

JAPAN INTERNATIONAL COOPERATION AGENCY

No.

MINISTRY OF TRANSPORTS, POSTS AND TELECOMMUNICATIONS
MINISTRY OF PUBLIC WORKS AND EQUIPMENT
REPUBLIC OF BURUNDI

THE EMERGENCY STUDY
ON
URBAN TRANSPORT
IN
BUJUMBURA
REPUBLIC OF BURUNDI

SUPPLEMENTAL REPORT

MARCH 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN ENGINEERING CONSULTANTS CO., LTD.
IN ASSOCIATION WITH
YACHIYO ENGINEERING CO., LTD.

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08-032

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jica Japan International Cooperation Agency

Prepared by



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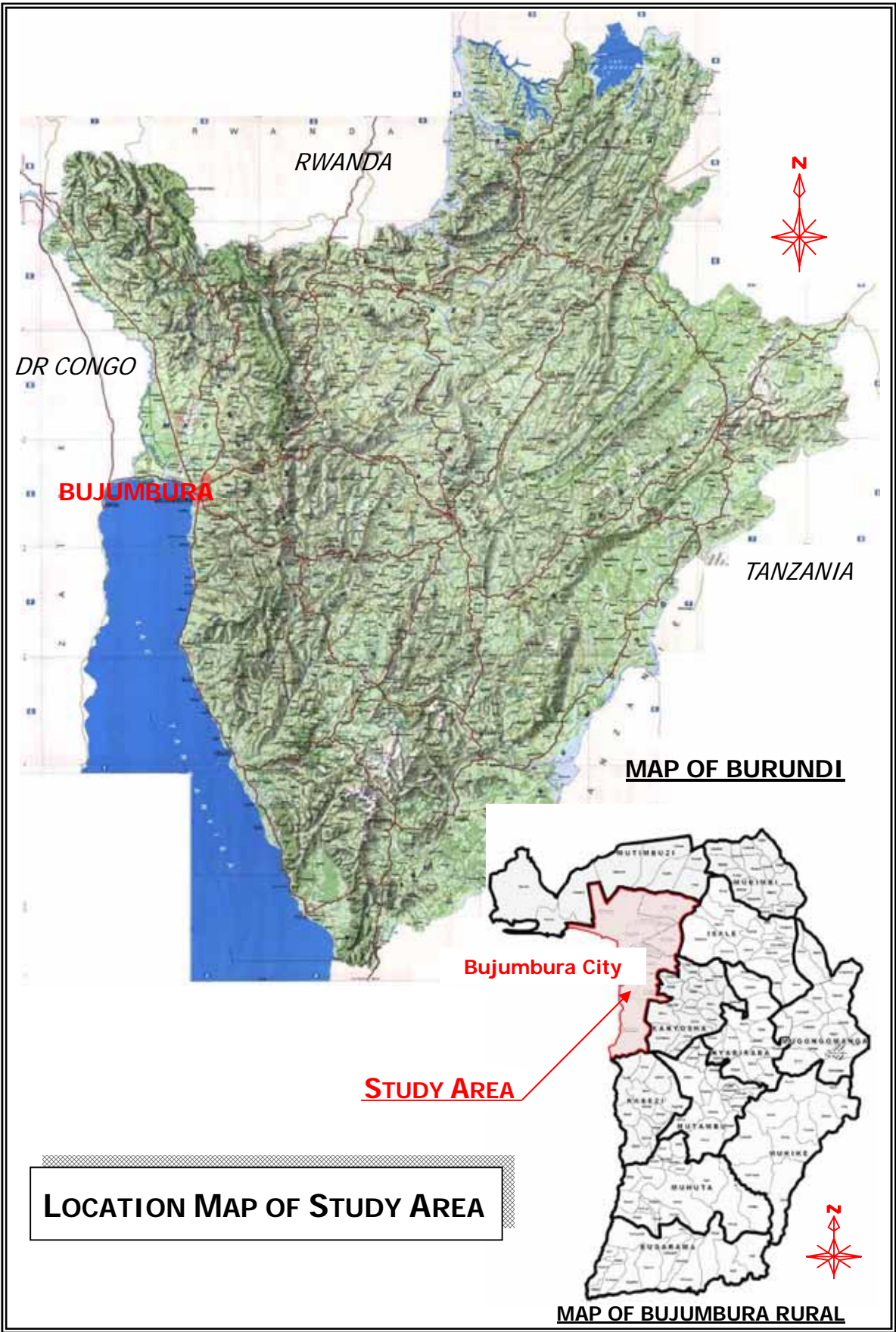
EXCHANGE RATE

August 2007

1 US\$ = 1,100 Burundi Franc

1 US\$ = 110.0 Yen

1 Yen = 10 Burundi Franc



RWANDA

DR CONGO

BUJUMBURA

TANZANIA

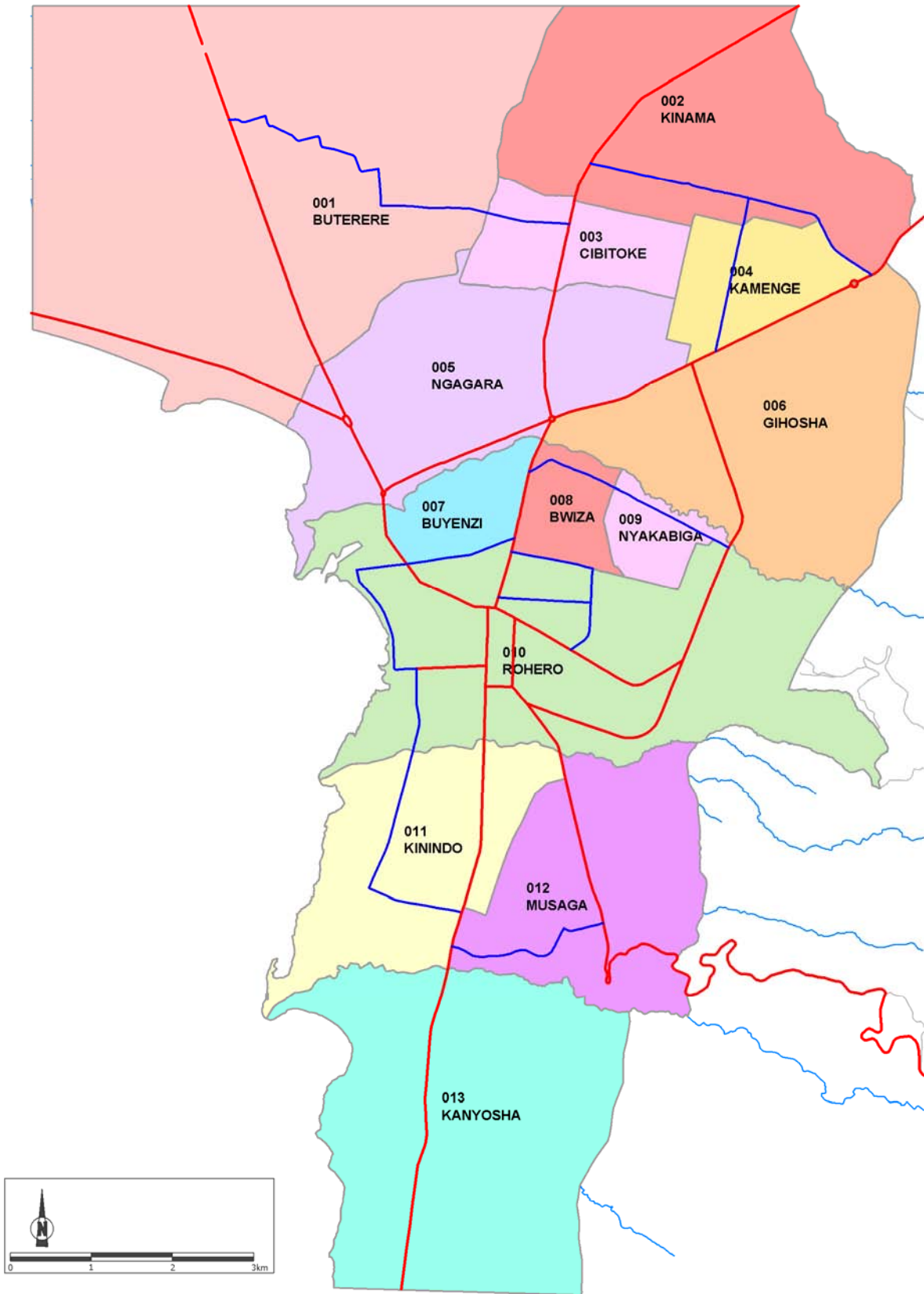
MAP OF BURUNDI

Bujumbura City

STUDY AREA

LOCATION MAP OF STUDY AREA

MAP OF BUJUMBURA RURAL



**DETAILED LOCATION MAP OF STUDY AREA
(BUJUMBURA CITY ADMINISTRATION MAP)**

SUPPLEMENTAL REPORT EXECUTIVE SUMMARY

PILOT PROJECT

(1) Objective

The objective of the Emergency Work as Pilot Project (EWPP) is to monitor improving living condition through the EWPP and to find out difficulties and problems in its execution. This experience is expected to be used for the implementation of the programmes which is proposed in the Study.

(2) Selection of EWPP

Condition of the EWPP

The condition given to EWPP is as follows;

- Location: Within Bujumbura city
- Duration of work: approx. 4-5 month
- Type of work:: Pavement rehabilitation

Selection of the section to be projected

The RN7 at Musaga commune with stretch of 1.6km and Av. De Government at Rohero commune with stretch of 0.13km were selected as the result of discussion with C/P and stake holders.

Expected Benefits by the EWPP

Direct Benefits

- Smoothing of traffic by the improvement of road conditions and resulting in contribution to the economic and civil activities.
- Improvement of traffic safety by the separation of pathway for vehicle and pedestrian at RN7
- Improvement of traffic confusion by the provision of bus bay at RN7

Indirect Benefits

- Activation of area economy by improvement of accessibility and transport condition
- Technical transfer of project management
- Creation of job opportunities for people at vicinity of the project road.

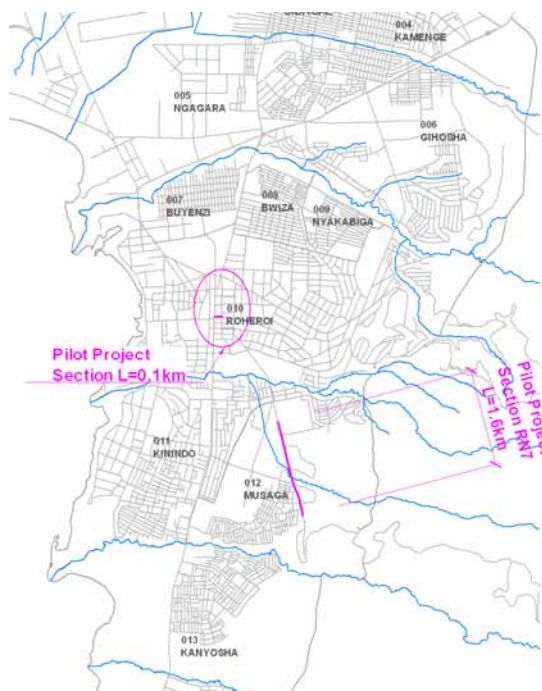
(3) Present Condition

General

The Project sites are located in two communes, Rohero and Musaga, which are adjoining each other. The Rohero commune is located in the central part of Bujumbura, and also includes CBD. Av. De Government is in the government

office quarter of CBD and functioning as a major thoroughfare of the area.

Musaga commune is perimeter area of the central district with approx. 78,500 populations. RN-7 is the trunk road for the transportation of the people in the Musaga commune and is also the national trunk road, which connects second largest city, Gitega.



Location of Pilot Project Road



Deteriorated Shoulder

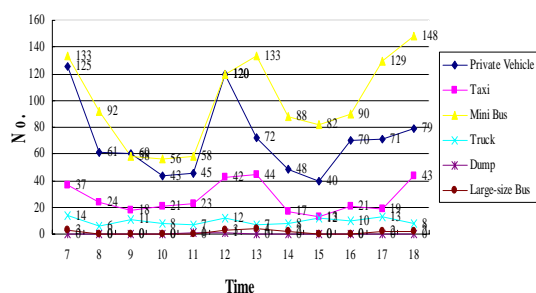


Many Potholes

Traffic Condition

RN-7

The ADT of RN-7 is calculated to be 2,873 and the majorities of the traffic are mini bus and private vehicle which occupies 47.9% and 33.7%. The specific character of this road is many pedestrians amounted as 2,351 per 12 hrs.

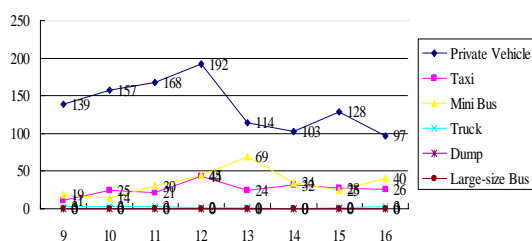


Hourly Traffic Variation of RN7

Av. de Government

The ADT of the road is calculated to be 3,785 and the majority of the traffic is private vehicle which occupies 68.5%

There are many traffic accidents at junction with Bd. Mwezi Gisabo as the junction has the deformed shape.



Hourly Traffic Variation of Av. de Government

Pavement Condition

RN-7

There are innumerable potholes on entire project section; their causes are considered to be poor drainage and unevenness of surface. Some potholes are filled by unsuitable articles such as concrete mass and clay soil. Those articles should be removed one by one carefully by the EWPP's work. Shoulders at the ending point are also heavily damaged and their road beds have already been washed away by storm water.

Av. de Government

This road is located on in front of the Ministry of Interior and there is a parking space for the Ministry adjacent to the road. The entire stretch is heavily damaged due to poor drainage and lack of maintenance. There is no rehabilitation method other than re-construction from sub-base course.



Plan View of Roads at CBD



Plan View of RN7 at Musaga Commune

(4) Design

Design Policy

The design policy of the EWPP is generally to restore road functions so that no upgrade and no future demand are considered in the design, the design work aims to attain appropriate traffic flow and safety for road users.

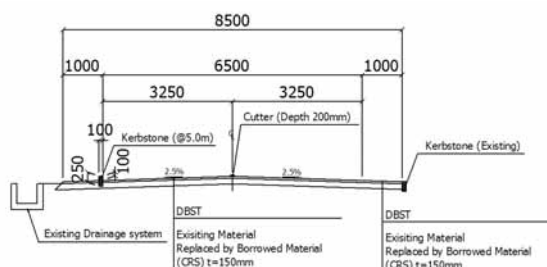
Design Criteria

The SATCC and Tanzanian Standard are referred mainly in consideration of recent trend in eastern African countries and similar natural condition as well as geographical features.

Engineering Design

• **Cross Sectional Design**

Among the total width constraint of 8.5m, the design provides 6.5m (3.25m x 2) for carriageway and 1.0m of walkway assuming ideas of minimum dimension from both the SATCC and Douro Kouzourei.



Typical Cross Section of RN-7

• **Pavement Design**

Considering constraint for the construction time and cost, the DBST is selected as surface pavement material with 15cm of base course re-construction. The design pavement composition is checked by AASHTO design methodology and the result is that life span of the pavement is equivalent to 5 years of design period.

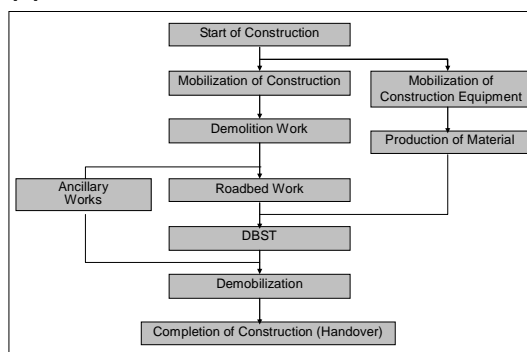
• **Safety Measure**

The following facilities are designed with different purposes;

- Baybay : To regulate bus stopping point
- Kerbstone: To demarcate corridor for vehicle and pedestrian
- Hump : To reduce vehicle's running speed
- Markings : To regulate traffic
- U-Cover : To secure the space for waiting

bus passenger

(5) Construction Plan



Construction Execution Flow

Working Schedule

Description	2007 Sep	Oct	Nov	Dec	2008 Jan	Feb	Mar
Tender							
Preparation of Agreement							
Mobilization		█	█	█			
Demolition			█	█			
Pavement Work				█	█	█	█
Drainage					█		
Ancillary Work				█			
Demobilization							█

(6) Environmental Management Plan

From the aspect of environmental and social consideration, the followings are recommended for the implementation of the EWPP.

- **Construction Materials:**
No illegal procurement is permitted. The Consultants' supervising team should monitor the procurement.
- **Construction Waste:**
To prevent illegal dumping of construction wastes, the construction specification that the construction wastes must be disposed properly.
- **Environmental Observation:**
In order to identify the environmental and social issues immediately, the Consultants' supervision team should observe the following items throughout the construction period.
 - Noise, vibration, dust, odor and exhaust gas caused by operation of heavy equipments
 - Traffic congestion and accident
 - Opinions and complaints from the drivers, residents, pedestrians and passengers.

(7) Major Findings in Execution**■ Public Reaction to EWPP**

The public generally welcome the EWPP and their opinions and behaviours were concluded by local authority. No interfere by public was experienced.

■ Traffic Control during the EWPP

Existing traffic by vehicle could be controlled when the alternation traffic was introduced and no conflict is raised; however there was a difficulty on controlling pedestrian and traffic modes other than vehicle.

■ Capability of Government Authorities

The government authorities understood the procedure of road works and pavement maintenance methodology was transferred to them. The issue is the budget arrangement to both maintaining human resource and civil work materials.

■ Capability of Private Sector

The private organizations both contractor and supplier are limited, available sort of works and goods are also insufficient for road work.

■ Construction Material

Raw materials such as soil, sand and aggregate are available at Burundi. However there is a problem of production of aggregate on quality and quantity due that the quality and capacity of the crushing plant is not sufficient.

Other constriction material including cement shall be purchased from outside of Burundi. The necessary time for transportation shall generally be estimated as 2 weeks from the origins.

■ Construction Equipment

Earthwork equipments are available at Bujumbura and however those are relatively in bad condition.

Pavement equipments shall be brought from outside of Burundi, either.

(8) Conclusion and Recommendation**Conclusion**

The EWPP was completed on 15th March 2008; actual construction time was approx. 6 month which was in accordance with planned construction time. No serous incidents were experienced during the construction period. From those, it can be evaluated that the EWPP is completed successfully. The rehabilitated roads are expected to contribute to improvement of living standards of Bujumbura people in near feature.

Recommendation

By experiences from the EWPP implementation, the following recommendations are made;

■ Strengthening Private Sector by Government Initiative

The EWPP clarified that the constriction industry in Burundi is not yet developed. To attain sustainable development in the country, the strengthening capability of private sector (contractor) is essential. The Government, by its initiative, shall consider and introduce strengthening program on private sector by whichever with or without foreign support.

Actual maintenance work, which is currently carried out by the officials. shall also be handed over to private sector; the officials shall concentrate management work in order to reduce recurrent expense.

■ Involving Local Commune Authorities from Early Stage of the Project

The EWPP discussed with the local commune authorities in addition to the C/P from early stage of the Project. And through the implementation, it was recognized that the authorities has strong power for public so that public opinions were concluded easily by them and it resulted to attain good cooperation with the EWPP.

In case of large scale project, it is recommended to establish working group and/or project implementation unit (PIU) with participation in the local authorities from the early stage.

A. Record of the implementation of the Pilot Project

A-1 Design Stage

April 5, 2007: *Steering Committee Meeting*

National Trunk Road No.7 was selected as a Pilot Project Road by the steering committee members at the steering committee meeting.

End of April, 2007: *Meeting with the Counterpart*

7 local roads at Rohero Commune which total length are 2.41km were added as second candidate roads at the meeting with the counterpart from Road Department of Ministry of Public Works and Equipments.

Beginning of May, 2007: *Meeting with the Counterpart*

Burundian Counterparts and JICA Study Team were agreed to shortlist the international contractors for the tender for the Pilot Project at the meeting with the counterpart, because there are no available local contractors which have experiences for the asphalt pavement works in Bujumbura.

June 19, 2007: *Public Consultation*

Explanation and Discussion for the contents of the Pilot Project prepared by JICA Study Team.

Mid of June to End of July, 2007: *Preparation of the drawings, cost estimate and construction schedule for the Pilot Project.*

End of July, 2007: *Change of the Pavement Structure*

Asphalt overlay was proposed in the original design. However, in case of the asphalt overlay works, it found that it was difficult to finish the works within required construction schedule because of the difficulty for the procurement of the equipments for the asphalt pavement works.

Pavement structure was changed from asphalt overlay to reconstruction from existing base course by DBST (Double Bituminous Surface Treatment), base course and subbase course in consideration of the

limited construction schedule for the Pilot Project.

A-2 Tender Stage

August 21, 2007: *Explanation of the tender documents to the counterparts*

JICA study team explained to the counterparts about the drawings, technical specification and contract

August 21, 2007: *Invitation to Tender to short-listed three contractors by e-mail.*

End of August, 2007: *Change of the subbase thickness from 15cm to 25cm.*

Subbase thickness was changed from 15cm to 25cm which was the minimum requirement pavement thickness for the National Trunk Road.

August 30, 2007: *Submission of the addendum which was mentioned about the change of the subbase thickness*

JICA submitted the addendum and confirmed to change the pavement thickness in the tender documents to the counterparts.

August 31, 2007: *Issuance of the Addendum*

JICA Study Team issued the addendum as the amendment to the tender documents to the tenderers.

September 3, 2007: *Closing date of questionnaire from the tenderers*

September 10, 2007: *Receiving and Opening of the tender documents at JICA Study Team Office, Bujumbura, Burundi*

Attendance

Counterparts and JICA Study Team

Tenderers:

Urban Tone Corporation(Japan),
Billdock Enterprises and Contractors (Kenya)

September 11, 2007: *Price negotiations with the lowest tenderer*

September 12 2007: *Signing of the Contract*

A-3 Construction Stage	Burundi Side are necessary for
September 12 2007: <i>Signing of the Contract</i>	Implementation of the programme-----3
	A3: No comment-----4
November 5 2007: <i>Ground Breaking Ceremony</i>	Q2: Comments to the result of the Pilot Project
Beginning of January 2008: <i>Technical Transfer to 3 counterparts</i>	A1: Very Satisfied-----12
	A2: Satisfied-----2
March 14, 2008: <i>Final Inspection and Issuance of the completion certificate</i>	A3: No comment-----1

March 21, 2008: *Handing Over Ceremony*

A-4 Counterparts to Technical Transfer

- 1) Mr. HAVYARIMANA Nestor: Counselor, Road Department
- 2) Mr. NSANZERUGEZE Sylvestre: Counselor, Road Department
- 3) MPAWENIMANA J. Paul: Counselor, Road Department

A. Workshop

Workshop was held on March 14 at Hotel Source du Nil, Bujumbura, Burundi.

Agenda:

Discussion about the result of the Pilot Project and the Study with the related organizations

Participants: Total 40 persons

{Burundi side}

41persons (31: counterparts and related organizations, 10: Journalists)

{JICA Study Team}

5persons

JICA Study Team requested the comments to the participants.

15 replies were received from the participants.

Main comments are shown as follows,

Q1: Comments to the contents of the Study

A1: Satisfied----- 8

A2: Strengthening of the capacity of the

ABBREVIATION

International Organizations

EU	European Union
FED	Kuwait Fund for Arab Economic Development
IDA	International Development Association
JICA	Japan International Cooperation Agency

Others

As	Asphalt Concrete Pavement
ADT	Average Day Traffic
AASHTO	American Association of State Highway and Transport Officials
CBD	Central Business District
CBR	California Bearing Ratio
DBST	Double Surface Treatment
DCP	Dynamic Cone Penetration
ESAL	Equivalent Single Axle Load
LL	Liquid Limit
MDD	Maximum Dry Density
PI	Plastic Index
PL	Plastic Limit
STACC	Cooperation of the South African Committee of State Road Authorities

**The Emergency Study on Urban Transport in Bujumbura City
SUPPLEMENTAL REPORT**

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND

With an estimated population of 550,000, Bujumbura, the capital city, is the political and economic center of Burundi. However, the basic infrastructures, particularly the road conditions of Bujumbura are extremely poor, and the reconstruction of these roads is very much essential before the living conditions of its people can be improved. Although the demand for road transportation in Bujumbura is expected to increase in near future as economic activity develops during the country's upcoming rehabilitation period. The road volumes as well as the road network are inadequate, and the existing facilities and traffic controlling system are so poor that traffic congestion in the city center is becoming a major concern.

The Government of Burundi requested the Government of Japan to conduct the study in connection with improvement of urban transport condition. In response to the request, the Government of Japan decided to conduct the study with title of "The Emergency Study on Urban Transport in Bujumbura" (hereinafter referred to as "the Study") and entrusted the Project to Japan International Cooperation Agency (JICA)

The JICA sent the study mission to the Bujumbura, headed by Mr. Yasushi OOWAKI with experts organized by Japan Engineering Consultants Co., Ltd, JAPAN and Yachiyo Engineering Consultants Co., Ltd, JAPAN (hereinafter referred to as "the Study Team") at January 2007.

An idea of the Emergency Work as Pilot Project (EWPP) was introduced on the Study's TOR. Its objective is to find out difficulties and problems in its execution. This experience is expected to be used for the implementation of the programmes proposed by the Study.

This supplemental report discusses the related matters of the EWPP and lessons as well as recommendations from the experience for implementation of the programmes proposed by the Study.

1-2 SELECTION OF THE EWPP

1-2-1 Condition of the EWPP

In the TOR of the Study, the following conditions for the EWPP were given, as follows;

- Location of the EWPP: Within Bujumbura city

- Expected type of work: Pavement rehabilitation for 2.5 to 3.0 km
- Duration of work approx. 4-5 month

As described in the main text of the Study, EU has road rehabilitation programme in Bujumbura city and the programme was in the process as of January 2007. The selection of the EWPP shall have no overlapping with the EU's programmes and keep some physical distance to them so as to avoid traffic congestion causing by the 2 programmes

Moreover, many compensation and resettlement by the EWPP shall be avoided from the aspect of social environmental consideration and time constraint of the EWPP.

The safety measure shall also be considered in the design because of the outlook of which traffic accidents may be increased due that vehicle running speed might be faster than that of before the EWPP.

1-2-2 Selection of the section to be projected

After investigation of all of the city roads in Bujumbura City, the Study Team came to select the RN7 at Musaga commune with stretch of 1.6km as a candidate for the EWPP; the reasons are as follows;

- The section is located within the Bujumbura City..
- There is no overlapping part with the EU programme .
- There are many damaged parts of the pavement due to lack of the maintenance and damaged parts is possible to complete rehabilitating them within 3-4 month.
- Recently, the population of the vicinity of the section is being increased, so it can be considered that the section is appropriate to monitor the changes by the EWPP.
- By above conditions, it can be expected that the EWPP contribute to improve the living condition for the peoples who are living nearby.
- The section is identified as one of the arterial roads in the Bujumbura city; the experience at the section can be developed and used to other arterial road improvement programmes which were introduced by the Study.
- There will be little compensation by EWPP so that smooth execution can also be expected.

In the Steering Committee held on 5th April 2007, the section of RN7 was proposed as candidate by the Study Team.

There was no objection to the proposal; the Committee thus approved to select the RN7 at Musaga commune for the EWPP.

In addition to that, the Ministry of Works and Equipment made a request to consider rehabilitating some roads in CBD area by the EWPP as well if the budget allows. The Committee accepted the Ministry’s proposal.

As the result of the Committee, the following roads and sections were selected as candidates for the EWPP;

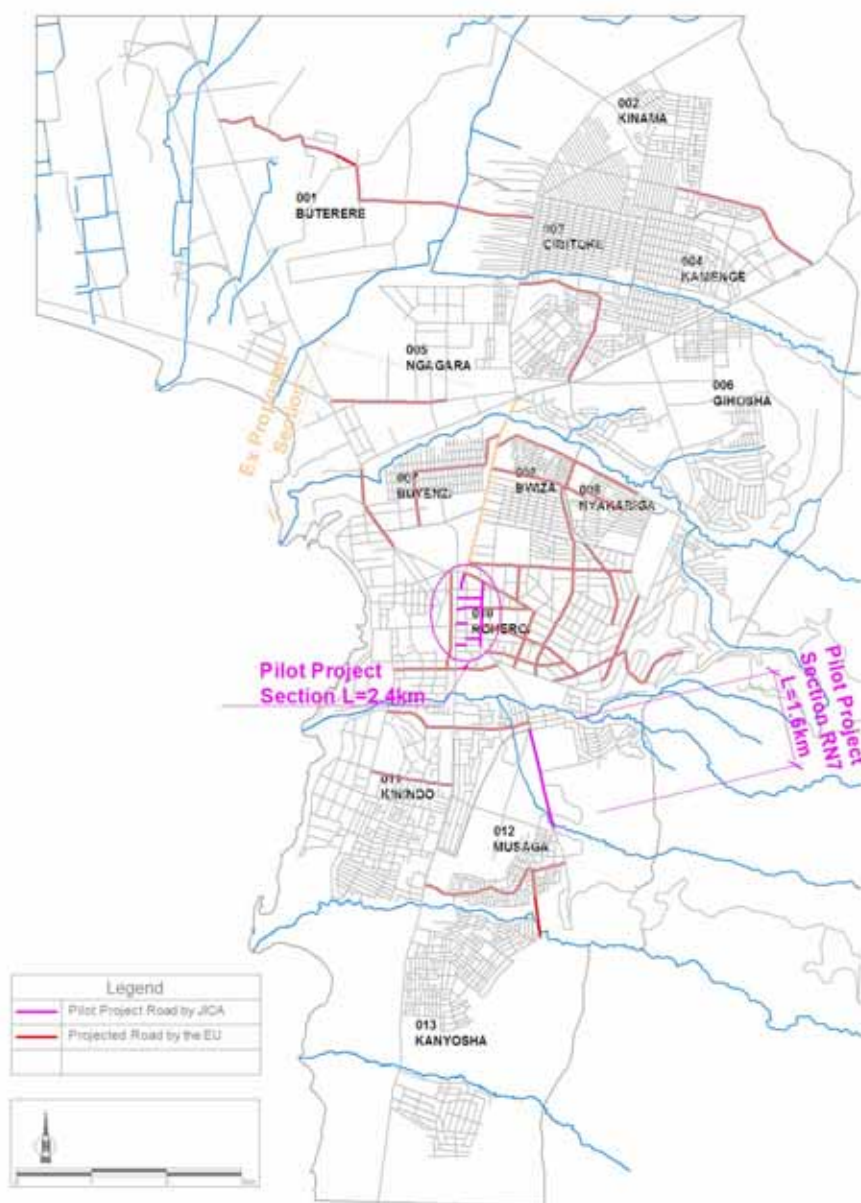


Figure 1-1 Location of Project Roads

1-3 OUTLINE OF THE CANDIDATES

The following table explains type of the works at each candidate;

Table 1-1 Outline of Candidate Roads

No	Name of Road	Location	Length (km)	Width (m)	Type of Works	Remarks
1	Bd. Ntre Rushatsi (RN7)	Musaga	1.56	8.5	Reconstruction	
2	Av. De Industrie	Rohero	0.07	13.0	Reconstruction	
3	Av. De Government	Rohero	0.13	7.0	Reconstruction	
4	Av. des Palmiers	Rohero	0.18	7.0	Reconstruction	

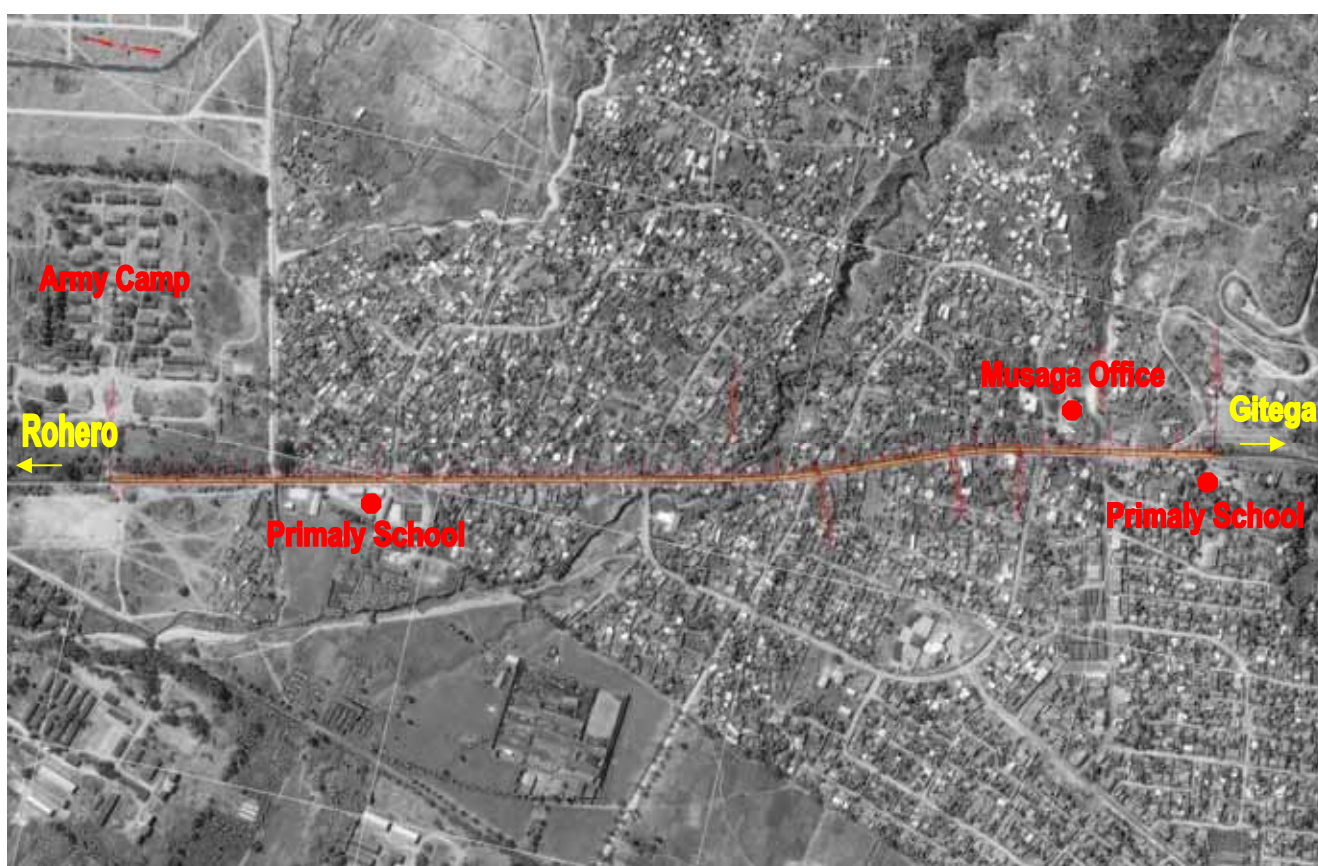


Figure 1-2 Plan View of RN7 at Musaga Commune



Figure 1-3 Plan View of Roads at CBD

1-4 EXPECTED DIRECT BENEFITS BY THE EWPP

As mentioned above, the EWPP is expected to improve the living condition along the project sections, the expected direct benefit by the EWPP are detailed as follows;

(1) Smoothing of Traffic by the Improvement of Road Conditions

At proposed sections, there are many damaged pavement parts and the damages are disturbing the smooth traffic flow. This situation dose not give damages on running vehicle but also makes bad effect on the economic activities.

By the EWPP, those situations are improved and resulting economic activities to be more effective.

(2) Improvement of Traffic Safety by the Separation of Corridor for Vehicle and Pedestrian

There is no clear demarcation between the corridor of pedestrian and vehicle although there are many pedestrians along the section, and sometime the pedestrians overflow into the vehicle's corridor; it results becoming dangerous situation.

Safe of pedestrians is expected to be secured by the introduction of the kerbstone in the design and when the kerbstone is provided, it results to secure the pedestrian corridor from Musaga to the City Centre.

(3) Improvement of Traffic Conflict by the Provision of Busbay at RN7

Since the width of the road is not wide enough, there is some conflict between running vehicle and stopping mini bus and taxi at end of proposed section. Moreover, there are many illegal kiosks around bus stopping point with many customers. These situations cause the disturbing smooth traffic flows.

By the provision of the Busbay, these situations can be improved and resulting to secure smooth traffic flow and safe of pedestrians.

Other than above direct benefits, the following indirect benefits can also be expected;

(1) Creation of Job Opportunities

The EWPP dose not only creates the job opportunity of its construction work concern but also creates the job opportunity at CBD by the improvement of accessibility to the project area's people.

(2) Activation of Area Economy by Improvement of Accessibility

By the improvement of transport condition, the transport time and damage of the products might be decreased. These will make activation of area economic activities.

(3) Technical Transfer of the Project Management

The EWPP is supervised by the Japanese experts. Through the EWPP, the methodology of the project management such as construction quality and time control as well as safety control is expected to be transferred to the Project's counterpart.

PHOTOGRAPHS OF EXISITING CONDITION (1/2)

No.1 RN7



Clear demarcation by kerb between Carriageway and Walkway (Just before project section)



Starting point of the project section (Military Camp Entrance)



Pavement condition around starting point (Pothole was filled by unsuitable articles)



Heavy eroded road shoulder at No.2 +40 (near by cross box culvert)



Primarily school at No.4 +20 on RHS



Common water tap for the area



Mini bus tends to stop at junction with access road because there have more space than others



MUSAGA COMMUN OFFICE at No.10+80 on LHS



Big confusion caused by mini bus and Taxi parking together with business of Kiosks at the roadside



Deteriorated shoulder at No.15+40



Mis positioned private property (Container) at No.16+20 on RHS



End point of the project section (Police's check gate)

PHOTOGRAPHS OF EXISITING CONDITION (2/2)

Av. Industirie



Provided pothole patching (not in good condition) at stating point of the road



One way traffic was introduced from the mid point toward Bld. Patrice Lumumba



Evenness of pavement surface was not maintained ,that created pothole

Av. De Government



Many Potholes on entire road



Parking spaces next to carriageway were provided but they does not look good condition



Two T junction were located without necessary clearance, traffic accidents occurs frequently

Av. Des Palmiers



No tarmac pavement existed



School and hospital are located along the road



Some big tree is located nearby the road

CHAPTER 2 EXISTING CONDITION

2-1 SOCIAL CONDITIONS

The Project sites are located on two communes which are (1) Rohero and (2) Musaga, those two communes adjoin each other. The following table summarizes social conditions of the two communes together with total or average Bujumbura's value.

Table 2-1 Social Conditions of (1) Rohero and (2) Musaga

Category	Item	Unit	(1) Rohero	(2) Musaga	Bujumbura	Remarks	
General	Area	Km ²	13.1	7.2	110.8		
	Population	Nos.	14,711	78,541	547,760		
	Household	Total	Nos.	2,948	13,978	97,561	
		Own	%.	38.7	46.8	40.4	
		Rent	%.	59.5	49.6	51.1	
		Rent Public	%.	0.0	0.0	1.5	
		Rent without payment	%.	1.8	3.6	6.7	
		Temporary	%.	0.0	0.0	0.3	
Average Monthly Income	BFu	157,332	42,536	49,791	per person		
Infrastructure	Electricity	%	77.7	33.1	55.9		
	Water Supply	%	75.7	30.9	44.8		
	Sewerage	%	73.0	21.0	35.6		
	Communication	%	67.0	13.7	30.9		
	Road	Total	Km	120.4	41.77	677.51	
		Paved	Km	74.6	13.61	186.35	
		Unpaved	Km	45.8	28.16	491.16	
Pavement Ration		%	62	33	28		
Road Density		Km/km ²	9.2	5.8	6.1		
Traffic Mode	Bicycle	%	6.7	6.7	9.8		
	Motorbike	%	1.3	0.0	1.9		
	Car	%	28.2	1.4	8.7		
	Bus	%	8.7	34.0	25.6		
	Taxi	%	6.7	0.4	1.3		
	Foot	%	38.2	57.5	52.7		

2-2 ROAD CONDITIONS

2-2-1 Pavement Condition

(1) RN7

There are innumerable potholes on entire project section; their causes are considered to be poor drainage and unevenness of surface finish due to lack of workmanship at initial construction. Some potholes are filled by unsuitable articles such as concrete mass and clay soil. Those articles should be removed one by one carefully by the EWPP's work.

Shoulders at the ending point are also heavily damaged and their road beds have already been washed away by storm water.

In order to confirm the existing pavement conditions, a geotechnical survey was conducted on May 2007, by entrusting to the NATIONAL LABORATORY OF BUILDING AND PUBLIC WORK, a geotechnical institution under the Ministry of Works, the Republic of Burundi. The conducted surveys were the DCP test and the CBR test as well as physical observations at existing pavement, detailed test results are discussed on 2-2-3 Geological Conditions.

The compositions of existing pavement was obtained as the result of the survey, they consisted of a layer of bituminous material as surface course and one or two layer with varied thickness of granular material as base course, the compositions of pavement at each survey point are shown in Figure 2-1

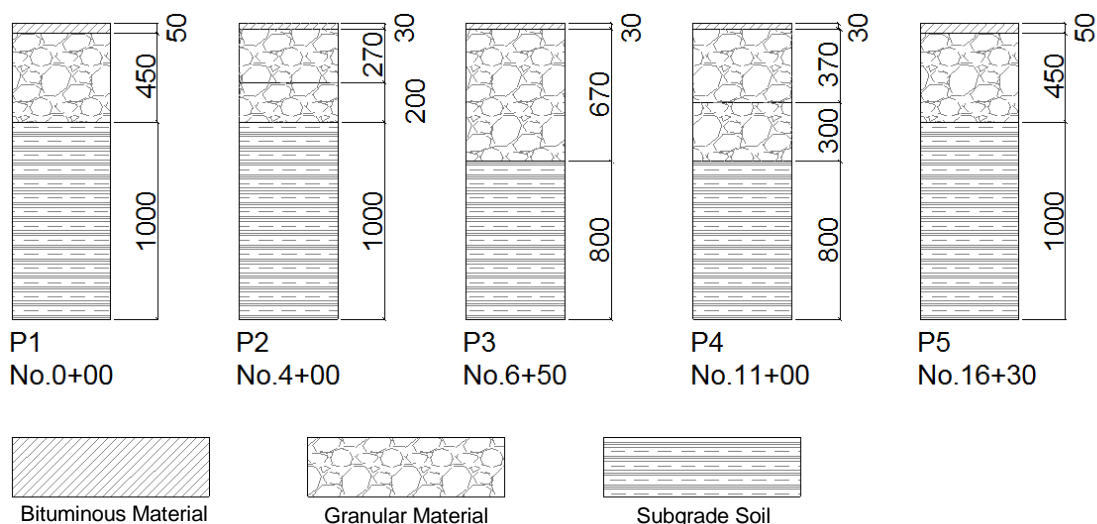


Figure 2-1 Existing Pavement Composition

(2) Av. de Industrie

Existing pavement condition at most of the stretch is relatively good with exception of the part where is near the junction with Bld. Patrice Lumumba. The damaged part is almost 70m in length, it is without proper evenness of the surface and some large size of pothole can also be observed. Accordingly the rehabilitation work shall be required to this damaged part only.

(3) Av. de Government

This road is located on in front of the Ministry of Interior and there is a parking space for the Ministry adjacent to the road. The entire stretch is heavily damaged due to poor drainage and lack of maintenance. There is no rehabilitation method other than re-construction from sub-base course.

(4) Av. des Palmiers

There is no tarmac pavement for entire stretch.

2-2-2 Traffic Condition

(1) RN7

The ADT of this road is calculated to be 2,873 and the majorities of the traffic are mini bus and private vehicle which occupies 47.9% and 33.7%. There is little heavy vehicle traffic although the road is classified as national road connecting to 2nd biggest city Gitega in Burundi.

The specific character of this road is many pedestrians amounted as 2,351 per 12 hrs.

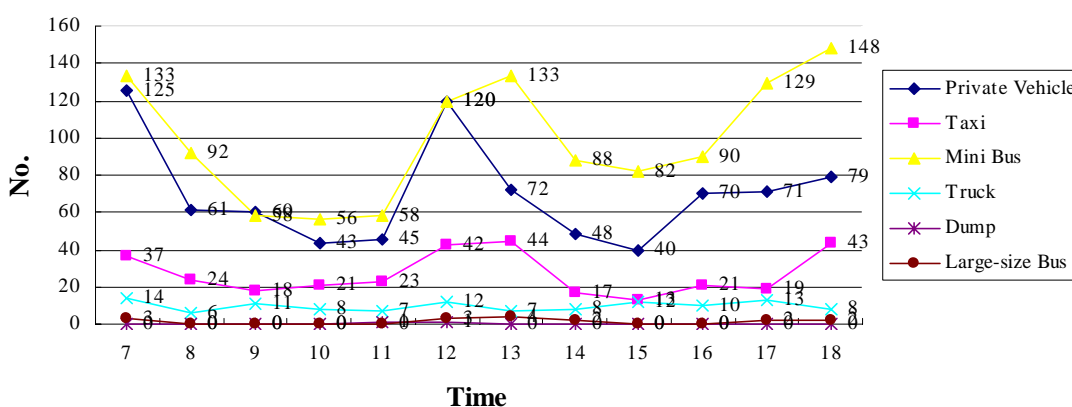


Figure 2-2 Hourly Traffic Variation of RN7

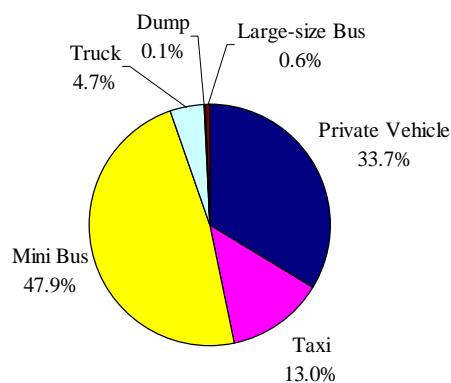


Figure 2-3 Traffic Composition of RN7

(2) Av. de Industrie

The ADT of this road is calculated to be 2,989 and the majority of the traffic is private vehicle which occupies 86.1%

There is many parking taxis at the end of the road where is near the junction of Bld. Patrice Lumumba

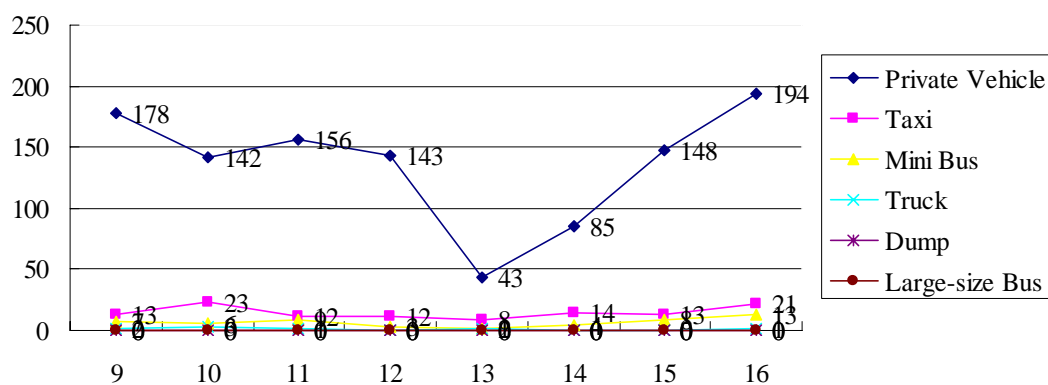


Figure 2-4 Hourly Traffic Variation of Av. de Industrie

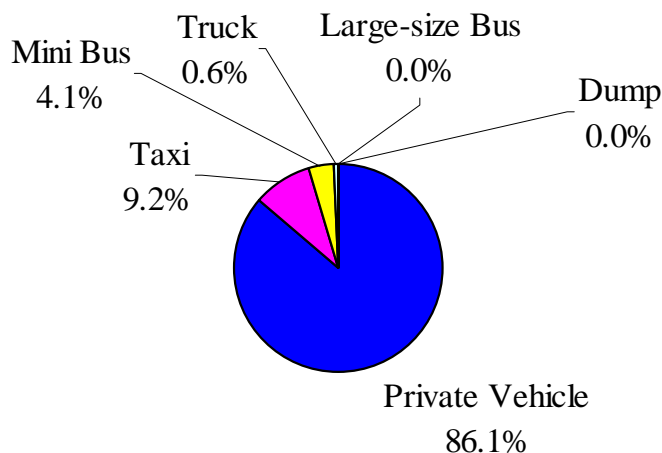


Figure 2-5 Traffic Composition of Av. de Industrie

(3) Av. de Government

The ADT of this road is calculated to be 3,785 and the majority of the traffic is private vehicle which occupies 68.5%

There are many traffic accidents at junction with Bd. Mwezi Gisabo. The junction is shaped like a step so that it is not well-visible for incoming traffic.

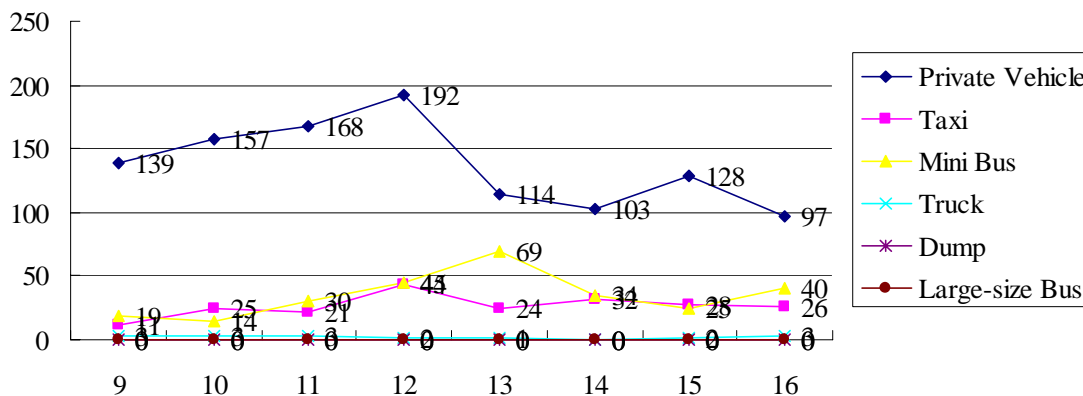


Figure 2-6 Hourly Traffic Variation of Av. de Government

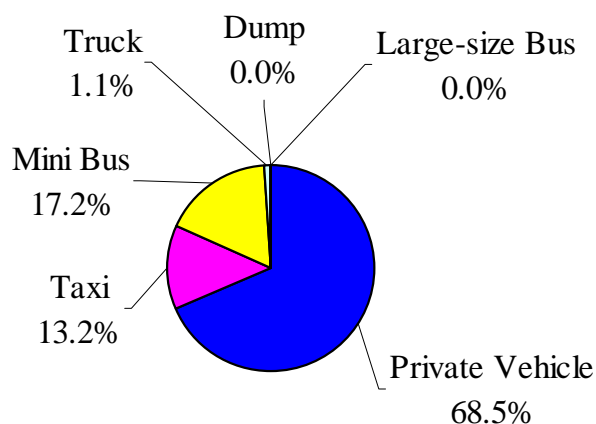


Figure 2-7 Traffic Composition of Av. de Government

(4) Av. des Palmiers

The ADT of this road is calculated to be 777 and the majority of the traffic is private vehicle which occupies 68.5%

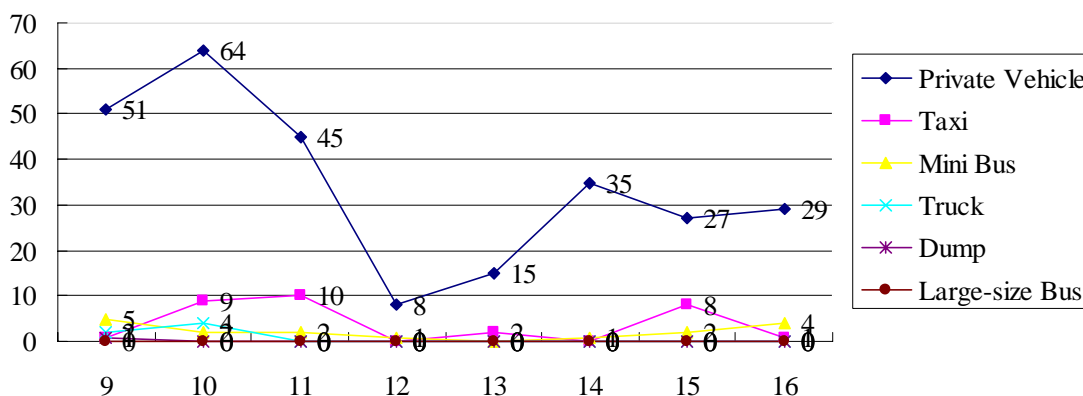


Figure 2-8 Hourly Traffic Variation of Av. des Palmiers

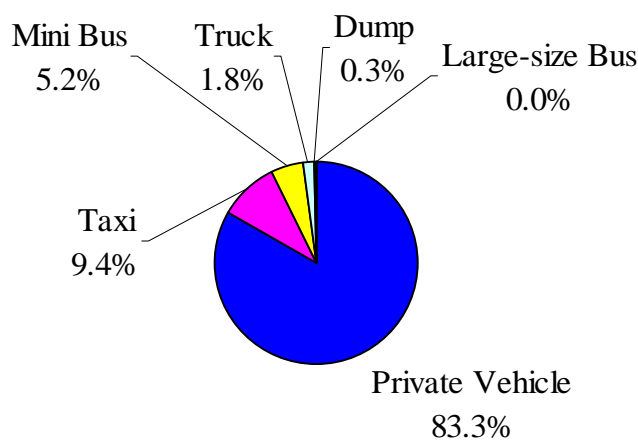


Figure 2-9 Traffic Composition of Av. des Palmiers

2-2-3 Geological Conditions

As mentioned on 2-2-1, the geotechnical survey was conducted and the survey consisted of 5 points of both the DCP test and CBR test. Both tests were conducted at same point, the following Figure 2-10 shows the survey points;



Figure 2-10 Geotechnical Survey Points

(1) General Features

The soil sections show in general a continuation of the following layers:

- Dense gravel layer and/or gravel with sand,
- Sandy clay (P2) or muddy clay (P1; P3; P4 and P5)

(2) DCP Test Results

The results of five penetrometer dynamic light tests are given on Annex. They are given under the form of chart called "Penetrogramme".

Those penetrogrammes are defined in the abscissa per the top resistance Q_d (resistance given in MPa, $1\text{Mpa}=10\text{ bars}$) represented in continuous line and ordinates or Y-axis by corresponding depth in meter.

Analyzing the obtained five penetrogrammes , the followings is noticed;

- 1) The penetrogranune of P1 is characterized by a resistance which increase quickly until 17.5 Mpa at 40 cm, the resistance decreases so as to evolve oscillating between 9 Mpa and 1.5Mpa from 90cm to 3.1 m, from 3.1m the resistance increase quickly until 4.4 m.
- 2) The penetrogramme of P2 is characterized by a resistance which increases in the first 40 cm in depth before decreasing until the minimum value of 3.3Mpa at 1.20 m. From this depth, the resistance increase oscillating around value of 5Mpa until 4.2

m before increasing quickly until 5.4m.

- 3) The penetrogramme of P3 is also characterized by a resistance increasing quickly until 17.5 Mpa at 40 cm in depth before decreasing in light switch back until the minimum value at 1.3 m., the resistance increase oscillating around value of 22Mpa until 2.1 m.
- 4) The penetrogramme of P4 is characterized by a maximum resistance from the first 40 cm in depth and decreases by reaching a minimum value of 1.30 m before increasing in switchback in depth at 4.3m.
- 5) The penetrogramme of P5 is characterized by a maximum resistance of 30 cm in depth, and then reaches the minimum resistance at 1.20 m and increase quickly until 3.2 m.

(3) CBR Test Results

In fact, the points P1, P3, and P4 indicate the very low value of CBR and the value of high plasticity which explained the presence of clayey plastic soil. Muddy clay plastic (P3) is the soil with characteristic which CBR value is decreased once it is soaked in water.

The points P2 and P5 are characterized by muddy soils with slightly plastic (little clayey) having acceptable CBR value.

Table2-2 CBR Tests Results

Point No.	Station	Depth (m)	W (%)	Sieve Analysis			Atterberg Limit			Proctor		CBR (%)		CBR Swell (%)
				Dmax (mm)	% <2mm	% <80μ	PL	LL	PI	pt (%)	d (KN/m ³)	90% MDD	95% MDD	
P1	No.0+00	0.5-1.50	9.8	3,15	98	65	25	48	23	14	17.6	2.2	2.6	0.0079
P2	No.4+00	0.5-1.50	21.4	3.15	97	42	14	24	10	9	20.1	7.5	14.9	0.07
P3	No.6+50	0.7-1.50	14.4	3.15	90	51	23	48	15	14.2	19.4	1.8	2.4	0.0063
P4	No.11+00	0.7-1.50	15.0	3.15	98	60	24	47	23	13.3	18.8	2.1	3.3	0.07
P5	No.16+30	0.5-1.50	12.8	3.15	98	50	19	29	10	12.8	19.4	5.0	8.5	0.055

2-3 PROCUREMENT CONDITIONS

2-3-1 Construction Material

As the Burundi is a landlocked country, most of the construction material is brought from outside of the country, Mombassa port, Kenya is main point of discharging of petroleum products and transport length to Burundi is 2,025km via Uganda and Rwanda. Because of that,

the price of petroleum products is relatively expensive comparing to other costal countries in Eastern Africa such as Tanzania and Kenya.

The following table summarizes the availability and origin of the construction material.

Table 2-3 Availability and Origin of Construction Materials in Burundi

Construction Material	Burundi	Others	Major Origin
Aggregate, Sand	X		
Petroleum Products		X	Kenya, Tanzania
Fuel		X	Kenya, Tanzania, South Africa
Cement		X	Tanzania, Uganda, Zambia
Reinforcement Bar		X	Uganda, Zambia
Construction Water	X		

The nearest quarry of Bujumbura city is located at 18km from the city centre along the RN 1 in Gitega direction. There is not crushing plant at the quarry so that the raw materials have to be brought and crushed with specified size at the crushing plant in the city.

The material gravity is heavy enough for the aggregate of concrete and asphalt and however as for fine aggregate with less than 5mm size is generally flat shape which is not appropriate for the asphalt hot mixture. This is supposed to be by a problem of machine quality and condition of the crusher.

PHOTOGRAPHS OF QUARRY



At the crushing plant, there is no storage space for the stock so that the supplier produces the aggregate as per order

2-3-2 Civil Work Contractor

The most of road construction work financed by the donors is being carried out by joint venture company organized by foreign general contractor and local Burundian contractor and

its primed by the foreign. Some project is by foreign contractor alone. Activities of those foreign contractors are limited to donor's project and the local contractors are being employed under the foreign or on maintenance work only.

The following table shows past road project in Bujumbura city.

Table 2-4 Lists of Road Projects in Bujumbura

Name of Road	Financer	Contractor	Nationality	Contract Amount (BFu)	Duration	Period
Peuple Murundi Bd	FED	SOGEA-COLAS	F	N/A	N/A	1989-1990
1er Novembre Bd	FED	SOGEA-COLAS	F	N/A	N/A	1989-1990
28 Novembre Bd	IDA	AMSAR-ASTALDI	B	3.996.635.657	8 Month	1998-1999
Ntare Rushatsi Bd	FED	SOGEA-COLAS	F	N/A	N/A	1989-1990
Mwezi Gisabo Bd	FED	SOGEA-COLAS	F	N/A	N/A	1989-1990
Prince Louis Rwagasore Road 1	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Prince Louis Rwagasore Road 2	IDA	AMSAR-ASTALDI	B	N/A	N/A	1998-1999
NR5 Route Aéroport	IDA	AMSAR-ASTALDI	B	N/A	N/A	1990-1991
NR4 Chanic PK5 Kajaga	IDA	AMSAR-ASTALDI	B	N/A	N/A	1990-1991
Large Avenue	FED	N/A	N/A	N/A	N/A	1991-1992
13rd October Avenue	FED	N/A	N/A	N/A	N/A	1991-1992
Patrice Lumumba Bd	FED	N/A	N/A	N/A	N/A	1991-1992
University Avenue	FED	N/A	N/A	N/A	N/A	1991-1992
Science Avenue	FED	N/A	N/A	N/A	N/A	1991-1992
Tanzanie Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Marais Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Usine Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Commerce Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Ruvubi Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Santé Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Ntahangwa Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Amitié Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Rusama Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Plage Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Mission Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
3rd September Bd	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992

Name of Road	Financer	Contractor	Nationality	Contract Amount (BFu)	Duration	Period
Afrique Bd	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Misugi Bd	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
5th February Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Force Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Munyinya Street	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Butaganzwa Avenue	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Kinama Road	FED	SOGEA-COLAS	F	N/A	N/A	1990-1992
Unité Bd	FED	N/A	N/A	N/A	N/A	N/A
Stade Avenue	FED	N/A	N/A	N/A	N/A	N/A
Indépendance Bd	Burundian Government	Road Général Direction AMSAR-ASTALDI	B	N/A	N/A	1984-1986

Note, F: French Contractor, B: Burundian Contractor
Source: Ministry of Works, Burundi


As table above shows that there were few projects of which the Burundian contractor was appointed, it is thus difficult to consider that Burundian contractor is available to carry out the road construction work, alone.





There are three (3) local general contractors in Bujumbura city, those contractor posses concrete batching plant and earthwork machineries but no paver and asphalt plant either.

The following tables show the profile of the local general contractors;

Table 2-5 Profiles of Local General Contractor in Bujumbura

Name	BERCO CONSTRUCTION
Address	B.P. 3343 Bujumbura, Burundi Tel +257-22 96 28/23 62 50 Fax:+257-21 37 82
Financial Condition	Capital: Approx.1.0 million USD Working Capital:3.0 million USD
Nos. Employees	Administrator: 30 Engineer: 10 Skilled Labour: 60
Kinds of Experienced Work	<ul style="list-style-type: none"> • Road • Structure • Bridge

	<ul style="list-style-type: none"> • Road Maintenance • Building
Remarks	<ul style="list-style-type: none"> • In the main camp, there is a factory of processing steel bar and other construction steel products and pre-casting concrete products as well. • Eng. Manirakiza, the manager of construction dept. had worked for Japanese contractor.
Photographs	
Name	GETRA CONSTRUCTION
Address	B.P. 1848 Bujumbura, Burundi Tel +257-24 27 49 Fax:+257-24 11 65
Financial Condition	Capital: Approx.1.0 million USD Working Capital:8.0 million USD
Nos. Employees	Administrator: 40 Engineer: 23 Skilled Labour: 60
Kinds of Experienced Work	<ul style="list-style-type: none"> • Road • Structure • Bridge • Road Maintenance • Building
Remarks	<ul style="list-style-type: none"> • In the main camp, there is a factory of processing steel bar and other construction steel products • The SETEMU appointed the GETRA together with SOGEA SATOM, French Contractor to Bujumbura City Roads Rehabilitation Project financed by E.U. • The GETRA was prized on the Official Commendation of Excellent Construction Work Company by France in 2006

Photographs		
Name	GETRA CONSTRUCTION	
Address	B.P. 325 Bureaux – Ateliers – Magasins Av.de l' O.U.A 16 Bujumbura Tel +257-22 44 99 Fax:+257-22 75 64	
Financial Condition	Capital: Approx.1.0 million USD Working Capital:8.0 million USD	
Nos. Employees	Administrator: 10 Engineer: 3 Skilled Labour: 40	
Kinds of Experienced Work	<ul style="list-style-type: none"> • Road • Structure • Bridge • Road Maintenance • Building 	
Remarks	<ul style="list-style-type: none"> • AMSAR used to be Belgium contractor, its independent was 1980's • AMSAR possess own asphalt paver but in Congo • AMSAR is most equipped contractor in Burundi, it possess aggregate crashing plant, pre-cast concrete factory, asphalt distributor, high tall tower crane and etc • But the facilities and machineries are relatively .old. 	
Photographs		

2-3-3 Taxation for Construction Activity concern

- (1) Rate of the import tax on construction machine is 15-20% of its value
- (2) Rate of the import tax on bituminous material is 35% of its value
- (3) Rate of the custom duty is 4-6% of good's value
- (4) Above-mentioned taxes are exempted when the material and/or machinery is used for the public works

2-3-4 Procurement Procedure (Tendering)

- (1) There is an existing regulations stating public procurement by the name of "Marchés Publics, Dispositions légales et réglementaires" administrated by the Ministry of Finance.
- (2) Normally, procurement is announced on major newspapers, and followed to it the EOI (Expression of Interest) is announced on the newspapers so as to make the long list. The contractors which submit the EOI are evaluated by the Client for the Client's criteria. As the result of evaluation, the short-list which is a list of candidate contractor is made. The short-listed contractor will receive the RFP (Request for Proposal) from the Client. Finally the Client appoints the contractor as the result of the evaluation of the proposals at tender opening ceremony. Total procedure takes at least 3 month from the first announcement.
- (3) Omitting some procedure of above, it is also applied that the tender procedure starts from the short-list when the project budget is a little.

CHAPTER 3 DESIGN

3-1 DESIGN POLICY

The design policy of the EWPP is generally to restore road functions so no upgrade and no future demand are considered with exception of some safety issues.

Beside of above, the work scope and methodology shall be determined and selected in accordance with construction time limitation and local material availability, the social environmental consideration aspects is most respectable in the design.

3-2 DESIGN CRITERIA

There is no road and pavement design standard in Burundi, the design in past project have been carried out by the other foreign standards such as French.

The EWPP restores the original road function which means that existing horizontal and vertical elements remain as they are.

Besides, for the designing of other elements and facilities, the following existing standards shall be referred;

1. AASHTO Pavement Design Standard
2. SATCC Draft of Practice for the Geometric Design of Trunk Roads
3. SATCC Draft Code of Practice Rehabilitation of Road Pavements
4. STACC Draft Standard Specifications for Road and Bridges Works
5. STACC Road Traffic Signs Manual
6. Pavement and Material Design Manual -1999, Ministry of Works Republic of Tanzania
7. Standard Specification for Road Works 2000, Ministry of Works, Republic of Tanzania
8. Douro Kouzourei, Japan Road Association, Japan

AASHTO is well-known standard for road design; recently most of the developing countries refer this AASHTO standard on the pavement and structure design.

STACC document are also widely used in Southern and East African countries because they

reflect regional conditions on their methodology so that they are believed as one of useful standard among the region.

Tanzania is one of the countries that make efforts to the road development; Tanzania developed the methodology of the STACC on its standards. As Burundi and Tanzania adjoin each other and they have similar features on climate as well as geographic. Accordingly the Tanzanian standards are more practical for the road design in Burundi.

3-3 ENGINEERING DESIGN

This section mainly discuss on the design for the RN7.

3-3-1 Horizontal Alignment Design

As discussed in 3.1 Design Policy, the EWPP shall not give any improvement on the existing horizontal alignment; the existing alignment is used and maintained as it is. However, for the calculation of quantity purpose, the existing alignment is expediently chainage-nized on the image data by the desk work, it is as follows;

Table 3-1 Horizontal Element of Existing Alignment

IP No.	Chainage 1	Chainage 2	Radius (m)	Length (m)	Accumulative Length(m)
0	No.0+00.000	No.9+32.614		932.614	-
1	No.9+32.614	No.10+62.769	900	135.155	1,062.769
2	No.10+62.769	No.12+62.008		199.240	1,262.008
3	No.12+62.008	No.13+66.125	600	104.117	1,366.125
4	No.13+66.125	No.14+83.064		116.938	1,483.064
5	No.14+83.064	No.16+57.365		173.301	1,657.365

As for the reference, above alignment satisfies with the requirement of design speed 80km/hr by the Douro Kouzourei, Japan

3-3-2 Cross Sectional Design

The existing road width is varied from 8.5m-10.0m and there is no critical part which disturbs traffic flow due to narrow road width.

Moreover, there are many exiting houses and public infrastructure facilities such as drainage ditch, water pipe line, electric pole and line just after the paved area ; those facilities is untouchable by the EWPP.

As for the carriageway, the STACC Draft Code of Practice for the Geometric Design of

Truck Roads introduces the minimum width of lane that is 3.1m in consideration of design vehicle dimension of 2.5m and minimum clearance of 0.3m on both sides, and however there is no description of minimum width of walkway. The Japanese Douro Kouzourei introduces the minimum width and design dimension of pedestrian which are 2.0m and 0.75m and however the 2.0m is from the consideration of width of wheel chair. As there is total width constraint of 8.5m, the design provides 6.5m (3.25m x 2) for carriageway width and 1.0m of walkway width as the result of combining the ideas of minimum dimension from the SATCC and Douro Kouzourei so as it to be within the constraint.

As for the cross fall, the STACC introduces 2.0% as normal rate, and the STACC also allows increasing it up to 3.0% in areas where heavy rainfall is common or where the most economical longitudinal gradient is 0%; this is because of the consideration of obtaining well-draining on the surface.

Considering above, the cross fall of 2.5% is introduced because of that, although 2.0% as normal rate is introduced the steeper cross fall is effective for the well-draining and it result to decrease maintenance cost, applying 3.0% is more effective than 2.5% in terms of the draining, however it has a difficulty on construction of the DBST which is introduced as pavement type and discussed later on this chapter..

Accordingly, the design provides the typical cross section for the RN7 as shown in below:

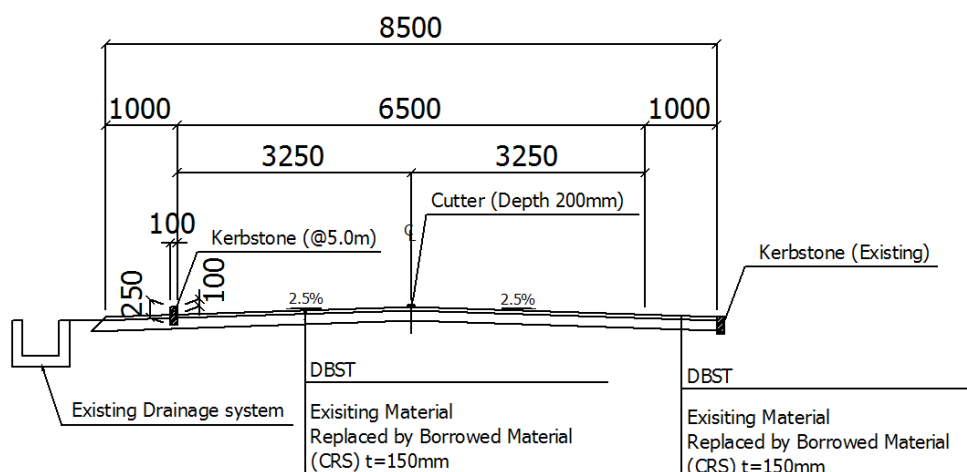


Figure 3-1 Typical Cross Section for RN7

In the existing road, there is no facility which demarcates pedestrian and vehicle corridor, it creates dangerous situation, and therefore the design is required to consider providing the facility for the demarcation.

Before the Project section (CBD side), the kerbstone on intermitting line is provided for the

demarcation and it looks well functioning although they are intermitted. Following this idea, the kerbstone is provided as same manner at before the Project section to the cross sectional design.

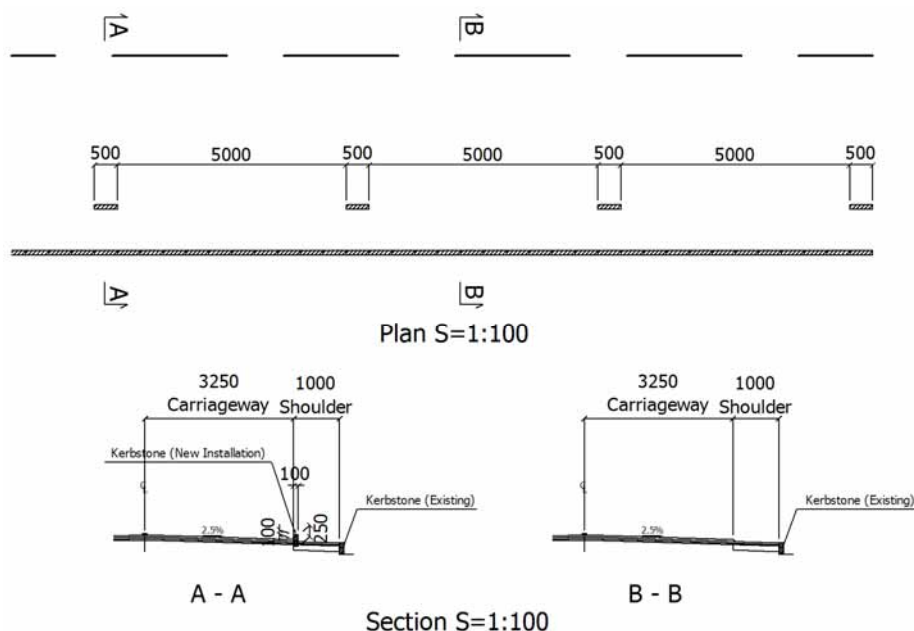


Figure 3-2 Design for Provision of Kerbstone

3-3-3 Pavement Design

(1) General

As described in preceding chapter, there are many potholes on entire section. Normally the cause of pothole is considered to be poor drainage and the poor drainage is caused by unevenness of pavement surface. Accordingly, the pavement design focuses to repair the pothole as well as restore the proper evenness.

In terms of the resorting of evenness of the pavement, surface type is key item; therefore the pavement type shall be selected at first.

(2) Selection of Surface Pavement Type

There are two alternatives for the surface pavement type which are the Asphalt Concrete pavement (hereinafter referred to as “the AC”) and the DBST.

Following table shows the comparison between the AC and the DBST from several aspects;

Table 3-2 Comparison of the AC and the DBST

No.	Item	AC		DBST	
1.	Material Production Plant	• Necessary		• Not Necessary	
2.	Required Machineries and the Availability in Burundi	Machinery	Availability	Machinery	Availability
		As Plant	N/A	Chips Spreader	A
		As Distributor	A	As Distributor	A
		Tire Roller	A	Tire Roller	A
		Macadam Roller	A	Macadam Roller	A
		Dump Track	A	Dump Track	A
		As Finisher (Paver)	N/A		
3.	Special Testing Equipment	• Necessary		• Not Necessary	
4.	Durability	• No Problem		• Inferior to the AS.	
5.	Evenness	• Good		• Inferior to the AS	
6.	Work Experience in Burundi	• A few		• Many	
7.	Approx. Construction Cost	• 30 USD /m ²		• 7 USD/m ²	

As shown above, the AC is preferable in terms of the durability; it means that there is an advantage of the maintenance compared with the DBST, however there is a problem of mobilization that main equipments such as AC plant and finisher are not available in Burundi so that those are necessary to mobilize to Burundi.

There is a time constraint for the construction that is 4-5 month; the mobilization time is a biggest item for judgment of selection of the AC. According to the result of investigation for availability on construction equipment and machinery, Kenya is most probable country where the AC plant and the finisher are available to arrange whatever hiring and purchase. If the EWPP hires existing mounted AC plant at Kenya, the necessary time of mobilization will be total 3 month which details the dismounting of 0.5 month, the transportation including custom clearance of 1 month, remounting of 0.5 month and adjustment including the design of AC content and trial construction, it is less than a case of newly purchase. With consideration of rainy season and above the AC is difficult to select as the surface pavement type. Furthermore, the mobilization and hiring cost of the AC plant is 62,000USD according to the estimation, it become almost 50% of total budget of the EWPP. Accordingly it is judged that AC pavement

is not feasible for the EWPP.

As the result of above, the DBST is selected as surface pavement martial.

(3) Work Contents

In case of selecting the DBST, the overlay the work is not effective to restore the pavement evenness; at least the reconstruction from the base course is necessary. There are many potholes on existing pavement, there is no exactly data regarding depth of the potholes but those look more than 10 cm. Because of this observation, the reconstruction depth shall be designed to be 15cm .

As for the composition of the DBST, 20mm for 1st layer (bottom) and 10mm for 2nd layer (top) is designed by following the normal case of the truck road design.

For the section where the road beds were washed away (after No.15), the construction from the subbase shall be introduced. The Ministry of Works and Equipments, Burundi recommended to adopt the minimum thickness of the National Road in Burundi to be 15cm and 25cm for base course and subbase course. So the design provides the cross section for the section as shown in below;

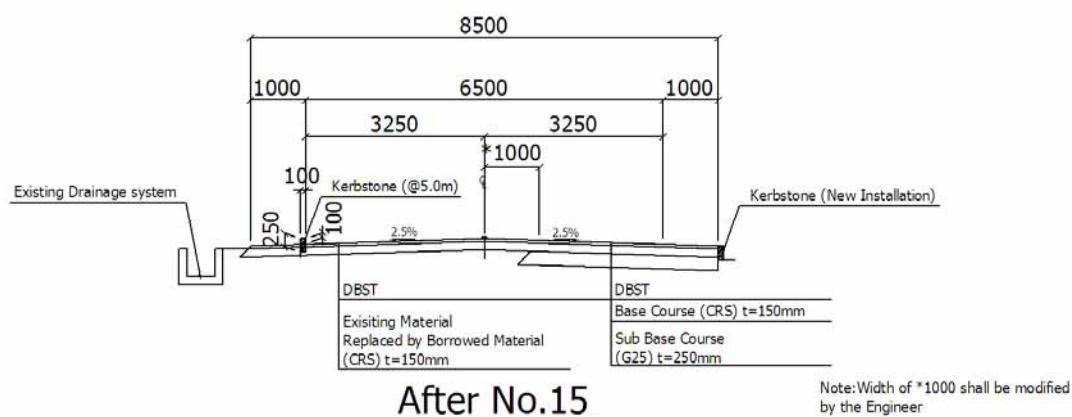


Figure 3-3 Cross Section for Heavily Damaged Section

(4) Engineering Justification

As the result of the consideration discussed above, the pavement composition is designed to be 3cm of DBST and 15cm of the base course. In addition to that, existing base course can be functioned as subbase course which is at least 30cm in thickness.

From the results of the geotechnical survey, the following equation between the CBR and

DCP test results is obtained;

$$Y = 1.24 X - 3.8736$$

Where: X= DCP value (Mpa), Y=CBR value (%)

As the DCP results at existing base course level is generally 12.5, using above equation the CBR value of existing base material is estimated to be 11.6 (%)

This 11.6% corresponds 0.078 of the SN according to the Layer Coefficient Graph introduced by the AASHTO.

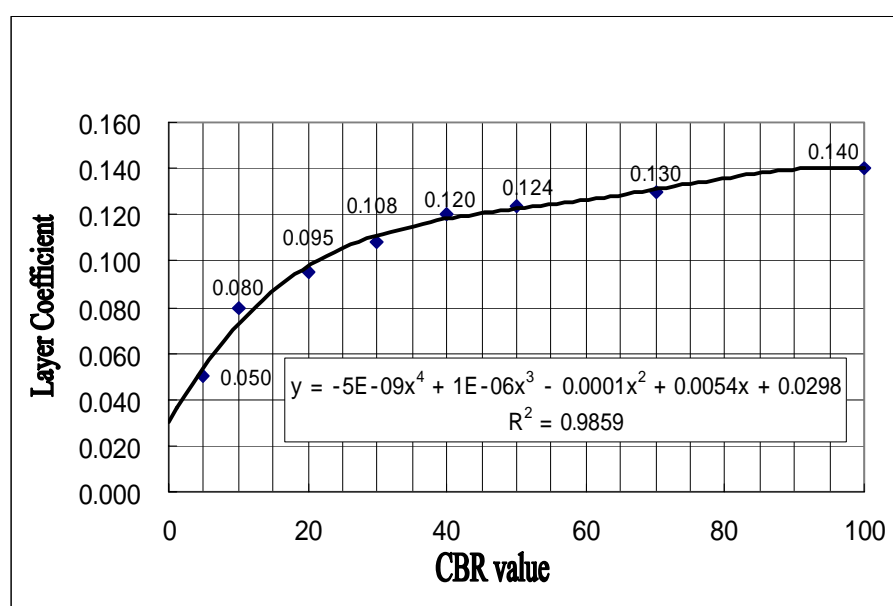


Figure 3-4 Layer Coefficient Graph

Besides, the average section CBR value shall be calculated from the results of CBR test, to be 6.0 %.

There is no data for axel loading in Burundi, when the ESAL value for each vehicle type are assumed as 0.2 of truck, 0.4 of Dump and 0.2 of Bus, total ESAL for 5 years is estimated to be approx. 61,000.

Using above values with some assumed factors; the design pavement composition is checked by the AASHTO pavement design methodology and the result then is as follows;

PAVEMENT THICKNESS DESIGN - FLEXIBLE PAVEMENT**(CBR 6%)****(AASHTO)****DATA TRAFFIC :**

Design Period	5
Distribution Factor	0.5
Lane Coefficient	0.8

Total ESAL for 5 Years	61,000
-------------------------------	---------------

CBR (%)	6.0	kg/cm ³
Resilient Modulus (MR)	9,000	psi
SERVICEABILITY :		
- Terminal Serviceability (Pt)	2.50	
- Initial Serviceability (Po)	4.20	
- Serviceability Loss (Δ PSI)	1.70	
RELIABILITY, R (%)	90.00	
STANDARD NORMAL DEVIATION (Zr)	(1.282)	
STANDARD DEVIATION (So)	0.40	
DRAINAGE COEFFICIENT (m)	1.30	
STRUCTURAL NUMBER (SN)	1.983	

CHECK EQUATION : $\boxed{4.785} = \boxed{4.786}$

TEBAL LAPIS PERKERASAN :

Jenis Lapis Perkerasan	Layer coeff.	Layer thickness (inch)	Structural Number
DBST	0.2	1.18	0.24
Base Course	0.14	5.91	0.83
Subbase Course	0.078	11.81	0.92
			0.00
			0.00
			1.984

3-3-4 Drainage Design

The terrain around the Project section runs down from East to West, there is existing open drainage on the Eastern (mountain) side of existing road edge. The storm water from the catchment area is collected by the existing drainage.

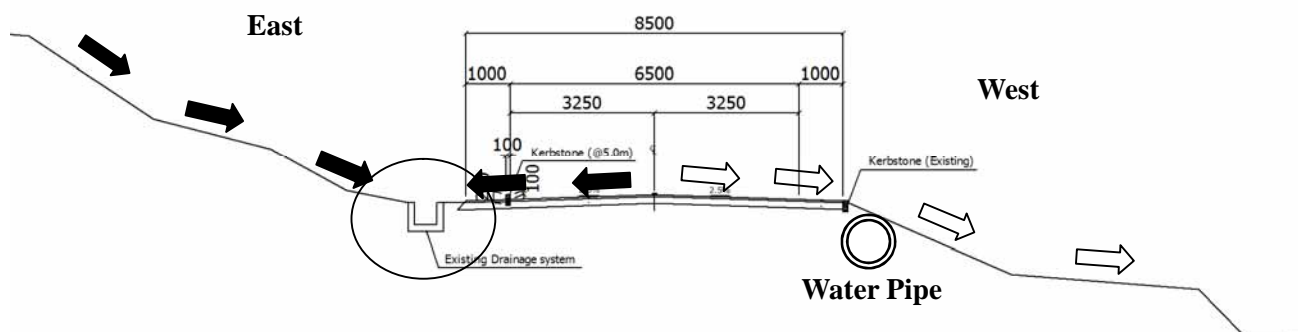


Figure 3-5 Storm Water Flow

On the other hand there is no existing drainage at west side, as above figure shows, the catchments of west side is small like a half of carriageway which is 4.25 m wide , and the open drainage has already been provided at some critical points. Furthermore, there is existing main water pipe line just after the boundary of the road with little earth cover, so it is not possible to provide the drainage unless the water pipe line is relocated. With consideration of small catchments and existing water pipe, it is decided that the design dose not provide the drainage on western side. However at the future improvement, it is suggested that there should be some drainage even if the catchments are small, the Government and/or Bujumbura City Council has to manage necessary land acquisition and relocation without any conflict.

3-3-5 Facility Design

The Busbay is provided in the design at the ending point where the stopping mini bus and taxi overflow into carriageway. The length of busbay shall be designed in consideration of land limitation and size of bus, the transition for in and out is also designed so as the vehicle to approach smoothly.

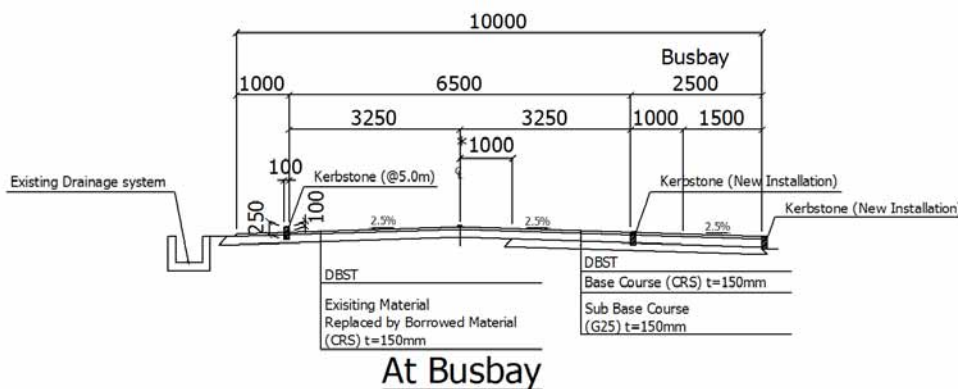


Figure 3-6 Sectional View of Busbay

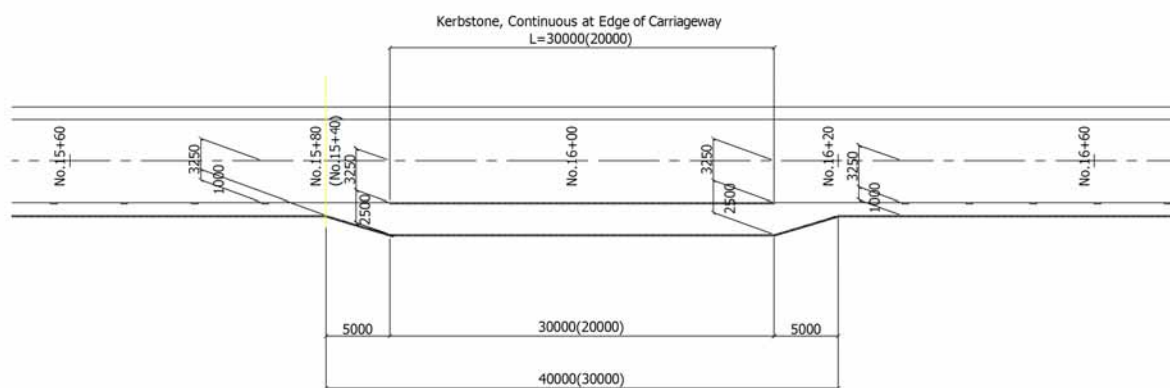


Figure 3-7 Busbay Layout

3-3-6 Safety Facility Design

(1) Humps

Hump is designed at the points where the people concentrate such as school and public office. The Hump is effective for reduction of vehicle's running speed, however at before and after of it, the pavement tends to be given damages due to the friction in between the tires. In addition, when the humps are provided more than necessity, it will give the reverse impact to traffic flow.

The design identifies the necessary and appropriate points for the hump where is near the primary school at No.4 and ending points; the ending points is also near another primary school.

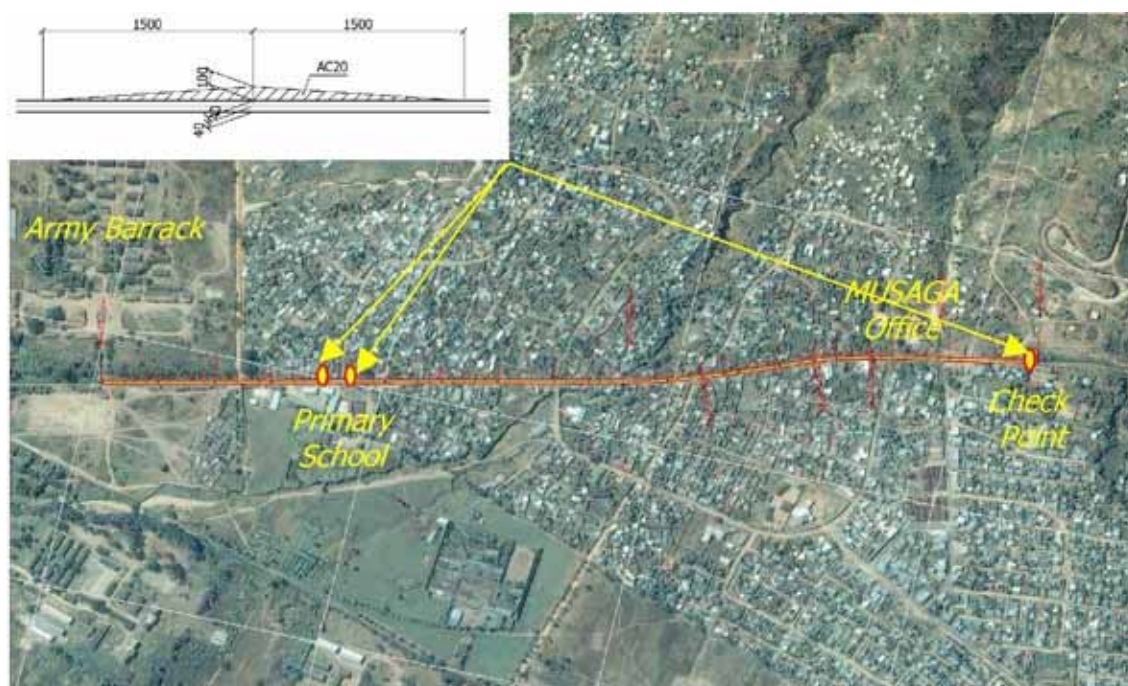


Figure 3-8 Position of Humps

(2) U-drainage Cover

Other than the Busbay discussed above, there is needs of busbays at the rest of the section. The mini bus tends to stop for collection of passengers at near the junction with feeder roads, however since there is not enough space, it is not possible to provide the busbay unless the space is obtained.

Instead of provision of proper shape of the busbay, the design provides the U-drainage cover on exiting open drainage at near the junction of feeder roads so as to secure some space for the bus passenger.



Casquettes du fossé au bord de la route



Figure 3-9 Position of Provision of U-Drainage Cover

CHAPTER 4 SOCIAL AND ENVIRONMENTAL CONSIDERATIONS

4-1 ENVIRONMENTAL SCREENING

“Environmental Screening” is the first step of the environmental and social consideration study and means of deciding whether the proposed pilot project is likely to have any impacts on the environment.

As the proposed pilot project includes rehabilitation works of existing road without upgrading, the environmental impacts are expected to be of small scale and limited within short term. According to the Article 24 in the environment code of Burundi, any maintenance and rehabilitation works does not require to prepare an EIA study. The result of the screening is shown in the following table. The environmental impacts which will occur in the construction phase are noise, vibration, dust, construction waste and traffic congestion.

Table 4-1 Matrix for EWPP Environmental Scope

Name of Cooperation Project: The Emergency Study on Urban Transport in Bujumbura, Pilot Project (Urgent rehabilitation works)													
		Likely Impacts	Overall Rating	Planning Phase	Construction Phase						Operation Phase		
				Land acquisition Change of land use plan, Control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipments and vehicles	Construction of roads, tollgates, parking lots, access roads for bridges and other related facilities	Traffic restriction in construction area	Increase of through traffic	Appearance/ Occupancy of toads and related building structures	Increasing influx of settlers
Social Environment *	No 1	Involuntary Resettlement											
	2	Local economy such as employment and livelihood, etc.								B			
	3	Land use and utilization of local resources											
	4	Social institutions such as social infrastructure and local decision-making institutions											
	5	Existing social infrastructures and services								C			

	6	The poor, indigenous and ethnic people											
	7	Misdistribution of benefit and damage											
	8	Cultural heritage											
	9	Local conflict of interests											
	10	Water Usage or Water Rights and Rights of Common											
	11	Sanitation											
	12	Hazards (Risk) Infectious diseases such as HIV/AIDS											
Natural Environment	13	Topography and Geographical features											
	14	Soil Erosion											
	15	Groundwater											
	16	Hydrological Situation											
	17	Coastal Zone											
	18	Flora, Fauna and Biodiversity											
	19	Meteorology											
		Landscape											
21	Global Warming												
Pollution	22	Air Pollution							B				
	23	Water Pollution											
	24	Soil Contamination											
	25	Waste							B				
	26	Noise and Vibration							B	B			
	27	Ground Subsidence											
	28	Offensive Odor								B			
	29	Bottom sediment											
	30	Accidents								B	B		C

Rating: A: Serious impact is expected.

B: Some impact is expected.

C: Extent of impact is unknown (Examination is needed. Impacts may become clear as the study progresses.)

No Mark: No impact is expected. IEE/EIA is not necessary.

*: Regarding the impacts on “Gender” and “Children’s Right” might be related to all criteria of Social Environment.

Reference:

- 1) Japan International Cooperation Agency (1992) “III Roads: Environmental Guidelines for Infrastructure Projects”, Tokyo, Japan.
- 2) Norman Lee and Clive George (2002) “Environmental Assessment in Developing and Transitional Countries”, JOHN WILEY & SONS, LTD., London, England.

4-2 INITIAL ENVIRONMENTAL EXAMINATION

4-2-1 Project Description

The proposed EWPP is summarized in the following table.

Table 4-2 Project Description

Item	Description
Name of Cooperation Project	THE EMERGENCY STUDY ON URBAN TRANSPORT IN BUJUMBURA Emergency Work as Pilot Project (EWPP)
Project Proponent	Ministry of Transport, Posts and Telecommunications Ministry of Public Works and Equipment, Road Department
Background	Bujumbura with estimated population of 550,000, the capital city, is the political and economic center of Burundi. However, the basic infrastructures, and road conditions in particular, are extremely poor, and so reconstruction is essential before the living conditions of the people can be improved. Although the demand for transportation in Bujumbura is expected to increase in future due to the increasing economic activity during the rehabilitation period, road volume and the road network are inadequate, and existing structures and traffic control are so poor that traffic congestion in the city center is becoming a major concern.
Objectives	The implementation of this project will provide an immediate rehabilitation of the collapsed national trunk road 7 to improve the road traffic.
Location	Musaga Commune, Bujumbura City, Burundi Residential Area
Beneficiaries Population	Directly: 95,000 or more people (Living in Rohero and Musaga Commune along the road) Indirectly: 350,000 people (living in Morobe Province)
Project Components	Re-construction works of existing pavement (National Trunk Road 7)
Type of Project	Construction / Rehabilitation
Type of Roads	Highway/ Ordinary, Urban/ Rural Area, Plain/ Mountainous Area
Target Year/ Traffic Volume	In year 2007, 5,000 cars/ 12 hours
Extension/ Width/ Lanes	Ext 1.7 km, Width 9.0~9.8 m, No. of Lanes 2
Road Structure	Bridge
Supplemental Facilities	Interchanges: 0 points, Toll Gates: 0 points
Others	The rehabilitation works are limited in the existing right of way and include paving work in bus stops.

Reference:

- 1) Japan International Cooperation Agency (1992) "III Roads: Environmental Guidelines for Infrastructure Projects", Tokyo, Japan.

4-2-2 Site Condition

The EWPP section of National Trunk Road 7 is located in the southeastern part of Bujumbura and passes through residential areas. The important public facilities along the roadside are an army camp, a school, three public water stations and a bus parking. Water pipe is laid underground along the western roadside.

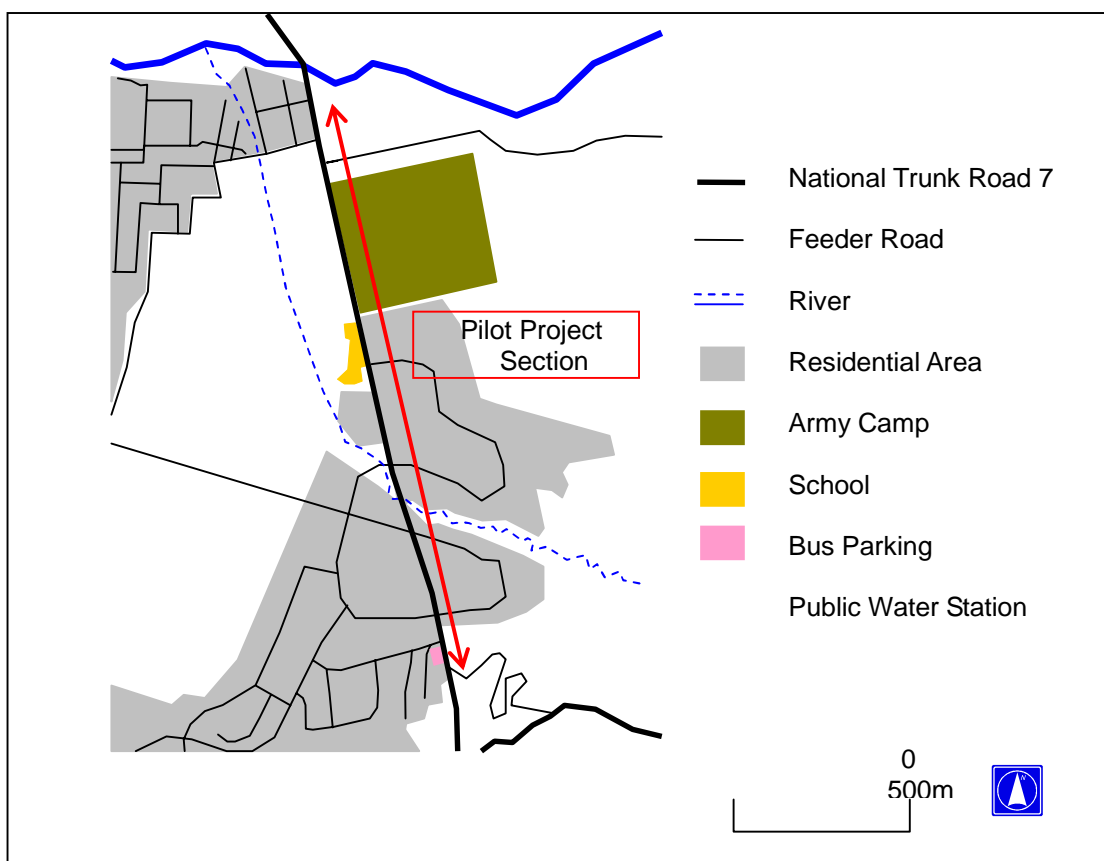


Figure 4-1 Project Site

4-2-3 Environmental Impact and Mitigation

A. Construction Phase

Air Pollution and Offensive Odor:

Convey of construction materials, heavy equipment operation and earthworks will generate harmful dust. Operation of heavy equipment and asphalt plant will generate exhaust gas. These dust and exhaust gas caused by construction works are unavoidable to some degree.

The contractor should keep their construction equipments in proper condition to avoid the imperfect combustion. If the residents and pedestrians complain about the dust, the preventive measures such as water spraying to reduce the dust should be carried.

Noise and Vibration:

Heavy equipment operation will generate noise and vibration. However, these noise and vibration caused by construction works is unavoidable to some degree.

To mitigate the nuisance by noise and vibration, the construction planning Consultant should consider the proper execution scheme. Because the EWPP site is located in residential areas, night time construction works should be avoided. The Contractor should keep their construction equipments in proper condition. If the residents complain about noise and vibration, the Supervision Engineers and the Contractors should reconsider the construction method.

Waste:

The re-pavement works of the existing paved road will be conducted after tearing up of the old pavement. Some part of old pavement may become the construction waste depending on the construction condition. Other construction waste such as fragments of construction materials and garbage from construction workers will be generated.

The contractor should consider proper disposal plan and manage the construction wastes. The Consultants' supervision team should monitor the waste disposal.

Existing Infrastructures and Facilities:

The Consultants' supervision team and the Contractor should study carefully the buried facilities such as water pipe to avoid the accidental destructions.

Accident and Traffic Conjunction:

As traffic restrictions will be required in the construction site, temporary traffic conjunction

will occur during the construction period. Accidents may be provoked by the traffic restriction. The pavement works in the bus parking area, where many buses and passengers are utilizing, will disturb the service.

To mitigate the traffic conjunction and disturbance, the construction planning Consultant should consider the proper execution scheme and the Contractor should install the sign that explains the construction components and period at the bus parking area well in advance of the construction works. If the drivers or passengers complain about the traffic conjunction and disturbance, the Supervising Engineers and the Contractors should reconsider the construction method.

B. Operation Phase

Accident and Non-Motorized Transport:

The road accident will be reduced with the improved road condition. On the other hand, as the traffic speed is expected to increase, the accidents may increase.

There are many pedestrians passing through the EWPP section. The traffic volumes are: vehicles about 5,000/12hours, pedestrians about 7,000/12hours, and bicycles about 2,000/12hours, respectively. The road design Consultant should consider the movement of non-motorized transports and incorporate the considerations into the design.

4-2-4 Environmental Management Plan

Construction Materials:

To prevent illegal exploitation of construction materials such as soil, gravel, etc., the construction materials must be procured officially. The Consultants' supervising team should monitor the procurement.

Construction Waste:

To prevent illegal dumping of construction wastes, the construction specification mentions that the construction wastes must be disposed officially. The Consultants' supervision team should monitor the waste disposal.

Environmental Monitoring:

To immediately identify the environmental and social issues, the Consultants' supervision team should monitor the following items throughout the construction period.

- Noise, vibration, dust, odor and exhaust gas caused by operation of heavy equipments

- and asphalt plant
- Traffic congestion and accident
- Opinions and complaints from the drivers, residents, pedestrians and passengers.

4-2-5 Public Consultation on EWPP

The public consultation on the EWPP was held at the Ministry of Finance on 19th June, 2007. Attended organizations were as follows:

- Ministry of Transport, Posts and Telecommunications
- Ministry of Public Works and Equipment
- OTRACO
- Administrative Office of Musaga Commune
- The 2nd Battalion (Camp Muha)
- Musaga Parking Lot Office
- Office of Gitaramuka Quarter
- Office of Kinanira I Quarter
- Office of Kinanira II Quarter
- Office of Kamesa Quarter
- Local Council of Musaga
- Committee of Parents of Musaga I School

Contents of discussions:

JICA study team made the following presentation:

1. Explanation of Outline of the Project
 - Project Section
 - Anticipated Project Period
 - Design Policy
 - Design Contents
 - Civil Work Sequence
2. Facilities for consideration to local people
 - Number and Installation Point of Road Humps
 - Installation Point and Length of Caps on Side Ditch
3. Undertakings by Burundian Side
 - Arrangement of Temporary Removal of Shops and Container in the Right of Way
 - Clarify Boundary between Official and Private Land in Bus Bay Area

Main opinions and questions from participants were as follows:

- Regarding traffic safety, besides installation of safety facilities, regulations of

traffic safety are important.

- Regarding road safety in Bujumbura, separation of traffic lanes among vehicles, bicycles and pedestrians is important.
- Thirteen accidents occurred in last year near Musaga I School where 2,500 students commute. The humps and pedestrian crosswalks are expected to reduce traffic accidents.
- The administrative office will hold a meeting with the local people on this project and order the owners of the illegal shops and container in the right of way to remove them in advance of the commencement of construction works.
- District office will enlighten this project to the local people to get their cooperation in the construction works.
- The cooperation of Japanese side to the minimal requests from the local residence in the construction period is expected for the success of this project.
- Q1: How to decide on the construction company, by tender? A1: By JICA's system including tender.
- Q2: Are signs, street lamps and bus shelters included in this project? A2: These facilities are not included in this project.
- Q3: How were the three installation points of side ditch caps selected? There were four official bus stops along the section in the past. A3: According to site survey, the points where many buses are stopping were selected.
- Q4: Is bridge rehabilitation included in this project? A4: Bank protection works to one river and one channel are included in this project.