

**MINISTRY OF LOCAL GOVERNMENT AND HOUSING (MLGH)**

**LUSAKA CITY COUNCIL (LCC)**

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

**THE STUDY ON COMPREHENSIVE URBAN DEVELOPMENT PLAN**

**FOR**

**THE CITY OF LUSAKA**

**IN**

**THE REPUBLIC OF ZAMBIA**

**FINAL REPORT**

**ANNEX I**

**SURVEY ON TRAFFIC DEMAND**

**MARCH 2009**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

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**KRI INTERNATIONAL CORP.**

**NIPPON KOEI CO., LTD.**

**JAPAN ENGINEERING CONSULTANTS CO., LTD.**

## **EXCHANGE RATE**

**USD 1 = ZMK 3,582 = JPY 106.53**

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JPY: Average rate of JICA rate, from January 2008 to October 2008

The Study  
on  
Comprehensive Urban Development Plan  
for  
the City of Lusaka  
in  
the Republic of Zambia

**Final Report**

**ANNEX 1 SURVEY ON TRAFFIC DEMAND**

Table of Contents

List of Tables

List of Figures

<b>CHAPTER 1. TRAFFIC SURVEY .....</b>	<b>A1-1</b>
1.1 Introduction .....	A1-1
1.1.1 General .....	A1-1
1.1.2 Outline of Traffic Survey .....	A1-1
1.2 Description of Traffic Survey .....	A1-2
1.2.1 Household Interview Survey .....	A1-2
1.2.2 Cordon Line Survey .....	A1-6
1.2.3 Screen Line Survey .....	A1-8
1.2.4 Public Transport Passenger Interview Survey .....	A1-9
1.2.5 Freight Interview Survey .....	A1-9
1.2.6 Travel Speed Survey .....	A1-10
1.3 Survey Results and Major Findings .....	A1-11
1.3.1 Results of Household Interview Survey .....	A1-11
1.3.2 Road Traffic Condition .....	A1-13
1.3.3 Characteristics of Traffic across Lusaka District Boundary .....	A1-18
1.3.4 Public Transport Passenger .....	A1-22
1.3.5 Freight Characteristics by Business Type .....	A1-24
1.3.6 Travel Speed .....	A1-25
1.4 Intersection Traffic .....	A1-26
1.4.1 Intersection Turning Movement Survey .....	A1-26
1.4.2 Results of Intersection Turning Movement Survey .....	A1-27
1.4.3 Intersection Analysis .....	A1-30
1.5 Traffic Count Survey .....	A1-33
<b>CHAPTER 2. DEMAND FORECAST .....</b>	<b>A1-44</b>
2.1 General .....	A1-44
2.1.1 Approach .....	A1-44
2.1.2 Zoning System for Demand Forecast .....	A1-44
2.1.3 Classifications of Trip Purpose and Transport Mode .....	A1-46

2.2	Trip Generation and Attraction.....	A1-46
2.2.1	Trip Generation and Attraction Model .....	A1-46
2.2.2	Vehicle Ownership .....	A1-47
2.3	Trip Distribution.....	A1-48
2.4	Modal Split.....	A1-48
2.4.1	Walk – Bus Split Model .....	A1-48
2.4.2	Modal Split by Trip Purpose .....	A1-49
2.5	Adjustment Factor .....	A1-51
2.6	Other Traffic .....	A1-51
2.6.1	External Traffic.....	A1-51
2.6.2	Truck Traffic Generated/Attracted by New Industrial Development.....	A1-51
2.7	Traffic Assignment .....	A1-52
2.7.1	Road Network .....	A1-52
2.7.2	Passenger Car Unit (PCU).....	A1-53
2.7.3	Method of Traffic Assignment .....	A1-53
2.8	Results of Demand Forecast.....	A1-53
2.8.1	Trip Generation and Attraction.....	A1-53
2.8.2	Trip Distribution.....	A1-54
2.8.3	Modal Share .....	A1-55

### **LIST OF TABLES**

Table 1.1.1	Outline of Traffic Survey .....	A1-1
Table 1.2.1	Traffic Zones in Lusaka District .....	A1-3
Table 1.2.2	Traffic Zones in the Outside of Lusaka District.....	A1-4
Table 1.2.3	Number of Samples for the HIS.....	A1-5
Table 1.2.4	Survey Schedule for the HIS.....	A1-6
Table 1.2.5	Survey Location for Cordon Line Survey.....	A1-7
Table 1.2.6	Survey Location for Screen Line Survey.....	A1-8
Table 1.2.7	Survey Routes for Travel Speed Survey .....	A1-10
Table 1.3.1	Traffic Volumes across Screen Line.....	A1-13
Table 1.3.2	Traffic Volumes across Cordon Line.....	A1-14
Table 1.3.3	Annual Growth Rate by Each Period.....	A1-17
Table 1.3.4	Number of Samples.....	A1-18
Table 1.3.5	Average Passenger Occupancy .....	A1-19
Table 1.3.6	Average Load of Trucks .....	A1-19
Table 1.3.7	Commodity Type.....	A1-20
Table 1.3.8	Truck Facilities of Origin and Destination.....	A1-20
Table 1.3.9	Result of Public Transport Passenger Interview Survey .....	A1-22
Table 1.3.10	Score of Assessment Item .....	A1-23
Table 1.3.11	Main Input and Output of Manufacturers .....	A1-24
Table 1.3.12	Average Travel Speed by Route.....	A1-25
Table 1.4.1	Result of Intersection Analysis- Kabwe Roundabout .....	A1-30
Table 1.4.2	Result of Intersection Analysis- Kafue Roundabout.....	A1-31
Table 1.4.3	Result of Intersection Analysis- Great East Road and Kamloops Road.....	A1-31
Table 1.4.4	Result of Intersection Analysis- Los Angeles Boulevard and Haile Selassie Avenue .....	A1-31
Table 1.4.5	Result of Intersection Analysis- Independence Avenue and Chindo Road .....	A1-31
Table 1.4.6	Result of Intersection Analysis- Kafue Road and Lumumba Road.....	A1-32
Table 1.4.7	Result of Intersection Analysis- Great North Road and Lumumba Road .....	A1-32
Table 1.4.8	Result of Intersection Analysis- Great East Road and Addis Ababa Drive.....	A1-32

Table 1.4.9	Result of Intersection Analysis- Mumba Road and Lumumba Road.....	A1-32
Table 1.4.10	Result of Intersection Analysis- Cairo Road and Church Road.....	A1-33
Table 1.5.1	Traffic Count Survey Stations.....	A1-33
Table 1.5.2	Great East Road near the University of Zambia.....	A1-34
Table 1.5.3	Great East Road near Chainama Golf Course.....	A1-35
Table 1.5.4	Great North Road near Emmasdale School.....	A1-36
Table 1.5.5	Great North Road near Kasangula Road.....	A1-37
Table 1.5.6	Kafue Road near TOTAL and BP gas stations.....	A1-38
Table 1.5.7	Independence Avenue between Nationalist and Yotum Muleya Road.....	A1-39
Table 1.5.8	Cairo Road near Katondo Street.....	A1-40
Table 1.5.9	Addis Ababa Drive near Nangwenya Road.....	A1-41
Table 1.5.10	Chilimbulu Road near St Patricks' School.....	A1-42
Table 1.5.11	Mumbwa Road near Nampundwe Road.....	A1-43
Table 2.2.1	Trip Generation.....	A1-46
Table 2.2.2	Trip Attraction.....	A1-47
Table 2.2.3	Parameters of Trip Distribution.....	A1-48
Table 2.4.1	Parameters of Walk – Bus Split Model.....	A1-49
Table 2.4.2	Modal Split Model for Work.....	A1-49
Table 2.4.3	Modal Split Model for School.....	A1-49
Table 2.4.4	Car Shares for Private.....	A1-50
Table 2.6.1	Growth Factors for External Traffic.....	A1-51
Table 2.6.2	Assumptions of the Growth Factors for External Traffic.....	A1-51
Table 2.6.3	New Industrial Development Area.....	A1-52
Table 2.6.4	Freight Handling Volumes and Truck Volumes at New Industrial Development Areas.....	A1-52
Table 2.7.1	Link Information.....	A1-52
Table 2.7.2	PCU and Average Occupancy.....	A1-53
Table 2.8.1	Trip Generation by District in Study Area.....	A1-54

## **LIST OF FIGURES**

Figure 1.2.1	Traffic Zones in Lusaka District.....	A1-3
Figure 1.2.2	Traffic Zones in the Outside of Lusaka District.....	A1-4
Figure 1.2.3	Survey Location for Cordon Line Survey.....	A1-7
Figure 1.2.4	Survey Location for Screen Line Survey.....	A1-8
Figure 1.2.5	Surveyed Bus Terminals for Public Transport Interview Survey.....	A1-9
Figure 1.2.6	Survey Routes for Travel Speed Survey.....	A1-10
Figure 1.3.1	Modal Share and Trip Purpose.....	A1-11
Figure 1.3.2	Modal Share by Age and Gender.....	A1-12
Figure 1.3.3	Modal Share by Household Income.....	A1-12
Figure 1.3.4	Distribution of Travel Time by Transport Mode.....	A1-13
Figure 1.3.5	Comparison of Vehicle Composition.....	A1-14
Figure 1.3.6	Hourly Distribution at Independence Avenue (SL8).....	A1-15
Figure 1.3.7	Hourly Distribution by Vehicle Type at Independence Avenue (SL8).....	A1-15
Figure 1.3.8	Hourly Distribution of Traffic Volume at Great North Road (CL1).....	A1-16
Figure 1.3.9	Hourly Distribution by Vehicle Type at Great North Road (CL1).....	A1-16
Figure 1.3.10	Comparison of Traffic Volumes among 1995 and 2007.....	A1-17
Figure 1.3.11	Comparison of Vehicle Composition between 1995 and 2007.....	A1-18
Figure 1.3.12	Trip Purpose by Vehicle Type.....	A1-19
Figure 1.3.13	Traffic Distribution at CL1 and CL5.....	A1-21
Figure 1.3.14	Traffic Distribution by Province and Country at CL1 and CL5.....	A1-21
Figure 1.3.15	Assessment on Present Bus Service.....	A1-23

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Figure 1.3.16	Distribution of Sampled Bus Passengers inside Lusaka District at Four Bus Terminal .....	A1-24
Figure 1.3.17	Travel Speed Conditions in the Morning and Evening .....	A1-26
Figure 1.4.1	Survey Locations of Intersection Traffic Count Survey .....	A1-26
Figure 1.4.2	Kabwe Roundabout .....	A1-27
Figure 1.4.3	Kafue Roundabout .....	A1-27
Figure 1.4.4	Great East Road and Kamloops Road .....	A1-27
Figure 1.4.5	Los Angeles Boulevard and Haile Selassie Avenue .....	A1-28
Figure 1.4.6	Independence Avenue and Chindo Road .....	A1-28
Figure 1.4.7	Kafue Road and Lumumba Road .....	A1-28
Figure 1.4.8	Great North Road and Lumumba Road .....	A1-29
Figure 1.4.9	Great East Road and Addis Ababa Drive .....	A1-29
Figure 1.4.10	Mumba Road and Lumumba Road .....	A1-29
Figure 1.4.11	Cairo Road and Church Road .....	A1-30
Figure 2.1.1	Process of Demand Forecast .....	A1-44
Figure 2.1.2	Traffic Analysis Zone (66 zones) .....	A1-45
Figure 2.1.3	Traffic Analysis Zone for Traffic Assignment (249 zones) .....	A1-45
Figure 2.2.1	Relationship between Household Income and Vehicle Ownership .....	A1-47
Figure 2.7.1	Applied QV Formula .....	A1-53
Figure 2.7.2	Trip Generation .....	A1-54
Figure 2.7.3	Major Trip Distribution in 2007 and 2030 .....	A1-55
Figure 2.7.4	Modal Share .....	A1-55

## ANNEX-1

### SURVEY ON TRAFFIC DEMAND

#### CHAPTER 1. TRAFFIC SURVEY

##### 1.1 Introduction

###### 1.1.1 General

It is necessary to understand the people's behaviour in the study area for the formulation of urban development master plan. A Household Interview Survey (HIS, otherwise known as the Person Trip Survey) is essential to obtain the data related to people's travel pattern through direct interview to members of the sample households. The data obtained from the HIS provide people's travel patterns, socio-economic condition and assessment on public services/facilities. In addition, the data are utilized for the future traffic demand forecast. Therefore, the HIS and the supplemental surveys as shown below were conducted in the Study:

- 1) Household Interview Survey (HIS)
- 2) Cordon Line Survey
- 3) Screen Line Survey
- 4) Public Transport Passenger Interview Survey
- 5) Freight Interview Survey
- 6) Travel Speed Survey

###### 1.1.2 Outline of Traffic Survey

The outline of the traffic surveys is summarized below:

**Table 1.1.1 Outline of Traffic Survey**

Survey	Objectives	Method	Coverage
1. Household Interview Survey	<ul style="list-style-type: none"> <li>• To collect socio-economic characteristics, trip behaviours, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Interview with household members</li> </ul>	<ul style="list-style-type: none"> <li>• 5,746 households</li> </ul>
2. Cordon Line Survey	<ul style="list-style-type: none"> <li>• To capture trip information of vehicles across Lusaka Boundary</li> </ul>	<ul style="list-style-type: none"> <li>• Interview with drivers at roadsides</li> <li>• Vehicular Traffic count</li> </ul>	<ul style="list-style-type: none"> <li>• 6 locations (12 hours)</li> <li>• 2 locations (24 hours)</li> </ul>
3. Screen Line Survey	<ul style="list-style-type: none"> <li>• To obtain traffic volumes on screen line</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicular Traffic count</li> </ul>	<ul style="list-style-type: none"> <li>• 7 locations (12 hours)</li> <li>• 3 locations (24 hours)</li> </ul>
4. Public Transport Passenger Interview Survey	<ul style="list-style-type: none"> <li>• To collect information about public transport users and their opinion</li> </ul>	<ul style="list-style-type: none"> <li>• Interview with bus users</li> </ul>	<ul style="list-style-type: none"> <li>• 5 bus terminals</li> </ul>
5. Freight Interview Survey	<ul style="list-style-type: none"> <li>• To collect information about freight movement</li> </ul>	<ul style="list-style-type: none"> <li>• Interview with the office staffs</li> </ul>	<ul style="list-style-type: none"> <li>• 20 companies</li> </ul>
6. Travel Speed Survey	<ul style="list-style-type: none"> <li>• To collect information on present traffic situation on major roads</li> </ul>	<ul style="list-style-type: none"> <li>• 4 round trips by route by passenger car</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• 6 main roads</li> <li>• 4 samples (round trip)</li> <li>• Morning and evening</li> </ul>

Source: JICA Study Team

## **1.2 Description of Traffic Survey**

### **1.2.1 Household Interview Survey**

#### **(1) General**

This survey is to carry out interview survey to collect information including socio-economic characteristics, trip behaviour of members in the household in a day and so on. Interviewers visit households with interview sheets and conduct interview with members of each household.

#### **(2) Interview Items**

Interview items are:

- 1) Household information and opinion
  - Family structure
  - Housing information
  - Household income
  - Vehicle ownership
  - Living condition
  - Assessment on public services/facilities, etc.
- 2) Household member information (all members aged five and above)
  - Age, sex, occupation, income
  - Vehicle ownership, etc.
- 3) Trip information for the members (all members aged five and above)
  - Origin/destination
  - Trip purpose
  - Mode of travel
  - Departure /arrival time
  - Transfer point

#### **(3) Survey Coverage**

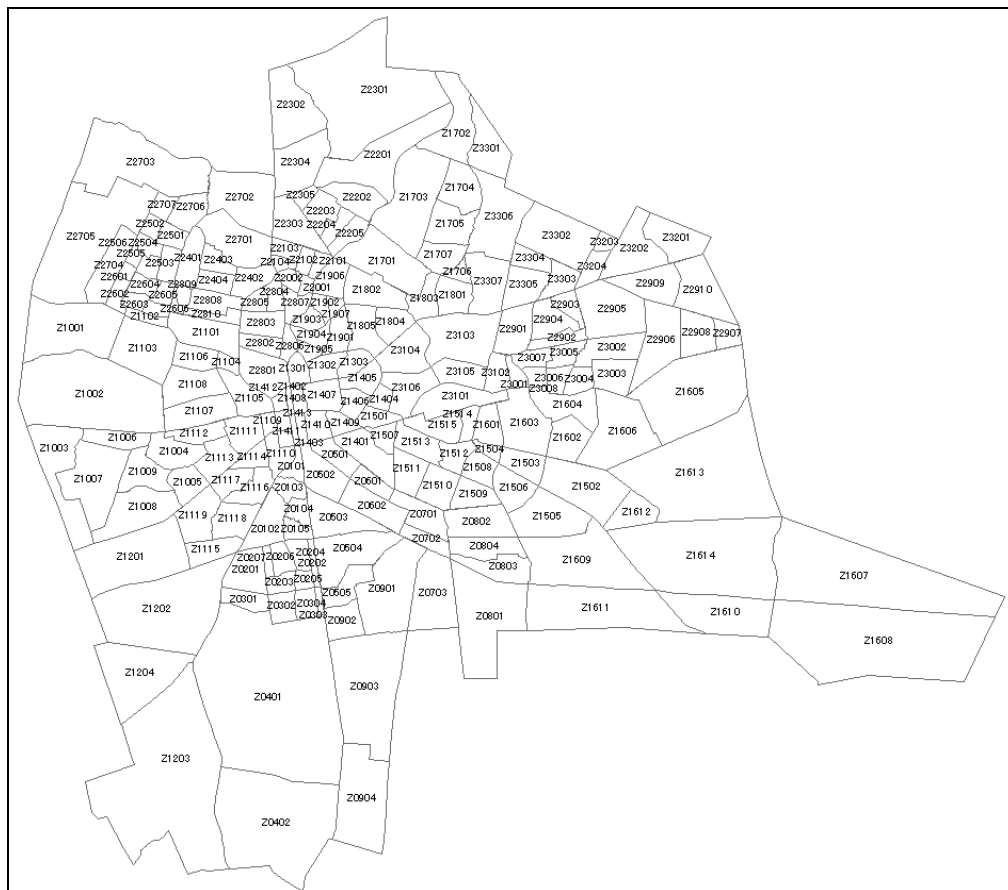
Lusaka District (33 wards) is divided into 218 traffic zones as shown in Table 1.2.1 and Figure 1.2.1. The outside of Lusaka District composing of adjoining districts, provinces and other countries is divided into 35 traffic zones as shown in Table 1.2.2 and Figure 1.2.2.



**Table 1.2.1 Traffic Zones in Lusaka District**

Traffic Zone No.	Ward	Traffic Zone No.	Ward
Z0101 - Z0105	Nkoloma	Z1801 - Z1805	Mulungushi
Z0201 - Z0207	Chawama	Z1901 - Z1907	Ngwerere
Z0301 - Z0304	John Howard	Z2001 - Z2002	Chaisa
Z0401 - Z0402	Lilayi	Z2101 - Z2104	Justine Kabwe
Z0501 - Z0505	Kamwala	Z2201 - Z2205	Raphael Chota
Z0601 - Z0602	Kabwata	Z2301 - Z2305	Mpulungu
Z0701 - Z0703	Libala	Z2401 - Z2404	Muchinga
Z0801 - Z0804	Chilenje	Z2501 - Z2506	Kapwepwe
Z0901 - Z0904	Kamulanga	Z2601 - Z2606	Lima
Z1001 - Z1009	Kanyama	Z2701 - Z2707	Mwembeshi
Z1101 - Z1119	Harry Mwaanga Nkumbula	Z2801 - Z2811	Matero
Z1201 - Z1204	Munkolo	Z2901 - Z2910	Chainda
Z1301 - Z1303	Silwizya	Z3001 - Z3008	Mtendere
Z1401 - Z1414	Independence	Z3101 - Z3106	Kalingalinga
Z1501 - Z1515	Lubwa	Z3201 - Z3204	Chakunkula
Z1601 - Z1614	Kabulonga	Z3301 - Z3307	Munali
Z1701 - Z1707	Roma		

Source: JICA Study Team



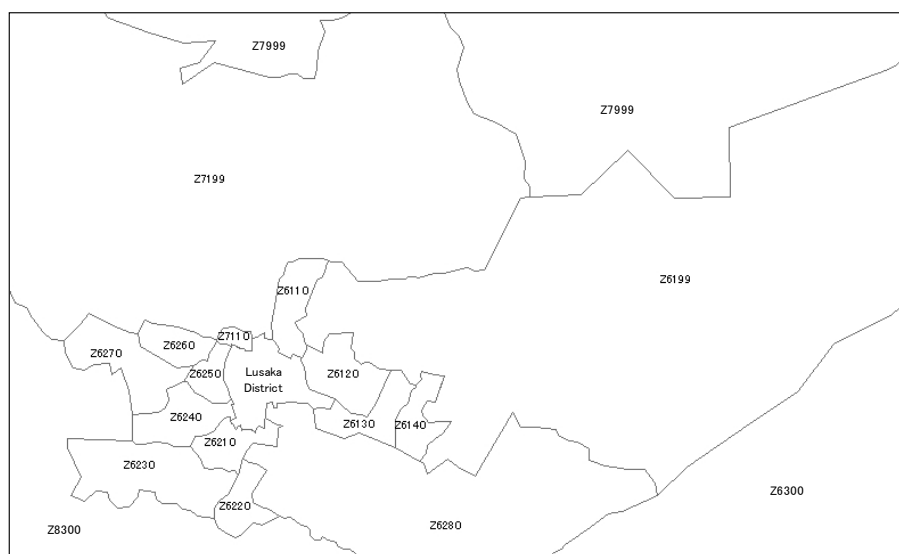
Source: JICA Study Team

**Figure 1.2.1 Traffic Zones in Lusaka District**

**Table 1.2.2 Traffic Zones in the Outside of Lusaka District**

No.	Traffic Zone No.	Ward	District	Province	Country
1	Z6110	Kapwayambale	Chongwe	Lusaka	Zambia
2	Z6120	Ntandabale	Chongwe	Lusaka	Zambia
3	Z6130	Nakatindi	Chongwe	Lusaka	Zambia
4	Z6140	Lukoshi	Chongwe	Lusaka	Zambia
5	Z6199	Others	Chongwe	Lusaka	Zambia
6	Z6210	Chilanga	Kafue	Lusaka	Zambia
7	Z6220	Lukolongo, Kafue, Matanda	Kafue	Lusaka	Zambia
8	Z6230	Shabusale, Kasenje, Mungu, Chikupi	Kafue	Lusaka	Zambia
9	Z6240	Chilongolo	Kafue	Lusaka	Zambia
10	Z6250	Namalombwe	Kafue	Lusaka	Zambia
11	Z6260	Nyemba	Kafue	Lusaka	Zambia
12	Z6270	Nakachenje, Chinyanja	Kafue	Lusaka	Zambia
13	Z6280	Chiyaba, Kambale, Malundu, Chisankane	Kafue	Lusaka	Zambia
14	Z6300	-	Luangwa	Lusaka	Zambia
15	Z7110	Chunga	Chibombo	Central	Zambia
16	Z7199	Others	Chibombo	Central	Zambia
17	Z7999	Others	Others	Central	Zambia
18	Z8300	-	-	Southern	Zambia
19	Z8400	-	-	Western	Zambia
20	Z8500	-	-	Copper-belt	Zambia
21	Z8600	-	-	North Western	Zambia
22	Z8700	-	-	Eastern	Zambia
23	Z8800	-	-	Northern	Zambia
24	Z8900	-	-	Luapula	Zambia
25	Z9110	-	-	-	Mozambique
26	Z9120	-	-	-	Zimbabwe
27	Z9130	-	-	-	Botswana
28	Z9140	-	-	-	Namibia
29	Z9150	-	-	-	Malawi
30	Z9160	-	-	-	Tanzania
31	Z9170	-	-	-	Democratic Republic of Congo
32	Z9180	-	-	-	Angola
33	Z9190	-	-	-	South Africa, Lesotho, Swaziland
34	Z9200	-	-	-	Others in Africa
35	Z9300	-	-	-	Others in World

Source: JICA Study Team



Source: JICA Study Team

**Figure 1.2.2 Traffic Zones in the Outside of Lusaka District**

#### (4) Sampling

The total number of sampled households was decided based on the population census

data in 2000. The sampled households were selected from each traffic zone in proportion to population so that the sampling rates in all zones become the same. 5,746 samples were selected as shown in Table 1.2.3.

**Table 1.2.3 Number of Samples for the HIS**

Ward No.	Ward Name	No. of Samples	Ward No.	Ward Name	No. of Samples
1	Nkoloma	222	18	Mulungushi	58
2	Chawama	260	19	Ngwerere	211
3	John Howard	114	20	Chaisa	88
4	Lilayi	50	21	Justine Kabwe	132
5	Kamwala	80	22	Raphael Chota	252
6	Kabwata	80	23	Mpulungu	116
7	Libala	55	24	Muchinga	204
8	Chilenje	185	25	Kapwepwe	123
9	Kamulanga	70	26	Lima	226
10	Kanyama	406	27	Mwembeshi	195
11	Harry Mwaanga Nkumbula	484	28	Matero	186
12	Munkolo	123	29	Chainda	250
13	Silwizya	39	30	Mtendere	294
14	Independence	141	31	Kalingalinga	167
15	Lubwa	218	32	Chakunkula	92
16	Kabulonga	268	33	Munali	177
17	Roma	180	<b>Total</b>		<b>5,746</b>

Source: JICA Study Team

## (5) Survey Implementation

### 1) Survey Preparation

The survey preparation took about one month in September and October 2007. During the period, the following tasks were carried out.

- Examination of survey planning
- Design of survey forms for the HIS
- Set up the survey organization
- Training of 42 surveyors on 3rd -5th October 2007.

### 2) Field Survey

The field survey was conducted during about two months in October and November 2007. A pilot survey was conducted by all the 42 surveyors under guidance by five (5) supervisors from 7:00 to 20:30 on 5th October 2007. Based on the experiences obtained from the pilot survey, the survey forms were adjusted and finalized.

The full scale interview survey was commenced on 8th October 2007. Initially, the targeted number of samples for each surveyor was set as five (5) samples so as to give a total daily target of 200 samples. The number of the obtained samples per day was increased, because the surveyors/supervisors were used to interviewing day by day. The full scale interview survey was continued throughout the period including weekends and public holidays. The survey was completed on 16th November 2007 except for Arakan barracks (Zambia Army Settlement). After the permission was obtained, the required samples were collected in Arakan barracks on 23rd and 24th November 2007.

### 3) Editing/Coding

The filled survey forms obtained through the field survey were edited and coded to input the data into PCs. In order to easily identify address, origin and destination with the number of the traffic zones, a zoning map was prepared by using Google Earth.

### 4) Data Input

The data input was commenced on 19th October 2007. The coded data was inputted in accordance with the input format prepared by Microsoft Excel.

### 5) Data Checking

The initial data checking using a program was started on 23rd November 2007 and completed on 8th December 2007. However, the inputted data were still observed illogical errors. Therefore, the full data checking by comparing the inputted data with each filled survey form was conducted until the middle of February 2008.

The overall survey schedule is shown in Table 1.2.4.

**Table 1.2.4 Survey Schedule for the HIS**

	2007				2008	
	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
1. Survey Preparation - Survey Planning - Design of Survey Form - Training of Surveyors	■	■				
2. Field Survey - Pilot Survey - Interview Survey		■	■	■		
3. Editing/coding			■	■	■	■
4. Data Input			■	■	■	■
5. Data Checking				■	■	■

Source: JICA Study Team

## 1.2.2 Cordon Line Survey

### (1) General

The cordon line in this Study was defined as the border of Lusaka District. This survey is to interview vehicle drivers on roadsides to collect information about origin and destination of vehicles, etc. Vehicles are flagged down for interview, and drivers are asked some questions in the survey. Since the survey forces drivers to stop on the road, cooperation of police is essential. In addition to the interview survey, the number of vehicles at the same locations on the same day is counted.

### (2) Survey Method

#### 1) Roadside Interview

Vehicles was flagged down with police assistance and guided to road side spaces for safe interview. The driver was interviewed based on the questionnaire, and the interviewer recorded the answers. The target sampling rate was set in order to be more than 20% of the total traffic by vehicle type. Buses were excluded from the roadside interview.

The interview items are: i) origin and destination, ii) trip purpose, and iii) number of passengers. For trucks, the following items are also included iv) commodity type, v) payload and vi) tones loaded.

#### 2) Traffic Count

The number of vehicles by vehicle type by direction was counted at the same

locations on the same day as the roadside interview survey. Vehicles are classified into 1) car & pickup, 2) taxi, 3) minibus (16 seats), 4) medium bus (26 seats), 5) large bus, 6) light commercial vehicle (less than 3 ton), 7) rigid truck, and 8) articulated truck, and 9) others.

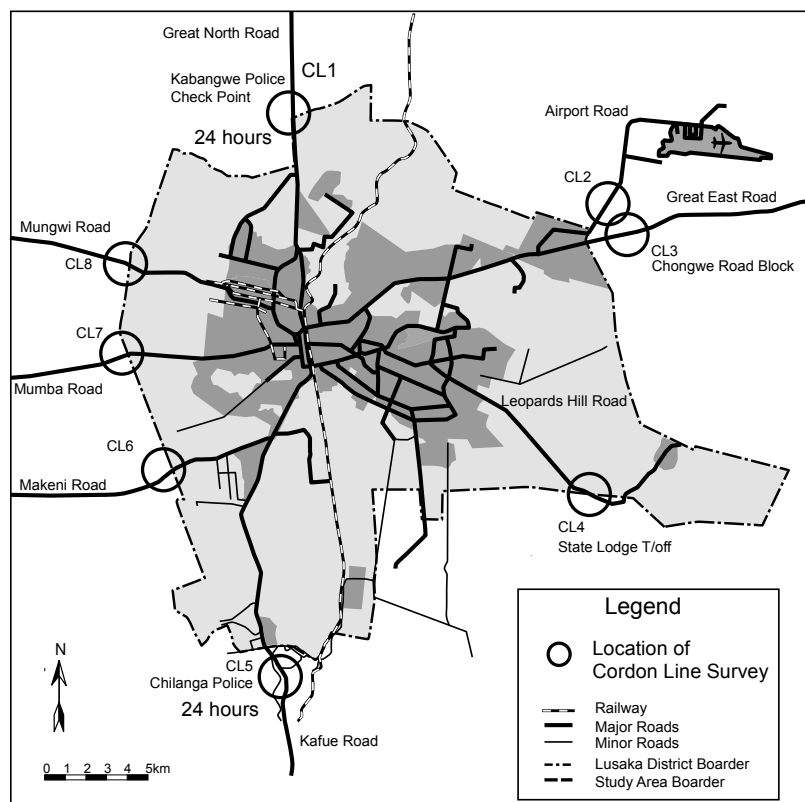
### 3) Survey Coverage

The survey hour is 12 hours (6:30 – 18:30) at six (6) locations and 24 hours at two (2) locations. The number of vehicles was recorded by each 15 minutes. Though the survey was planned at the beginning of October 2007, it was postponed due to the fuel shortage in Zambia. After the fuel situation was stabilized, the survey was commenced on 18th October 2007. The survey locations and their survey dates are shown in Table 1.2.5 and Figure 1.2.3.

**Table 1.2.5 Survey Location for Cordon Line Survey**

No.	Survey Location	Survey hour	Survey Date
CL1	Kabangwe Police Check Point on Great North Road	24	25.10.2007
CL2	Airport Road	12	15.11.2007
CL3	Chongwe Road Block	12	18.10.2007
CL4	State Lodge T/off	12	18.10.2007
CL5	Kafue Road at Chilanga Police	24	25.10.2007
CL6	Makeni Road at the district border of Lusaka	12	22.10.2007
CL7	Mumba Road at the district border of Lusaka	12	22.10.2007
CL8	Mungwi Road at the district border of Lusaka	12	14.11.2007

Source: JICA Study Team



Source: JICA Study Team

**Figure 1.2.3 Survey Location for Cordon Line Survey**

### 1.2.3 Screen Line Survey

#### (1) General

This survey is to count the number of vehicles on roads which crosses the screen line at 10 locations. The screen line in this Study was defined as the railway line. The results will be used for calibrating OD matrices prepared through the HIS.

#### (2) Survey Method

The number of vehicles by vehicle type by direction across the screen line was counted. Vehicles are classified into 1) car & pickup, 2) taxi, 3) minibus (16 seats), 4) medium bus (26 seats), 5) large bus, 6) light commercial vehicle (less than 3 ton), 7) rigid truck, 8) articulated truck, and 9) others.

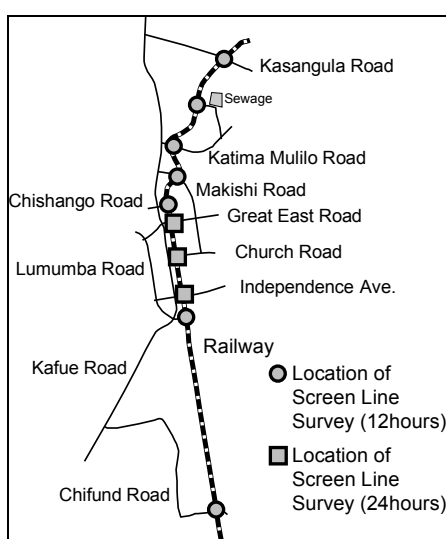
#### (3) Survey Coverage

The survey was composed of 12 hours (6:30 – 18:30) at seven (7) locations and 24 hours at three (3) locations, and the number of vehicle is recorded by each 15 minutes. The survey locations and their survey date are shown in Table 1.2.6 and Figure 1.2.4.

**Table 1.2.6 Survey Location for Screen Line Survey**

No.	Survey Location	Survey hour	Survey Date
SL1	Kasangula Road	12	18.10.2007
SL2	Sewage-Garden	12	23.10.2007
SL3	Katima Mulilo Road	12	14.12.2007
SL4	Makishi Road	12	14.12.2007
SL5	Chishango Road	12	14.12.2007
SL6	Great East Road	24	11.12.2007
SL7	Church Road	24	12.12.2007
SL8	Independence Avenue	24	13.12.2007
SL9	Lumumba Road	12	23.10.2007
SL10	Chifund Road	12	23.10.2007

Source: JICA Study Team



Source: JICA Study Team

**Figure 1.2.4 Survey Location for Screen Line Survey**

#### 1.2.4 Public Transport Passenger Interview Survey

##### (1) General

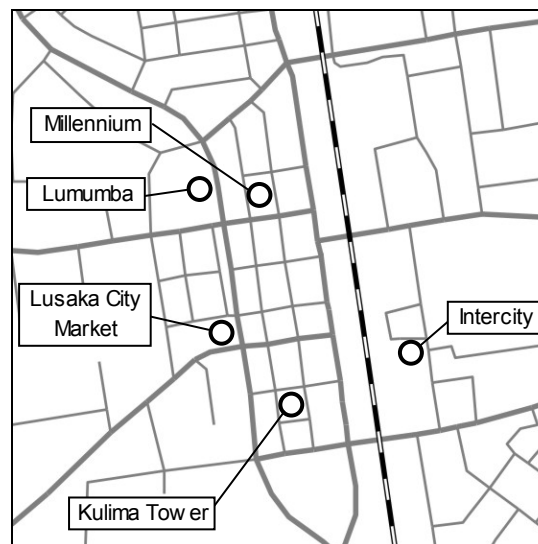
This survey is to collect information about public transport users and their opinion for the service of public transport system.

##### (2) Survey Method

Bus users were interviewed by interviewers according to interview forms. Interviewees were randomly selected from people who are waiting for bus (or people who have arrived) at bus terminals. The questionnaire items are included in personal attribute, trip information and opinion of bus service.

##### (3) Survey Coverage

The survey was conducted at five bus terminals from 9th to 16th October, as shown in Figure 1.2.5.



Source: JICA Study Team

**Figure 1.2.5 Surveyed Bus Terminals for Public Transport Interview Survey**

#### 1.2.5 Freight Interview Survey

##### (1) General

This survey is to collect information about freight movement from/to factories, manufacturing companies, etc by interview.

##### (2) Survey Method

A company list was prepared in consultation with Lusaka City Council. Surveyors made appointments to the companies which generate a huge volume of freight traffic and visited them to ask overall information about freight movement by using the survey sheets. The following questionnaire items are included:

- Company profile
- Facility condition
- Truck transport condition

(3) Survey Coverage

The survey was conducted through interview with the relevant office staffs. The selected companies were consisted of 20 companies including manufacturer, transport, petroleum, marketing and distributor.

1.2.6 Travel Speed Survey

(1) General

This survey aims to collect information on present traffic situation in the study area. The result is useful for understanding congested sections.

(2) Survey Method

The survey was carried out on the main roads selected through site observations. By driving on the survey roads, the time was recorded by each certain road section.

(3) Survey Coverage

For this survey, six (6) main roads were selected as survey routes as shown in Table 1.2.7 and Figure 1.2.6. The survey was conducted during the morning and evening hours on weekdays in October 2007. Four (4) samples (round trip) were collected.

**Table 1.2.7 Survey Routes for Travel Speed Survey**

Route No.	Survey Route
1	Great North Road (Kabwe Roundabout – Intersection at Kasangula Road)
2	Cairo Road (Kafue Roundabout - Kabwe Roundabout)
3	Kafue Road (Intersection at Makeni Road - Kafue Roundabout)
4	Lumumba Road (Intersection at Kafue Road - Intersection at Great North Road)
5	Great East Road (Kabwe Roundabout – Intersection at Airport Road)
6	Independence Avenue (Kafue Roundabout - Intersection at Musi O Tunya Road)

Source: JICA Study Team



Source: JICA Study Team

**Figure 1.2.6 Survey Routes for Travel Speed Survey**



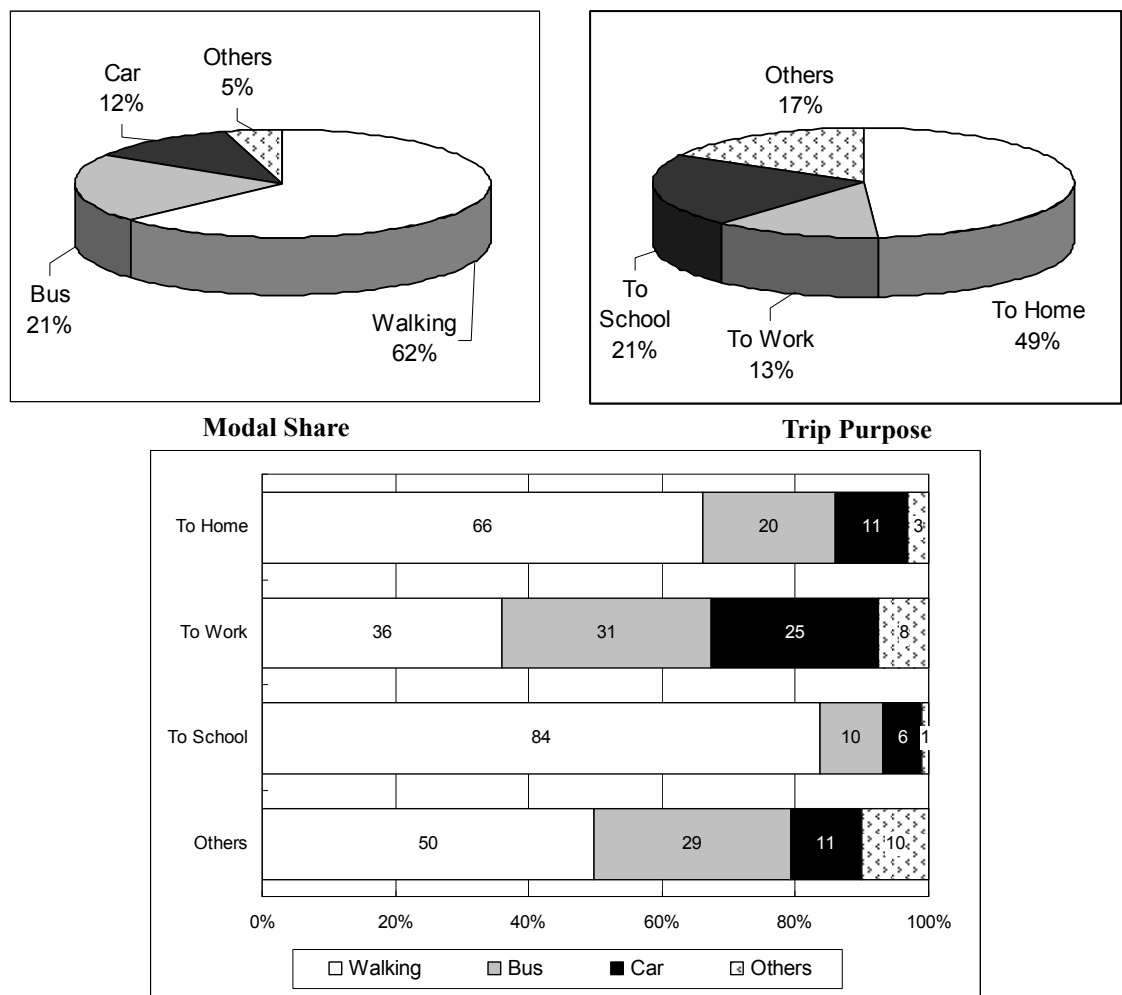
### 1.3 Survey Results and Major Findings

#### 1.3.1 Results of Household Interview Survey

The data of the household interview survey (HIS) has not expanded yet. The results describes in this section by using the raw data. Note that the results below are tentative ones because data verification has not been finished yet.

##### (1) Trip Purpose

Figure 1.3.1 shows the result of modal share and trip purpose of person trip. Regarding the modal share, the highest share is walking (62%), followed by bus (21%) and car (12%). Regarding the trip purpose, “to home” is a share of 49%. “To school” and “to work” are 21% and 13%, respectively. Major transport mode is walking for “to home” and “to school”, while bus and car are used for “to work”.



Source: JICA Study Team

Figure 1.3.1 Modal Share and Trip Purpose

##### (2) Age and Gender

As illustrated in Figure 1.3.2, modal share varies by age and gender. The dominant share is walking for both male and female less than 18 years. On the other hand, bus

and car indicate relatively higher shares for more than 18 years old. It is clearly showed that female at any age tends to have trip by walking, mainly.

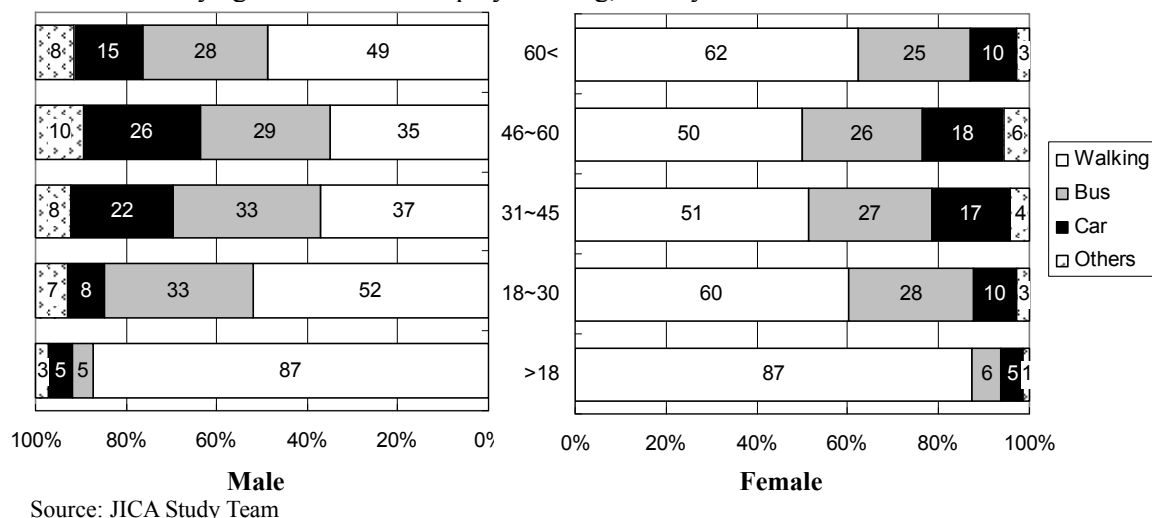


Figure 1.3.2 Modal Share by Age and Gender

(3) Household Income

The modal share has a strong relationship with household income group, as illustrated in Figure 1.3.3. As increasing the household income, the share of car is increasing and the share of walking is decreasing. The share of bus is stable with a range 18 to 25% in all household income groups.

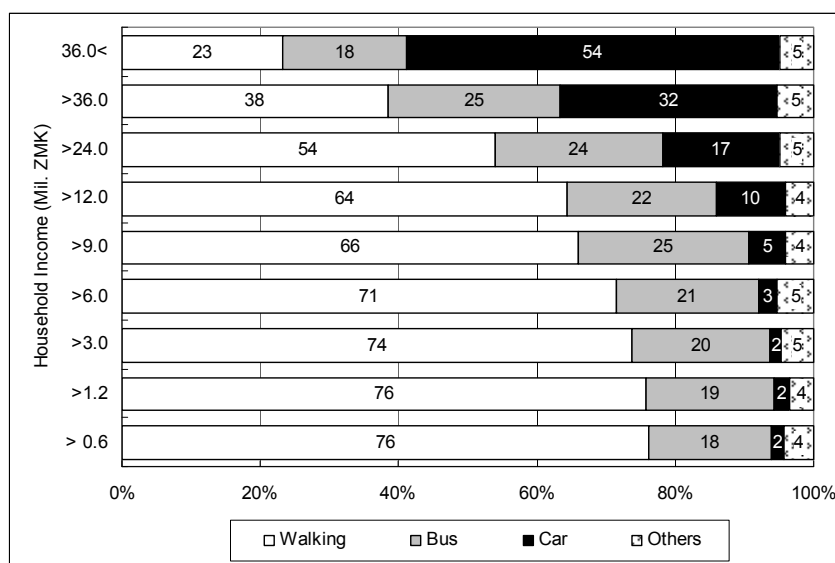
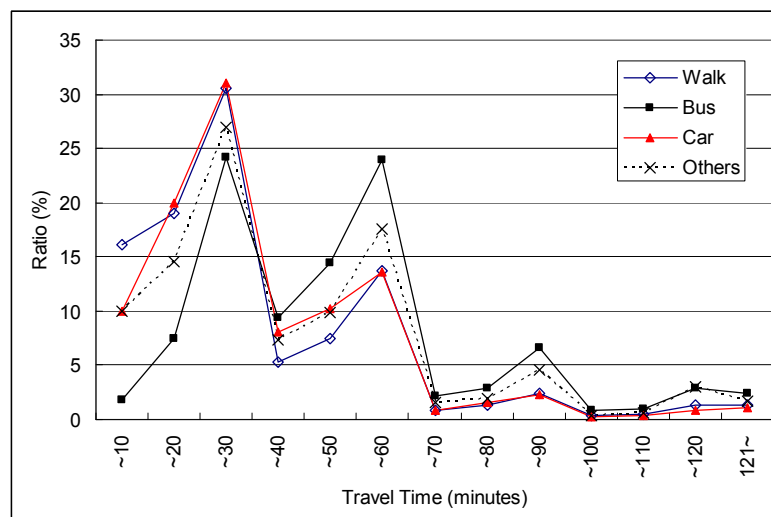


Figure 1.3.3 Modal Share by Household Income

(4) Travel Time

Figure 1.3.4 shows distribution of travel time by transport mode. Most of the trips are less than one hour regardless of the transport mode, but the travel time of bus seems longer than that of the other modes. This reason might be explained by the waiting time at bus stop/terminal.



Source: JICA Study Team

**Figure 1.3.4 Distribution of Travel Time by Transport Mode**

### 1.3.2 Road Traffic Condition

#### (1) Traffic Volume

##### 1) Traffic Volumes across Screen Line

The screen line survey was carried out at 10 locations across the railway line running from north to south in Lusaka District. Table 1.3.1 shows traffic volumes by vehicle type and survey location. 12-hour traffic volumes at seven locations are expanded by applying the expansion factors by vehicle type obtained from 24-hour survey locations (SL6, SL7 and SL8). The high traffic volumes are observed at Great East Road, Church Road and Independence Avenue which are close to the centre of the city. Most of the survey locations are observed dominant share of car and pickup. Minibus which is major public transport shows a significant share at Great East Road, Independence Avenue and Chifund Road.

**Table 1.3.1 Traffic Volumes across Screen Line**

No.	Survey Location	Number of Vehicles, 24hours, both directions									
		Car & Pickup	Taxi	Minibus	Medium Bus	Large bus	Light Commercial Vehicle	Rigid Truck	Articulated Truck	Others	Total
SL1	Kasangula Road	1,722 (58.3)	95 (3.2)	170 (5.8)	32 (1.1)	40 (1.3)	611 (20.7)	215 (7.3)	40 (1.4)	26 (0.9)	2,951 (100.0)
SL2	Sewage-Garden	100 (26.1)	21 (5.4)	27 (7.1)	5 (1.3)	0 (0.0)	90 (23.5)	118 (30.7)	13 (3.3)	10 (2.5)	385 (100.0)
SL3	Katima Mulilo Road	6,362 (76.6)	198 (2.4)	358 (4.3)	60 (0.7)	6 (0.1)	782 (9.4)	421 (5.1)	86 (1.0)	30 (0.4)	8,303 (100.0)
SL4	Makishi Road	8,443 (83.6)	176 (1.7)	328 (3.2)	51 (0.5)	13 (0.1)	637 (6.3)	297 (2.9)	124 (1.2)	33 (0.3)	10,101 (100.0)
SL5	Chishango Road	5,971 (82.6)	319 (4.4)	316 (4.4)	84 (1.2)	76 (1.1)	221 (3.1)	182 (2.5)	19 (0.3)	37 (0.5)	7,226 (100.0)
SL6	Great East Road	22,691 (73.1)	569 (1.8)	4,247 (13.7)	1,415 (4.6)	74 (0.2)	1,382 (4.5)	495 (1.6)	148 (0.5)	35 (0.1)	31,056 (100.0)
SL7	Church Road	24,402 (88.0)	1,074 (3.9)	708 (2.6)	256 (0.9)	230 (0.8)	677 (2.4)	271 (1.0)	64 (0.2)	47 (0.2)	27,729 (100.0)
SL8	Independence Avenue	33,628 (71.7)	1,210 (2.6)	8,962 (19.1)	633 (1.4)	132 (0.3)	1,576 (3.4)	611 (1.3)	107 (0.2)	21 (0.0)	46,880 (100.0)
SL9	Lumumba Road	3,996 (61.2)	244 (3.7)	807 (12.3)	50 (0.8)	8 (0.1)	723 (11.1)	571 (8.7)	129 (2.0)	7 (0.1)	6,534 (100.0)
SL10	Chifund Road	427 (35.1)	22 (1.8)	313 (25.7)	65 (5.3)	5 (0.4)	194 (15.9)	186 (15.2)	4 (0.3)	3 (0.2)	1,218 (100.0)

Note: Figures in parentheses indicate % share.  
Source: JICA Study Team

### 2) Traffic Volumes across Lusaka District Boundary

Higher traffic volumes across Lusaka District boundary are observed at CL1, CL2 and CL5. Since CL1 and CL5 locates on main trunk roads across north and south of Lusaka District boundary, traffic from/to or through Lusaka District is active. On the other hand, the high traffic volume at CL2 can be explained access/egress to/from Lusaka International Airport. The ratio of freight traffic is more than 40% at six locations except for CL2 and CL8.

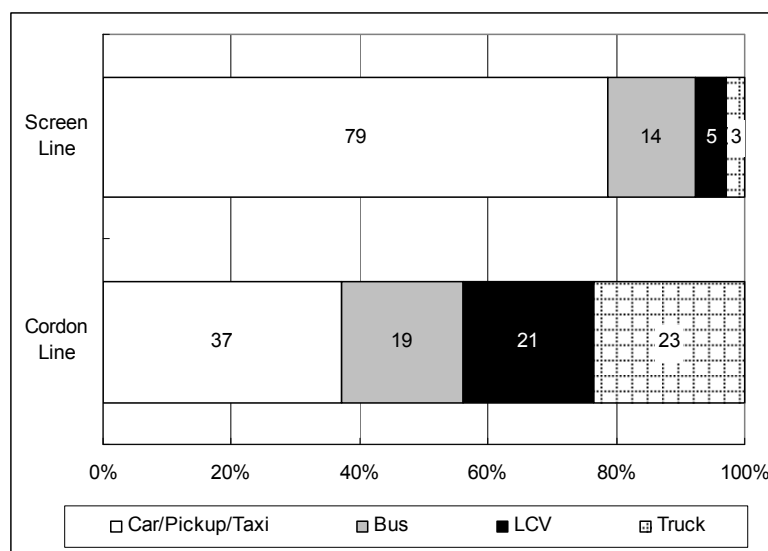
**Table 1.3.2 Traffic Volumes across Cordon Line**

No.	Survey Location	Number of vehicles, 24hours, both directions									
		Car & Pickup	Taxi	Mini bus	Medium Bus	Large bus	Light Commercial Vehicle	Rigid Truck	Articulated Truck	Others	Total
CL1	Kabangwe Police Check Point on Great North Road	1,354 (25.2)	134 (2.5)	610 (11.4)	206 (3.8)	169 (3.1)	1,104 (20.5)	1,082 (20.1)	702 (13.1)	12 (0.2)	5,373 (100.0)
CL2	Airport Road	3,017 (54.6)	481 (8.7)	312 (5.7)	59 (1.1)	80 (1.5)	959 (17.4)	553 (10.0)	23 (0.4)	36 (0.6)	5,521 (100.0)
CL3	Chongwe Road Block	295 (17.7)	2 (0.1)	269 (16.2)	116 (6.9)	43 (2.6)	468 (28.1)	274 (16.4)	197 (11.8)	3 (0.2)	1,667 (100.0)
CL4	State Lodge T/off	517 (41.5)	61 (4.9)	66 (5.3)	14 (1.1)	16 (1.3)	346 (27.8)	199 (16.0)	17 (1.4)	9 (0.7)	1,245 (100.0)
CL5	Kafue Road at Chilanga Police	1,455 (27.9)	49 (0.9)	917 (17.6)	249 (4.8)	157 (3.0)	1,090 (20.9)	399 (7.6)	898 (17.2)	8 (0.2)	5,222 (100.0)
CL6	Makeni Road at the district border of Lusaka	361 (27.6)	7 (0.6)	235 (18.0)	13 (1.0)	0 (0.0)	254 (19.4)	362 (27.7)	70 (5.3)	6 (0.4)	1,307 (100.0)
CL7	Mumba Road at the district border of Lusaka	191 (16.8)	41 (3.7)	279 (24.5)	126 (11.1)	17 (1.5)	251 (22.1)	184 (16.2)	46 (4.1)	0 (0.0)	1,135 (100.0)
CL8	Mungwi Road at the district border of Lusaka	304 (32.0)	12 (1.3)	263 (27.7)	3 (0.3)	11 (1.2)	113 (11.9)	232 (24.5)	2 (0.2)	10 (1.1)	949 (100.0)

Note: Figures in parentheses indicate % share.  
Source: JICA Study Team

### 3) Comparison of Vehicle Composition between Screen Line and Cordon Line

The vehicle composition estimated by the total traffic volumes of both screen line and cordon line is depicted in Figure 1.3.5. Since the screen line survey was conducted inside Lusaka District, car/pickup/taxi represented as passenger transport has a significant share with 79%. Looking at the cordon line, the vehicle composition varies by each vehicle type.



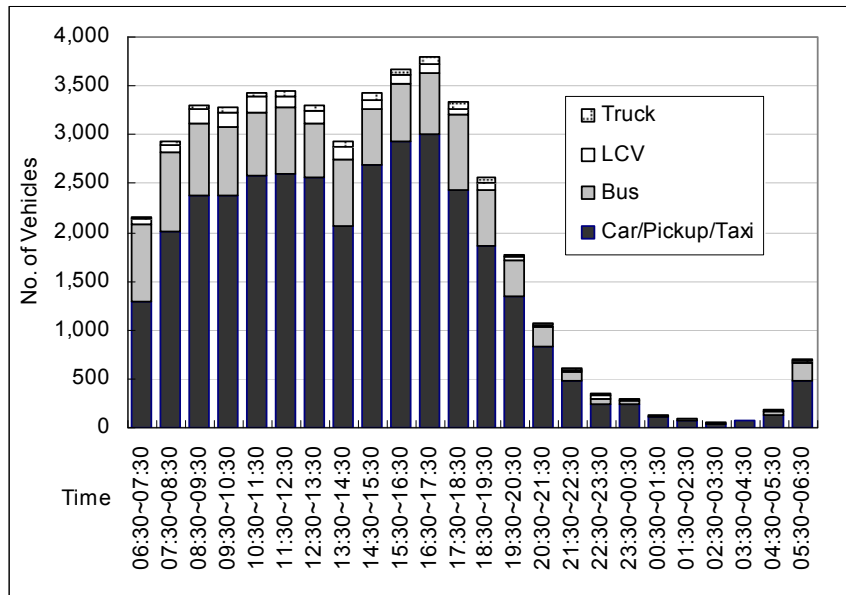
Source: JICA Study Team

**Figure 1.3.5 Comparison of Vehicle Composition**

(2) Hourly Distribution of Traffic Volume

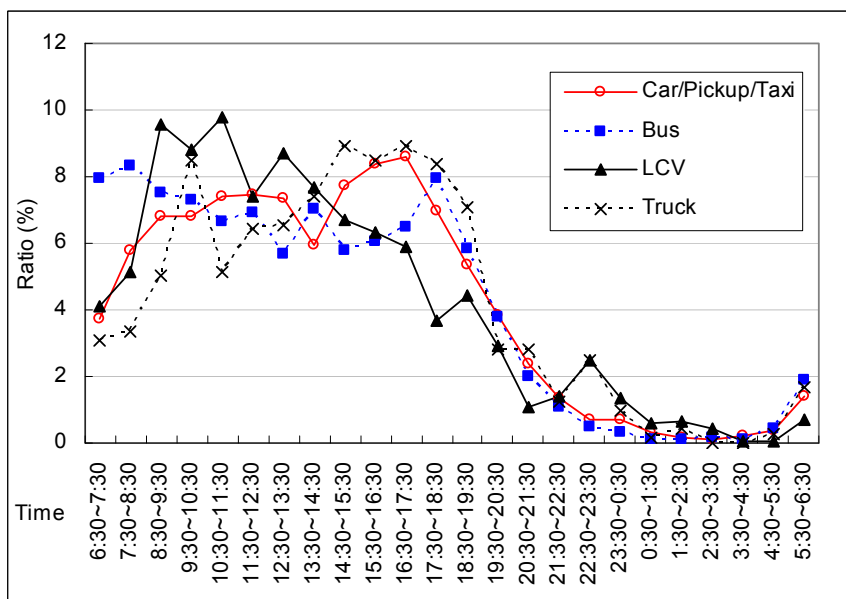
1) Hourly Distribution of Traffic Volume at Independence Avenue

Based on the result of the screen line survey, the hourly distribution at Independence Avenue (SL8) is illustrated in Figure 1.3.6 and 1.3.7. From the figures, constant high volumes are observed from 7:30 to 18:30. The morning and evening peaks are not clearly appeared. The highest hourly traffic volume is observed from 16:30 to 17:30. The hourly traffic volume is gradually decreased after 17:30. This phenomenon is obvious at the other 24-hour survey locations (SL6 and SL7).



Source: JICA Study Team

Figure 1.3.6 Hourly Distribution at Independence Avenue (SL8)

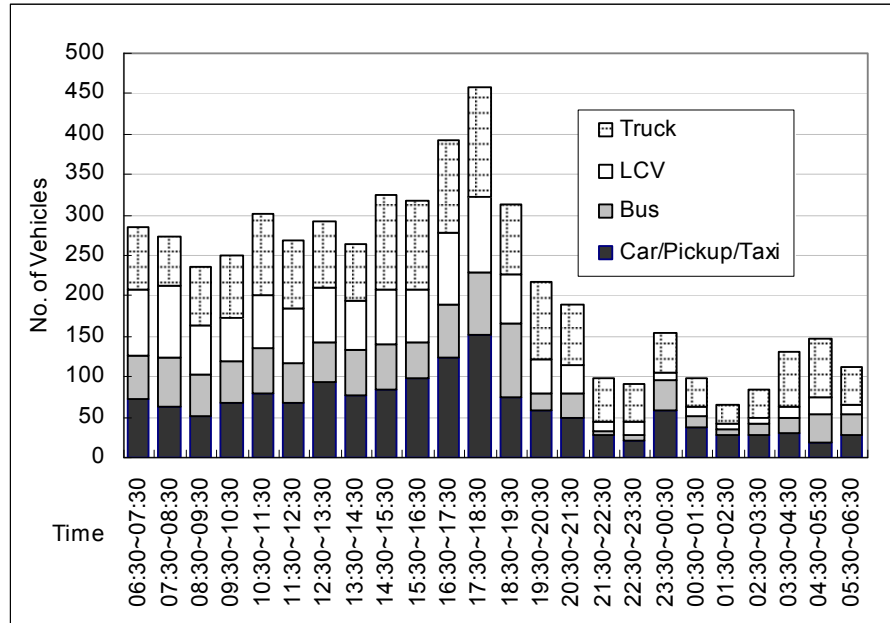


Source: JICA Study Team

Figure 1.3.7 Hourly Distribution by Vehicle Type at Independence Avenue (SL8)

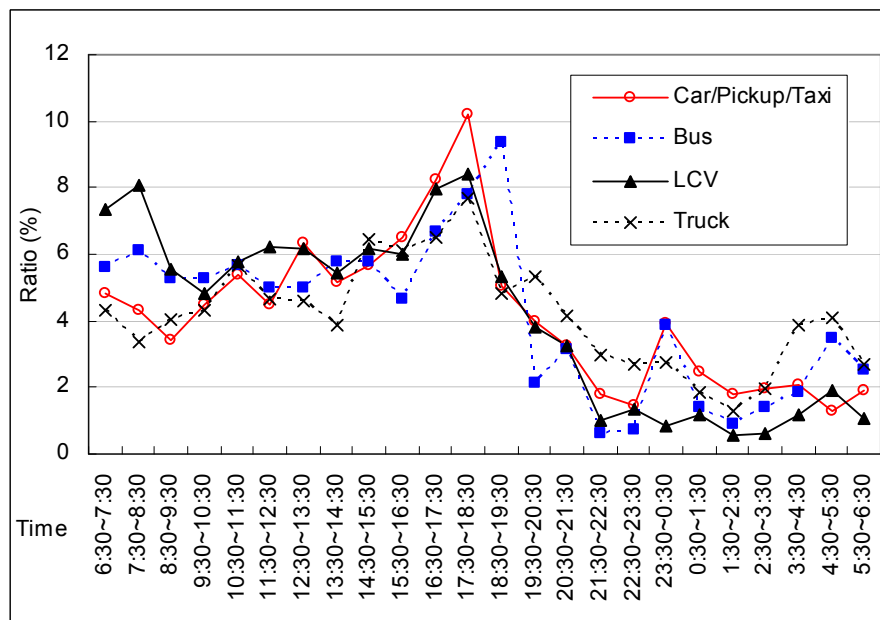
2) Hourly Distribution of Traffic Volume at Great North Road (CL1)

From the result of the cordon line survey, Figure 1.3.8 and I.3.9 illustrate the hourly distribution at Great North Road. The highest hourly traffic volume is appeared from 17:30 to 18:30. Even the night time, a certain amount of traffic is observed.



Source: JICA Study Team

Figure 1.3.8 Hourly Distribution of Traffic Volume at Great North Road (CL1)



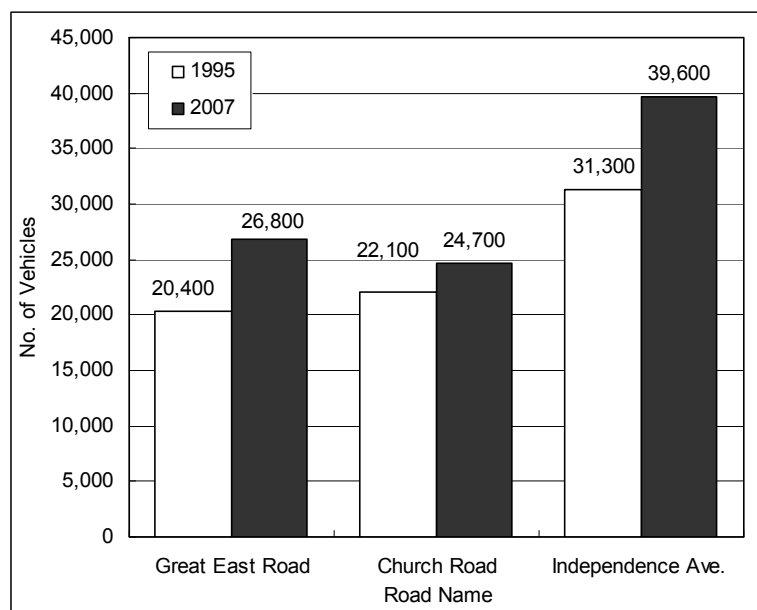
Source: JICA Study Team

Figure 1.3.9 Hourly Distribution by Vehicle Type at Great North Road (CL1)

(3) Comparison with Past Traffic Count Survey

1) Comparison of Traffic Volume

Figure 1.3.10 shows the comparison of the traffic volumes at three locations. The past traffic volumes in 1995 was obtained from “Basic Design Study on the Project for Improvement and Maintenance of Lusaka City Roads”. The traffic volumes increase with the annual growth rate at 1.8% between 1995 and 2007 as shown in Table 1.3.3.



Note: 12-hour traffic volumes, both directions

Source: JICA Study Team and Basic Design Study on the Project for Improvement

**Figure 1.3.10 Comparison of Traffic Volumes among 1995 and 2007**

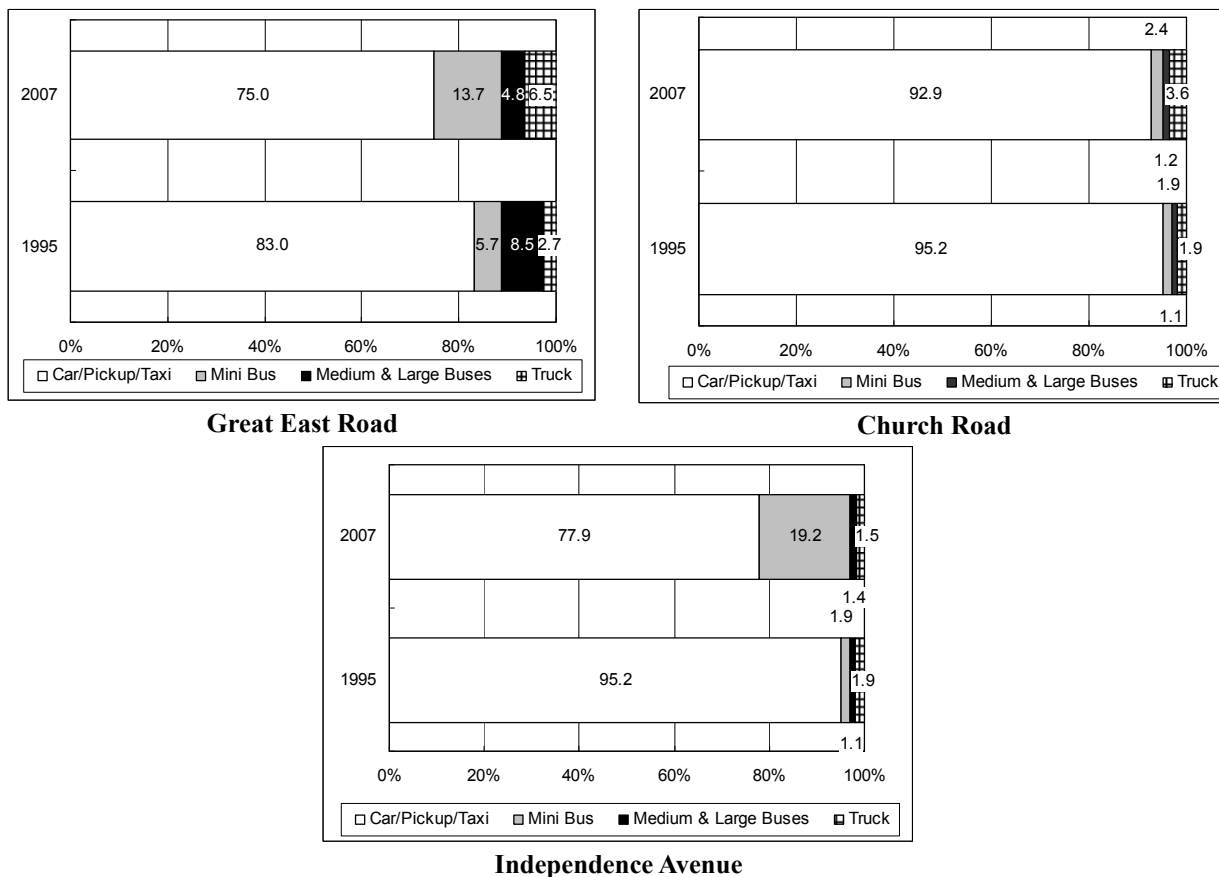
**Table 1.3.3 Annual Growth Rate by Each Period**

Road Name	Annual Growth Rate (1995 – 2007)
Great East Road	2.3%
Church Road	0.9%
Independence Avenue	2.0%
Total	1.8%

Source: JICA Study Team

2) Comparison of Vehicle Composition

Figure 1.3.11 illustrates the comparison of vehicle composition at three locations in 1995 and 2007. The dominant share of car/pickup/taxi does not change from 1995 to 2007. On the other hand, the share of minibus is significantly increasing at Great East Road and Independence Avenue. This reason may be affected by public bus operation, because these two roads are designated as intra-city bus routes by Lusaka City Council at present.



Source: JICA Study Team and Basic Design Study on the Project for Improvement and Maintenance of Lusaka City Roads

**Figure 1.3.11 Comparison of Vehicle Composition between 1995 and 2007**

### 1.3.3 Characteristics of Traffic across Lusaka District Boundary

#### (1) Number of Samples

The roadside interview was conducted in the cordon line survey, to grasp the travel pattern and transport characteristics across Lusaka District Boundary. Table 1.3.4 shows the number of samples by each location. The total sampling rate is 20.7%.

**Table 1.3.4 Number of Samples**

No.	Car/Pickup	Taxi	Light commercial vehicle	Rigid Truck	Articulated Truck	Total	Sampling Rate (%)
CL1	391	20	42	197	163	813	18.6
CL2	485	91	29	125	7	737	19.7
CL3	106	0	10	47	22	185	20.4
CL4	208	5	10	27	5	255	29.6
CL5	443	4	35	81	141	704	18.1
CL6	119	2	4	42	6	173	22.0
CL7	68	1	27	29	7	132	25.2
CL8	151	1	22	51	0	225	44.8
Total	1,971	124	179	599	351	3,224	20.7

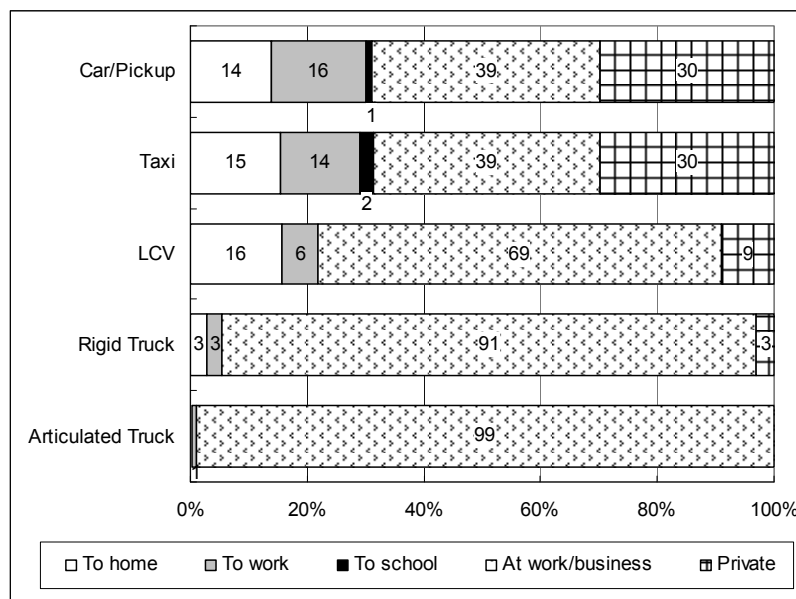
Source: JICA Study Team

#### (2) Trip Purpose

As illustrated in Figure 1.3.12, the highest percentage of trip purpose is “at



work/business” in all vehicle types. It is noted that private purpose is indicated as the second highest share in car/pickup and taxi.



Source: JICA Study Team

**Figure 1.3.12 Trip Purpose by Vehicle Type**

### (3) Passenger Occupancy

In the roadside interview, the number of passengers including the driver is interviewed. As a result, the average passenger occupancy by vehicle type is calculated as shown in Table 1.3.5.

**Table 1.3.5 Average Passenger Occupancy**

Vehicle Type	Total Number of Passengers	Number of Samples	Average Passenger Occupancy (Passengers/vehicle)
Car & Pickup	4,918	1,971	2.50
Taxi	335	124	2.70
Light Commercial Vehicle	452	179	2.53
Rigid Truck	1,446	599	2.41
Articulated Truck	675	351	1.92

Source: JICA Study Team

### (4) Freight Transport

#### 1) Loading Condition

Table 1.3.6 shows average load and empty rate by vehicle type in terms of freight traffic. It is noted that the empty rate tends to decrease as vehicle size becomes larger.

**Table 1.3.6 Average Load of Trucks**

Vehicle Type	Average Load (ton/vehicle)	Empty Rate (%)
Light Commercial Vehicle	2.0	56.4
Rigid Truck	9.3	45.1
Articulated Truck	26.5	33.9

Source: JICA Study Team

## 2) Commodity Type

Table 1.3.7 shows percentage of commodity type carried by freight traffic across Lusaka District Boundary. Commodity related to agriculture, forest and fishery shows the highest share in all commodity types. Manufacturing product, construction material and mineral are indicated relatively higher share for rigid and articulated trucks.

**Table 1.3.7 Commodity Type**

Unit: %

Commodity Type	Vehicle Type			Total
	Light Commercial Vehicle	Rigid Truck	Articulated Truck	
Agriculture, Forest, Fishery	48.7	25.8	17.8	25.7
Manufacturing Product	30.3	21.8	26.1	24.4
Construction Material (sand, stone, cement)	11.8	37.5	7.0	23.3
Mineral (coal, copper, etc)	0.0	3.1	19.6	8.7
Oil, POL	2.6	2.5	8.7	4.8
Iron, Steel, Metal	2.6	3.7	3.9	3.6
Container	0.0	1.8	7.0	3.5
Others	2.6	1.2	4.3	2.5
Auto (car, motorcycle)	0.0	1.8	2.6	1.9
Liquid (Chemical)	1.3	0.6	3.0	1.6
Total	100.0	100.0	100.0	100.0

Source: JICA Study Team

## 3) Truck Facilities of Origin and Destination

Table 1.3.8 shows facilities of origin and destination for freight traffic. In total, commercial building is the highest share of all facilities. Trucks using truck terminal have origin/destination in Johannesburg (South Africa), Harare (Zimbabwe) and Chirundu (border facility between Zambia and Zimbabwe). The low percentage of port is included Port of Beira in Mozambique and Port of Walvis Bay in Namibia.

**Table 1.3.8 Truck Facilities of Origin and Destination**

Unit: %

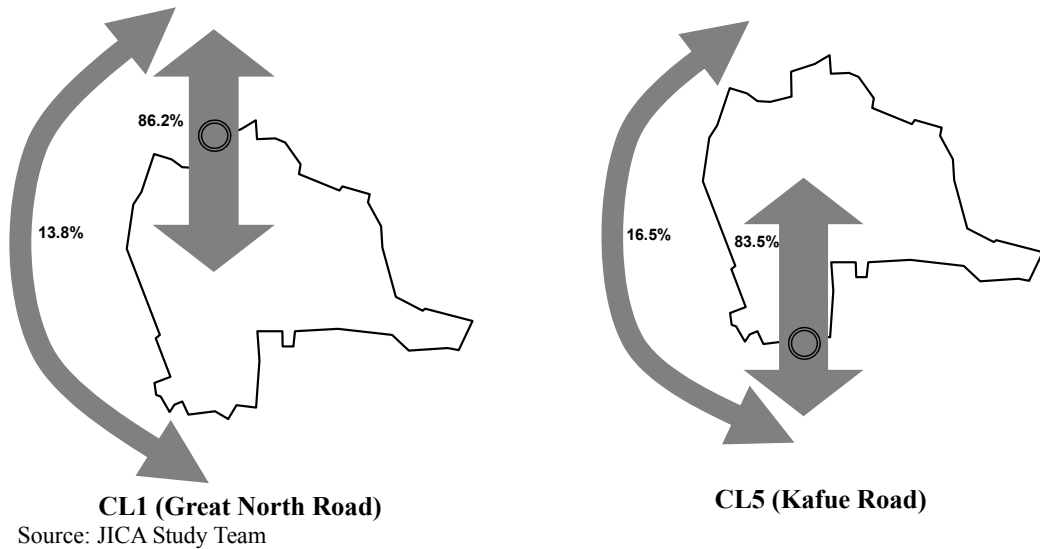
Facility	Origin				Destination			
	Light Commercial Vehicle	Rigid Truck	Articulated Truck	Total	Light Commercial Vehicle	Rigid Truck	Articulated Truck	Total
Commercial building	17.9	22.5	25.4	22.7	15.8	20.2	26.5	14.2
Factory	5.8	11.7	26.5	15.4	3.5	6.2	23.1	7.4
Station	16.2	18.6	8.5	15.1	24.0	14.0	9.4	9.3
Market	14.5	8.0	2.0	7.1	24.6	17.1	5.4	9.6
Warehouse	4.0	5.3	9.4	6.4	5.3	8.0	20.8	7.7
Airport	5.2	1.9	0.9	2.1	0.6	3.1	0.6	1.3
Truck Terminal	0.0	0.0	2.6	0.8	0.0	0.2	0.6	0.2
Port	0.0	0.2	1.1	0.4	0.0	0.0	1.4	0.3
Others	36.4	31.9	23.6	30.0	26.3	31.3	12.3	50.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Others were construction site, farm, quarry site, residence, etc.

Source: JICA Study Team

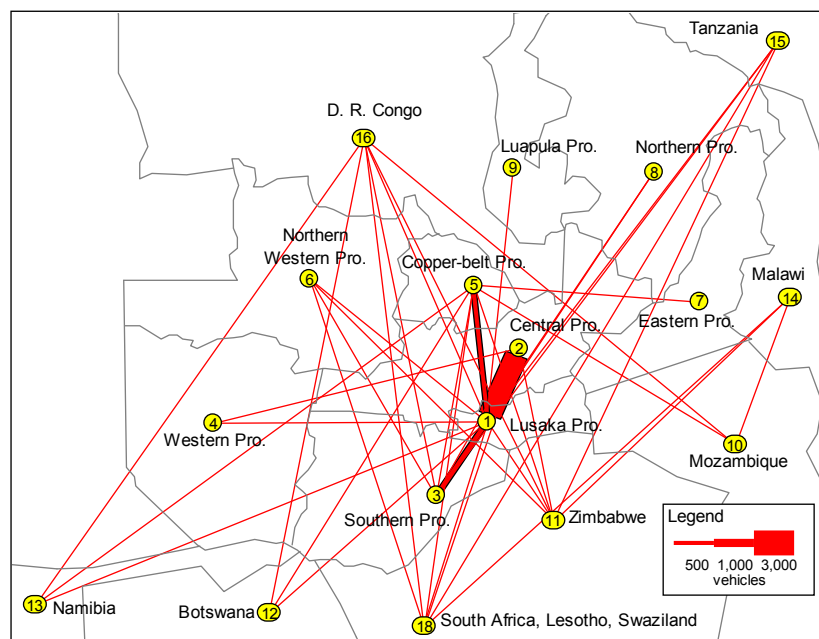
(5) Traffic across Lusaka District Boundary

CL1 (Great North Road) and CL5 (Kafue Road) are crossing points at north and south boundaries of Lusaka District, respectively. Figure 1.3.13 illustrates the traffic distribution at CL1 and CL5. 86.2% of CL1 and 83.5% of CL5 have origin or destination in Lusaka District. In other words, 13.8% of CL1 and 16.5% of CL5 are through traffic which has origin and destination outside of Lusaka District.



**Figure 1.3.13 Traffic Distribution at CL1 and CL5**

Traffic distribution obtained at CL1 and CL5 are strongly connected in Zambia as illustrated in Figure 1.3.14. It is noted that there is international traffic which has origin or destination in Mozambique, Zimbabwe, Botswana, Namibia, Malawi, Tanzania, Democratic Republic of Congo and South Africa. Thus, Lusaka District is an important city not only for domestic traffic but also for international traffic.



**Figure 1.3.14 Traffic Distribution by Province and Country at CL1 and CL5**

### 1.3.4 Public Transport Passenger

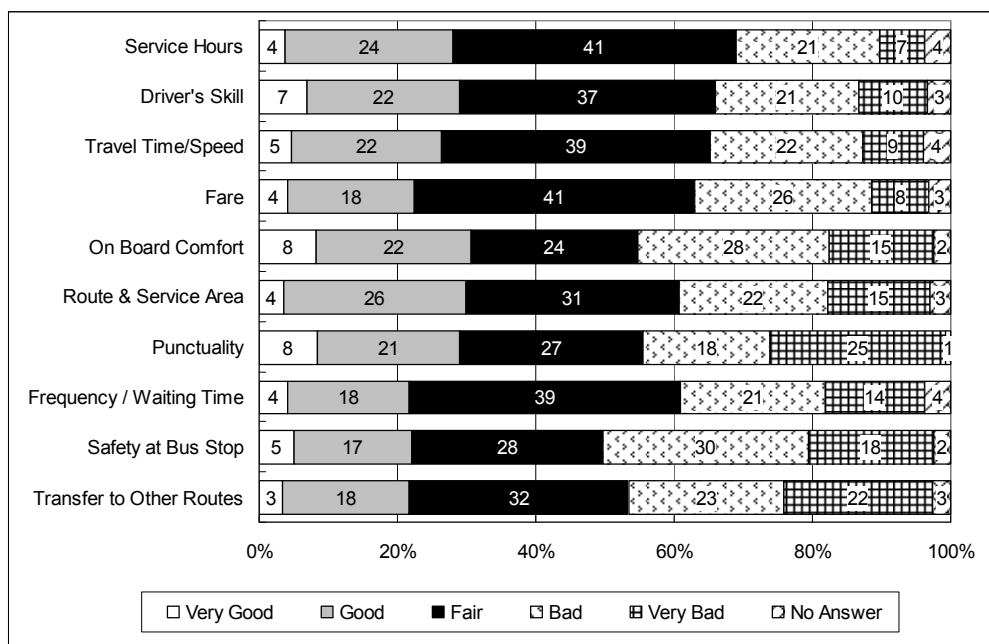
At five bus terminals, the public transport passenger interview survey was conducted to understand present situation of bus service. As a result, 1,911 samples are obtained as shown in Table 1.3.9. Regarding occupation, office worker indicates the highest percentage in total, but pupil/student and housewife/jobless also indicate significant percentages. Middle age (16 – 45 years old) of bus users are dominant share with about 90% in total. Regarding car ownership and waiting time for transfer, the bus users at the intercity bus terminal show significantly different figures (higher car ownership and longer waiting time), compared to other four bus terminals. Regarding number of transfer, bus users have 2.2 times to transfer to other bus or modes on average.

**Table 1.3.9 Result of Public Transport Passenger Interview Survey**

		Name of Bus Terminals					Total
		City Market	Lumumba	Millennium	Kulima Tower	Intercity	
No. of Samples		419	399	396	250	447	1,911
Gender (%)	Male	52.3	54.9	54.5	57.0	54.8	53.6
	Female	47.7	45.1	45.5	43.0	45.2	45.1
Occupation (%)	Office Worker	43.7	39.3	53.8	36.8	37.1	42.4
	Pupil/Student	18.4	28.3	34.3	27.2	26.4	26.8
	Housewife/Jobless	27.2	25.1	11.1	17.2	15.0	19.3
	Others	10.7	7.3	0.8	18.8	21.5	11.5
Age (%)	>15	3.2	5.5	2.8	3.7	3.4	3.7
	16-25	36.3	34.8	58.8	39.8	34.2	40.7
	26-45	54.4	50.6	36.1	49.2	53.5	48.9
	46-60	4.9	6.3	1.3	5.7	6.3	4.9
	60<	1.2	2.8	1.0	1.6	2.5	1.8
Car Ownership (%)	Yes	9.4	9.3	10.4	14.2	22.6	13.3
	No	90.6	90.7	89.6	85.8	77.4	86.7
Waiting Time (%)	0-5	20.1	10.0	10.9	18.8	8.1	13.1
	6-10	10.3	8.8	23.5	16.4	2.5	11.7
	11-30	38.3	25.1	38.9	34.8	16.3	30.1
	31-60	26.3	38.6	21.5	21.2	26.4	27.2
	61-120	3.8	14.8	5.1	8.0	24.8	11.8
	121-240	1.0	2.8	0.3	0.8	15.9	4.7
	241<	0.2	0.0	0.0	0.0	6.0	1.5
Average Waiting Time		29.6	44.9	28.2	30.2	97.3	48.4
No. of Transfer (%)	0	2.4	6.0	0.8	3.2	4.3	3.4
	1	37.8	22.8	11.1	26.4	48.1	30.1
	2	33.0	50.4	54.8	48.4	27.3	41.8
	3	3.8	6.3	5.8	8.0	7.2	6.1
	4	10.8	13.0	22.5	11.6	10.7	13.8
	5	7.7	0.5	1.5	1.2	1.6	2.6
	5<	4.5	1.0	3.5	1.2	0.9	2.3
Average Number of Transfer		2.3	2.0	2.6	2.1	1.8	2.2

Source: JICA Study Team

Figure 1.3.15 illustrates the assessment on present bus service. The bus users felt fair on each assessment item. The total and average scores by each assessment item are estimated by the weighted score in accordance with the degree as shown in Table 1.3.10. As a result, the highest score is service hour, followed by driver's skill. On the other hand, the lowest score is transfer to other routes, followed by safety at bus stop. The lower score in the items are critical issues for bus users.



Source: JICA Study Team

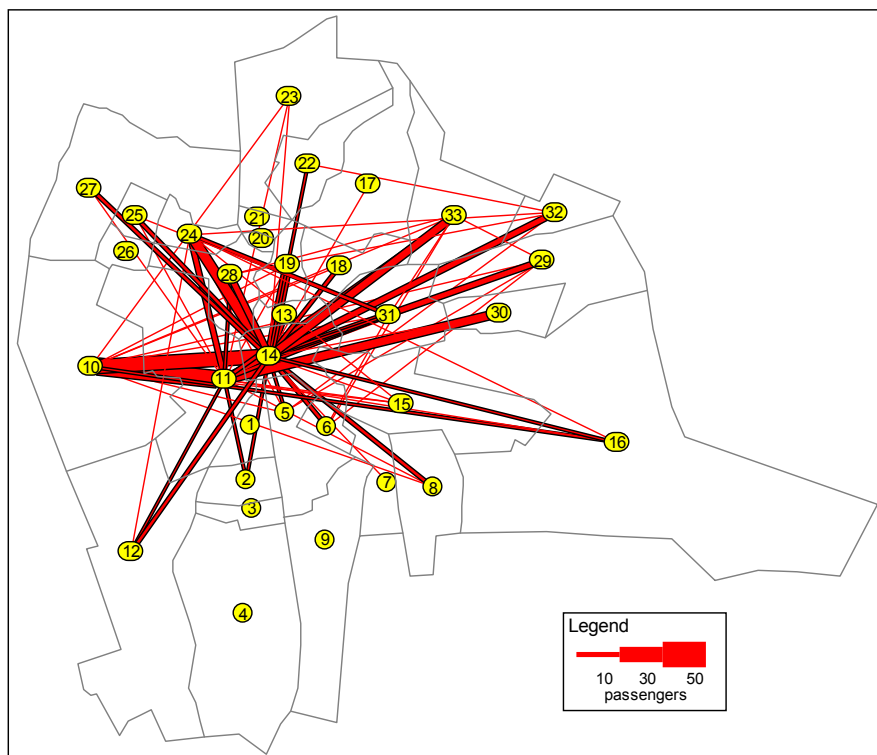
**Figure 1.3.15 Assessment on Present Bus Service**

**Table 1.3.10 Score of Assessment Item**

Assessment Item	Total Score	Ave. Score	Rank
Service Hours	5,485	2.87	1
Driver's Skill	5,452	2.85	2
Travel Time/Speed	5,344	2.80	3
Fare	5,252	2.75	4
On Board Comfort	5,233	2.74	5
Route & Service Area	5,226	2.73	6
Punctuality	5,081	2.66	7
Frequency / Waiting Time	5,060	2.65	8
Safety at Bus Stop	4,850	2.54	9
Transfer to Other Routes	4,811	2.52	10

Source: JICA Study Team

Figure 1.3.16 illustrates the distribution of sampled bus passengers based on their origin and destination inside Lusaka District at four bus terminals except for Intercity bus terminal. The sampled bus users are mainly generated or attracted from Kanyama (Ward No.10), Harry Mwaanga Nkumbula (Ward No.11) and Independence (Ward No.14).



Source: JICA Study Team

**Figure 1.3.16 Distribution of Sampled Bus Passengers inside Lusaka District at Four Bus Terminal**

### 1.3.5 Freight Characteristics by Business Type

Based on the results of the freight interview survey, major findings are described below:

#### (1) Manufacturer

Table 1.3.11 shows the main input and output by commodity type. The dominant freight characteristics are indicated that raw materials imported from foreign countries are manufactured and distributed to various areas in Zambia. On the other hand, the raw materials related to maize are transported from domestic production area.

**Table 1.3.11 Main Input and Output of Manufacturers**

Input		Output	
Main Commodities	From	Main Commodities	To
- PVC Compound	- Zambia	- Footwear	- Various areas in Zambia
- Glue	(Lusaka, Mazabuka, Mkushi, Chipata, Kabwe, etc)	- Beverage	- South Africa
- Leather		- Soap	- Democratic Republic Congo
- Liquid glucose		- Beer	- Malawi
- Sulphuric acid		- Flour	- Zimbabwe
- Sodium Sulphate		- Cereal	
- Coal	- South Africa	- Maize	
- Malt	- Zimbabwe	- Paint	
- Diesel	- Kenya	- Sugar	
- Maize	- China	- Maize Seed	
- Wheat	- India	- Sweets	
- Sugar	- Korea		
- Maize seed			
- Beans			
- Ground nuts			

Source: JICA Study Team

## (2) Petroleum

Companies related to petroleum are imported diesel oil and petrol from Mozambique, Tanzania and South Africa, and distributed to various areas in Zambia. It is found that the importing countries show similarity to the results of the roadside interview in the cordon line survey. These companies have own truck terminals which may be used for storage and played a role of distribution function.

## (3) Transport and Marketing/Distributor

Companies related to transport and marketing/distributor are handled coal, maize, wheat, copper, ore, cement and fertiliser, etc. The freight characteristics are different by commodity type. The agricultural commodities are mainly transported for domestic production and consumption, while the mineral commodities are exported to foreign countries.

### 1.3.6 Travel Speed

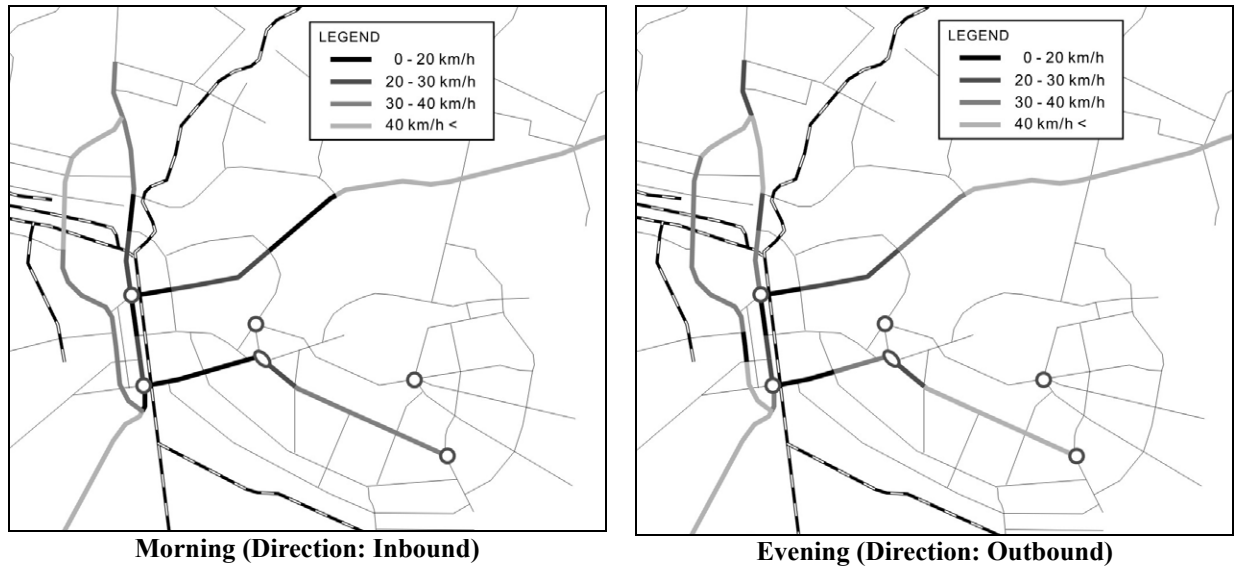
The travel speed survey was carried out on six (6) routes. Table 1.3.12 shows the average travel speed by route by direction in the morning and evening. The lowest average travel speed is observed at Cairo Road running on the centre of the city. The average travel speed in the evening is lower than that in the morning.

**Table 1.3.12 Average Travel Speed by Route**

No.	Route Name	Direction	From	To	Average Travel Speed (km/h)		Distance (km)
					Morning	Evening	
1	Great North Road	Inbound	Kabwe Roundabout	Intersection at Kasangula Road	46.3	34.8	4.79
		Outbound	Intersection at Kasangula Road	Kabwe Roundabout	28.7	41.0	
2	Cairo Road	Inbound	Kafue Roundabout	Kabwe Roundabout	19.2	14.7	1.84
		Outbound	Kabwe Roundabout	Kafue Roundabout	27.6	15.5	
3	Kafue Road	Inbound	Kafue Roundabout	Intersection at Makeni Road	50.8	41.6	3.81
		Outbound	Intersection at Makeni Road	Kafue Roundabout	30.9	53.8	
4	Lumumba Road	Inbound	Intersection at Kafue Road	Intersection at Great North Road	41	26.9	7.17
		Outbound	Intersection at Great North Road	Intersection at Kafue Road	43	30.2	
5	Great East Road	Inbound	Kabwe Roundabout	Intersection at Airport Road	48.6	40.4	1.4
		Outbound	Intersection at Airport Road	Kabwe Roundabout	29.2	34.9	
6	Independence Avenue	Inbound	Kafue Roundabout	Intersection at Musi O Tunya Road	43.9	30.3	6.83
		Outbound	Intersection at Musi O Tunya Road	Kafue Roundabout	21.9	38.1	
Average Travel Speed of All Routes					34.8	33.2	

Source: JICA Study Team

Figure 1.3.17 illustrates the travel speed conditions in the morning and evening. As clearly shown in the figure, the travel speed is slow in and around the centre of the city. The congested sections appear around three roundabouts (Kabwe, Kafue and Cathedral Hill) and one intersection at Great East Road and Addis Ababa Road.



Source: JICA Study Team

**Figure 1.3.17 Travel Speed Conditions in the Morning and Evening**

## 1.4 Intersection Traffic

### 1.4.1 Intersection Turning Movement Survey

Traffic count survey was carried out to obtain traffic volume and vehicle type data of directional traffic flow at selected ten at-grade intersections including five (5) roundabouts. Names and locations of the intersections are shown in Figure 1.4.1.

The survey was conducted during morning and evening peak hours for 3 hours respectively on weekday as follows;

- Morning Peak Hours (7:30-10:30)
- Evening Peak Hours (15:30-18:30)



**Figure 1.4.1 Survey Locations of Intersection Traffic Count Survey**



### 1.4.2 Results of Intersection Turning Movement Survey

#### (1) Kabwe Roundabout

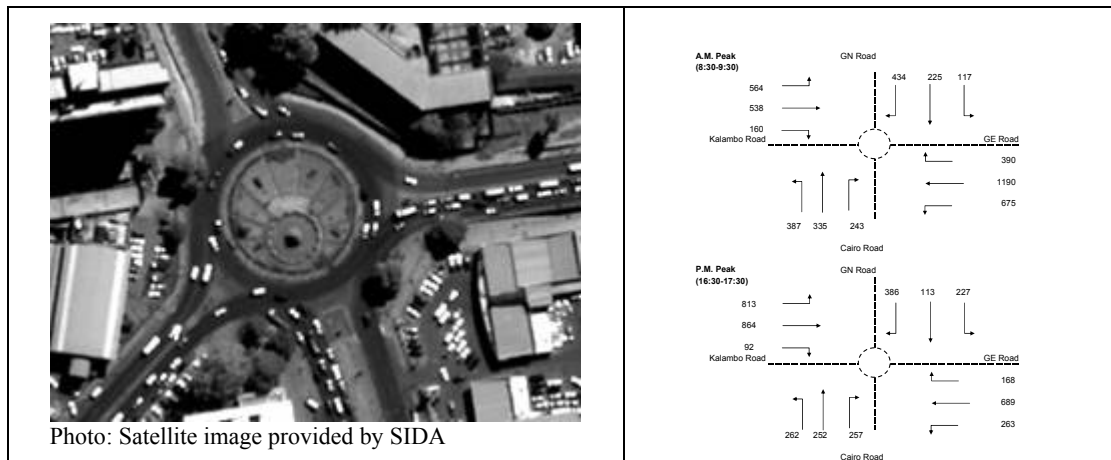


Figure 1.4.2 Kabwe Roundabout

#### (2) Kafue Roundabout

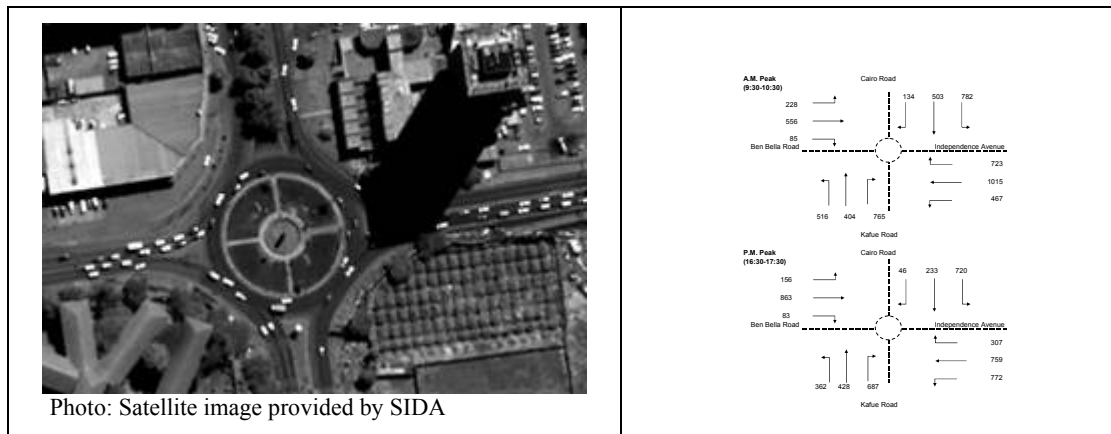


Figure 1.4.3 Kafue Roundabout

#### (3) Roundabout at Great East Road and Kamloops Road



Figure 1.4.4 Great East Road and Kamloops Road

(4) Roundabout at Los Angeles Boulevard and Haile Selassie Avenue

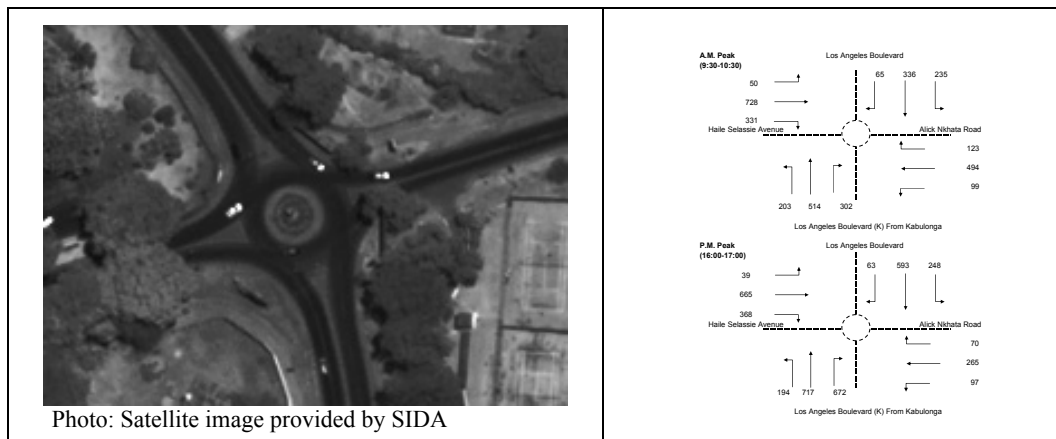


Figure 1.4.5 Los Angeles Boulevard and Haile Selassie Avenue

(5) Roundabout at Independence Avenue and Chindo Road

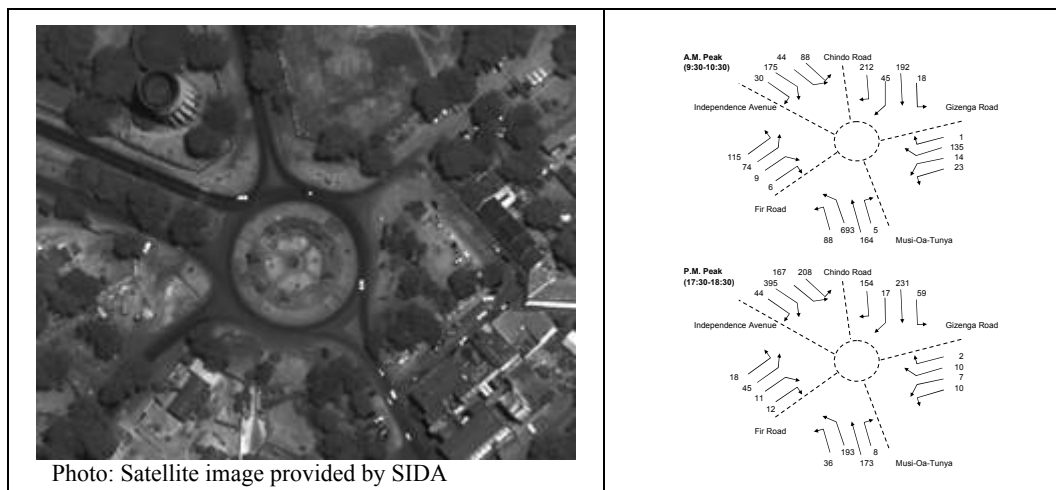


Figure 1.4.6 Independence Avenue and Chindo Road

(6) Intersection at Kafue Road and Lumumba Road

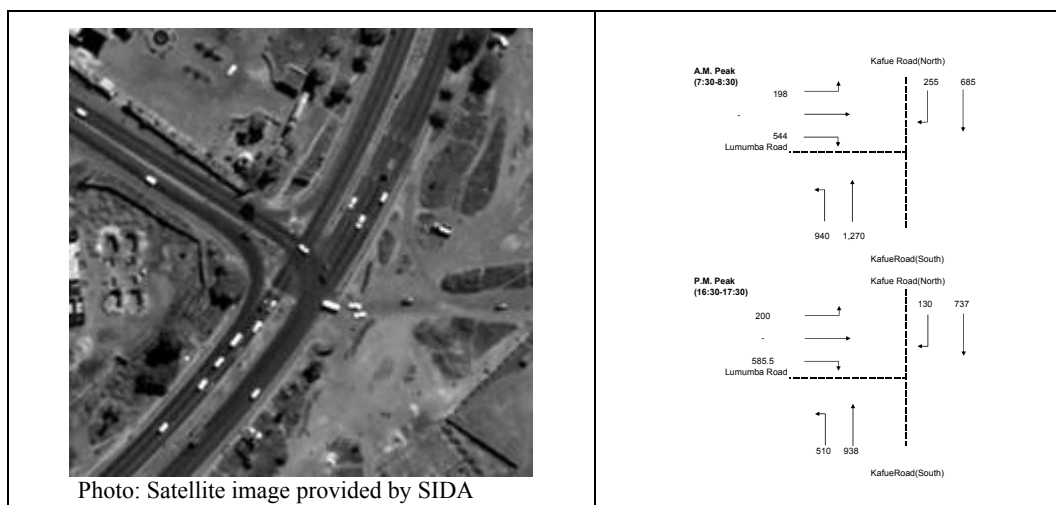


Figure 1.4.7 Kafue Road and Lumumba Road

(7) Intersection at Great North Road and Lumumba Road

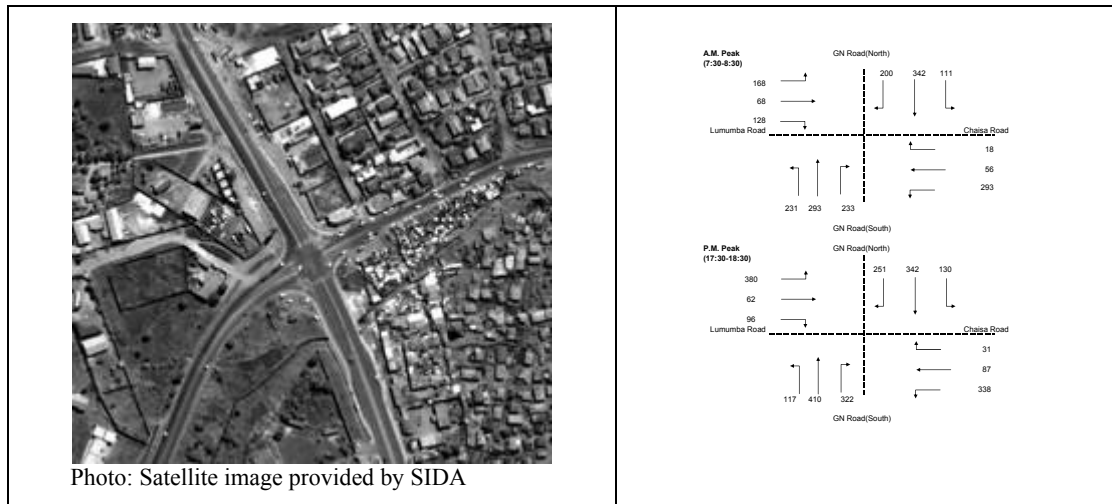


Figure 1.4.8 Great North Road and Lumumba Road

(8) Intersection at Great East Road and Addis Ababa Drive

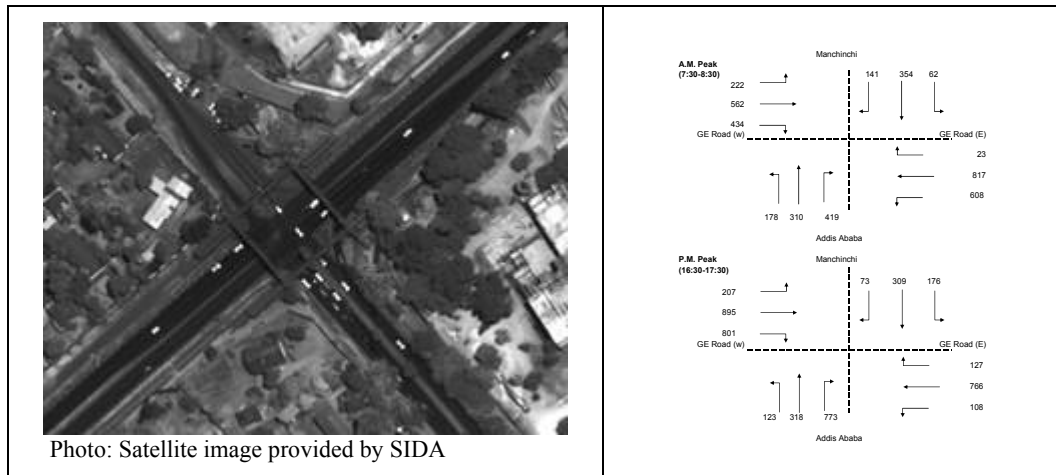


Figure 1.4.9 Great East Road and Addis Ababa Drive

(9) Intersection at Mumba Road and Lumumba Road

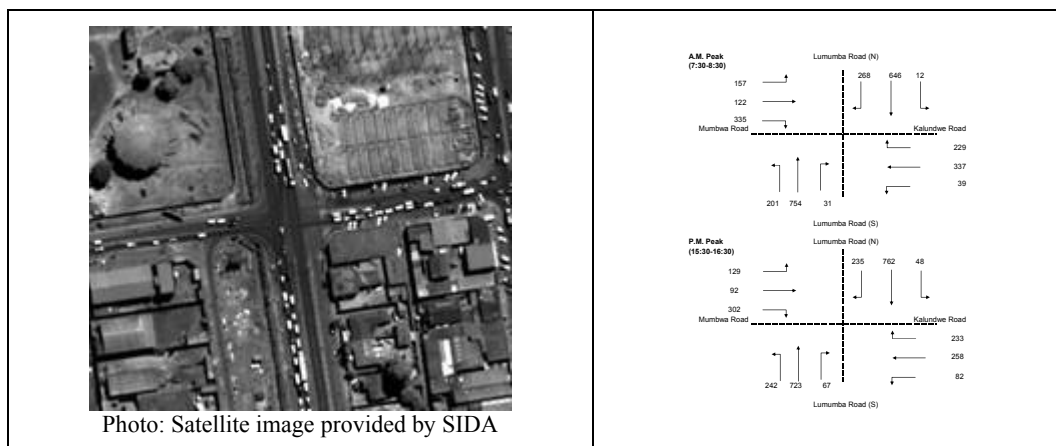


Figure 1.4.10 Mumba Road and Lumumba Road

(10) Intersection at Cairo Road and Church Road

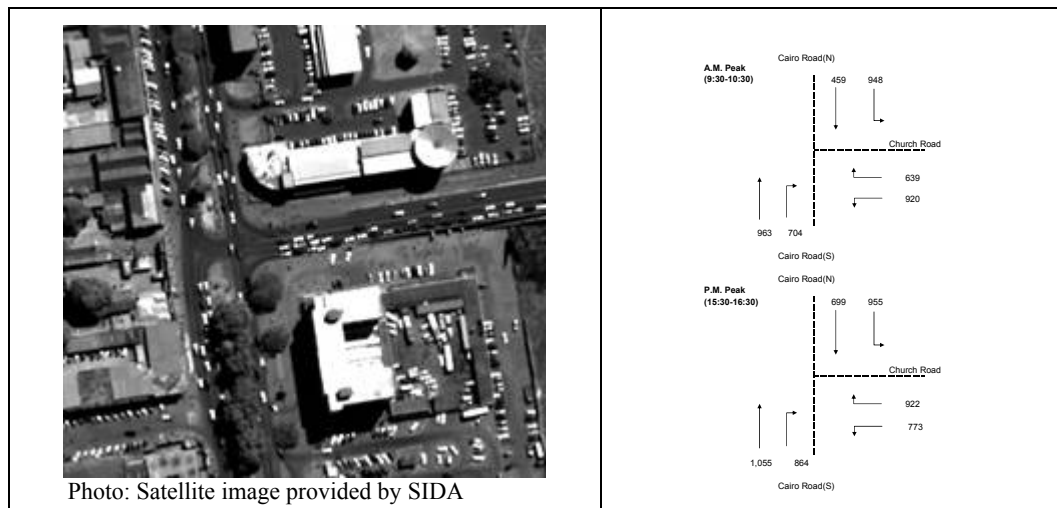


Figure 1.4.11 Cairo Road and Church Road

1.4.3 Intersection Analysis

(1) General

Intersections are complex and severe individual locations because of many vehicular movements (through, left-turn and right-turn from each approach road) and pedestrian crossings. On the other hand, the project cost and more resettlement will be required if high-grade and over specification intersection types are applied.

(2) Intersection Analysis

Capacity analysis of major intersections in Lusaka city was conducted and results of analysis are shown in following tables. Preliminary improvement measures for saturated or nearly saturated intersections are proposed.

1) Kabwe Roundabout

Kabwe roundabout has 4-legs with 2 circular lanes and diameter of center Island is approximately 50 m.

Table 1.4.1 Result of Intersection Analysis- Kabwe Roundabout

Saturation degree (Present)	A.M. Peak	0.69	Improvement Measures
	P.M. Peak	0.58	
Saturation degree (Improved)	A.M. Peak	-	No saturation
	P.M. Peak	-	

2) Kafue Roundabout

Kafue roundabout has 4-legs with 2 circular lanes and diameter of center Island is approximately 56 m. Saturation degree of this roundabout does not show saturated situation. However, congested situation of this roundabout is often observed and most of congestion is occurred chained with neighbor intersections traffic jam. Therefore, area-wide traffic congestion mitigation measures such as introduction of coordinated traffic signal, etc. are necessary.

**Table 1.4.2 Result of Intersection Analysis- Kafue Roundabout**

Saturation degree (Present)	A.M. Peak	0.84	Improvement Measures
	P.M. Peak	0.74	
Saturation degree (Improved)	A.M. Peak	-	- Introduction of coordinated traffic signal system
	P.M. Peak	-	

3) Roundabout at Great East Road and Kamloops Road

This roundabout has 4-legs with 2 circular lanes and diameter of center Island is approximately 60 m.

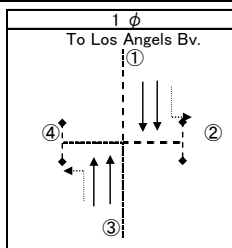
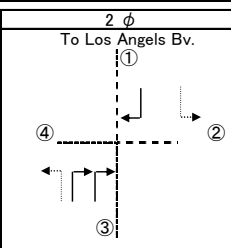
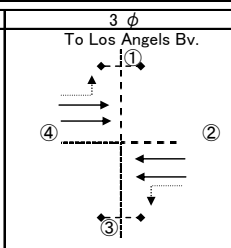
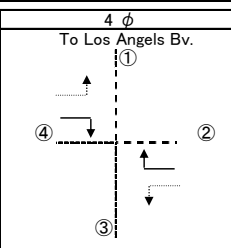
**Table 1.4.3 Result of Intersection Analysis- Great East Road and Kamloops Road**

Saturation degree (Present)	A.M. Peak	0.33	Improvement Measures
	P.M. Peak	0.40	
Saturation degree (Improved)	A.M. Peak	-	No saturate
	P.M. Peak	-	

4) Roundabout at Los Angeles Boulevard and Haile Selassie Avenue

This roundabout has 4-legs with a circular lanes and diameter of center Island is approximately 17 m.

**Table 1.4.4 Result of Intersection Analysis- Los Angeles Boulevard and Haile Selassie Avenue**

Saturation degree (Present)	A.M. Peak	0.83	Improvement Measures
	P.M. Peak	0.95	
Saturation degree (Improved)	A.M. Peak	0.57	- Signalized intersection
	P.M. Peak	0.74	
Proposed signal phasing and lane arrangement	1 $\phi$ To Los Angeles Bv. 		
	2 $\phi$ To Los Angeles Bv. 		
	3 $\phi$ To Los Angeles Bv. 		
	4 $\phi$ To Los Angeles Bv. 		

5) Roundabout at Independence Avenue and Chindo Road

This roundabout has 5-legs with a circular lanes and diameter of center Island is approximately 60 m.

**Table 1.4.5 Result of Intersection Analysis- Independence Avenue and Chindo Road**

Saturation degree (Present)	A.M. Peak	0.39	Improvement Measures
	P.M. Peak	0.33	
Saturation degree (Improved)	A.M. Peak	-	No saturation
	P.M. Peak	-	

6) Intersection at Kafue Road and Lumumba Road

This T-Junction is signalized with channelizing left turn lanes. New road which will formulate cross intersection with this junction has been developed.

**Table 1.4.6 Result of Intersection Analysis- Kafue Road and Lumumba Road**

Saturation degree (Present)	A.M. Peak	0.61	Improvement Measures  No saturation
	P.M. Peak	0.46	
Saturation degree (Improved)	A.M. Peak	-	
	P.M. Peak	-	

7) Intersection at Great North Road and Lumumba Road

This crossed intersection is signalized with channelizing left turn lanes.

**Table 1.4.7 Result of Intersection Analysis- Great North Road and Lumumba Road**

Saturation degree (Present)	A.M. Peak	0.32	Improvement Measures  No saturation
	P.M. Peak	0.37	
Saturation degree (Improved)	A.M. Peak	-	
	P.M. Peak	-	

8) Intersection at Great East Road and Addis Ababa Drive

This crossed intersection is signalized with channelizing left turn lanes.

**Table 1.4.8 Result of Intersection Analysis- Great East Road and Addis Ababa Drive**

Saturation degree (Present)	A.M. Peak	0.85	Improvement Measures - Additional right turn lane for Addis Ababa road and Great East road (W). - Traffic signal upgrading.
	P.M. Peak	1.26	
Saturation degree (Improved)	A.M. Peak	-	
	P.M. Peak	0.81	
Proposed signal phasing and lane arrangement	1 $\phi$ To Manchinchi		
	2 $\phi$ To Manchinchi		
	3 $\phi$ To Manchinchi		
	4 $\phi$ To Manchinchi		

9) Intersection at Mumba Road and Lumumba Road

This crossed intersection is signalized and saturation degree does not show saturated situation. However, traffic flow of this intersection is often disturbed by chaotic pedestrian and vehicle movement because city market is near the intersection. Therefore, segregation measures for different purpose traffic are essential to ensure function of the intersection.

**Table 1.4.9 Result of Intersection Analysis- Mumba Road and Lumumba Road**

Saturation degree (Present)	A.M. Peak	0.77	Improvement Measures - Installation of guard fence to prevent J-walk - Relocation of market entrance
	P.M. Peak	0.71	
Saturation degree (Improved)	A.M. Peak	-	
	P.M. Peak	-	

10) Intersection at Cairo Road and Church Road

This T-Junction is signalized and wide median is installed on the Cairo road.

**Table 1.4.10 Result of Intersection Analysis- Cairo Road and Church Road**

Saturation degree (Present)	A.M. Peak	0.95	Improvement Measures - Additional left turn lane for Church road. - Traffic signal upgrading.
	P.M. Peak	0.93	
Saturation degree (Improved)	A.M. Peak	0.70	
	P.M. Peak	0.76	
Proposed signal phasing and lane arrangement			

## 1.5 Traffic Count Survey

As parts of the person trip survey, traffic count surveys were conducted at 18 locations in total in Screen Line Survey and Cordon Line Survey in 2007. The survey locations of the traffic count surveys were specialized along the screen line and the city border. To study the traffic volume on other sections, the additional traffic count surveys were conducted at 10 stations in 2008. The followings are the survey stations.

**Table 1.5.1 Traffic Count Survey Stations**

Code	Road Name	Location	Hours	Date
1	Great East Road	Near the University of Zambia	24	29-May
2	Great East Road	Near Chainama Golf Course	12	28-May
3	Great North Road	Near Emmasdale School	12	2-June
4	Great North Road	Near Kasangula Road	12	2-June
5	Kafue Road	Near TOTAL and BP gas station	24	3-June
6	Independence Ave.	Nationalist – Yotum Muleya Rd.	24	29-May
7	Cairo Road	Near Katondo Street	24	29-May
8	Addis Ababa Drive	Near Nangwenya Road	12	3-June
9	Chilimbulu Road	Near St Patricks' School	12	3-June
10	Mumbwa Road	Near Nampundwe Road	12	2-June

Vehicles are classified as:

- 1) Passenger car, pick-up,
- 2) Taxi,
- 3) Minibus,
- 4) Medium bus,
- 5) Large bus,
- 6) Light commercial vehicle (LCV),
- 7) Rigid truck,
- 8) Articulated truck,
- 9) Others

The results of the traffic count survey are shown in the following tables.

**Table 1.5.2 Great East Road near the University of Zambia**

ST01: Great East Road		From Town						To Airport			29-May-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	353	43	119	101	4	18	10	10	7	665		
07:30-08:30	436	76	82	52	2	36	13	6	3	706		
08:30-09:30	559	26	102	36	1	49	19	7	4	803		
09:30-10:30	573	17	65	41	2	40	30	6	8	782		
10:30-11:30	531	17	73	51	8	28	26	5	8	747		
11:30-12:30	590	20	59	33	1	52	15	7	3	780		
12:30-13:30	733	33	74	47	2	52	26	8	1	976		
13:30-14:30	574	22	76	47	3	40	18	3	0	783		
14:30-15:30	508	22	93	39	0	47	30	8	2	749		
15:30-16:30	596	21	80	44	2	46	40	2	1	832		
16:30-17:30	586	13	141	60	2	61	52	12	6	933		
17:30-18:30	801	8	103	62	8	31	31	7	1	1,052		
18:30-19:30	704	93	75	49	1	28	25	6	2	983		
19:30-20:30	354	43	68	46	0	18	12	5	30	576		
20:30-21:30	484	31	15	11	0	11	8	1	0	561		
21:30-22:30	304	30	8	3	1	6	10	3	0	365		
22:30-23:30	256	7	4	4	0	3	6	6	1	287		
23:30-00:30	84	9	1	2	0	12	6	3	1	118		
00:30-01:30	94	0	0	0	0	2	2	0	0	98		
01:30-02:30	53	0	0	2	0	0	1	1	0	57		
02:30-03:30	29	0	3	1	0	0	0	0	0	33		
03:30-04:30	49	0	2	0	3	0	3	1	0	58		
04:30-05:30	165	4	11	11	1	1	3	3	0	199		
05:30-06:30	239	22	38	19	1	11	9	0	0	339		
Total	9,655	557	1,292	761	42	592	395	110	78	13,482		

ST01: Great East Road		From Airport			To Town			29-May-08		
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	705	6	205	89	24	76	35	11	9	1,160
07:30-08:30	1,038	12	126	71	3	69	16	5	4	1,344
08:30-09:30	1,115	14	93	65	5	50	17	10	7	1,376
09:30-10:30	622	16	118	105	3	53	32	8	9	966
10:30-11:30	531	16	83	58	0	43	17	4	4	756
11:30-12:30	774	18	87	39	5	38	15	11	6	993
12:30-13:30	648	23	64	51	0	43	20	8	1	858
13:30-14:30	603	21	57	54	0	32	16	0	0	783
14:30-15:30	816	18	87	69	4	45	27	10	1	1,077
15:30-16:30	584	23	110	41	0	54	25	10	0	847
16:30-17:30	734	17	91	85	0	46	28	2	3	1,006
17:30-18:30	758	8	81	72	3	32	27	10	2	993
18:30-19:30	530	8	91	101	3	17	12	13	1	776
19:30-20:30	352	4	47	23	0	9	8	3	1	447
20:30-21:30	334	8	5	8	0	8	5	3	0	371
21:30-22:30	265	6	2	1	0	5	3	3	1	286
22:30-23:30	108	5	0	4	1	1	4	1	1	125
23:30-00:30	48	1	4	2	3	3	3	1	3	68
00:30-01:30	17	1	1	2	0	0	2	0	2	25
01:30-02:30	17	1	0	1	0	2	2	0	3	26
02:30-03:30	14	0	1	0	0	7	4	0	4	30
03:30-04:30	19	1	0	0	3	3	2	1	3	32
04:30-05:30	41	5	9	3	0	7	1	0	1	67
05:30-06:30	38	4	38	7	0	13	2	3	2	107
Total	10,711	236	1,400	951	57	656	323	117	68	14,519

ST01: Great East Road		Both Directions									29-May-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	1,058	49	324	190	28	94	45	21	16	1,825		
07:30-08:30	1,474	88	208	123	5	105	29	11	7	2,050		
08:30-09:30	1,674	40	195	101	6	99	36	17	11	2,179		
09:30-10:30	1,195	33	183	146	5	93	62	14	17	1,748		
10:30-11:30	1,062	33	156	109	8	71	43	9	12	1,503		
11:30-12:30	1,364	38	146	72	6	90	30	18	9	1,773		
12:30-13:30	1,381	56	138	98	2	95	46	16	2	1,834		
13:30-14:30	1,177	43	133	101	3	72	34	3	0	1,566		
14:30-15:30	1,324	40	180	108	4	92	57	18	3	1,826		
15:30-16:30	1,180	44	190	85	2	100	65	12	1	1,679		
16:30-17:30	1,320	30	232	145	2	107	80	14	9	1,939		
17:30-18:30	1,559	16	184	134	11	63	58	17	3	2,045		
18:30-19:30	1,234	101	166	150	4	45	37	19	3	1,759		
19:30-20:30	706	47	115	69	0	27	20	8	31	1,023		
20:30-21:30	818	39	20	19	0	19	13	4	0	932		
21:30-22:30	569	36	10	4	1	11	13	6	1	651		
22:30-23:30	364	12	4	8	1	4	10	7	2	412		
23:30-00:30	132	10	5	4	3	15	9	4	4	186		
00:30-01:30	111	1	1	2	0	2	4	0	2	123		
01:30-02:30	70	1	0	3	0	2	3	1	3	83		
02:30-03:30	43	0	4	1	0	7	4	0	4	63		
03:30-04:30	68	1	2	0	6	3	5	2	3	90		
04:30-05:30	206	9	20	14	1	8	4	3	1	266		
05:30-06:30	277	26	76	26	1	24	11	3	2	446		
Total	20,366	793	2,692	1,712	99	1,248	718	227	146	28,001		



**Table 1.5.3 Great East Road near Chainama Golf Course**

ST02: Great East Road		From Town To Airport						28-May-08		
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	322	1	38	3	1	15	5	12	25	422
07:30-08:30	451	13	32	4	1	39	10	31	17	598
08:30-09:30	447	3	27	6	3	31	12	23	3	555
09:30-10:30	319	6	34	14	5	45	14	36	0	473
10:30-11:30	323	15	39	10	1	30	15	22	4	459
11:30-12:30	477	5	36	4	1	42	17	49	0	631
12:30-13:30	658	7	33	9	0	46	6	53	0	812
13:30-14:30	417	1	18	6	3	50	9	27	1	532
14:30-15:30	328	8	13	3	1	49	11	24	1	438
15:30-16:30	520	6	51	19	1	59	23	5	1	685
16:30-17:30	584	9	50	24	1	74	9	7	0	758
17:30-18:30	1,700	7	74	50	2	35	9	15	6	1,898
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	6,546	81	445	152	20	515	140	304	58	8,261

ST02: Great East Road		From Airport To Town			28-May-08					
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	815	101	57	22	1	8	3	23	0	1,030
07:30-08:30	1,250	14	89	44	1	32	8	96	4	1,538
08:30-09:30	810	12	65	34	1	38	15	49	3	1,027
09:30-10:30	637	13	47	34	0	37	10	40	0	818
10:30-11:30	476	13	48	24	2	40	18	64	0	685
11:30-12:30	560	9	45	32	2	42	17	66	0	773
12:30-13:30	568	12	52	34	4	46	16	70	1	803
13:30-14:30	626	11	38	38	1	40	9	53	0	816
14:30-15:30	535	10	60	31	3	50	10	58	1	758
15:30-16:30	552	13	53	41	2	57	22	57	3	800
16:30-17:30	633	22	62	54	4	72	9	68	1	925
17:30-18:30	600	8	64	54	4	36	8	42	0	816
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	8,062	238	680	442	25	498	145	686	13	10,789

ST02: Great East Road		Both Directions								28-May-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	1,137	102	95	25	2	23	8	35	25	1,452
07:30-08:30	1,701	27	121	48	2	71	18	127	21	2,136
08:30-09:30	1,257	15	92	40	4	69	27	72	6	1,582
09:30-10:30	956	19	81	48	5	82	24	76	0	1,291
10:30-11:30	799	28	87	34	3	70	33	86	4	1,144
11:30-12:30	1,037	14	81	36	3	84	34	115	0	1,404
12:30-13:30	1,226	19	85	43	4	92	22	123	1	1,615
13:30-14:30	1,043	12	56	44	4	90	18	80	1	1,348
14:30-15:30	863	18	73	34	4	99	21	82	2	1,196
15:30-16:30	1,072	19	104	60	3	116	45	62	4	1,485
16:30-17:30	1,217	31	112	78	5	146	18	75	1	1,683
17:30-18:30	2,300	15	138	104	6	71	17	57	6	2,714
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	14,608	319	1,125	594	45	1,013	285	990	71	19,050

**Table 1.5.4 Great North Road near Emmasdale School**

ST03: Great North Road near Emmasdale School										From	Town	To	Kabwe (Northward)			2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total						
06:30-07:30	279	8	214	21	31	12	11	6	0	582						
07:30-08:30	350	7	348	42	8	18	6	1	1	781						
08:30-09:30	361	6	212	19	1	25	17	20	2	663						
09:30-10:30	370	7	188	15	2	49	26	7	1	665						
10:30-11:30	396	17	130	8	7	19	14	17	0	608						
11:30-12:30	672	8	125	13	4	41	16	7	1	887						
12:30-13:30	600	15	112	12	3	32	34	20	3	831						
13:30-14:30	605	9	117	11	6	39	21	5	0	813						
14:30-15:30	456	15	118	14	6	45	23	9	1	687						
15:30-16:30	527	10	128	14	10	44	24	33	1	791						
16:30-17:30	812	17	306	27	17	43	18	25	0	1,265						
17:30-18:30	1,008	21	250	34	6	46	16	16	2	1,399						
18:30-19:30																
19:30-20:30																
20:30-21:30																
21:30-22:30																
22:30-23:30																
23:30-00:30																
00:30-01:30																
01:30-02:30																
02:30-03:30																
03:30-04:30																
04:30-05:30																
05:30-06:30																
Total	6,436	140	2,248	230	101	413	226	166	12	9,972						

ST03: Great North Road near Emmasdale School										From	Kabwe	To	Town (Southward)			2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total						
06:30-07:30	553	10	333	38	8	51	16	9	4	1,022						
07:30-08:30	858	13	316	35	3	47	10	7	1	1,290						
08:30-09:30	495	1	234	24	8	31	16	9	1	819						
09:30-10:30	415	8	156	13	4	39	19	13	0	667						
10:30-11:30	402	11	134	12	5	34	20	8	3	629						
11:30-12:30	407	7	134	17	3	19	9	14	3	613						
12:30-13:30	402	5	104	12	0	25	12	2	1	563						
13:30-14:30	568	5	133	21	7	34	17	13	2	800						
14:30-15:30	373	8	115	14	8	39	20	14	1	592						
15:30-16:30	740	12	144	16	5	29	17	12	2	977						
16:30-17:30	622	11	194	22	6	34	7	6	0	902						
17:30-18:30	552	12	250	39	3	30	12	4	1	903						
18:30-19:30																
19:30-20:30																
20:30-21:30																
21:30-22:30																
22:30-23:30																
23:30-00:30																
00:30-01:30																
01:30-02:30																
02:30-03:30																
03:30-04:30																
04:30-05:30																
05:30-06:30																
Total	6,387	103	2,247	263	60	412	175	111	19	9,777						

ST03: Great North Road near Emmasdale School										Both Directions		2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	832	18	547	59	39	63	27	15	4	1,604		
07:30-08:30	1,208	20	664	77	11	65	16	8	2	2,071		
08:30-09:30	856	7	446	43	9	56	33	29	3	1,482		
09:30-10:30	785	15	344	28	6	88	45	20	1	1,332		
10:30-11:30	798	28	264	20	12	53	34	25	3	1,237		
11:30-12:30	1,079	15	259	30	7	60	25	21	4	1,500		
12:30-13:30	1,002	20	216	24	3	57	46	22	4	1,394		
13:30-14:30	1,173	14	250	32	13	73	38	18	2	1,613		
14:30-15:30	829	23	233	28	14	84	43	23	2	1,279		
15:30-16:30	1,267	22	272	30	15	73	41	45	3	1,768		
16:30-17:30	1,434	28	500	49	23	77	25	31	0	2,167		
17:30-18:30	1,560	33	500	73	9	76	28	20	3	2,302		
18:30-19:30												
19:30-20:30												
20:30-21:30												
21:30-22:30												
22:30-23:30												
23:30-00:30												
00:30-01:30												
01:30-02:30												
02:30-03:30												
03:30-04:30												
04:30-05:30												
05:30-06:30												
Total	12,823	243	4,495	493	161	825	401	277	31	19,749		

**Table 1.5.5 Great North Road near Kasangula Road**

ST04: Great North Road near Kasangula Road										2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	From Medium Bus	Town Large bus	To LCV	Kabwe (Northward) Rigid truck	Articulated Truck	Others	Total
06:30-07:30	162	2	187	49	33	19	11	13	1	477
07:30-08:30	236	2	83	28	9	23	14	9	2	406
08:30-09:30	127	11	79	16	5	25	24	24	1	312
09:30-10:30	191	6	55	21	3	38	23	16	1	354
10:30-11:30	216	17	50	19	4	40	43	16	1	406
11:30-12:30	199	36	71	53	4	43	31	21	2	460
12:30-13:30	165	15	76	31	4	33	48	15	3	390
13:30-14:30	266	9	90	53	19	26	35	26	2	526
14:30-15:30	322	13	56	51	22	31	28	25	2	550
15:30-16:30	257	15	71	54	20	49	42	32	1	541
16:30-17:30	336	27	185	107	23	49	23	59	1	810
17:30-18:30	281	27	102	53	3	43	26	43	1	579
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	2,758	180	1,105	535	149	419	348	299	18	5,811

ST04: Great North Road near Kasangula Road										2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	From Medium Bus	Kabwe Large bus	To LCV	Town (Southward) Rigid truck	Articulated Truck	Others	Total
06:30-07:30	240	6	68	28	3	28	20	12	3	408
07:30-08:30	361	9	370	0	0	41	23	15	2	821
08:30-09:30	113	1	42	4	2	37	23	20	2	244
09:30-10:30	104	2	50	4	1	38	23	12	3	237
10:30-11:30	114	4	35	5	3	20	21	11	1	214
11:30-12:30	143	4	27	9	4	26	22	9	2	246
12:30-13:30	128	6	19	5	1	26	26	9	0	220
13:30-14:30	151	5	28	11	3	14	26	10	4	252
14:30-15:30	175	4	44	10	11	17	33	4	0	298
15:30-16:30	190	5	33	13	5	27	20	24	5	322
16:30-17:30	173	7	53	18	7	24	22	15	3	322
17:30-18:30	169	7	19	13	4	26	18	20	1	277
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	2,061	60	788	120	44	324	277	161	26	3,861

ST04: Great North Road near Kasangula Road										2-Jun-08
	Passenger car, Pick-up	Taxi	Minibus	Both Directions Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	402	8	255	77	36	47	31	25	4	885
07:30-08:30	597	11	453	28	9	64	37	24	4	1,227
08:30-09:30	240	12	121	20	7	62	47	44	3	556
09:30-10:30	295	8	105	25	4	76	46	28	4	591
10:30-11:30	330	21	85	24	7	60	64	27	2	620
11:30-12:30	342	40	98	62	8	69	53	30	4	706
12:30-13:30	293	21	95	36	5	59	74	24	3	610
13:30-14:30	417	14	118	64	22	40	61	36	6	778
14:30-15:30	497	17	100	61	33	48	61	29	2	848
15:30-16:30	447	20	104	67	25	76	62	56	6	863
16:30-17:30	509	34	238	125	30	73	45	74	4	1,132
17:30-18:30	450	34	121	66	7	69	44	63	2	856
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
Total	4,819	240	1,893	655	193	743	625	460	44	9,672

**Table 1.5.6 Kafue Road near TOTAL and BP gas stations**

ST05: Kafue Road		From Town To Kafue (Southward)								3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	506	35	217	50	258	30	36	22	1	1,155	
07:30-08:30	566	13	201	37	5	40	33	23	1	919	
08:30-09:30	596	33	162	44	2	74	51	15	0	977	
09:30-10:30	726	25	123	67	1	81	56	26	4	1,109	
10:30-11:30	532	29	95	39	2	81	54	28	0	860	
11:30-12:30	558	28	94	33	3	72	54	28	1	871	
12:30-13:30	698	5	157	44	10	77	64	38	3	1,096	
13:30-14:30	379	6	112	31	8	60	63	23	0	682	
14:30-15:30	477	17	143	50	52	54	58	32	3	886	
15:30-16:30	797	20	182	64	58	59	60	43	2	1,285	
16:30-17:30	790	30	204	69	3	77	42	52	3	1,270	
17:30-18:30	587	9	206	104	6	77	48	30	4	1,071	
18:30-19:30											
19:30-20:30											
20:30-21:30											
21:30-22:30											
22:30-23:30											
23:30-00:30											
00:30-01:30											
01:30-02:30											
02:30-03:30											
03:30-04:30											
04:30-05:30											
05:30-06:30											
<b>Total</b>	<b>7,212</b>	<b>250</b>	<b>1,896</b>	<b>632</b>	<b>408</b>	<b>782</b>	<b>619</b>	<b>360</b>	<b>22</b>	<b>12,181</b>	

ST05: Kafue Road		From Kafue To Town (Northward)								3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	792	22	73	24	11	50	47	32	3	1,054	
07:30-08:30	686	15	69	32	6	82	52	50	6	998	
08:30-09:30	659	9	75	47	3	76	40	28	1	938	
09:30-10:30	602	5	45	28	5	81	60	33	4	863	
10:30-11:30	461	7	87	29	16	100	71	39	810	1,620	
11:30-12:30	440	13	35	11	3	45	32	48	4	631	
12:30-13:30	421	4	60	11	5	58	45	44	1	649	
13:30-14:30	619	2	68	13	0	60	41	34	3	840	
14:30-15:30	435	10	47	19	3	90	71	32	6	713	
15:30-16:30	460	12	35	27	6	94	59	36	4	733	
16:30-17:30	432	5	63	32	6	88	52	65	2	745	
17:30-18:30	498	3	62	39	7	94	64	48	6	821	
18:30-19:30											
19:30-20:30											
20:30-21:30											
21:30-22:30											
22:30-23:30											
23:30-00:30											
00:30-01:30											
01:30-02:30											
02:30-03:30											
03:30-04:30											
04:30-05:30											
05:30-06:30											
<b>Total</b>	<b>6,505</b>	<b>107</b>	<b>719</b>	<b>312</b>	<b>71</b>	<b>918</b>	<b>634</b>	<b>489</b>	<b>850</b>	<b>10,605</b>	

ST05: Kafue Road		Both Directions								3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	1,298	57	290	74	269	80	83	54	4	2,209	
07:30-08:30	1,252	28	270	69	11	122	85	73	7	1,917	
08:30-09:30	1,255	42	237	91	5	150	91	43	1	1,915	
09:30-10:30	1,328	30	168	95	6	162	116	59	8	1,972	
10:30-11:30	993	36	182	68	18	181	125	67	810	2,480	
11:30-12:30	998	41	129	44	6	117	86	76	5	1,502	
12:30-13:30	1,119	9	217	55	15	135	109	82	4	1,745	
13:30-14:30	998	8	180	44	8	120	104	57	3	1,522	
14:30-15:30	912	27	190	69	55	144	129	64	9	1,599	
15:30-16:30	1,257	32	217	91	64	153	119	79	6	2,018	
16:30-17:30	1,222	35	267	101	9	165	94	117	5	2,015	
17:30-18:30	1,085	12	268	143	13	171	112	78	10	1,892	
18:30-19:30											
19:30-20:30											
20:30-21:30											
21:30-22:30											
22:30-23:30											
23:30-00:30											
00:30-01:30											
01:30-02:30											
02:30-03:30											
03:30-04:30											
04:30-05:30											
05:30-06:30											
<b>Total</b>	<b>13,717</b>	<b>357</b>	<b>2,615</b>	<b>944</b>	<b>479</b>	<b>1,700</b>	<b>1,253</b>	<b>849</b>	<b>872</b>	<b>22,786</b>	

**Table 1.5.7 Independence Avenue between Nationalist and Yotum Muleya Road**

ST06: Independence Ave.		From Town						To State House (Eastward)			29-May-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	232	1	7	3	3	13	1	3	3	266	
07:30-08:30	426	2	10	3	4	7	5	3	1	461	
08:30-09:30	311	2	11	5	1	8	3	2	0	343	
09:30-10:30	343	3	18	3	1	19	10	4	0	401	
10:30-11:30	362	6	18	1	1	14	5	1	1	409	
11:30-12:30	464	1	18	4	1	18	2	4	1	513	
12:30-13:30	654	3	14	3	0	14	1	1	1	691	
13:30-14:30	387	1	11	3	0	11	0	0	1	414	
14:30-15:30	412	3	35	6	1	23	1	1	0	482	
15:30-16:30	635	7	21	3	2	10	3	2	1	684	
16:30-17:30	903	9	27	2	0	23	5	4	1	974	
17:30-18:30	1,011	7	31	3	0	8	2	2	0	1,064	
18:30-19:30	474	0	12	0	2	11	1	0	1	501	
19:30-20:30	262	2	6	0	0	6	1	1	0	278	
20:30-21:30	182	0	1	0	0	4	0	0	0	187	
21:30-22:30	59	0	1	1	0	1	1	0	0	63	
22:30-23:30	50	0	0	0	0	6	0	0	0	56	
23:30-00:30	24	0	0	0	0	3	1	0	0	28	
00:30-01:30	9	0	0	0	0	0	0	0	0	9	
01:30-02:30	4	0	0	0	0	4	0	0	0	8	
02:30-03:30	5	1	0	0	0	0	0	0	0	6	
03:30-04:30	11	0	0	0	0	1	0	0	0	12	
04:30-05:30	12	0	0	0	0	0	0	0	0	12	
05:30-06:30	20	0	6	1	0	0	1	0	1	29	
<b>Total</b>	<b>7,252</b>	<b>48</b>	<b>247</b>	<b>41</b>	<b>16</b>	<b>204</b>	<b>43</b>	<b>28</b>	<b>12</b>	<b>7,891</b>	

ST06: Independence Ave.		From State House						To Town (Westward)			29-May-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	900	3	14	9	3	13	10	13	5	970	
07:30-08:30	1,177	9	28	7	2	11	23	22	3	1,282	
08:30-09:30	781	3	25	1	4	14	16	12	3	859	
09:30-10:30	540	0	10	3	3	11	16	6	2	591	
10:30-11:30	356	3	6	5	2	12	6	17	6	413	
11:30-12:30	271	3	11	2	1	10	4	0	1	303	
12:30-13:30	319	2	21	3	0	16	8	1	2	372	
13:30-14:30	761	2	12	1	0	20	3	0	7	806	
14:30-15:30	511	3	17	1	0	11	5	0	1	549	
15:30-16:30	431	3	11	4	2	14	4	5	1	475	
16:30-17:30	409	4	9	6	3	21	5	0	1	458	
17:30-18:30	386	1	7	3	1	12	4	5	0	419	
18:30-19:30	266	0	5	4	3	15	1	1	0	295	
19:30-20:30	133	0	4	0	0	4	5	1	1	148	
20:30-21:30	98	0	4	0	0	5	2	0	1	110	
21:30-22:30	56	0	1	0	0	3	2	0	0	62	
22:30-23:30	14	0	1	0	0	0	0	0	0	15	
23:30-00:30	1	0	0	0	0	0	0	0	1	2	
00:30-01:30	14	0	0	0	0	0	0	0	0	14	
01:30-02:30	10	0	0	0	0	0	0	0	0	10	
02:30-03:30	3	0	0	0	0	0	0	0	0	3	
03:30-04:30	6	0	0	0	0	0	0	0	0	6	
04:30-05:30	18	0	1	0	0	0	0	0	0	19	
05:30-06:30	34	0	0	1	0	8	1	3	0	47	
<b>Total</b>	<b>7,495</b>	<b>36</b>	<b>187</b>	<b>50</b>	<b>24</b>	<b>200</b>	<b>115</b>	<b>86</b>	<b>35</b>	<b>8,228</b>	

ST06: Independence Ave.		Both Directions									29-May-08
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	1,132	4	21	12	6	26	11	16	8	1,236	
07:30-08:30	1,603	11	38	10	6	18	28	25	4	1,743	
08:30-09:30	1,092	5	36	6	5	22	19	14	3	1,202	
09:30-10:30	883	3	28	6	4	30	26	10	2	992	
10:30-11:30	718	9	24	6	3	26	11	18	7	822	
11:30-12:30	735	4	29	6	2	28	6	4	2	816	
12:30-13:30	973	5	35	6	0	30	9	2	3	1,063	
13:30-14:30	1,148	3	23	4	0	31	3	0	8	1,220	
14:30-15:30	923	6	52	7	1	34	6	1	1	1,031	
15:30-16:30	1,066	10	32	7	4	24	7	7	2	1,159	
16:30-17:30	1,312	13	36	8	3	44	10	4	2	1,432	
17:30-18:30	1,397	8	38	6	1	20	6	7	0	1,483	
18:30-19:30	740	0	17	4	5	26	2	1	1	796	
19:30-20:30	395	2	10	0	0	10	6	2	1	426	
20:30-21:30	280	0	5	0	0	9	2	0	1	297	
21:30-22:30	115	0	2	1	0	4	3	0	0	125	
22:30-23:30	64	0	1	0	0	6	0	0	0	71	
23:30-00:30	25	0	0	0	0	3	1	0	1	30	
00:30-01:30	23	0	0	0	0	0	0	0	0	23	
01:30-02:30	14	0	0	0	0	4	0	0	0	18	
02:30-03:30	8	1	0	0	0	0	0	0	0	9	
03:30-04:30	17	0	0	0	0	1	0	0	0	18	
04:30-05:30	30	0	1	0	0	0	0	0	0	31	
05:30-06:30	54	0	6	2	0	8	2	3	1	76	
<b>Total</b>	<b>14,747</b>	<b>84</b>	<b>434</b>	<b>91</b>	<b>40</b>	<b>404</b>	<b>158</b>	<b>114</b>	<b>47</b>	<b>16,119</b>	

**Table 1.5.8 Cairo Road near Katondo Street**

ST07: Cairo Road		From Kafue					To Kabwe			29-May-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	530	6	30	3	1	41	2	1	9	623	
07:30-08:30	1,510	29	23	4	1	37	7	1	10	1,622	
08:30-09:30	1,130	9	16	6	3	38	3	0	9	1,214	
09:30-10:30	1,298	40	34	7	7	59	2	1	13	1,461	
10:30-11:30	1,150	49	32	1	0	45	13	1	14	1,305	
11:30-12:30	2,110	21	30	3	1	38	7	0	10	2,220	
12:30-13:30	1,873	20	33	1	0	35	11	2	14	1,989	
13:30-14:30	1,241	32	9	5	3	32	7	0	15	1,344	
14:30-15:30	1,292	35	32	12	2	35	5	0	9	1,422	
15:30-16:30	1,006	34	25	1	1	26	7	0	4	1,104	
16:30-17:30	1,177	33	25	13	0	40	13	0	14	1,315	
17:30-18:30	1,186	21	29	1	9	16	8	2	3	1,275	
18:30-19:30	153	9	1	1	0	18	8	0	0	190	
19:30-20:30	121	5	1	1	0	11	13	0	2	154	
20:30-21:30	85	0	0	0	0	16	9	1	0	111	
21:30-22:30	65	1	0	0	0	6	8	1	1	82	
22:30-23:30	37	1	0	0	0	1	0	0	0	39	
23:30-00:30	8	0	0	0	0	3	3	2	1	17	
00:30-01:30	3	1	0	0	0	4	2	0	3	13	
01:30-02:30	3	0	0	0	0	2	3	0	0	8	
02:30-03:30	8	0	0	0	0	6	3	1	0	18	
03:30-04:30	8	0	0	0	0	2	2	1	0	13	
04:30-05:30	14	0	0	0	0	2	0	0	0	16	
05:30-06:30	30	6	6	6	0	9	1	0	1	59	
Total	16,038	352	326	65	28	522	137	14	132	17,614	

ST07: Cairo Road		From Kabwe					To Kafue			29-May-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total	
06:30-07:30	523	15	30	3	1	18	8	1	9	608	
07:30-08:30	1,635	22	23	4	1	25	6	1	10	1,727	
08:30-09:30	2,320	15	16	6	3	34	16	0	9	2,419	
09:30-10:30	1,851	18	34	7	7	34	12	1	9	1,973	
10:30-11:30	1,602	32	32	1	0	34	11	0	20	1,732	
11:30-12:30	1,520	23	30	3	1	56	5	1	10	1,649	
12:30-13:30	1,144	20	33	1	0	31	11	3	14	1,257	
13:30-14:30	1,418	21	7	0	3	43	7	0	15	1,514	
14:30-15:30	950	24	32	12	2	46	16	0	9	1,091	
15:30-16:30	969	18	19	1	1	32	14	0	7	1,061	
16:30-17:30	382	11	25	13	0	29	10	0	14	484	
17:30-18:30	316	8	29	1	9	7	1	2	3	376	
18:30-19:30	330	2	29	3	0	12	8	3	1	388	
19:30-20:30	276	4	3	1	1	3	1	1	3	293	
20:30-21:30	210	1	2	0	0	3	3	1	6	226	
21:30-22:30	160	1	0	0	0	10	1	2	1	175	
22:30-23:30	79	0	0	0	0	6	2	2	3	92	
23:30-00:30	23	0	0	0	0	4	1	1	1	30	
00:30-01:30	30	1	0	0	0	4	0	0	6	41	
01:30-02:30	4	0	0	0	0	9	2	0	8	23	
02:30-03:30	14	1	0	0	0	8	3	0	0	26	
03:30-04:30	12	0	10	7	0	12	3	2	0	46	
04:30-05:30	31	1	8	2	0	7	1	5	23	78	
05:30-06:30	61	3	23	8	2	8	2	3	1	111	
Total	15,860	241	385	73	31	475	144	29	182	17,420	

ST07: Cairo Road		Both Directions									29-May-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	1,053	21	60	6	2	59	10	2	18	1,231		
07:30-08:30	3,145	51	46	8	2	62	13	2	20	3,349		
08:30-09:30	3,450	24	32	12	6	72	19	0	18	3,633		
09:30-10:30	3,149	58	68	14	14	93	14	2	22	3,434		
10:30-11:30	2,752	81	64	2	0	79	24	1	34	3,037		
11:30-12:30	3,630	44	60	6	2	94	12	1	20	3,869		
12:30-13:30	3,017	40	66	2	0	66	22	5	28	3,246		
13:30-14:30	2,659	53	16	5	6	75	14	0	30	2,858		
14:30-15:30	2,242	59	64	24	4	81	21	0	18	2,513		
15:30-16:30	1,975	52	44	2	2	58	21	0	11	2,165		
16:30-17:30	1,559	44	50	26	0	69	23	0	28	1,799		
17:30-18:30	1,502	29	58	2	18	23	9	4	6	1,651		
18:30-19:30	483	11	30	4	0	30	16	3	1	578		
19:30-20:30	397	9	4	2	1	14	14	1	5	447		
20:30-21:30	295	1	2	0	0	19	12	2	6	337		
21:30-22:30	225	2	0	0	0	16	9	3	2	257		
22:30-23:30	116	1	0	0	0	7	2	2	3	131		
23:30-00:30	31	0	0	0	0	7	4	3	2	47		
00:30-01:30	33	2	0	0	0	8	2	0	9	54		
01:30-02:30	7	0	0	0	0	11	5	0	8	31		
02:30-03:30	22	1	0	0	0	14	6	1	0	44		
03:30-04:30	20	0	10	7	0	14	5	3	0	59		
04:30-05:30	45	1	8	2	0	9	1	5	23	94		
05:30-06:30	91	9	29	14	2	17	3	3	2	170		
Total	31,898	593	711	138	59	997	281	43	314	35,034		

**Table 1.5.9 Addis Ababa Drive near Nangwenya Road**

ST08: Addis Ababa Drive		From Church Road					To Manda Hill				3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	457	4	23	10	1	6	0	0	3	504		
07:30-08:30	1,000	18	38	4	2	18	3	1	2	1,086		
08:30-09:30	668	21	23	9	6	24	10	3	2	766		
09:30-10:30	795	13	31	6	0	12	2	0	5	864		
10:30-11:30	771	18	27	3	1	28	12	3	5	868		
11:30-12:30	995	17	28	3	2	31	7	0	7	1,090		
12:30-13:30	1,656	22	23	2	3	39	6	1	4	1,756		
13:30-14:30	1,070	16	28	2	0	15	6	0	2	1,139		
14:30-15:30	944	32	32	6	2	23	6	1	2	1,048		
15:30-16:30	1,355	28	15	4	0	34	7	2	5	1,450		
16:30-17:30	2,307	30	12	5	3	29	14	1	7	2,408		
17:30-18:30	1,740	25	14	4	1	9	6	0	4	1,803		
18:30-19:30												
19:30-20:30												
20:30-21:30												
21:30-22:30												
22:30-23:30												
23:30-00:30												
00:30-01:30												
01:30-02:30												
02:30-03:30												
03:30-04:30												
04:30-05:30												
05:30-06:30												
Total	13,758	244	294	58	21	268	79	12	48	14,782		

ST08: Addis Ababa Drive		From Manda Hill					To Church Road				3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	988	15	20	4	2	10	0	0	4	1,043		
07:30-08:30	1,598	27	23	12	1	17	7	0	4	1,689		
08:30-09:30	800	18	13	13	0	27	3	0	3	877		
09:30-10:30	794	16	22	6	0	26	8	2	6	880		
10:30-11:30	901	16	21	5	0	23	8	0	5	979		
11:30-12:30	863	14	38	2	2	12	5	3	5	944		
12:30-13:30	1,066	22	23	8	6	32	6	4	7	1,174		
13:30-14:30	860	17	16	2	1	12	9	2	3	922		
14:30-15:30	984	27	14	1	2	17	7	2	5	1,059		
15:30-16:30	907	20	35	2	0	12	9	0	6	991		
16:30-17:30	1,064	28	34	7	2	20	9	2	1	1,167		
17:30-18:30	998	21	23	3	0	5	12	1	296	1,359		
18:30-19:30												
19:30-20:30												
20:30-21:30												
21:30-22:30												
22:30-23:30												
23:30-00:30												
00:30-01:30												
01:30-02:30												
02:30-03:30												
03:30-04:30												
04:30-05:30												
05:30-06:30												
Total	11,823	241	282	65	16	213	83	16	345	13,084		

ST08: Addis Ababa Drive		Both Directions									3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total		
06:30-07:30	1,445	19	43	14	3	16	0	0	7	1,547		
07:30-08:30	2,598	45	61	16	3	35	10	1	6	2,775		
08:30-09:30	1,468	39	36	22	6	51	13	3	5	1,643		
09:30-10:30	1,589	29	53	12	0	38	10	2	11	1,744		
10:30-11:30	1,672	34	48	8	1	51	20	3	10	1,847		
11:30-12:30	1,858	31	66	5	4	43	12	3	12	2,034		
12:30-13:30	2,722	44	46	10	9	71	12	5	11	2,930		
13:30-14:30	1,930	33	44	4	1	27	15	2	5	2,061		
14:30-15:30	1,928	59	46	7	4	40	13	3	7	2,107		
15:30-16:30	2,262	48	50	6	0	46	16	2	11	2,441		
16:30-17:30	3,371	58	46	12	5	49	23	3	8	3,575		
17:30-18:30	2,738	46	37	7	1	14	18	1	300	3,162		
18:30-19:30												
19:30-20:30												
20:30-21:30												
21:30-22:30												
22:30-23:30												
23:30-00:30												
00:30-01:30												
01:30-02:30												
02:30-03:30												
03:30-04:30												
04:30-05:30												
05:30-06:30												
Total	25,581	485	576	123	37	481	162	28	393	27,866		

**Table 1.5.10 Chilimbulu Road near St Patricks' School**

ST09: Chilimbulu Road		From Town To Kabwata (Eastward)							3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	130	4	109	38	1	14	33	3	1	333
07:30-08:30	232	9	88	13	0	14	8	1	3	368
08:30-09:30	153	15	115	5	0	15	10	0	150	463
09:30-10:30	172	4	116	4	0	32	14	1	1	344
10:30-11:30	190	4	60	4	0	27	15	0	31	331
11:30-12:30	243	8	88	4	0	18	2	0	35	398
12:30-13:30	268	12	63	2	0	15	16	1	3	380
13:30-14:30	223	7	115	14	1	26	8	3	1	398
14:30-15:30	216	5	97	0	0	25	17	0	14	374
15:30-16:30	357	7	102	0	0	35	15	1	1	518
16:30-17:30	369	11	160	11	5	26	16	4	28	630
17:30-18:30	490	19	57	0	1	27	16	2	24	636
18:30-19:30										0
19:30-20:30										0
20:30-21:30										0
21:30-22:30										0
22:30-23:30										0
23:30-00:30										0
00:30-01:30										0
01:30-02:30										0
02:30-03:30										0
03:30-04:30										0
04:30-05:30										0
05:30-06:30										0
<b>Total</b>	<b>3,043</b>	<b>105</b>	<b>1,170</b>	<b>95</b>	<b>8</b>	<b>274</b>	<b>170</b>	<b>16</b>	<b>292</b>	<b>5,173</b>

ST09: Chilimbulu Road		From Town To Kabwata (Eastward)							3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	657	0	105	4	0	8	4	6	3	787
07:30-08:30	1,105	4	158	8	1	25	2	1	4	1,308
08:30-09:30	713	7	140	4	2	38	11	1	1	917
09:30-10:30	318	2	124	4	1	30	9	1	2	491
10:30-11:30	320	2	102	1	0	23	5	2	4	459
11:30-12:30	405	0	74	2	0	24	5	5	3	518
12:30-13:30	310	8	84	0	0	14	4	8	2	430
13:30-14:30	247	1	107	4	1	21	8	4	0	393
14:30-15:30	165	12	85	1	0	14	6	3	3	289
15:30-16:30	460	23	104	2	1	27	7	2	1	627
16:30-17:30	386	4	109	3	0	7	4	4	2	519
17:30-18:30	233	5	104	8	1	30	24	4	1	410
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
<b>Total</b>	<b>5,319</b>	<b>68</b>	<b>1,296</b>	<b>41</b>	<b>7</b>	<b>261</b>	<b>89</b>	<b>41</b>	<b>26</b>	<b>7,148</b>

ST09: Chilimbulu Road		Both Directions							3-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	787	4	214	42	1	22	37	9	4	1,120
07:30-08:30	1,337	13	246	21	1	39	10	2	7	1,676
08:30-09:30	866	22	255	9	2	53	21	1	151	1,380
09:30-10:30	490	6	240	8	1	62	23	2	3	835
10:30-11:30	510	6	162	5	0	50	20	2	35	790
11:30-12:30	648	8	162	6	0	42	7	5	38	916
12:30-13:30	578	20	147	2	0	29	20	9	5	810
13:30-14:30	470	8	222	18	2	47	16	7	1	791
14:30-15:30	381	17	182	1	0	39	23	3	17	663
15:30-16:30	817	30	206	2	1	62	22	3	2	1,145
16:30-17:30	755	15	269	14	5	33	20	8	30	1,149
17:30-18:30	723	24	161	8	2	57	40	6	25	1,046
18:30-19:30										
19:30-20:30										
20:30-21:30										
21:30-22:30										
22:30-23:30										
23:30-00:30										
00:30-01:30										
01:30-02:30										
02:30-03:30										
03:30-04:30										
04:30-05:30										
05:30-06:30										
<b>Total</b>	<b>8,362</b>	<b>173</b>	<b>2,466</b>	<b>136</b>	<b>15</b>	<b>535</b>	<b>259</b>	<b>57</b>	<b>318</b>	<b>12,321</b>



**Table 1.5.11 Mumbwa Road near Nampundwe Road**

ST10: Mumbwa Road		From Mumbwa To Town (Eastward)							2-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	270	13	51	4	0	14	10	7	1	370
07:30-08:30	320	22	89	4	0	42	22	9	2	510
08:30-09:30	270	9	132	11	0	49	33	13	6	523
09:30-10:30	255	4	46	6	1	26	33	17	3	391
10:30-11:30	256	2	31	3	0	41	19	15	2	369
11:30-12:30	203	7	45	3	0	63	15	11	4	351
12:30-13:30	131	3	45	2	2	57	18	8	1	267
13:30-14:30	173	1	47	5	1	30	12	8	2	279
14:30-15:30	175	5	65	4	0	50	35	9	3	346
15:30-16:30	185	10	61	6	1	31	17	15	3	329
16:30-17:30	177	1	74	1	1	46	16	10	2	328
17:30-18:30	291	4	104	5	3	42	20	15	2	486
18:30-19:30										0
19:30-20:30										0
20:30-21:30										0
21:30-22:30										0
22:30-23:30										0
23:30-00:30										0
00:30-01:30										0
01:30-02:30										0
02:30-03:30										0
03:30-04:30										0
04:30-05:30										0
05:30-06:30										0
Total	2,706	81	790	54	9	491	250	137	31	4,549

ST10: Mumbwa Road		From Town To Mumbwa (Eastward)							2-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	230	7	189	21	7	18	8	2	0	482
07:30-08:30	271	27	169	2	1	31	8	12	0	521
08:30-09:30	248	9	80	7	1	30	24	7	4	410
09:30-10:30	275	8	107	13	1	37	29	3	1	474
10:30-11:30	215	14	100	0	0	37	37	38	0	441
11:30-12:30	253	6	27	0	0	24	25	12	2	349
12:30-13:30	229	14	76	1	1	29	42	15	4	411
13:30-14:30	127	4	77	2	0	41	37	1	4	293
14:30-15:30	149	1	92	3	0	51	28	1	1	326
15:30-16:30	175	8	87	0	2	53	45	19	0	389
16:30-17:30	249	4	53	7	0	53	36	13	0	415
17:30-18:30	306	9	261	8	0	36	29	2	0	651
18:30-19:30										0
19:30-20:30										0
20:30-21:30										0
21:30-22:30										0
22:30-23:30										0
23:30-00:30										0
00:30-01:30										0
01:30-02:30										0
02:30-03:30										0
03:30-04:30										0
04:30-05:30										0
05:30-06:30										0
Total	2,727	111	1,318	64	13	440	348	125	16	5,162

ST10: Mumbwa Road		From Town To Mumbwa (Eastward)							2-Jun-08	
	Passenger car, Pick-up	Taxi	Minibus	Medium Bus	Large bus	LCV	Rigid truck	Articulated Truck	Others	Total
06:30-07:30	500	20	240	25	7	32	18	9	1	852
07:30-08:30	591	49	258	6	1	73	30	21	2	1,031
08:30-09:30	518	18	212	18	1	79	57	20	10	933
09:30-10:30	530	12	153	19	2	63	62	20	4	865
10:30-11:30	471	16	131	3	0	78	56	53	2	810
11:30-12:30	456	13	72	3	0	87	40	23	6	700
12:30-13:30	360	17	121	3	3	86	60	23	5	678
13:30-14:30	300	5	124	7	1	71	49	9	6	572
14:30-15:30	324	6	157	7	0	101	63	10	4	672
15:30-16:30	360	18	148	6	3	84	62	34	3	718
16:30-17:30	426	5	127	8	1	99	52	23	2	743
17:30-18:30	597	13	365	13	3	78	49	17	2	1,137
18:30-19:30										0
19:30-20:30										0
20:30-21:30										0
21:30-22:30										0
22:30-23:30										0
23:30-00:30										0
00:30-01:30										0
01:30-02:30										0
02:30-03:30										0
03:30-04:30										0
04:30-05:30										0
05:30-06:30										0
Total	5,433	192	2,108	118	22	931	598	262	47	9,711

## CHAPTER 2. DEMAND FORECAST

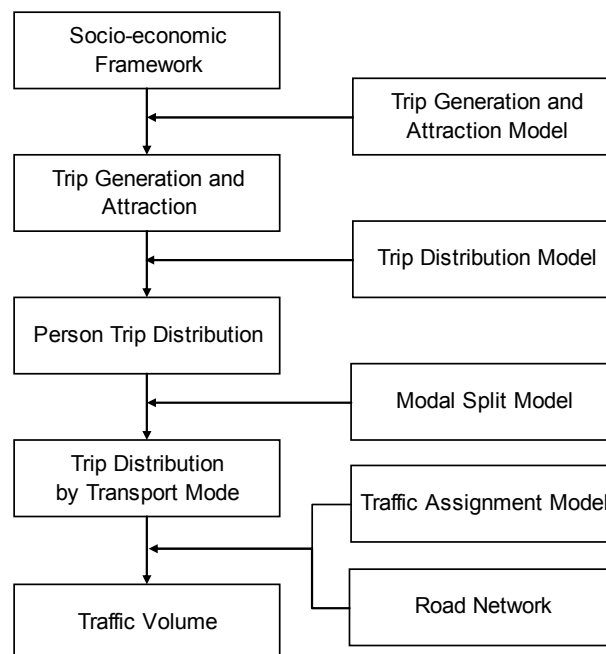
### 2.1 General

#### 2.1.1 Approach

The demand forecast models were developed to estimate traffic demands by adopting the conventional four-step method. The steps include the following components:

- 1) Trip generation/attraction: estimation of the number of trips generated from and attracted to each zone by trip purpose,
- 2) Trip distribution: estimation of the number of trips between zones,
- 3) Modal split: estimation of the number of trips made by each transport mode, and
- 4) Traffic assignment: estimation of the number of trips on each link of the road network.

The overall process of the demand forecast is illustrated in Figure 2.2.1.



**Figure 2.1.1 Process of Demand Forecast**

For building the demand forecast models, the results of the traffic survey including the household interview survey and the supplemental surveys (e.g., screen line survey, cordon line survey, etc.) were utilized. The traffic demands in 2015, 2020 and 2030 were forecasted by applying the demand forecast models to the study area covering Lusaka District and parts of Chongwe District, Kafue District and Chibombo District..

#### 2.1.2 Zoning System for Demand Forecast

To estimate future demands in the study area, the traffic analysis zones were defined as 66 zones including 58 zones in the study area and 8 zones in the external area as illustrated in Figure 2.1.2. This zoning system was adopted to build the models for trip generation/attraction, distribution and modal split.



**Figure 2.1.2 Traffic Analysis Zone (66 zones)**

For traffic assignment, 66 zones were divided into 249 zones in total as illustrated in Figure 2.1.3.



**Figure 2.1.3 Traffic Analysis Zone for Traffic Assignment (249 zones)**

### 2.1.3 Classifications of Trip Purpose and Transport Mode

In the demand forecast, the trip purposes and transport modes were classified into the following categories:

- 1) Trip Purposes
  - a. Work
  - b. School
  - c. Business
  - d. Private
  - e. Home
- 2) Transport Modes
  - a. Walk
  - b. Bus
  - c. Car

## 2.2 Trip Generation and Attraction

### 2.2.1 Trip Generation and Attraction Model

Trip generation and attraction models by trip purpose were developed to estimate the number of trips as shown below:

$$G_i = a_i * X_i$$

$$A_j = a_j * X_j$$

where,  $G_i$  = Trip generation in zone  $i$

$A_j$  = Trip attraction in zone  $j$

$X_i, X_j$  = Variables in zone  $i, j$

$a_i, a_j$  = Parameters

**Table 2.2.1 Trip Generation**

Trip Purpose	Vehicle Ownership	Variables	Parameter
Work	Owner	Number of resident workers	0.70
	Non- Owner	Number of resident workers	0.50
School	Owner	Number of resident students	0.90
	Non- Owner	Number of resident students	0.86
Business (Home based)	Owner	Number of employees (workers at working place)	0.30
	Non- Owner	Number of employees (workers at working place)	0.30
Business (Non-home based)	-	Number of business population at working place*	0.60 (zone 1) 0.30(other zones)
Private (Home based)	Owner	Population	0.20
	Non- Owner	Population	0.20
Private (None-home based)	-	Trip attraction by work, school, business (home based) and private (home based)	0.05

Note: \*: The business population was defined as “number of employees” + “trip attraction by business” – “trip generation by business”.

**Table 2.2.2 Trip Attraction**

Trip Purpose	Vehicle Ownership	Variables	Parameter
Work	Owner	Trip attraction by work	1.00
	Non- Owner	Trip attraction by work	1.00
School	Owner	Trip attraction by school	1.00
	Non- Owner	Trip attraction by school	1.00
Business (Home based)	-	Number of employees (workers at working place)	0.60 (zone 1) 0.20 (zone 4) 0.05 (other zones)
Business (Non-home based)	-	Trip generation by business (non-home based)	1.00
Private (Home based)	-	Number of employees (workers at working place)	1.50 (zone 1) 0.54 (other zones)
Private (None-home based)	-	Trip generation by private (non-home based)	1.00

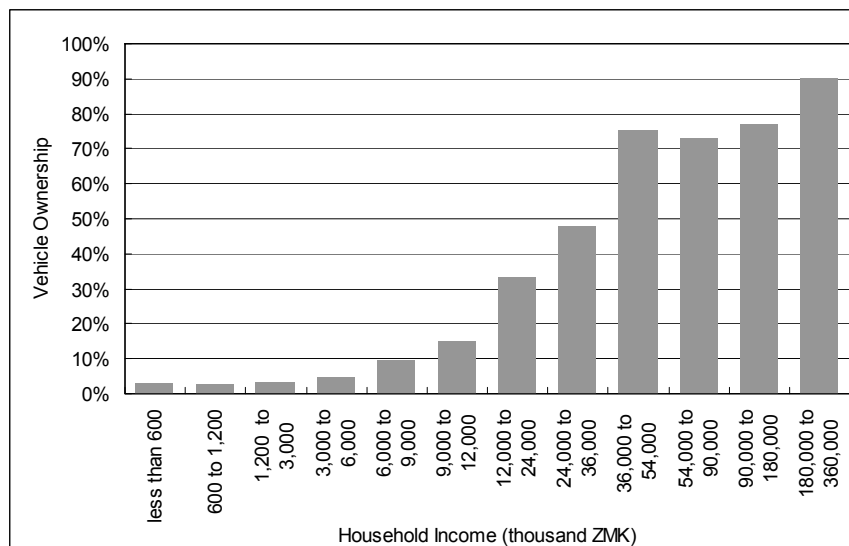
Note 1: The variables for trip attraction of work and school applied the trip data obtained from the household interview survey, because the socio-economic data were not available in the study area.

Note 2: Future trip attraction by work was estimated based on number of the future employees by zone.

Note 3: Trip generations and attractions were adjusted and balanced before the process of trip distribution model.

### 2.2.2 Vehicle Ownership

The vehicle ownership rate was 15% in 2007, according to the results of household interview survey. As increasing the household income level, the vehicle ownership increases as illustrated in Figure 2.2.1.



**Figure 2.2.1 Relationship between Household Income and Vehicle Ownership**

The future vehicle ownership rate was estimated from the relationship with the household income level. According to the future socio-economic framework, GDP per capita in the study area was estimated to be 1.40 times in 2015, 1.76 times in 2020 and 2.80 times in 2030. Based on the assumption that the income level increases in accordance with the growth rate of GDP per capita, the future vehicle ownership was estimated to be 20% in 2015, 23% in 2020 and 30% in 2030. Considering the increase of the future vehicle ownership in 2015, 2020 and 2030, the trip generation and attraction by trip purpose by vehicle ownership were estimated.

## 2.3 Trip Distribution

The trip distribution model is to estimate the number of trips generated/attracted from/to zones for each zone pair. The following model which was improved from the gravity model was adopted. The parameters were shown in Table 2.2.3.

$$t_{ij} = A_i \cdot B_j \cdot O_i \cdot D_j \cdot \exp(-\alpha R_{ij})$$

$$A_i = \frac{1}{\sum_k^N B_k D_k \exp(-\alpha R_{ik})}$$

$$B_j = \frac{1}{\sum_k^N A_k O_k \exp(-\alpha R_{jk})}$$

where,  $t_{ij}$  : Number of trips between zone  $i$  and zone  $j$

$A_i, B_j$  : Parameter between zone  $i$  and zone  $j$

$R_{ij}$  : Distance between zone  $i$  and zone  $j$

$O_i$  : Trip generation of zone  $i$

$D_j$  : Trip attraction of zone  $j$

$\alpha$  : Parameter

**Table 2.2.3 Parameters of Trip Distribution**

Trip Purpose	Vehicle Ownership	$\alpha$
Work	Owner	0.1630
	Non- Owner	0.2609
School	Owner	0.2911
	Non- Owner	0.5083
Business (Home based)	Owner	0.1510
	Non-Owner	0.1984
Business (Non-home based)	-	0.1868
Private (Home based)	Owner	0.1508
	Non- Owner	0.2692
Private (None-home based)	-	0.3406

## 2.4 Modal Split

The modal split models were developed to estimate modal shares of transport modes by trip purpose.

### 2.4.1 Walk – Bus Split Model

Disaggregated model was developed to split between walk and bus for most of the trip purposes. The walk share was estimated with the following equation and parameters:

$$P_{walk} = \frac{1}{1 + \exp\{-aF - b(T_{bus} - T_{walk})\}}$$

where,  $P_{walk}$  : Walk share

$F$  : Travel cost by bus

$T_{bus}$  : Travel time by bus

$T_{walk}$  : Travel time by walk

$a, b$  : Parameters

**Table 2.4.1 Parameters of Walk – Bus Split Model**

Vehicle Ownership	$a$	$b$
Owner	0.8831 (-4.66)	0.03743 (-8.16)
Non- Owner	1.412 (-22.3)	0.02893 (-26.2)

Note: Parenthesis indicates t-value.

## 2.4.2 Modal Split by Trip Purpose

In the Study, the modal shares were estimated by each trip purpose to reflect the trip characteristics of them. Methodologies applied by each trip purpose are described below:

### (1) Work

Firstly, the car share was estimated by using the following equation including travel distance as the variable.

**Table 2.4.2 Modal Split Model for Work**

Vehicle Ownership	Equation
Owner	$P_{car} = 0.9 - 0.5 \exp(-0.5x)$
Non- Owner	$P_{car} = 0.008x + 0.04$

Note:  $P_{car}$  : Car share

$x$  : Travel distance

Secondly, the walk and bus shares were estimated by applying the walk – bus split model.

### (2) School

The modal shares among car, bus and walk were estimated from the following equations:

**Table 2.4.3 Modal Split Model for School**

Vehicle Ownership	Equation
Owner	$P_{car} = 0.39 \ln(x^{0.54} + 1)$ $P_{bus} = (1 - P_{car}) \cdot \frac{1}{1 + \exp(1.5x - 6)}$ $P_{walk} = 1 - P_{car} - P_{bus}$
Non- Owner	$P_{walk} = \frac{0.98}{1 + \exp(x^{1.2} - 6^{1.2})}$ $P_{bus} = 0.925(1 - P_{walk})$ $P_{car} = 0.075(1 - P_{walk})$

Note:  $P_{car}$  : Car share

$P_{bus}$  : Bus share

$P_{walk}$  : Walk share

$x$  : Travel distance

(3) Business (Home Based)

The car shares for business (home based) were estimated as 62.5% for vehicle owner and 1.2% for non-vehicle owner, respectively. The walk – bus split model was adopted for walk and bus modes.

(4) Business (Non Home Based)

According to the analysis of the household interview survey, walk characteristics indicated that the walk mode is not chosen if the travel distance is more than 7km. Considering the fact, the walk modal share was estimated with the following equation:

$$P_{walk} = 0.21 - 0.03x(x < 7)$$

$$0(x > 7)$$

where,  $P_{walk}$  : Walk share  
 $x$  : Travel distance

To estimate the car share, the following equation was adopted:

$$P_{car} = \frac{1}{1 + \exp\{1.1 \cdot (G - F) + 0.046 \cdot (T_{car} - T_{bus})\}}$$

where,  $P_{car}$  : Car share  
 $G$  : Fuel cost by car  
 $F$  : Travel cost by bus  
 $T_{car}$  : Travel time by car  
 $T_{bus}$  : Travel time by bus

In the equation, the fuel cost by car and the travel cost by bus were assumed as follows:

$$G = 0.1x$$

$$F = 1 + 0.01x$$

where,  $x$  : Travel distance

(5) Private (Home Based and None Home Based)

The car shares by vehicle ownership were adopted with the following percentages.

**Table 2.4.4 Car Shares for Private**

Vehicle Ownership	Car Share
Owner	$P_{car} = 33.3\%(x < 1.5)$
	$P_{car} = 59.7\%(x > 1.5)$
Non- Owner	$P_{car} = 3.0\%$

Note:  $P_{car}$  : Car share  
 $x$  : Travel distance

The walk – bus split model was adopted for walk and bus modes.

(6) Home

As for home of trip purpose, the OD trips were calculated by replacing origin and destination of work, school, business (home-based) and private (home-based).



## 2.5 Adjustment Factor

The OD matrices by transport mode in 2007 were estimated through trip generation/attraction, trip distribution and modal split. It is necessary to adjust between estimated and observed passenger volume across the screen line. The adjustment factors were estimated as 1.2465 for bus and 1.1024 for car. Those factors were multiplied to the OD matrices.

## 2.6 Other Traffic

### 2.6.1 External Traffic

The external traffic was classified into “internal – external” and “external - external” traffic. Based on the present traffic obtained from the cordon line survey, future external traffic was estimated by multiplying the growth factors against 2007 by vehicle type as shown in Table 2.6.1. The growth factors were assumed as the growth rates of population, GDP per capita and GDP in the study area or national level as shown in Table 2.6.2.

**Table 2.6.1 Growth Factors for External Traffic**

Type	Year	Bus & Car	Truck
Internal ⇔ External	2015	1.22	1.40
	2020	1.40	1.76
	2030	1.99	2.80
External ⇔ External	2015	1.26	1.29
	2020	1.45	1.51
	2030	1.92	2.06

**Table 2.6.2 Assumptions of the Growth Factors for External Traffic**

Type	Bus & Car	Truck
Internal ⇔ External	Growth rate of population in the study area	Growth rate of GDP per capita in the study area
External ⇔ External	Growth rate of population in Zambia	Average growth rate of GDP in Zambia between 1994 and 2005

Note 1: The growth rates of population and GDP per capita were estimated in this Study.

Note 2: The growth rate of population in Zambia was obtained from “Zambia 2000 Population and Housing, Population Projections Report, CSO (Nov., 2003)”.

Note 3: The average growth rate of GDP in Zambia between 1994 and 2005 was obtained from “National Account Statistical Bulletin No.9 1994-2005, Central Statistics Office” and estimated as 3.2% per annum.

### 2.6.2 Truck Traffic Generated/Attracted by New Industrial Development

Considering the new industrial development, truck traffic newly generated from and attracted to the planned industrial areas was estimated. As shown in Table 2.6.3, the new industrial development areas were identified by each traffic analysis zone. According to the analysis of the freight interview survey, the handling volume per square meter of the exiting manufacturing companies was calculated at 0.038 ton per day. Using the average load (9.3 ton/vehicle) of a rigid truck obtained from the cordon line survey, truck volumes were calculated as shown in Table 2.6.4. It was assumed that the OD patterns are the same as those of trucks obtained from the cordon line survey.

**Table 2.6.3 New Industrial Development Area**

Unit: ha

Traffic Analysis Zone No.	2015	2020	2030
18	0	75	147
37	0	140	289
38	0	200	448
67	0	80	160
228	30	240	400
240	0	25	83
242	0	25	58
244	150	213	355
Total	180	998	1,940

**Table 2.6.4 Freight Handling Volumes and Truck Volumes at New Industrial Development Areas**

Traffic Analysis Zone No.	Ton/day			Vehicles/day		
	2015	2020	2030	2015	2020	2030
18	0	14,244	27,845	0	3,063	5,988
37	0	26,588	54,797	0	5,718	11,784
38	0	37,983	85,018	0	8,168	18,283
67	0	15,193	30,386	0	3,267	6,535
288	5,698	45,579	75,966	1,225	9,802	16,337
240	0	4,748	15,758	0	1,021	3,389
242	0	4,748	10,930	0	1,021	2,350
244	28,487	40,357	67,419	6,126	8,679	14,499
Total	34,185	189,439	368,118	7,352	40,739	79,165

## 2.7 Traffic Assignment

The final step in the conventional four step method is to assign the trips between origin and destination pairs to road network.

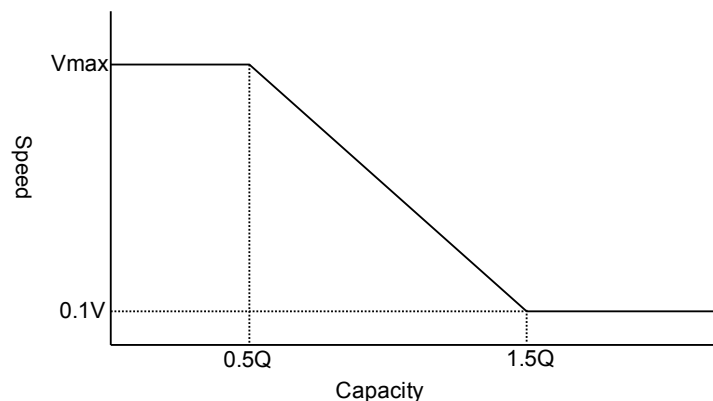
### 2.7.1 Road Network

Prior to the traffic assignment, the road network was developed based on GIS data prepared by a local consultant and the simple road inventory survey by the JICA Study Team. The total number of links was about 1,500. The road network composes of link length, free-flow speed and road capacity. Considering urban traffic situation in the study area, the free-flow speed and the road capacity were determined as shown in Table 2.7.1.

**Table 2.7.1 Link Information**

No. of Lane	Surface	Area	Capacity (pcu/day)	Free-flow speed (km/h)
1	Unpaved	Urban & Suburban	5,000	15
2	Unpaved	Urban & Suburban	10,000	20
2	Paved	Urban	15,000	30
2	Paved	Suburban	18,000	40
4	Paved	Urban	39,000	40
		Suburban	56,000	50
6	Paved	Urban	58,000	45
		Suburban	83,000	60

As for the speed/capacity restraint function for the traffic assignment, the following QV formula was applied:



**Figure 2.7.1 Applied QV Formula**

### 2.7.2 Passenger Car Unit (PCU)

It is necessary for the traffic assignment to convert from person trip to vehicle trip. The Passenger Car Unit (PCU) and average occupancy applied in the traffic assignment are shown in Table 2.7.2.

**Table 2.7.2 PCU and Average Occupancy**

Mode	PCU	Average Occupancy
Car	1.0	1.3
Bus	1.2	10.0

### 2.7.3 Method of Traffic Assignment

JICA STRADA (System for Traffic Demand Analysis) was utilized to carry out the traffic assignment. Incremental assignment and transit assignment were applied to confirm the validity between simulated and observed traffic volumes in 2007. Since the traffic assignments were separately applied, the result of the transit assignment for bus was used as pre-load volume for the incremental assignment. As for traffic assignment in 2015, 2020 and 2030, the incremental assignment was applied for all vehicle types under the assumption that buses will be freely operated. In addition, internal truck volumes in the study area were allocated on each link, considering the vehicle composition obtained from the results of the traffic count survey.

## 2.8 Results of Demand Forecast

### 2.8.1 Trip Generation and Attraction

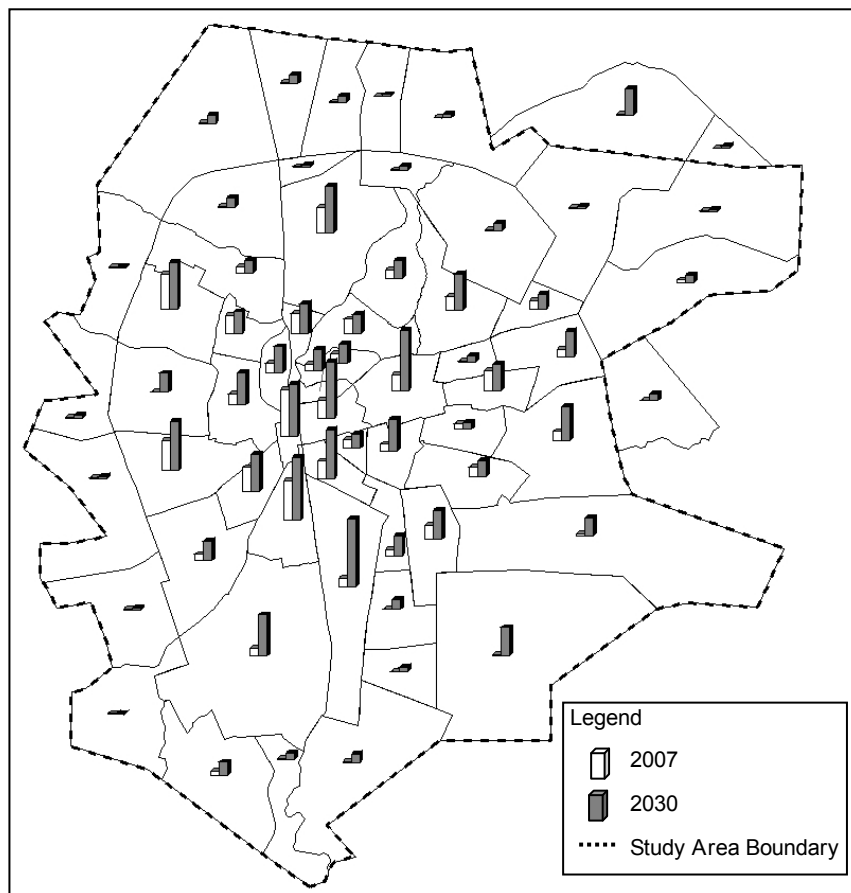
The future traffic demand was estimated based on the future socio-economic framework. The future trip generations for all purposes are shown in Table 2.8.1. Figure 2.7.2 illustrates the future trip generation by zone and the trip distribution for all purposes in 2030. The total trip generation is about 5.2 million trips in the study area in 2030. It is expected that future trip generation will increase in new commercial, business and residential area.

**Table 2.8.1 Trip Generation by District in Study Area**

Unit: trips/day

Name of District	2007	2015	2020	2030
Lusaka	2,023,191	2,439,875	2,892,975	4,466,547
Chongwe	33,789	56,958	100,261	264,406
Chibombo	19,280	32,737	53,925	147,345
Kafue	48,082	63,044	107,345	321,943
Total	2,124,342	2,592,614	3,154,506	5,200,241

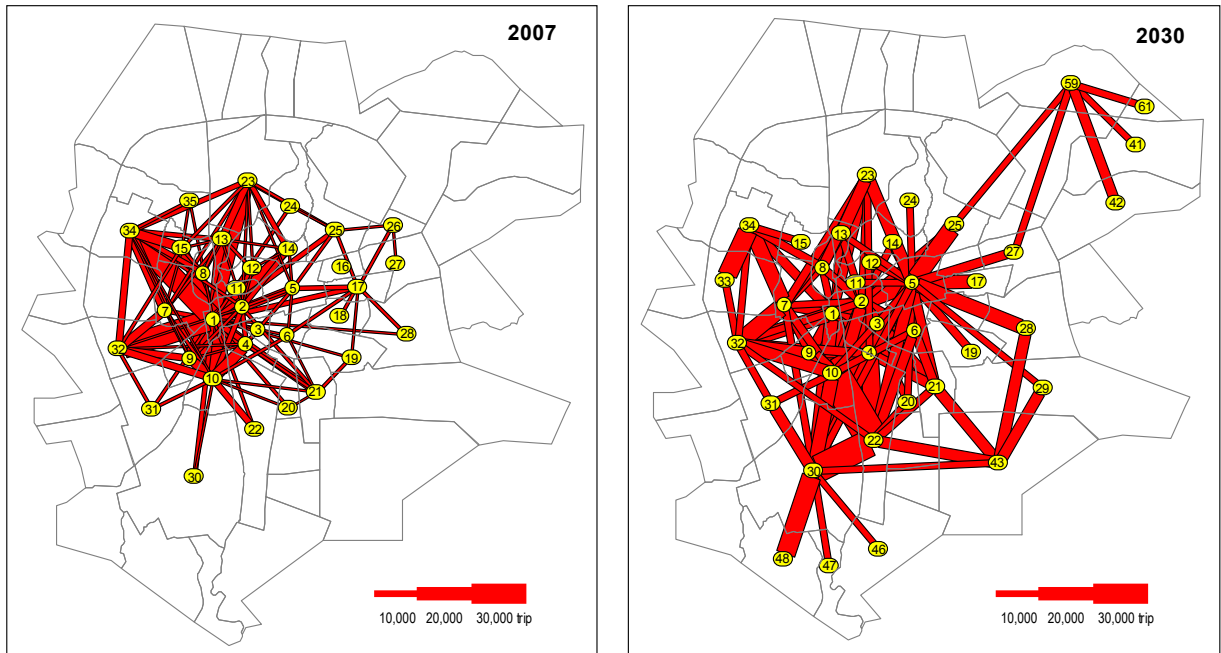
Source: JICA Study Team



**Figure 2.7.2 Trip Generation**

### 2.8.2 Trip Distribution

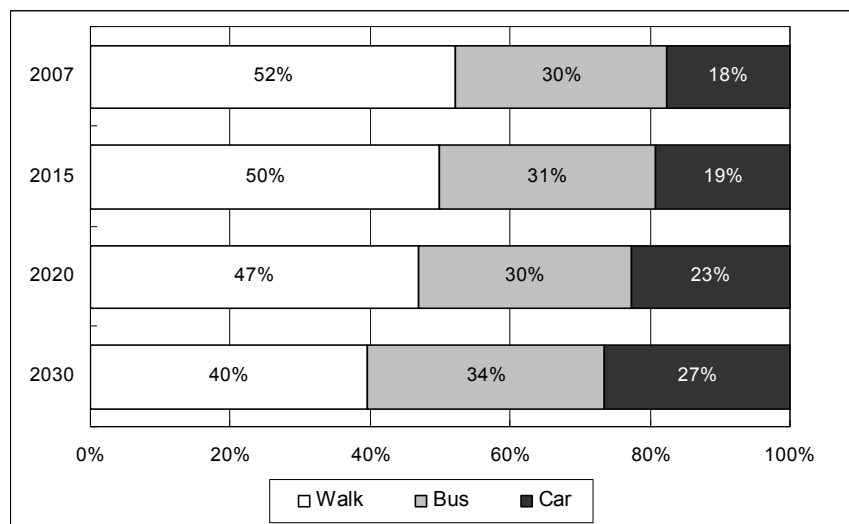
Figure 2.7.3 illustrates the trip distributions for all purpose in 2007 and 2030. The major trip flows are limited in Lusaka City in 2007, while those cover Lusaka City and link among new development areas in 2030.



**Figure 2.7.3 Major Trip Distribution in 2007 and 2030**

### 2.8.3 Modal Share

Future modal share by mode was estimated considering the future income level and vehicle ownership. The future modal share of car will increase to 26% in 2030, when the ratio for the vehicle-owning households increases in accordance with the growth rate of future GDP per capita in the study area. On the other hand, bus will be 34% when the present bus routes are improved in 2030.



**Figure 2.7.4 Modal Share**