduce their adverse effects on human health, natural resources, flora and fauna or the quality of the environment in general.

Relevance to the Project

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Wastes that will be generated by construction activities shall be handled, managed, and treated in a manner that do not cause adverse impact to the environment

**Article 122**

Specifies that any producer of industrial wastes producer must take all possible measures to ensure or improve the environmentally sound management of these, apply new techniques low-waste, ensure separate storage and disposal of such wastes. This waste must be disposed of in the nature of sites or facilities authorized by the administration of the Environment

Relevance to the Project

Wastes that will be generated by construction activities shall be handled, managed, and treated in a manner that do not cause adverse impact to the environment

**Article 126**

Requires that sewage, waste oils and other liquid waste from industrial, commercial, craft, agricultural or livestock must be treated by physical, biological or chemical process prior to disposal in accordance with the application of this Code.

Relevance to the Project

Sewage, waste oil and other liquid wastes that will be generated by construction activities shall be treated or disposed of in a manner that will have minimum impact to the environment.

**Article 131 and 132**

Among others prohibits emission of noise, beyond a set limit in order to prevent harming the health of man, of undue nuisance to neighbours or harm the environment.

Relevance to the Project

The Contractor shall comply with emission and noise level limits

**2.2.2 Law N° 1/02 of 26 March 2012 on Water Code**

The present Code sets the basic rules and related institutional framework to ensure rational and sustainable management of water resources, amenities, and hydraulic public interest works, so as to allow:

- The conservation and protection of this resource against all forms of pollution and degradations, without prejudice to the provisions on environment.
- Its use and rational exploitation for different needs and state of priorities, local communities, and individuals

The Following Sections of the act are relevant to this Project:

- Articles 5:
- Prohibits anthropogenic activities within 150m from the edge of L.Tanganyika, 50m from any other lake in the country, 25m from rivers that discharge into L.Tanganyika, and 5m from edges of all other rivers.

Relevance to the Project

The study noted substantial number anthropogenic activities within the buffer zones specified by the law. The anthropogenic activities noted include settlements and farming.

**Article 45:**

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Prohibits any activity which is likely to directly or indirectly cause impair the quality of water which is used by the public for consumption or make it unfit for consumption within water resource buffer zone

The prohibition focuses on the following activities:

- Deposits of garbage, filth and detritus;
- Manure spreading, watering, penning livestock or animals;
- Deposits of oil and any substances presenting a risk of toxicity, including chemicals, fertilizers and pesticides;
- Exploitation of quarries and other mineral substances open;
- Installation piping of wastewater of any kind
- Installation of cemeteries
- Disposal of faecal sludge from a septic tank

Relevance to the Project

- The study noted burying of dead human bodies within the buffer zone of L.Tanganyika
- The Contractor shall manage waste oil in a such manner that the oil does not cause pollution of water resources

**Article 52:**

It is prohibited to direct or indirect discharge sewage or spill of any nature, or commit acts that may cause or increase the pollution of surface water or groundwater.

Relevance to the Project

The Contractor will be obliged to prevent any entrance of wastes that can cause pollution of water resources.

**Article 53:**

- Forbids throwing of bodies in water or burying them within less than five hundred metres away from wells, fountains, public drinking water or water resource protection buffer zone
- Where water table is less than 2m deep, It is forbidden to install cemeteries, burying corpses, digging latrines, install dumps or landfills

Relevance to the Project

The Contractor shall comply with all the above legal requirements

- Article 84:
- Requires that a permit be obtained from the Minister responsible for water resource management prior to abstraction of surface or ground water.

Relevance to the Project

The Contractor will be required to obtain water abstraction permit from the Ministry of Water, Environment, and Urban Planning before abstracting water from any river for construction works.

- Article 94:

Among others, extraction of sand, stones, earth, gravel and other materials from the bed and from the banks of streams or lakes require permit from responsible Minister.

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### Relevance to the Project

River beds are potential sources of such materials as sand and stones for construction activities. The Contractor will therefore require a permit for borrowing materials from such sources.

### **2.2.3 Law N° 1/07 of 15 July 2016 on Revision of the Forest Code**

The law aims at establishing a harmonious relationship between the need to protect ecosystems and forest resources on the one hand, and the economic, environmental, cultural and social needs of the population on the other hand.

The law intends to:

- Halt forest cover reduction through sustainable forest management, through forest protection, regeneration, afforestation, reforestation, increased efforts to prevent forest degradation;
- Enhance the economic benefits of forests, including improving the livelihoods of forest-dependent people;
- Increase the area of protected forests, sustainably managed forests and increase the proportion of forest products from sustainably managed forests

The following articles of the law are relevant to the proposed project:

#### **Article 25:**

This law establishes three categories of forest domains as follows:

- The State forest
- The communal forest estate and public establishments
- The private forest estate

#### **Article 26**

Group State forest estate into:

- Crown land that carries timber and non-timber forest products of natural or man-made origin and is managed for forestry purposes;
- Non-forested public lands, in particular those requiring reforestation for the conservation or restoration of soils, the regulation of water systems or the increase of forest production, as soon as they have been the subject of the classification procedure defined in sections 28 to 31 of this Act

#### **Article 27:**

Under the law, protected areas, the edges of national and provincial roads, the banks of rivers and lakes within the limits of the fluvial domain, the marshes of the natural public domain and the woodlands open to public use in the urban perimeters, make part of the State forest estate pursuant to Article 26 of its first paragraph

#### **Article 33:**

Prohibits establishing settlements, farming, or dumping spoil material on a State forest estate

#### **Article 37**

The classification as forest of protection prohibits any change of use or use of land cover which is likely to compromise the conservation of the forest.

### **Article 83**

The state forest shall be protected against any form of degradation or destruction, particularly mining and quarrying, illegal logging, over-exploitation, overgrazing, burning, and land clearing and deforestation.

### **Article 88**

Any clearing of estate, commune, public, or private forest whose size surface exceeds half a hectare is subjected to a permit of clearing and granting of a clearing permit is subject to the completion of an environmental impact study. The request for obtaining this permit of clearing is addressed to the Minister having forests in his attribution.

### **Article 91**

Clearing of forests and scrub within 25 meters on either side of banks, bodies of water and rivers flowing from Lake Tanganyika is forbidden. For other rivers, this activity is clearing of scrubs and forest within 5 meters on either side of the banks is prohibited.

### **Article 95**

Specifies that before carrying out excavations in the ground, to exploit quarries or mines, to open a way of communication or to rectify the route, to build constructions on a forest domain of the State, of the municipality or public institutions or on a private forest estate having at least half a hectare, any natural or legal person is obliged to:

- Obtain the authorization of the Minister having forests in his attributions and, where applicable, a cutting or clearing permit;
- To take all protective and conservation measures to ensure that the activities do not cause or aggravate erosion, degrade the soil or damage the vegetation around the sites or exploitations, alter the quality of the water and do not disturb stream flows
- Restore the site of excavations, extractions or work sites in good condition after prospecting and exploitation

### **Article 122**

Any tree cutting is subject to the issue of a tree cutting permit, with the exception of private trees found on an area of less than half a hectare or trees in enclosed grounds adjoining a dwelling house or an industrial, commercial or administrative building

### **Article 125**

The issuance of a tree cutting permit is subject to prior payment of the timber cutting authorization fees which is determined by a joint order of the ministers having forests and finance in their attributions

### **Article 128**

Where the trees that have to be cut are not likely to regenerate because of their age or genetic characteristics, the cutting permit requires, in addition to the fees, an equivalent number and species be compensated.

## **2.2.4 Law N° 1/10 of 30 May 2011 on Establishment and Management of Protected Areas**

A protected area is defined as a geographically designated, delimited, regulated and managed area with a view to achieving specific conservation objectives.

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An area is protected area when the conservation of fauna, flora, soil, atmosphere, water and, in general, the natural environment presents has a special interest and the importance of preserving to evade any artificial intervention, appearance, composition and, evolution.

As part of the sub-regional cooperation, the State involved, through bilateral or multilateral agreements, to the creation and management

Trans-boundary protected areas in particular to the conservation of natural habitats, protecting wildlife species and flora, the development of research and tourism

### **2.2.5 Law N° 1/21 of 15 October 2013 on Mining Code**

The provisions of this Code apply to prospecting, research, industrial and artisanal exploitation, processing, holding, transport and trade operations as well as the closure of mines, mineral or fossil substances, thermal waters and quarry products.

The following articles of the law are relevant:

#### **Article 3**

Quarries consist of the following:

- Construction, stone, lime and cement materials
- Materials for the ceramic industries
- Soil improvers for land cultivation and similar substances with the exception of phosphates, nitrates, alkali salts and other related salts in the same deposits
- Peat

#### **Article 9**

The article specifies that only holders of a mining license have legal right to extract material.

The owner of the land does not have the right to carry out any prospection, research, exploitation, transformation or detention of the mineral substances and products of career being or likely to be under the land.

#### Relevance to the Project

The Contractor shall apply for a mining licence under the name of OdR prior to commencing quarrying activities.

#### **Article 70**

If during exploitation the holder of an exploitation license discovers substances other than those subject to the operating permit in force, he must declare them to the competent authority at the risk of having his operating license cancelled and legal proceedings instituted

#### Relevance to the Project

In the event that the Contractor discovers that substances other than construction material, he shall immediately report the matter to OBM.

#### **Article 82**

Among others, the holder of an exploitation license or the lessee is obliged to:

- Take out insurance for its employees
- Report without delay to the Minister any accident that occurs in a mine, a mine site or in their dependencies.



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#### Relevance to the Project

The Contractor shall ensure that every incident and accident resulting from quarrying activities is reported to either OBM or Minister of Energy and Mining immediately after its occurrence.

#### **Article 105:**

Quarries are divided into two categories:

- When the volume of material to be extracted annually exceeds 20,000m<sup>3</sup>, the quarry is an industrial quarry whether operating in the open pit or underground.
- When the volume of material to be extracted annually is less than 20,000m<sup>3</sup>, it is an open pit quarry

#### **Article 106:**

A quarry cannot be operated without a licence by the Minister of the sector.

#### Relevance to the Project

The Contractor shall not commence quarrying activities prior to obtaining a quarrying a licence from relevant authority.

#### **Article 107**

The owner of the ground cannot object to the industrial exploitation of the quarry. However, the land owner prior commencement of the quarry operation, the land owner must be compensated for all or part of the land and structures which is affected quarry.

#### Relevance to the Project

OdR will have a legal right to extract hard stone from any piece of land owned by individual as long as compensation of the land owner has been done in accordance with law.

#### **Article 113**

At the expiration of a permit for a quarry whatever the cause, the affected areas are free from all rights pertaining thereto and the quarry permit holder must perform at its expense, work for public safety, and rehabilitation of the site in accordance with the requirements for environmental protection and conservation career and isolation of various levels permeable.

#### Relevance to the Project

As soon as quarrying activities are completed, the Contractor shall immediately reinstate the quarry to make it safe to the public.

#### **Article 117**

The beneficiary of an industrial quarry permit shall exploit quarry products for which the exploitation permit has been rationally granted in accordance with the standards of public health and safety at work, the preservation of environment and marketing of production.

#### Relevance to the Project

The Contractor shall ensure that the safety of his workers as well as the public at large is protected from his quarrying activities.

#### **Article 136**

Among others, the article requires good management of the quarrying wastes

#### Relevance to the Project



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Suring quarrying, the Contractor shall manage wastes in a manner that protects the environmental

#### **Article 137**

Applicant of a mining licence is required to prevent irreversible damage the environment and prevent. He is also required to undertake progressive rehabilitation and rehabilitation of the perimeters covered by its title as well as of all places affected by its quarrying activities.

#### Relevance to the Project

The Contractor shall install erosion control measures and reinstate the quarry immediately after completion of his quarrying activities.

#### **Article 138**

Requires that any prospecting authorization, research permit or artisanal and quarry permit must include a simplified environmental impact study, in the forms specified by regulation.

#### Relevance to the Project

This EIA study is being conducted to comply with this requirement.

#### **Section 141**

The holder of a mining license is required to provide the Department with an annual activity report detailing the environmental impact of the work being undertaken and the measures taken to address it.

Holders of other permits and prospecting permits are required to complete and submit annually an environmental impact report to the Ministry in charge of the environment. The model of this report is determined by regulation.

#### Relevance to the Project

This EIA study is being conducted to comply with this requirement.

#### **Article 142**

Six months before the expiry of the mining or quarry permit, whatever the cause, the holder of a mining license shall submit to the responsible Minister a plan of the proposed rehabilitation works.

#### Relevance to the Project

The Contractor shall submit to the Minister of Energy and Mining a plan to reinstatement a quarry 6 months before plan closure of the quarry.

### **2.2.6 Law N° 1/13 of 9 August 2011 Revising the Burundi Land Code**

#### **Article 1**

This Code lays down the rules which determine the land rights recognized or recognizable on all the lands situated on the national territory and all that is unites and incorporates them, either naturally or artificially.

All lands in the national territory constitute the national land heritage. Special laws regulate certain aspects of real estate activity such as urban planning, real estate development and real estate professions.

#### **Article 2**

The national land heritage includes:

- Lands belonging to the public domain of the State and that of other public persons;
- Lands belonging to the private domain of the State and that of other public persons;
- The lands of private persons, physical or moral.

Some of these lands may be subject to a special legal regime of protection, including lands under protected areas

#### **Article 10**

Regardless of the classification in Article 4, land is classified as residential, industrial, commercial, agricultural, livestock or other use, depending on the use by its occupant. However, such use may be imposed by the public authority, pursuant to the provisions relating to the planning, development and maintenance of the use of surrendered or conceded land.

#### **Article 44**

The emphyteusis is the right to have for a definite duration, the full enjoyment of a building belonging to another, to the charge to develop it, to maintain it and to pay to the owner a royalty in kind or in money as agreed.

It cannot be established for a term of less than eighteen years. If it is granted for a shorter period, it is deemed to be void.

Nor can it be granted for a period exceeding fifty years. If it is granted for a longer period, it is automatically reduced to this term.

#### **Article 108**

The footstep along navigable or buoyant rivers, the construction or repair of roads, roads and other public works are legal servitudes. All that concerns this kind of servitude is determined by particular laws. Such are in particular the aeronautical easements, the servitudes of water flow, the servitudes of transport, distribution of electrical energy or telecommunication.

The law subjects landowners to different obligations regardless of any agreement.

#### **Article 189**

The following natural resources are public domains:

- Beds and the waters of rivers and other streams from their source to their mouths or to their exit from the national territory as well as islands, islets, landings or relays existing or forming in the beds of said courses
- Bottoms and waters of lakes and ponds
- Banks or edges of yards and bodies of water over a length of determine by decree from the
- line formed by the highest level reached by the waters in their periodic floods before overflowing
- Marshes as defined by Article 442 of this Code

#### **Article 194**

The following relevant artificial resources are public domains:

- Public roads and places (squares)
- Public water installations and infrastructures;

- Public facilities and infrastructure for the production and distribution of water, current
- Electric and gas;
- Public facilities and infrastructures intended for radio-communication, television and other modes of electronic communication and the frequencies used for the same purposes
- The cemeteries

#### **Article 195**

Also part of the artificial public domain of the State, allowance for public utility, such as:

- Facilitation of passage, location, support and circulation required for the establishment, maintenance and operation of the facilities referred to in section 194;
- Allowance of development, in particular:
  - a) For defence and security
  - b) For urban planning
  - c) Transmissions
  - d) For safety of air, land or sea navigation
  - e) For safety of road traffic: servitude of visibility
  - f) For the protection of monuments and sites.

#### **Article 411**

The right of ownership exercised by virtue of a land title, a land certificate, an administrative title or a customary mode of acquisition, may be expropriated for public purposes for the benefit of the State or of any other public person, subject to the payment of a fair and prior compensation.

#### **Article 424**

The compensation for expropriation must fully compensate for the loss suffered by the expropriated party. It is negotiated amicably between the interested parties or, failing that, by the competent jurisdiction within the meaning of Article 428 of this Code, seized by one of the parties.

#### **Article 425**

The compensation for expropriation may take the form of a monetary compensation or an exchange accompanied, where appropriate, by a partial compensation for the resettlement of the expropriated person. However, the expropriated party may demand monetary compensation

#### **Article 426**

Ministers in charge of lands within their remit set by Joint Ordinance the minimum level of compensation rates for buildings by type after consulting the National Land Commission. These rates must be regularly updated

#### **Article 428**

The expropriated persons may also appeal to the competent court to contest the validity of the expropriation, the consistency of the indemnity or the delay of eviction

#### **Article 433**

The compensation for expropriation must be based on the value of the expropriated property assessed at the date of the judgment. It must be paid before the registration of the transfer and at

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the latest within four months of the mutual agreement of the parties or the service of the irrevocable judgment relating thereto. After this period, the expropriated party may request the expropriating authority or the competent court to cancel the expropriation, with damages if applicable

## **2.2.8 Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code**

The following sections of the act are relevant to this project:

### **Article 3 and 125:**

Prohibits employment of children under the age of sixteen. A child below the age 16 years but not less than 12 years can only be employed after being the approval of the Minister of Labour. Pregnant women should not be given jobs that are beyond their physical capabilities. If the same cannot be implemented, the contract should be terminated, after payment of compensation

Relevance: The road construction is likely to trigger employment of children under 16. The Contractor shall not be allowed to employ workers under the age of 16 years.

### **Article 5:**

Requires that employees be fairly remunerated

Relevance: The Contractor shall pay wages to his workers that are in accordance with the law.

### **Article 6:**

Requires everyone to be given equal opportunity and treatment in employment and in the work, without any discrimination. It opposes any distinction, exclusion or preference based on race, colour, religion, sex, opinion stated policy, union activity, ethnic or social origin during hiring, pro- motion, compensation and termination.

### **Article 7:**

Workers have the right to organize freely in accordance with the Charter of National Unity, the Constitution, laws and regulations to defend their employment interests

Relevance: Contractor's workers will have the right form and to join trade unions to defend their employment interest.

### **Article 11:**

- Every worker must have adequate measures in his workplace to protect his health and safety
- The Contractor has imperative obligation to prevent accidents at work places
- The Contractor is obliged to organize and implement safety training to his workers
- Since Burundi is a member of ILO, the Republic of Burundi is gradually bringing its legislation into conformity with the standards of this organization. Ratified Conventions prevail over a national legal provisions
- Article 18:
- Specifies details that have to be specified in the workers employment Contracts

Relevance: The Contractor shall issue employment contracts to everyone who will be recruited for construction works. The Contract shall be as detailed as specified by the law.

### **Article 81:**

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Wages paid to workers must be stipulated and paid in lawful currency and may not be less than the minimum fixed by the orders of the Minister of Labour.

#### **Article 112**

Hours of work are normally eight hours a day and forty hours a week. These are the hours during which the worker is at the disposal of his employer.

#### **Section 122 and 124:**

The following are relevant to this project:

- Any pregnant woman whose health status has been confirmed by a doctor may suspend work without notice
- In the course of employment, and without this interruption of service being considered as a cause of breach of contract, every woman is entitled, on production of a medical certificate attesting the presumed date of her delivery, to a maternity leave.
- During the period of breastfeeding, she is entitled, for a period of six months to rest one hour a day. These breaks are paid as working time

Relevance: The Contractor shall comply with these requirements as well as other relevant legal requirements.

- Article 130:

Every worker is entitled to paid annual leave

Relevance: The Contractor shall grant paid annual leave to all the workers in accordance with the law.

- Article 171:

Anyone who intends start a business of any kind is obliged to notify the relevant Labour Inspectorate for inspection before approval of the business.

Relevance: The Contractor shall register his construction camp with the labour inspector office immediately after its establishment, but before commencing construction activities.

## **2.3 LEGAL FRAMEWORK - REGULATIONS**

### **2.3.1 Decree N° 100/22 of 7<sup>th</sup> October 2010 on the Procedure for Environmental Impact Assessment**

The purpose of this decree is to determine the conditions and modalities of implementation of the environmental impact assessment procedure, as laid down in Chapter 3 of Title II of Law No. 1/010 of 30 June 2000 on Environment Code.

#### **Article 4:**

The article specifies projects that are subject to impact study, regardless of the cost of their implementation.

#### **Relevance**

This project falls in the list of projects that require an EIA

#### **Article 13:**

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Specifies that preparation of the EIA study is an obligation of the project proponent, but the proponent may entrust the EIA study to a third party or to a recognized specialized body, be it a research office, or a private public research institution or even of a nature protection association with qualified people in the field. In the latter case, the impact study must specify:

- The name of the drafter (s).
- The financial burden is borne by the petitioner or by the project manager

**Article 15:**

Requires that right from the start of the impact study, the ESIA experts to seek and document views and opinions of the project stakeholders (statutory and public stakeholders) on possible impacts of the project on their environment and the people. The views and opinions of the stakeholders shall be incorporated in the ESIA study report.

Relevance: Relevant stakeholders of this project were consulted and their opinions and views have been incorporated in this ESIA report.

**Article 16:**

Specifies the content of the ESIA report in accordance with Article 23 of the Environmental Code, Environmental impact studies relating to works and installations projects require analysis of the following data:

Relevance: The content of the ESIA report has complied with this requirement.

**Article 18:**

The impact assessment is accompanied by a non-technical summary, intended to facilitate the public understanding, with a translation into national language. The summary in a synthetic form is an essential elements and the overall conclusion of the study, highlighting the solution comprising the hands of drawbacks, taking into account the constraints noted

**Article 19**

The report containing the environmental impact study shall be filed by the petitioner or the owner in three copies with the Ministry of the Environment, for examination and for the purposes of its approval. One copy is reserved for each of the other ministries - entitled - to - intervene in the process authorization for the realization of the work

**Article 23:**

The petitioner or the client may always request, from the moment of the submission of the impact assessment file, the confidentiality of certain data appearing in the filed file and whose advertising is likely to infringe the industrial property rights or has commercial interests that deserve protection

**Relevance:**

This EIA report has complied with Articles 18, 19, and 23

### **2.3.2 Ministerial Decision No. 770/083 of 9<sup>th</sup> January 2013 on the Procedure for Conducting Scoping**

The ministerial decision provides procedure for conducting environmental scoping. Environmental scoping is an open and interactive process that serves to limit and supervise the scope of the environmental impact study, provide guidelines on how to conduct the study, and facilitate the evaluation of the environmental impact assessment and quality of the study

### **Article 3:**

Specifies that scoping exercise has to be done in a participatory manner and has to be done on the basis of fixed Terms of Reference (Draft Terms of Reference provided by administration) with specific elements for the project, as elaborated by the proponent and after public involvement. The scoping exercise will assist the EIA experts to develop site specific Terms of Reference for conducting the Environmental Impact Assessment

### **Article 4:**

Specifies the procedure that has to be following during scoping as follows:

- Make information available on the project (which will allow the Ministry in charge of the Environment to evaluate the proposed Terms of Reference)
- Propose (based on the Standard Terms of Reference) a long list of impacts to be studied
- Propose which elements should be specific for the project (using standardized guidelines, with consultation option with the Ministry in charge of the Environment)
- Public consultation and field visit
- Preparation of Draft Terms of Reference (with justification of choices). Make available this draft reference term
- Draft Terms of Reference and submission to the Ministry in charge of Environment for approval

### **Relevance:**

- The ESIA study has followed the above procedure

## **2.5 CONVENTION, TREATIES, AND PROTOCOLS**

### **2.5.1 East African Community Treaty, 1999**

The following articles of the East African Community, of which Burundi is a member, are relevant to this project:

- Article 5: The promotion of sustainable utilization of the natural resources of the Partner States and the taking of measures that would effectively protect the natural environment of the Partner States
- Article 112: Integrate environmental management and conservation measures in all developmental activities such as trade, transport, agriculture, industrial development, mining, and tourism in the Community.

### Relevance to the project:

The project proponent shall comply with all the above articles.

### **2.5.2 East African Protocol on Environmental and Natural Resource Management, 2005**

The East Africa Community Protocol on Environmental and natural Resource Management govern the Partner States in their cooperation in the management of environment and natural resources over areas within their jurisdiction including trans-boundary environment and natural resources.



The following articles are relevant to this project:

#### **Article 4 – Principles**

Requires that Partner States manage the environmental and natural resources in the community in accordance with the following principles:

- i) Principle of sustainable development
- ii) The principle of public participation in the development of policies, plans, processes and activities
- iii) The principle of strategic environmental assessment and environmental impact assessment of projects, policies and activities

#### **Article 8 – Sustainable Development:**

The Partner States are required to ensure that conservation and management of environmental and natural resources are treated an integral part of national and local development plans. They are also obliged to ensure that consideration is given to environmental factors in the formulation of all development plans

##### Relevance to the Project:

- This ESIA is being carried out to fill the requirement of the article

#### **Article 13 – Management of Water Resources:**

The Relevant item in this article is the one that gives the obligation of each Partner State to protect and conserve the water resources and their ecosystem in the community through protecting and the water quality, preventing the introduction of alien species into the water resources, and protecting and conserving biological diversity in the water resources

##### Relevance to the Project:

- During road rehabilitation, especially across rivers as well as where the contractors have to abstract water from the rivers for construction purpose, the contractors shall ensure that water resources are protected from pollution.

#### **Article 21 – Soil and Land Use Management:**

The partner states are required to:

- i) Control loss of surface soils and vegetation cover caused by poor and inappropriate land use
- ii) Regulate the inflow and application of agro-chemicals to water bodies
- iii) Ensure that all forms of land use, including but not limited to public works, urban centres, mining and disposal of wastes, do not result in land degradation and pollution
- iv) Take measures to control fires, forest exploitation, land clearing for cultivation, overgrazing by domestic and wild animals

##### Relevance to the Project:

- As much as it is practical, construction activities, in particular clearing works, construction in steep slopes, and development of borrow areas will ensure erosion control measures are in place
- During construction, the Contractor shall not be allowed to use firewood as a source of energy



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- Treatment of wastes by burning shall be done in a controlled manner
  - The Contractor shall not be allowed to dispose of concrete wastes or slurry on water courses

#### **Article 28 - Management of Chemicals:**

The Partner States are obliged to take all necessary measures to ensure environmentally sound management of chemicals

##### Relevance to the Project:

During construction of the proposed road the contractor shall ensure chemicals such as concrete additives; paints, fuel, lubricants, concrete, etc. are handled in a manner that there are no leakages to the ground or water resources.

#### **Article 29 - Management of Wastes and Hazardous Wastes:**

The article requires that Partner States take measures to minimize and ensure segregation of wastes at source points up to final disposal

##### Relevance to the Project:

During construction of the proposed road the contractor shall use methods and technologies that minimize the amount of wastes generated. They shall also prevent leakages of wastes until disposed of at designed point.

#### **Article 30 – Pollution Control and Management:**

The article requires that Partner States take all reasonable measures in the event of occurrence or discovery of oil spill or other oily residues or mixtures into the environment for the purpose of preventing damage to the environment. The Partner States shall also be required to adopt measures for the safe handling, use, transportation and storage of toxic chemicals and hazardous substances

##### Relevance to the Project:

During construction, as much as possible, the contractors shall prevent leakages of hazardous materials during transport, handling, use, and storage of chemical so that they do pollute water and land resource

#### **Article 31 - Environmental Impact Assessment and Audits:**

The articles requires that an environmental Impact assessment be carried out for a trans-boundary activities and projects that are likely to have significant adverse environmental impacts

##### Relevance to the Project:

This ESIA has been carried out to fulfil the requirement of the article

### **2.5.3 Convention on Sustainable Management of Lake Tanganyika**

The Convention on the Sustainable Management of L.Tanganyika, signed on 12<sup>th</sup> June 2003 in Dar es Salaam by the countries bordering L.Tanganyika, i.e. Republic of Burundi, United Republic of Tanzania, Democratic Republic of Congo, Republic of Zambia. The convention aims at ensuring the protection and conservation of biological diversity and sustainable use of natural resources of Lake Tanganyika and its basins.

The objective of the convection is to ensure that the protection and conservation of the biological diversity and sustainable use of the natural resources of L.Tanganyika and its basins by the

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Contracting States on the basis of integrated and co-operative management. The following articles of the convention are relevant to this project:

**Article 6: Prevention and minimization of trans-boundary adverse impacts**

- The Contracting States shall ensure that activities within their jurisdiction or control do not cause trans-boundary adverse impacts<sup>1</sup>.
- The Contracting States shall take appropriate measures to address the cause or potential causes of adverse impacts within their jurisdiction or control, to prevent adverse impacts and to mitigate those adverse impacts that cannot be prevented, and thereby reduce the risk and magnitude of trans-boundary adverse impacts

**Article 8: Prevention and control of pollution**

The Contracting States shall as a matter of priority, take appropriate measures to prevent and reduce pollution of L.Tanganyika and its environment arising from activities within their jurisdiction of control. Each Contracting State shall:

- To the extent possible, construct and maintain installation within their territory to reduce the risk of pollution of the lake and its environment
- Ensure that waste is not disposed of into L.Tanganyika except under, and accordance with, a permit issued by the relevant authority of the Contracting State concerned, and
- Develop, adopt, implement and enforce appropriate legal, administrative, and technical measures to prevent, control, monitor, and reduce pollution

**Article 9: Prevention of sedimentation**

Each Contracting State, as a matter of priority, take appropriate legal, administrative and technical measures to prevent all causes of excessive sedimentation in the Lake, such as deforestation, land degradation, and the destruction of wetlands.

**Article 15: Environmental Impact Assessment**

Requires among others that each Contracting State, in order to avoid and minimize adverse impacts to adopt and implement appropriate legal, administrative and other measures requiring an assessment to be conducted of the environmental impacts of the proposed projects and of activities within its jurisdiction or control, that are likely to give rise to adverse impacts

**Relevance to the project**

During the road rehabilitation, the Contractor shall prevent causing adverse impacts to L.Tanganyika, among others prevention of pollution of L.Tanganyika, in particular sedimentation. Notably, this ESIA study is in line with the requirement of the convention. that road rehabilitation and as well as the operation of the road do not cause diverse impact to the .Tanganyika.

**2.5.4 East African Community Treaty, 1999**

The Republic of Uganda, the United Republic of Kenya, and the United Republic Tanzania signed the treaty for the establishment of the East Africa Community on the 30<sup>th</sup> of November, 1999.

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<sup>1</sup> Tran-boundary adverse impacts are any adverse impact that extends beyond the territory of the Contracting States in which the physical origin of the adverse impact is situated

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The following articles of the East African Community, of which Burundi is a member, are relevant to this project:

- Article 5: The promotion of sustainable utilization of the natural resources of the Partner States and the taking of measures that would effectively protect the natural environment of the Partner States
- Article 112: Integrate environmental management and conservation measures in all developmental activities such as trade, transport, agriculture, industrial development, mining and tourism in the Community.

Relevance: The project proponent shall comply with all the above articles.

### **2.5.5 Protocol on Environmental and Natural Resource Management, 2005**

The East Africa Community Protocol on Environmental and natural Resource Management govern the Partner States in their cooperation in the management of environment and natural resources over areas within their jurisdiction including trans-boundary environment and natural resources.

The following articles are relevant to this project:

- Article 4 - Principles: Requires that Partner States manage the environmental and natural resources in the community in accordance with the following principles:
  - iv) Principle of sustainable development
  - v) The principle of public participation in the development of policies, plans, processes and activities
  - vi) The principle of strategic environmental assessment and environmental impact assessment of projects, policies and activities
- Article 8 – Sustainable Development: The Partner States are required to ensure that conservation and management of environmental and natural resources are treated an integral part of national and local development plans. They are also obliged to ensure that consideration is given to environmental factors in the formulation of all development plans

Relevance: This ESIA is being carried out to fill the requirement of the article

- Article 13 – Management of Water Resources: Relevant item in this article is the one that gives the obligation of each Partner State to protect and conserve the water resources and their ecosystem in the community through protecting and the water quality, preventing the introduction of alien species into the water resources, and protecting and conserving biological diversity in the water resources

Relevance: During construction the road, especially across rivers as well as where the contractors have to abstract water from the rivers for construction purpose, the contractors shall ensure that water resources are protected from pollution.

- Article 21 – Soil and Land Use Management: The partner states are required to:
  - v) Control loss of surface soils and vegetation cover caused by poor and inappropriate land use
  - vi) Regulate the inflow and application of agro-chemicals to water bodies
  - vii) Ensure that all forms of land use, including but not limited to public works, urban centres, mining and disposal of wastes, do not result in land degradation and pollution

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- viii) Take measures to control fires, forest exploitation, land clearing for cultivation, overgrazing by domestic and wild animals

Relevance:

- As much as it is practical, construction activities, in particular clearing works, construction in steep slopes, and development of borrow areas will ensure erosion control measures are in place
- During construction, the Contractor shall not be allowed to use firewood as a source of energy
- Treatment of wastes by burning shall be done in a controlled manner
- The Contractor shall not be allowed to dispose of concrete wastes or slurry on water courses
- Article 28 - Management of Chemicals: The Partner States are obliged to take all necessary measures to ensure environmentally sound management of chemicals

Relevance: During construction of the proposed road the contractor shall ensure chemicals such as concrete additives; paints, fuel, lubricants, concrete, etc. are handled in a manner that there are no leakages to the ground or water resources.

- Article 29 - Management of Wastes and Hazardous Wastes: The article requires that Partner States take measures to minimize and ensure segregation of wastes at source points up to final disposal

Relevance: During construction of the proposed road the contractor shall use methods and technologies that minimize the amount of wastes generated. They will also be obliged to prevent leakages of wastes until disposed of at designed point.

- Article 30 – Pollution Control and Management: The article requires that Partner States take all reasonable measures in the event of occurrence or discovery of oil spill or other oily residues or mixtures into the environment for the purpose of preventing damage to the environment. The Partner States shall also be required to adopt measures for the safe handling, use, transportation and storage of toxic chemicals and hazardous substances

Relevance: During construction, as much as possible, the contractors shall prevent leakages of hazardous materials during transport, handling, use, and storage of chemical so that they do pollute water and land resource

- Article 31 - Environmental Impact Assessment and Audits: The articles requires that an environmental Impact assessment be carried out for a trans-boundary activities and projects that are likely to have significant adverse environmental impacts

Relevance: This ESIA has been carried out to fulfil the requirement of the article

## **2.5.6 International Convention on Biological Diversity**

The Convention on Biological Diversity (CBD) is an international legally binding agreement or treaty on the use and conservation of biological diversity, which was adopted at the Earth Summit, in Rio de Janeiro, in 1992. The treaty has three main goals: conservation of biodiversity; sustainable use of biodiversity; fair and equitable sharing of the benefits arising from the use of genetic resources. The overall objective is to encourage actions, which will lead to a sustainable future. The overall objective is to encourage actions, which will lead to a sustainable future. In other words, its objective is to develop national strategies for the conservation and sustainable use of biological diversity.

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The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5th June 1992 and entered into force on 29 December 1993 and Burundi signed the CBD on 15<sup>th</sup> April 1997.

**Relevance:** The project road traverses along one natural forest reserve at Nkayamba which will have to be protected during rehabilitation of the project road because of their recognised natural and ecological values. The nature reserves are essential for biodiversity conservation, providing habitat and protection from hunting for threatened and endangered species.

### **2.5.7 United Nations Convention on Climate Change**

The United Nations Convention on Climate Change (UNFCCC), following the Rio Summit de Janeiro in 1992. The convention aims to stabilize concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. This level should be such to allow ecosystems to adapt naturally to climate change, food production is not threatened and to enable economic development to proceed in a sustainable manner.

**Relevance:**

Burundi is a signatory of UNFCCC since 6th January 2018 and has identified the following climate related Hazards:

- Flooding (flash)
- Changes in river morphology
- Loss of water bodies
- Drought and low flows
- Intense rainfall

## **2.6 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK**

### **2.6.1 Government Agencies Responsible for Environmental Issues**

The administrative and institutional arrangements for environmental management for all sectors in Burundi are stipulated in Law N° 1/010 of 30<sup>th</sup> June 2000 on the Code of Environment. Another legal institution which is responsible for Environment is the Burundian Office for Environment Protection (OBPE). The Minister is however is the overall in-charge for administration of all matters related to the environment.

#### **2.6.1.2 Ministry of Ministry of Water, Environment, and Urban Planning**

The implementation of national environmental protection and management policy is provided by the Minister having Environment in its attributions, acting alone or jointly with the other Ministers concerned. Currently, the Minister of water, environment, and urban planning is the overall responsible for all matters pertaining to environment, responsible for all policy matters necessary for the promotion, protection, and sustainable management of Environment in Burundi.

#### **2.6.1.3 Burundian Office for Environment Protection (OBPE)**

Burundian Office for Environment Protection was formed by Decree N° 100/240 of October 29, 2014. The Office's mission is to monitor and ensure sustainable management of environment in general, and natural resources in particular, in all national development. Among others, OBPE is responsible to:

- Ensure compliance with the Water Code, the Forest Code, the Environment Code and issues related to the protection of the environment
- Establish and monitor trade and international trade mechanisms for wildlife and flare species
- Enforce environmental standards and propose all measures safeguarding and protecting nature
- Monitor and evaluate development programs to ensure compliance with environmental standards in the planning and execution of all development projects that may have a negative impact on the environment
- Ensure the implementation of obligations arising from conventions and agreements environmental issues to which Burundi is a party.

## **SECTION 3: DESCRIPTION OF PROJECT AND JUSTIFICATION**

### **3.1 PROJECT BACKGROUND**

#### **3.1.1 Project Justification**

Burundi and Tanzania form an integral part of the East African Community (EAC), comprising of United Republic of Tanzania, Kenya, Uganda, Rwanda, Republic of Burundi, and South Sudan.

The transport system in both counties consists of:

- Road network of about 91,211km, of which over 94% are in Tanzania and the rest in Burundi
- Two railway systems, consisting of Tanzania Zambia Railway Authority and Tanzania Railway Limited, both in Tanzania
- Maritime with two dominant ports of Dar es Salaam in Tanzania and Bujumbura in Burundi and four subsidiary ports each, in Tanzania – Zanzibar, Tanga, Mwanza, Kigoma and Mtwara and Rumonge in Burundi. Burundi is linked with rail in Kigoma along L.Tanganyika and the project road under consideration.
- Civil aviation in each country

Transport sector in each of the two countries has supported national development and serve as vital transit corridors for the neighbouring land locked countries in eastern Africa and the Lake Victoria Basin region, notably Rwanda, Burundi, Uganda, Zambia, and Democratic Republic of Congo (DRC). With the formation of the EAC, transport links between the countries, in particular roads also serve to promote regional integration and economic development within the region. The condition infrastructure, on which the transport system operates, particularly road and rail, does not permit efficient operation of the system because of physical deterioration arising from inadequate maintenance.

The project road is part of Class No. RN3 along RTRN Corridor EA 5 (Tunduma – Sumbawanga – Kigoma – Mugina – Nyanza Lac – Bujumbura Corridor).

The project road, which is narrow bituminous paved, in poor conditions is located in Bujumbura and Southern Provinces of the Republic of Burundi crossing Bururi and Bujumbura Provinces through Bujumbura, Kabezi, Rutunga, and Rumonge urban centres. The two provinces produce subsistence crops. The economic activities include among others palm oil, coffee, banana, maize, beans, fishing, and tourism.

The importance of the project road lays on the fact that apart from linking Burundi with Tanzania, the road provides transportation route for agricultural and mining produce to and from the Great Lakes countries in particular the eastern DRC. Others products includes mercantile from Kigoma and Kasulu centres, rice, ground nuts, coconut, salt, oranges, simsim, pineapple, apples, pears, etc. from western regions of Tanzania regions to Bujumbura. The road is therefore a driver of the economy of the Great Lakes countries and Burundi in particular

Upgrading of the road will therefore:

- (i) Facilitate more efficient transportation of agricultural and marine products from the project area to the markets in the areas of consumption and verse versa
- (ii) Promote regional integration/cooperation



- (iii) Facilitate/ increase tourism activities within the project areas as well as adjoining area
- (iv) Reduce maintenance costs of the road
- (v) Reduce Vehicles Operating Costs
- (vi) Improve access to social services such as markets and health services

### 3.1. 2 Project Location

The project road is part of Class N° RN3 (as per Burundian road network Classification) along RTRN (Regional Trunk Route Network) EA 5 (as per East African Community Classification) (Tunduma – Sumbawanga – Mpanda - Kigoma – Mugina – Nyanza Lac – Bujumbura Corridor). The project road is located in the western part of Burundi along L.Tanganyika, at the foot of Mimirwa Mountains for the western branch of East African Rift Valley. It is located in the provinces of Bujumbura City, Bujumbura Rural, Rumonge, and Bururi in communes of Mukaza, Muha, Kabezi, Muhuta, Rutunga, Bugarama, and Rumonge communes. The road passes Bujumbura City, Kabezi, Kabezi, Rutunga, and Rumonge urban centres.

The project road starts off at Bujumbura City Centre, at the traffic light, beside Independence Square and ends at Mutambara roundabout. Figure 1 shows the location of the project road relative to Tanzania while Figure 2 shows the location of the project road in Burundi. The project road traverses twenty four (24) collines as shown in Table 1 below:

**Table 1: Locations of Collines along the Project Road**

No.	Colline	Commune	Province	Chainage in Km at Colline Centre
1.	Rohero	Mukaza	Bujumbura	00+000
2.	Kinindo	Muha	Bujumbura	
3.	Kinamira	Muha	Bujumbura	
4.	Muha	Muha	Bujumbura	
5.	Kanyosha	Muha	Bujumbura City	4+500
6.	Ruziba	Muha	Bujumbura City	8+600
7.	Ramba	Kabezi	Bujumbura Rural	
8.	Kabezi	Kabezi	Bujumbura Rural	16+900
9.	Migera	Kabezi	Bujumbura Rural	22+400
10.	Gavaniro	Muhuta	Rumonge	23+900
11.	Gasange	Muhuta	Rumonge	25+200
12.	Gitaza	Muhuta	Rumonge	26+400
13.	Mubone	Muhuta	Rumonge	27+000
14.	Rutunga	Rutunga	Rumonge	33+500
15.	Chashi	Rutunga	Rumonge	34+000
16.	Magara	Bugarama	Rumonge	39+500
17.	Rutumo	Rumonge	Rumonge	41+600
18.	Muturigwa	Rumonge	Rumonge	46+800
19.	Minago	Rumonge	Rumonge	50+700
20.	Kagongo	Rumonge	Rumonge	57+100
21.	Kizuka	Rumonge	Rumonge	62+100
22.	Mwange	Rumonge	Rumonge	65+500
23.	Rumonge	Rumonge	Rumonge	71+700
24.	Mutambara	Rumonge	Bururi	76+200





Figure 1: Map Showing Location of the Project Road

Source: University of Texas Libraries, available at <http://legacy.lib.utexas.edu/maps/burundi.html>, accessed on 15<sup>th</sup> February 2018



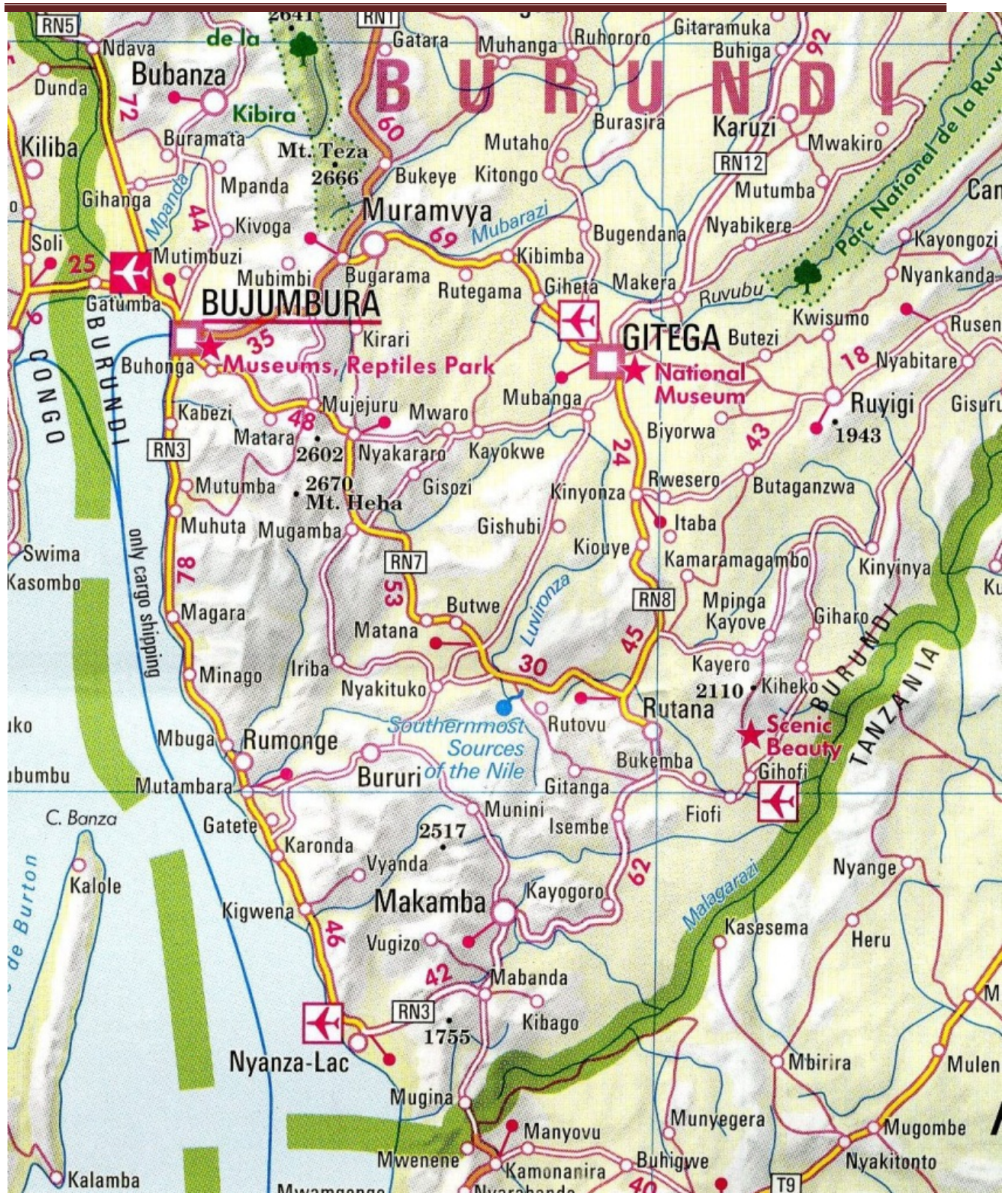


Figure 2: Map of Part of Burundi Showing the Project Road

Source: Road Travel Map, 4<sup>th</sup> Edition, harms-ic-verlag, 2013



### 3.2 DESIGN CONCEPT

The project road, which covers a total length of 78km, will constitute widening, realignment and upgrading the existing double bituminous surface Treatment road to Asphalt concrete standard. New cross drainage structures will be constructed to replace the existing structures that are hydraulically inadequate. One (1) bridge, one hundred twenty eight (8) cell structures (box culverts), and twenty eight (28) pipe culverts will be constructed. The remaining structures will be retained as they adequate.

The road upgrading will also involve improving of safety on various sections of the road with infringed sight distance (sharp horizontal and vertical curves), which are prone to accidents. Improvement of the road will also involve introducing a number of safety features such as climbing lanes, non-motorised lane, service roads in town sections, and widening of shoulders in town sections.

On average, in rural road sections the proposed road will have double carriageways of 7.0m width, and 2.0m wide shoulders. The road upgrading will also involve construction of lined and non-lined side ditches/drains as required.

All box culverts will be 7.0 wide and will have 2.0m protected foot path (with guard rails) on both sides of the bridge. With exceptions of bypasses and a few sections, the proposed road will almost follow the existing alignment.

A One stop Border Post (OSBP) facility has been proposed to be constructed at Manyovu/Mugina border between Tanzania and Burundi (refer to Figure 2)

An OSBP is a border post that combines two stops for national border control processing into one and consolidates border control functions in a shared space for exiting one country and entering another. It uses simplified procedures and joint processing wherever appropriate as opposed to the traditional post where two sets of activities are performed separately at each border post:

- Procedures required to exit a country and
- Procedures required to enter another country

In the existing border post, exit procedures are carried out on one side of the border for persons, vehicles and goods leaving the country. Entry procedures are carried out on the other side for persons, vehicles and goods arriving in the country. Activities generally involve immigration, customs and other border control functions depending on the size and characteristics of the border and the national laws that govern border controls. For the user, the existing border post involves going through a variety of paperwork, procedures and payments and then driving a few hundred meters and repeating the process on the other side.

Border controls at the existing traditional two stop border post takes long, especially when mistakes or miscalculations delay payment. This adds cost directly affects the cost of imports to consumers. A second cost derived from border delays and poor facilitation on the route is high inventory costs. When supply routes are not reliable, buyers choose other sources of goods. Falsification of documents may be prevalent where two stop border posts are in operation due to non-sharing of intelligence. This is demonstrated by disparities between export and import of the two border countries. Declaring of differing values for goods is usually motivated by the desire to avoid or reduce duties payable. Failure to collect all revenues affects the bordering countries heavily. Therefore, there is a strong relationship between the time and reliability lost on

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corridors, including border crossing time, and growth in trade with its potential impact on economic growth, revenue collection and job generation.

An OSBP means that parking and entry into the building will be done only once. All procedures related to documentation and passports will be processed in a single public hall for exiting one country and entering the adjacent country. If inspection of cargo is required, it will be done once through a joint inspection involving all necessary agencies of both countries at the same time. Scanning of cargo, if deemed necessary, will be done once.

For passenger cars and buses, introduction of OSBP procedures will cut down the border processing time to almost in half. For example, at a tradition border, buses stop at one side of the border and the passengers go into the terminal. Luggage and cargo are off loaded and inspected as needed. This takes one to two hours, then the bus is driven to the other side of the border and the same processing is repeated for another one to two hours. Passengers will enter one terminal and do both exit and entry processing. Cargo is off loaded once and inspection done jointly. Most bus clearances will be done in one hour. Freight processing is more complicated and the gains are dependent on a great deal of coordination which takes more time to achieve. Nevertheless, the potential time reductions are also considerable, if more gradual.

In addition to reducing processing time due to single window processing and single administrative documents, a common control zone will facilitate in cases of irregular migration. In cases of refused entry ineligibility or for cancellation of visa/permit, the readmission to the country of departure could be almost an automatic system process.

Completion of the on-going construction of the OSBP will therefore enhance the operation of the proposed road upgrading project through reduction of border crossing time and costs

Throughout the discussion in this ESIA report, the reference of distance measurements (chainage convention) to any point along the road is made from Bujumbura at the traffic light beside Independence Square.

The chainages are presented as Km A+bbb, of which the first number (A) represents the distance in Km, while the second number (bbb) represents the distance in metres. Km A+bbb therefore will refer to the chainage at the distance of A.bbb Km

### **3.4 PROJECT ACTIVITIES, MATERIALS, WASTES, AND EQUIPMENT**

Upgrading of the road will entail the following main activities:

#### **3.4.1 Mobilization Phase**

##### **3.4.1.1 Activities during Mobilization Phase**

The mobilization phase of the project, which is estimated to take about 6 months, will entail the following activities:

- Land acquisition for the construction of camps and materials borrow sites. Land acquisition will involve compensation of land.
- Establishment of construction of camps (Contractors' and Engineer's camps), which shall include among others residential houses and site offices, workshops (mechanical, carpentry, steel workshops), material and equipment storage areas, materials processing yards (e.g. concrete pre-cast yard, concrete batch plant, asphalt facility), including sanitation facilities. The following activities will be involved during establishment of the camp:

- a) Clearing of camp construction site
- b) Excavation works for foundation
- c) Construction of a foundation: concrete or/and block works
- d) Construction of timber sub – structure
- e) Roofing works
- f) Construction of sanitation facilities
- g) Installation of electrical infrastructure
- h) Installation of water and wastewater infrastructure
- i) Construction of fence for campsites
- Identification of naturally-occurring material borrow sites (sand, fill, gravel borrow and quarry sites), including land acquisition of land for the sites
- Identification of sources of water for domestic and construction works
- Transport and assembling of construction plants and equipment to the construction site
- Transport of fuel and construction materials from sources to the construction site

Notably, acquisition of land for sitting the campsite and sources of construction materials will precede mobilization of equipment and construction of the camp.

#### **3.4.1.2 Materials required during Mobilization Phase**

The following materials will be required during mobilization phase of the project:

- Cement, sand, and aggregates for block and concrete works
- Water for general construction works and dust abatement
- Timber, galvanised iron sheets, paints, nails, etc. for roofing and fencing works
- Electrical works: conduits, cables, fittings
- Plumbing works: unplasticized Poly Vinyl Chloride (uPVC) and Galvanised Steel (GS) pipes, fittings
- Fuel for the operation of construction machines and equipment
- Fencing wire and poles for fencing off the camps from the neighbourhood

Cement, galvanised iron sheets, nails, fence wire, electrical and plumbing utilities will mainly be imported from outside the country, while sand, aggregates, and timber will be obtained locally.

#### **3.4.1.3 Equipment Required During Mobilization Phase**

The major equipment which will be required during mobilization phase of the project will include:

- Bull dozers/motor graders, excavators for site clearing, excavation, and grading of the camp construction site
- Light duty vehicles and heavy trucks for the transport of construction materials, small machines and staff
- Water pumps, block making machines, stationery concrete mixers and trans mixers, etc. for making of blocks and concrete mixes for concrete works
- Electric power generator(s)

### 3.4.1.4 Wastes Generated During Mobilization Phase

Mobilization phase of the project will generate the wastes shown in Table 2 below.

**Table 2: Wastes likely to be generated During Mobilization Phase**

Aspect	Solid Waste	Liquid Waste	Gaseous Waste
Site clearing and excavation	Earth, green cutting	None	Generation of air pollutants (dust)
Construction of foundation(s): block/concrete works	Concrete, blocks, hessian cement bags	Water slurry, wash-down water	None
Construction of the main structure	Cement bags, mortar, steel reinforcements, nails, timber, iron sheet wastes, etc.	Concrete slurry	Paint
Installation of electrical infrastructure	conduit pipes, cables	None	None
Installation of water infrastructure	uPVC and GS pipes	None	None
Labour force	Plastic bottles/ bags, food wastes	Sanitary wastes	None
Servicing of construction equipment	Used batteries, used tyres, used metals parts, used oil and fuel filters, empty oil drums	Waste oil	

### 3.4.1.5 Treatment and Disposal of Wastes Generated During Mobilization Phase

The treatment methods for the wastes generated during mobilization phase shall be based on re-using, re-cycling, burying, or burning, and on site treatment.

- During site clearing, top soil and green cutting shall disposed of in old borrow pits or other areas approved by the Engineer
- Concrete and cement blocks wastes shall be disposed of in borrow pits during their reinstatement as approved by the Engineer.
- Metal wastes such as GS pipes, nails, reinforcement bars, and used equipment parts shall be disposed of by recycling. They will be collected and stored; until enough quantities are obtained before being disposed of by the Contractor to steel rolling factories within or outside Burundi as certified by Burundian Office for Environment Protection (OBPE) and verified by the Engineer.
- Degradable materials such as paper cement bags and paper boxes shall be treated on site by either controlled burning.
- Non degradable wastes such as plastic, PVC pipes, and plastic bottles shall be collected and transported to plastic factories within or outside Burundi after being certified by OBPE and verified by the Engineer.
- Used batteries, empty metals drums, used oil filters shall be disposed of through OBPE approved disposing companies as described in sub-section 3.4.2.5
- Temporary pit latrines shall be constructed at active mobilization sites (camp sites) for the disposal of sanitary wastes.

### **3.4.2 Construction Phase**

#### **3.4.2.1 Construction Activities**

The entire road project is proposed to be constructed one Contractor. The construction phase of the project, which is estimates to take 36 month will encompass following major activities:

- Earth works to facilitate widening and re-alignment of the road. Earth works will entail the following activities:
  - a) Clearing and grubbing (clearing of vegetation, including trees (only trees within the road prism shall be removed)
  - b) Removal of top soils
  - c) River dredging
  - d) Cutting and filling
  - e) Road widening and re-alignment and compaction
  - f) Excavation to facilitate construction of storm water drainage system such as side drains and cross drains (culverts), etc.
- Construction of detours and diversions and construction of access roads to sources of naturally-occurring construction materials
- Demolition of buildings within the RoW
- Demolition/ dismantling of the existing hydraulic structures (bridges and culverts)
- Collection and disposal of dredges, spoilt, demolition materials from the existing road and its furniture, buildings, and excavated earth materials
- Extraction of naturally-occurring construction materials. This will include:
  - a) Excavation and transport of natural sand, gravel, and sub-base materials to construction sites.
  - b) Stone quarrying (including blasting), crushing and transport of crushed aggregates to construction sites
  - c) Transport and handling of fuel, lubricants etc. from their sources to the project site
- Fabrications and installation of pipe culverts
- Construction of bridges, culverts, and road side drains. Construction of culverts will involve such activities as excavation, cutting, bending, and fixing of re-bars, concrete works, and protection works
- Filling and reshaping the road section to sub-grade level
- Abstraction of water from surface and underground sources for the treatment and compaction of different road layers as well as mitigation of generation of dust
- Laying of cement-stabilized sub-base pavement layers, including compaction and curing with water
- Laying of CRR (Crushed Rock) pavement layer, including compaction and slashing
- Heating of bitumen
- Priming of CRR pavement layer with hot bitumen
- Pre-coating of stone chippings with bitumen
- Spraying of hot bitumen on CRR pavement layer

- Spreading of different two layers of chippings on the bitumen sprayed on CRR layer

### 3.4.2.2 Materials Required During Construction Phase

During the project construction, the following materials (Table 3) will be required:

**Table 3: Materials required During Construction Phase**

No	Material	Usage	Source
1.	Ordinary Portland Cement (OPC) and Pozollana Portland Cement	Production of mortar, laying of C1 and C2 pavement, construction of structural works (bridges and culverts)	Imported from outside Burundi
2.	Sand	Production of mortar and general concrete works	River beds sand pits (to be established by Contractors)
3.	Crushed aggregate	Concrete works (Structural works), construction of drainage systems, production of chippings for surface dressing	Table 7
4.	Steel reinforcement bars	Reinforced concrete works (construction of bridges, and other drainage structures)	Imported from outside Burundi
5.	Steel shutters and form works	Concrete works	Imported
6.	Soft timber	Production of timber formworks and shutters	Locally and imported
7.	Nails	Nails for fixing timber form works	Imported from outside Burundi
8.	Hard stone	Construction and protection of drainage structures, production of base course material, production chippings for surfacing	Table 7
9.	Gabion boxes and mattresses	Protection works	Imported
10.	Natural gravel	For sub-base pavement layers	Borrow pits (Table 6)
11	Earth fill material	Sub-grade layers	Borrow pits (Table 6)
12.	Different grades of bitumen	Priming and production of asphalt concrete pavement layer	Imported
13.	Thermoplastic paints	Road marking and metal marking paints for sign board marking	Imported
14.	Geo-textile fabrics	The soil stabilization, drainage, and erosion control	Imported
15.	Water	Drinking, concrete works, spraying during compaction and curing of cement stabilised pavement layers, laying of base course pavement layer, dust suppression	Perennial rivers and boreholes along the road
16.	Concrete admixtures	For different treatments of concrete	Imported
17.	Different grades of	Lubrication of construction equipment	Imported



No	Material	Usage	Source
	lubricants (oil and grease)		
18.	Diesel and gasoline fuel	Operation of construction machines and equipment	Imported
19.	Assorted spare parts and consumables	Repair of equipment and operation of mechanical workshop etc.	Imported

Lubricants, fuels, bitumen, concrete, and paints are among hazardous and toxic substances that will be used during the construction phase of the road. Lubricants, fuels, bitumen, and concrete present a threat to the quality of surface and ground water as well as soil in the event of accidental spillage or leakage.

### 3.4.2.3 Equipment Required During Construction Phase

The construction phase of the project road will require a wide range of construction machines, machinery and equipment, as well as vehicles and trucks for transport of staff and construction materials. The following table (Table 4) gives the basic machinery, equipment, and vehicles that will be used during construction phase.

**Table 4: Machinery & Equipment Required for Construction Works**

No	Machinery/equipment	Activity for which it is required
<b>Construction Equipment: Type and Characteristics</b>		
1.	Backhoe excavator	General earth works, e.g. excavation of drains and river dredging
2.	Bull dozer with ripper	General earth works
3.	Wheeled loader	General earth works and transport of concrete
4.	Motor grader	General grading works, including earth works
5.	Vibrating/sheep foot roller compactor	Compaction works
6.	Vibrating steel drum roller compactor	Compaction works
7.	Tandem roller compactor: 8 – 10 ton	Compaction works
8.	Pneumatic Tired Roller compactor	Compaction works
9.	Hydraulic hammer	Piling works
10.	Truck mounted crane	Lifting of construction materials e.g. pre-cast culverts
<b>Construction Machines</b>		
1.	Concrete batching plant	Preparation of concrete (batch concrete mixing)
2.	Concrete truck mixer (trans mixer))	Concrete mixing
3.	Concrete mixer	Concrete mixing
4.	Stationery bitumen heater	Heating of bitumen
5.	Bitumen distributor/ sprayer	Distribution of bitumen
6.	Mechanical broom	Cleaning of road surface
7.	Single jaw crusher:	
8.	Stone crushing plant with associated screens	Production of chipping (aggregates) from hard stones)
9.	Quarry dump trucks	Transport of stones and aggregates
10.	Dump trucks	Transport of construction materials and wastes
11.	Power bloom and blower	Blowing of surfaces before paving
12.	Equipment for geotechnical	Geotechnical investigation works

No	Machinery/equipment	Activity for which it is required
	investigations	
13.	Concrete vibrator and poker	Vibrating concrete
14.	Dewatering pump	Dewatering to allow for waterless construction
15.	Air compressor and wagon drill	To create pressurised air during drilling and cleaning during road surfacing etc.
16.	All essential supporting units such as electric power generators, mobile workshop, tyre repair shops, welding facilities, services trucks, low-bed trailer (low-loader) units etc.	Repair and maintenance of machinery and equipment
<b>Transport Facilities</b>		
1.	Light duty vehicles	Transport of light construction materials, stationery machines, and staff
2.	Water and fuel tankers	Dewatering of earth surfaces to attain effective compaction, minimizing generation of dust, and transport of fuel

#### 3.4.2.4 Wastes Generated During Construction Phase

The wastes generated during construction phase of the project will result from operation of construction campsite, machinery, and equipment maintenance, batch plant operations, road construction, concreting activities, and construction of structures. The wastes which will be generated during construction phase of the project are shown in Table 5.

**Table 5: Wastes likely to be generated during Construction Phase**

Aspect	Solid Waste	Liquid Waste	Gaseous Waste	Hazardous Waste
<b>Operations of Campsite</b>				
	Paper	Sanitary waste	-	-
	Litter	-	-	-
	Toner, cartridges	-	-	-
	Paper litter	Sanitary waste	-	-
	Plastic bottles/bags	-	-	-
	Aluminium cans	-	-	-
	Food wastes	-		
<b>Machinery and equipment Maintenance</b>				
	Plastic and glass (containers), used tyre, metal (used parts), plastic and cable parts, used lead-acid batteries,	Waste oil and grease, battery acid (dilute sulphuric acid)	Refrigerant/ air conditioning gas, Emission of greenhouse gases and air pollutants (hydrogen gas etc.)	Gases that are compressed, liquefied or dissolved under pressure may be hazardous. Flammable liquids including oil, grease and petroleum compounds are also hazardous
	-	Lubricant,	-	-

Aspect	Solid Waste	Liquid Waste	Gaseous Waste	Hazardous Waste
		coolants (radiator fluid), hydraulic fluid, waste water		
<b>Earth Works and demolition</b>				
	Green cutting, dredges, top soil	-	-	-
	Demolition wastes (earth, concrete, timber, iron sheets)	-	-	-
<b>Road Construction</b>				
	Earth, sand, dredges, aggregates, stones	Wastewater	Emission of air pollutants	-
	Bitumen	Bitumen, oil	-	-
	Bitumen containers (drums)	-	-	-
	Cement packing (hessian or paper bags)	-	-	-
	Metal cans	Paints (road marking etc.	Emission of air pollutants	
<b>Batch Plant Operations</b>				
	Concrete additives, additives empty drums, concrete waste	Concrete wastewater slurry	Emissions of greenhouse gases and air pollutants	-
<b>Concreting activities and Bitumen Surfacing</b>				
	Concrete, cement bags	Curing compounds/water slurry	Emission of greenhouse gases and air pollutants	-
	-	Wash-down water	-	-
	Bitumen		Bituminous air emissions	
<b>Construction of drainage cross structures</b>				
	Concrete	Wastewater		
	Steel	-	-	-
	Earth	-	-	-
	Metals (nails, reinforcements, old bailey bridge parts, old Armco culvert)	-	-	-
<b>Surfacing with bitumen</b>				
	Empty bitumen drums, bitumen	Bitumen		

Aspect	Solid Waste	Liquid Waste	Gaseous Waste	Hazardous Waste
	contaminated soil			

### 3.4.2.5 Treatment and Disposal of Wastes Generated During Construction Phase

The treatment methods for the wastes generated during construction phase will depend on whether they are degradable, non-degradable, hazardous, or non-hazardous. Depending on the nature of the wastes, the wastes will either be re-used, re-cycles, buried, or burnt.

- Green cutting and top soil shall be stockpiled for site reinstatement and top soiling of cleared areas to promote vegetation. Excess top soil shall be spoiled in borrow pits in areas approved by the Engineer.
- Metal wastes such as iron sheet, nails, metal cans, reinforcement bars, and used machine parts shall be disposed of as specified by OBPE.
- Used oil filters (with metallic housing) will be hot drained, and then disposed of as specified by OBPE.
- Used lead-acid batteries shall be collected and transported to battery factories as directed by OBPE and verified by the Engineer
- Motor oil (engine, transmission, and hydraulic oils) have value even after it has been drained from equipment, as it be recycled, and turned into fuel oil or used as a raw material for the refining and petrochemical industries. The oil can be reprocessed and used in furnaces for heat or in power plants. It can also be sent to a refinery that specializes in processing used oil and re-refined into lubricating base oils that can be used to formulate engine oils meeting API (American Petroleum Institute) specifications. Since there are oil collection centres in Burundi, the contractor should enter into an agreement with its supplier of lubricants or any OBPE certified company to collect oil for disposal.
- Sanitary wastewater at camps shall be disposed of by the use of water closets, septic tanks, and soak away pits, while at active construction sites will be disposed of by the use of mobile toilets or pit latrines
- Non degradable wastes such as plastic bottles shall be collected and transported to factory recycling plant through OBPE certified waste collectors for recycling by plastic recycling factories (used to make plastic bags).
- Biodegradable wastes such as cement paper bags and paper box will either be treated by controlled burnt or burying on site
- Non-bio gradable wastes such as hessian bags will be treated on site by controlled burning.
- Before demolition buildings along the road, owners of the properties shall be allowed to salvage valuable materials such roofing iron, windows, doors, and timber. Non-degradable demolition materials such as cement blocks and clay bricks will be collected so that they are used to fill pits and quarries during their reinstatement. The contractor shall add soil to any area backfilled with blocks to fill large voids and top prevent future settlement. The backfilled areas should be capped with at least 60 cm of soil, contoured to match the surrounding grade, covered with top soil, and if necessary re-vegetated.
- Empty bitumen drums shall be disposed of through OBPE certified companies who will transport them to steel smelting factories for recycling.

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- Excess bitumen (though rare to happen) will be returned to the containers (drums) for future use
  - Excess concrete will be used as bottom materials during reinstatement of pits and quarries as described in Sub-Section 2.4.1.5
  - Food wastes will be treated by composting
  - Inert or readily bio degradable materials from the construction camp will be used to fill quarries and pits
  - Used tyres shall be disposed of through OBPE certified companies

### **3.4.3 Demobilization Phase**

#### **3.4.3.1 Demobilization Activities**

After completion of road construction, Engineer's camps shall be reverted to the government through OdR which will decide on their future use. However, Contractors' camps shall be closed out. The main activities during demobilization phase, which will take 1 year, will engross the following:

- Collection and disposal of storage facilities such as pallets, packing, boxes
- Collection and disposal of construction materials and wastes such as waste oil, sewage, solid wastes (plastics, wood, metal, papers, etc.) at the workshop, site office etc. to authorized dumpsite
- Disassembling and transport of construction machines, machinery and equipment
- Removal of temporary infrastructure, installations and equipment from the campsite
- Rehabilitation/landscaping of the campsite to the original condition by shaping and grading
- Handing over of permanent structures and facilities in the campsite to OdR who will decide its future use
- Restoration of material borrows areas to safer condition.

#### **3.4.3.2 Materials required During Demobilization Phase**

Materials required during demobilization phase will include fuel for the operation of equipment, soils and tree seedlings for reinstatement of borrow pits and campsite. During this phase, labour, water, and energy will also be required.

#### **3.4.3.3 Equipment Required During Demobilization Phase**

The equipment required during demobilization phase will include vehicles and trucks for transport of wastes, graders and bull dozers and front loaders for the landscaping the campsite surroundings.

#### **3.4.3.4 Wastes Generated During Demobilization Phase**

The following wastes will be generated during demobilization phase of the project:

- Hazardous waste such as used lubricants (oil and grease), used lead-acid batteries, empty bitumen drums, rejected bitumen, empty plastic bottles, etc.
- Empty barrels and tins
- Plastic and paper packing

- Used equipment parts

### **3.4.3.5 Treatment and Disposal of Wastes Generated During Demobilization Phase**

The wastes generated during demobilization will be treated or disposed as phase will be treated or disposed described in sub-sections 2.4.1.5 and 3.4.2.5.

## **3.4.4 Operation and Maintenance Phase**

### **3.4.4.1 Operation and Maintenance Activities**

The maintenance activities of the project road will pertain to the road pavement and its embankments, hydraulic and drainage structures and road furniture and where necessary, re-surfacing/patching. The main activities during maintenance phase will entail the following:

- Installation of damaged or stolen signboards.
- Road re-marking with thermo-plastic paint
- Maintenance of damaged road sections, which will include such activities as:
  - Transport of construction materials from their sources to the construction sites
  - Sealing of cracks and patching of pot holes
  - Routine de-silting and clearing of debris from road side and cross drains
  - Repair and replacement of road furniture (side and cross drains)
  - Proper disposal of wastes from road-maintenance activities
  - Maintenance of grass covers on road sides and management to reduce pollutant concentrations in runoff.
  - Road side grass slashing
- Storage and management of maintenance materials and equipment.
- Awareness rising on proper road use and road environment management to the communities.
- Monitoring and evaluation of road performance and management

Other activities will include design/ planning of and implementation of HIV and AIDS awareness campaigns. This activity will span from mobilization to decommissioning phases.

### **3.4.4.2 Materials Required During Operation and Maintenance Phase**

The following materials will be required during operation phase of the maintenance phase of the project:

- Thermoplastic paints for road marking
- Sign boards to replace damaged or stolen ones
- Bitumen for repair of pot holes/patching
- Crushed aggregates, cement, and sand for repairs of potholes and drainages structures

### **3.4.4.3 Equipment Required During Operation and Maintenance Phase**

The main equipment which will be required during maintenance phase of the project will be:

- Pneumatic/hydraulic demolishing machine
- Air compressor

- Roller compactor for compaction
- Concrete-bitumen processing plant
- Back hoe loader for de-silting of side drains and a during spot resurfacing

#### **3.4.4.4 Wastes Generation during Operation and Maintenance Phase**

The wastes generated during operation and maintenance phase of the project will mainly consist of litter, silt, and construction material wastes and will be disposed as described in sub-sections 3.4.1.5 and 3.4.2.5

### **3.4.5 Project activities from Mobilization to decommissioning phase**

#### **3.4.5.1 HIV/AIDS/STIs Awareness Campaign:**

Campaign to be undertaken during mobilization, construction and decommission phases amongst workers for the duration of the contract shall include the display AIDS/'STIs awareness posters in all buildings frequented by workers employed on contract, where such buildings fall under the control of the contractor. AIDS/STIs awareness shall be included in the orientation process of all workers to be employed on the contract. Sexual abuse and exploitation of children shall also form part of this campaign.

#### **3.4.5.2 AIDS Prevention Campaign**

As part of the contract the Contractor shall be required to make condoms available to all workers. This activity shall be carried out during mobilization, construction, and decommission phases of the contract.

#### **3.4.5.3 HIV/AIDS/STIs Training**

Training will be conducted as per HIV/AIDS policy at work place by a qualified Contractor's staff or organization. This activity will be undertaken during the construction phase.

#### **3.4.5.4 Employment of Local Staff that is gender sensitive**

Gender mainstreaming awareness will target both individuals and local communities. Activities to be undertaken during mobilization and construction phases

- Provision of information to women on potential employment opportunities in the road works especially for neighbouring communities
- Organizing meetings with women groups
- Employ women as much as possible. Sections that women are competitive include traffic control, store keeping, landscaping, surfacing, top soiling and variety of labour-intensive tasks and control and circulation of traffic
- Awareness creation on gender sensitivity at camp sites, constructions sites and roads including the use of gender sensitive language in all road works
- Preparation of gender disaggregated data for various activities
- Promotional billboards to raise awareness and integration of gender issues during road construction
- Training for various categories of workers: drivers, operators, supervisors, inspectors, top management team on gender mainstreaming and sensitivity etc.



### 3.4.6 Potential Sources of Natural Construction Materials

Borrow pits are sites where stones, sand, gravel or other granular soils will be extracted for the road construction. The term “pit” is used when granular material is extracted. The term “quarry” is used where consolidated rock is removed.

#### 3.4.6.1 Sources of Gravel Materials

Several borrow sites for fill, sub-grade, base, and sub-base materials have been identified along and off the existing road alignment. The following table (Table 6) lists locations of the identified sources, together with their estimated quantities.

The vegetation around the existing borrow sites is generally characterised by grassland and scattered miombo woodland.

The survey noted that borrowing of gravels from the existing borrow sites have involved clearing of a significant number of trees and no re-instatement has been done after their uses.

It is worth to note that the identified borrow areas in Table 6 are only for information to Contractors. The Contractor is therefore not bound to use the identified borrow areas and at liberty to source materials from other sites.

**Table 6: Sources of Gravel and Fill Materials (Sub-grade and Sub-base layers)**

Nº	Borrow Name	Easting (m)	Northing (m)	Qty (m³)	Borrow Area
		WGS84			
1.	BP1	765714	9621281	>50000	BA1
2.	BP2	765716	9621293		
3.	BP3	765718	9621310		
4.	BP4	765693	9621328		
5.	BP5	765646	9621365		
6.	BP6	762637	9615790	30000	BA2
7.	BP7	762632	9615815		
8.	BP8	762592	9615841		
9.	BP9	762573	9615805		
10.	BP10	762577	9615827		
11.	BP11	762621	9612112	>45000	BA3
12.	BP12	762611	9612103		
13.	BP13	762555	9612013		
14.	BP14	762599	9612015		
15.	BP15	762629	9612067		
16.	BP16	761799	9607409	>35000	BA4
17.	BP17	761783	9607390		
18.	BP18	761786	9607417		
19.	BP19	761760	9607423		
20.	BP20	761777	9607445		
21.	BP21	761086	9600772	>35000	BA5
22.	BP22	761084	9600794		
23.	BP23	761100	9600778		
24.	BP24	761113	9600784		
25.	BP25	761111	9600768		
26.	BP26	758662	9592711	>35000	BA6
27.	BP27	758661	9592743		
28.	BP28	758665	9592787		
29.	BP29	758675	9592737		



Nº	Borrow Name	Easting (m)	Northing (m)	Qty (m³)	Borrow Area	
		WGS84				
30.	BP30	758680	9592747	>45000	BA7	
31.	BP31	758175	9587308			
32.	BP32	758154	9587315			
33.	BP33	758159	9587299			
34.	BP34	758152	9587278			
35.	BP35	758172	9587270			
36.	BP36	759717	9584021	>50000	BA8	
37.	BP37	759755	9584019			
38.	BP38	759728	9583994			
39.	BP39	759713	9583967			
40.	BP40	759751	9583982			
41.	BP41	761098	9578851			
42.	BP42	761113	9578872	>45000	BA9	
43.	BP43	761120	9578892			
44.	BP44	761141	9578883			
45.	BP45	761146	9578862			
46.	BP46	762460	9576372	>50000	BA10	
47.	BP47	762488	9576384			
48.	BP48	762483	9576357			
49.	BP49	762474	9576335			
50.	BP50	762499	9576344			
51.	BP51	762501	9575391	>50000	BA11	
52.	BP52	762515	9575404			
53.	BP53	762530	9575436			
54.	BP54	762549	9575440			
55.	BP55	762580	9575423			
56.	BP56	767768	9567659	>40000	BA12	
57.	BP57	767798	9567657			
58.	BP58	767782	9597672			
59.	BP59	767789	9567696			
60.	BP60	767765	9567674			
61.	BP61	769596	9563866	>45000	BA13	
62.	BP62	769599	9563891			
63.	BP63	769559	9563916			
64.	BP64	769539	9563877			
65.	BP65	769533	9563907			

Source: Adapted from Consultant's Materials Report

### 3.4.6.2 Hard stone and aggregates for Road Surfacing from Crushed Rock

Suitable sources of rocks for concrete mix, base, and surface dressing have been identified at four locations are indicated in Table 7 below.

**Table 7: Sources of hard stone**

Nº	Hard stone Point	Easting (m)	Northing (m)	Qty (m³)	Hard stone Area
		WGS84			
1.	HP1	762396	9607233	>70000	HA1
2.	HP2	762412	9607227		
3.	HP3	762414	9607212		
4.	HP4	762440	9607218		
5.	HP5	762444	9607232		

Nº	Hard stone Point	Easting (m)	Northing (m)	Qty (m³)	Hard stone Area
		WGS84			
6.	HP6	764348	9572269	>65000	HA2
7.	HP7	764329	9572253		
8.	HP8	764311	9572272		
9.	HP9	764298	9572295		
10.	HP10	764321	9572303		

Source: Adapted from Consultant's Materials Report

It should be noted here that all quarry sites are existing crushing sites which can provide quantities of crushed stones for construction works.

### 3.4.6.3 Sand

Six potential sources of sand have been identified along and off the existing road alignment. The following table (Table 8) lists locations of the identified sources of sand together with estimated quantities.

**Table 8: Potential of sources of Sand for Construction Works**

N°	Sand Point	Easting (m)	Northing (m)	Hard stone Area
		WGS84		
1.	SP1	760112	9609177	SA1
2.	SP2	761347	9615051	SA2
3.	SP3	773318	9552839	SA3

Source: Adapted from Consultant's Materials Report

### 3.4.6.4 Water

Water for construction purposes along the entire project section is very abundant as there are many perennial rivers along the project road. Some of the potential sources of water for construction works are indicated in Table 9.

**Table 9: Potential Sources of Water for Construction Works**

Nº	Location	Easting (m)	Northing (m)	Qty (m³)	Remarks
		WGS84			
1.	R.Muhembwe	771723	9557095		Permanent river
2.	R.Dama	769071	9562975		Permanent river
3.	R.Kizuka	765661	9569501		Permanent river
4.	R.Cugaro	762475	9575728		Permanent river
5.	R.Ngonya	761312	9577705		
6.	R.Shanga	759964	9582570		Permanent river
7.	R.Ruzibazi	757807	9587394		Permanent river
8.	R.Rutunga	759717	9596521		Permanent river
9.	R.Nyamurenge	760550	9599571		Permanent river
10.	R.Kirasa	761488	9602388		Permanent river
11.	R.Muha	762298	9624320		Permanent river
12.	R.Kanyosha	761840	9621477		

Source: Adapted from Consultant's Materials Report

### 3.4.7 Materials that will be imported

The following materials shall be obtained outside the project area.

- Cement

- Reinforcement bars
- Concrete admixtures
- Timber
- Steel form works and shutters
- Gabions boxes and mattresses for construction and protection of drainage structures
- Paints
- Geo-textile fabrics
- Bitumen
- Spare parts

### **3.5 STAFFING AND SUPPORT**

At minimum, the following staff will be required:

- Engineers for general supervising of construction works: Will be obtained both locally in Burundi and outside Burundi
- Surveyors: Most of these will be obtained locally in Burundi
- Technicians for supervision of artisans: These will be obtained from within Burundi and outside Burundi
- Other skilled labourers: Artisans specialized in woodwork, steel fixing, concrete works, metal work, operators, and drivers for operations of construction machinery, equipment, heavy duty trucks and light duty vehicles, and construction machines, and support staff such as accountants etc.). These expected to be obtained from within Burundi
- Unskilled labourers that will be required for general works which do not required specialised skills. It is anticipated that most of the unskilled labourers will come from within the project area.

Their exact number cannot be established now by the Consultant. However, based on Consultant's experience of past projects of similar size, each of the two Contractors will need around 500 (inclusive of expatriates).

### **3.6 REQUIRED OFF SITE INVESTMENT**

The following off site facilities will be required during implementation of the project:

#### **3.6.1 Power Source**

Not all the collines along the project road are connected to national grid power supply. The main source of power will be from diesel driven generators that will be installed to supply power to the camps and for the operation of electrically-operated equipment at work sites.

#### **3.6.2 Water Supply**

Water will be required for construction activities such as concrete works, earthworks, laying of some of the pavement layers, dust suppression, as well as for domestic purposes at the camps. Water for construction works will be obtained from L.Tanganyika, rivers, and boreholes. Domestic water will be pumped directly from boreholes to storage tanks before being distributed by pipelines. Water for construction works will be pumped from L.Tanganyika and rivers and

delivered to work sites by water tankers. The amount of water required during construction of the project is yet to be established.

### **3.6.3 Diversions and Access Roads**

Diversion roads will be created to divert traffic away from active construction sites, especially during construction of cross drainage structures. Access roads will be constructed to construction materials borrow sites which are located off the main alignment.

### **3.6.4 Other Facilities Required**

Other infrastructures that will be required during construction include:

- Fuel storage tanks. The tanks will have to be placed on secondary containment basins to catch any possible spills or leak. Underground fuel storage tanks shall not be allowed
- Storage facilities for construction materials (cement, bitumen, paints, steel, timber etc.)
- Mechanical workshop for repair and maintenance of construction machinery, equipment, and vehicles.
- Accommodation and offices for the Contractor and Engineer (Engineer) key and support staff. The housing will be furnished with all necessary services such as water and sanitation facilities. Since it is not a Contractual obligation for the Contractor to provide housing for his staff, it cannot be established now whether the Contractor will construct a labour camp. Otherwise, the rest of the staff will be required to rent houses in the neighbourhood of the camps.

## **3.7 LAND REQUIREMENT**

When it is considered that the proposed project road will have be of 7.0m width and 2.0m wide shoulders, the minimum total land area of land that will be required for road rehabilitation is approximately 94 hectares. In addition, the project will require land for the construction of site camp. Other places to be affected, whose areas cannot be determined now, will include material borrow areas (borrow pit, sand pit, water boreholes, and quarry sites), as well as detours and access roads. Nonetheless, such area will only be occupied by the project during its construction phase.

## **SECTION 4: DESCRIPTION OF PROJECT ENVIRONMENT**

### **4.1 PROJECT BOUNDARIES**

#### **4.1.1 Spatial Boundaries of the study area**

The study area was mainly confined to the RoW, potential sources of naturally-occurring construction materials (water, gravel, crushed aggregates, fill materials, sand) and their access roads, camps, diversions and detours and the area immediately after the RoW (100m on both sides). The 100m has been chosen to accommodate/give allowance for establishment of borrow pit, contractor's campsite or materials storage yard close to the road alignment. The DIZ was determined on the basis of the following factors:

- The distance of travel of noise, vibrations, dust, and exhaust fumes from construction plants and machinery from the site boundary
- Marginal zones and developments from the site within 100 m as it is within this distance that impacts are likely to be felt

The study has also considered the area beyond the DIZ (AI) where most of the environmental impacts will be induced or influenced by the project activities. It is not subject to direct contact with the site, but is directly or indirectly affected by the presence of the proposed road. Areas around sources of construction materials are also considered as areas of influence. Villages that are linked to the existing road through village roads can be considered to be the AI.

#### **4.1.2 Temporal Boundaries**

The temporal boundaries of the project consist of the durations for mobilization, construction, and demobilisation phases of the project. In addition, the temporal boundaries are the design periods of the road and its components (road pavement, bridges etc.). The following are the estimated temporal boundaries of the project:

<b>Phase</b>	<b>Time</b>
Mobilization period:	6 months
Construction period:	36 months
Demobilization period:	1 year (inclusive of defect liability period)
Design period of the road pavement:	20 years
Design return period for pipe culverts:	25 years
Design return period for box culverts:	50 years
Design return period for bridges	100 yrs.

#### **4.1.3 Institutional Boundaries of the project**

The road project falls under the Ministry of Transport, Public Works, and Equipment. The project is being implemented by OdR, which has the primary function of developing and maintaining the road network of Burundi.

When it comes to fulfilment of other legal frameworks, then comes Minister for Water, Environment, and Urban Planning with the following institutions:

- Burundian Office for Environment Protection (OBPE): OBPE was formed by Decree N° 100/240 of October 29, 2014. The Office's mission is to monitor and ensure sustainable management of environment in general, and natural resources in particular, in all national development
- Lake Tanganyika Authority: The Lake Tanganyika Authority (LTA) was established in December by the governments of Burundi, Democratic Republic of Congo, Tanzania, and Zambia. LTA promotes regional cooperation required for socio-economic development and sustainable management of the natural resources in the L.Tanganyika basin.
- Bujumbura City, Bujumbura Rural, and Rumonge Provinces under mayors where the project road traverses
- At lower levels comes commune administration, and finally colline level comes colline leaders etc.

These are the institutional boundaries of the road project where the consultant intends to liaise with.

#### 4.1.4 Administrative Boundaries

Administratively, the project road is located in Bujumbura Urban, Bujumbura Rural, and Rumonge Provinces. The project road traverses seven (7) communes<sup>2</sup> (Mukaza, Muha, Kabezi, Muhuta, Rutunga, Bugarama, and Rumonge) and twenty three (23) collines<sup>3</sup> (Rohero, Kinindo, Kinamira, Muha, Kanyosha, Ruziba, Ramba, Kabezi, Migera, Gavaniro, Gasange, Gitaza, Mubone, Rutunga, Chashi, Magara, Rutumo, Muturigwa, Minago, Kagongo, Kizuka, Mwange, Rumonge, and Mutambara)

### 4.2 PHYSICAL ENVIRONMENT

#### 4.2.1 Topography

The project road is part of part of the western extension of the East African Rift Valley and traverses along L.Tanganyika. The project road traverses areas with varied topography. The topography varies from nearly flatland to rolling topography which is dissected by both seasonal and perennial rivers. A small section of the project road (9%) between Bujumbura City Centre and Kanyosha and Muha Commune is characterised by nearly flatland, while nearly half (48.3%) of the project road is characterised by undulating topography. The remaining section of the project road (43%) has undulating to rolling topography. Generally speaking, the project road lies around 800m above sea level.

Some sections of the project road traverses along Lake Tanganyika. Such sections are located between Km 27+600 and Km 32+300 and between Km 35+700 and Km 38+800

The following table (Table 10) describes the topography, including elevations variations for different sections of the road as one travels from Bujumbura City Centre to Mutambara.

**Table 10: Description of Topography across the Project Road**

N°	Road Section (Chainage)	Description of Topography
1.	0+000 – 01+500	Flatland to undulating topography

<sup>2</sup> Commune is similar to a Ward

<sup>3</sup> Colline is similar to a Village

N°	Road Section (Chainage)	Description of Topography
	(Rohero – Muha)	
2.	01+500 – 06+600 (Muha – Ruziba)	Nearly flat with gentle slopes
3.	06+600 – 10+900 (Ruziba – Ramba)	Undulating to rolling topography with gentle slopes. There are however few sections with rather steep slopes
4.	10+900 – 15+900 (Ramba – Kabezi)	Rolling to undulating topography with steep slopes in some sections
5.	15+900 – 19+200 (Kabezi – Migera)	Undulating to rolling topography with gentle topography
6.	19+200 – 22+400 (Kabezi – Migera)	Undulating to rolling topography with gentle topography
7.	22+400 – 23+900 Migera – Gavaniro	Undulating to rolling topography with gentle topography
8.	23+900 – 25+200 (Gavaniro – Gasange)	Undulating to rolling topography with gentle topography
9.	25+200 – 26+400 (Gasange – Gitaza)	Undulating to rolling topography with moderate slope
10.	26+400 – 27+000 (Gitaza – Mubone)	Rolling to undulating topography with moderate slope
11.	27+000 – 33+500 (Mubone – Rutunga)	Rolling to undulating topography with moderate slope
12.	33+500 – 34+000 (Rutunga – Chashi)	Rolling to undulating topography with moderate slope
13.	34+000 – 39+500 (Chashi – Magara)	Rolling to undulating topography with moderate slope
14.	39+500 – 41+600 Magara - Rutumo	Undulating topography with gentle slope
15.	41+600 – 46+800 Rutumo - Muturigwa	Undulating topography with gentle slope
16.	46+800 – 50+700 (Muturigwa – Minago)	Undulating topography with gentle slope
17.	50+700 – 57+100 (Minago – Kagongo)	Undulating topography with gentle slope
18.	57+100 – 62+100 (Kagongo – Kizuka)	Undulating topography with gentle slope
19.	62+100 – 65+500 (Kizuka – Mwange)	Undulating topography with gentle slope
20.	65+500 – 71+700 (Mwange – Rumonge)	Undulating topography with gentle slope
21.	71+700 – 76+200 (Rumonge – Mutambara)	Undulating topography with gentle slope

**Source:** Consultant's Survey and interview with local people

#### 4.2.2 Climate

The project area is located in what is termed as Zimbo climatic zone which is characterised by tropical equatorial climate. Its average annual temperature is 23<sup>0</sup>C. Rainy season starts from



September and end in May, while dry season starts from June and ends in August. The following table (Table 11) describe typical climatic characteristics of Rumonge area.

**Table 11: Climatic characteristics of Rumonge Area**

Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Avg. Temp (°C)	23.6	23.7	23.6	23.6	23.3	22.4	22.4	23.4	24.3	24.3	23.5	23.6
Min. Temp (°C)	19.2	19.2	19	19.1	18.4	16.6	16.1	17.1	18.3	19.1	19	19.2
Max. Temp (°C)	28.1	28.3	28.2	28.2	28.2	28.3	28.7	29.7	30.3	29.5	28.1	28
Avg. Temp (°F)	74.5	74.7	74.5	74.5	73.9	72.3	72.3	74.1	75.7	75.7	74.3	74.5
Min. Temp (°F)	66.6	66.6	66.2	66.4	65.1	61.9	61.0	62.8	64.9	66.4	66.2	66.6
Max. Temp (°F)	82.6	82.9	82.8	82.8	82.8	82.9	83.7	85.5	86.5	85.1	82.6	82.4
Rainfall (mm)	123	116	153	169	83	15	4	9	34	71	132	147

### 4.2.3 Geology and Soils

The geology of the project area is characterised by Pre-Cambrian Craton. The Precambrian is the earliest of the geologic ages, which are marked by different layers of sedimentary rock.

### 4.2.4 Water Resources and Hydrology

#### 4.2.4.1 Surface Water and Hydrology

The project road traverses along Lake Tanganyika and the road section between Km 27+600 and 32+300 is very close to the lake. In addition, the road traverses fifty (50) significant perennial and seasonal rivers and several drainages. Eighteen (18) of the rivers are perennial (flow throughout the year) while the rest flow only during rainy season. Table 12 describes main river and drainage systems that cross the project road.



**Table 12: List of Rivers and Streams across the Project Road**

N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
1.	R.Muha	1+500		A perennial river which marks the border for Mukaza and Muha communes. The river is characterised by Christmas, East Africa cordia, and hedges trees. One 10” and three 4” steel water pipe lines are supported by the bridge on its RHS, while one 4” GS water pipe lines is supported by the bridge on its LHS (Photo 1). Its crossing is made of two-lane bridge, which is provided with pedestrian walkway and steel guardrail on both sides.
2.	R.Kanyosha	4+400	Muha/ Kanyosha	<p>A perennial river which marks the border for Muha and Kanyosha Collines. It’s downstream riparian is characterised by umbrella, bamboo, and mango trees (Photo 2). It’s upstream riparian, which does not have significant vegetation is used for growing Amaranth greens vegetable (Photo 2).</p> <p>The river appears to be heavily polluted by domestic wastes in particular solid wastes such as plastic bags and bottles (Photo 3). Its riparians are have been encroached by settlements as close as 3m from the edge of the river. Like R.Muha. One 10”, one 6”, and four 4” steel water pipe lines are supported by the bridge on its RHS, while one 4” steel pipe line is supported by the bridge on its LHS. Its crossing is also made of two-lane bridge, which is provided with pedestrian walkway and steel guardrail on both sides.</p>
3.	R.Kizingwe	6+600	Kanyosha/ Ruziba	A seasonal river which marks the border for Kanyosha and Ruziba Collines. The river is characterised by eucalyptus tree on its upstream riparian no significant vegetation it is downstream riparian. Its soil appears prone to gully erosion and both upstream and downstream have gabions as their protection work. A masonry fence has been constructed 4m from the edge of the river. Two 4” and one 3” water pipe lines are supported by the bridge on its RHS, while one 8” steel pipe line is supported by the bridge on its LHS. Its crossing is made of two-lane concrete box culvert, with neither pedestrian walkway nor guardrail.
4.	R.Mugere	10+900	Ruziba/ Ramba	A perennial river marks the border for Ruziba and Ramba Collines as well as the border for Muha and Kabazi Communes. The river also marks the border for Bujumbura and Bujumbura Rural Provinces. Its riparian vegetation consists of grass only. It has been noted that waste water from an abattoir located on its riparian is

N°	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				discharged to the river (Photo 4). Its soil appears prone to gully erosion and both upstream and downstream have stone pitching as their protection work. Its downstream is used for aggregates making (Photo 5) from stones and rocks that are transported from the mountain by the river during rainy season. Its crossing is also made of two-lane bridge, which is provided with pedestrian walkway and steel guardrail on both sides.
5.	R.Gatemala	13+800	Ramba	A seasonal river which is characterised by eucalyptus trees on its upstream riparian and eucalyptus and neem trees on its downstream riparian. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. Its crossing is made of two-lane Armco pipe culvert, with neither pedestrian walkway nor guardrail.
6.	R.Nkubure	14+400	Ramba	A seasonal river with only grass as its upstream and downstream riparian vegetation. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. Its crossing is made of two-lane concrete box culvert, with neither pedestrian walkway nor guardrail.
7.	R.Ramba	14+800	Ramba	A seasonal river with only grass as its upstream and downstream riparian vegetation. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. Its crossing is made of two-lane concrete box culvert, with pedestrian walkway both sides but without guardrail
8.	R.Nyagonga	15+900	Ramba/ Kabezi	A seasonal river which marks border for Ramba and Kabezi Collines. It is characterised by grass as its upstream and downstream riparian vegetation. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. Its crossing is made of two-lane concrete box culvert, with pedestrian walkway both sides but without guardrail
9.	R.Nyabage	16+900	Kabezi	A seasonal river which is characterised by grass as its upstream and downstream riparian vegetation. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. Its crossing consisting of two-lane concrete box culvert has pedestrian walkway both sides but without guardrail. It has been reported by the locals that during rainy season the river carries large stones and rocks from the mountains across the road. Overflow of the river causes the

N°	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				stones to flow off its course, causing serious damages of properties along it
10.	R.Kanyamazi	17+400	Kabezi	A seasonal river which is characterised by eucalyptus tree on both upstream and downstream riparian. Its soil appears prone to erosion and has gabions as its protection on both upstream and downstream. It's downstream riparian as far as the edge of the river is used for gardening in particular tomato growing (Photo 6). One 4" and two 1½" steel pipe lines are supported by the bridge on its LHS. Its crossing consisting of two-lane concrete box culvert has neither pedestrian walkway nor guardrail
11.	R.Nyabisagi	18+100	Kabezi	A seasonal river which is characterised by grass on its upstream riparian and grass and one fig tree on its downstream riparian. Its soil appears prone to erosion but there is no protection on both upstream and downstream. Its crossing, consisting of two-lane concrete box culvert has neither pedestrian walkway nor guardrail
12.	R.Kigozi	18+900	Kabezi	A seasonal river which is characterised by eucalyptus trees on its upstream riparian and grass and one fig tree on its downstream riparian. Its soil appears prone to erosion but there are no protection on both upstream and downstream. A 2½" water pipe line is supported by the bridge on its LHS. Its crossing, consisting of two-lane concrete box culvert has neither pedestrian walkway nor guardrail
13.	R.Nyankara	19+200	Kabezi/ Miger	A seasonal river which marks the border for Kabezi and Miger Collines. The river is characterised by grassland as its vegetation on both upstream downstream riparians. Its soil appears prone to erosion and has gabions as its protection works on upstream and downstream. Its crossing, consisting of two-lane concrete box culvert has but without guardrail.
14.	R.Chumya	19+900	Migera	A seasonal river without any significant vegetation both upstream and downstream riparian except grass. Its soil appears prone to gully erosion and has gabions as its protection works on upstream and downstream. Its crossing, consisting of two-lane concrete box culvert is with pedestrian walkway but without guardrail
15.	Unnamed river	20+200	Migera	A seasonal river without any significant vegetation both upstream and downstream riparian except grass. Its soil appears prone to gully erosion. Its crossing, consisting of two-lane concrete box culvert is with pedestrian walkway but without guardrail
16.	R.Nyabigega	20+400	Migera	A seasonal river with grass vegetation in the upstream riparian and grass and yellow

N°	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				cassia ( <i>Senna siamea</i> ) on the downstream riparian except grass. Its soil appears prone to gully erosion but has protection work only on the downstream. Its crossing, consisting of two-lane Armco culvert is with neither pedestrian walkway nor guardrail.
17.	R.Nyabigega	21+400	Migera	A seasonal river, which is a distributary of the above river. It is characterised by grass vegetation in the upstream riparian and grass and yellow cassia on the downstream riparian except grass. It is a distributary of the above river. Its soil appears prone to gully erosion but do not have any protection work. Its crossing, consisting of two-lane Armco culvert is with neither pedestrian walkway nor guardrail. The pipe culvert is heavily silted to over 50 per cent of its hydraulic capacity (Photo 7).
18.	R.Nyanduvugu	22+400	Migera	A seasonal river with grassland a few yellow cassia trees on its upstream and downstream riparian. Its soil appears prone to gully erosion but do not have any protection work. Its crossing, consisting of two-lane concrete box culvert with neither pedestrian walkway nor guardrail. A 2½” and 1” steel water pipe line are supported by the bridge on its LHS
19.	R.Karonke	23+100	Migera	A perennial river, which is characterised by grassland both on the upstream and downstream riparian and a one yellow cassia tree on the downstream riparian. Its soil appears prone to gully erosion and has gabions as protection work both in the upstream and downstream. The downstream gabion has however collapsed owing to erosion. During rainy season the river transports stones and rocks from the mountains across the road (Photo 8). Its crossing, consisting of two-lane bridge with pedestrian walkway and guardrail
20.	R.Kirasa	23+900	Migera/ Gavaniro	A perennial river which marks the border for Migera and Gavaniro Collines as well as the border for Kabezi and Muhuta Collines. The river also marks the border for Bujumbura Rural and Rumonge Provinces. It is characterised by oil palm trees and red cassia ( <i>Ceylon senna</i> ) on the upstream riparian and red cassia, yellow cassia, tangerine/ mandarin fruit trees on the downstream riparian. Its soil appears prone to gully erosion and has gabions as protection work both in the upstream and downstream. During rainy season the river also transports stones and rocks from the mountains across the road. A 2½” steel sleeve carrying fibre optic cable water is

N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				supported by the bridge on its LHS. Its crossing, consisting of two-lane bridge with pedestrian walkway and guardrail
21.	R.Nyamibemba	24+700	Gavaniro/ Gasange	A seasonal river which marks the border for Gavaniro and Gasange Collines. The river is characterised by grassland on its upstream riparian and grassland and a few mango and yellow cassia trees on the downstream riparian. Its soil is susceptible to erosion but has no protection both on the upstream and downstream. Its crossing, consisting of two-lane Armco culvert is with neither pedestrian walkway nor guardrail. The pipe culvert is heavily silted to over 50 per cent of its hydraulic capacity. A 4” steel water pipe line is supported by the bridge on its RHS.
22.	R.Nyakabenga	25+700	Gasange/ Gitaza	A seasonal river which marks the border for Gasange and Gitaza Collines. The river is characterised by grassland on its upstream riparian and yellow cassia trees on the downstream. Its soil is susceptible to erosion but has no protection both on the upstream and downstream (Photo 9). Its crossing, consisting of 2-lane Armco culvert is with neither pedestrian walkway nor guardrail. Two 2 <sup>1/2</sup> ” steel sleeves carrying fibre optic cable is supported by the bridge on its RHS
23.	R.Nyamusenye	26+900	Gitaza/ Mubone	A perennial river which marks the border for Gitaza and Mubone Collines. The river is characterised by tangerine/ mandarin fruit trees, oil palm tree, neem trees, and yellow cassia tree on its upstream riparian and yellow cassia trees on the downstream riparian. Its soil is susceptible to erosion and has gabions protection works on the upstream and downstream. Its crossing, consisting of 2-lane bridge with pedestrian walkway and guardrail. The river is skewed across the road, but not the bridge. One 2 <sup>1/2</sup> ” steel sleeve carrying fibre optic cable is supported by the bridge on its RHS (Photo 10). During rainy season the river carries large stones and rocks from the mountains across the road. Overflow of the river causes the stones to flow off its course. Apart from causing serious damages of properties along it the rocks significantly reduce hydraulic capacity of the river. The fibre optic cable has been laid too shallow to the ground and too close to the road as close as 1m from the edge of the road, while limited cable (posts) are as close as 5m from edge of the road.
24.	R.Gatororongo	27+300		A seasonal river, which is characterised by grassland vegetation on upstream and

N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
	(tributary of river at km 27+400)			downstream riparians. Its soil is susceptible to erosion with protection works on the downstream only. Its crossing, consisting of 2-lane box culvert with neither pedestrian walkway nor guardrail. A 2 <sup>1/2</sup> " steel sleeve carrying fibre optic cable is supported by the bridge on its RHS
25.	R.Gatororongo (main stream)	27+400	Mubone/ Rutunga	A seasonal river which marks the border for Mubone and Rutunga Collines. The river is characterised by grassland vegetation on its upstream riparian and mango, yellow cassia tree on its downstream riparian. Its crossing, consisting of 2-lane box culvert with neither pedestrian walkway nor guardrail. The crossing is very close to the lake (about 80m). One 2 <sup>1/2</sup> " steel sleeve carrying fibre optic cable is supported by the bridge on its RHS. During rainy season the river carries large stones and rocks from the mountains across the road. The road is skewed across the river
26.	R.Mwambuko	28+800	Rutunga	A seasonal river, which is characterised by grassland vegetation on its upstream and downstream riparians. Its soil is susceptible to erosion but has protection works. Its crossing, consisting of 2-lane box culvert with neither pedestrian walkway nor guardrail. The crossing is very close to the lake. During rainy season the river carries large stones and rocks from the mountains across the road. The road is skewed across the river.
27.	R.Rutunga	30+200	Rutunga	A perennial river, which is characterised by yellow cassia trees on its upstream riparian and grass on its downstream riparian. Its soil is susceptible to erosion with gabions protection works both upstream and downstream. Its crossing consists of a bridge with pedestrian and walkway both sides of the road. During rainy season the river carries large stones and rocks from the mountains across the road. The road is skewed across the river. In year 2014 when the river flooded, 15 people were killed by rocks that were transported from the mountain (Photo 11)
28.	R.Gahoma	30+900	Rutunga	A seasonal river, which is characterised by grassland vegetation on its upstream grevillea and yellow cassia tree on its downstream riparian. Its crossing, consisting of 2-lane box culvert with neither pedestrian walkway nor guardrail. Both approaches to the bridge are curved. The soil is prone to erosion.
29.	R.Mahamba	31+200	Rutunga	A perennial river, which is characterised by grassland both upstream and downstream riparians. Its soil appears to be fairly stable against erosion because the banks are

N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				rocky. Its crossing consists of a 2-lane Armco with neither pedestrian walkway nor guardrail.
30.	R.Kavugangwe	32+500	Rutunga	A perennial river, which is characterised by elephant grassland both upstream and downstream riparians. Its soil appears to be erosive and has gabions protections works both upstream and downstream fairly stable against erosion. Its crossing consists of a 2-lane Armco with neither pedestrian walkway nor guardrail. Both approaches to the bridge are curved (Photo 12) and the road is very close to the edge of the lake. The crossing is very close to the lake (about 20m) from the edge of the lake. Fibre optic cable runs very close to the crossing on the ground surface.
31.	R.Nyaruhongoka	33+700	Rutunga/ Chashi	A perennial river which marks the border for Rutunga and Chashi Collines. It is characterised by open land both upstream and downstream riparians. Its crossing has a temporary crossing as construction of its permanent box culvert crossing is on-going. During rainy season the river carries large stones and rocks from the mountains across the road. The road is skewed across the river.
32.	R.Nyangwe	35+300	Chashi	A seasonal river, which is characterised by yellow cassia trees on the upstream and downstream riparians. Its crossing consists of a 2-lane box culvert with neither pedestrian walkway nor guardrail.
33.	R.Ruzibazi	40+800	Chashi/ Magara	A perennial river which marks the border for Chashi and Magara Collines. The river also marks the border for Bugarama and Rumonge Communes. It is characterised by elephant grassland on both upstream and downstream riparians. Its crossing consists of a bridge pedestrian walkway and guardrail on both sides of the bridge. A small scale palm oil factory has been constructed on the RHS upstream riparian. Waste water from the factory is discharged to the river.
34.	R.Nyeshungwe	41+700	Magara/ Rutumo	A seasonal river which is characterised by elephant grassland, yellow cassia, palm oil and tangerine/ mandarin trees. Its crossing consists of a box culvert with neither pedestrian walkway nor guardrail on both sides of the culvert. The river marks the border for Magara and Rutumo collines
35.	R.Gatare	43+600	Rutumo	A perennial river which is characterised by grassland and palm oil, grevillea, and tangerine/ mandarin trees. Its crossing consists of a box culvert with neither pedestrian walkway nor guardrail on both sides of the culvert. The river is known to



N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				flood during rainy season
36.	R.Rukamba	44+400	Rutumo	A seasonal river which is characterised by elephant grass and oil palm trees on the upstream riparian and fig, mango, and banana on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail. The river is known to flood during rainy season
37.	R.Shanga	46+100	Rutumo/ Muturigwa	A perennial river which marks the border for Rutumo and Muturigwa Collines. The river is characterised by oil palm trees and elephant grass on the upstream riparian and oil palm and mandarin tree and banana on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail. A 2 $\frac{1}{2}$ " steel sleeve carrying fibre optic cable is supported by the bridge on its RHS and one $\frac{3}{4}$ " GS water pipe are supported on the RHS of the bridge. Both upstream and downstream riparians are used for gardening and raising tree nursery
38.	R.Rugata	48+300	Muturigwa/ Minago	A perennial river which marks the border for Muturigwa and Minago Collines. The river is characterised by oil palm trees on the upstream riparian and oil palm, bamboo, mango, and eucalyptus trees on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail. A 2 $\frac{1}{2}$ " steel sleeve carrying fibre optic cable is supported by the bridge on its RHS. A palm oil extraction factory (Savor Company) has been constructed on the edge of the river on its RHS downstream riparian. Waste water from the factory is discharged to the river. In addition, there are settlements as close as to the edge of the river on both upstream and downstream riparians (Photo 13).
39.	R.Kayengwe	50+300	Minago	A seasonal river, which is characterised by oil palm trees on the upstream riparian and yellow cassia, mango, and shrubs on the downstream riparian. Its crossing consists of a 2-lane Armco culvert with neither pedestrian walkway nor guardrail. Its soil is susceptible to erosion with gabions protection works both upstream and downstream.
40.	R.Ngonya	51+200	Minago	A perennial river which is characterised by oil palm trees on the upstream riparian and oil palm and shrubs on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail. A palm oil extraction factory has been constructed on the RHS bank of the upstream and waste water from the factory is



N°	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				discharged to the river (Photo 14). A 2 <sup>1/2</sup> " steel sleeve carrying fibre optic cable is supported by the bridge on its RHS
41.	R.Mpimbiguye	52+000	Minago	A seasonal river, which is characterised by mandarin, oil palm trees on the upstream riparian and oil palm and eucalyptus tree on the downstream riparian. Its crossing consists of a 2-lane box culvert with neither pedestrian walkway nor guardrail.
42.	R.Gikaro	53+500	Minago/ Kagongo	A perennial river which marks the border for Minago and Kagongo Collines. A seasonal river, which is characterised by oil palm, elephant grass, and bamboo on the upstream riparian and oil palm trees on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail on both sides. A 2 <sup>1/2</sup> " steel sleeve carrying fibre optic cable and 3" GS pipe are supported by the bridge on its RHS.
43.	R.Kayongwe	55+600	Kagongo	A seasonal river, which is characterised by oil palm trees on both its upstream and downstream riparians. Its crossing consists of Armco culvert with neither pedestrian walkway nor guardrail. Its soil appears to be fairly stable.
44.	R.Chinjira (Kainjura?)	56+200	Kagongo	A seasonal river, which is characterised by oil palm, red cassia, eucalyptus on the upstream riparian and mandarin, bamboo, and oil palm trees on the downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail on both sides. Its soil appears stable against erosion. A 2 <sup>1/2</sup> " steel sleeve carrying fibre optic cable and 3" GS pipe are supported by the bridge on its LHS
45.	R.Kaguve	56+800	Kagongo	A seasonal river, which is characterised by oil palm trees on both upstream and downstream riparians. Its crossing consists of a bridge with pedestrian walkway and guardrail on both sides. Its soil appears fairly stable against erosion because it is rocky. Its riparian as well as its bed is used for growing oil palm (Photo 15)
46.	R.Gakora (Kakera?)	58+700	Kagongo/ Kizuka	A seasonal stream which marks the border for Kagongo and Kizuka. The river is characterised by mandarin and oil palm trees on its upstream riparian and oil palm and exotic trees on its downstream riparian. Its crossing consists of a bridge with pedestrian walkway and guardrail on both sides. Its soil appears fairly stable against erosion
47.	R.Kizuka	60+700	Kizuka	A perennial river which is characterised by grassland and a few oil palm trees on the upstream riparian and bamboo trees on the downstream riparian. Its crossing consists of a bridge with pedestrian walkways and guard rails on both sides and a 3" PVC pipe

N <sup>o</sup>	River/ Stream	Chainage (Km)	Colline	Brief Environmental Profile
				and tow 2 <sup>1</sup> / <sub>2</sub> ” GS pipe are supported by bridge on bridge on the LHS. A small scale oil extraction factory has been established about 3m from the edge of the river on the LHS of its upstream riparian and waste water from the factory is discharged to the river
48.	R.Munege	63+800	Kizuka/ Mwange	A seasonal stream which marks the border for Kizuka and Mwange. The river is characterised by oil palm trees on its upstream riparian and shrubs on its downstream riparian. Its crossing consists of a bridge with pedestrian walkways and guard rails on both sides. A small scale oil extraction factory has been established on the LHS of its upstream riparian and waste water from the factory is discharged to the river
49.	R.Dama	68+200	Mwange/Rumoge	A perennial river which marks the border for Mwange and Rumonge Collines. The river is characterised by oil palm trees on the upstream and downstream riparians as well as the river bed. A small scale oil extraction factory has been established about at the edge of the river on the LHS of its upstream riparian. It's downstream riparian is used for maize farming. Its crossing consists of a bridge with pedestrian walkways and guard rails on both sides. A 10” GS water pipe is supported by the bridge on its LHS.
50.	R.Murembwe	74+600	Mutambara	This is the largest perennial river across the project road. It is characterised by elephant grass and oil palm trees on both upstream and downstream riparians. Its crossing consists of a bridge with pedestrian walkways and guard rails on both sides. It's downstream riparian is used for gardening and its soil appears stable against erosion.

**Source:** Consultant's Survey and interview with local people

#### 4.2.4.2 Ground Water Resources

Groundwater is abundant throughout along the project road. This is evidenced by the presence of substantial number of fig trees along the project road and the presence of boreholes with hand pumps along the road (Photo 34). There are places with shallow groundwater table as evidenced by the presence of flood plains (sub-section 4.2.4.4).

#### 4.2.4.3 Surface and Ground Water Quality

Data on the quality of domestic water supply was not available to the consultant during the study. However, the quality groundwater supply from shallow wells and boreholes that have been drilled through district water authorities can be guaranteed. The quality of water supply from L.Tanganyika and rivers cannot be guaranteed as they are prone to pollution by sedimentation and anthropogenic activities, including agricultural nutrients and faecal matter.

#### 4.2.4.4 Flood Plains

A floodplain is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge, mainly during rainy season. It includes the floodway, which consists of the stream channel and adjacent areas that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current.

It is the natural place for a river to dissipate its energy. Meanders are formed over the floodplain to slow down the flow of water and when the channel is at capacity the water spills over the floodplain where it is temporarily stored. In terms of flood management the upper part of the floodplain (piedmont zone) is crucial as this is where the flood water control starts. Artificial canalisation of the river here will have a major impact on wider flooding. This is the basis of sustainable flood management.

Floodplains can support particularly rich ecosystems, both in quantity and diversity. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly; however the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture.

The vegetation pattern of the flood plain responds to water flow and the duration of flooding. Moving from relatively high ground within the flood plain to the river edge, one experiences the following plant communities:

- Sparsely distributed mosaics of flood plain trees and shrubs.
- Dry grassland
- Wet prairies occupying the less saturated soils, and
- Aquatic plant communities occupying the saturated soils (very close to rivers).

The fauna of the flood plain is mostly different species of local birds, which reside in the trees and frogs as aquatic creatures. The flood plain vegetation play important roles in filtering sediments and nutrients, stabilization of river banks, provide habitat and food for stream organisms, and, by shading streams.

The project road traverses three (3) floodplains at the following locations as described is Table 13 below:

**Table 13: Flood Plains across the Project Road**

No.	Location (Chainage)	Colline	Adjoining rivers	Characteristics/ Land use
1.	Around Km 63+500	Kizuka	None	Characterised by palm oil tree on the upstream and shrubs on the downstream
2.	Km 67+100	Mwange	None	Characterised by palm oil tree on both sides of the road
3.	<ul style="list-style-type: none"> <li>Km 72+600 – 74+500</li> </ul>	Rumonge	Murembwe	Characterised by palm oil planation on both sides of the road

#### 4.2.5 Road Side Air Quality

Typical air pollutants from road transportation sources are Carbon Monoxide (CO), Nitrogen Dioxide (NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>) and volatile compounds; and particulate matters (dust).

This study has tried to estimate current daily traffic emission, particularly Carbon Dioxide based on the current traffic volume counts – Annual Average Daily Count (AADT), which is defined a measure used primarily in transportation planning and transportation engineering. Traditionally, it is the total volume of vehicle traffic of a highway or road for a year divided by 365 days. AADT is a useful and simple measurement of how busy the road is.

One of the primary determinants of CO<sub>2</sub> emissions from mobile sources is the amount of carbon in the fuel. Carbon content varies, but typically we use average carbon content values to estimate CO<sub>2</sub> emissions. Based on United States Environmental Protection Agency, a gallon (3.8 litres) of gasoline gives a carbon content value of 2,421 grams, which produces 8,877g of CO<sub>2</sub>. (The carbon content is multiplied by the ratio of the molecular weight of CO<sub>2</sub> to the molecular weight of carbon: 44/12), while diesel produces 2,778 grams of CO<sub>2</sub>.

The Intergovernmental Panel on Climate Change (IPCC) guidelines for calculating emissions inventories require that an oxidation factor be applied to the carbon content to account for a small portion of the fuel that is not oxidized into CO<sub>2</sub>. For all oil and oil products, the oxidation factor used is 0.99 (99 per cent of the carbon in the fuel is eventually oxidized, while 1 per cent remains un-oxidized).

Therefore:

CO<sub>2</sub> emissions from a gallon of gasoline = 2,421 grams x 0.99 x (44/12) = 8,788 grams = 8.8 kg/gallon = 2.3 Kg/litre of gasoline.

CO<sub>2</sub> emissions from a gallon of diesel = 2,778 grams x 0.99 x (44/12) = 10,084 grams = 10.1 kg/gallon = 2.7 Kg/litre of diesel.

The following table (Table 12) summarizes computations of the amount of carbon dioxide which is the currently generated by traffic along Bujumbura – Rutunga – Rumonge road based on AADT.

According to Table 13, the average amount of CO<sub>2</sub> currently generated per day along Bujumbura – Rutunga – Rumonge road is estimated to be around 58 tons.

**Table 14: Estimates of Amount of CO<sub>2</sub> Currently Generated by Traffic Daily in Kg/day Based on AADT**

No.	Type of vehicle	No of vehicles [a]	Type of fuel	Estimated average fuel consumption (Km/litre) [b]	Estimated Fuel consumption for 78km = (78/b) x a [c]	Amount of CO <sub>2</sub> generated per day kg after the road is upgraded to bitumen standard [c] multiplied by 2.3 (for gasoline engine) or 2.7 (for diesel engine)
1.	Motor cycle	402	Gasoline	20	1,567.8	3,605.9
2.	Medium car	1,233	Gasoline	10	9,617.4	22,120.0
3.	4-Wheel drive	646	Gasoline	8	599.5	1,378.9
4.	Pickup	509	Diesel	8	4,988.2	13,468.1
5.	Mini buses	285	Diesel	8	2,793.0	7,541.1
6.	Medium buses	41	Diesel	6	533.0	1,439.1
7.	Large buses	2	Diesel	2	78.0	210.6
8.	LGV	19	Diesel	5	296.4	800.3
9.	MGV	61	Diesel	2	2,379.0	6,423.3
10.	HGV	3	Diesel	2.0	117.0	315.9
11.	Articulated	2	Diesel	1.5	104.0	280.8
12.	Others	1	Diesel	1.5	52.0	140.4
<b>Total current daily emissions of CO<sub>2</sub> (Kg)</b>						<b>57,584.0</b>

**Source:** Consultant's Evaluation

**Key:** LGV: Light Goods Vehicle, MGV: Medium Goods Vehicle, HGV: Heavy Goods Vehicle

#### 4.2.6 Noise and Vibrations

Despite the fact that data on noise pollution of the project area was not available during the time of conducting the survey, it goes without saying that like air emission, the level of noise and vibrations due to traffic is dependent on the volume of traffic, speed, and the type of pavement. Since the traffic volume is low, the noise and vibrations levels are rated to be insignificantly low.

#### 4.2.7 Scenic and Visual Impacts

There are no obvious sources of deterioration of scenic and visual and quality of the road.

## **4.2.8 Road Conditions and Safety**

The geometry of the existing surface dressing road is such that it is narrow and in a number of sections it has sharp horizontal curves (sharp corners and steep slopes). In addition, some road sections are located very close to the edge of L.Tanganyika and either they are not provided with crash barriers or the crash barriers provided are weak to prevent crashes. Further to that, many sections of the road have settlements very close to the edge of the road. It has also been noted that some approaches to hydraulic structures (culverts and bridges) are curved and so presents safety concern. Road sections that are sharply curved are detailed under sub-section 4.9.7, while road sections that are located very close to L.Tanganyika approached to some of the bridges are curved creating safety concern. As discussed under sub-section 4.9.6, approaches to rivers Gahoma (Km 30+900) and Kavugangwe (Km 32+500) are curved.

## **4.2.9 Natural Disaster**

The main natural disasters along the project road are land slide (discussed in detail under sub-section 4.9.5, seasonal flooding of rivers, and transport of rocks and stones from mountains. The three disasters are discussed in detail under sub-sections 4.9.5 and 4.9.9. As noted earlier in Table 10, the following rivers are known to transport rocks and stoned during their seasonal flooding, causing serious disaster to the locals nearby:

- R.Nyabage (Km 16+900) – Kabezi colline
- R.Karonke (Km 23+100) – Migera colline
- R.Kirasa (Km 23+900) – Migera/ gavaniro collines
- R.Nyamusenye (Km 26+900) – Giteza/ Mubone collines
- R.Gatororongo (Km 27+400) – Mubone/ Ritunga collines
- R.Mwambuko (Km 28+800) – Rutunga colline
- R.Rutunga (Km 30+200) – Rutunga colline

In addition, the following rivers tend to flood during rainy season causing serious damages to properties:

- Gatare (Km 43+600) – Rutumo colline
- Rukamba (Km 44+400) – Rutumo colline
- R.Nyaruhongoka (Km 44+400) – Rutunga/ Chashi collines

## **4.3 HUMAN ENVIRONMENT**

### **4.3.1 Population**

#### **4.3.1.1 Composition of Households**

Demographic data shows that the number of female is greater than male in many interviewed households. The survey also revealed that there are few vulnerable groups in households groups include disabled, widows, and orphans and divorced, in some cases these groups are not available in some households. According to the surveyor people aged between 0-5 years are few in many households, and the dominant age groups are those between 6-17, 18-35, and 36-50 years whereas those who are between 50-70 years and 71 years and above seems to be fewer. Most of the households are headed by male.

#### **4.3.1.2 Age distribution of the households**

Majority of the population in the households are in the age ranging 6-37, evenly sparse between the ages 6-17 and 18-37. The ages of 0 to 6 years are very few. Ages 36-50 years; ages 50-70 years old; very few people are aged above the age of 70

#### **4.3.1.3 Gender Distribution**

Female and males are almost equally represented in the respondents' population, with more female than male. By percentage 51% are female and 49% are male.

Majority of families comprises of father, mother and children. However, like other African communities, most families in the study area have extended family set up. It is possible to find married couples living with one of their parents, orphan children, brother/sisters, in-laws or even uncles and aunts.

#### **4.3.1.4 Head of Households**

Most of the households (88.5%) are headed by male members of families in the area. This is consistent with the social structure of the patrilineal hierarchy, where the man is usually the head of family. In many African societies men are head of households as well as properties in the households. They own most of means of production. Women are mainly considered as helpers who obey their husband. Of the total of 148 families, 17 have females as head of household (equivalent to 11.5%).

#### **4.3.1.5 Vulnerable groups**

Among the vulnerable groups in the area are widows, disabled persons, orphan, and the divorced. There are 21 widows, 44 disabled persons, 40 orphans, and 8 divorced. Therefore there is a need to support these groups during implementation of the project particularly those households headed by these vulnerable groups

### **4.3.2 Gender Issues**

Traditionally gender inequality exists in the project area. In case where gender concerns in development have surfaced and been hypothesized; the problem has been to translate theory into practice. Resistant factors contributing to failure to do this include the following:

- (i) Role of culture in resistance to change
- (ii) Socialization process
- (iii) Resource allocation
- (iv) Unequal power relations between women and men
- (v) Lack of information (education)

There is unequal distribution of roles between women and men. Women are the of households doing chores at household level while men spend time drinking local brew and playing draft games. Women do cultivation, take care of family members, cooking, cleaning of the house, and etc. To make the situation worse, women have no say on the products harvested from the farm though they are the main producers of these products.



### **Low involvement in the decision making**

Women involvement in the decision making is limited. Most of the decisions made at household are done by men and involvement of women is minimal or not there at all. Some men make detrimental decisions to their families.

### **Limited Education opportunities**

Most of the parents do not give enough opportunities to girls for advisement, particularly education; boys are given better education facilities than girls. This trend affects women advancement in life

### **Low access to resources**

Women have poor access to resources including ownership of means of production. Girls are not regarded as important compared to men. Inheritance of properties is skewed to boys while girls are left with nothing.

## **4.4 CULTURAL ENVIRONMENT**

### **4.4.1 Ethnicity**

The main group are the Tutsi and Hutu. There are also minority groups who migrated from DRC to Burundi, mainly Nyamulenge group.

### **4.4.2 Religion**

There two dominant religions in the project area. These include Christianity and Islam. The majority are Christians followed by Muslims. Muslims are found in town centres.

### **4.4.3 Settlement Patterns and Housing**

Settlements are concentrated along the road closer to L.Tanganyika. Their village centres where main services are found such as shops, schools and medical services. Many of the zone are located at these locations.

### **4.4.4 Cultural Sites**

The only cultural sites close to the road which was noted during the study are graves. One grave yard and a grave were identified at Ruziba and Minago collines respectively as follows:

- Km 9+00, 5m RHS from the edge of the road (Ruziba colline): Christian grave yard
- Km 49+700, 10m RHS (Minago colline): Christian grave

### **4.4.5 Archaeological, Historical or Heritage Sites**

There are no known archaeological, historical or heritage site in the project area.

## **4.5 ECONOMIC ENVIRONMENT**

The analysis of social economic activities determined income and expenditure pattern of people living along the project road. In access to, and utilization of production resources, both genders are involved. Although men are still regarded as the family breadwinner gender relationships

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reflect the importance of both men and women in the present socio-economic set-up and activities in the area.

Ownership of means of production such as land, labour, basic capital assets, and seasonal inputs such as seed is also gender balanced. However, at the end men are regarded as the owner and final decision maker over the family resources.

#### **4.5.1 Agriculture**

The Burundian economy is mainly depending on agriculture. Statistics estimate indicate that 90% of the population relies on agriculture combined with livestock for their livelihood. There are two types of crops cultivated: Food crops (beans, bananas, sweet potatoes, cassava, maize and sorghum) and cash crops (coffee, tea, cotton and quinine). Agriculture generates value-added estimated at about 58% of gross domestic product and produces most the foreign exchange coming to the country. It should be noted that coffee (Arabica and Robusta accounts for nearly 90% of the country's export earnings and that plantations remained for the most part village enterprises. The tea produced in Burundi is high quality. The tea crop contributes to poverty alleviation in Burundi, because 95% of its production is exported. Burundi plans to increase the tea production by privatizing some complexes of production and by increasing the area of cultivation. Cotton constitutes the third traditional produce for export. Burundi cotton is a highly appreciated produce because of its quality. Burundi plans to increase the export offer by extending its growing area to the Imbo and Moso regions. The main food crops are: maize, sorghum, sweet potatoes, banana, beans, cassava, taro, palm oil, meat, etc. Livestock farming contributes 3% of gross domestic product.

#### **4.5.2 Livestock and Farming**

Livestock keeping is one of main economic activity in the area. Livestock kept are cows, goats, sheep, pigs, donkeys, and chicken. 29 per cent raise pigs, 26 per cent raise chicken, 15 per cent are keeping cows, 11 per cent rearing goats, 12 per cent raise sheep, and 7 per cent have donkeys.

Livestock provides a good source of food, mainly from meat, milk and eggs. Moreover, they provide farm manure and labour for ploughing the field, transporting heavy loads and source of hives and furs. In addition, they generate income when sold and bought

In the past, the cow was less an animal than an institution; cattle were not regarded from the utilitarian angle, as a factor in the economy but as status symbol. The size of the herd was an index of the individual's wealth and social status.

Livestock rearing is not well integrated into farming and remains essentially extensive in nature. At the present time, research is proceeding with strategies for reconstituting livestock herds and the genetic improvement of animal breeds.

An integrated herd reconstitution program will be established, and will include highly prolific, short-cycle small livestock that will yield a quick improvement in rural family incomes. This kind of livestock is also more suitable to agro-sylvo-pastoral integration. Improving rural incomes will also require the promotion of cottage industries and handicrafts that will create non-farm employment and will also help to reduce imports. This subsector is currently very underdeveloped, from all points of view, and will require efforts involving training, extension work and financing. As a first step, handicrafts associations will be organized and established through the provision of credits; productive units that were destroyed during the crisis will be rehabilitated; and a handicrafts support fund will be established.

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The quality of the cattle herd will be improved by crossbreeding with highly productive stock. This will be done primarily through semen imports followed by an artificial insemination program, which is likely to produce better results than importing animals that are not adapted to local climatic conditions. Veterinarians from the extension services will train communities to install and manage insemination centres.

Herd management techniques will be improved, particularly through permanent stabling for heavy livestock, swine and poultry, so as to make better use of harvest residues and enhance animal productivity in terms of livestock products and organic fertilizer.

Efforts to intensify livestock productivity will not be successful without proper feeding conditions, in terms of forage and concentrates. Forage crops will therefore be encouraged. In particular, attention will be given to herbaceous and woody legumes, which will not only provide high-quality forage but will enhance soil fertility as well. In the short term, seeds will have to be imported for species that have already been tested by ISABU. The emerging seed industry will also have to produce forage seeds that can be multiplied, in due course, by farmers' associations and cooperatives. These associations will also have to see to the growing of legumes and cereals for producing concentrates.

In order to take full advantage of intensive livestock grazing, a sustained effort will be required to prevent and treat the most frequent and serious diseases. In the short run, purchase of the required inputs will have to depend on government agencies and donors. Responsibility can then be transferred gradually to communities and private operators, as associations and producers receive the required training

#### **4.5.3 Fishing**

Burundi boarded Lake Tanganyika which is known in the world to be a lake containing a lot of fish of different varieties. The national production is estimated to 15,000 tones. The artisan fishing contributes to 90% and the development of the industrial fishing should enable the country to have an exportable surplus. The identified products for export are the frozen and smoked fishes, the ornamental living fishes and the crabs. The fishes locally known as "INDAGALA" are the unique species found only in the Lake Tanganyika, and this offers a considerable advantage for export.

#### **4.5.4 Employment**

Most of households' members are farmers. Very few are employed either by the government or by the private sector. Most of household members are self-employed, as a result of poor record keeping they were not able to mention net profits gained from monthly self-employment

#### **4.5.5 Income of Households**

The small scale farmers and livestock keepers were not able to mention their income from produce they sale. These include crops, vegetables, fruits, nut sales, livestock as well as animal products

#### **4.5.6 Household's expenditure**

The average expenditure per day in the household varies. This is because of the variation in number of members in each household and their individual income. In many households, people are not involved in either formal employment or small business.

#### 4.5.7 Property Ownership in the Household

Many households reported to own radio, television set, cell phone, bicycle, table, chair/Bank stool and Beds.

#### 4.5.7 Tourism

Tourism represents among the most valuable resource in Burundi as it is a major source of forex exchange. According to the Travel and Tourism Economic Impact 2017 report for Burundi, the sector main contribution to GDP was USD 0.1 billion which represented 2.6% if the total GDP in 2016 is considered. The sector also supported 43,500 jobs which was 2.2% of the total employment in the county.

Bujumbura Marie, Bujumbura Rural and Rumonge provinces are well considered for eco-tourism as the three provinces host Lake Tanganyika which is considered as a major natural habitat for wildlife. The lake supports quite a number of activities which include tourism, hunting, camping, photography, research and fishing among others.

Burundi is also well known for its local drummers commonly known as Abatimbo and is one of the major cultural attractions in the Country.

The country hosts ten sites which are tentatively on the UNESCO's list of World Heritage Sites. The ten sites include, Gishora, Mugamba, Muramvya, Gasumo (the southernmost source of the Nile), Lake Rwihinda Natural Reserve, Lake Tanganyika, Rusizi National Park, Kibira National Park, Ruvubu National Park and the Kagera waterfalls. Table 15 shows the trend of visitors to Burundi by mode of travel.

**Table 15: Tourists Arrivals by Mode of Travel**

Transport Mode/ Year	2010	2011	2012	2013	2014	2015	2016
Air	32,731	22,504	36,435	76,567	63,214	21,321	39,871
Road/Route	83,963	98,756	87,985	132,768	137,775	80,294	93,720
Water/Lac	25,615	23,121	23,289	24,719	34,673	29,876	53,485
<b>Total</b>	<b>142,309</b>	<b>144,381</b>	<b>147,709</b>	<b>234,054</b>	<b>235,662</b>	<b>131,491</b>	<b>187,076</b>

Source: Burundi Institute of Statistics and Economic Studies of Burundi (ISTEEBU), 2017

As shown above, the number of visitors arriving in Burundi steadily increased from 142,309 in 2010 to 235,662 in 2014 before declining to 131,491 in 2015 and thereafter increasing to 187,076 in 2016. The decline in the number of tourist arriving in Burundi post 2015 was mainly attributed to the Political Crisis of 2015. It was observed that most tourists arriving in Burundi mainly used roads as their main mode of transport followed by Water and Air.

Figure Figure 3 below shows the flow of visitors to Burundi through major frontiers as of December 2010. As can be seen, four frontiers Kanyaru (Rwanda Border), Bujumbura International Airport, Gasenyi (Rwanda Border) and Kobero (Tanzania Border) recorded 57.3%, 16.4%, 12.6% and 10.6% of the total tourist flows. Mabanda/Mugina/Manyovu (Tanzania Border) recorded 1.5% of the total traffic which showed there was demand for transport through the border.

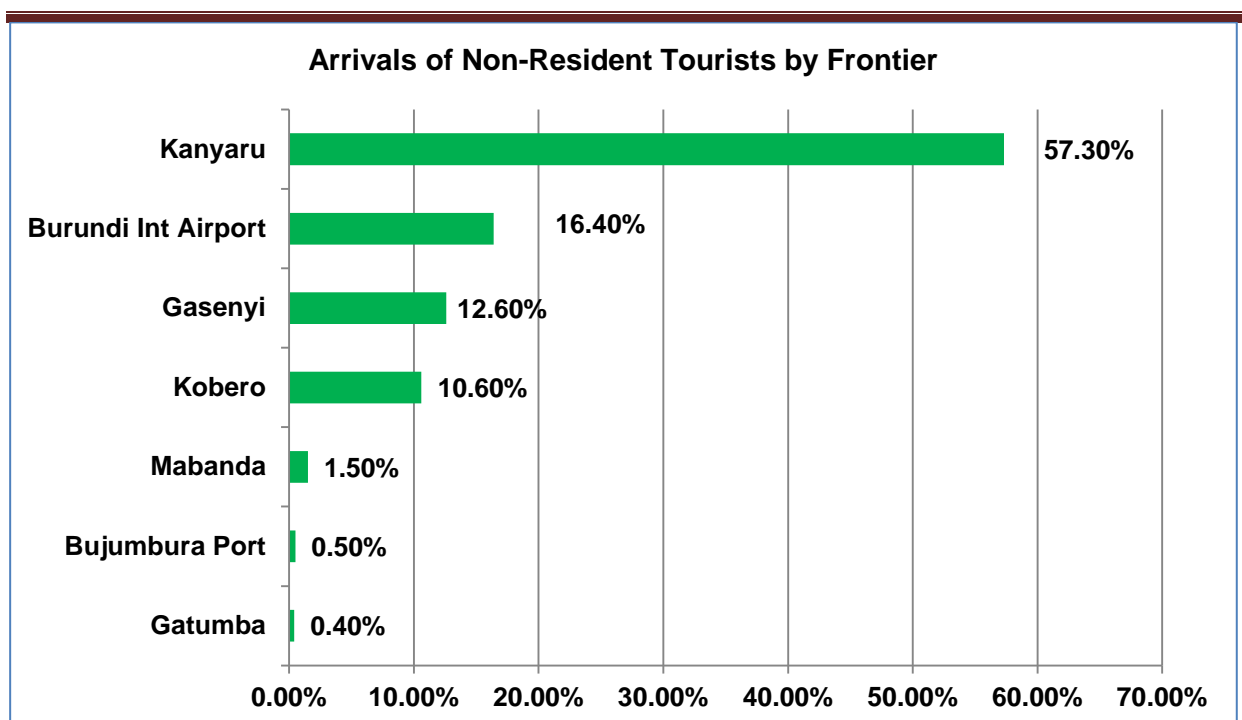


Figure 3: Flow of Visitors to Burundi through Major Frontiers

## 4.6 INFRASTRUCTURE AND SOCIAL SERVICES

Social services delivery and provision is undertaken mainly by governmental institutions and few by private institutions. The services examined include the provision of education, health, water, energy and travel and transport.

### 4.6.1 Energy

All the collines along the road section from Bujumbura to Kanyosha and Magara to Mutambara road sections are connected to national power supply grid. The remaining collines along the road section from Ruziba to Chashi are not connected to national power supply grid.

At several road sections power supply utilities cross the project road and so during construction such utilities are likely to be disrupted.

According to REGIDESO, the power supply lines in the city have been installed underground. Some of the power lines run along and across the road. The power lines, comprising of both medium and high tension lines are located between 2m and 2.5m from the edge of the road and 0.5m to 0.8m deep. Some of the cables have been installed in sleeves while others are not sleeved. Such utilities are likely to be disrupted by the road construction activities. In addition, above ground power transmission lines run on both sides of the road along Kanyosha road section.

#### 4.6.1.1 Source of Energy for Cooking

Firewood, charcoal and kerosene are the main source of domestic energy. Very few households are connected to electricity. Firewood is the mostly used as sole source of energy for cooking. It is as well used in combination with charcoal. Very few households use electricity as source of energy, as most households do not have access to electric grid and they are far away from main roads where electrical power lines are located. Electricity is mainly used for lighting and operating radio and television whereas firewood and charcoal remain for cooking.

Due to extensive deforestation and overgrazing, firewood and charcoal have become more scarcely. Women and girls bear the burden for firewood collection, often travel long distances to collect them. Of those 28 per cent rely on firewood for cooking; only 21 per cent have electricity for cooking, and 51 per cent depend on charcoal.

#### 4.6.1.2 Source of Lighting

The sources of light in the project area are as followed: kerosene, electricity and solar energy. Kerosene is the mostly used as source of light by 58 per cent, electricity provides light for 30 per cent. Kerosene is used more because it is cheaper than electricity. The use of solar energy as the source of light is at 12% and it is growing steadily.

#### 4.6.2 Water Supply

The Ministry of Ministry of Water, Environment, and Urban Planning, through its Directorate General for Water and Energy, heads up policy formulation and the administrative functions of the central government as they relate to the Water supply and sanitation sector.

In the rural areas Directorate General of Rural Water and Electricity, an entity under Ministry of Water, Environment, and Urban Planning oversees and coordinates drinking water and sanitation.

The Water and Electric Authority (REGIDESO), a public utility with autonomous legal and financial status that operates under the supervision of the Ministry of Water, Environment, and Urban Planning, and Communal Water Authorities undertake actual service provision. REGIDESO is responsible for catchment, treatment, and distribution of drinking water in the urban or urbanizing centers. The Communal Water Authorities supply drinking water to the rural areas.

Major sources of domestic water supply for settlements along the project road are pipe water which is L.Tanganyika and rivers across the road.

The main source of domestic water supply for Bujumbura city is L.Tanganyika. Water is pumped from the lake to a treatment plant, which is located near national Radio and Television station, within the city. The treated water is the pumped to elevated reservoirs that are located at Rohero and Kamenge before being distributed by gravity to the consumers.

According to The Board of Production and Distribution of Water and Electricity (REGIDESO), the main line from the treatment plant to reservoirs crosses the project road at the junction to the national radio and television station. Besides, pipe lines having diameters 150mm, 175mm, 200mm, and 400mm cross the project a number several locations. In addition the main line from the treatment plant to reservoirs crosses the project road at the junction to the national radio and television station

In addition, during site survey it was noted that a number of water pipe lines either cross (through culverts) or runs along the road, within the right of way. In addition a number of Domestic Points (DPs) are located within the right of way. Table 16 below describes domestic water supply profile for villages along the project road. The table also describe locations where such utilities are located within the right of way.

**Table 16: Water supply profile for Collines along the project road**

No.	Commune	Source of Water Supply	Remarks
1.	Mukaza and Muha	Supplied with drinking by REGIDESO, with	Water supply main and distribution lines cross the project road between the start of



No.	Commune	Source of Water Supply	Remarks
		L.Tanganyika as its major source. Water is pumped from the lake to a treatment plant located in the neighbourhood of national Radio and Television station, The treated water is the pumped to reservoirs that are located at Rohero and Kamenge before being distributed by gravity to the consumers.	<p>the project road up to Kanyosha. Pipe lines of 150mm, 175mm, 200mm, 400mm. In addition the main line from the treatment plant to reservoirs crosses the project road at the junction to the national radio and television station.</p> <ul style="list-style-type: none"> <li>• Km 4+400: five 5” GS, one 6”, one 10”, and one 4” ductile iron water pipes lines are supported by bridge for R.Kanyosha</li> <li>• Km 4+700: 6” steel water pipeline crosses the road</li> <li>• Km 4+700 RHS: DP</li> <li>• Km 5+000: uPVC water pipe line crosses the road</li> <li>• Km 5+200 RHS: DP</li> <li>• Km 5+300: one 4” and one 10” GS water pipe lines cross the road</li> <li>• Km 6+500, RHS: Non-operational DP</li> <li>• Km 6+600: two one 3”, two 4”, and one 8” GS pipe lines cross the road are supported by bridge for R.Kizingwe</li> <li>• Km 8+600: one 6” GS pipe run on the RHS of the road</li> <li>• Km 9+600, 5m RHS: DP</li> <li>• Km 17+400: 4” GS pipe run on the LHS of the road</li> </ul>
2.	Kabezi	Kabezi Commune does not have clean and safe drinking water. Major source of drinking water for collines along the road in this commune is L.Tanganyika. The source is not safe because it is not treated and much polluted by sedimentation. Water and domestic points along the road are not operational. Efforts by the government to source water from ground resource are on-going	<ul style="list-style-type: none"> <li>• Km 20+100, 5m LHS: water reservoir</li> <li>• Km 21+200, 7m LHS: water reservoir (Photo 31)</li> </ul>
3.	Muhuta	Untreated water from L.Tanganyika and Pipe water from gravity scheme	<ul style="list-style-type: none"> <li>• Km 24+700: 4” GS pipe line supported by the bridge for R.Nyamibembe</li> <li>• Km 25+500: DP 5m RHS</li> </ul>



No.	Commune	Source of Water Supply	Remarks
			<ul style="list-style-type: none"> <li>Km 25+700: DP 5m RHS</li> <li>Km 26+500 and 26+600, 7m RHS: water reservoirs</li> </ul>
4.	Rutungu	Pipe water from gravity scheme and untreated water from L.Tanganyika	<ul style="list-style-type: none"> <li>Km 27+100, 7m LHS: water reservoir</li> <li>Km 29+900: Operational DP 2m on the RHS (Photo 33)</li> <li>Km 30+300, 5m RHS: water reservoir</li> </ul>
5.	Bugarama	Pipe water from gravity scheme and untreated water from L.Tanganyika	<ul style="list-style-type: none"> <li>Km 30+900, 5m RHS: DP</li> <li>Km 37+900, 7m LHS: DP</li> <li>Km 38+900, 7m RHS: water reservoir</li> </ul>
6.	Rumonge	Pipe water from gravity scheme and untreated water from L.Tanganyika	<ul style="list-style-type: none"> <li>Km 46+00, 5m RHS: DP</li> <li>Km 48+100, 10m RHS: Operational borehole with hand pump (Photo 34)</li> <li>Km 49+100, 3m RHS: DP</li> <li>Km 53+400: 3" GS pipe supported by bridge for R.Gikaro</li> <li>Km 57+200, 15m RHS: DP</li> <li>Km 57+900, 15m RHS: DP and water reservoir</li> <li>Km 60+300, 15m LHS: Water reservoir</li> <li>Km 65+000, 5m LHS: Water reservoir</li> <li>Km 65+500, 15m LHS: Water reservoir and DP</li> <li>Km 68+200: 10" GS pipe under the bridge for R.Dama</li> </ul>

#### 4.6.3 Waste Disposal

Most of the households do not have adequate solid and liquid waste disposal. Solid waste disposal is done through burning, burying, throwing in the farm and littering anywhere. The solid and liquid wastes are disposed haphazardly; some are used for manure for backyard garden while others burn or bury the waste. The result of poor sanitation is one of causes of some of the water-borne diseases including diarrhoea. Burning and burying are predominantly used to dispose 37% and 18% of solid waste; throwing in the farm to dispose 33%, and 12% is unaccounted for, thus disposed anywhere.

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#### **4.6.3.1 Waste Water Management in Bujumbura City**

According to Technical Services ("Services Techniques Municipaux"- SETEMU), there are two types of management of sanitation systems in Bujumbura City: Onsite and Offsite sanitation systems. Onsite sanitation is a sanitation in which excreta and wastewater are collected, stored or treated at the same location (same plot) where they are generated. These include pit latrines and septic tanks with soak pit. The Off-site sanitation is a sanitation in which excreta and waste water are collected and conveyed by a sewerage system before being centrally treated by waste water stabilization ponds that located at Buterere in the outskirts of the city. Only a small percentage of the Bujumbura's population is connected to centralized sanitation system and such areas Rohero, Bwiza, Nyakaviga, Buyenzi, Ngagara, Aziatiki, and Mutaga South zones. The rest of the population use onsite sanitation system.

The main sewer line runs at the middle of the road between the road section between Waka Waka Pub and the office Building for the Ministry of Transport, Public Works, and Equipment road section. In addition lateral sewer lines runs perpendicular to the project road to connected to the main sewer lines. All such utilities are likely to be affected by the road rehabilitation.

#### **4.6.4 .2 Solid Waste Management in Bujumbura City**

SETEMU, which is also responsible for the management of solid waste in Bujumbura City collection and disposal of solid waste has contracted the management of solid waste to privately, owned companies that are directly paid by customers. In return, the companies pay a certain percentage of their collections to SETEMU. The collected wastes are transported and disposed of at a centralised municipal solid waste dump site which is located at Buterere - Muvone

#### **4.6.4 Telecommunications**

Like the rest of Burundi, the project area is served by efficient telecommunication services network. The most popular cellular networks in the region include Econet Leo, Lumitel, and Smart Mobile.

Burundi is connected to the outside world through fibre optic cable through Tanzania via Manyovu, Kigoma. The backbone is managed by Burundi Backbone System (BBS). Construction of the system was completed in year 2010.

Among the customers of BBS are all telecommunications companies, except Lumitel, all banks, all universities, all government institutions (e.g. revenue authority, National radio and televisions, immigration department, military, police), hotels, etc.

During site survey it was noted the fibre optic cable has been laid very close to the edge of the road and very shallow on the ground. On several places the cable was seen on the ground surface. At water course crossing the cable, placed in 2 inch uPVC pipe is supported by beams of culverts and bridges (refer to Table 12). Other areas of interest are the manholes of the optic cables that are located at Kanyosha road section as follows:

- Km 4+700 RHS
- Km 5+200 RHS
- Km 5+300 RHS

The following describe locations of concerns of the fibre optic cable:

#### 4.6.5 Education Services

The level of education of the inhabitants in the impacted villages is low. Primary school education is the highest level achieved by the majority of the population, about half of the population (52%). Households with high education normally have better income than families with low education. Poverty levels are strongly correlated with the education levels achieved by the heads of household.

The figure shows only few (3%) have completed up to college/ university level and 2% has attended technical school, and 23% has at least secondary school level education. However, there are still 20% without any formal education. The level of education among people in the community is reflected through ability to read and write that can be attributed to the presence of primary schools in the project area. The following schools (Table 17) are located along the project road:

**Table 17: List of schools located along the Project road**

No	Name of Black Spot	Colline	Chainage
1.	Kanyosha Government primary school	Kanyosha	5+35, RHS
2.	Kanyosha Government primary school	Kanyosha	5+500, RHS
3.	Kanyosha Government secondary school	Kanyosha	5+800 RHS
4.	Ruziba primary and secondary school	Ruziba	9+600 RHS
5.	Kabezi Market	Kabezi	17+200 RHS
6.	Migera primary school	Migera	20+800 RHS
7.	Migera open market	Migera	22+400
8.	Kirasa primary school	Gavaniro	24+000 RHS
9.	Gitaza Market	Gitaza	26+300 RHS
10.	Rutunga primary and secondary school	Rutunga	30+400 RHS
11.	Nyaruhongo primary and secondary school	Rutunga	33+600, 6m RHS
12.	Magara primary and secondary school	Magara	38+900 RHS
13.	Magara secondary school	Magara	40+200
14.	Rutumo Market	Rutumo	41+600 RHS
15.	Gatare primary and secondary school	Rutumo	43+800 RHS
16.	Muturigwa primary school	Muturigwa	46+400, RHS
17.	Minago Market	Minago	48+900 RHS
18.	Minago primary and secondary school	Minago	49+600 RHS
19.	Minago secondary school	Minago	49+700 LHS
20.	Bitano primary and secondary school	Minago	51+700 LHS
21.	Kagongo primary school	Kagongo	56+400
22.	Kakora primary and secondary school	Kizuka	58+900
23.	Nyamibu primary and secondary school	Kizuka	61+400 LHS
24.	Kizuka Market	Kizuka	62+000 LHS
25.	Rumonge primary and secondary school	Rumonge	71+700 RHS

**Source:** Consultant field Survey

## 4.7 LAND USE AND OWNERSHIP PATTERNS

### 4.7.1 Land Use

Land use categories within the road impact area can be divided into six categories:

- (i) Settlement (residential and institutional)
- (ii) Agriculture
- (iii) Transport corridor
- (iv) Water bodies, (rivers, wetlands)
- (v) Conserved (forest and wildlife protected areas)
- (vi) Open (recreational areas).

However, major land uses are farming, residential and grazing. 57 per cent of the interviewed people use their land for farming only. Moreover, people who use their land for grazing animals only were found to be 16 per cent, and finally, those who use their land for residential purpose were found to be 27 per cent.

Commonly grown crops include oil palm, bananas, sweet potato, cassava, maize, mango, mandarin,

Most of the households have access to arable land within the RoW and land is being cultivated. The size of land owned varies for different families as depend on the availability of land and accessibility to land. The land tenure systems for most of household are buying and inheritance. Land along the road is mostly used for residential and farming and is cultivated yearly.

As noted earlier, the project road passes along a forest protected areas. Sub-section 4.8.4 gives details of the forest.

### 4.7.2 Land Ownership

Most of the households have access to arable land within the RoW and land is being cultivated. The size of land owned varies for different families as depend on the availability of land and accessibility to land. The land tenure systems for most of household are buying and inheritance. Land along the road is mostly used for residential and farming and is cultivated yearly

## 4.8 BIOLOGICAL ENVIRONMENT

### 4.8.1 Flora

The flora along the project road is characterised by varied mosaics of shade trees and street strip trees, tree crops, and grassland. Shade and street strips trees are mainly exotic as most of the indigenous trees have been cleared. The remaining indigenous trees consist of mainly fig, bamboo, and to a small extend miombo woodland from a protected area. Exotic trees consist of mainly of *Cordia Africana*, eucalyptus, Christmas, grevillea, yellow cassia, red cassia, neem, *Terminalia ivorensis* (white afara), and *araucaria exelsa*. Tree crops consist of palm oil, avocado, mango, and tangerine/ mandarin. Some of the trees are located very close to the edge of the road and some of them along and on water courses. The following table (Table 18) describes significant vegetation cover along the project road.

**Table 18: Vegetation Cover Characteristics along the Project Road**

No.	Road Section	Colline	Significant Vegetation Characteristics along the Road
1.	Km 0+800 – 01+500	Rohero - Kinindo	Street strip and shade trees consisting of black afara ( <i>terminalia ivorensis</i> ), <i>araucaria exelsa</i> , yellow cassia, coconut, palm oil (Photo 17). Most of these are located within fenced properties. Other trees include mango, hedge, grevillea, fig, and Christmas. Most of these are located in opened areas outside fenced properties (Photo 18)
2.	01+500 – 06+600	Kinindo – Kanyosha	Shade and street strips consisting of Christmas, hedge (fence tree), yellow cassia, <i>araucaria exelsa</i> .
3.	Km 6+600 – 10+900	Kanyosha - Ruziba	Grevillea, yellow cassia as strip vegetation (Photo 16)
4.	Km 10+900 – 15+900	Ruziba - Ramba	<i>Araucaria exelsa</i> , eucalyptus, and grevillea trees as strip and shade trees
5.	Km 15+900 – 19+200	Ramba – Kabezi	Scattered grevillea, white afara, palm oil, yellow cassia, a few fig, and eucalyptus trees
6.	Km 19+200 – 23+900	Kabezi - Migera	Yellow cassia, a few but scattered eucalyptus, and mango trees
7.	Km 23+900 – 24+700	Migera - Gavaniro	Mango, mandarin, neem, grevillea, yellow cassia, palm oil, white afara, and fig trees
8.	Km 24+700 – 25+700	Gavaniro - Gasange	Mango, mandarin, neem, grevillea, yellow cassia, palm oil, white afara, and fig trees
9.	Km 25+700 - 26+900	Gasange – Gitaza	Yellow cassia, neem, and avocado, mango, and palm oil tree crops
10.	Km 26+900 – 27+400	Gitaza - Mubone	Eucalyptus, yellow cassia, neem, avocado, mango, palm oil
11.	Km 27+400 – 33+700	Mubone - Rutunga	Grevillea, yellow cassia, eucalyptus, neem, and palm oil At around Km 30+700 there is a long strip of large eucalyptus trees, 3m from the edge of the road (Photo 32)
12.	Km 33+700 – 34+000	Rutunga - Chashi	Yellow cassia and palm oil
13.	Km 34+000 – 40+800	Chashi - Magara	Palm oil, yellow cassia, mango, and grevillea,
14.	Km 40+800 – 41+100	Magara - Rutumo	Palm oil, neem, mandarin, eucalyptus, and avocado
15.	Km 41+100 – 48+300	Rutumo - Muturigwa	Yellow cassia, Palm oil, mango, and mandarin
16.	Km 48+300 – 53+500	Muturigwa - Minago	Yellow cassia, Palm oil, mango, and mandarin
17.	Km 53+500 – 58+700	Minago - Kagongo	Mango, eucalyptus, palm oil, mandarin, yellow cassia,
18.	Km 58+700 – 63+800	Kagongo - Kizuka	Yellow cassia,, white afara, eucalyptus,

No.	Road Section	Colline	Significant Vegetation Characteristics along the Road
			palm oil, mandarin eucalyptus, avocado, and few Indian almond
19.	Km 63+800 – 68+200	Kizuka - Mwange	Palm oil, mango, mandarin, yellow cassia, eucalyptus, and grevillea
20.	Km 68+200 – 68+700 LHS	Mwange – Rumonge	Scattered palm oil, mango, grevillea, eucalyptus and a few Indian almond trees in the neighbourhood of R.Dama. R.Dama marks the start of Nkayamba Natural Forest Reserve. The forest which is characterised by miombo woodland.
21.	Km 68+200 – 74+600	Mwange – Rumonge (Mutambara)	Scattered palm oil, mango, grevillea, eucalyptus, and a few Indian almond

**Source of Data:** Consultant's field survey Consultation with Directorate of Forestry, OBPE

#### 4.8.2 Fauna

As noted earlier in Table 18, the road section between 68+200 and 68+700 traverses along Nkayamba Natural Forest Reserve; a habitat of wildlife. Based on the Environmental Expert's interview with Directorate of Forestry under OBPE, the forest reserve is a home of wildlife such as primates, antelopes, jackals, and different species of birds. The project road is therefore within the DIZ of wildlife area. Other fauna in the project area include such domestic animals as livestock, dogs, chicken, etc.

#### 4.8.3 Fish and Aquatic Habitats

As noted earlier in Sub-section 4.2.4, the project road traverses along L.Tanganyika and across eighteen perennial rivers. Lake Tanganyika and the perennial rivers are habitats of different fish species.

The study noted obvious degradation of fish habitats in some of the rivers, which include discharge of waste water from palm oil refinery factory and farming activities on rivers riparian.

#### 4.8.4 Protected/ Ecologically Sensitive Area, Rare and endangered Species

Sub-section 4.8.1; Table 18, item 19 and sub-section 4.8.2 indicated that there is one forestry protected area, namely Nkayamba Forest Area. The forest reserve located between Km 68+200 and 68+700 on the LHS of the project road. The forest reserve, characterised by miombo woodland is a habitat of wildlife. There is no specific endangered species.

### 4.9 ENVIRONMENTAL PROBLEMS

During the study and interview with authorities, the following environmental problems were noted and mentioned as significant environmental problems along the project road:

#### 4.9.1 Farming Along and Across Water Resources

The study noted a common practice of farming on water courses as well as on riparians of water courses. As noted in Table 12, the following riparians are used for agricultural activities:

- Km 4+400 (R.Kanyosha): Vegetable growing along the river (Photo 2)



- 
- Km 17+400 (R.Kanyamazi): Vegetable growing along the river (Photo 6)
  - Km 46+100 (R.Shanga): Vegetable growing and tree nursery along the river
  - Km 56+800 (R.Kaguwe): Growing palm oil on the river bed (Photo 15)

The practice of farming on the riparians of water courses causes significant sedimentation of river and drainage systems. This is because agricultural activities make soil loose to be easily carried away by storm water.

Apart from reducing hydraulic capacities of cross drainage structures, sedimentation raises river beds to the extent of causing overtopping storm water after downpour.

Riparian zones are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. Riparian zones dissipate stream energy. The meandering curves of a river, combined with vegetation and root systems, dissipate stream energy, which results in less soil erosion and a reduction in flood damage. Sediment is trapped, reducing suspended solids to create less turbid water, replenish soils, and build stream banks. Pollutants are filtered from surface runoff which enhances water quality via bio-filtration.

Vegetation surrounding the stream helps to shade the water, mitigating water temperature changes. The vegetation also contributes wood debris to streams which is important to maintaining geomorphology. From a social aspect, riparian zones contribute to nearby property values through amenity and views.

Riparian zone acts as a sacrificial erosion buffer to absorb impacts of factors including increased runoff from urbanisation and increased boat wake without damaging structures located behind a setback zone.

Therefore, carrying out agricultural activities in the riparian, apart from compromising its ability to protect river banks against soil erosion, cause sedimentation of the rivers system as well as Lake Tanganyika where nearly all the rivers discharge to. In addition, agricultural activities are likely to cause pollution of the river systems and Lake Tanganyika, especially if used for gardening; known to be heavy feeder of agro-chemicals. The negative impact due to agricultural activities in the riparian is gauged to be moderate and long term.

Conducting of agricultural activities along water courses is contrary to Article 5 of Law No. 1/02 of 26 March 2012 on water code which prohibits human activities within 25m from edges of rivers that discharge into L.Tanganyika.

#### **4.9.2 Dumping of Solid Waste and Discharge of Waste Water on Water Resources**

It has been noted several locations domestic solid wastes and industrial waste water being dumped/ discharged into water courses, causing pollution of the rivers. The following rivers are affected by such a practice:

- Km 4+400 (R.Kanyosha): Solid wastes, in particular plastic bags and bottles are dumped in the river (Photo 3)
- Km 10+900 (R.Mugere): Waste water containing animal blood from an abattoir which is located along the river is discharged to the river (Photo 4)
- Km 26+300, RHS: The edge of the market is 50m from the edge of L.Tanganyika and waste water from the market is directed to the lake (Photo 19)



- 
- Km 40+800 (R.Ruzibazi): Waste water from a small-scale palm oil extraction factory, which has been constructed on the RHS upstream riparian discharges its waste water to the river
  - Km 48+300 (R.Rugata): Waste water from palm oil extraction factory (Savonor Company) which is located on the RHS downstream riparian discharges its waste water to the river
  - Km 51+200 (R.Ngonya): Waste water from a small-scale palm oil extraction factory which is located on the RHS upstream riparian discharges its waste water to the river (Photo 14).
  - Km 60+700 (R.Kizuka): A small scale oil extraction factory, located about 3m from the edge of the river on the LHS of its upstream riparian discharges waste water to the river
  - Km 63+800 (R.Munege): Waste water from a small-scale palm oil extraction factory which is located on the LHS upstream riparian discharges its waste water to the river
  - Km 68+200 (R.Dama): Waste water from a small-scale palm oil extraction factory which is located on the LHS upstream riparian discharges its waste water to the river

#### **4.9.3 Encroachment of Water Resources by Settlements**

The survey noted substantial encroachment of water resources; L.Tanganyika and water courses by settlements. Encroachment of water resources by settlements were noted at the following locations:

- Km 48+300: Settlements have encroached R.Rugata to as close as to the edge of the river (Photo 13)
- The following area have settlements very close to the L.Tanganyika: Around Km 27+500, 28+800, 29+600, 30+800, 33+200, and 35+700 – 38+800

Sitting of settlements to the edge of rivers and L.Tanganyika is a violation of Article 5 of Law No. 1/02 of 26 March 2012 on water code which prohibits human activities within 25m from edges of rivers that discharge into L.Tanganyika and 150m from the edge of L.Tanganyika.

#### **4.9.4 Soil Proneness to Gully Development**

The soil of the project road for a number of sections is susceptible to gully erosion development and a number of gullies have developed along and across the project road as described here:

- Km 15+500 RHS: A gully erosion is developing just about 4.5m from edge of the road (Photo 20)
- Km 15+800: Gully erosion development caused such serious damage to the project road that necessitated realignment of the road to the LHS causing unnecessary sharp curve to the road (Photo 21)

In addition, most river crossings are susceptible to gully erosion as discussed under by Table 12. Development of gully erosion is jeopardizing the project road.

#### **4.9.5 Soil Susceptibility to Land Slide**

The eastern side of the project road section between Km 28+200 and 32+300 is characterised by steep slopes. The road section around Km 28+600LHS is susceptible to land slide as it is very steep and its soil material is bare and very loose. During the survey the Consultant noted accumulation of soil material on the road that had been transported from the road side following

landslide. The Consultant was informed that such incidences have been happening many times during rainy season and there are times the road is completely closed by accumulated material.

The consultant was also informed that during rainy season in March 2016 the movement of goods and people along the road was paralyzed following a landslide. The road section was blocked after material from landslide completely blocked the road. Vehicles had to be parked at this location and passengers had to board other vehicles on the other side of the blocked section.

#### 4.9.6 Traffic Accident Associated with Road Proximity to L.Tanganyika

The road sections from Km 25+000 - 29+800, Km 31+500 - 33+000, 36+200 – 36+300, and Km 53+800 – 54+400 are very close to L.Tanganyika and there are places where the road is as close as 2m from the edge of the lake and some of these sections have impaired sight distances because they have sharp curves, making them very unsafe for traffic, especially because some of them are not provided with crash barriers or guard rails. The consultant is informed that about two years ago the then a Member of Parliament for Burundi drowned in L.Tanganyika around Km 31+700 following loss of control of her car while driving along the road.

The following sections of the road have the road located very close to the lake:

- Around Km 27+600: The road is located 6m from the edge of the lake (Photo 22)
- Around Km 28+100: The road is as close as 2m from the edge of the lake
- Around Km 28+600
- Around Km 29+300: The road is located 3m from the lake at sharp curve (Photo 23)
- Around Km 32+300: The road is located 3m from the lake at sharp curve

#### 4.9.7 Traffic Accident Associated with Sharply Curved Road Sections

A number of sections of the project road have infringed site distances because they have sharp horizontal curves. The table below (Table 19) list road sections that have infringed site distances. Such sections are not very safe to traffic as some of them have not been provided with crash barriers. The following sections of the road have sharp curves:

**Table 19: Typical Road Sections where the road is Sharply Curved**

No	Road Section	Remarks
1.	Km 27+600	The road sections is also very close to the edge of the lake (Photo 22)
2.	Km 28+600	The road sections is also very close to the edge of the lake (Photo 24)
3.	Km 29+300	The road sections is also very close to the edge of the lake (Photo 23)
4.	Km 29+700	None
5.	Km 30+900	None
6.	Km 32+300	<ul style="list-style-type: none"> <li>• The road sections is also very close to the edge of the lake</li> </ul>
7.	Km 32+900	the road sections is also very close to the edge of the lake and has masonry
8.	Km 33+200	A series of two sharp curves
9.	Km 34+600	A series of two sharp curves (Photo 26)
10.	Km 35+200	None
11.	Km 35+800	None
12.	Km 36+600	None
13.	Km 38+100	None
14.	Km 41+100	None

No	Road Section	Remarks
15.	Km 42+000	None

- **Source:** Site Survey by Environmental Expert

#### 4.9.8 Encroachment of Project Road by Settlements

The study noted substantial number of settlements that are located very close to the project road. There are sections that have been encroached by settlements as close as 2 m from the edge of the road. The houses are used for both settlements and business activities. Typical locations where settlements are located very close to the road are:

- Around Km 4+500: Kanyosha business centre
- Around Km 16+900: Kabezi settlements as close as 3m from the edge of the road
- Around Km 21+400
- Around Km 26+300: Gitaza colline (Photo 25)
- Around 28+800: Rutunga colline
- Around Km 34+600: Rutunga colline (Photo 26)
- Rumonge road Section (Photo 27)

Such road encroachment by settlements jeopardise the safety of not only traffickers but also occupiers of the houses in the event traffickers lose control of vehicles. Remarkably, during the OdR was unable to avail to the ESIA expert the width of the project road's right of way.

#### 4.9.9 Hazard Associated with Transport of Stones and Rocks by Storm Water

In sub-section 4.2.4.1 (Table 12) it was indicated that during rainy season storm water transport stones and rocks from the Mumirwa steep mountainous area along some of the rivers. It was also stated that in the event that the rivers flood some of the stones and rocks are transported off the course of the rivers causing serious damages to properties, including buildings as well as fatal accidents. The Environmental Expert was informed that in year 2014, several houses were flattened and at least fifteen (15) people killed by stones and rocks following flooding of R.Rutunga. Apart from causing accidents, the stone carrying rivers also blocked the project road by boulders buried (Photo 30). The following are the rivers that are known to transport rocks and stones from the mountain during rainy season:

- Km 16+900: R. Nyabange
- Km 23+100: R.Karonke (Photo 28)
- Km 23+900: R.Kirasa
- Km 26+900: R.Nyamusanye
- Km 27+300: R.Gatororongo
- Km 28+800: R.Mwambuko
- Km 30+200: R.Rutunga (Photo 29)
- Km 33+700: R.Nyaruhongoka

#### **4.9.10 Transport of Sediments to L.Tanganyika**

Most of land on the LHS of the project road is steep and bare, which makes it very susceptible to erosion and there are sections of the road that are prone to gully erosion as discussed earlier under sub-section 4.9.4. As a result, large volume of sediments is transported from the mountain to L.Tanganyika either directly or through water courses. The sediments transported to the lake apart from reducing the volume of the lake, makes the lakes turbid, causes damages to the breeding sites of fish in the lake. It is very important that transport of sediments to the lake is checked in order to protect the lake.

#### **4.10 OTHER RELEVANT DEVELOPMENT INITIATIVES**

A number of development initiatives within the project's area of influence or impact zone are likely affect or to be affected by the proposed road upgrading. Such projects are:

- On-going upgrading of Nyakanazi – Kabingo road section (50Km) to bitumen standard
- Proposed upgrading of Kabingo (Kakonko District) – Kibondo - Kasulu – Manyovu Road Section (268Km) to bitumen standard
- The proposed upgrading of Nyanza Lac – Rumonge road section (42Km)
- The proposed construction of One Stop Border Post (OSBP) facilities for Tanzania and Burundi at Manyovu/ Mugina

## **SECTION 5: PRESENTATION OF ALTERNATIVES CONSIDERED**

Identification of alternatives is one of the key aspects of a success of the ESIA. All feasible alternatives have to be fully addressed and their advantages and disadvantages compared in order to determine the best alternative. There are however some significant constraints that have to be taken into account when identifying alternatives for a project of this scope. Such constraints include financial, social, and environmentally related issues that will be discussed in the evaluation of the alternatives. Alternatives can be identified according to:

- (i) The No-Action alternative (Zero Alternative)
- (ii) Activity alternatives (alternative undertakings)
- (iii) Process alternatives (or Alternative technologies)
- (iv) Scheduling alternatives;
- (v) Input alternatives (Alternative sources of construction materials)
- (vi) Location alternatives (alternative sites)
- (vii) Alternative Design

For any alternative to be considered feasible such an alternative must meet the need and purposes of the development proposal without presenting significantly high associated impacts. Alternatives are typically distinguished into discrete or incremental alternatives. Discrete alternatives are overall development options, which are typically identified during the pre-feasibility, feasibility and or scoping phases of the ESIA process. Incremental alternatives typically arise during the ESIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation measures and therefore are not specifically identified as distinct alternatives. Three alternatives have been identified as follows:

### **5.1 NO GO, ZERO OR BASE (ALT0) ALTERNATIVE**

The “No Go “Alternative” refers to the alternative of not embarking the proposed road rehabilitation at all. This alternative would imply that the current status quo without the proposed road construction would continue. It is important to note that the No Go Alternative is the baseline (Base Alternative or ALT0) against which all other alternatives and the development proposal are assessed.

When considering the Zero alternative the impacts (both positive and negative) associated with any specific alternative or the development proposal would not occur and in effect the impacts of the Zero Alternative are therefore inadvertently assessed by assessing the other alternatives. In addition to the direct implications of retaining the status quo there are certain other indirect impacts, which may occur should the Zero alternative be followed.

Overall, the impact of “No Go” alternative impact is considered to be significant in hampering development in terms of local, regional, and national wise transport. The consideration of “No Go” was dismissed as an alternative due to the need and desirability of rehabilitating this road in order to cope with rapid increase in demand for transit of goods and services into other regions.

## 5.2 DESIGN ALTERNATIVES

Design alternatives has considered pavement design and the number of carriageway for Bujumbura town section

### 5.2.1 Alternative Pavement Design

Pavement design has considered two options for materials for Sub-grade, Base Course and Surfacing as follows:

#### Alternative 1

- Stabilization of material<sup>4</sup> for Sub-Base layer by cement
- Dense Bituminous Macadam for base Course
- Asphalt Concrete for Surfacing

#### Alternative 2

- Stabilization of material for Sub-Base layer by Lime and Cement or Lime only: The interest of the lime or lime-cement stabilization consists not only in reusing the fine-grained soils involved in the works, but also in improving the bearing capacity of the sub-grade and, therefore, the structural efficiency of the pavement, much more than is allowed by using granular materials
- Graded Crushed Stone for base Course
- Asphalt Concrete for Surfacing

Comparison of Sub-grade Material Stabilization Options: Cement and Lime

N <sup>o</sup>	Alternative	Advantages	Disadvantages
1.	<b>ALT1:</b> Use of cement-stabilized sub-base material	<ul style="list-style-type: none"> <li>• Unlike lime-stabilization, cement stabilization can be used stabilize materials with plasticity index less of than 10 per cent</li> <li>• Reduces earthworks of unsuitable material and energy consumption and cost</li> <li>• Suitable where granular material is abundant and land for borrowing material is not scarce.</li> </ul>	<ul style="list-style-type: none"> <li>• Portland cement is expensive as it is a manufactured material</li> <li>• Has higher carbon footprint due to energy demanding production of cement and large need for transportation of ex situ material. Off-site soil material, increased amounts of cement or pulverization is usually necessary to satisfy requirements regarding soil particle sizes</li> <li>• It is not a good “green” alternative because cement is a manufactured material</li> <li>• Requires selected material and so importation of</li> </ul>

<sup>4</sup> Material stabilization is the process of the alteration of the geotechnical properties of natural-occurring material to satisfy the engineering requirements

N°	Alternative	Advantages	Disadvantages
			<p>material from borrow sites will be necessary. The impacts of borrowing and transport of selected material from borrow area are loss of vegetation, generation of noise, generation of dust, generation of waste from spoil material, increased traffic movement and congestion, deterioration of scenic and visual quality, increased consumption of energy in the form of fuel and so contribution to greenhouse gases</p> <ul style="list-style-type: none"> <li>• Unsuitable where granular material is not abundant and land for borrowing material is scarce.</li> </ul>
2.	<b>ALT2:</b> Use of Lime stabilized sub-base material	<ul style="list-style-type: none"> <li>• Many sections of the project road are characterised by clayey, expansive soils, which is plastic soil. The soil has rather high plasticity index (high swelling potential) which makes less making it incompressible. Treatment of the material with lime decreases plasticity index (swelling potential) of the soil</li> <li>• Considering the land scarcity in the project area, high volumes of material that will be required during the road construction, lime treatment will have a major impact to the environment, especially in preserving the quality of natural resources by minimizing the need of borrowing and transporting selected granular material from borrow areas to construction sites and that of spoil/ waste material (i.e. unsuitable soils that cannot be used for construction purposes unless treated) from the existing road to the dump/ spoil area. The use of lime for the treatment of material that would have been otherwise declared unsuitable for construction works will minimize the volume and number of borrow sites, generation of waste in the</li> </ul>	<ul style="list-style-type: none"> <li>• A minimum clay content of 10 per cent is desirable for lime stabilization</li> <li>• The use of hydrated lime during stabilization is associated with a number of health problems if the lime is not handled properly as follows: <ul style="list-style-type: none"> <li>a) Eye contact with lime can cause severe irritation or burning of eyes, including permanent damage</li> <li>b) Skin contact with lime can cause irritation of skin</li> <li>c) Ingestion of lime can cause severe irritation of gastrointestinal tract if swallowed</li> <li>d) Inhalation of lime can cause severe irritation of the respiratory system. Long-term exposure may cause permanent damage</li> <li>e) Although hydrated lime is not listed as a carcinogenetic, it may contain trace amounts of crystalline silica in the</li> </ul> </li> </ul>



N°	Alternative	Advantages	Disadvantages
		<p>form of spoil material, clearing of vegetation, deterioration of scenic and visual quality, soil erosion, noise and vibrations, traffic congestion, generation of dust by dump trucks, and consumption of energy for the haulage of spoil material, and transport of material from borrow sites. Reduced consumption of energy in the form of fuel will result into reduced emissions and decreased contribution to greenhouses gases</p> <ul style="list-style-type: none"> <li>• Lime treatment of the material increases workability (during excavation, loading, discharging and levelling), compressibility, strength (CBR), and durability of the material (the capability to resist adverse effects of wet-dry and cycles resulting from changes in environmental conditions during the year), the result of which is decreased energy consumption and so reduced emission and generation of greenhouse gases.</li> <li>• Water content-density relationship: When lime is used to treat the material, soil particles became large-sized clusters, resulting in texture change. The enlarged particle size causes the void ratio to increase. This increase in void ratio reflects the decrease in maximum dry density. The moisture content for the soil-lime mixture compaction is increased. Thus, the required density can be easily achieved for a broad range of water content, thereby conserving time, effort and energy. This will result into reduced emissions and decreased contribution to greenhouses gases</li> </ul>	<p>form of quartz or crystallite, which has been classified carcinogen to humans when inhaled. Inhalation of silica can also cause a chronic lung disorder, silicosis</p>

Given the land scarcity because of the high population of Burundi, stabilizing of sub-base with either lime or lime and cement can be a better option than stabilizing it with cement alone as it can easily utilize local material.

### 5.2.2 Alternative Number of Carriage way for Bujumbura Town Section

Bujumbura is a growing city and the road leading out towards Rumonge is carrying an increasing amount of traffic. This will be further increased by trucks using RN3. Therefore a comparison

was undertaken between building a single and dual carriageway for the first 11km of Bujumbura urban section.

Dual carriageways have more capacity in terms of Passenger car unit per hour and therefore as traffic increases the costs of congestion are postponed further into the future.

However, this option was found to be unfeasible because it could cause serious impact due to resettlements.

## **SECTION 6: POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS**

### **6.1 INTRODUCTION**

This chapter presents analysis of impacts of various components of the project. Several techniques and methods are available for the prediction and analysis of impacts. Examples of such methods include Mathematical Models, Mass Balance Models, Statistical Models, Physical, Image, or Architectural Models, Field and Laboratory Experimental Methods, and Analogues Models.

The methods that were used in this study were mainly Field Method and Analogue Model. The Field Method uses existing data inventories, which is supplemented by field surveys to predict impacts on receptors.

The Analogue Model make predictions based on analogue situations, including comparing the impacts of the proposed project with a similar existing projects, comparing environmental conditions at one site with those at similar sites elsewhere, comparing an unknown impact (e.g. impacts of wet product on human skin) with a known environmental impact. The model was developed from site visits, literature searches, expert opinion, and on expert's previous experience.

The impacts are either positive (beneficiary) or negative (adverse). Whether positive or negative, the impacts are classified into direct short term, direct long term, and indirect impacts, reversible or irreversible. Negative impacts need to be abated, while those identified as positive will need to be strengthened so that the objective of the project is enhanced.

#### **6.1.1 Direct Impact**

Direct impacts are caused by the road itself that is to say, by road building processes such as land consumption, removal of vegetation, and severance of farmland. For example, the removal of gravel material from a borrow pit, for use in surfacing the road, is an obvious direct impact of road construction. In this case, the land area in which the pit site is located has been directly affected by activities associated with the road project. Direct impacts are generally easier to identify, assess, and control than indirect impacts, since the cause-effect relationship is usually obvious.

##### **6.1.1.1 Direct Short-Term impacts**

Direct short term impacts are direct impacts that may be apparent only during the construction stage of the project. Such impacts include impacts that are related to construction works.

##### **6.1.1.2 Direct Long-Term impacts**

These are direct impacts that will appear after the construction has been completed, and include impacts related to both construction works and the use of the road.

#### **6.1.2 Indirect Impacts**

Indirect impacts are sometimes called secondary, tertiary or chain impacts, depending on how many steps there are between the original source and its impact. They are not a direct result of the strategic action, but occur away from the original source of impact or as a result of a complex

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pathway. They are linked closely with development projects and may have more profound consequences on the environment than direct impacts.

Indirect impacts are not easier to identify, assess, and control due to difficulties in understanding the cause-effects relationships, but can ultimately be more important. Over time they can affect larger geographical areas of the environment than anticipated.

Examples of indirect impacts include degradation of surface water quality by the erosion of land cleared as a result of a new road and urban growth near a new road.

A subset of indirect impacts is **generated impacts**: where one type or phase of development attracts or facilitates another. An example of a generated impact is a new transport link to a remote area which triggers new housing and employment development.

Indirect impacts are identified by using a causal chain diagram (or causal network diagram).

### 6.1.3 Cumulative Impacts

Cumulative impacts are caused by combined results of past, current and future activities. Over time, direct and indirect human activities combine to collectively impact the environment.

The impacts may differ from the original, individual activities. For example, ecosystems can be damaged by the combined effects of human activities, such as air, land, and/or water pollution, improper handling of industrial waste, and other human development activities. Global warming is the cumulative effect caused by too much greenhouse gas, and it may then cause a loss in biodiversity and acid rain.

The process of cumulative environmental change can arise from any of the four following types of events:

- Single large events, i.e. a large project
- Multiple interrelated events, i.e. road projects within a region
- Catastrophic sudden events, i.e. a major landslide into a river system; and
- Incremental, widespread, slow change, such as a poorly designed culvert or drainage system along a long road extending through a watershed.

These can generate additive, multiplicative or **synergetic effects**, which can then result in damage to the function of one or several ecosystems (such as the impairment of the water regulation and filtering capacity of a wetland system by construction of a road across it), or the structure of an ecosystem (such as placement of a new road through a forest, leading to migration or land clearing which results in severe structural loss to the forest).

A cumulative impact, in the context of road development, might be the de-vegetation and eventual erosion of a roadside pull-out. The scenario might unfold as follows: a road cutting through a mountain range offers some spectacular views, and in the absence of designated rest areas, motorists stop indiscriminately. Roadside vegetation is damaged by vehicle and foot traffic, and the soil is left unprotected. Subsequent rainfall causes erosion and siltation of nearby watercourses. The vegetation never has enough time to recover (because of high traffic volume on the road), and the problem is exacerbated over time.

### 6.1.4 Residual Impacts

Residual impacts are those impacts that remain following the implementation of the mitigation measures proposed for each project phase, taking into account the background environmental conditions and the impacts from existing, committed, and planned projects.

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The impacts considered in this study pertain not only to the road right-of-way but also to sites associated with the road. These will include:

- Deposit and quarry and borrow sites
- Construction equipment and materials storage yards;
- Materials processing areas (e.g. concrete batch plant and bitumen heating area)
- Detours and access roads
- Construction camps

In order to identify the impacts easily and effectively, each phase of the project has been broken down into main activities, from which possible impacts have been delivered. The identified potential environmental and social impacts have been classified in accordance with activities causing them. The Prediction and evaluation of environmental impacts of the proposed roads project has been done using the matrix in Table 21. The likely interactions between the development actions/activity and the impact subjects are described (rated) in terms of magnitude and importance on a common scale of between -3 through +3 for both positive and negative impacts as follows:

+3 = Major Positive, +2 = Moderate Positive, +1 = Minor Positive, 0 = No Impact,  
-3 = Major Negative -2 = Moderate Negative, +1 = Minor Negative,

It is important to note that the impacts discussed below are presented as worst-case scenarios, in the absence of any best management practices (e.g. proper waste disposal) or mitigation measures, such as horizontal realignment to avoid excessive clearing of trees or improvement of sight distance and so road safety, etc.

## **6.2 MOBILIZATION PHASE**

As noted earlier, the main activities during mobilization phase of the project will be the transportation of construction equipment to the site, establishment of camps, and establishment of sources of naturally occurring construction materials.

The camp will be required for the storage of construction materials and equipment, material processing, carpentry workshop, steel workshop, mechanical workshop, and pre-cast yard. The camp will also be required to provide site office and accommodation for Supervising Consultant and a few senior staff of the Contractors. Accommodation may not be necessary for workers coming from the project area. Mobilization activities are expected to bring about the following impacts.

### **6.2.1 Creation of Employment**

Establishment of construction camp site will create direct and indirect employment to the local as well as people from other places. Direct employment will be in the form of skilled labour as well as non-skilled labour. Indirect employment will include employment of food vendors (especially women) and other small businesses like soft drinks. The impact will be direct and indirect, positive, moderate, and short term.

### **6.2.2 Loss of Vegetation**

Clearing works during establishment of camps and material borrow areas will involve removal of vegetation, including trees. Clearing of vegetation apart from exposing soil to water erosion, it

will remove fertile top soil which is good for supporting plant growth. The negative impact is gauged to be a direct long terms and moderate, and irreversible.

### **6.2.3 Deterioration of Scenic and Visual Quality**

Loss of aesthetic quality will result from accumulation of top soil cleared from camp sites, construction material wastes such as concrete, nails, timber, steel, iron sheets etc., and material packing such as cement bags etc. This will create eye-sore to the by passers. The negative impact is gauged to be direct, short term, and minor, and reversible.

### **6.2.4 Generation of Noise and Vibrations**

Pollution due to noise and vibrations will result from operations of construction equipment and trucks during transportation and delivery of construction materials, and works at the camps. Increased traffic movement across and along settlements is likely to cause considerable noise and vibrations. This is likely to interfere with audio communication.

The impact is likely to be eminent if the equipment and trucks are poorly maintained. Since there are settlements throughout along the project road, the impact due to noise and vibrations due to material extraction activities will be felt by both local people and construction workers. The negative impact due to noise and vibrations is gauged to be direct, moderate, but short term. The impact is residual since it cannot be mitigated fully.

### **6.2.5 Deterioration of Ambient Air Quality**

Deterioration of ambient air quality will be due to generation of dusts at the campsite, during site preparation, construction activities especially those involving the use of cement and extraction of materials at material borrow sites. Deterioration of ambient air quality will also arise from transportation and stockpiling of construction materials at camp site. In addition, the transport trucks may generate clouds of dust as they move across settlements. The impact is estimated to be direct, moderate, and short term, and reversible. The impact is residual since dust cannot be managed fully.

### **6.2.6 Risk of Road Traffic Accidents**

Project activities during mobilization phase will increase the traffic volume and movements. This is likely to increase the likelihood of accidents, especially along materials stock/ source routes discussed in borrow pits) and road crossings, especially settlement centres. Settlements that are likely to be affected most are the relatively high populated ones such as Kanyosha, Ruziba, Kabezi, Migera, Gitaza, Rutunga, Magara, Minago, and Rumonge. The impacts due to pressure on traffic and road safety are gauged to be direct, moderate and short term and irreversible.

## **6.3 CONSTRUCTION PHASE**

### **6.3.1 Creation of Employment**

Construction phase of the project will create both direct and indirect employment. Direct employed people will be those working in the direct construction of the road and will include skilled labour (engineers, surveyors, technicians, machinery and equipment operators, drivers, artisans etc.) and unskilled labour. Indirect employed people will include food vendors (especially women) and other small businesses like soft drinks, which are likely to be

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concentrated at village centres, active construction sites as well as in the neighbourhood of campsites.

This will be a direct, moderate, and short term impact, since it will only occur during the construction period of the project.

### **6.3.2 Extraction, Processing, and Delivery of naturally-occurring Construction**

#### **Materials**

Environmental and social impacts due to borrowing of materials from borrow pits and sand pits as well quarrying activities will include loss of vegetation, waste disposal, deterioration of aesthetics, and generation of noise and vibrations. Extractions of construction materials from the pits and quarries identified in sub-section 3.4.6 are likely to cause the following negative environmental impacts:

##### **6.3.2.1 Loss of Vegetation and Farmland**

As indicated earlier in sub-section 4.8, the project road is characterised by different types of vegetation consisting of grassland, exotic trees and tree crops. Exotic trees comprise black afara, yellow cassia, eucalyptus, grevillea, Indian almond, and neem trees, while tree crops consists of palm oil, avocado, mandarin, mango. Also included are different species of natural trees. Of particular interest is the Nkayamba natural forest reserve, which is discussed under sub-section 4.8.4.

Borrowing of materials will obviously involve excavation and so clearance of vegetation around. Clearance of vegetation is likely to result into degradation of the production value of farmlands and forestry due to loss of fertile top soil. Removal of vegetation will amount to further degradation of land and landscape, making the area susceptible to water and wind erosion. In addition, quarrying and excavation will destroy the economic and aesthetic value of the quarry site. The impact is gauged to be direct negative moderate, short term, and reversible.

##### **6.3.2.2 Generation of Noise and Vibrations**

Generation of noise and vibrations will result from the blasting of rocks at quarry site discussed in sub-section 3.4.6. In addition, noise and vibrations will be generated by construction equipment and trucks during extraction (borrowing), transport, and delivery of construction materials to the project site. The problem is likely to be worse if the equipment and trucks are poorly maintained. However, since there are no settlements in the neighbourhood of the identified quarry and borrow sites, the impact due to noise and vibrations will only be felt by construction workers. However, increased traffic movement across settlements and material routes during transport of materials will cause increased noise and vibrations. This will in turn interfere with audio communication.

If the borrow pits are located within Nkayamba Natural Forest Reserve, the noise and vibrations will scare/ disturb wild animals resulting into:

- Interference with animals' behaviours due to restriction of their free movement
- Interfere with animals' home range (grazing, resting, and water drinking area)
- Cause animals to migrate

The negative impact is gauged to be direct, moderate, reversible, and short term, since it will only be felt during the construction phase of the project. The impact is residual since it cannot be mitigated fully.



### **6.3.2.3 Deterioration of Ambient air Quality**

Air quality deterioration will be a major direct negative impact during the construction phase of the project. Pollution of ambient air by dust will arise from transportation and stockpiling of construction materials.

Gravel and fill materials will generate dust as they are being transported in uncovered trucks or being off loaded at the site. In addition, the transport trucks may generate clouds of dust as they move across village settlements whose road is not paved.

Although dust is a permanent feature along sections with damaged road pavement, especially during dry season, it is likely to increase beyond the current level especially during earthworks, causing alarming effect to the locals.

Further to that, dust will be generated by stone crusher at the quarry sites. Production of dust by transport trucks near settlements along the road is likely to affect human health. The dust is likely to cause bronchial health problems, including URTI (Upper Respiratory Tract Infection) to the villagers and workers, let alone being a nuisance to the environment.

Pollution of ambient air will also occur at materials borrow due to emission of SO<sub>2</sub> NO<sub>x</sub>, CO, and CO<sub>2</sub> from exhaust fumes from material extraction equipment and stone crusher at quarry site. The impact is estimated to be direct, major, reversible, and short term since it will only occur during the construction phase of the project.

The impact will be direct, of moderate significance for short periods in close proximity to material borrow areas, and dwellings during the day and evening.

The impact due to pollution of ambient air by dust and fumes will be residual impact because it cannot be avoided or abated fully.

### **6.3.2.4 Deterioration of Scenic and Visual Quality**

Borrow pits left after extraction of construction materials will impair aesthetics. Dust generated by construction equipment, machinery, and vehicles will impair visibility making construction sites prone to traffic accidents. In addition, stockpiles of construction materials on road sides will impair scenic and visual quality.

Discolouration of buildings and vegetation along the construction site will occur due to the dust blown by wind. The impact due to deterioration of scenic and visual quality is weighed to be direct, short term, moderate, reversible, and short term, since it will occur during the construction phase of the project.

### **6.3.2.5 Risk of Accidents to Wild Animals and Humans**

If pits and quarries sites are left un-reinstated, they may become filled with rainwater and become dangerous to livestock and human, in particular children, due to possible drowning. They may also create breeding sites for vectors like mosquitoes and bilharzias, when filled with rainwater. In addition, if borrowing of materials is done in Nkayamba natural forest reserves, unreinstated borrow pits will be accident black spot for wild animals.

The impact due to accidents to human and animals due to un-reinstated borrow pits is estimated to be indirect, moderate, reversible, and short term since it can be mitigated as soon as the construction is completed.

#### **6.3.2.6 Soil erosion**

Clearing of vegetation during extraction of construction materials is likely to cause soil erosion in pits and quarries. Soil erosion will occur because vegetation and topsoil are either removed or disturbed, leaving behind loose soil, which is too poor to sustain good plant growth and resist erosion due to surface runoff. The impact is likely to be worse if borrow sites are located on steep slopes and near a water course, in particular the road sections between Km 25+000 - 29+800, Km 31+500 - 33+000, 36+200 – 36+300, and 53+800 – 54+400 where either the RHS of the road is located very close to the L.Tanganyika and therefore borrow pits can only be opened on the LHS of the road which is rather steep. This is because higher velocity of runoff will easily transport loose material from the road sides. The impact due to soil erosion is estimated to be moderate, reversible, and long term.

#### **6.3.2.7 Impact to Nkayamba Natural Forest Reserves**

It was noted earlier in sub-sections 4.8.1 and Table 18 that the project road traverses along a natural forest reserve, namely Nkayamba Natural forest reserve. The nature reserve is also a habitat of wildlife.

If borrowing or quarrying is done within the protected area, pits and quarries left after extraction of construction material may cause accidents to the animals. The impact will be direct, moderate, and long term, and reversible.

#### **6.3.2.8 Impact Related to Blasting, Drilling and Rock Excavation**

Blasting is used to loosen or break up rocks for removal. Blasting will involve drilling of rock and loosening rock with the aid of explosives. Potential environmental impacts will include dust (air quality), contaminant spills, sedimentation, safety (workers, storage), fly rocks and debris, noise and explosive detonation effects on people, and structures. The negative impact is estimated to be moderate and short term.

### **6.3.3 General Earthworks during Road and Bridges Construction**

#### **6.3.3.1 Loss of Vegetation**

As indicated earlier in sub-section 4.8, the project road is characterised by different types of vegetation consisting of grassland, exotic trees and tree crops. Exotic trees comprise black afara, yellow cassia, eucalyptus, grevillea, Indian almond, and neem trees, while tree crops consist of palm oil, avocado, mandarin, mango. The only indigenous noted along the road is fig tree. This vegetation is likely to be cleared.

As noted under sub-section 4.8, around Km 30+700RHS there is a long strip of eucalyptus tree which is located just 3m from the edge of the road.

Widening of the existing road to accommodate increased carriage width and its shoulders, road side drain, horizontal realignment of the existing road to improve safety (reduce sharp curves, avoid approaching bridges and culverts at curves will require more land beyond the existing road width and cause clearing of vegetation as well as loss of farmlands, especially because the vegetation are very close to the edge of the road. Vegetation of particular importance is the Nkayamba natural forest which discussed under sub-section 4.8.1 and 4.8.4.

The negative impact due to loss of vegetation due to earth works is estimated to be direct, moderate, irreversible, and long term, since once lost, it will take very long time to recover the benefits of the lost trees.

### **6.3.3.2 Roadside Soil Erosion**

Roadside soil erosion will occur because, vegetation will be cleared, and top soil will be removed/ disturbed, leaving behind infertile soil, which is too poor to sustain good plant growth and susceptible to wind and water erosion. The road section which is likely to be affected most is around Km 15+500 (Photo 20) and 15+800 (Photo 21) because it is prone to gully erosion. This road section, detailed in sub-section 4.9.4 if not well protected will undermine the road.

In addition, where earth works involve materials cuttings or cut embankment (cutting of material from a hill), the road sides will slope towards the road. But where earth works involve material filling (construction across a flood plain or a river), the road sides slope away from the road. In both cases, the roadside slopes are prone to shallow mass movements or development of gullies.

Sub-section 4.2.4.4 noted that the road traverses three (3) floodplains. Construction of fill embankments will be necessary across these flood plains. The embankments are prone to shallow mass movements and formation of gullies. Erosion of the embankment will undermine the road.

The negative impact due to roadside erosion is gauged to be major, long term, and reversible if appropriate mitigation measures are not put in place.

### **6.3.3.3 Displacement and Loss of Properties**

Upgrading of the road will result into demolition of buildings that are located within the old RoW. Sub-section 4.9.8 noted that substantial number of buildings is located very close to the edge of the road. Such buildings jeopardize the safety of not only traffickers but also occupiers of the houses in the event traffickers lose control of vehicles. In addition, perennial crops in particular fruit trees and pam trees are located very close to the road. Properties that are located very close to the edge of the road are likely to be cleared to improve the safety of the road. The magnitude of the impact will depend on the width of the corridor that will be required.

As noted in sub-section 4.9.8, settlements that are likely to be highly affected due to demolition buildings are Kanyosha, Kabezi, Migera, Gitaza, Minago, Rutunga, and Rumonge

The unfortunate part of it is that even if people are compensated it may be difficult for them to get comparable sites. Some of the houses that will be demolished are within the prime business areas and it could be difficult for these people to obtain similar sites and if they manage to do so it might be at a high cost. Additionally, there are difficulties of adjusting to new areas and for older people who are uprooted it will result in increased stress and even early deaths. This issue of settlement is thus an area of potential conflict between the people and the government and has social, political, and legal implications. The negative impact due to displacement is weighed to be major, long term, and irreversible.

### **6.3.3.4 Disruption/Destruction of Public Utilities and Service**

Sub-section 4.6 has given details of public utilities that are likely to be affected by the road upgrading as electric supply power lines, domestic water supply pipe lines, sewer lines, and fibre optic cable system.

#### **Disruption of Power Supply**

Table 27 stated that power supply lines in the city have been installed underground and that some of the power (both low voltage and medium tension) lines run along and across the road. Earthworks during the road rehabilitation, if not done carefully may cause damages to the power lines, especially because some of the power lines are not placed in sleeves.

### **Disruption of Domestic Water supply System**

As noted in sub-section 4.4.2 (Table 16), a number of domestic water supply pipelines either run very close or cross the project road at a number of locations. In addition, Table 27 noted that water supply main and distribution lines, some of them of concrete run along and across the project road between the start of the project road up to Kanyosha. In addition the main line from the treatment plant to reservoirs crosses the project road at the junction to the national radio and television station. These pipe lines are likely to be disrupted by earthworks during the road rehabilitation. In addition to water pipe lines, a number of reservoirs and domestic points (Table 16) which are located very close to the edge of the road as close as 3m from the edge of the road are also likely to be disrupted. The impacts will be direct, major, short term, and reversible.

### **Disruption of Sewer Lines**

Again (Table 27) indicated that the main sewer line runs at the centreline of the project road between Waka Waka Pub and the office Building for the Ministry of Transport, Public Works, and Equipment road section. In addition lateral sewer lines runs perpendicular to the project road to connect to the main sewer lines

Rehabilitation of the road if not done carefully may disrupt the sewer lines causing serious land contamination and health problem. The impacts is gauged to be direct, moderate, short term, and irreversible.

### **Disruption of Telecommunication System**

Sub-section 4.6.4 noted that Burundi is connected to the outside world through a fibre optic cable system and nearly all telecommunications companies, banks, universities, government institutions (in particular revenue authority, National radio and televisions, immigration department, military, police), and hotels, depend on its service. Notably, in many sections along the project road the cable fibre optic cable has been laid very close to the edge of the road and very shallow on the ground. In addition, a number of manholes for the fibre optic cable system are located very close to the edge of the project road.

During the road rehabilitation, earthworks and construction of drainage structures is likely to disrupt the fibre optic cable; and the impact of which will be serious disruption of telecommunication. The negative impact due to disruption of telecommunication will be direct, moderate, short term, and reversible.

#### **6.3.3.5 Generation of Noise and Vibrations by construction Equipment and Vehicles**

Earth moving, compaction, and other construction activities will generate noise and vibrations due to reactions between earth and equipment. In addition, movement of the machinery, equipment, and dump trucks will also generate noise and vibrations. The noise and vibrations generated will agitate and impair audio communications at settlements along the road. The noise impact will also be felt by construction workers and locals. Other impacts of noise and vibrations will be scaring/ disturbance of wildlife in Nkayamba Natural forest protected area discussed under sub-section 4.8.4. This is because noise and vibrations may:

- Interference with animals' behaviours due to restriction of their free movement
- Interfere with animals' home range (grazing, resting, and water drinking area)
- Cause animals to migrate

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The impact will be direct, reversible, of moderate significance, for short periods in close proximity to dwellings and wildlife area during the day and evening. It is a residual impact since it cannot be mitigated fully.

#### **6.3.3.6 Deterioration of Ambient Air Quality by Dust and Fumes**

Deterioration of ambient air quality will be due to production of fumes either as exhaust or bitumen. Exhaust fumes from stationary as well as or moving construction machinery and equipment will emit SO<sub>2</sub>, NO<sub>x</sub>, CO, and CO<sub>2</sub>, while bituminous fumes will come from bitumen processing plant. The impacts due to fumes will affect residents along the project road as well as construction workers. In addition, moving of earth as well as movement of construction machinery and vehicles will generate clouds of dust. Although dust is a permanent feature along road sections that have worn-out road pavement during the dry season, it is likely to increase beyond the current levels due to increased traffic volume and movements. Apart from nuisance, excessive dust level can negatively affect human health. Dust can cause several bronchial problems, including URTI (Upper Respiratory Tract Infection).

In addition, dust particles can affect the growth of crops and other vegetation. Dust abrading leaf surfaces, dust blocking stomata (clogging of pores) of plants, dust increasing the amount of absorbed incident radiation. These are just a number of different impacts dust can have on vegetation and plants. But overall, the effects seem to be a reduction in photosynthetic abilities, the result of which can be stunting their growth due to shading effect, and clogging of the plant's pores.

The negative impact is estimated to be direct, of moderate significance for short periods in close proximity to active construction sites (borrow, quarry, crusher, and road sides) and dwellings during the day and evening. The impact will be residual because it cannot be mitigated fully.

#### **6.3.3.7 Generation of Solid and Liquid Wastes**

Among the wastes that will be generated during construction are:

- Top soil and cleared greens from along rivers, existing road and general clearing works
- Excess (spoil) material, excavated from the road
- Demolition materials from existing buildings and road structures such as clay bricks (from demolished buildings), corrugated steel culverts), concrete (from demolished concrete culverts), steel reinforcements (from demolished culverts and bridges), steel parts from dismantling of the existing bailey bridges, etc.
- Material wastes such as sand, fill material, aggregates, gravel, concrete, bitumen, etc.
- Sanitary wastes from project staff working outside the campsite

Apart from impairing the scenic and visual quality of the project site, the wastes generated are likely to cause the following impacts:

- Pollute surface water resources if exposed to surface runoff
- Cause waterborne or airborne diseases (sanitary wastes) if improperly disposed of

The negative impact is gauged to be direct, moderate, reversible, and short term as disposal of solid and liquid wastes shall be part and parcel of the construction activities of the project.

#### **6.3.3.8 Road Traffic Congestion and Accidents**

During the construction phase, increased project activities will increase traffic volume as well as movements. These activities will cause traffic congestion and disruption; and possibly accidents,



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especially because the existing right of way is too narrow to allow for construction of diversion road. It is likely that half width construction will be necessary to allow third party/ public traffic movement during construction. Moreover, along materials stock routes, and specifically at road crossings, especially village/settlements centres, road accidents may occur during construction phase. Other accident black spot areas are where school pupils and students have to cross the project road, nearly at all villages.

The negative impact due to pressure on traffic and road safety are will be moderate, reversible and long term since they will span over construction as well as operation phase of the project.

#### **6.3.3.9 Increased Consumption of Energy and Natural Resources**

Energy will be consumed to operate construction machinery and equipment as well as other transportation facilities. More energy in the form of fuel and lubricants will be consumed during the construction stage of the project. The energy will be used in the operations of construction equipment. In addition, pressure on natural resources will increase due to increased consumption of natural resources in the form of fuel wood and charcoal. Past experience by the Environmental Expert in the supervision of road construction projects has shown that some Contractors have tendencies of cutting/ using fire wood as a source of energy for boiling bitumen or cooking. Other Contractors cut trees to make road markers pegs, claiming that the pegs have been made from trees cleared from road side or borrow pits. The impact will be indirect, minor, short term, and reversible.

#### **6.3.3.10 Resources Use Conflict**

Presence of worker's camps is potentially a source of social and environmental problems as a result of interaction of local people and workers in the project area. Conflicts between the two groups of people may result due to sharing of social services, like water resources for domestic and construction activities. The negative impact is gauged to be indirect short term and moderate.

#### **6.3.3.11 Impact to Cultural Sites**

Sub-section 4.4.5 identified two burial sites at Ruziba and Minago collines that are located close to the edge of the road. If earthworks are not done with care, they are likely to cause damages to the burial sites. The impact to cultural sites is gauged to be direct, moderate, short term, and reversible.

#### **6.3.3.12 Impact to Nkayamba Natural forest protected area**

Apart from disturbance by noise and vibrations discussed that will interfere with wildlife home range (already discussed earlier), another impact to the game reserves will be those related with illegal hunting or poaching by project workers. The impact will be indirect, moderate, short term, and reversible.

#### **6.3.3.13 Deterioration of Visual and Scenic Quality**

Increased traffic movement and speeds during construction will increase the generation of dust. Clouds of dust generated by construction equipment will impair visual quality, making the site prone to traffic accident. The generated dust will impair visual quality due to discolouration of vegetation and buildings along the road. The impact will be direct, moderate, reversible, and short term.

#### **6.3.3.14 Surface Water and Soil pollution**

Surface water pollution will be due to sedimentation. This is earthworks will clear vegetation and disturb soil. The loose soil will easily be transported to water courses as well as L.Tanganyika across the road discharged into L.Tanganyika. The impact will be indirect, moderate, long term, and irreversible.

#### **6.3.4 Construction of Cross Drainage Structures**

Construction across water courses will encompass among others demolition of existing and construction of new culverts and bridges. The following impacts are anticipated:

##### **6.3.4.1 River Bank Erosion during Riparian zone Construction**

Works across rivers, drainages, and in the riparian zones during the construction of bridges and culverts is likely to disturb or cause losses of vegetation, in particular trees along their banks and riparian zone, discussed under sub-sections 4.2.4.1 and 4.2.4.4 (Table 12). Loss of vegetation will make the banks susceptible to further erosion, especially because the soils of most of the rivers are vulnerable to erosion. Since at least all the culverts bridges will be either be improved or replaced with new ones, nearly all the water courses across the project road will be affected because significant earthworks will be carried out along their riparians. The impact due to river bank erosion and sedimentation of river systems due to work across rivers and in the riparian zone will be direct, moderate, reversible, and long term.

##### **6.3.4.2 Surface Water and Soil pollution**

During construction of bridges and culverts, pollution of river systems and soil may occur due to sedimentation, accidental spillage of hazardous material such as concrete, fuel, and oils from construction equipment. Spillage of hazardous material to water courses, which will be later be transported to the lake is potentially very detrimental to aquatic fauna such as fishes. Though one cannot predict the location or type of spillage, any spillage to water will be local in nature. This is an unwelcome possibility.

Deposition of concrete and fine sediments during construction across the permanent rivers and other semi-permanent rivers discussed in Table 12 is likely to affect fish (though few) and their habitats. Works in the river systems, such as piling and dredging may cause fish mortalities due to entrainment in excavator's buckets etc.

The negative impact due to water and soil pollution will be direct, moderate, long term, and reversible since once it has occurred; it will take long term for the ecosystem system to regenerate itself.

##### **6.3.4.3 Modification of Surface and Ground Water Regime**

###### **Surface water flow modification**

Construction of fill embankments will be necessary across road sections rivers Kizuka (Km 63+500), Mwange (Km 67+100), and Rumonge (Km 72+600 – 74+500) that cross the flood plains noted in sub-section 4.2.4.4. In addition construction of bridges and culverts may involve construction of fill embankment. Construction of road fill embankment across the flood plains and rivers is likely to interfere with natural surface water flow patterns, where by concentrating flow in the upstream, resulting into flooding, soil erosion, channel modification, and sedimentation of streams/rivers far from the vicinity of the road. Another potential impact with



the surface water flow could be diversion of river beds. This could be a direct, moderate, irreversible, and long term impact.

### **Modification of water table**

Although exact locations of such an impact cannot be predicted now, it is a possibility which should be anticipated where construction has to be done across rivers and flood plains. Whereas soil excavations can lower water table in the surrounding areas, embankment can raise water table by restricting water flow-leading into deterioration of vegetation, increased susceptibility to erosion, loss of water for drinking (downstream), agricultural use, and habitat loss. Again, the effect of raising water table to surrounding agriculture and ground water resource availability can be anticipated across the flood plains discussed earlier in sub-section 4.2.4.4 due to the construction of fill embankment. This will be a direct, long term, moderate, and irreversible, which would occur during the life time of the operation phase of the project.

#### **6.3.4.3 Generation wastes**

Apart from spoil material, other types of wastes that will be generated during construction of cross drainage structures will include demolition material such as concrete and reinforcements bars (from old pipe culverts), old Armco culverts, bailey bridge parts, and hard stones (from protection works). These wastes if not properly disposed of will create eye sore to by passers.

### **6.3.5 Construction of Roadside drainage Systems**

#### **6.3.5.1 Increased Risk of Roadside Soil Erosion**

As noted earlier in Table 12, all the rivers originates from highlands and discharged to L.Tanganyika. They therefore traverse through hilly topography with steeper slopes, at rather high velocities. Gullies may easily therefore be formed along ditches, drainage channels, as well as culverts. Formation of such gullies may, apart from destroying farmland and crops beyond the drainage, undermine the road itself. The negative impact due to increased risk of roadside erosion will be indirect, moderate, irreversible, and long term.

#### **6.3.5.2 Disruption of Community Access to their Dwellings and Business Areas**

During construction, disruption of community access to their business activities and residential places at all settlements along the road will occur due to creation of barriers. One of the potential barriers is the construction of road side drainages. The impact of these barriers would be an increase in travel time for local residents to their business and residential areas. This will be direct, moderate, reversible, and short term negative impact.

### **6.3.6 Concrete Works and Construction of Cement-stabilized Layers**

#### **6.3.6.1 Health Problems Associated with Handling of Cement and Wet-cement Products**

Construction of road pavement (laying of cement stabilized sub-base layer), culverts, and lined roadside drains will expose workers to cement and wet-cement products (mortar and concrete). Construction workers working with cement and wet-cement products are likely to be affected by URTI due to inhaling cement dust and dermatitis infection due to prolonged contact with cement and wet-cement concrete.

Cement has constituents that produce both Irritant Contact Dermatitis (ICD) and corrosive effects (from alkaline ingredients such as lime) and sensitization, leading to Allergic Contact Dermatitis (ACD) [from ingredients such as chromium IV].

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Allergic Contact Dermatitis is inflammation of the skin typically manifested by erythema, mild edema, and scaling. ICD is a nonspecific response of the skin to direct chemical damage that releases mediators of inflammation predominantly from epidermal cells. A corrosive agent causes immediate death of epidermal cells, manifested by chemical burns and cutaneous ulcers

Allergic Contact Dermatitis is an allergic response (immunological response) of the skin as a result of exposure to a chemical. Chemical exposures that may result in allergic contact dermatitis include epoxy resins, chromates, rubber chemicals, amine hardeners, and phenol-formaldehyde resins.

Findings indicate that cement and wet-cement products (e.g. concrete and mortar) should be treated as hazardous materials, and that workers handling such products should reduce exposure wherever possible. OPC contains varying amounts of hexavalent chromium (Chromium IV), a known carcinogenic, and toxin hazardous to skin, eyes and lungs (Winder, C et al (2009).

### **Skin contact**

The hazards of wet cement are due to its caustic, abrasive, and drying properties. Wet concrete contacting the skin for a short period and then thoroughly washed off causes little irritation. But continuous contact between skin and wet concrete allows alkaline compounds to penetrate and burn the skin.

When wet concrete or mortar is trapped against the skin may cause skin burn or skin ulcer. Cement dust released during bag dumping can also irritate the skin. Moisture from sweat or wet clothing reacts with the cement dust to form a caustic solution, which has a burning effect to the skin.

### **Allergic skin reaction**

Some workers become allergic to the hexavalent chromium in cement. A small yet significant percentage of all workers using cement will develop an allergy to chromium, with symptoms ranging from a mild rash to severe skin ulcers.

In addition to skin reactions, hexavalent chromium can cause a respiratory allergy called occupational asthma. Symptoms include wheezing and difficulty breathing. Workers may develop both skin and respiratory allergies to hexavalent chromium.

Studies have shown that it is possible to work with cement for years without any allergic skin reaction and then to suddenly develop such a reaction. The condition gets worse until exposure to even minute quantities triggers a severe reaction. The allergy usually lasts a lifetime and prevents any future work with wet concrete or powder cement (Dru Sahai, 2001)

### **Eye contact**

Exposure to airborne dust may cause immediate or delayed irritation of the eyes. Depending on the level of exposure, effects may range from redness to chemical burns and blindness.

### **Inhalation**

Inhaling high levels of dust may occur when workers empty bags of cement. In the short term, such exposure irritates the nose and throat and causes choking and difficult breathing. Prolonged or repeated exposure can lead to a disabling and often fatal lung disease called “silicosis”. There is a link between crystalline silica exposure and lung cancer (ibid).

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### **6.3.6.2 Soil and Water Pollution by Concrete Slurry and Concrete Wastewater**

Concrete works during construction of bridges, culverts, and lining of roadside drains is likely to cause leakage of concrete slurry to road sides. Concrete slurry will pollute soil and affect the growth of young trees. In addition, there is a likelihood of the concrete slurry to find their way to rivers either directly during construction of culverts or through storm water system, especially when concreting is done when raining.

Lime is a major component of cement and is found in all concrete products. It dissolves in water to produce an alkaline solution that will burn and kill fish, insects, and plants. Water that comes into contact with unset concrete or concrete dust quickly increases in alkalinity and will be highly toxic to aquatic life. Notably, concrete wastewater has a pH of 12 -13 and is as toxic as bleach, while the pH of freshwater is between 6 and 7. Concrete wastewater causes burns in a similar way to a strong acid. A single bucket of concrete wastewater will easily kill hundreds of fishes.

In addition, leakage of concrete slurry to road sides is likely to cause soil pollution and so killing or stunting the growth of young trees, especially regenerating ones. The negative impact due to soil and water pollution is weighed to be direct, moderate, reversible, long term.

### **6.3.7 Construction of Road Pavement**

#### **6.3.7.1 Health Problems Associated with Handling of Cement and Wet-cement Products**

The impact associated with handling of cement and wet cement products has already been discussed in sub-section 6.3.6

#### **6.3.7.2 Deterioration of Ambient Air Quality by Bituminous Fumes**

Apart from dust exhaust fumes from construction equipment, deterioration of ambient air quality will be due to generation of bitumen fumes from bitumen processing plant as well as during spraying of bitumen. The impacts due to bitumen fumes will affect construction workers as well as residents along the project road.

#### **6.3.7.3 Health Problems Associated with Hydrated Lime**

During construction, naturally occurring materials that have high plasticity index (very plastic) are likely to be stabilized with hydrated lime. Hydrated lime if not handled properly, can cause the following health problems:

- Eye contact with lime can cause severe irritation or burning of eyes, including permanent damage.
- Skin contact with lime can cause irritation of skin.
- Ingestion of lime can cause severe irritation of gastrointestinal tract if swallowed.
- Inhalation of lime can cause severe irritation of the respiratory system. Long-term exposure may cause permanent damage.

Although hydrated lime is not listed as a carcinogenetic, it may contain trace amounts of crystalline silica in the form of quartz or cristallite, which has been classified carcinogen to humans when inhaled. Inhalation of silica can also cause a chronic lung disorder, silicosis.

### **6.3.8 Operations of a Construction Camp**

Operations of site office, mechanical workshops, site stores, as well as pre-cast yards are likely to have a number of impacts as narrated in the following sub-sections.

#### **6.3.8.1 Generation of Solid and Liquid Wastes**

Operations of camps (offices, workshops, storage yards, and kitchens) will generate the following wastes:

- Solid wastes such as plastic and glass containers, steel and aluminium cans, used tyres, used lead-acid batteries, used oil and fuel filters, litter, used printer cartridges, used metal plastic parts, food wastes
- Liquid wastes such as used motor oils and grease, battery acid, grey and black waters

The concern here is their management. If they are not properly managed, treated, or disposed of, they will impair aesthetic quality of the campsite, cause soil, and/ or ground water. The impact will be indirect, moderate, reversible, and short to long term.

#### **6.3.8.2 Fire and Explosion Risks**

Activities at mechanical workshops during repair and maintenance of construction equipment poses a risk of fire or explosion, although minor. Small quantities of flammable liquids and compressed gases will be stored and used. Liquids will include fuels (petrol, diesel and, paints, and cleaning solvents). Compressed gases will include oxy-acetylene (for welding and cutting). The impact will be indirect, moderate, irreversible, and short term.

#### **6.3.8.3 Risks of Leakage of Hazardous Materials**

The project will utilize a number of chemicals during construction and maintenance of construction equipment. Some of the materials will have to be transported from outside the project area, and will therefore require special attention in their transport, handling, and storage. Such materials will include different grades of lubricants (oils, grease etc.), fuels, and bitumen (all hydrocarbons compounds), paints and solvents, brake fluids, battery acid.

Leakage of such chemicals poses a risk of soil contamination as well as surface and groundwater pollution. The impact is gauged to be indirect, moderate, irreversible, and long term since when it occurs, clean-up of chemicals, apart from being very expensive, will take long time.

#### **6.3.8.4 Generation of Human Sanitary Wastes**

Among the wastes that will be generated at the construction camps will be sanitary wastes from construction workers. If sanitation facility is not provided for, they are likely to relieve themselves in the bush causing outbreak of waterborne diseases such as dysentery and diarrhoea. The impact will be indirect, moderate, short term, and reversible.

### **6.3.9 Marital and Social Conflicts**

Road project will lead to increased marital and social conflicts because of increased interaction. Project workers with extra earnings could be the sources of conflicts as they engage in extra-marital affairs. The impact will be indirect, moderate, and short term.

### **6.3.10 Increase in unwanted Pregnancies**

Increased and unwanted pregnancies especially among school girls as project workers could easily entice school girls with money in return for sexual relationships. This will be an indirect, moderate, and short term negative impact.

### **6.3.11 Occupational Health and Safety Hazards**

Mobilization, construction, demobilization, and phase of the project activities will expose workers, visitors, and the general public to different hazards as follows:

#### **6.3.11.1 Physical Hazards**

##### **6.3.11.1.1 Falling of people, objects or materials**

Working at height during construction of camps (e.g. roofing and block work), construction of box culverts and bridges, working above excavation will expose workers to fall hazards resulting into physical injury or fatal accident. In addition, the public will be exposed to excavation fall hazard, especially if the worksite is not physically separated from the surrounding. Similarly, workers working below height (during construction of camp, culverts, and bridges) and by passers will be exposed to physical injury due to possible fall of object or material from height.

##### **6.3.11.1.2 Stepping on or striking against objects**

Hazards associated with stepping on objects will result from mainly poor housing keeping at work sites and lack of personal protective gears. Hazards will include being punctured by sharp objects (e.g. nails or any other metallic material) left on the ground and tripping/ tumbling on object.

##### **6.3.11.1.3 Manual Handling Injury -- Overexertion**

Physical hazard associated with lifting and over-exertion is discussed under sub-section 6.3.11.2.2

##### **6.3.11.1.4 Workers being struck by Excavating or Crane machinery**

Project workers working near mobile equipment such as crane, concrete mixer, etc. or members of the community near such equipment will be exposed to physical hazards due to the possibility of being hit or entangled by the equipment during their operations.

##### **6.3.11.1.5 Transport**

Operations of equipment transporting materials etc. will expose workers and members of the community to traffic accidents.

##### **6.3.11.1.6 Electrical Shock**

A number of stationery construction and workshop equipment will be operated by electricity. Examples of such equipment include stone crusher plant, concrete batch plant, cement-stabilized material mixing plant (pug mill), bitumen heater, steel reinforcement workshops machines (bar bender, bar cutter, etc.), and workshop metals machines. When control panels of this equipment are not well insulated, exposed, or not earthed or their cables are poorly insulated, will expose workers to electrocution hazard.

### **6.3.11.1.7 Fire and Explosion**

The impact associated with fire and explosion has already been discussed in sub-section 6.3.8.2

### **6.3.11.2 Health Hazards**

Construction activities, involving the use of different construction materials will expose workers and the public to health hazards. Health hazards can be categorized into chemical health hazard (due to liquids, dusts, gases, and fumes), physical health hazards to (due to heat, noise and vibrations, compressed air, and manual handling), and biological health hazards.

#### **6.3.11.2.1 Chemical Health Hazards**

##### **Contact with Skin**

Dermatitis is the most occupational skin disease. This will result from exposure to wet cement or cement product

##### **Inhalation of harmful Chemicals**

Inhalation of harmful chemicals causes the following respiratory diseases:

- Silicosis (lung scarring) due to inhaling silica dust and commonly found in many rocks, granite rock, aggregates, sand. Inhalation of dust (including cement dust) also causes asthma
- Headache, nausea, dizziness, and loss of co-ordination due to inhalation of carbon dioxide from internal combustion engines exhaust, carbon dioxide welding, especially when working in highly confined space). Headache, dizziness, and vomiting can also be caused by inhalation of solvent vapours. Solvents are used in a wide range of products, which are likely to be used in the construction activities such as adhesives, sealers, paints, solvents, lubricants, and lacquers.
- Drowsiness, vomiting, loss of muscular control, including death due to cadmium poisoning through breathing of cadmium fumes, released during cutting, welding, or brazing operations of cadmium plated steel (especially in confined space). Fatigue, anaemia, colic or wrist-drop due to lead poisoning through breathing lead dust or lead fumes lead poisoning, resulting from demolition of (cutting and burning) old structures covered in lead-based paint.
- Metal-fume fever – a flu-like illness due to inhalation of complex welding fumes from the welding parent metal and its coatings. In addition, zinc fumes are evolved from the welding, brazing, and flame cutting of galvanized steel. Breathing them may cause zinc-fume fever

#### **6.3.11.2.2 Physical Health Hazards**

Physical hazards are hazards resulting from general environment that will be experienced by the workers or from their particular occupation. Physical health hazards include the following:

##### **Noise**

Prolonged exposure to high noise levels from plant and machinery on site or in workshops likely to cause irreversible damage to hearing. The general acceptable sound level upper limit is 85 dB (A), where the sound is reasonably steady and exposure is continuous for 8 hours.



## **Vibration**

Continuous exposure of the hands to high frequencies of vibrations from tools such as pneumatic hammers, concrete breakers, drills, and chipping hammers cause most common injuries (called vibration white fingers). It starts with a slight tingling or numbness in the fingers and eventually causes whiteness to the tips. The attack may last for about an hour and end with a sudden rush of blood to the affected tip, often causing considerable pain.

## **Manual Handling Injury**

While handling construction materials manually (e.g. lifting concrete block, cement bags, etc.), workers are likely to be affected through spraining and strains due to over exertion. The effect of which may be to have musculoskeletal injury (total, back injury, upper and lower limb disorders).

### **6.3.11.2.3 Biological Health Hazards**

The likely biological hazard during construction will be drinking of unsafe water, eating contaminated water or food contaminated with rat urine. The diseases that are related with unsafe water are water borne diseases such as diarrhoea, cholera, and amoebic dysentery

Another health hazard will be due to exposure to ionizing radiation. Exposure to ionizing radiation will result from the use of a nuclear gauge, which contain radioactive materials and therefore emits ionizing radiation.

### **6.3.11.4 Increased Transmission of STIs/HIV**

Construction of the road will increase mobility, migration, and interaction. This is likely to increase transmission of communicable diseases such as HIV/AIDS and other STIs. Increased spread of transmission of HIV/AIDS from construction workers to the local people during and after the construction is one big potential challenge that has to be taken into consideration during and after the construction of the road. The negative impact is likely to be moderate, long term, and irreversible.

## **6.4 DEMOBILIZATION PHASE**

### **6.4.1 Generation of Solid Wastes**

Wastes from site office, mechanical workshop, pre-cast yard, and stores at the end of the construction phase are likely to cause scenic degradation, pollution and become an eye sore. The wastes likely be generated will include demolition materials from temporary structures, storage facilities (pallets), packing (plastic bags, paper and timber boxes), wastes from pre-cast yard (concrete wastes, metal reinforcements etc. The impact will be indirect, minor, short term, and reversible since it disposal of solid and liquid wastes shall be part and parcel of the construction activities of the project.

### **6.4.2 Deterioration of Ambient air Quality**

Demobilization; demolition, collection, and transport of demolition wastes will generate dust. The dust generated will affect workers at the site as well as residents as the trucks move across settlements. The impact is gauged to be direct, moderate, reversible, and short term.



### **6.4.3 Loss of Employment and Economic Activities at the End of the Project**

At the completion of road construction activities nearly all workers will be declared redundant and will therefore be laid off. This will automatically result into loss of income. In addition, traders that had established along the road during construction of the road will no longer be able to trade, this will affect livelihood of the traders. The impact will be indirect, moderate, short term, and reversible.

## **6.6 OPERATION AND MAINTENANCE PHASE**

### **6.6.1 Positive Impacts**

#### **6.6.1.1 Improved Ambient Air Quality**

The upgraded road will have very minimum pollution of ambient air due to particulate matter, since dust generation will be very low. The only source of deterioration of ambient air quality will be emission due to exhaust fumes from traffic.

It can therefore be concluded that during the operation phase of the project, there will be very significant improvement of air quality due to reduced dust generation and insignificant level of air pollution by exhaust gases from traffic.

The positive impact due to reduction in dust generation along the road will be major and long term, while the impact due to reduced air pollution from exhaust gases is gauged to moderate and long term.

#### **6.6.1.2 Improved Hydrology and Drainage**

Upgrading of the road will improve the drainage, due construction new bridges, culverts, as well as road side drainage with adequate hydraulic capacities. Sedimentation of culverts and road side drains will be reduced due to provision control devices and cover vegetation. Sediment carrying storm water runoff from the road will be discharged away from the road by drainage channels. Water stagnation within and on roadsides will be eliminated. As such, given proper operation of the facilities, the operation of the road will have an indirect long term, major, positive, impact on the hydrology and drainage of the project road.

#### **6.6.1.3 Reduction in Vehicle Operating Costs**

Lower speeds due to poor road imparts extra stress on motor vehicles' engines (higher engine revolution per unit time) and so faster engine wear as compared to when a vehicle travels at higher speeds (lower engine revolutions per unit time). In addition, rehabilitation of the existing road will result into serving in mileage per litre of fuel as vehicles will be able to travel at relatively higher speeds. Improvement of travel speeds due to upgrading of the road will therefore reduce operating and maintenance costs of vehicles. This will be an indirect, major, and long term positive impact.

#### **6.6.1.4 Reduced Rate of Energy Consumption**

Energy consumption rates for vehicles operating on the roadway can be differentiated by comparing changes in traffic operations, as measured by vehicle kilometres travelled and changes in traffic speed throughout the study area. Fuel consumption is proportional to distance travelled, and decreases as speed increases up to about 100 Km per hour (on average). Fuel consumption increases as speed increases above that point. It is anticipated that vehicles will be

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able to travel at higher speeds (above 60km/hr.). This will consequently lead to decreased consumption of energy per unit distance in the form of fuel. This will be an indirect, moderate, and long term positive impact.

#### **6.6.1.5 Reduced Traffic Accidents**

Rehabilitation of the road will involve widening of the existing road, change in the road geometry, and installation of safety features such as speed humps, warning signs, and crash barriers. Increased road width and change of geometry, including increasing in radii of curves and especially on accident black spots, and installation of safety features are expected to significantly improve the safety of the road, the result of which will be reduction in accident rates. The impact is gauged to be direct, major, and long term.

#### **6.6.1.6 Reduced Travel Time, and Comfort to Passengers**

Rehabilitation of the road will significantly reduce travel time, since vehicles will be able to travel at relatively higher speeds. It is estimated that the travel time will be reduced to almost one third of the present travel time. The served travel time could be used to other productive ventures. In addition, though cannot be quantified, upgrading of the road will improve comfort to passengers, due to the absence of corrugations. It is most likely that better passengers' buses will be plying the routes. The impact is gauged to be direct, major, positive, and long term since it will be felt throughout the operation phase of the project.

#### **6.6.1.7 Improve Access to Social Services**

The road rehabilitation will improve access to social services like modern health facilities, which will be beneficial for women and children who are the groups that deploy these facilities for a considerable extent. Also, school children will benefit since they can reach their school in time. This is apparent to secondary school students who many of them travel from distant collines where there are no secondary schools and easy access to Government administrative offices. The positive impact will be direct, major, and long term.

#### **6.6.1.8 Reduced Transport and Transportation Costs**

The costs of transport and transportation between villages along the project road are high due to poor road. Bus fares are high during rainy season as road condition deteriorates. With the improved road the fares are expected to be relatively low. The operating cost of bus operators will also be reduced affecting the bus fares positively. The impact will be direct, moderate, and long-term.

#### **6.6.1.9 Increased household income due to increased trading activities**

Increased household income is expected due to improved road conditions and increased traffic volume. It is thus expected that there will be a positive impact on businesses and trading activities adjacent to the road, thereby increasing the income of households along the road. The impact will be direct, moderate, and long-term.

#### **6.6.1.10 Improved Road Condition**

Repair and maintenance will focus on activities that ensure the long-term serviceability of the road. Repair and maintenance activities will pertain to the road pavement and its embankments, hydraulic and drainage structures and road furniture and where necessary, re-surfacing. All repair and maintenance works will virtually have positive impacts that will enhance the intended functions of the road and lengthening its life time, especially when it is considered that the number and scope of routine maintenance of the road will be greatly reduced.

#### **6.6.1.11 Improved Tourism**

Rehabilitation of the road is likely to influence the increase in tourism activities in Burundi, in particular through Kigoma. This is because tourists will be able to travel easily between Kigoma and Bujumbura. The impact will be direct, moderate, and long term.

With the improved Mugina - Mabanda-Nyanza Lac RN-3 Road and the planned improvement of Nyanza-Lac- Kigwena-Rumonge - Rutunga-Bujumbura Road RN-3, traffic flows for tourist visitors through Mugina/Mabanda/Manyovu border will likely become significant. This is also because on the Tanzanian side, a major section from Nyakanazi-Kibondo-Kasulu-Manyovu Road section is planned for improvement will provide an alternative route from the central corridor to Burundi.

#### **6.6.1.12 Complementation of other Development Initiatives**

Rehabilitation of Bujumbura – Rutunga – Rumonge road will augment other on-going road projects such as the on-going upgrading of Nyakanazi – Kabingo road section (50km) to bitumen standard, the proposed upgrading of Kabingo (Kakonko District) – Kibondo - Kasulu – Manyovu Road Section (268km) to bitumen standard, the proposed upgrading of Nyanza Lac – Rumonge road section (42km), and the proposed construction of One Stop Border Post (OSBP) facilities for Tanzania and Burundi at Manyovu/ Mugina.

Rehabilitation of the road will flatter the above initiatives, the result of which will be a direct and shorter link for transport and transportation for goods and people between Tanzania and Burundi and EAC countries at large. This will enhance social and economic integration of EAC countries which is hindered by poor road condition.

### **6.6.2 Negative Impacts**

#### **6.6.2.1 Increased Traffic Accidents**

It has been projected (Table 14 and Table 20) that rehabilitation of Bujumbura – Rutunga – Rumonge road will increase traffic volume substantially. Improvement of the road will obviously result into increased travel speeds. The road accidents are minimal at present because of the poor road conditions. With the current poor road conditions even reckless drivers are forced to drive slowly. Invariably, improved road conditions attract more bus services to the road project. This could in turn lead to the increase in the number of accidents especially at school crossings, and settlements. Specific black spots are crossings for school children listed in Table 17. Other black spots are settlements in all the colline centres.

The negative impact is gauged to be indirect, moderate, reversible, and long term since it will occur during the entire life of the project. This is a residual impact because accident cannot be prevented fully.

#### **6.6.2.2 Increased Noise and Vibrations Pollution**

Rehabilitation of the road will definitely results into higher utilization of the roads and so higher traffic volume by generated (additional vehicles travel that results from the road improvement). Since asphalt road propagates noise and vibrations much more effectively compared to the current worn-out surface dressed road, rehabilitated road will increase noise and vibrations. Ultimately, the increased traffic volume will result into increased noise and vibrations. The increase in noise and vibration impacts due to operation of the road is anticipated to be direct, long term, irreversible, and minor. The impact due to noise and vibrations cannot be mitigated at the project level and therefore a residual impact.

#### **6.6.2.3 Increased Rate of Crimes**

Improved road is more likely to attract more advanced criminal activities in the project area. Criminals will be able to move faster across the project area. The life of residents will be more in danger than it is now. Advanced weapons are more likely to increase. Influx of opportunity seekers and subsequent crime poses a threat to security in the project area. The negative impact is will be indirect, moderate, and long term.

#### **6.6.2.4 Abuse of Road Corridor**

Past experience has shown that local communities along the road have a tendency of carrying out activities other than those intended for the road reserve. Normally any road has a road reserve, which is utilised for other infrastructure including water supply system, installation of electric, and telephone poles, though the area is under OdR. Other users have to get permission from OdR to be able to utilise the road reserve. However, communities have the tendency of using the road reserve for farming and other economic activities resulting into soil erosion and eroding the road. Such activities impact the sustainability of the road. The impact is gauged to be direct, moderate, reversible, and long term.

#### **6.6.2.5 Reduced Economic Activities at Closure of the Project**

Traders will establish trading activities points along the route during construction of the road, but as construction activities come to halt, the traders will not be able to trade, this will affect livelihood of the traders. The impact will be direct, moderate, and short term.

#### **6.6.2.6 Interference with smooth Traffic Flow**

Maintenance activities will interfere with smooth traffic flow. The impact, which is gauged to be insignificantly small, will include interference with smooth flow of traffic and effects related to acquisition, storage, processing, and application of construction materials and their equipment. The impact is gauged to be direct, insignificantly minor, and short term.

#### **6.6.2.7 Contribution to climate change effect due to emission of Green House Gases**

Increased traffic volume during the operation phase of the road will increase the generation of Green Houses Gases (GHGs), particularly CO<sub>2</sub> and N<sub>2</sub>O exhaust gases, the result of which will be contribution to greenhouse effect, global warming, and so climate change. This is because C<sub>2</sub>O and N<sub>2</sub>O are among the six greenhouse gases (others are methane, hydro fluorocarbons, per fluorocarbons, sulphur hexafluoride, and water vapour).

Global warming and climate change refer to an increase in average global temperatures. This is caused by increases in GHGs.

A warming planet thus leads to a change in climate which can affect weather in various ways.

The term greenhouse is used in conjunction with the phenomenon known as the greenhouse effect as narrated hereunder.

- Energy from the sun drives the earth's weather and climate, and heats the earth's surface;
- In turn, the earth radiates energy back into space;
- GHGs trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse;

Based on the method described in sub-section 4.2.5, the contribution of carbon dioxide due to the increased volume of traffic (projected traffic volume); one year after the road upgrading has been rehabilitated has been estimated as shown in Table 20.

It is clear from Table 14 and Table 20 that the proposed road upgrading will cause the amount of greenhouse gases generated by the present volume of traffic to increase from 0.06 tons/ days to 0.6 tons/ day. This implies that the road rehabilitation will cause the generation of carbon dioxide to increase by nine times the current level.

**Table 20: Estimated Amount of CO<sub>2</sub> Generated Daily by Traffic by 2022 in Kg/day**

No.	Type of vehicle	No of vehicles [a]	Type of fuel	Estimated average fuel consumption (Km/litre) [b]	Estimated Fuel consumption for 78km = (78/b) x a [c]	Amount of CO <sub>2</sub> generated per day kg after the road is upgraded to bitumen standard [c] multiplied by 2.3 (for gasoline engine) or 2.7 (for diesel engine)
1.	Motor cycle	5,308	Gasoline	20	20,701.2	47,612.8
2.	Medium car	6,685	Gasoline	10	52,143.0	119,928.9
3.	4-Wheel drive	3,220	Gasoline	8	31,395.0	72,208.5
4.	Pickup	2,293	Diesel	8	22,356.8	60,363.4
5.	Mini buses	3,598	Diesel	8	35,080.5	94,717.4
6.	Medium buses	135	Diesel	6	1,755.0	4,738.5
7.	Large buses	46	Diesel	2	1,794.0	4,843.8
8.	LGV	217	Diesel	5	3,385.2	9,140.0
9.	MGV	451	Diesel	2	17,589.0	47,490.3
10.	HGV	69	Diesel	2.0	2,691.0	7,265.7
11.	Articulated	924	Diesel	1.5	48,048.0	129,729.6
<b>Total Current daily emissions of CO<sub>2</sub> (Kg)</b>						<b>598,038.9</b>

Global warming has several effects on earth. The following effects of the global warming are relevant to the proposed project:

1. Global warming effects on animals: A large number of animal species will disappear from the planet, owing to the loss of habitat triggered by global warming.
2. Global warming effects on plants: Drastic changes in temperature levels will cause various plant species to experiencing difficulties in adapting to the new climate. The growing season of some plant species will be altered, which in turn will disturb their reproduction cycles, thus giving a drastic blow to the plant population. Even the changes in precipitation patterns can lead to hazardous effects on various plants species. A global warming effect on agriculture is the best possible example one can give to explain the effects of global warming on plants. Frequent rains will lead to flooding, whereas less rain will result in drought, both of which will only lead to the destruction of agricultural fields.
3. Global warming effects on weather: Increasing temperatures will lead to adverse effects on weather as well. Even minor alterations in global temperatures will trigger a series of weather extremities, and alter the climatic patterns of the planet. On one hand, heating of the ocean due to global warming gives rise to ferocious hurricanes, while more than the normal temperature on land gives rise to intense heat waves. Higher temperature leads to



faster evaporation of water and leads to drought in one part, and brings in heavy rain falls and causes flooding in other part of the world.

4. Global warming effects on sea levels: One of the most grievous among the various global warming effects on earth is the rise in sea levels, which are threatening to encroach up on land. If the sea levels rise it will result in a watery grave to several low lying areas. Rising global temperatures are causing the water bodies to heat, expand, and thus encroach on land.
5. Global warming effects on humans: Human will be the worst affected beings because directly or indirectly we are dependent on all the above mentioned components of the environment. Animals and plants are related to each other, extinction of either will put tremendous pressure on other, eventually leading to its extinction. Humans, in turn, are dependent on both for many purposes, so extinction of animals or plants will also affect humans to a great extent.
6. Global warming effects on economy: Global warming will affect the economy of various countries. The most affected would be the countries with agriculture-led economy. Global warming will trigger a series of changes in weather conditions which will take a toll on agriculture and allied activities. Owing to unnatural precipitation pattern, crop failure will become a very common phenomenon. Economies dependent on tourism, such as Maldives, will also bear the brunt of global warming.

The impact due to contribution of the project to global warming during the operation phase cannot be mitigated at the project level. Like anywhere else, an effort by the government by enforcing relevant legislation are enforced to ensure that only road worth vehicles are allowed to operate on the road will be required.

#### **6.6.2.8 Contribution to depletion of ozone layer**

Increased traffic volume will contribute to increased depletion of ozone layer due to increased emissions of GHGs.

The Earth's atmosphere is divided into five layers - stratosphere being one of them. Within the stratosphere, there lays a layer, made of a specialized form of oxygen, known as the ozone layer. The layer is made up of three oxygen atoms, contradictory to the usual two oxygen atoms. With no demarcated boundary, the ozone layer is found between 10 to 20 miles above the surface of the Earth. This layer traps the harmful ultraviolet-B (UV-B) radiation emitted by the Sun, and hence plays a crucial role in supporting life on the Earth.

The ozone layer is threatened by a global warming because the fall of its temperature increases the rate of its depletion. This is because GHGs trap the Sun's radiation which in turn makes the planet warmer. This actually means that the heat which is supposed to be reflected back to the space is trapped within the troposphere. When this heat is trapped, it does cause the temperature in the troposphere to increase, but at the same time, it also causes the temperature of the stratosphere to decrease. As the temperature in the stratosphere falls, the ozone molecules in this layer become vulnerable to destruction by the harmful emissions.

The effect to increased depletion of ozone layer cannot be mitigated at the project level and therefore a residual impact.

#### **6.6.2.9 Reduced life span of the road due to climate change**

As stated earlier, the design life time of the road (with double surface dressing) is 20 years. Variation or increase in temperatures resulting from global warming is likely to affect the life

span of the road. Excessive temperatures are likely to cause bleeding of bitumen if mitigation measures are not in place. Similarly, during preparation of sub base layer, cracking of cement-stabilized sub-base layer is likely to occur if curing is not done properly. High temperatures are likely to cause damages of concrete hydraulic structures, especially bridges and culverts due to expansion. In addition, flooding resulting from global warming is likely to cause serious damages to or overtopping of hydraulic structures (bridges, culverts)

#### **6.6.2.10 Wildlife Road Kills across Nkayamba Natural Forest Reserve**

Increased traffic volume and speeds across Nkayamba natural protected forest is likely to cause wildlife road kills. This concern was also raised by the Directorate of Forestry from OBPE.

#### **6.6.2.11 Continued Landside and Interruption of Road Transport during Rainy Season**

It was noted earlier under sub-section 4.9.5 that the road section between 28+200 and 32+300 is characterised by steep slopes and that the road section around Km 28+600 is experiences landslide that material from the landslide has on several occasions during rainy season caused paralysed road transport. This problem is expected to continue if measures are not taken to prevent the landslide.



**Table 21: Environmental and Social Impact Assessment Matrix**

PROJECT PHASE	M	C						D		O & M	
Impact	Construction of a camp	Extraction, processing and delivery of construction materials	General earthworks	Construction cross drainage structures	Construction of roadside drainage systems	Concrete and bituminous works	Operation of construction camps	Demolition of temporary structures	Disposal of demolition material	Operation of the road	Repair and maintenance of the road
Creation of employment	+2	+2	+2	+2	+2	+2	+1	+1	+1	0	+1
Loss of vegetation and farmlands	-1	-2	-2	-2	-1	-2	0	0	0	-2	0
Deterioration of aesthetics as related to discolouration of vegetation and buildings, unreinstated borrow pits	0	-2	-2	0	0	0	0	0	0	0	0
Impacts related to generation of solid wastes	0	-1	-2	0	-1	-1	-2	-1	0	-1	-1
Generation of noise and vibrations	-1	-2	-2	-2	-2	-2	-2	-2	-1	-2	-1
Deterioration of ambient air quality by particulate (dust)	-2	-3	-3	-1	-2	-2	0	0	-2	+3	-1
Deterioration of ambient air quality exhaust: fumes (SO <sub>2</sub> , NO <sub>x</sub> , CO)	-1	-2	-2	-1	-1	-1	-1	-1	-1	-2	-1
Deterioration of ambient air quality by bituminous fumes	0	0	0	0	0	-2	0	0	0	0	0
Risk of accidents to human and livestock due to borrow pits	-1	-2	0	0	0	0	0	0	0	-2	-2
Road traffic accidents to human	-1	-2	-2	-2	0	0	-2	-1	-1	-2	-1
Accidents related to blasting, drilling, and rock excavation	0	-2	0	0	0	0	0	0	0	0	0
Soil erosion	1-	-1	-2	0	-2	0	0	0	0	-2	0
Impact to Nkayamba natural forest reserve	0	-2	-1	0	0	0	0	0	0	-2	0
Impacts related to blasting, drilling, and rock excavation	0	-2	0	0	0	0	0	0	0	0	0
Displacement and loss of properties	0	0	-3	0	0	0	0	0	0	0	0
Disruption of domestic water supply systems	0	0	-2	-2	-2	0	0	0	0	0	0

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

PROJECT PHASE	M	C						D		O & M	
Impact	Construction of a camp	Extraction, processing and delivery of construction materials	General earthworks	Construction cross drainage structures	Construction of roadside drainage systems	Concrete and bituminous works	Operation of construction camps	Demolition of temporary structures	Disposal of demolition material	Operation of the road	Repair and maintenance of the road
Disruption of Sewer lines	0	0	-2	0	0	0	0	0	0	0	0
Disruption of telecommunication system	0	0	-2	-2	-2	0	0	0	0	0	0
Increased consumption of energy in the form of fuel and lubricants	-1	-2	-2	-2	-1	-2	-2	-1	-1	+2	-1
Resource use conflict	0	0	-2	0	0	-2	-2	0	0	0	0
River banks erosion	0	0	-2	-2	-2	0	0	0	0	0	0
Surface water and soil pollution by oil, concrete/concrete slurry	0	0	0	-2	-1	-2	0	0	0	0	0
Risk of leakage of hazardous wastes	-1	-1	-1	-1	-1	-1	-1	0	0	-1	-1
Modification of surface water flow pattern	0	0	-2	-2	0	0	0	0	0	-1	0
Modification of water table	0	0	-2	-2	0	0	0	0	0	-1	0
Disruption of community access to dwellings and business areas	0	0	-2	0	-2	0	0	0	0	0	0
Impact to cultural sites	0	0	-2	0	0	0	0	0	0	0	0
Health problems associated with handling of cement and wet cement products	-2	0	0	-2	-2	-2	-2	0	0	0	0
Fire and explosion risks	0	0	0	0	0	0	-2	0	0	0	0
Occupational health and safety related impacts	-2	-2	-2	-2	-2	-2	-2	-2	-2	0	-2
Risks of leakage of hazardous materials	-1	-1	-2	-2	-1	-2	-2	-1	-1	-1	-1
Marital and social conflicts	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Increase in unwanted pregnancies	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Physical hazard due to fall from height or being hit by falling object	-2	-1	0	-2	-1	0	-2	0	0	0	0
Physical hazard due to stepping on sharp object or striking/	-2	0	0	-2	-2	0	-2	-1	0	0	0

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

PROJECT PHASE	M	C						D		O & M	
Impact	Construction of a camp	Extraction, processing and delivery of construction materials	General earthworks	Construction cross drainage structures	Construction of roadside drainage systems	Concrete and bituminous works	Operation of construction camps	Demolition of temporary structures	Disposal of demolition material	Operation of the road	Repair and maintenance of the road
stumbling on objects											
Physical hazard due to manual handling (over-exertion)	-2	0	0	-2	-2	0	-2	0	0	0	0
Physical hazard due to being struck by excavating or crane machinery	0	-2	-2	-2	-2	0	-1	0	0	0	0
Physical hazard due to electrocution	-1	-2	0	0	0	-2	0	0	0	0	0
Chemical health hazard due to chemical contact with skin	-1	-1	-1	-2	-2	-2	-2	0	0	0	0
Chemical health hazard due to inhalation of harmful chemicals	-1	-2		-2	-2	-2	-2	0	0	0	0
Physical health hazard due to noise and vibrations	-1	-2	-2	-1	-1	-1	-1	-1	-1	-2	-1
Biological health hazard due to drinking unsafe water or eating contaminated food	-2	-2	-2	-2	-2	-2	-1	-2	-2	0	0
Biological health hazard due to exposure to ionizing radiation	0	0	-2	0	0	0	0	0	0	0	0
Increased infection of HIV/AIDS	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Improved ambient air quality	0	0	0	0	0	0	0	0	0	-2	-2
Improved hydrology and drainage	0	0	0	0	-2	0	0	0	0	+3	0
Reduced vehicle operating costs	0	0	+1	+1	+1	+1	+1	+1	+1	+3	+3
Reduced traffic accidents	0	0	0	0	0	0	0	0	0	+2	+1
Reduced travel time and comfort to passengers	+1	+1	+1	+1	+1	+1	+1	+1	+1	+3	+3
Improved access to social services	0	0	0	0	0	0	0	0	0	+3	+3
Increased household income due to increased trading activities	0	0	0	0	0	0	0	0	0	+2	+2
Improved tourism	0	0	0	0	0	0	0	0	0	+2	0

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

PROJECT PHASE	M	C						D		O & M	
Impact	Construction of a camp	Extraction, processing and delivery of construction materials	General earthworks	Construction cross drainage structures	Construction of roadside drainage systems	Concrete and bituminous works	Operation of construction camps	Demolition of temporary structures	Disposal of demolition material	Operation of the road	Repair and maintenance of the road
Reduced transport and transportation costs	0	0	0	0	0	0	0	0	0	+3	+3
Complementation of other development initiatives	0	0	0	0	0	0	0	0	0	+3	0
Increased rate of crimes	0	-1	-1	-1	-1	-1	-1	0	0	-2	0
Abuse of road corridor	0	0	0	0	0	0	0	0	0	-2	-2
Reduced economic activities after closure of the project	0	0	0	0	0	0	0	0	0	-1	0
Contribution to climate change effect due to emission of GHGs	0	0	0	0	0	0	0	0	0	-1	-1
Contribution to depletion of ozone layer	0	0	0	0	0	0	0	0	0	-1	-1
Reduced life span of the road due to climate change	0	0	0	0	0	0	0	0	0	-1	-1
Diversification of local economy	0	0	0	0	0	0	0	0	0	+3	+3
Increased interaction of people drive for social change	0	0	0	0	0	0	0	0	0	+2	+3
Continued land slide and interruption of road transport during rainy season	0	0	0	0	0	0	0	0	0	+3	0

Impact Rating:

## **SECTION 7: MITIGATION/ ENHANCEMENT MEASURES AND COMPLEMENTARY INITIATIVES**

The following sections describe measures that shall be followed by the contractor to ensure that the anticipated environmental and social impacts are avoided, abated, or remediated. Since most of the proposed mitigation measures will be contractual obligations of the contractor (some will not be mitigated by the contractor), they are also included in the Tender Document (Technical Specifications and Bill of Quantities). The Sections under which the proposed measures are found in the Technical Specifications are indicated in bracket after the proposed mitigation measure.

### **7.1 MOBILIZATION PHASE**

#### **7.1.1 Creation of Employment**

The impact shall be enhanced by the Contractor by ensuring that:

- Priority of employment is given to the local people
- Contractor Complies with Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code, in particular ensuring that all workers have employment contracts (Article 18), paying wages in accordance with the law (Article 5), not employing people who are below the age of 16 years (articles 3 and 125),.

#### **7.1.2 Loss of Vegetation**

To mitigate the impact due to loss of vegetation, the following shall be done:

- The contractor shall avoid unnecessary removal of the vegetation, especially trees
- When removal of vegetation is not avoidable, they shall be replaced by original species soon after completion of construction works/ closure of the camp, and its facilities (pre-cast yard, workshop, bitumen processing area, concrete batch plant, etc.)
- During site clearing for the camps, top soil shall be stockpiled so that it is used for vegetation during site reinstatement
- Cleared trees should be stockpiled and left on the road side for the local people to collect as firewood.
- Under any circumstance the Contractor shall not use the cleared trees for other purposes such as firewood or making marker pegs as past experience has shown.

#### **7.1.3 Deterioration of Scenic and Visual Quality**

The impact due to deterioration of scenic and visual quality shall be mitigated as follows:

- Top soil shall be stockpiled aside for later use for vegetation during reinstatement of camps.
- Material wastes such as concrete and cement blocks wastes will be stockpiled so that it is used in the reinstatement of pits

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- Metal wastes such as iron sheet, nails, metal cans, reinforcement bars, and used machine parts shall be disposed of as specified by OBPE. The Contractor shall seek advice from OBPE on the method of disposal of the wastes
  - Cement paper bags and paper boxes (biodegradable) shall be treated on site by either burying or controlled burning
  - Non usable timber wastes will be given to the local people to be used as fire wood
  - Hessian bags will be treated on site by controlled burning
  - PVC pipes, plastic and glass bottles (non-biodegradable) shall be disposed of as specified by OBPE. The Contractor shall seek advice from OBPE on the method of disposal of the wastes

#### **7.1.4 Generation of Noise and Vibrations**

To reduce the impact due to noise and vibrations, the contractor shall adhere to Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code by ensuring that equipment; including trucks are well maintained and properly fitted with exhaust mufflers to minimize noise and vibrations. In addition, workers exposed to severe noise level shall be equipped with earplugs to protect them against prolonged and excessive exposure to noise.

#### **7.1.5 Deterioration of Ambient Air Quality**

The impact due to pollution of ambient air at the construction camps and material borrow sites shall be mitigated by sprinkling water on access roads to materials and across settlements areas. Workers exposed to severe dust level shall be equipped with dust masks.

#### **7.1.6 Risk of Road Traffic Accidents**

The impact due to accidents shall be mitigated by limiting speeds of project vehicles as well as third party vehicles to 60 Km/ hr by among others installing speed limiting systems in all project cars, providing warning signs at junctions to material stocks routes to warn other road users, speed humps across material stock routes.

### **7.2 CONSTRUCTION PHASE**

#### **7.2.1 Creation of Employment**

To enhance the impact due to employment, the measures proposed in Sub-Section 7.1.1 shall apply

#### **7.2.2 Extraction, Processing, and Delivery of naturally-occurring Construction**

##### **Materials**

##### **7.2.2.1 Loss of Vegetation and Farmland**

To mitigate the impact of loss of vegetation due to extraction of construction materials, the following measures are proposed:

- Existing borrow sites shall be used prior to trucking in materials from new sites

- In excavating new or expanding existing pits, relatively fertile/organic top soils shall be well stripped and stockpiled so that it is used to cover the pits after restoration for vegetation growth.
- Site clearing shall be minimised but will permit safe and efficient movement of personnel, materials and equipment, while allowing for excavation of materials
- Cleared trees should be left for the local people to collect as firewood
- Immediately after construction, all the borrow pits and quarries shall be rehabilitated by trimming at a maximum slope of 1:3 (vertical: horizontal), backfilling with top soil to promote re-vegetating.
- Before opening a borrow pit or quarry, the Contractor shall submit to the Engineer a request for review and approval. The request among others shall include a sketch showing its location, coverage (area), adjoining features, and management and closure plan. The request shall also include a written consent of land owners that he/she is prepared to release his land for borrowing material.
- In accordance with Article 5 of Law N° 1/02 of 26 March 2012 on Water Code, borrowing of materials shall not be allowed near water courses. The minimum distance from the edge of the edge borrow pit or quarry from any water course shall be 60m.
- The Contractors shall not be allowed to open a borrow pit or quarry areas within Nkayamba natural forest reserve
- Before a borrow pit or quarry is opened, runoff control measures in the form of catch water drain, berms, etc. shall be put in place re-direct surface runoff away from access route and pit and quarry walls
- Where materials have to be extracted from agricultural land, the land owner shall be compensated after the land has been evaluated by government certified Valuer. After completion of construction of the project, the compensated borrow sites shall be the property of OdR.
- All borrow pits shall be reinstated to the satisfaction of the Engineer before a takeover certificate is issued to the Contractor

#### **7.2.2.2 Generation of Noise and Vibrations**

To reduce the impact due to noise and vibrations, the contractor shall:

- Adhere to Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code by ensuring that construction equipment are properly maintained (including proper tuning of engines) and properly fitted with exhaust mufflers to minimize noise and vibrations due to materials transport trucks
- Adhere to Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code by ensuring that workers exposed to noise level above the limit of 85dB are equipped with ear plugs to protect them against excessive noise level
- Under any circumstance, blasting of rocks at quarry sites shall not be allowed during the night. A day before blasting, the local community surrounding the quarry area shall be informed of the intention to carry out blasting. In addition, 30 minutes prior to blasting, a siren shall be sounded to warn the public
- Where applicable and possible work face of the pit and quarry shall be oriented away from nearby settlements. This practice will direct noise away from settlements and minimize aesthetics impacts



### **7.2.2.3 Deterioration of ambient air quality**

The impact due to pollution of ambient air by dust and exhaust fumes shall be mitigated as follows:

- The project road, material haul/ access roads and diversion roads across settlements and active construction sites shall be sprayed with water at least twice a day to suppress the generation of dust
- Haulage trucks carrying dusty material shall be covered with tarpaulin to prevent escape of dust from material being transported
- When equipment are not in use, they shall be switched off to minimize the concentration of exhaust fume from equipment and so protect the workers at material borrow sites
- The Contractor shall properly tune engine of equipment to ensure complete combustion of fuel and so minimize exhaust fumes
- The Contractor shall provide workers with dust masks and ensure that they are used properly to prevent them from inhaling polluted air

### **7.2.2.4 Deterioration of Scenic and Visual Quality**

To mitigate the impact of loss of scenic and visual quality due to borrow pits the following measures shall be applied:

- The minimum distance from the road and new borrow pits shall be 100m
- The contractor shall regularly sprinkle water on the project road, diversion roads across settlements, active construction sites, as well as access to roads to materials borrow sites in order to minimize deterioration of visual and scenic quality due to dust.

### **7.2.2.5 Risk of Accidents to Livestock, Wild Animals and Humans**

To minimize the risk of accidents to animals and humans

- Under any circumstance, the Engineer shall not approve any borrow pit proposal from the Contractor if it is located within Nkayamba natural forest reserve
- The depth of borrow pit shall not exceed 3m
- To prevent ponding of borrow pit from rainwater, the Contractor shall ensure that all borrow pits are self-draining throughout (when operational and after being reinstated).
- As much as possible, spoil material shall be spoiled in borrow pits when no longer in use. The Engineer, prior to approving a new spoil area, shall make sure that there is no exhausted borrow pit nearby the proposed spoil areas or there is no possibility of using a nearby borrow pit
- All borrow pits shall rehabilitated by trimming their side slopes to at least 1:3, properly landscaped, their beds flattened to the satisfaction of the Engineer, before a take-over certificate is issued to the Contractor.
- The minimum distance from the road from any borrow pits shall be 60m. The minimum distance from borrow pits to a dwellings area shall be 100m
- The maximum depth of quarry face shall be 10 m and the quarry face shall be benched to 4m high and at least 4m wide

### **7.2.2.6 Soil erosion**

The following measures shall be applied to mitigate the impact due to soil erosion:

- 
- Minimize soil disturbance by avoiding unnecessary clearing of vegetation
  - Control measures for runoff, such as the use of catch water drain, cut off drains, berms and drainage swales in the upper slope of the borrow sites shall be put in place to redirect surface runoff away from access routes and pit walls
  - The Contractor shall not be allowed to borrow construction materials within a buffer of 60m from any water course. The minimum distance from a borrow pit or quarry to water course shall be 60m. In addition, as much as it is practical, the Contractor shall not be allowed to borrow material from an area established by the Engineer to have a likelihood of causing serious soil erosion and siltation of a water course.

#### **7.2.2.7 Impact to Nkayamba Natural Forest Reserve**

To mitigate the impact, under any circumstance, the contractor shall not be allowed to borrow materials from Nkayamba natural forest reserve. The Engineer shall not approve of any borrow pit if it is located within these forest protected areas.

#### **7.2.1.8 Impact Related to Blasting, Drilling and Rock Excavation**

To mitigate impacts related to blasting and rock excavation, the following practices shall be followed:

- The Contractor shall acquire, transport, store, use, and manage explosives in accordance with relevant law: Explosives shall be stored in a magazine in accordance with Burundian Law, explosives shall be handled and blasting done by a person holding a blasting certificate issued by relevant authority
- Drilling sites for blasting shall clearly be marked with flags
- Whenever possible, large charges shall be divided into smaller multiple time delayed charges
- Vehicles and, machinery and equipment shall be kept in good working condition and free of fuel leaks
- Blasting shall be done between 08:00 hrs and 16:00 hrs. Under any circumstance, the Contractor shall not carryout blasting during the night

#### **7.2.3 General Earthworks in Road and Bridges Construction**

##### **7.2.3.1 Loss of Vegetation**

To mitigate the impact due to loss of vegetation, the following shall be implemented:

- During construction of the road, diversion road, and access roads, fertile top soils shall be well stockpiled so that it is used for top soiling back slopes and other cleared sites as well as reinstatement of borrow pits to promote the growth of grass as discussed in sub-section 7.2.3.2
- As much as possible, the contractor shall avoid unnecessary removal of vegetation; especially the identified riparian and riverine trees by confining clearing works to within the working width of 12m - 15m from the centreline of the new alignment.
- All the construction affected surfaces shall be rehabilitated by filling and grading. The affected surfaces will be reinstated by re-vegetating with natural species and forestry species appropriate to the area as instructed by the Engineer.

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- A total of 3,000 trees shall be planted to compensate the indigenous trees that will be lost due realignment of the existing road. The Directorate of Forestry for OBPE and officer for Technical Support for Economic and Business Development for all the communes along the long shall be involved in the identification of tree species suitable for the area for compensation purpose. It is recommended that the local communities along the project road are involved in the preparation, rising of nurseries of seedlings, planting of trees, as well as management of young trees. This will create employment for the local people.
  - Cleared trees shall be left along the road for the local people to use as firewood. Under any circumstance the Contractor shall not be allowed to use cleared trees either firewood or any other construction activity such as making marker pegs. ESIA expert's past experience has shown that in their effort to cut down costs, some Contractor tend cut trees to make marker pegs. It becomes very difficult to establish whether the pegs are made from trees cleared from the road side or trees are cut purposely to make marker pegs.

### **7.2.3.2 Roadside Soil Erosion**

The following measures shall be implemented to prevent and control soil erosion:

By controlling erosion as follows:

- All high fills (above 2.5m) and cuts not paved or covered by permanent structures shall be grassed after placing at least 10cm of top soil immediately after construction. The Engineer shall determine sections that require grassing and instruct the Contractor accordingly.
- Top soil of at least 10cm shall be placed on all sections with shallow fills and cuts (less than 2.5m) not paved or covered by permanent structures to promote the growth grass immediately after construction. The Engineer shall determine sections that require top soiling and instruct the Contractor accordingly
- The extent of disturbance shall be limited and the soil surface shall be stabilized immediately
- Existing vegetation shall be preserved to the extent possible, by confining construction activities to road alignment

By controlling surface run off by:

- Diverting storm water from undisturbed area to avoid disturbed areas: Catch water drains shall be excavated on upper sides of slopes to collect and direct runoff water away from cut slopes
- Long slopes shall be broken with temporary diversion to reduce the velocity of runoff
- As much as it is practical grades (slopes) shall be maintained to minimize the velocity of sheet flow over disturbed area and promote evaporation and infiltration of storm water directly into the ground
- Barriers such as check dams, sediment traps, or silt fence<sup>5</sup> shall be installed to control erosion on long steep slopes adjoining water courses. Gabions will be installed to prevent formation of erosion gully along drainage channel in steep slopes.

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<sup>5</sup> A silt fence is a temporary barrier designed to retain sediment on the construction site or wherever there is bare disturbed earth. It is designed to filters out sediment from construction run-off, yet allows clean water to pass through.

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- On high fill sections, kerb stones shall be installed on the edges of carriageway to direct runoff from pavement to down chutes which shall be installed at determined intervals
  - River systems shall be protected. As much as possible, areas adjoining water course shall be left undisturbed as buffers

### **7.2.3.3 Displacement and Loss of Properties**

To mitigate the impact due to loss of properties, pursuant to Law N° 1/13 of 9 August 2011 Revising the Burundi Land Code, all the affected properties shall be compensated before commencement of construction works. The buildings, land, crops and other properties that are entitled for compensation shall be identified and their values established in accordance with the law.

### **7.2.3.4 Disruption/Destruction of Public Utilities and Service**

#### **Disruption of Power Supply**

To mitigate the impact on water supply utilities:

- The Contractor shall consult REGIDESO – Electricity Supply and Distribution for Bujumbura City to establish exact locations of power supply lines within the corridor of impact (CoI). In that respect, the Contractor shall obtain a map showing the layout of power supply lines
- The Contractor shall work carefully not to damage power supply lines utilities along and across the road.
- Where is necessary to excavate the road beyond power supply lines depth, before commencement of Construction works, REGIDESO shall carefully remove power lines within CoI. The utilities shall be reinstated immediately after completion of earth works in respective road section.
- The contractor shall provide ducts for power supply lines crossing for future expansion/ extension of existing power supply lines or new project as instructed by the Engineer. The Engineer shall work closely with REGIDESO to establish locations of such service ducts.

#### **Disruption of Domestic water supply Systems**

To mitigate the impact on water supply utilities:

- The Contractor shall consult REGIDESO – Water Production and Supply; and officers Technical Support for Economic and Business Development for Bujumbura City and rural areas respectively, to establish exact locations of water supply utilities within the corridor of impact (CoI). In that respect, where practical, the Contractor shall obtain a map showing the layout of the water supply pipe lines.
- The contractors shall work carefully not to damage domestic water utilities along and across the road.
- Where is necessary to excavate the road beyond the pipe lines depth, the contractor shall carefully remove pipe lines which cross the road before commencement construction works. The utilities shall be reinstated immediately after completion of earth works in respective road section.
- The contractor shall provide ducts for domestic water pipe line crossing for future expansion/ extension of the existing pipe lines networks or new project as instructed by

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the Engineer. The Engineer shall work closely with REGIDESO as well as officers for Technical Support for Economic and Business Development to establish locations of service ducts.

### **Disruption of Sewer Lines**

To mitigate the impact due to disruption of sewer lines:

- To mitigate the impact it is strongly recommended that the design of pavement level should maintain the present level in order to avoid causing damage to the sewer line and as well as burying the manholes.
- The Contractor should work closely with SETEMU in order to establish exact locations of the sewer lines. The designer of the road should obtain the sewer line layout as well as profile from SETEMU
- During construction, the Contractor should avoid dumping solid material in the sewer line (through manhole) in order to avoid clogging the sewer line
- The manholes should not be covered with material to allow the operation of the manholes

### **Disruption of Telecommunication System**

To prevent damage to fibre optic cables:

- The Contractor shall work closely with BBS to establish exact locations of fibre optic cable lines. The Contractor shall request from BBS a drawing showing the layout of the fibre cable utility
- The contractors shall work carefully not to damage the fibre optic cables along and across the road, including where it is supported by hydraulic structures
- Where it is necessary to excavate the road beyond the fibre pipe lines depth, or during construction of hydraulic structures that supports the fibre optic cable, the contractor shall carefully fibre optic cable before commencement construction works. The utilities shall be reinstated immediately after completion of earth works and construction of the structures in respective road section.
- The contractor shall provide ducts for fibre optic cable crossing for future expansion/extension of the lines or new project as instructed by the Engineer. The Engineer shall work closely with BBS to establish locations of such service ducts.

#### **7.2.3.5 Generation of Noise and Vibrations by construction Equipment and Vehicles**

To mitigate the impact due to noise and vibrations, the measures proposed in Sub-Section 7.2.2.2 shall be applied here as well. In addition, as much as possible, sitting of stationary equipment near sensitive area, in particular Nkayamba natural forest reserve shall be avoided

#### **7.2.3.6 Deterioration of Ambient Air Quality by Dust and Fumes**

To mitigate the impact due to air quality deterioration due to dust, the measures proposed in Sub-Section 7.2.2.3 will apply.

#### **7.2.3.7 Generation of Solid and Liquid Wastes**

The following measures will be applied to mitigate the impacts due to deterioration of visual and scenic by solid wastes:

- Top soil shall be stockpiled so that it is used for top soiling to promote regeneration of vegetation

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- Excess (spoil) material, excavated from the road shall be spoiled in areas only approved by the Engineer outside the RoW. The height of spoil shall not exceed 2.5m in order to avoid collapsing and transport to water courses
  - Spoil areas shall be vegetated with indigenous tree species as approved by the Engineer
  - Prior to demolishing buildings in the RoW, owners of the properties shall be allowed to salvage valuable materials such roofing iron, windows, doors, and timber.
  - Non degradable demolition and material wastes such as concrete, sand, earth, blocks, stones, gravel, and aggregates shall be used to fill pits during their reinstatement. During site reinstatement, the contractor shall add soil to any area backfilled with blocks to fill large voids and top prevent future settlement. The backfilled areas shall be capped with at least 60cm of soil, contoured to match the surrounding grade, covered with top soil, and re-vegetated.
  - Reinforcement bars from the demolition of hydraulic structures (culverts and bridges) shall be disposed of as described earlier in sub-section 3.4.2.5.
  - Degradable wastes such as cement paper and hessian bags and boxes, and wooden boxes shall be disposed of by controlled burning or buried on site.
  - Cleared trees shall be left on the road side for the local people to collect them for fire wood or other uses. The Contractor shall not be allowed to use cleared trees as a source of energy.
  - Liquid wastes, such as grey water (domestic liquid wastes) shall be directed to onsite sanitary treatment system (septic tanks and soak away pits). Mobile sanitation facilities or pits latrines shall be provided by the contractor at all work sites other than the camp that last for at least a month.

#### **7.2.3.8 Road Traffic Congestion and Accidents**

The impact due road traffic congestion and accidents shall be mitigated as follows:

- Where a new cross drainage structure (culvert and bridge) has to be constructed at the same location as the existing structure then the Contractor shall avail a suitable temporary crossing structure to accommodate traffic and flow of water prior to demolishing the existing crossing.
- The Contractor shall devise proper traffic management, including deploying a traffic management personal at all active construction sites.
- The Contractor shall appropriately post night-reflective traffic warning signs (speed limit, speed humps, works ahead), affixed with reflective hazard warning tape, to notify the public from distant about potential dangers
- The Contractor shall separate working area from public traffic by providing physical barriers such as reflective barricade blocks (affixed with reflective hazard warning tape), guardrails, reflective hazard warning tape, and diversion roads or walkways) and the Contractor shall use guards to protect employees and the communities from physical hazards.
- All moving plants and machinery will be shielded for safety reasons. In addition, warning signs [stating DANGER, WARNING] shall be installed to give warning on potential dangers.
- The Contractor shall design and implement a training programme to create road safety awareness for all the schools (refer to Table 17) along the project road



- Temporary speed restraining humps shall be installed near settlements

The barriers and guards shall be used to:

- Reroute pedestrian and vehicular traffic to completely avoid a construction site.
- Guard any permanent ground openings, deep excavation, or pits into which a person or vehicles could fall
- Guard moving or parked construction machinery
- Protect work immediately at the end of the activity or at the end of each day.

#### **7.2.3.9 Increased Consumption of Energy and Natural Resources**

Measures to reduce energy consumption during construction stage of the project will include:

- Limiting unnecessary idling of construction equipment as well as adequately tuning of engines of the construction equipment and vehicles to minimize fuel consumption).
- Encourage carpooling (sharing of vehicles – although this cannot be imposed to the Contractor) among construction workers.
- The Contractor shall not be allowed to use firewood and charcoal for boiling of bitumen. In addition, the Contractor shall not be allowed to use firewood (including trees cleared from borrow pits and road side) and charcoal as sources of energy for cooking.
- The Contractor shall not be allowed to cut trees or use trees cleared from road side or borrow pits to make markers pegs

#### **7.2.3.10 Resources Use Conflict**

To mitigate the impact due to resource use conflict, the Engineer shall not approve siting of construction camp site in the neighbourhood of settlements and the camp shall be totally catered by the contractor. The camp shall be furnished with all the necessary social services to minimize interactions of the workers with the local people.

#### **7.2.3.11 Impact to Cultural Sites**

To mitigate the impact to graves at Ruziba and Minago, the Contractor shall work carefully so as not to cause any damage to the identified grave. In the event that graves are identified within the RoW, the graves shall be deconsecrated in accordance to UNESCO's code of conduct, i.e. according to the rights of traditional of the people claiming ownership. The graves at shall be relocated by excavation to a place selected by the Commune government. This shall be done right before commencement of the construction work, and shall be done in consultation with affected people/owners of the graves through Colline and religious leaders (where applicable) to avoid friction.

#### **7.2.3.12 Impact to Nkayamba Natural Forest Reserve**

The impact due to illegal hunting by project workers shall be mitigated by creating awareness among Contractor's staff not to be involved in illegal hunting of wildlife in the forest reserve.

#### **7.2.3.13 Deterioration of Visual and Scenic Quality**

To mitigate the impact of deterioration of scenic and visual quality due to dust generation, the Contractor shall regularly sprinkle water on the diversion roads across settlements, active construction sites, as well as access to roads to materials borrow sites. To minimize the impact



due to deterioration of scenic quality due to cuts, the design has specified that all back slopes shall be well trimmed to at least 1:2

#### **7.3.3.14 Surface Water and Soil pollution**

To mitigate the impact:

- The Contractor shall not be allowed to dispose of spoil or excess material near water bodies (i.e. water course and courses or L.Tanganyika) but shall do only at areas that have been approved by the engineer.
- Catch water drain shall be excavated on the upslope side of the road to direct runoff away from the lake.

### **7.2.4 Construction of Cross Drainage Structures**

#### **7.2.4.1 River Bank Erosion during Riparian zone Construction**

To mitigate the impacts, the measures proposed in sub-sections 7.2.3.2 shall be applied. In addition, disturbed river banks and heads in the neighbourhood of bridges will be stabilized by planting grass.

#### **7.2.4.2 Surface Water and Soil pollution**

The impact due to pollution of water course and soil shall be mitigated by good working practice. The contractors' construction activities shall be performed by methods that will prevent entrance, or accidental spillage of solid matter, contaminants, debris and other pollutants and wastes into surface and ground water bodies.

The following other measures shall be implemented by the Contractor to mitigate the impact due to pollution of soil and water courses:

- The Contractor shall comply with articles No. 45, 52, and 53 of Law N° 1/02 of 26 March 2012 on Water Code
- The Contractors shall isolate concrete works from watercourses
- Concrete handling equipment and vehicles shall be washed down in an area that is isolated from the watercourses so that the toxic leachate is not allowed to enter the watercourses
- As much as it is practical, servicing and/or re-fuelling of equipment shall be restricted at the contractor's yard.
- Oil containers shall be kept properly on concrete containment (secondary containment) built in such a way that spilled oils can be easily recovered
- All construction equipment like excavators working near the riverbanks shall be well serviced to ensure that there is no oil leakage
- Excavated materials and other construction materials shall not be stockpiled or deposited near or on stream banks, or near the edge of L.Tanganyika where they can be washed away by high water or storm run offs or can in any way encroach upon the water course itself

### **7.2.4.3 Modification of Surface and Ground Water Regime**

#### **Surface water flow modification**

The impact due to modification of water flows has been addressed in the design through proper design of culverts to ensure that they are capable of sustaining possible peak water flows. To minimise impacts on rivers flows, construction in river beds and along river banks will be done during dry seasons.

#### **Modification of water table**

The impact due to modification of water table has been considered in the design of road pavement. A study of boundaries of floodable zones has been used in the design to ensure adequate cross drains to minimise ponding on one side of the embankment. However, it is strongly recommended that fill materials should be borrowed from raised hillocks rather than adjacent to the road alignment.

### **7.2.4.3 Generation wastes**

The impact shall be mitigated by disposing the wastes as follows:

- Concrete wastes and steel reinforcement bars shall be disposed of as described in sub-section 3.4.2.5
- Hard stone shall be disposed of by reuse by the Contractor, either for protection works or rock fill works
- Old Armco culverts and bridge metal demolition materials shall be transported to OdR office for future reuse

## **7.2.5 Construction of Roadside drainage Systems**

### **7.2.5.1 Increased Risk of Roadside Soil Erosion**

To mitigate the impact, measures proposed in sub-section 7.2.3.2 shall be applied. In addition:

- All line drain sections with slopes steeper than 4% shall be lined with concrete or stone masonry
- Areas of ground surface clearance (exposed soil) will be minimised by re-vegetating with natural vegetation. In addition, during excavation and grading, top soils will be stored for reuse on slopes to form top soil
- Unnecessary disturbance of sensitive areas like steep slopes shall be avoided
- To prevent formation of erosion gullies along drainage channels areas with steep slopes along the road, especially, the drains shall be extended far from the road and protected by gabions
- Speeds of storm water flows, especially for side drains will be reduced by constructing erosion checks, along all steep slopes
- As much as it is practical, existing vegetation shall be preserved to the extent possible, by confining construction activities to road alignment

### **7.2.5.2 Disruption of Community Access to their Dwellings and Business Areas**

To abate the impact due to disruption of community access:

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- The contractor shall provide temporary/ permanent concrete slabs across line drain to enable pedestrians gain access to their business and residential premises.
  - The road design has provided permanent access culverts to enable motorists gain access to their feeder roads

## **7.2.6 Concrete Works and Construction of Cement-stabilized Layers**

### **7.2.6.1 Health Problems Associated with Handling of Cement and Concrete**

The following measures will be followed in handling and using cement and concrete safely:

#### **Personal protection**

To protect skin from cement and cement mixtures, workers working in severe cement/concrete environment shall be equipped with:

- Alkali-resistant gloves
- Coveralls with long sleeves and full-length trousers (pull sleeves down over gloves and tuck pants inside boots and duct-tape at the top to keep mortar and concrete out)
- Waterproof boots high enough to prevent concrete from flowing in when workers must stand in fresh concrete
- Suitable dust/respiratory protective gear (dust masks) when cement dust can't be avoided
- Suitable eye protection gears where mixing, pouring, or other activities may endanger eyes (minimum - safety glasses with side shields or goggles, under extremely dusty conditions, tight-fitting unvented or indirectly vented goggles).

#### **Work practices**

The contractor shall ensure that workers:

- Work in ways that minimize the amount of cement dust released
- Mix dry cement in well ventilated areas
- Make sure to work upwind from dust sources
- Where possible, use ready-mixed concrete (mixing by concrete batch plant) instead of mixing on site
- When kneeling on fresh concrete, use a dry board or waterproof kneepads to protect knees from water that can soak through fabric
- Remove jewellery such as rings and watches because wet cement can collect under them

#### **Hygiene**

The contractor shall ensure that construction workers adhere to the following:

- Clothing contaminated by wet cement is quickly removed. Skin in contact with wet cement is washed immediately with large amounts of cool clean water
- Do not wash hands with water from buckets used for cleaning tools
- Provide adequate hygiene facilities on site for workers to wash hands and face at the end of a job and before eating, drinking, smoking, or using the toilet. Facilities for cleaning boots and changing clothes should also be available at the campsite

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### **7.2.6.2 Soil and Water Pollution by Concrete Slurry and Concrete Wastewater**

To mitigate the impact due to possible leakage of concrete wastewater the contractor shall make sure that:

- Concrete slurry or wastewater is not allowed to enter the storm water system
- Concrete slurry and wastewater are collected or diverted to grass or bare soil.
- Slurry control is put in place before concreting is started
- To divert run-off using sandbags, soil or other materials, to a grassed area, pit or bare ground to soak in.
- The area of grass/soil is big enough to deal with the volume of wastewater produced.

### **7.2.7 Construction of Road Pavement**

#### **7.2.7.1 Health Problems Associated with Handling of Cement and Wet-cement Products**

Mitigation measures for health problems associated with handling of cement and wet cement products have already been discussed in sub-section 7.2.6.1

#### **7.2.7.2 Deterioration of Ambient Air Quality by Bituminous Fumes**

To mitigate the impact due to deterioration of ambient air quality due to bituminous fumes the following shall be observed:

- Bitumen processing facilities (bitumen heater and chipping pre-coating) shall be located in an open, well-ventilated area to minimize the concentration of bitumen fumes
- During bitumen spraying, apart from coveralls, workers shall be equipped with appropriate respirators

#### **7.2.7.3 Health Problems Associated with Hydrated Lime**

The impact shall be mitigated by:

##### **Safe handling/ storage of material:**

- Handling: Keep in tightly closed plastic or non-aluminium metal containers. Protect containers from physical damage. Avoid direct skin contact with the material.
- Storage: Store in a cool, dry, and well-ventilated location. Do not store near acids or other incompatible materials. Keep away from moisture. Do not store or ship in aluminium containers

##### **Exposure control/ personal protection:**

- Provide ventilation adequate to maintain Permissible Exposure Limits (PELs).
- Respiratory protection: Use NIOSH/MSHA approved respirators if airborne concentration exceeds PELs.
- Skin protection: Use appropriate gloves and footwear to prevent skin contact. Clothing should fully cover arms and legs. Should lime get inside clothing or gloves, remove the clothing and the lime promptly.
- Eye Protection: Use safety glasses with side shields or safety goggles. Contact lenses should not be worn when working with lime products.
- Other: Eye wash fountain/stations and emergency showers should be available

The following first aid measures should be followed:

- **Eyes:** Immediately flush eyes with generous amounts of water or eye wash solution if water is unavailable. Pull back eyelid while flushing to ensure that all lime dust has been washed out. Seek medical attention promptly if the initial flushing of the eyes does not remove the irritant. Do not rub eyes.
- **Skin:** Brush off or remove as much dry lime as possible. Wash exposed area with large amounts of water. If irritation persists, seek medical attention promptly.
- **Inhalation:** Move victim to fresh air. Seek medical attention. If breathing has stopped, give artificial respiration.
- **Ingestion:** Do not induce vomiting. Seek medical attention immediately. Never give anything by mouth unless instructed to do so by medical personnel

## **7.2.8 Operations of a Construction Camp**

### **7.2.8.1 Generation of Solid and Liquid Wastes**

To mitigate the impacts due to generation of wastes, the generated wastes shall be treated and disposed as describe in sub-section 3.4.2.5.

### **7.2.8.2 Fire and Explosion Risks**

To mitigate impact due to possible fire and explosion, safe working environment shall be exercised. This shall include, but not limited to:

- The Contractors shall maintain appropriate fire extinguishers within easy access at all work areas
- The Contractors shall recruits Safety Officers who will be responsible for training of all workers how to use fire extinguishers
- The Contractors shall prohibit smoking in hot work areas (welding, cutting, and grinding)

### **7.2.8.3 Risks of Leakage of Hazardous Materials**

The following measures shall be implemented to mitigate the potential impact due to leakage of hazardous chemicals:

- Fuel (petrol and diesel) shall be transported by special fuel transport tankers and stored in onsite tanks.
- Lubricating oils, paints, solvents, grease shall be packed in barrel and tins and will be transported by fire extinguisher equipped trucks.
- Underground fuel storage tanks shall not be allowed
- Fuel storage tank(s) at the campsite will be installed in a concrete containment.
- Fuelling stations, equipment service bays and pits shall be concrete paved and provide with drains and oil-water separators
- Refuelling at campsite will be done by a pumps
- Refuelling of construction equipment shall be closely supervised to avoid leaks or releases. Should a spill occur during refuelling, it shall immediately be properly cleaned up.
- Liquids such as fuel, lubricants, and bituminous materials shall be properly handled to avoid leakages to the ground/soil. Lubricating oils stored onsite shall be contained in

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barrels. All power generators shall be kept within secondary containment to contain any oil or fuel or leak. The barrels will be stored in a secondary containment area to contain any spillage, or in temporary warehouse

- When filling machinery and equipment with oils, the oil shall be pumped from a tank within a temporary secondary containment area to contain any spillage.
- Chemicals such as paint, solvents, and concrete additives shall be stored in a locked utility shed or secured in a fenced area.
- Paint and solvents containers shall be tightly sealed and properly stored to prevent leaks or spills. Unused paints shall be disposed of in accordance with applicable regulations. Spray painting shall not be done on windy days, and drop cloths shall be used to collect and dispose of drips and over-spray associated with all painting activities.
- In the event of spill or leak of hydraulic fluid, oil and other petroleum products, they will immediately be cleaned up to prevent discharge of these fluids into the ground or storm water runoff. Absorbent materials such as polypropylene boom and pads saw dust will be kept on hand for clean-up of spilled liquids on pavement, water, and soil. In the event that there is oil spill on the soil, the soil shall be excavated and treated by incineration.

#### **7.2.7.4 Generation of Human Sanitary Wastes**

The impact due to improper disposal of human sanitary wastes shall be mitigated by construction of sanitation facility at the camp. The type of facility will be of water closet (flush type). The sanitary waste water shall be treated and disposed of on-site by septic tank – soak away method.

#### **7.2.9 Marital and Social Conflicts**

The impact due to marital and social conflicts will be a residual impact as it cannot be mitigated at the project level.

#### **7.2.10 Increase in unwanted Pregnancies**

The mitigation measures proposed in sub-section 7.2.11.2.4 shall be used to mitigate the impact due to increased unwanted pregnancies. This will be a residual impact because it is impractical to prevent the increase in unwanted pregnancies completely.

#### **7.2.11 Occupational Health and Safety Hazards**

##### **7.2.11.1 Physical Hazards**

##### **7.2.11.1.1 Falling of People, Objects or materials**

Measures to prevent workers fall from work platform will include:

- Providing toe boards and guard rails that will be fitted to the outer side and ends of the working platforms and so secured so as to prevent their outward movement. All scaffolds will be close boarded (boards placed with no space between adjacent boards).
- Areas that are slippery after spillage shall be immediately cleaned and sanded as necessary. Chipping from concrete and dust from materials shall be cleaned and not allowed to accumulate
- Materials deposited on the scaffold platform shall be neatly stacked and a clear passageway shall be maintained between the materials and the edge of the platform



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- When people are likely to suffer fall of 1 m or more into an excavation, rigid guard rails or barriers of at least 0.9 m with a toe board and an intermediate rail to reduce any unprotected gap to 0.5 m or less shall be put in place. When people are likely to fall into a shallow trench of less than 1 m depth, warning tape shall be put in place to prevent trip and fall will be used

Measures to prevent workers fall from height due to scaffold collapse will include:

- Prevention of overloading including avoiding accumulation of materials and stacking materials
- Scaffold board shall be carefully examined before use to be free from unacceptable faults, such as large knots, knot clusters, large splits
- Scaffolding erection shall be done by an experienced scaffolders and competent supervision

Measures to prevent fall hazard while using ladders

- When used for access, ladders shall be securely tied at their upper ends
- It shall be made sure that they stand on a firm and level ground
- The rung and users footwear shall be kept clean and free from slippery mud, for example
- Along ladder shall be secured to prevent sway
- When works is to be performed from the ladder, when the ladder cannot be tied at the top or secured at the bottom, to prevent movement, the ladder shall be footed
- The ladder shall extend beyond the place of landing by at least 1 m unless adequate handhold is available
- Ladders with missing or defective rungs shall never be used
- Ladders shall always be inspected to identify defects and timber ladders shall not be painted since this may hide defects – transparent varnish or linseed oil will be used as a preservative

Measures to prevent accident due workers working below platform being struck by falling object/ material will include:

- Whenever there is any possibility of people below being struck by materials or tools falling through a gap in the working platform, on all scaffolds the boards will be laid close boarded (side by side) and end without space between the edges of adjacent boards.
- Workers under the platform shall wear safety helmet and shoes at all times

#### **7.2.11.1.2 Stepping on or striking against Objects**

Measures to prevent hazards resulting from stepping sharp objects or striking/ tumbling on objects shall include:

- Work areas shall maintain good housekeeping all the time to prevent possible accidents due to slipping, tumbling, or striking against an object
- The Contractor shall equip all the workers with steel-toe safety shoes

#### **7.2.11.1.3 Manual Handling Injury -- Overexertion**

To prevent manual handling injury, the Contractor shall ensure:

- Team handling e.g. using two or more persons



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- The use of mechanical aid such as hydraulic crane, wheelbarrow that requires the use manual loading and unloading.
  - Where applicable, breaking down the load into manageable components
  - Using persons strong enough for the task to be undertaken

#### **7.2.11.1.4 Workers being struck by excavating or Crane machinery**

To prevent workers being struck by excavating machinery

- During excavation cycle, no person shall be allowed in the vicinity of the machine.
- People in the trench shall be well away from the face and those at ground level kept outside slewing radius of the machine.
- When the excavator operator cannot see all parts of the jib and bucket during the excavation cycle, or when the machine used as crane, to lower materials an experienced banks man shall be used to guide the operator and to ensure that other workers remain well clear of the operation being carried out

#### **7.2.11.1.5 Transport**

Measures to mitigate hazards associated with transport of materials will include limiting speeds of construction vehicles to 60km/hr and ensuring that construction vehicles are properly serviced.

#### **7.2.11.1.6 Electrical Shock**

The Contractor shall ensure that all electrical control panels and cable are properly insulated and earthed.

#### **7.2.11.1.7 Fire and Explosion**

Measures to prevent fire and explosion hazard have already been discussed in sub-section 7.2.8.2

### **7.2.11.2 Health Hazards**

#### **7.2.11.2.1 Chemical Health Hazards**

##### **Contact with skin**

Measures to prevent hazards associated with contact with hazardous materials have been discussed in sub-sections 7.2.6.1

##### **Inhalation of harmful Chemicals**

Measures to prevent inhalation of harmful chemicals will include personal protection and work practices that have been discussed in sub-section 7.2.6.1.

#### **7.2.11.2.2 Physical Health Hazards**

##### **Noise**

Measures to prevent physical health hazard due to noise have been presented in sub-section 7.2.2.2 and 7.2.3.5.

## **Manual Handling**

Measure to prevent physical health hazard due to manual handling have been discussed in sub-section 7.2.11.1.3.

### **7.2.11.2.3 Biological Health Hazards**

To prevent biological hazards related with sanitation and unavailability of safe drinking water, the Contractors shall:

- Provide adequate sanitation facilities at work site.
- Sanitary waste will be disposed of by the use of toilets with septic tanks and soak away pits
- Provide adequate safe drinking water to his workers at all work sites
- Food waste collection bins with lids shall be provided at relevant locations at the camp. The bins shall be emptied on regular basis to pits

The waste management plan described in Environmental and Social Management Plan (ESMP) shall be followed in the management of different types of wastes

To mitigate the impact due to exposure to ionizing radiation, the Contractor shall:

- Prior to using the gauge, obtaining a licence to own and use it
- Store, transport, and use the nuclear gauge in accordance with the law and regulations
- Ensure that only workers trained to use the gauge in accordance with law are allowed to use it
- Ensure that the gauge is used in manner that protect the public as specified by the law and regulations
- Appoint a radiation officer, whose duties and responsibilities are as specified by the law and regulations
- Ensure that records of exposure for users of the gauge are kept and available for inspection

### **7.2.11.2.4 Increased Transmission of STIs/HIV**

To mitigate the impact due to increased transmission of STIs/ HIV, there shall be a HIV alleviation program. The Contractor hire an organization (Sub-Contractor) experienced in the provision of HIV/AIDS awareness and prevention activities to prepare and implement HIV alleviation program on their behalf. The Sub-contractors shall work closely with various stakeholders (including communities and their leaders, schools and health centres, civil societies to have an educational awareness campaign during mobilization, construction, and demobilization phases of the project in order to prevent the further spread of HIV/AIDS due to road construction activities.

## **7.3 DEMOBILIZATION PHASE**

### **7.3.1 Generation of Solid Wastes**

The impact shall be mitigated as follows:

- The above wastes shall be treated and disposed of as described in sub-section 3.4.2.5

- Prior to demobilization, the Contractors shall submit to the Engineer for review and approval a closure plan for the camp (including fuel storage facility, workshop, pre-cast yard), bitumen storage and heating facilities. The plan shall outline steps that the Contractors shall adopt to reinstate the facilities, including disposal of old structures and all facilities that were used in the camp which would no longer be needed and are likely to be of environmental and health hazard.

### **7.3.2 Deterioration of Ambient air Quality**

The impact due to pollution of ambient air by dust shall be mitigated by sprinkling water on the access roads to dump sites as well as covering transporting trucks to minimize escape of wastes from the trucks wastes. The workers at the demolition site shall be provided and ensure that they use dust masks to prevent them from inhaling polluted air.

### **7.3.3 Loss of Employment and Economic Activities at the End of the Project**

The impact due to loss of employment at the closure of the project will be a residual impact as cannot be mitigated at the project level. To manage the impact, while recruiting workers the Contractors shall inform the expected duration of their employment. In addition, employment and labour relations act shall be adhered to by the Contractors during termination of redundant workers.

## **7.4 OPERATION AND MAINTENANCE PHASE**

### **7.4.1 Positive Impacts**

#### **7.4.1.1 Improved Ambient Air Quality**

To enhance the positive impact due to improvement of ambient air quality people along the project roads shall be encouraged to plant strip street trees on road sides which will provide cleaning effect, alleviating air quality deterioration effects.

#### **7.4.1.2 Improved Hydrology and Drainage**

The impact due to improved hydrology and drainage shall be enhanced by ensuring proper and timely maintenance of the road furniture facility, including de-silting of culverts and side drain.

#### **7.4.1.3 Reduction in Vehicle Operating Costs**

The impact due to reduced rate of consumption of energy consumption shall be enhanced by ensuring proper repair and timely repair of the project road.

#### **7.4.1.4 Reduced Rate of Energy Consumption**

The impact due to reduced rate of consumption of energy consumption shall be enhanced by ensuring proper repair and timely repair of the project road.

#### **7.4.1.5 Reduced Traffic Accidents**

The impact due to improved safety shall be enhanced by ensuring that repair and maintenance of the road is done properly and on time.

#### **7.4.1.6 Reduced Travel Time, and Comfort to Passengers**

The impact due to reduction in travel and cost shall also be enhanced by ensuring that repair and maintenance of the road is done timely and properly.

#### **7.4.1.7 Improved road condition**

Repair and maintenance will focus on activities that ensure the long-term serviceability of the road. The activities will pertain to the road pavement and its embankments, hydraulic and drainage structures and road furniture and where necessary, re-surfacing. All repair and maintenance works will virtually have positive impacts that will enhance the intended functions of the road and lengthening its life time, especially when it is considered that the number and scope of routine maintenance of the road will be greatly reduced.

#### **7.4.1.8 Improved Tourism**

The impact due to improved tourism shall also be enhanced by ensuring that repair and maintenance of the road is done timely and properly

#### **7.4.1.9 Complementation of other Development Initiatives**

The impact shall also be enhanced by ensuring that repair and maintenance of the road is done timely and properly.

### **7.4.2 Negative Impacts**

#### **7.4.2.1 Increased Traffic Accidents**

To mitigate possible impact due to possible traffic accident:

- “Zebra” crossings with appropriate warning signs shall be put up at all accident black spots. Accident black spots are approaches to settlements, school children, and livestock crossings.
- Warning signs, a series of rumble strips followed by speed restraining humps shall be constructed on both approaches to settlements, school children (refer to Table 17)
- In addition OdR shall launch awareness campaign in the use and road safety

#### **7.4.2.2 Increased Noise and Vibrations Pollution**

The impact due to noise and vibrations during the operation phase of the project cannot be mitigated at the project level and therefore a residual impact.

#### **7.4.2.3 Increased Rate of Crimes**

The impact due to increased rate of crimes cannot be mitigated at the project level and therefore a residual impact.

#### **7.4.2.4 Abuse of Road Corridor**

To minimize the tendency of local people to encroach the road reserve, the design has included installation of concrete markers for end of road reserve.

#### **7.4.2.5 Reduced Economic Activities at Closure of the Project**

This is a residual impact as it cannot be mitigated at the project level.

#### **7.4.2.6 Interference with smooth Traffic Flow**

The measures to mitigate the impact due to interference of traffic flow in sub-section 7.2.3.8 shall be applied here as well.

#### **7.4.2.7 Contribution to climate change effect due to emission of Green House Gases**

The impact due to contribution of the project to global warming during the operation phase cannot be mitigated at the project level. Like anywhere else, an effort by the government by enforcing relevant legislation to ensure that only road-worthy vehicles are allowed to operate on the road will be required.

#### **7.4.2.8 Contribution to depletion of ozone layer**

The effect to increased depletion of ozone layer cannot be mitigated at the project level and therefore a residual impact.

#### **7.4.2.9 Reduced life span of the road due to climate change**

To mitigate the effect of bleeding of bitumen during the operation phase of the road, the design of the pavement shall consider climate zoning, which determines the type of pavement and treatment to be used. The design shall use bitumen which can sustain temperatures of the project area. In addition, relevant spray rate of bitumen shall be proposed in the design to minimize bleeding at high temperatures.

To prevent damages to concrete hydraulic structures resulting from high temperatures to hydraulic structures, the design has provided expansion joints to all bridges and box culverts to allow for free expansion when temperatures increases.

To prevent overtopping and failures of hydraulic structures during flooding, the design is based on 100 years of flood return period<sup>6</sup>. It is therefore expected that the hydraulic structures will last for at least 100 years.

#### **7.4.2.10 Wildlife Road Kills across Nkayamba Natural Forest Reserve**

The impact due to wildlife road kills across the nature reserves shall be mitigated by installing speed restraining humps as well as posting warning signs at both approaches to the game reserves.

#### **6.6.2.11 Continued landside and Interruption of Road Transport during Rainy Season**

To mitigate the impact due to landslide, the amount as well as the speed of runoff from the mountains on the right-hand side of the road (western side of the road) shall be controlled by planting deep rotted vegetation, in particular vetiver grass and trees. This will ensure that the speed of runoff is reduced and will give enough time for water to seep into the ground.

Table 26 summarizes impact and measures that have been proposed to mitigate the identified the impacts.

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<sup>6</sup> A return period also known as a recurrence interval is an estimate of the interval of time between events like an earthquake, flood or river discharge flow of a certain intensity or size. It is a statistical measurement denoting the average recurrence interval over an extended period of time, and is usually required for risk analysis and also to dimension structures so that they are capable of withstanding an event of a certain return period (with its associated intensity).

## **SECTION 8: EXPECTED RESIDUAL EFFECTS AND ENVIRONMENTAL HAZARD MANAGEMENT**

### **8.1 RESIDUAL IMPACTS**

Sections 6 and 7 describe the potential impacts that would occur along the route as a result of different phases of the project road, and how the proposed mitigation measures would contribute to minimizing or eliminating the impacts. It is clear from the discussion that not all the impacts can be fully mitigated and residual effects will be experienced by the environmental and social receptors affected by the project.

This section discusses and summarizes the potentially significant environmental and social residual impacts of the road project, i.e. those described as major and moderate. Residual impacts are the effects that will, or may arise as a consequence of the project after implementation of the mitigation measures. Where necessary, this section also identifies activities that will determine the nature or extent of particular residual impacts that are not yet fully defined.

#### **8.1.1 Generation of Noise and Vibrations**

(Related with impact in sub-sections 6.2.4, 6.3.2.2, and 6.3.3.5)

Generation of noise and vibrations will result from construction equipment and trucks during extraction, transportation and delivery of construction materials, as well as due construction activities, particularly earthworks. The impact will be of moderate significance for short periods in close proximity to dwellings during the day and evening.

Excessive noise and vibrations mitigation measures are already proposed and noise will be monitored at sensitive locations (e.g. settlements at which the criteria are thought to be at risk). If noise is likely to cause a nuisance at sensitive locations, additional noise suppression techniques will be considered, but may not be practical. Further measures to control the effect of such noise levels would include close liaison with the residents.

#### **8.1.2 Deterioration of Ambient Air Quality by Dust**

(Related with impact in sub-sections 6.2.3, 6.3.2.3, 6.3.3.6, 6.3.6.1, 6.3.7.1, and 6.3.11)

Deterioration of ambient air quality by dust will mainly result from the following activities:

- Extraction of natural materials, particularly borrowing of fill materials, quarrying and crushing/ screening of hard stones
- General earthworks: excavation, filling, and compactions works during the construction of the project, diversion, and access roads
- Movements of construction equipment, particularly trucks and other light duty vehicles, as well as public traffic.
- Concrete works and laying of cement-stabilized layers

The impact will be of moderate significance for short periods in close proximity to active construction sites (borrow, quarry, crusher, and road sites) and dwellings during the day and evening.



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Mitigation measures due to generation dust have already been proposed and dust level will be monitored at work sites and dwellings (at which the criteria are thought to be at risk). If dust level is likely to cause a nuisance at sensitive locations, additional dust suppression techniques will be considered. Further measures to control the effect of deterioration of ambient air quality by dust would include use of higher quality dust masks by workers and increased the frequency of water spraying on the diversion roads, and use of advanced dust suppression technique at the crusher plant such as the use vacuum pump technology to suck dust from screens.

### **7.5.3 Deterioration of Ambient Air Quality by Bituminous Fumes**

(Related with impact in sub-section 6.3.7.1)

Apart from dust, deterioration of ambient air quality will be due to generation of bitumen fumes from bitumen processing plant as well as during spraying of bitumen products. The impacts due to bitumen fumes will affect construction workers as well as residents along the project road.

Mitigation measures due to generation bitumen fumes have already been proposed. Nevertheless, the impact, particularly the pungent smell from freshly-sprayed bitumen-product will be felt by the residents in the neighbourhood of the road.

Further measures to control the effect of such noise levels would include avoiding spraying bitumen during the night when dwellers are at home.

### **8.1.4 Loss of Vegetation**

(Related with impact in sub-sections 6.2.2, 6.3.2.1, and 6.3.3.1)

Loss of vegetation will result from extraction of natural materials from borrow pits, widening of and upgrading of the existing road to improve safety. The impact will be of moderate significance for a long term to for the only some of the trees to regenerate naturally (from reinstated trees). The impact will be of moderate significance for long time.

The proposed mitigation measures will not mitigate the impact fully because only a small percentage of the lost vegetation, particularly trees lost from materials borrow areas will be recovered by natural regeneration after over 5 years, and vegetation lost due to the widening and realignment of the existing road cannot be recovered. The mitigation measures proposed to minimize the loss of vegetation and reinstate the affected sites will be monitored.

### **8.1.5 Loss of Land and other Properties**

(Related with impact in sub-sections 6.3.2.1, 6.3.3.1, and 6.3.3.3)

Displacement and loss of properties will result from acquisition of land and demolition of buildings in order to widen the existing road, realignment of the existing road to improve safety, and borrowing of material. The impact will be of major significance and long term. The proposed mitigation measures will not mitigate the impact fully. This is because even if people are compensated it may be difficult for them to get comparable sites. Some of the houses that will be demolished are within the prime business areas and it can be difficult for these people to obtain similar sites and if they manage to do so it might be at a high cost. Additionally, there are difficulties of adjusting to new areas and for older people who are uprooted it will result in increased stress and even early deaths.

### **8.1.6 Road Traffic Congestion**

(Related with impact in sub-sections 6.2.6 and 6.3.3.8)



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Traffic congestion due to increased movement of construction equipment and vehicles, diverting the already congested public traffic to narrow and relatively poor diversion roads will be a major and short term significant impact. The proposed mitigation measures are therefore not expected to mitigate the impact fully.

Further measures to minimize congestion would include minimizing the lengths of continuous diversions roads.

### **8.1.7 Soil Erosion**

(Related with impact in sub-sections 6.3.3.2 and 6.3.4.1)

Clearing of vegetation, which play a great role is stabilizing soil against erosion and disturbance of soil during borrowing of construction materials, construction of bridges and culverts, particularly where the soil is more susceptible to erosion as well construction across fill and cut sections are likely to cause soil erosion . The impact is anticipated to be of moderate significance and long term. The mitigation measures proposed are expected to make the impact due to soil erosion low. However, certain areas are particularly prone to erosion (e.g. sections with clay soils – refer to Table 12 and sub-section 6.3.3.2) and any soil disturbance in these areas could initiate a significance increase in present erosion rate. In these areas the significance of the residual impact can only reasonably be mitigated to a moderate level.

### **8.1.8 Surface Water and Soil Pollution**

(Related with impact in sub-sections 6.3.3.7, 6.3.4.2, 6.3.6.2, and 6.3.8.1)

Water pollution of surface water will occur during the construction across water course (bridges discussed in Table 12). Water pollution may be caused by either deposition of fine sediments during the construction across rivers courses, where the road is close to L.Tanganyika or accidental spillage of hazardous materials such as concrete or hydrocarbons.

Soil pollution by oil or fuel will occur due to accidental spillage of oil, poor managed oil, or leakage of fuel or oil containers.

In the unlikely situation that unplanned event leads to spillage of concrete waste water or oil to a water course or ground, it is possible that water course/ ground could be affected. However, the project Incident Response Plan (IRP) shall include measures for clean-up of water course and soil.

### **8.1.9 Disruption/Destruction of Public Utilities and Services**

(Related with impact in sub-sections 6.3.3.4)

The mitigation measures identified for public utilities and services will, if implemented correctly and in full, prevent any unplanned significant impacts. However, it is likely that there will be instances when unforeseen utilities or services are accidentally disrupted without notice or prior planning. Such disruption could affect large numbers of people living in extensive areas and as well as private and government institutions, although temporary. This will also result in residual resentment towards the project. Such instances will be dealt with through the compensation procedure.

### **8.1.10 Accidents Involving Community Members**

(Related with impact in sub-sections 6.2.6 and 6.3.3.8, and 6.6.2.1)

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It is possible that accidents involving local community members along the project road could occur at some stage during both the construction and operation phases of the project. This could include traffic-related accidents or accidents involving falling in open excavations, or other accidents. Traffic-related accidents during the construction phase of the project will be caused by increased traffic volume, while during the operation phase of the project; it will be caused by increased traffic volume as well as increased traffic speeds. Although all practical measures have been proposed to ensure that no accidents occur, any incident that harms a person will have a major residual impact in terms of diminishing the quality of life for the victim, negatively impacting them or their household livelihood, and potentially creating hostility towards the project and project team.

Successful implementation of the proposed mitigation measures, including safety training, traffic management, and driver training (during the construction phase), and high priority placed on safety should ensure that the risk of serious accidents during the construction phase of the project is low.

Mitigation measures have been developed to ensure safety close to residential areas, thereby avoiding the possibility of residual impacts occurring. During construction, the Contractor shall work with communities to manage issues or anxiety surrounding accidents and to give advice on the risks and dangers associated with the project.

#### **8.1.11 Accidents on open trench or borrow pits involving livestock**

(Related with impact in sub-sections 6.3.2.5 and 6.3.11.1)

It is likely that there will be minor accidents involving livestock within and outside the RoW. Basic health and safety management measures are in place to minimize this, there is a risk that animals could move beyond any marker fences, and on to borrow pits, which could result in accidents. Compensation measures via a grievance process will be established which will mitigate any losses incurred reducing the impact to a low level.

If pits and quarries sites are left un-reinstated after their use, they may become filled with rainwater and become dangerous to children and animals. They may also create breeding sites for vectors like mosquitoes and bilharzias, when filled with rainwater.

The impact due to accidents to human and animals due to un-reinstated borrow pits is estimated to be indirect, moderate, reversible, and short term since it can be mitigated as soon as the construction is completed.

#### **8.1.12 Un-met employment expectations**

(Related to the impact in Sections 6.2.1 and 6.3.1: Creation of Employment)

Because unemployment in the project area, residents in directly affected settlements that are unsuccessful in their job applications are likely to become frustrated when they do not gain employment. All the villages along the project road will anticipate employment opportunities. This could create resentment and possibly hostility towards those who win job and could cause resentment towards the project.

Measures to manage expectations regarding employment opportunities will help to reduce this potential impact. However, it is likely to remain a key concern of communities and the public in general given the high interest in employment found during the consultations. Hence the impact could be Major.

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It is also possible that there will be a short-term residual impact of discontent and perhaps resentment towards the project arising from perceptions of bias in recruitment process. Experience of large scale construction projects indicates that it will be extremely difficult to eliminate all bias from the recruitment process. This residual impact is therefore expected to be moderate.

#### **8.1.13 Tension between communities, workers and the project**

(Related to Impact in Section 6.3.3.10: Resources Use Conflict)

It is likely that there will be incidents and tensions between workers and communities at particular times and locations during the construction phase given the number and range of impacts that will affect communities. The mitigation measures proposed will minimize the project impacts but where any incidents are not completely resolved there could be a localized residual impact in loss of trust and increased discontent with the project and project team. The community relations plan and activities should be designed to address these situations and to minimize residual discontent or resentment among communities.

#### **8.1.14 Transmission of STIs/HIV**

(Related to Impact in Section 6.3.11.4)

There is a residual risk that interaction of the workforce with local communities will increase the transmission of communicable diseases such as HIV/AIDS and other STIs, despite health training on communicable diseases. The likelihood and severity will depend upon the health of the workforce and the level of interaction with the local settlements. This impact may include short term outbreaks of diseases (STDs), but also more serious communicable diseases with long term effect on community mortality levels (HIV/AIDs).

A rise in STIs/ HIV is to occur in relatively developed communities rather than smaller communities, where prostitution is strongly discouraged because of stiffer social norms in small villages.

#### **8.1.15 Grievance over Land and Properties Compensation**

(Related with impact in sub-sections 6.3.2.1, 6.3.3.1, and 6.3.3.3)

Experience has shown that there will be dispute and dissatisfaction between the project and some land owners and users on the project route. This will be caused by perceived or actual instances of disagreement with regard to the compensation process and/or methodology, and associated impact on livelihoods. This could cause resentment and possibly hostility towards the project.

The nature and scale of these negative residual impacts will depend on the quality of implementation of the land acquisition and compensation process, community relations and the grievance procedures. However, where grievances occur, it is expected that these will be of moderate significance until solved.

#### **8.1.16 Additional Cash injected into communities**

(Related to the impact in Sections 6.2.1 and 6.3.1: Creation of Employment)

Employment is the most significant positive social impact associated with the project, in the short-medium term. There will be a positive residual impact of the income obtained and spent by local workers in the community. This will be limited in each individual community by the short term nature of the employment of unskilled workers, but more prolonged in the case of semi-

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skilled or skilled labour. The result should be an increase in the standard of living for families and additional indirect employment for local business as a result of more cash in the local economy. The key issue in determining the scale of this impact will be the total number of Burundians employed in the construction works, and the duration of their employment.

There will also be a positive residual impact from money spent locally on goods and services by foreign construction workers in the local communities, which could also help create temporary indirect employment.

Additional cash will also be injected into local communities through the land compensation programme. This positive impact will depend on the extent of out-migration from the affected communities.

#### **8.1.17 Wide distribution of economic benefits**

(Related to the impact in Sections 6.2.1 and 6.3.1: Creation of Employment)

Management measures for the recruitment process should ensure that the distribution of jobs and therefore the distribution of economic benefits are spread out over the route. However, individual unskilled jobs will be relatively short. Skilled and semi-skilled workers may benefit from longer periods of employment.

#### **8.1.18 Enhanced local experience and employability**

(Related to the impact in Sections 6.2.1 and 6.3.1: Creation of Employment)

There will be benefits in terms of the additional experience and skills gained by the construction workers. This will apply to some extent to all workers, though mostly to skilled workers, who will be employed for longer periods. The future employment prospects of these workers will be enhanced. Hence, the indirect benefit to the families and communities could be significant.

The potential to realize this positive impact will depend on the training programmes developed by Contractor(s) and to some extent on the individual's willingness to learn. Employees are more likely to enhance employment prospects following construction, since they may also be eligible for positions in other industries. This will be a positive residual impact for the Contractor(s) and employees.

#### **8.1.19 Economic benefit of indirect employment opportunities**

(Related to the impact in Sections 6.2.1 and 6.3.1: Creation of Employment)

If local people remain living within the local communities much of the cash injected is likely to remain within the local economy beyond construction period, creating a positive residual impact.

#### **8.1.20 Access to new culture and international attitudes**

(Related with impact in sub-section 6.6.1.9)

There are some opportunities for the internationalization of local communities/ greater tolerance and awareness of other cultures which can be seen as a positive impact if communities welcome this. This is because it is most likely that some of the construction workers will be expatriates. The presence of expatriates will give expose the local people to new cultures and international attitudes.

### **8.1.21 Complains procedure**

(Related with impact in sub-sections 6.3.2.1, 6.3.3.1, and 6.3.3.3)

A fair and effective complaints procedure will help to establish a legacy of trust and good relations with communities. The level of trust will be determined by the quality of implementation of all measures, not simply those related to community relations.

## **8.2 ENVIRONMENTAL HAZARD MANAGEMENT AND CONTINGENCY PLAN**

This section describes a general plan through which the Contractor shall prepare himself and response to an emergency environmental hazard.

An emergency is a sudden unforeseen event, which may arise from natural, environmental, physical or personal unforeseen occurrences. Emergencies which are likely to occur during the construction of the road project may cover one of the following events:

- Worker injury at construction sites or workshops (mechanical, steel, or precast yard, carpentry), quarry, crusher plant, batch plant etc.
- Injuries to workers or member of the public due to collisions or run over
- Fires or explosions at camp sites
- Mishap spills of hazardous material such as large amount of concrete, bitumen, oil, fuel, or paint on the ground or in a river system;
- Outbreak of pandemic diseases such as cholera, diarrhoea, meningitis
- Serious pollution to the water source (by hydrocarbons) which is relied on by the local people for living.

Accident and Emergency Response Plan (ERP) is a detailed program of action to control and/or minimize the effects of emergency requiring prompt corrective measures beyond normal procedures to protect human life, minimize injury, to optimize loss control, and to reduce the exposure of physical assets and the environment from an accident.

### **8.2.1 Purpose and Scope**

The purpose of this ERP is to identify emergency personnel and the logical sequence of actions that should be taken in the event of an emergency during construction of the road project.

The ERP begins to establish written emergency procedures, communication coordination, and clean-up responsibility to minimize hazards resulting from construction and traffic accidents, leakage, mishap spill, fire and explosion.

### **8.2.2 Emergency Response Team**

The contractor shall form an Emergency Response Team (ERT) as outlined below. The ERT will report through the normal, internal management chain-of-command. Due to the diverse locations, and variety of field activities, which will be involved during construction, establishment of more than one ERT may be necessary. Under all circumstances, prompt and

proper treatment of the employee injured employee or person, as well as response of hazardous spills, fires, or explosions, is of utmost importance.

### **8.2.3 Emergency Response Team during Construction**

The team that will be used during construction listed in sub-section 8.2.4 with titles, functions, and reporting relationship.

### **8.2.4 Incident Notification**

Prior to commencement of construction, the contractor will establish the ERT that may include the positions listed below.

- Project Manager: will be the Incident Commander and will have an overall management of emergencies, including the activation and deactivation of ERT
- Construction Manager: will be the Operation Manager and will be responsible for managing emergency' tactical activities as per ERP
- Environmental and Social (E & S) Manager and Health and Safety (H & S) Manager - responsible for managing emergency' tactical activities as per ERP
- Construction Supervisor/foreman: will be the Logistic Provider, whose responsibility will be to provide logistical support for operations during emergency.

First Responder: will be the first person receiving a call on emergency.

### **8.2.5 Emergency Communication Procedure**

An important key to effective emergency response is a communication system which relays accurate information quickly. To do this, mobile telephone communication method will be used, and personnel trained. There will be alternative telephone numbers in case one fails by emergency (lack of signal or out of charge). In the event that there are sections of the project road where mobile signals are either weak or unavailable, the Contractor shall provide alternative mode of communications (say satellite phones or radio calls) as alternative means of communication. The list of emergency telephone numbers will be made accessible by all relevant personnel of the project. Where practical, the emergency mobile numbers shall be posted at all sites.

Other important emergency telephone numbers are:

- Police Emergency telephone number
- Police Station(s)
- Fire brigade for (Bujumbura and Rumonge)
- District hospitals

The emergency response plan posted in a noticeable place on the project shall identify the designated equipment and the people to operate it.

The following steps shall be followed in communicating for an emergency situation: The person receiving the call (information) will be designated as the "First Responder." First Responder is a member of ERT.



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#### **8.2.5.1 STEP 1: Incoming Calls to the First Responder**

During road construction, the emergency calls will most likely be generated by Contractor's or Engineer's inspection personnel and will be received by a member of the ERT listed above in sub-section 8.2.4 from a workgroup supervisor/ foremen, worker, an outside agency, or the public. Each foreman/supervisor or lead person on each phase of the road construction (clearing, excavation, grading, etc.) will be equipped with a mobile telephone.

#### **8.2.5.2 STEP 2: Classifying Incidents**

The risks associated with road construction are generally related to environmental pollution and personal injury. Emergencies associated with camp site/workshop operations could include:

- Worker injury at construction sites or workshops (mechanical, steel, or precast yard, carpentry), quarry, crusher plant, batch plant etc.
- Injuries to workers or member of the public due to collisions or run over
- Fires or explosions at camp sites
- Mishap spills of hazardous material such as large amount of concrete, bitumen, oil, fuel, or paint on the ground or in a river system;
- Outbreak of pandemic diseases such as cholera, diarrhoea, meningitis disease
- Serious pollution to the water source (by hydrocarbons) which is relied on by the local people for living

#### **Level 1 Emergency**

There is no potential danger to outside the project's right-of-way, no threat to the public, and project personnel can handle the situation. Notification to the Supervisors and other authorities should be within 12 hours.

Examples of Level 1 emergencies include:

- An oil, fluid, or fuel spill of any magnitude that is confined to the site and does not flow onto private, or enter a stream, or river
- An employee or Contractor injury accident resulting into minor injury that may require medical attention, but does not require hospitalization
- Minor property damage that does not compromise the safe operation of equipment or vehicles
- Small bush or structure fire that has been contained within the right-of-way

#### **Level 2 Emergency**

The potential exists for the emergency to extend beyond the right-of-way.

Examples of Level 2 emergencies include:

- An oil, fluid, or fuel spill of any magnitude that leaves the lease and flows onto private,



or that may enter a stream, or river

- An employee or contractor injury accident resulting in hospitalization
- Property damage resulting from fires, explosions, impact, or contacts that exceeds the safety threshold of the equipment or the structure

### **Level 3 Emergency**

Safe operating control has been lost, a fatality has occurred, the public safety is jeopardized, or there is a significant and on-going environmental impact.

Examples of Level 3 emergencies include:

- An oil, fluid, or fuel spill of any magnitude that enters a watercourse and threatens the intake of a local water supply
- Any leak or spill (controlled or uncontrolled) that causes significant environment damage
- A fire, explosion, impact, or contact resulting in the destruction of the project property, injury to the general public and/or damage to private or public structures
- An employee or contractor injury accident resulting in a human fatality

Level 2 and 3 require notification of the project management (Project manager) who will then notify outside the district council's services and OBPE and in certain situation the police authority so that they may be kept informed of the situation. Immediate notification to the supervisor is mandatory.

#### **8.2.5.3 STEP 3 Classification of Emergency Level and Notification**

The workgroup supervisor will determine whether or not the incident is an emergency. If an emergency exists, the Supervisor will classify the Emergency Level and determine the notification level as who has to be notified.

Level 1 emergency will be notified to Supervisors and E & S Manager

Level 2 and 3 emergencies require notification to the Project manager, who will then notify the district council's services and in certain situation OBPE so that they may be kept informed of the situation. Immediate notification to the Engineer is mandatory, who in turn must notify the Employer.

#### **8.2.6 Emergency Response Procedure**

An emergency will be reported from any source: supervisor/ foremen, worker on site, an outside agency, or the public. It should be borne in mind that circumstances may change during the course of an emergency.

The Incident Commander (Project Manager, and/or local emergency agency) will be responsible for the coordination of all on-site activities, emphasizing protecting people first, then environment, and finally property, including:

- Securing the area
- Accounting for personnel and the public; and

- Taking actions depending on the type of emergency.

Responders with appropriate training and fire suppression will be authorized to assist in fire emergency response within the limits of their training and available equipment. Similarly, employees with appropriate training and spill response and clean-up will be authorized to assist in an emergency response within the limits of their training and available equipment. The Incident Commander will have the ultimate authority over how to dispatch project employees to assist with an emergency response. A level 2 or 3 emergency could cause a need for evacuation such as fire and explosion, particularly at quarry and camp site.

The following table (**Table 22**) summarises the procedure which will be followed in different emergency situations

**Table 22: Response Procedure for Emergencies**

No.	Emergency	Receptor	Emergency Action
1.	Mishap spills of hazardous material such as large amount of concrete, bitumen, oil, fuel, or paint on the ground or in a river system	Escape through site drains to cause soil, surface, groundwater pollution, water source that is used by	<ul style="list-style-type: none"> <li>• If safe to do so, isolate source of leak or spillage to prevent further losses</li> <li>• Isolate the affected area to prevent unauthorised access</li> <li>• Protect side drains by sealing outfall using suitable bung</li> <li>• Use absorbent or brooms to contain spread of spillage - stock held in main workshop</li> <li>• Notify OBPE and Project Manager</li> <li>• Transfer any residual contents and contaminated absorbents to a suitable temporary storage container</li> <li>• Obtain specialist advice of decontamination of surfaces, drains and the interceptors</li> <li>• Remove bung from outfall chamber only when authorised by OBPE</li> </ul>
2.	Fire or explosion	Properties, site users and staff	<ul style="list-style-type: none"> <li>• Shout loudly “Fire, Fire!” and “Moto, Moto!” to inform others of the emergency</li> <li>• Isolate the affected area and evacuate site</li> <li>• If safe to do so, tackle any fire using appropriate fire fighting equipment or appliance (fire extinguisher, sand, water etc.)</li> <li>• Dial police emergency number</li> </ul>
3.	Personal injury to workers or member of the public resulting from accident at site	Staff or member of the public	<ul style="list-style-type: none"> <li>• The Project manager will be notified of the injury</li> <li>• A qualified first aid attendant will administer first aid until the injured is taken to hospital (where necessary)</li> <li>• Where deemed necessary, the site construction manager will notify the police (e.g. death)</li> <li>• All key supervisors will be notified of the injury</li> <li>• Should a an employee become injured and require emergency off-site medical transportation, he/she will be accompanied by a project representative to give pertinent information needed</li> <li>• In the event of death, the construction manager will inform the deceased’s next of kin</li> </ul>
4.	Outbreak of pandemic diseases such as cholera, diarrhoea, meningitis disease	Workers	<ul style="list-style-type: none"> <li>• The project Manager will be notified of the outbreak</li> <li>• Workers will be informed of the outbreak and advised on measures to prevent themselves from contracting the diseases</li> <li>• The H &amp; S Manager to carryout appropriate measures, including treatment of the affected workers, prevent further spread of the disease</li> <li>• Commune officers shall also be informed</li> </ul>

## **8.2.7 Emergency Preparedness**

Emergency preparedness is essential for effective emergency response. Essential elements of emergency preparedness will include:

- Chain of Command
- Resources
- Training; and
- Public Education (Community Planning)

### **8.2.7.1 Chain of Command**

The organizational structure outlined earlier identifies the ERT; the role of project management in classifying the incident as a Level 1, 2 or 3; and how members of the ERT will coordinate with and advise the management and Incident Commander.

The First Responder will act as the On-Site Commander until a Incident Commander and/or a member of the project management (e.g. Construction Manager) arrives and gives direction to respond to the situation.

The Incident Commander will usually be the on-site commander. Until the Incident Commander arrives, members of the ERT will be responsible for securing the area, mobilizing the emergency response personnel, accounting for all personnel and members of the public, overseeing public and environmental protection, establishing and maintaining communications; and taking direction from the Incident Commander.

Any incidents which require an emergency response will be post-appraised and documented by the First Responder in conjunction with the ERT.

### **8.2.7.2 Resources**

Resources for emergency response will include standard medical first aid kits, fire fighting equipment (fire extinguishers, sand, etc.), containment and clean equipment [absorbent (absorbent booms and pads, rice hull, sand), brooms, shovel], construction equipment (e.g. bulldozer, forklift, etc.), workers trained in first aid, emergency vehicles, and hospital/dispensaries.

### **8.2.7.3 Training**

Daily safety meetings will be conducted during construction that will inform employees of the emergency response procedures, directions to medical facilities, emergency action plans, and the location of written documentation.

The contractor's foremen shall attend specific safety training that addresses familiarization with the terrain and environmental issues in the project area. The agenda for this specialized training may include:

- Geographical considerations: elevation and terrain
- Particularly sensitive habitats
- Travel considerations: 4-wheeler, foot travel
- Wildlife: Bugs to Snakes

- Laws
- Spill prevention
- First aid and First aid kit familiarization
- Common illness/diseases
- Drug and alcohol issues
- Vehicle safety
- Emergency contacts
- Forest fires and what to do to prevent forest fires
- Communications
- Sensitivity of local residents; and/or

During construction, field personnel will also be trained by the Contractor in a variety of measures to make the job site safe:

- When and how to notify all others when actions or activities undertaken by them could affect health or safety of employees; to inform the Contractor of all injuries to workers; and who/how to report to Contractor any unsafe conditions that come to their attention.
- If in the course of the work an employee could be exposed to hazardous chemicals, or harmful physical agents, the location of material safety data sheets will be specified and made available for review.
- PPEs are expected to be worn that may include reflective vest, protective eyewear, gloves, hard hat, and footwear appropriate for the job site. Steel-toed footwear will be required on a project-specific basis.

## SECTION 9: MONITORING PROGRAM

Environmental and Social Monitoring Plan is an objective, periodical, reliable, and continuing process of observation and assessment of environmental changes. It is intended to ensure implementation of mitigation measures is done in accordance with regulations and standards. It is therefore based on monitoring indicators, which will have to be compared with targets to gauge the effectiveness of the mitigations plans.

It is one of the most important elements of the ESMP and has the following objectives:

- Collection of environmental and social baseline data (Table 22) as basis for gauging the effectiveness of implementation of proposed mitigation measures
- To ensure that mitigation and benefit enhancement measures have been adopted and are effective
- To identify any negative impacts unforeseen during ESIA stage and propose appropriate mitigation measures
- To provide information on the actual nature and extent of key impacts and effectiveness of mitigation and benefit enhancement measures

### 9.1 MONITORING PLAN

#### 9.1.1 Modes of Monitoring

Two basic forms of monitoring shall be performed as described hereunder:

Effects monitoring: Effect monitoring will record the consequences of activities on one or more environmental components. This will involve physical measurement of selected parameters or the execution of surveys to establish the nature and extent of induced changes.

Measurement Based Inspection: This will involve evaluation of trends in the values of environmental and social parameters systematically measured (quantitatively and/or qualitatively) and collected, to ensure that they are within acceptable legal and technical standards. This will involve collection of samples for analysis. In this, water and air samples will be collected and analysed.

The main tools that will be used for monitoring are checklists, visual examinations, and quantitative measurements of environmental effects monitoring parameters. Written records will be kept detailing the dates that monitoring took place and the findings of the monitoring.

#### 9.1.2 Baseline Data Collection

Prior to commencement of construction activities, during mobilization phase, the Contractors shall collect and document baseline data for different environmental aspects at strategic locations: settlements, camp, quarry, borrow sites, and water courses. The baseline data that shall be collected will include air quality (dust level), water quality (pH, turbidity), and noise levels. The baseline data collected will be used to compare environmental impacts of the “No Project” and in the presence of the project and so determine the extent of impacts caused by the project. The following table (Table 23) list baseline parameters that shall be collected.

**Table 23: Locations of sites where baseline data will be collected**

No.	Parameter	Location for Data Collection
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No.	Parameter	Location for Data Collection
1.	Air quality (dust level)	Across settlements, borrow, quarry, camp sites, crusher plant, batch plant, active road construction site
2.	Water quality (turbidity and pH)	Main rivers, open traditional wells
3.	Noise level	Across settlements, borrow, quarry, camp sites
4.	Vegetation cover	Access or diversion routes, quarry and borrow sites, across river systems
5.	Soil erosion	Wherever vegetation cover has been removed: access or diversion routes, across river systems, quarry, and borrow sites, wherever earthmoving activities (cut or fill) take place, the camp site, stock pile areas, and spoil disposal areas

## 9.2 MONITORING OF ENVIRONMENTAL AND SOCIAL PARAMETERS

The following table (Table 24) describe how monitoring of the implementation of proposed mitigation measure will be carried. The table lists the monitoring actions to be taken, the frequency of monitoring actions, locations where such actions are required to be taken, the units of measurement (where applicable), the target levels established and the responsible bodies. Notwithstanding the table-listed key issues, other unanticipated impacts shall also be monitored, and accordingly similar procedure for dealing with these impacts shall be followed to the satisfaction of the Engineer, the Employer, legal provisions.

**Table 24: Environmental and Social Monitoring Plan**

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
1.	Creation of employment	<ul style="list-style-type: none"> <li>Age of employees</li> <li>Ratio of local people to immigrants employed by the Contractor,</li> <li>Workers employment contract</li> <li>Wages paid to workers</li> <li>Working hrs</li> </ul>	Camps, quarry, active construction sites	Throughout mobilization construction & demobilization phases	<ul style="list-style-type: none"> <li>Interview with workers and Contract</li> <li>Review of employment records (payrolls)</li> </ul>	<ul style="list-style-type: none"> <li>Age of workers</li> <li>Percentage of employee especially non-skilled from the local community</li> <li>Percentage of female workers</li> </ul>	<ul style="list-style-type: none"> <li>No workers under the age of 16yrs is employed by the Contractors</li> <li>Non- skilled workers dominated by people from the local community</li> <li>All workers have employment Contract</li> <li>Working hrs. are in accordance with Labour relations act</li> <li>Wages are in accordance with government scale.</li> </ul>	Contractor under supervision of Engineer, commune government leaders along the project road
2.	Generation of Dust	<ul style="list-style-type: none"> <li>Level of dust generated by construction activities</li> <li>Implementation of dust suppression measures</li> <li>Use of dust masks/ respirators</li> </ul>	<ul style="list-style-type: none"> <li>Project road and diversion roads across dwellings and work sites</li> <li>Access roads to material borrow areas</li> <li>Quarry sites, and crusher plant</li> <li>Concrete batch plant</li> <li>Active work sites</li> </ul>	<ul style="list-style-type: none"> <li>Weekly during dry season for project, diversion, and access roads</li> <li>Weekly throughout the year for quarry, crusher, and concrete batch plant based monitoring</li> <li>Twice a week during demobilization</li> </ul>	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Use of Dust Level meter</li> <li>Interview of workers and communities along the road</li> </ul>	<ul style="list-style-type: none"> <li>Percentage of workers using dust masks in areas with high</li> <li>Whether water is sprayer on the roads</li> <li>Level of dust at PM<sub>2.5</sub> scale</li> </ul>	<ul style="list-style-type: none"> <li>Dust abatement measures are done as prescribed</li> <li>Absence of clouds of dust</li> <li>All workers working in high dust level equipped with dusk mask</li> <li>Zero complains by workers and local communities</li> <li>PM<sub>2.5</sub> ≤ 25µg/m<sup>3</sup></li> </ul>	Contractor under supervision of Engineer, communities along the project road
3.	Gaseous emissions	<ul style="list-style-type: none"> <li>Level of exhaust generated by equipment, bitumen fumes</li> <li>Working environment for workers exposed to hazardous gaseous fumes</li> <li>Use of respirators and masks by workers carrying out spray</li> </ul>	Borrow pits, quarry sites, crusher plant, campsite, mechanical workshop, construction sites	Weekly during mobilization and construction period	Visual observation	<ul style="list-style-type: none"> <li>Presence of high level of smoke</li> <li>Whether engine tuning, spray painting, and welding works are carried out in well ventilated areas</li> <li>Whether appropriate PPEs are worn by</li> </ul>	<ul style="list-style-type: none"> <li>No excessive smoke from equipment</li> <li>Equipment engine tuning, spray painting, and welding done in a well-ventilated area</li> <li>Appropriate respirators used by workers during spray painting, and bitumen</li> </ul>	Contractor under supervision of Engineer



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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
		painting, and bitumen spraying				workers during spray painting, and bitumen spraying	spraying	
4.	Generation of noise and vibrations	<ul style="list-style-type: none"> <li>Level of noise, generated by equipment</li> <li>Presence of exhaust mufflers</li> <li>Use of ear plugs by staff working in very noisy environment</li> </ul>	<ul style="list-style-type: none"> <li>Mechanical workshop, quarry site, crusher plan, batch plant</li> </ul>	Weekly Daily	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Listening</li> <li>Interview with workers</li> <li>Sound level meter</li> </ul>	<ul style="list-style-type: none"> <li>Percentage of workers in high noise environment using ear plugs, of ear plugs</li> <li>Whether all equipment have exhaust mufflers</li> <li>Noise level in dBA scale</li> </ul>	<ul style="list-style-type: none"> <li>Equipment engines properly tuned</li> <li>All equipment fitted with mufflers</li> <li>All workers working in very noisy environment equipped with ear plugs</li> <li>Noise level <math>\leq</math> 85 dBA</li> </ul>	Contractor under supervision of Engineer
5.	Loss of vegetation	<ul style="list-style-type: none"> <li>Implementation of measures to prevent or minimize loss of vegetation</li> <li>Implementation of compensation of lost vegetation</li> <li>Management of cleared trees</li> </ul>	<ul style="list-style-type: none"> <li>Along Nkayamba forest reserve</li> <li>Material borrow areas and quarries</li> <li>Diversion and access roads</li> </ul>	<ul style="list-style-type: none"> <li>Once after every one week during mobilization</li> <li>Weekly during construction period</li> </ul>	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with local communities</li> </ul>	<ul style="list-style-type: none"> <li>Whether width of clearing is limited to within CoI</li> <li>Whether unnecessary clearing of trees is avoided</li> <li>Whether top soil removed during clearing and grubbing, material borrowing stockpiled for future use</li> <li>whether grass planted on bare soil around streams and steep slopes, whether cleared tree are not buried but left for the local people to use for fire wood</li> </ul>	<ul style="list-style-type: none"> <li>Width of clearing confined to CoI</li> <li>Top soil removed during clearing and grubbing and material borrowing stockpiled for top soiling</li> <li>Cleared trees left around borrow pit and road side for the local people</li> <li>Contractor does not use trees as a sources of energy or Contractor does cut trees or use cleared trees to make marker pegs</li> </ul>	Contractor under supervision of Engineer, local people
6.	Loss of land and resettlement	<ul style="list-style-type: none"> <li>Land acquisition procedure</li> </ul>	Camps, all borrow pits, quarries, and spoil areas	Monthly	<ul style="list-style-type: none"> <li>Review of borrow pits documents</li> <li>Interview of owners of land</li> </ul>	<ul style="list-style-type: none"> <li>Whether compensation of land and crops done in accordance with the land Code</li> </ul>	<ul style="list-style-type: none"> <li>Land acquisition done in accordance with land Code</li> </ul>	

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
7.	Soil erosion	<ul style="list-style-type: none"> <li>Implementation of measures to prevent/minimize soil erosion</li> <li>Condition of areas adjoining rivers</li> <li>Management of storm water during construction of bridges and culverts</li> </ul>	<ul style="list-style-type: none"> <li>All rivers</li> <li>Borrow pits, quarry, bridges and culverts</li> <li>Where there has been clearing of ground cover</li> <li>During earthworks (fill and cut) take place, fill</li> </ul>	Monthly	Visual observation	<ul style="list-style-type: none"> <li>Whether specified temporary erosion control measures are in place</li> <li>Whether specified temporary measures to control surface runoff are in place</li> <li>Whether specified permanent erosion control measures (top soiling, grassing, checks, stone pitching, and tree planting) are implemented</li> </ul>	<ul style="list-style-type: none"> <li>Specified temporary erosion control measures are in place</li> <li>Specified temporary measures to control surface runoff are in place</li> <li>Specified permanent erosion control measures (top soiling, grassing, checks, stone pitching, and tree planting) are implemented</li> </ul>	Contractor under supervision of Engineer
8.	Soil pollution by fuel, oil, and bitumen	<ul style="list-style-type: none"> <li>Implementation of measures to prevent and deal with oil / fuel spill</li> <li>Operations of mechanical workshops</li> <li>Operations of bitumen heating and chipping pre-coating facilities</li> <li>Management (including storage) of lubricants and bitumen</li> <li>Management of used oil and fuel filters</li> </ul>	<ul style="list-style-type: none"> <li>Workshops at both camps</li> <li>Bitumen storage, heating and chipping pre-coating site</li> </ul>	Weekly throughout construction period	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with local communities, turbidity meter</li> <li>Review of Contractors documents</li> </ul>	<ul style="list-style-type: none"> <li>Whether lubricants containers placed on concrete-paved ground with secondary containment</li> <li>Whether filling and topping up of lubricant is done by a hand pump/funnel</li> <li>Whether topping up of lubricant done in the presence of drip pan</li> <li>Whether there is no leakage of fuel or oil from equipment</li> <li>Whether used oil is kept in sealed leak-proof containers on concrete-paved ground with secondary containment</li> <li>Whether used oil and fuel filters are stored in leak</li> </ul>	<ul style="list-style-type: none"> <li>Lubricants containers placed on concrete-paved ground with secondary containment</li> <li>Filling and topping up of lubricant is done by a hand pump/funnel</li> <li>Topping up of lubricant done in the presence of drip pan</li> <li>There is no leakage of fuel or oil from equipment</li> <li>Used oil is kept in sealed leak-proof containers on concrete-paved ground with secondary containment</li> <li>Used oil and fuel filters are stored in leak proof containers on concrete-paved ground secondary containment</li> </ul>	Contractor under supervision of Engineer

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						<ul style="list-style-type: none"> <li>proof containers on concrete-paved ground secondary containment</li> <li>Whether bitumen drums are stored on polythene lined level ground with at least 10cm layer of sand</li> </ul>	<ul style="list-style-type: none"> <li>Bitumen drums stored on polythene lined level ground with at least 10cm layer of sand</li> <li>Waste oil, used oil and fuel filters, and empty bitumen drums collected for disposal by OBPE company</li> </ul>	
9a.	Sedimentation of river systems	<ul style="list-style-type: none"> <li>Implementation of measures to prevent sedimentation of rivers</li> <li>Level of sedimentation of river systems</li> </ul>	All perennial rivers	Weekly week during construction across the river systems	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with local communities, turbidity meter</li> </ul>	<ul style="list-style-type: none"> <li>Whether spoil or construction materials are disposed or stocked near water courses</li> <li>Whether there is no disturbance on areas adjoining rivers</li> <li>Whether there is any complaints from downstream users on water pollution</li> </ul>	<ul style="list-style-type: none"> <li>Measures to prevent sedimentation are implemented</li> <li>Turbidity as measured in NTU <math>\leq</math> 10% deviation from the baseline</li> <li>No complaint is received from downstream users of a river</li> </ul>	Contractor under supervision of Engineer
9b.	Pollution of river systems by hydrocarbons (oils and bitumen)	<ul style="list-style-type: none"> <li>Implementation of measures to prevent pollution</li> <li>Presence of hydrocarbons in river course</li> </ul>	All perennial rivers	<ul style="list-style-type: none"> <li>Twice per week during construction across the river systems</li> <li>Weekly when water is abstracted from any river for construction works</li> </ul>	Visual observation	<ul style="list-style-type: none"> <li>Whether equipment working on river banks has fuel or oil leaks</li> <li>Whether refuelling is done near water courses</li> <li>Whether refuelling is done by pump</li> <li>Whether there is any sign of floating hydrocarbon product (thin-film, rainbow sheen)</li> </ul>	<ul style="list-style-type: none"> <li>No fuel or oil leak from equipment working on river banks</li> <li>No refuelling is done near water courses</li> <li>No sign of floating hydrocarbon product</li> </ul>	Contractor under supervision of Engineer
9c.	Pollution of river systems by fresh cement products (concrete, concrete slurry,	<ul style="list-style-type: none"> <li>Level of pollution by cement</li> <li>Implementation of measures to prevent pollution</li> </ul>	All major rivers	Once per week during construction of bridges and culverts	<ul style="list-style-type: none"> <li>Visual observation</li> <li>pH meter</li> </ul>	<ul style="list-style-type: none"> <li>Whether concrete are isolated from water courses</li> <li>Whether washing of concrete handling</li> </ul>	<ul style="list-style-type: none"> <li>Concrete works are isolated from water courses</li> <li>No washing of concrete handling equipment is done near water courses</li> </ul>	Contractor under supervision of Engineer

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
	cement wastewater	<ul style="list-style-type: none"> <li>Level of water pollution in acidity unit</li> </ul>				<ul style="list-style-type: none"> <li>equipment is done near water courses</li> <li>Complains from local people in the downstream</li> <li>Acidity in pH scale</li> <li>turbidity in NTU scale</li> </ul>	<ul style="list-style-type: none"> <li>No complaints from local people in the downstream</li> <li>pH <math>\leq 1</math> deviation from the baseline</li> </ul>	
10a.	Disruption of Power supply	<ul style="list-style-type: none"> <li>Consultation with REGIDESO prior to commencement of earthworks in the section with power lines</li> <li>Implementation of measures to prevent disruption of power lines</li> <li>Damages to power lines</li> <li>Installation of power line service ducts</li> </ul>	Where power lines cross or within the CoI of the road	Weekly during construction of the road section with power supply utilities within CoI	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with REGIDESO</li> </ul>	<ul style="list-style-type: none"> <li>Whether Contractor liaise with REGIDESO prior to commencement of earthworks at section with power lines</li> <li>Power lines are not damaged</li> <li>Whether installations of service ducts for power lines is done in consultation with REGIDESO</li> </ul>	<ul style="list-style-type: none"> <li>The Contractor liaise with REGIDESO prior to commencement of earthworks at section with power lines</li> <li>Power lines are not damaged</li> <li>Installations of service ducts for power lines is done in consultation with REGIDESO</li> </ul>	Contractor under supervision of Engineer, REGIDESO
10b.	Disruption of domestic water supply	<ul style="list-style-type: none"> <li>Damages to water pipe lines</li> <li>Implementation of measures to prevent damages to water supply utilities</li> <li>Response to complaints with regard to damaged water supply utilities</li> <li>Reinstatement of damaged water supply utilities</li> <li>Installation of service ducts</li> </ul>	Where there are water supply utilities within the CoI.	Weekly during construction of the road section with water supply utilities within CoI	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with REGIDESO and local communities</li> </ul>	<ul style="list-style-type: none"> <li>Whether Contractor liaise with REGIDESO and local water authorities whenever construction is being done across sections with water utilities within CoI</li> <li>Whether utilities within CoI carefully removed before commencement of construction</li> <li>Whether utilities not damaged</li> <li>Whether there is timely response to complaints with regard to damages to water supply utilities</li> </ul>	<ul style="list-style-type: none"> <li>Contractor liaise with REGIDESO local water authorities before commencement of construction across sections with utilities within CoI</li> <li>Utilities within CoI carefully removed before commencement of construction</li> <li>Utilities not damaged</li> <li>There is timely response to complaints with regard to damages to water supply utilities</li> <li>Locations of service ducts determined in consultation</li> </ul>	Contractor under supervision of Engineer, REGIDESO, local water utilities

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						<ul style="list-style-type: none"> <li>Whether installations of service ducts done in consultation with local water supply authorities</li> </ul>	of local water supply authorities	
10c.	Disruption of Sewer lines	<ul style="list-style-type: none"> <li>Consultation with SETEMU prior to commencement of earthworks in the section with power lines</li> <li>Implementation of measures to prevent dumping of solid materials in sewer lines</li> </ul>	Where power lines cross or within the CoI of the road	Weekly during construction of the road section with sewer lines within CoI	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with SETEMU</li> </ul>	<ul style="list-style-type: none"> <li>Whether Contractor liaise with SETEMU prior to commencement of earthworks at section with sewer lines</li> <li>Whether there are measures to prevent dumping of solid material into manholes</li> </ul>	<ul style="list-style-type: none"> <li>The Contractor liaise with SETEMU prior to commencement of earthworks at section with sewer lines</li> <li>There are measures to prevent dumping of solid material into manholes</li> </ul>	Contractor under supervision of Engineer, SETEMU
10d.	Disruption of telecommunication system	<ul style="list-style-type: none"> <li>Consultation with BBS prior to commencement of earthworks in the section with fibre optic cable utilities</li> <li>Implementation of measures to prevent damages to fibre optic cables</li> <li>Installation of service ducts for fibre optic cable</li> </ul>	All along the project road	Weekly	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with BBS</li> </ul>	<ul style="list-style-type: none"> <li>Whether there is regular consultation with BBS by the Contractor throughout the construction of the road</li> <li>Whether fibre cable utilities are carefully removed before commencement of construction</li> <li>Whether utilities not damaged</li> <li>Whether installations of service ducts done in consultation with BBS</li> </ul>	<ul style="list-style-type: none"> <li>There is regular consultation with BBS by the Contractor throughout the construction of the road</li> <li>Fibre cable utilities are carefully removed before commencement of construction</li> <li>Whether utilities not damaged</li> <li>Installations of service ducts done in consultation with BBS</li> </ul>	Contractor under supervision of Engineer, BBS
11.	Generation of wastes (visual impact, soil and surface and ground water pollution)	<ul style="list-style-type: none"> <li>Management of wastes</li> <li>Treatment and disposal of wastes</li> </ul>	Camps and work sites	Weekly throughout mobilization, construction and demobilisation periods	Visual observation	<ul style="list-style-type: none"> <li>Whether wastes are managed, treated, and disposed of as prescribed in Sub-Section 3.4.2.5 and 7.1.3, and 7.2.4.3</li> </ul>	<ul style="list-style-type: none"> <li>Wastes are managed, treated, and disposed of as prescribed in Sub-Section 3.4.2.5 and 7.1.3</li> </ul>	Contractor under supervision of Engineer
12.	Impact to Nkayamba forest reserve	Requests and approval of material borrow areas	OBPE	Weekly	<ul style="list-style-type: none"> <li>Visual observation</li> </ul>	<ul style="list-style-type: none"> <li>Whether Contractor request material</li> </ul>	<ul style="list-style-type: none"> <li>All requests from Contractors for borrowing</li> </ul>	Contractor under supervision of Engineer

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
					• Review of Contractor's submissions	borrowing from within Nkayamba forest reserve	material from within Nkayamba forest reserve forest reserve are rejected by the Engineer	
13.	Increased consumption of energy and natural resources	Sources of energy for cooking and other construction activities	Camps and work sites	Monthly	• Visual observation	• Whether the Contractor uses charcoal and firewood for cooking and bitumen boiling	• The Contractor does not use charcoal and firewood for cooking and bitumen boiling	Contractor under supervision of Engineer
14.	Impact to cultural sites	Measures to prevent damage to graves	Around grave yard	During construction across sections with grave yards specified in sub-section 4.3.5	• Visual observation • Review of Contractors' submissions • Interview with local communities	• Whether all the graves within CoI are relocated in accordance the law and UNESCO code before commencement of construction work • Whether graves outside CoI are clearly marked/ and protected from damage during construction of respective sections • Whether there are any complaints from local communities	• All the graves within CoI are relocated in accordance the law and UNESCO code before commencement of section with graves • Graves outside CoI are clearly marked/ and protected from damage during construction of respective sections • No complaints from local communities	Contractor under supervision of Engineer
15.	Impact to Nkayamba forest reserve wildlife	Awareness of Contractor's workers about the protected area	General work site	Monthly	• Visual observation • Interview with workers and local communities	• Whether Contractor's staff are aware of the protected area • Evidence that Contractor's staff is hunting from the nature reserves	• Contractor's staff are aware of the protected area • There are no evidence that Contractor's staff is hunting from the nature reserves	Contractor under supervision of Engineer
16.	Disruption of community access to dwellings and business areas	Availability of temporary pedestrian crossings at settlements	Dwellings	Monthly	• Visual observation • Interview with local communities	• Whether appropriately spaced temporary pedestrian crossing are availed at all dwellings • Whether local communities complain	• Appropriately spaced temporary pedestrian crossing are availed at all dwellings • There are no complaints about lack of pedestrian	Contractor under supervision of Engineer, local communities

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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						about the absence of pedestrian crossings	crossings	
17.	Health problems associated with handling cement and concrete	<ul style="list-style-type: none"> <li>• Work practice</li> <li>• Use of PPE</li> <li>• Hygiene</li> </ul>	<ul style="list-style-type: none"> <li>• Bridge and culvert work sites</li> <li>• Concrete batch plant area</li> <li>• Precast yard</li> <li>• Where there is laying of cement-stabilized layer</li> </ul>	Monthly	<ul style="list-style-type: none"> <li>• Visual observation</li> <li>• Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>• Whether appropriate PPE are used by workers working with cement and concrete</li> <li>• Whether workers work in the manner that minimizes release of cement dust and contact with wet cement product</li> <li>• Whether PPE are issued as required and worn-out PPE are replaced as required</li> </ul>	<ul style="list-style-type: none"> <li>• Workers working with cement and concrete are equipped with appropriate PPE (gloves, coveralls, with long sleeves, water-proof boots, suitable dust masks, eye protection gear) are used</li> <li>• Workers work in the manner that minimizes release of cement dust and contact with wet cement product</li> <li>• PPE are issued and worn-out PPE are replaced immediately</li> </ul>	Contractor under supervision of Engineer
18.	Risks of fire and explosion	<ul style="list-style-type: none"> <li>• Workers behaviours</li> <li>• Implementation of measures to prevent fire and respond to fire incident</li> </ul>	Workshop	Monthly	<ul style="list-style-type: none"> <li>• Visual observation</li> <li>• Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>• Whether adequate, appropriate, and easily accessible fire extinguishers are availed at strategic locations</li> <li>• Whether there is evidence that workers are trained how to use fire extinguishers</li> </ul>	<ul style="list-style-type: none"> <li>• The Contractor avail adequate, appropriate, and easily accessible fire extinguishers are availed at strategic locations</li> <li>• The Contractor has evidence that workers are trained how to use fire extinguishers</li> </ul>	Contractor under supervision of Engineer
19.	Generation of human sanitary wastes	Availability of ablution facilities	Work sites	Monthly	<ul style="list-style-type: none"> <li>• Visual observation</li> <li>• Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>• Whether there are ablution facilities at all work sites that lasts for at least a month</li> </ul>	<ul style="list-style-type: none"> <li>• All work sites that last for at least month have ablution facilities</li> </ul>	Contractor under supervision of Engineer
20.	Traffic congestion and accidents	<ul style="list-style-type: none"> <li>• Implementation of measures to prevent traffic congestion and accidents</li> <li>• Implementation of road</li> </ul>	<ul style="list-style-type: none"> <li>• Project, diversions, and access roads across dwellings and schools</li> <li>• Schools</li> </ul>	Weekly for monitoring implementation of measures to prevent accidents	<ul style="list-style-type: none"> <li>• Visual observation</li> <li>• Interview of road users, schools, local</li> </ul>	<ul style="list-style-type: none"> <li>• Whether there are flagmen at approaches to all active construction sites and material borrow area junctions</li> </ul>	<ul style="list-style-type: none"> <li>• Flagmen are deployed at approaches to active construction sites and material borrow area junctions</li> </ul>	Contractor under supervision of Engineer, school children/ teachers



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No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
		safety training programme for schools • Travel speeds of project vehicles		• Monthly for monitoring implementation of road safety training programme	communities • Review of contractors monthly ESMP and HSMP compliance reports	• Whether there are appropriately posted night-reflective warning signs to warn the public about potential danger (speed limit, speed humps, works ahead, etc.) • Whether there are physical barriers (concrete barricades, tape etc.) to protect employees and other road users • Whether there are speed-restraining humps on approaches to all accident black spots (e.g. school children crossing, dwellings, etc.) • Whether pedestrians and other traffic are rerouted away from active construction sites • Whether the public is protected from all ground openings into which a person or vehicles could fall by night-reflective barricades • Whether the Contractor has evidence that there is awareness creation program on road safety issues among school children • Whether parked construction equipment	• Night-reflective warning signs (speed limit, speed humps, works ahead, etc.) appropriately posted to warn the public about potential danger (speed limit, works ahead, etc.) • Physical barriers (concrete barricades, tape etc.) are in place to protect employees and other road users • Speed-restraining humps are installed at approaches to all accident black spots (e.g. school children crossing, dwellings, etc.) • Pedestrians and other traffic are rerouted away from active construction sites • The public is protected from all ground openings into which a person or vehicles could fall by night-reflective barricades • Review of Contractors' compliance reports and interviews with school children and teachers provide evidence that the Contractors implement awareness creation program on road safety issues among school children • Parked construction equipment are guarded • Works are protected	

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						<ul style="list-style-type: none"> <li>are guarded</li> <li>Whether works are protected immediately at the end or end of the day,</li> <li>Whether all accidents and incidents are reported to the Engineer soon after their occurrence</li> <li>Whether drivers of project vehicles are formally informed of speed limit of 60km/ hr and that they adhere to this speed limit</li> <li>Whether measures to prevent re-occurrence of accidents and incidents</li> </ul>	<p>immediately at the end of the day</p> <ul style="list-style-type: none"> <li>All accidents and incidents are immediately reported to the Engineer</li> <li>Drivers of project vehicles are formally informed of speed limit of 60km/ hr and that they adhere to this speed limit</li> <li>There are measures to prevent re-occurrence of accidents and incidents</li> </ul>	
21.	Risk of accidents to animals and human associated with material borrowing	<ul style="list-style-type: none"> <li>Management of material operational borrow areas</li> <li>Closure of material borrow areas</li> </ul>	Borrow pits and quarries	Weekly	<ul style="list-style-type: none"> <li>Visual inspection</li> <li>Reviews of requests by Contractors' for approval of material borrow areas</li> </ul>	<ul style="list-style-type: none"> <li>Whether only borrow pit at minimum distance of 100m from dwellings are approved by the Engineer</li> <li>Whether all borrow pits and quarries are self-draining when operational and after their closure</li> <li>Whether no approval for borrow pit located within Nkayamba forest reserve are not granted to Contractor</li> <li>Whether maximum depth of borrow pits is 3m</li> <li>Whether maximum depth of quarry face is 10m</li> </ul>	<ul style="list-style-type: none"> <li>Only request for borrow areas located at minimum distance of 100m from dwellings are approved by the Engineer</li> <li>The Contractor ensures that all borrow pits and quarries are self-draining when operational and after their closure</li> <li>No approval for borrow pit located within Nkayamba forest reserve is granted</li> <li>Depths of borrow pits are limited to 3m</li> <li>Maximum depth of quarry face is 10m</li> <li>All borrow pits and quarries</li> </ul>	Contractor under supervision of Engineer

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						<ul style="list-style-type: none"> <li>Whether all borrow pits and quarries are reinstated to the satisfaction of the Engineer before the Contractor is issued with take over certificate</li> </ul>	are reinstated in accordance to the satisfaction of the Engineer before the Contractor is issued with take over certificate	
22.	Safety risk associated with to blasting, drilling and rock excavation	<ul style="list-style-type: none"> <li>Storage and management of explosive</li> <li>Operations at quarries</li> </ul>	<ul style="list-style-type: none"> <li>Magazine</li> <li>Quarries</li> <li>Rock excavation site along the project road</li> </ul>	Monthly	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Review of documents from Contractor</li> <li>Interview of local communities near quarries</li> </ul>	<ul style="list-style-type: none"> <li>Whether Contractors have licences for explosive storage magazines</li> <li>Whether blasting done by holders of blasting certificates issued by relevant authority</li> <li>Whether blasting done between 08:00 hrs and 16:00 hrs</li> </ul>	Contractors have licences for explosive storage magazines Blasting is done by holders of blasting certificates issued by relevant authority Blasting is done between 08:00 hrs and 16:00 hrs	Contractor under supervision of Engineer
23.	Hazard due to workers fall from height or being hit by falling objects or materials	<ul style="list-style-type: none"> <li>Conditions of scaffold, ladders, and work platform</li> <li>Use of PPE by workers</li> </ul>	<ul style="list-style-type: none"> <li>Workshops</li> <li>Culverts and bridges construction work sites</li> </ul>	Weekly	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether overloading of scaffold is prevented</li> <li>Whether scaffold board is free from unacceptable faults</li> <li>Whether scaffold is erected by experienced scaffolders and competent supervision</li> <li>Whether ladders used for access are securely tied at their upper ends</li> <li>Whether ladders stand on a firm and level ground</li> <li>Whether ladders are secured to prevent sway</li> <li>Whether ladders that cannot be tied at their top</li> </ul>	<ul style="list-style-type: none"> <li>Overloading of scaffold is prevented</li> <li>Scaffold board is free from unacceptable faults</li> <li>Scaffold is erected by experienced scaffolders and competent supervision</li> <li>Ladders used for access are securely tied at their upper ends</li> <li>Ladders stand on a firm and level ground</li> <li>Ladders are secured to prevent sway</li> <li>Ladders that cannot be tied at their top secured at the bottom are footed</li> <li>Ladders extend beyond the</li> </ul>	Contractor under supervision of Engineer

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						<p>secured at the bottom are footed</p> <ul style="list-style-type: none"> <li>Whether ladders extend beyond the place of landing by at least 1 m unless adequate handhold is available</li> <li>Whether there are no ladders with missing or defective rungs</li> <li>Whether boards of platform are laid close boarded and end without space between the edges of adjacent boards, whenever there is any possibility of people below being struck by materials or tools falling through a gap in the working platform</li> <li>Whether all workers under the platform are equipped with safety helmet and shoes all times</li> </ul>	<p>place of landing by at least 1m unless adequate handhold is available</p> <ul style="list-style-type: none"> <li>There are no ladders with missing or defective rungs</li> <li>Boards of platform are laid close boarded and end without space between the edges of adjacent boards, whenever there is any possibility of people below being struck by materials or tools falling through a gap in the working platform</li> <li>All workers under the platform are equipped with safety helmet and shoes all times</li> </ul>	
24.	Hazard due to stepping on sharp object or striking/ tumbling against objects	<ul style="list-style-type: none"> <li>Housekeeping at work sites</li> <li>Use of PPE by workers</li> </ul>	<ul style="list-style-type: none"> <li>Workshops</li> <li>Culverts and bridges construction work sites</li> </ul>	Weekly during construction	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether a good housekeeping is maintained all the time</li> <li>Whether all the workers are equipped with steel-toe safety shoes</li> </ul>	<p>A good housekeeping is maintained all the time</p> <p>All the workers are equipped with steel-toe safety shoes</p>	Contractor under supervision of Engineer
25.	Hazard due to manual handling – overexertion	<ul style="list-style-type: none"> <li>How manual handling of loads is done</li> <li>Implementation of measures to prevent over-exertion</li> </ul>	<ul style="list-style-type: none"> <li>Workshops</li> <li>Culverts and bridges construction work sites</li> </ul>	Weekly during construction	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether team handling is practices when carrying heavy loads</li> <li>Whether mechanical aid (e.g. wheelbarrow, hydraulic crane etc.) is used when</li> </ul>	<ul style="list-style-type: none"> <li>Team handling is practices when carrying heavy loads</li> <li>Mechanical aid (e.g. wheelbarrow, hydraulic crane etc.) is used when</li> </ul>	Contractor under supervision of Engineer

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
						hydraulic crane etc.) is used when loads being carried are heavy	loads being carried are heavy	
26.	Hazard due to workers being struck by excavating or crane machinery	<ul style="list-style-type: none"> <li>How excavation and lifting by crane is done</li> <li>Implementation of measures to prevent workers and the public being hit by rotating equipment</li> </ul>	<ul style="list-style-type: none"> <li>Culverts and bridge work sites</li> <li>Line drain work sites</li> </ul>	Weekly during construction	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether there is no worker or member of public within swivel radius of machine during excavation</li> <li>Whether workers in the trench are kept well away from the face and those at ground level kept outside slewing radius of the machine.</li> <li>Whether experienced banks man is used to guide the operator and to ensure that other workers remain well clear of the operation when operator cannot see all parts of the jib and bucket</li> </ul>	<ul style="list-style-type: none"> <li>There is no worker or member of public within swivel radius of machine during excavation</li> <li>Workers in the trench are kept well away from the face and those at ground level kept outside slewing radius of the machine.</li> <li>Experienced banks man is used to guide the operator and to ensure that other workers remain well clear of the operation when operator cannot see all parts of the jib and bucket</li> </ul>	Contractor under supervision of Engineer
27.	Hazard due to electrocution	<ul style="list-style-type: none"> <li>Insulation and earthing of electrical panel and cables</li> </ul>	<ul style="list-style-type: none"> <li>Control rooms for crusher, pug mill, concrete batch plant, bitumen heating facility, and generator sets</li> <li>Power outlets at workshops</li> </ul>	Monthly during construction	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether control panels and cabling are well insulated and earthed</li> </ul>	<ul style="list-style-type: none"> <li>Control panels and cabling are well insulated and earthed</li> </ul>	Contractor under supervision of Engineer
28.	Risk of contracting waterborne diseases (diarrhoea, cholera, and amoebic dysentery)	<ul style="list-style-type: none"> <li>Supply of safe drinking water to workers by Contractor</li> <li>Availability of sanitation facilities with cleaning water at work sites</li> </ul>	<ul style="list-style-type: none"> <li>All work sites for drinking water</li> <li>All work sites that last for a least 1 month for sanitation facilities</li> </ul>	Twice per month during construction	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether safe drinking water is supplied to workers at all work sites</li> <li>Whether all work sites that last for a month are equipped with sanitation facilities with cleaning water</li> </ul>	<ul style="list-style-type: none"> <li>Safe drinking water is supplied to workers at all work sites</li> <li>All work sites that last for a month are equipped with sanitation facilities with cleaning water</li> </ul>	Contractor under supervision of Engineer

Environmental and Social Impact Assessment Report for the Proposed Rehabilitation of Bujumbura – Rumonge Road (78km) Section

No.	Impact	Parameter/ Aspect to be Monitored	Sampling area	Monitoring Frequency	Measuring Method	Measuring Unit	Target Level/ Indicator	Responsibility
	after drinking unsafe water or eating unsafe food							
29.	Risk of excessive exposure of workers and communities to ionizing radiation resulting from the use of nuclear gauges	<ul style="list-style-type: none"> <li>Storage of gauge</li> <li>Transport of gauge it is transported</li> <li>Protection of workers and public against exposure to radiations</li> </ul>	<ul style="list-style-type: none"> <li>Storage facility for nuclear gauges</li> <li>Work site (where the gauge is used)</li> </ul>	Weekly	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether the Contractor has a licenses to own and use the nuclear gauges</li> <li>Whether the gauges are stored in accordance with the law</li> <li>Whether transportation of gauges done by a dedicated car marked with warning signs</li> <li>Whether trained staff are allowed to operate gauges</li> <li>Whether working areas are demarcated by reflective tapes</li> </ul>	<ul style="list-style-type: none"> <li>The Contractor has licenses to own and use the nuclear gauges</li> <li>Gauges are stored in accordance with the law</li> <li>Gauges transported by a dedicated car marked with warning signs</li> <li>Only trained staff are allowed to operate the gauges</li> <li>Working areas are always demarcated by reflective tapes</li> </ul>	Contractor under supervision of Engineer
30.	Increased incidence of HIV / AIDS	<ul style="list-style-type: none"> <li>HIV/AIDs alleviation program</li> <li>Distribution of condoms</li> </ul>	Camps, work sites, toilets	Monthly	<ul style="list-style-type: none"> <li>Visual observation</li> <li>Review of training reports</li> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether condoms are distributed at strategic points</li> <li>Whether there is evidence that the Contractor conducts training</li> <li>Whether No. of trainings conducted are in accordance with approved training programme</li> </ul>	<ul style="list-style-type: none"> <li>Condoms are distributed at strategic points</li> <li>There is evidence that the Contractor conducts training</li> <li>Whether No. of trainings conducted are in accordance with approved training programme</li> </ul>	Contractor under supervision of Engineer, approved HI/AIDs provider
31.	Loss of employment	<ul style="list-style-type: none"> <li>Compliance with Employment and Labour relations act by the Contractor</li> </ul>	Work sites and Contractors Human resources Office		<ul style="list-style-type: none"> <li>Review of training reports</li> <li>Visual observation</li> <li>Interview with workers</li> </ul>	<ul style="list-style-type: none"> <li>Whether laid off workers receive their terminal benefits in accordance with the law</li> </ul>	<ul style="list-style-type: none"> <li>Laid off workers receive their terminal benefits as stipulated by the law</li> </ul>	Contractor under supervision of Engineer

The total cost for implementing mitigation measures and monitoring plans, excluding the cost of compensation of affected properties is therefore **USD 744,330 (USD Seven hundred forty four thousand three hundred thirty only)**

### **9.3 DETAILS ON MONITORING FOR POLLUTION OF SURFACE WATER**

As indicated in Table 28, the effects of construction activities across/along main permanent rivers monitoring and reporting on water quality shall be done by the Contractor (through E & S Manager). The monitoring shall basically entail routine monitoring of rivers across the project road during earthworks and construction of bridges or culverts. It shall consist of making field measurements of turbidity and pH. The procedure for routine monitoring shall be as follows:

- Two water sampling points shall be established at all major rivers and those used for domestic purposes, one 100m upstream, and the other point will be placed 50 down stream
- Measurements of pH (a gauge for effectiveness of control of water pollution during concreting activities) and Turbidity (NTU) [a gauge for effectiveness of soil erosion control] shall be taken at point approximately 30 minutes before the start of construction activity each day.
- pH measurement shall be taken at each site twice/day during construction activities
- Measurements for Turbidity and pH will be taken at mid depth in the water column.

### **9.4 RESPONSIBILITIES FOR MONITORING IMPLEMENTATION OF ESMP**

To ensure effective implementation of the mitigations measures, the Supervising Engineer shall deploy an Environmental and Social Specialist (ESS), who will be responsible for regular monitoring of implementation of ESIA, ESMP, Site Specific Environmental and Social Management Plan (SSEMP), and Site Specific Health and Safety Management Plan (SSHSM) by the Contractor. He/she should as well be responsible for ensuring that reporting of implementation of the measures is completed in accordance with the requirements.

The ESS will have the following responsibilities:

- Review Contractor's SSEMP and SSHSM
- Monitoring the effectiveness of the ESMP and other mitigation measures.
- Asses the performance of environmental controls and proposed mitigation measures
- Ensure that the Contractor corrects/ review mitigation measures that are not functioning acceptably
- To provide regular reports on monthly basis on the status of the Contractor's compliance with the ESIA, ESMP, SSEMP, and SSHSM.
- When available on site, attend monthly progress meetings
- To provide input for the preparation of monthly progress report by the Supervising Engineer

The ESS shall visit the project site for 14 days every month. During the visit the ESS shall carry out site inspection and review relevant Contractors documents to determine the compliance of the Contractor with SSHSM. If necessary, the ESS may interview Contractor's staff.



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If the ESS believes that there is a potential for unacceptable impacts, he/she may require changes in the operating procedures or additional mitigations measures. If on the opinion of the ESS, there is serious environmental, social, of health and safety violation by the Contractor, he/she may advise the Resident Engineer to suspend part or all works, until such time that the Contractor has rectified all the serious environmental, health and safety deficiencies to the satisfaction of the Engineer.

## **SECTION 10: SUMMARY OF PUBLIC CONSULTATIONS AND OPINION EXPRESSED**

An important element in the process of impact assessment is consultation with stakeholders (Interested and Affected Parties) to gather information needed to complete the assessment. It is a process whereby different stakeholders influence and share their views regarding development initiatives, decisions, and resources that have an impact on their lives and livelihoods.

Public consultation encourages easier project acceptance and reduces resistance which would otherwise slow down or hamper the project implementation.

Fundamentally these consultations are intended to collect views, concerns, perceptions of the stakeholders related to the rehabilitation of the road. Information related to population, socio-economic activities, environmental issues, sources of livelihood and living standards are also collected.

Stakeholders and public involvement was therefore aimed at assisting the consultant in:

- Determining the scope of the ESIA review
- Deriving specialist knowledge about the site
- Evaluating relative significance of the likely impacts
- Improve project design and, thereby, minimize conflicts and delays in implementation;
- Proposing mitigation measures
- Ensuring that the ESIA review is objective, truthful and compete
- Facilitate the development of appropriate and acceptable entitlement options;
- Increase long term project sustainability and ownership

### **10.1 PROJECT STAKEHOLDERS**

The project stakeholders of this project can be classified into the following categories:

- Ministry of Transport, Public Works, and Equipment: Environment Section is responsible for overseeing management of environment within the road sector and the preparation/implementation of ESIA required in the road sector
- The project proponent – Office des Routes
- Mukaza, Muha, Kabezi, Muhuta, Rutunga, Bugarama, and Rumonge Communes' administration under the officer responsible for Technical Support for Economic and Business Development
- Government institutions:
  - a) Directorates of Environment and Climate Change and Forestry under Burundian Office for Environment Protection (OBPE)
  - b) Department of Water Resources Management and Sanitation under Ministry of Water, Environment, and Urban Planning
  - c) Lake Tanganyika Authority (LTA)
  - d) Municipal Technical Services (SETEMU)

- e) The Board of Production and Distribution of Water and Electricity (REGIDESO) – Water Production and Distribution
- f) The Board of Production and Distribution of Water and Electricity (REGIDESO) – Electricity Supply and Distribution
- (i) The Burundian Office of Mines and Quarries (OBM)
- (ii) Burundi Backbone System (BBS)
- Communities in the DIZ and AI of the project area

During ESIA study all the above stakeholders were consulted as shown by stakeholders consultation form in Appendix III which is signed by each of the stakeholder who was consulted.

## 10.2 HOW STAKEHOLDERS WERE INVOLVED

Prior to the commencement of detailed ESIA, the experts visited the OdR in Bujumbura to inform them of the impending ESIA as well as obtain environmental and social issue of concern.

Consultation with statutory bodies and institutions were made through direct personal interviews. The agenda for these consultations included:

- Presenting the Project
- Defining the provincial/ Communal and institutional frameworks
- Discussing recent experience with respect to compensation eligibility criteria and entitlement packages
- Obtaining from the authorities their environmental and socio-economic concerns and perceptions regarding the proposed road
- Presence of public utilities along and across the project road and how the project is likely to affect the utilities
- Environmental profile in the project area, possible environmental impacts of the project and mitigation measures
- Existence of any protected forest or wildlife areas in the neighbourhood of the project area and possible impact of the project to the same.

The following table (Table 25) lists dates, names, and issues that were discussed with statutory officials as well as governmental and non-governmental organizations that were consulted during ESIA study.

**Table 25: Schedule of Consultation with Statutory Bodies and Institutions during ESIA Study**

Date	Name of Person	Title	Issues Discussed
14-17/10/2017	Eng. Pastel BISEGERE	Planning Engineer, OdR	Organizing and coordinating meetings with various stakeholders
14/10/2017	Daniel NDIKUMANA,	Environmentalism - OdR	<ul style="list-style-type: none"> <li>• Environmental problems along the project road</li> <li>• Potential environmental impacts of the proposed road rehabilitation</li> <li>• Measures to mitigate potential</li> </ul>

Date	Name of Person	Title	Issues Discussed
			environmental impacts
14/10/2018	Alphonse POLISI –	Director of Environment and Climate Change, (OBPE)	<ul style="list-style-type: none"> <li>• Legislations governing environmental management</li> <li>• Procedures for conducting ESIA</li> </ul>
19/10/2017	Eng. Jean Morie MBIRANTIZE	Director General, LTA	<ul style="list-style-type: none"> <li>• Environmental problems along the project road</li> <li>• Proposal for measures that should be taken by the project to check the problems</li> </ul>
25/10/2017	Gabriel HAKIZAMANA,	Director of Environment, LTA	Ditto
30/10/2017	Revocate MUKAMA	Director of Environment and Climate Change	Procedures for conducting ESIA
30/10/2017	Claude HAKIZIMANA	Directorate of Forestry, OBPE	Presence of any forestry protected area and legislation governing management of forestry protected areas
30/10/2017	Eng. Joseph NIMFASHA	Water Quality and Sanitation Engineer, Department of Water Resources Management and Sanitation, Ministry of Water, Environment, and Urban Planning	<ul style="list-style-type: none"> <li>• Environmental problems along the project road</li> <li>• Potential impacts of the proposed road projects and proposal for mitigation measures</li> </ul>
30/10/2017	Eng. Christopher NYABENDA	Municipal Technical Services	<ul style="list-style-type: none"> <li>• Water supply profile along and across the project road</li> <li>• Potential impacts of the proposed road project on water supply utilities and proposal for mitigation measures</li> </ul>
30/10/2017	Eng. Claver NDAYIHIMBAZE	Board of Production and Distribution of Water and Electricity – Water Production and Supply	<ul style="list-style-type: none"> <li>• Water supply profile along and across the project road</li> <li>• Potential impacts of the proposed road project on water supply utilities and proposal for mitigation measures</li> </ul>
30/10/2017	Eng. Engene KARORERO	Board of Production and Distribution of Water and Electricity – Electricity Supply and Distribution	<ul style="list-style-type: none"> <li>• Power supply profile along and across the project road</li> <li>• Potential impacts of the proposed road project on electric power supply utilities and proposal for mitigation measures</li> </ul>

Date	Name of Person	Title	Issues Discussed
30/10/2017	Edmund BIGENDA KO	Director, Burundian Office of Mines and Quarries	Legislations governing procedures for acquiring mining licence
31/10/2017	Callixte HAYARIMANA,	Burundi Backbone System	<ul style="list-style-type: none"> <li>• Fibre optic cable profile along and across the project road</li> <li>• Potential impacts of the proposed road project on fibre optic cable system utilities and proposal for mitigation measures</li> </ul>
31/10/2017	Eng. Venuste NDABAGOYE	Technical Support for Economic and Business Development, Muha Commune, Bujumbura Rural Province	<ul style="list-style-type: none"> <li>• Water supply profile along the project road</li> <li>• Environmental problems along the project road</li> <li>• Potential impacts of the proposed road projects and proposal for mitigation measures</li> </ul>
31/10/2017	Ferdinand NDIKUMANA,	Technical Support for Economic and Business Development, Kabezi Commune, Bujumbura Rural Province	<ul style="list-style-type: none"> <li>• Water supply profile along the project road</li> <li>• Environmental problems along the project road</li> <li>• Potential impacts of the proposed road projects and proposal for mitigation measures</li> </ul>

The public was consulted through public meetings which were conducted at selected collines. The main objectives of community consultations were:

- To provide clear and accurate information about the project to the communities along the proposed road
- To obtain main concerns and perceptions of the population and their representatives regarding the road;
- To obtain opinions and suggestions directly from the affected communities on their preferred mitigation measures

To ensure that these groups participate in meetings, advance notices were sent to colline government leaders to inform the communities, including disabled, women, aged people, and youth of the meeting. Secondly, every colline indicated the convenient date, time, and venue to convene the meetings. In collaboration with village leaders, central locations were identified for the meeting venues.

Consultations and public meetings were held in six (6) different venues to allow community members to participate fully by arranging close to their places of residences. People from groups of different interests were involved as well as ward and village and district officials whereby

varying views, concerns and questions about the project were expressed by communities and other stakeholders and were collected by the consultant team for review and or further use.

During consultation the stakeholders were briefed on the proposed road project as well as the ESIA process, and the governing legislations. The public was then given opportunities to air their views and opinions concerning the project. Potential impacts – both positive and negative impacts as well as mitigation measures were also gathered as presented in the preceding section.

Presented in Table 26 is a schedule of public consultative meetings, which were held in different villages along the project road corridor. The schedule shows dates, participated Villages, and the number of community members that participated in the meetings.

Table 26: Schedule of Consultative Meetings with Communities along the road

No	Date	No of Participants	
		Colline	Participants
1.	19 <sup>th</sup> October 2017	Karonda	90
2.	19 <sup>th</sup> October 2017	Mutambara	87
3.	19 <sup>th</sup> October 2017	Rumonge	47
4.	20 <sup>th</sup> October 2017	Kizuka	55
5.	20 <sup>th</sup> October 2017	Magara	62
6.	20 <sup>th</sup> October 2017	Gitaza	11

The meetings were chaired by colline chairmen and recording of minutes was done by colline secretary. Copies of minutes of the meetings are attached as Appendix III. It is important to note that although the minutes were recorded by the colline representatives, the consultant also recorded issues, concerns, and views of the participants to be included in the public consultation chapter of this report to ensure that all discussed issues do not pass unrecorded.

## 10.3 RESULTS OF STAKEHOLDERS CONSULTATION

### 10.3.1 Consultation with Statuary Bodies and Institutions

The following table (Table 27) summarizes issues and concerns that were raised by the statutory bodies and institutions that were consulted during ESIA study.

Most of the concerns which were raised by stakeholders during consultation have been incorporated in the ESIA. Nevertheless, some of the concerns or proposals by the stakeholders could not be included due to technical and legal reasons.

**Table 27: Results of consultation with Statuary Bodies and Institutions**

No.	Institution/ Village	Issues/ concerns
1.	Daniel NDIKUMANA, Environmentalist, OdR	<ul style="list-style-type: none"> <li>• The road section between Kabezi and Bugarama is very close to L.Tanganyika and its land is prone to land slide because of its steep slopes.</li> <li>• Large volumes of sediment and large stones and rocks are transported by runoff from the mountain to the L.Tanganyika causing sedimentation of the lake.</li> <li>• A strong hydrological study must be conducted on the mountainside to enable establish measures to combat the problem of land slide and transport of sediment and stones and rocks to the lake and settlements along water courses. Sediment transported to the lake cause damage to breeding sites of fish and so reduces the population of fish. It is important to devised measures to check this serious environmental problem.</li> <li>• Settlements along L.Tanganyika are contrary to Law on Water Code. These settlements have to be removed</li> <li>• Several road sections are located very close to L.Tanganyika. Such sections pose dangers to road users due to possible traffic accidents. A member of parliament drowned in the lake a few years ago after losing control of her while driving along the road. Measures, such as guard rails have to be installed along such sections to prevent crashes into the lake.</li> <li>• A number of small scale palm oil extraction factories that are located along rivers; along the project road discharge waste water to the rivers. Apart from polluting the rivers, the waste water also cause pollution of L.Tanganyika because entirely all the rivers discharge into L.Tanganyika. The ESIA should propose measures that will prevent continued pollution of the lake.</li> <li>• The project road traverses a forest protected area which is located about 75km from Bujumbura toward Rumonge. The Contractor should not borrow materials from the protected area</li> <li>• L.Tanganyika is also a water resource protected area. Apart from different species of fish, the lake is a home to hippopotamus and crocodiles. At Bugarama crocodiles and hippopotamus have tendencies to get close to the coast of the lake.</li> </ul>
2.	Alphonse POLISI – Director of Environment and Climate Change, Burundian Office for Environment Protection (OBPE)	<ul style="list-style-type: none"> <li>• The Burundian Office for the Protection of the Environment (OBPE) was created by Decree N ° 100/240 of October 29, 2014</li> <li>• Among the duties and responsibilities of OBPE are: <ul style="list-style-type: none"> <li>a) Ensure compliance with the Water Code, the Forest Code, the Environmental Code and other texts related to the protection of the environment</li> <li>b) Enforce environmental standards and propose all safeguarding and protection measures;</li> <li>c) Monitor and evaluate development programs to ensure compliance with environmental standards in</li> </ul> </li> </ul>



No.	Institution/ Village	Issues/ concerns
		<p>the planning and execution of all development projects that may have a negative impact on the environment;</p> <p>d) Ensure the implementation of the obligations arising from international environmental conventions and agreements to which Burundi is a party;</p> <p>e) Identify and propose new protected areas and other areas rich in biodiversity requiring special protection measures</p> <p>f) Put in place mitigation and adaptation mechanisms to climate change</p> <ul style="list-style-type: none"> <li>• The procedure to conducting an ESIA in Burundi is that the proponent of the project which in accordance with the law requires an ESIA required to the collect standard Terms of Reference (ToR) from the office Head of Environment and Climate Change. The proponent shall then customize/ improve the ToR to suit the proposed project.</li> <li>• The proponent then submits the improved/ customized ToR to OBPE for review before approving it. The approved ToR will therefore be used by the project proponent to conduct the ESIA study</li> <li>• The project proponent then conduct ESIA study in accordance with the ToR and submit the ESIA report to the Minister for the Ministry of Water, Environment, and Urban Planning, with two copies to the Director General of Director of OBPE for review and approval</li> </ul>
3.	Claude HAKIZIMANA - Directorate of Forestry, OBPE	<ul style="list-style-type: none"> <li>• The project road traverses along a natural forest protected area, named Nkayamba Natural Forest Reserve</li> <li>• The forest reserve is a habitat of such wildlife as primates, antelopes, jackals, and different species of birds</li> <li>• Only two types of human activities are allowed in the forest, i.e. research and tourism. Any other anthropogenic activities (e.g. cutting of trees, borrowing of construction materials, settlements are forbidden)</li> <li>• Common environmental problems are encroachment of the forest reserve by settlements, poaching of animals, fire burning, tree cutting, and illegal agriculture</li> <li>• Rehabilitation of the road will have the following environmental impacts: <ul style="list-style-type: none"> <li>a) Loss of trees due to the widening of the current road. A strip of about 400m on the LHS of the road will be mostly affected. The possibility of aligning the road to the RHS should be considered in order to minimize this possible impact</li> <li>b) During construction, generation of noise and vibrations is likely to scare animals from the forest, causing them to migrate away from the protected area towards settlements areas. The migration of animals to settlement area may cause injury to the locals as well as domestic animals such as goat. Since</li> </ul> </li> </ul>

No.	Institution/ Village	Issues/ concerns
		<p>noise and vibrations cannot be avoided, the project should sensitize the locals not to kill animals when seen in their neighbourhood, after escaping from the forest reserve.</p> <p>c) Increased vehicular speeds after the road is rehabilitated are likely to cause road accidents, with possible road kills. Speed humps should be installed at the forest reserve section in order to control traffic speeds. In addition, warning sign should be posted at both approaches to the forest reserve to warn drivers to slow down</p> <p>d) Spoiling of unusable material in the protected area during construction will cause damage to the biodiversity of the forest. Spoiling of material should not be done in the forest</p>
4.	Eng. Joseph NIMFASHA, Water Quality and Sanitation, Department of Water Resources Management and Sanitation, Ministry of Water, Environment, and Urban Planning.	<ul style="list-style-type: none"> <li>• Major environmental problems along the project road are: <ul style="list-style-type: none"> <li>a) Encroachment of riparians for farming</li> <li>b) Poor enforcement of laws pertaining to water resources management and protection because of limited financial resources and poor collaboration between local administration and central government</li> <li>c) Settlements close to water resources, including L.Tanganyika. These settlements are illegal as according to Article 5 of Water Law of 26<sup>th</sup> March 2012, human activities are prohibited within 150m from L.Tanganyika, 25m from rivers banks. The settlements are however entitled for compensated as they have been there before the law was enacted</li> <li>d) Regarding settlements along the road, the right of way is 6m from the edge of the road</li> </ul> </li> <li>• The proposed project rehabilitation will improve the economy of the country, livelihood of the people through facilitation of transport people and transportation of goods</li> <li>• Permits to borrow construction materials such as sand and stones is issued by the department</li> <li>• The project will have the following impacts: <ul style="list-style-type: none"> <li>a) Relocation people that are close to the road. The road section between Kanyosha and Rumonge will be mostly affected as settlements are very close to the road.</li> <li>b) During the construction of large bridges such as R.Muha, R.Kanyosha, Mugere, etc. will cause sedimentation of water, deteriorating water quality. Measures to reduce sedimentation should be implemented</li> </ul> </li> </ul>
5.	Eng. Jean Morie MBIRANTIZE – Director General, LTA	<ul style="list-style-type: none"> <li>• The proposed road upgrading is a good initiative as it aimed at improving the poor road and so transport and transportation of people and goods</li> <li>• The settlements that are located as close as 2m to the edge of the lake needs to be demolished as they illegally constructed</li> </ul>

No.	Institution/ Village	Issues/ concerns
		<ul style="list-style-type: none"> <li>• During rains, the runoff from the Mumirwa steep mountains on the LHS of the lake transport substantial volume of sediment from the mountains to lake which causes serious sedimentation of the lake. As it is impossible to keep the runoff away from the lake, the transport of sediment to the lake can be substantially minimized by reducing the speed of runoff. At present there is means of prevention of sediment and rubbles. This can be achieved by constructing storm water collector drains and siltation ponds along the road. The drains and ponds should slow down the speed of runoff as well as cause sediments to settle in the ponds before the water is discharged to the lake</li> <li>• The transport of sediments from the open land on upper side of the mountains should be minimized by preventing soil erosion through vegetating the mountains with deep-root vegetation such as trees and grass</li> </ul>
6.	Gabriel HAKIZAMANA, Director of Environment, LTA	<ul style="list-style-type: none"> <li>• Among environmental problems of the lake along the project road are:               <ol style="list-style-type: none"> <li>a) Settlements along the bank of the lake, as close as 2m from the edge of the lake. These settlements must be relocated in accordance with the law as apart from causing damages to the banks of the lake, they pollute the lake by domestic waste water</li> <li>b) The road is located very close to the lake. In some section the RHS edge of the road is as close 3m from the edge of the lake. Apart from jeopardising the safety of traffic. The design consider aligning the sections that are very close to the lake away from the lake as much as it is practical</li> <li>c) Sedimentation of the lake by soil material that transported by runoff from the mountains. LTA has made several initiatives to protected sedimentation of the lake by material being transported from the mountains in the eastern side of the lake. Among the initiatives done by LTA is the planting of grass and trees on the upper slopes of the Mumirwa Mountains in order to slow down the speed runoff. It is proposed that the road project also implement mitigation to minimize future damage of the road by erosion as well sediment transport from the mountain to the lake. This can be achieved by planting vegetation on the mountain by vetiver and elephant grasses as well as deep rotted trees. In addition, immediate discharge of turbid runoff from the road to the lake should be prevented. This can be achieved by constructing long but gentle side drains that will collect runoff for a longer distance and discharge it to siltation ponds before the water is discharged to the lake across the road. It is also recommended to protect/ stabilize the RHS of the road (bank of the lake) by planting deep rotted trees</li> </ol> </li> </ul>
7.	Eng. Christopher NYABENDA, Municipal Technical Services, called “Services Techniques Municipaux” (SETEMU)	<ul style="list-style-type: none"> <li>• There are two types of management of sanitation systems in Bujumbura City: the Onsite and Offsite sanitation systems. Onsite sanitation is a sanitation in which excreta and wastewater are collected, stored or treated at the same location (same plot) where they are generated. These include pit latrines and septic tanks</li> </ul>

No.	Institution/ Village	Issues/ concerns
		<p>with soak pit. The Off-site sanitation is a sanitation in which excreta and waste water are collected and conveyed by a sewerage system before being centrally treated by waste water stabilization ponds that are located at Buterere in the outskirt of the city. Only a small percentage of the Bujumbura's population is connected to centralized sanitation treatment system, such areas include Rohero, Bwiza, Nyakaviga, Buyenzi, Ngagara, Aziatiki, and Mutaga South zones. The rest of the population use the onsite sanitation system.</p> <ul style="list-style-type: none"> <li>• The main sewer line runs at the middle of the road between the road section between Waka Waka Pub and the office Building for the Ministry of Transport, Public Works, and Equipment. In addition lateral sewer lines runs perpendicular to the road to connect to the main sewer lines.</li> <li>• Collection and disposal of solid waste in Bujumbura is contracted by SETEMU to privately owned companies who are directly paid by customers. In return, the companies pay a certain percentage of their collections to SETEMU. The collected wastes are transported and disposed of at a centralised municipal solid waste dump site which is located at Buterere - Muvone</li> <li>• During rehabilitation of the road, the sewer lines are likely to be damaged if construction is not done carefully. <ul style="list-style-type: none"> <li>a) To mitigate the impact it is strongly recommended that the design of pavement level should maintain the present level in order to avoid causing damage to the sewer line and as well as burying the manholes.</li> <li>b) The Contractor should works closely with SETEMU is order to establish exact locations of the sewer lines. The designer of the road should obtain the sewer line layout as well as profile from SETEMU</li> </ul> </li> <li>• During construction, the Contractor should avoid dumping solid material in the sewer line (through manhole) in order to avoid clogging the sewer line</li> <li>• The manholes should not be covered with material to allow the operation of the manholes</li> </ul>
8.	Eng. Claver NDAYIHIMBAZE, The Board of Production and Distribution of Water and Electricity “La Régie de Production et de Distribution d'Eau et d'Electricité” (REGIDESO) – Water	<ul style="list-style-type: none"> <li>• The main source of domestic water supply for the municipal is L.Tanganyika. Water is pumped from the lake to a treatment plant located in the neighbourhood of national Radio and Television station, within the city. The treated water is the pumped to elevated reservoirs that are located at Rohero and Kamenge before being distributed by gravity to the consumers.</li> <li>• Water supply main and distribution lines, some of them of concrete run along and across the project road between the start of the project road up to Kanyosha. Pipe lines of 150mm, 175mm, 200mm, 400mm. In addition the main line from the treatment plant to reservoirs crosses the project road at the junction to the</li> </ul>

No.	Institution/ Village	Issues/ concerns
	Production and Supply	<p>national radio and television station.</p> <ul style="list-style-type: none"> <li>The road rehabilitation is likely to cause damages to water pipe lines. To mitigate the impact is strongly recommended that the Contractor works closely with REGIDESO so that exact locations of the water pipe lines can be established. The Contractor should also obtain a map showing the layout of the pipe lines</li> </ul>
9.	Eng. Engene KARORERO, The Board of Production and Distribution of Water and Electricity “La Régie de Production et de Distribution d'Eau et d'Electricité” (REGIDESO) – Electricity Supply and Distribution	<ul style="list-style-type: none"> <li>The power supply lines in the city have been installed underground. Some of the power lines run along and across the road. The power lines, all them made of copper are located between 2m and 2.5m from the edge of the road and 0.5m to 0.8m deep. Some of the cables have been installed in sleeves while others are not sleeved. The power lines comprise <ul style="list-style-type: none"> <li>a) Medium tension lines: 3X 185mm<sup>2</sup> and 3X120mm<sup>2</sup></li> <li>b) Low voltage (220/380V): 4X35mm<sup>2</sup>, 4X50mm<sup>2</sup>, 4X50mm<sup>2</sup>, 4X75mm<sup>2</sup>, 4X100mm<sup>2</sup></li> </ul> </li> <li>Construction of the road if not done carefully is likely to cause serious impact to the city because of possible power interruption. To prevent damage and so power interruption, it recommended that: <ul style="list-style-type: none"> <li>a) The Contractor must work very closely with REGIDESO. The Contractor should consult REGIDESO to establish exact locations of the power lines along and across the road.</li> <li>b) Service ducts should be installed across the road to allow future extension of the power supply without damaging the road</li> </ul> </li> </ul>
10.	Edmund BIGENDAKO, Director, The Burundian Office of Mines and Quarries (“L’Office Burundais des Mines et Carrières” - OBM)	<ul style="list-style-type: none"> <li>The procedure for acquiring borrow and quarry site is as follows: <ul style="list-style-type: none"> <li>a) Identify site for borrowing of material</li> <li>b) Compensate owner of the land form which suitable borrow/ quarry sites has been identified</li> <li>c) OdR applies to OBM to apply for a licence, specifying identified site(s), land size and quantities of material that will be extracted</li> <li>d) OBM reviews the applicable and approves as necessary. During the entire lifetime of the licence OBM monitor the operations of borrow and quarry sites.</li> </ul> </li> </ul>
11.	Callixte HAYARIMANA, Burundi Backbone System (BBS)	<ul style="list-style-type: none"> <li>Construction of Burundi Backbone System was completed in year 2010. The system is connected to the outside world through Tanzania via Manyovu, Kigoma.</li> <li>Among the customers of BBS are all telecommunications companies, except Lumitel, all banks, all universities, all government institutions (e.g. revenue authority, National radio and televisions, immigration department, military, police), hotels, etc.</li> <li>Construction activities, especially construction of drainage structures and widening of the road are likely damage the fibre optic cable as the cable is laid along the road and in some section the cable is supported by</li> </ul>

No.	Institution/ Village	Issues/ concerns
		<p>drainage structures. Damage of the cable will cause serious impact to the beneficiaries and the nation as well. To prevent damage to the cable it is strongly recommended that the Contractor works closely with BBS to establish exact location of the cable. BBS is prepared to provide the Contractor with a layout drawing of the cable</p>
12.	<p>Eng. Venuste NDABAGOYE, Technical Support for Economic and Business Development, Muha Commune, Bujumbura Rural Province</p>	<ul style="list-style-type: none"> <li>• Common environmental problems along the project road are: <ul style="list-style-type: none"> <li>a) Unlike the road section between R.Muha and R.Kanyosha which has a road side drain to collect runoff and discharge to the rivers, the road section between R.Kanyosha and R.Mugera do not have a road side drain to collect and discharge runoff to the nearby rivers. As a result during rainy season, as there is no control of runoff from uphill cause floods and serious damages to private properties. The new road should consider providing side drain to prevent such problems</li> <li>b) Lack of vegetation along the road to control the speed of runoff</li> </ul> </li> <li>• Source of domestic water: supplied with drinking water by REGIDESO</li> <li>• The proposed road is likely to cause the following impacts: <ul style="list-style-type: none"> <li>a) Destruction of houses and other properties along the road to allow widening the road</li> <li>b) Damage to building along the road due to vibrations during compaction of the road. Kanyosha business centre is likely to be mostly affected as buildings are built very close to the road. The destruction of the building will cause serious conflict with commune government leaders as they won't be able to defend them. The mistake was done in the past by not preventing the people from building close to the road</li> <li>c) Construction activities will cause traffic congestion as the road will be closed and the traffic will have to be diverted somewhere else, most likely across residential area. Diversion of the traffic across residential area may cause dust generated (as the road are unpaved). The diverted traffic is also likely to cause accidents to children as well as damages to water pipe lines across street road as they laid very close to the ground surface</li> </ul> </li> </ul>
13.	<p>Ferdinand NDIKUMANA, Technical Support for Economic and Business Development, Kabezi Commune, Bujumbura Rural Province</p>	<ul style="list-style-type: none"> <li>• Common environmental problems along the project road are: <ul style="list-style-type: none"> <li>a) Soil erosion as caused by runoff from the Mumirwa steep mountains in the eastern side of the L.Tanganyika coastline</li> <li>b) Sedimentation of the lake Tanganyika by soil material brought by runoff</li> <li>c) Lack of safe and clean drinking water. Major source of drinking water for villages along the road is L.Tanganyika. The source is not safe because it is not treated and much polluted by sedimentation. The tanks and domestic points along the road are not operational. Efforts by the government to source water</li> </ul> </li> </ul>

No.	Institution/ Village	Issues/ concerns
		<p>from ground resource is on-going</p> <p>d) Lack of sanitation facilities for fishermen (most fishermen defecate in open areas), causing pollution of the lake. Efforts are on-going to construct public toilets</p> <ul style="list-style-type: none"> <li>• The proposed road is likely to cause the following impacts: <ul style="list-style-type: none"> <li>a) Destruction of houses and other properties along the road to allow widening the road as well as cracking of the houses due to vibrations during road compaction</li> <li>b) Damage to building along the road due to vibrations during compaction of the road</li> <li>c) Recently constructed water infrastructures along the road, in particular water tanks as well as pipe lines are likely to be damaged due to the widening of the road as they are close to the road</li> </ul> </li> </ul>



### **10.3.2 Consultation with Communities along the Project**

The following table (Table 28) summarizes issues and concerns that were raised by the public through public meetings and interviews during ESIA study. It is worth to note that the views are not categorized according to village/meeting because there were many repeated points.

**Table 28: Results of consultation with the Public**

N°	Issues/Comment from community	Remarks by Consultant
1.	Creation of Employment <ul style="list-style-type: none"> <li>The project will create minor jobs such as small business especially to people who like to do restaurant near building site, it is like food vendors. Small shop near the road.</li> <li>During road construction residents will get temporary and permanent employment from the contractors</li> </ul>	During the road construction, priority for employment opportunities should be given to villagers instead of bringing in people from other places to work. Local youth should be given a priority
2.	There will be easy communication between East Africa countries particularly those landlocked countries of Burundi, Rwanda, and Uganda. Burundi will be connected to important port of Dar-Es- salaam, this will easy transportation of goods	Valid comment
3.	Improved transport and transportation: Travelling will be facilitated because The road will be in good condition. People who cannot afford plane fares to Dar-es salaam and other parts of the country, will now travel by buses and arrive at reasonable time	Valid comment
4.	Improved access to social services: This road upgrading will enable villagers to reach social facilities in short time and at even lower fares	Valid comment
5.	Loss of land and properties: Many people will lose properties such as house structures, business premises, crops and land	The consultant will identify the affected people and present it to the Burundian government through the Office of Road of Burundi. The Burundian government will decide on how to deal with compensation issues
6.	Psychological disturbance: This will be faced by affected people who will lose their properties and not entitled for compensation	All eligible affected people will be compensated according to the Burundian regulations and international good practice
7.	Family conflicts among the married couples due to unfaithful partners who might develop sexual relationship with project workers: Divorce will be observed in some households in case the unfaithful couples develop sexual relationship with road construction workers and even with local colleagues	Some actions need to be developed among the communities to reduce the chances of such behaviour including self-disciplines among the family members and HIV/ Aids programme
8.	Increased HIV/ AIDS prevalence: Road project might increase growth rate of HIV/AIDS infections in the project area	The HIV/AIDS campaign will be launched along the road project construction to all project workers as well as communities surrounding the project
9.	Reduced traffic accident rates: The present road is too narrow as the result head to head	It is true that head on collision accidents will be

N°	Issues/Comment from community	Remarks by Consultant
	collision accidents have been happened. The expansion of the road will reduce such kind of accident. However, the increased traffic volume and speed vehicles will increase accidents	reduced but during construction the contractor will use heavy machines therefore safety traffic management need to be in place. A traffic management plan should be developed
10.	Strong relationship between East African countries 'citizens: People from different East African countries will move easily and increase interactions among themselves. Some will discover new places and make new friends. This interaction will be beneficial for all East African member states	This will have impact on different culture
11.	Number of Urban centres will increase: Along the road, there will be built urban centres especially for expanding business	Valid comment
12.	Deteriorating of education status in the project area: Children living crosser to the road will lose interest in studying because they will look for jobs in this project. Also young ladies will flirt with project workers, the project workers will seduce women as they will have reliable source of income than some villagers who depend on seasonal crops	Local administration is called to conduct sensitization in order to prevent this to happen. There should be effort from the parents, contractors and communities administrations to sort out this problem
13.	Students/pupils absenteeism from school: Due to the road construction many students/pupils might drop out from school in search for unskilled job. This might cause a decline in the quality of education in the project area, therefore school committees, teachers, education administrators, parents and students should set clearly strong policy and rules to guide/ protect students/pupils during this implementation of the road	Local administration is called to conduct sensitization in order to prevent this to happen. There should be effort from the parents, contractors and communities administrations to sort out this problem
14.	Business will increase due to the new road that will be well built. Traders will take short time to go to buy goods and the movement of goods will increase (in and out of goods): The proposed project will increase number of buyers and sellers (increased demand). Increased demand will raise prices of farm produce, handcraft producer, service provider and consequently increased income for business people, hence accelerated quality of life	Valid comment
15.	Increase in road accidents: Many people are not familiar with road signs especially children, elders and while others are normally drunk while crossing the road	Sensitization is needed to empower people on road safety including use and s signs
16.	Family instabilities: The project workers are likely to solicit couple for unsafe sex; this might cause conflict within families or breaking of marriages contracts (divorce).	Being aware of that, local leaders is called to mobilize people to be faithful to their partners because this will happen to unfaithful couples

N°	Issues/Comment from community	Remarks by Consultant
17.	Unfair compensation: The villagers are worried that the government might compensate them fairly, at rates lower than actual ones	The government will compensate eligible affected person according to the government policy
18.	Replacement of social infrastructure: If the project affect any public property e.g. school, water facilities, village market, church, mosque or any other institution, Government should make sure that those properties are relocated, for instance at Rumonge village there is community water well, community market and worshipping structures	All affected community structures will be compensation and the users will be able to elect a new structure for use
19.	Compensation procedures: Compensation exercise should be implemented in a participatory manner and compensation done on tome	Valid comment
20	Adequate time should be provided to affected people for relocate	The Burundian legislations and good international practice will be adopted
21.	Demolition of the infrastructure: During this road rehabilitation, public and private infrastructure will be demolished	Public infrastructure will be replaced and private ones will be compensated to eligible PAP
22.	Fight of HIV/AIDS: The villagers suggested that education program for HIV/AIDS has to be developed and implemented	Valid comment
23.	Competent contractor is required for sustainable road: They want the Government to choose the best contractor to avoid sub-standard road that are not sustainable	They want the Government to choose the best contractor to avoid sub-standard road that are not sustainable
24.	Increase of imported goods from outside: After road construction many people will be interested to import products from Tanzania due to reliable and smooth transportation services	Valid comment
25.	Employment should consider local people: Employers should be not only for foreigners but the contractor should recruit local workers	Where possible local people will be employed
26.	Rehabilitation should much done as soon as possible: The implementations should be as quick as possible so as people return back to their daily activities this is because the road rehabilitation will disturb people living crosser to the road	There is time schedule for implementation , we hope will be strictly followed
27.	A need to strengthen and increase capacity of existing health services: People will migrate into the project area. The available social services will be inadequate to cope with the demand	People will migrate into the project area. The available social services will be inadequate to cope with the demand
28.	Development in socio economic status of the village: The village in general will benefit to some extent as the road will enhance efforts on social development activities, i.e.	Valid comment

N°	Issues/Comment from community	Remarks by Consultant
	health, education, agriculture	
29.	Reduced transport costs: It will reduce transport cost which is now seems to be burden to us; Travelling from one place to another will be easy with reliable and comfortable transport	Valid comment
30.	Business near the road will increase: Due to accelerated movement of people, business near the road will increase such as: restaurants, snack bar that will serve people	Valid comment
31.	Village needs assistance for resettlement issues to make upright decisions: It is recommended that there should be capacity building to induce affected people to make right decisions on resettlement matters before implementation and after	The OdR shall conduct RAP study to deal with project affected people and eligible one will be supported according to Burundian laws and good international practice
32.	Social conflicts due to interactions with influx of people. It will also increase marital conflict within the family and between families: Family conflicts, separations and divorces caused by presence of project workers with more financial capabilities than local people	Family conflicts, separations and divorces caused by presence of project workers with more financial capabilities than local people
33.	Compensation of land used for borrowing of construction materials: People also wanted to know what will be the procedures to compensate people whose plots/land will be used as sources materials for road constructions, e.g. gravel, sand and stones	The eligible affected people will be compensated by the contractor if in the process the contractor damage people's properties. The agreement will be made between both parties
34.	Installation of bumps to reduce road accidents: It is important for the road design to put road bumps at every village centres and where the road transverse primary schools	Valid concern
35.	Promotion investment: The improvement of road will create a room for investors to invest their capital, technology and skills in Bujumbura that will boost development	Valid concern
36.	Increase of crime rates: Presence of crime cases will increase in the villages as a result of immigrants who are seeking employment. Also the improved road will make it possible to travel long distance within a short time therefore robbery and stealing can be easily committed if precautions are not taken	Community policing should be established and strengthening
37.	Children will give up school for minor job during road implementation: During implementation of this road project, students/ pupils might look for employment and give up schooling. Even young ladies will be seduced by project workers and some of them will be negatively affected by drop out from schooling	Deliberate effort is required by respective school management. Parents, school children and zone offices to develop some measures to reduce such chances of behaviour

N°	Issues/Comment from community	Remarks by Consultant
38.	Market opportunities: The interaction of people in the project area will accelerate the outflow of goods, establishment of enterprises and jobs opportunities	Valid comment
39.	Utilization of available natural resources: The project will promote utilization of natural resources and traditional things. Locally produced commodities will be sold in towns instead of relying on village market	Yes, workers from outside will dwell in hotels of Bujumbura and they will consume local products that will bring income for local village
40.	Accelerated development for Rumonge and neighbouring provinces: The proposed project will bring development because different people will be attracted to invest in Bujumbura due to availability of good transportation network	Valid comment
41.	Demolition of Kinindo Zonal office: Community members were also worried about the existing zone office that are likely to be removed	In the event the office is demolished, a replacement will be made
42.	Fulfilment of promise on road improvement: The government should fulfil their promises for this road rehabilitation because it is pending case. People are in need of this road	Valid concern
43.	Improve communication between Village leaders and contractor: The Contractor should also be told to report and maintain frequent communications with community leaders. This will help in solving some common conflicts between project workers and the community members	Valid concern
44.	Appreciation on community participation in the project: They congratulated this program because participation has been fully while in many projects participation have been minimal or without any consultation	Noted

## **SECTION 11: CONCLUSION AND RECOMMENDATIONS**

### **11.1 CONCLUSION**

The road upgrading is essential for the development of the economy of Burundi, the neighbouring countries of Tanzania, Rwanda, and EAC at large. The project will have both positive and negative impact to the environment and the local communities along it.

Among the positive impacts the project will have are improved road safety, reduced maintenance costs of the road, reduced operations costs of vehicles, reduced transport and transportation costs, improved tourism, and regional integration,

One of the most negative significant sociological impacts that will result from the road project will be loss of properties and resettlement owing to widening, realignment and improvement of the existing road safety. Other negative impacts will include soil erosion, deterioration of ambient air quality increased traffic accidents, pollution of water resources, and disruption of public utilities during the road construction.

The spread of HIV/AIDs, STIs associated with immigrant road construction workforce, sitting of the construction camps and later the presence of truck drivers that will use the project road were mentioned to be sociological impacts of the project. This was a major concern and was highlighted during public consultations and the measures to be taken by the Contractor were mentioned to the respective communities consulted.

Measures have been proposed to enhance impacts which are positive to the environment and the workers and local communities. For those impacts that are negative, mitigation measures have been proposed to avoid or abate them to the extent possible for the purpose of maximizing benefits of the road project and minimizing detriments of the project intervention to the communities.

### **11.2 RECOMMENDATIONS**

Our recommendation, based on the assessment of the available information is that the road project be taken a step further into upgrading. Furthermore, it is recommended that the proposed mitigations measures be made binding for the construction and operation of the project road. This will ensure that environmental impacts are minimized and properly monitored during construction and operation and that unnecessary incidents and accidents are avoided. What's more important, there are settlements close to the edge of the road that will have to be resettled to allow widening of the road as well as to improve the safety of the road. Since there is no law that stipulates the right of way of the road, owners of these properties will have to be compensated accordingly before commencement of the road rehabilitation.



## **APPENDIX I: LIST OF PROFESSIONALS WHO CONDUCTED THE ESIA STUDY**

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## APPENDIX II: PHOTOS



Photo 1: R. Muha at Km 1+500 (note riparian vegetation)



Photo 2: R. Kanyosha at Km 4+400 (note vegetable growing along the river)



Photo 3: Disposal of Solid Wastes on R. Kanyosha at Km 4+400



Photo 4: Waste water from Abattoir discharged to R. Mugere at Km 10+900



Photo 5: Aggregates making at R. Mugere at Km 10+900



Photo 6: R. Kanyamazi at Km 17+400 Note Tomato Growing on



the downstream riparian



Photo 7: R.Nyabigega at Km 21+400– Note Armco culvert silted to over half of its hydraulic capacity



Photo 8: R.Karonke at Km 23+100– note collapse of gabion protection works



Photo 9: R.Nyakabenga – note vegetation characteristic



Photo 10: R.Nyamusenye at Km 26+900



Photo 11: R.Rutunga at km 30+200 – note deposition of stones along the river



Photo 12: R.Kavugangwe at Km 32+200 – note sharp curved approaches to the River crossing





**Photo 13: R.Rugata at Km 48+300 – note settlements at the edge of the river**



**Photo 14: R.Ngonya at Km 51+200 – note PVC pipe used to discharge waste water from oil processing factory to the river)**



**Photo 15: R.Kaguwe at Km 56+800 – note palm tree on the river**



**Photo 16: Typical vegetation characteristics along Ruziba – Ramba Road Section**



**Photo 17: Typical vegetation along the road between Bujumbura and Muha**



**Photo 18: Typical vegetation along the road between Bujumbura and Muha**





**Photo 19: Waste water channel from Gitaza Market at Km 26+300 directed to L.Tanganyika**



**Photo 20: Erosion gully Development at Km 15+500 close to the edge of the road**



**Photo 21: Realigned Road Section due to Road damage by Gully Erosion at Km 15+800**



**Photo 22: Sharp curve very close to the lake around Km 27+600**



**Photo 23: Sharp curve very close to the lake around Km 29+300**



**Photo 24: Road Section very close to the edge of L.Tanganyika at Km 28+600**





**Photo 25: Settlements very close to road at Km 26+300 RHS (Gitaza)**



**Photo 26: Road encroachment by Settlements at Km 34+600**



**Photo 27: Road Encroachment by settlements at Rumonge**



**Photo 28: Typical stones transported from Mountain along R.Karonke (Km 23+100) downstream**



**Photo 29: Typical stones transported from Mountain along R.Karonke (Km 30+200) upstream**



**Photo 30: A Section of the Church which was destroyed by stones at Km 30+400RHS**





**Photo 31: Typical reservoir, 7m from the road at Km 21+200**



**Photo 32: A strip of eucalyptus tree 3m on the RHS of the road around Km 30+700**



**Photo 33: Typical DP located 2m from the edge of the road at Km 29+900**



**Photo 34: Operational Borehole with hand pump located at Km 48+100, 10m on the RHS of the road**



## **APPENDIX III: LIST OF CONSULTED STAKEHOLDERS AND MINUTES OF CONSULTATIVE MEETINGS**

## **APPENDIX IV: APPROVED TERMS OF REFERENCE AND LETTER OF APPROVAL**

## REFERENCES

Child Labour Policy

Convention on Sustainable Management of Lake Tanganyika

Decree N° 100/22 of 7<sup>th</sup> October 2010 on the Procedure for Environmental Impact Assessment

Decree-Law N° 1/037 of 7<sup>th</sup> July 1993 on Labour Code

East African Community Treaty, 1999

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Economic Policy

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Law N° 1/010 of 30<sup>th</sup> June 2000 on the Code of Environment

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