29.4 CAR PARKING STUDY IN THE CBD

29.4.1 Introduction

Nairobi is not only the capital city of Kenya but also a major business/commercial center in the Eastern African Region. However, the functions of Nairobi Metropolitan Area as a central business district (CBD) are undermined by the inefficient use of road space, such as illegal on-street parking, the lack of convenient public transport system and the cheap parking fees levied in the CBD.

Based on the previous study and car parking surveys conducted, parking countermeasures that could effectively cope with the future parking demand are proposed.

The study procedure of car parking is illustrated in Figure 29.4-1.

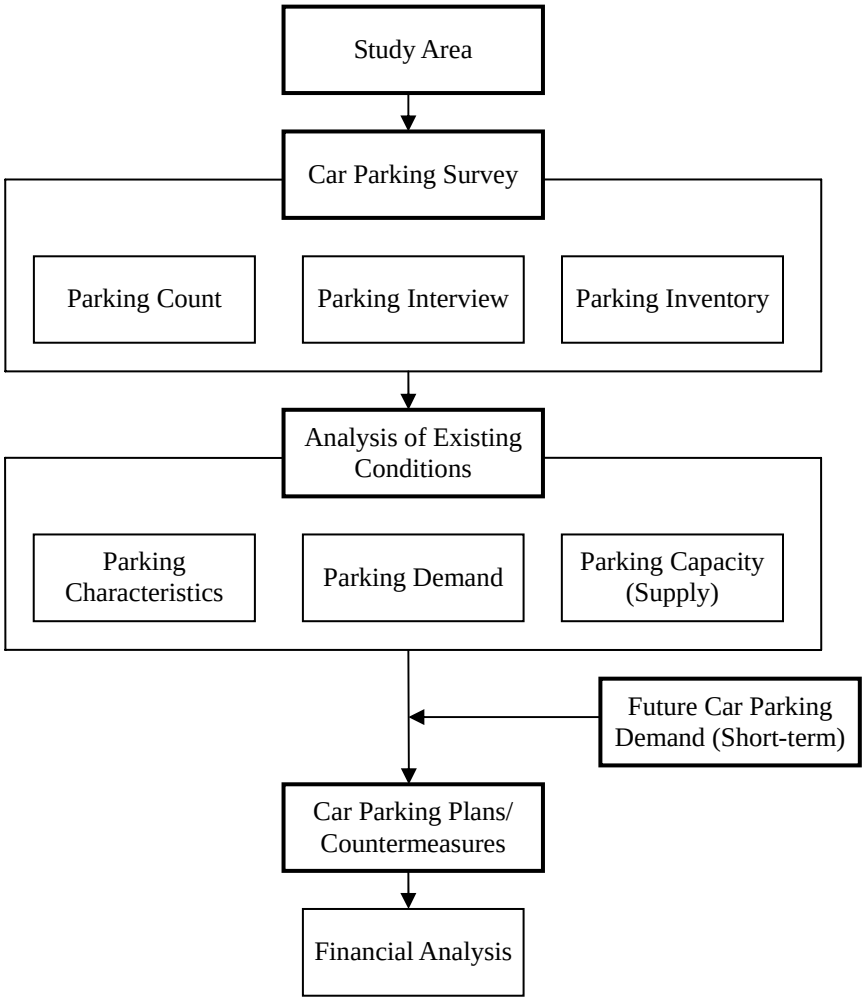


FIGURE 29.4-1 STUDY PROCEDURE

29.4.2 Car Parking Survey

Three car parking surveys namely; car parking count, car parking interview and car parking inventory were conducted. Figure 29.4-2 shows the survey locations and the summary of the survey results discussed afterwards.

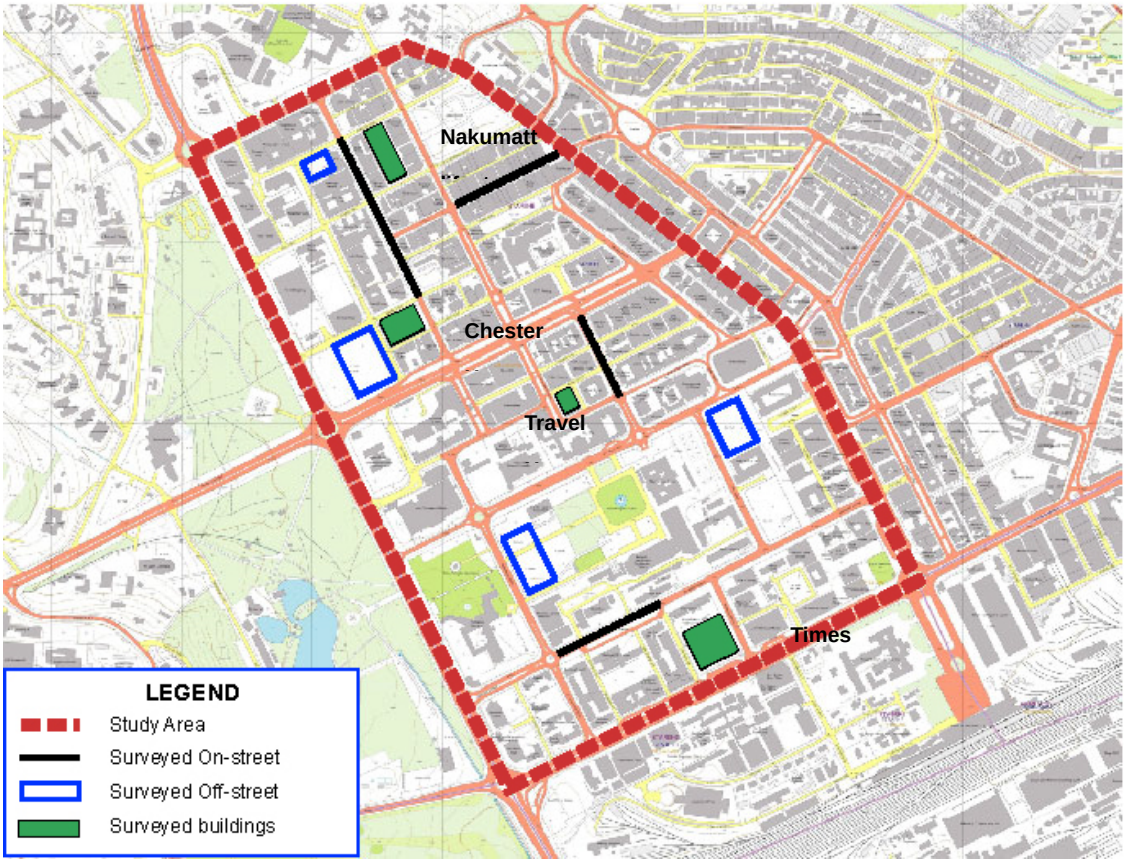


FIGURE 29.4-2 STUDY AREA AND CAR PARKING SURVEY LOCATION

(1) Parking Count Survey

In order to collect the data on demand and supply and parking duration by type of car parking, car parking count surveys were conducted in selected 12 car parks including on-street, off-street and car parking in the buildings.

The output of the survey is as follows:

1) <u>In and out traffic volume by time and maximum occupancy of the car park</u>
In and out traffic volume determined by time and maximum occupancy in relation to the three surveyed car park locations by type is shown in Figure 29.4-3 (1) to (3). The double and/or triple parking of on-street parking along the street is obvious because the maximum occupancy is much higher than the number of slots at all of the surveyed parking locations. On the other hand, the demand (maximum occupancy) of most of off-street parking and parking in the buildings is lower than the supply (number of slots available).

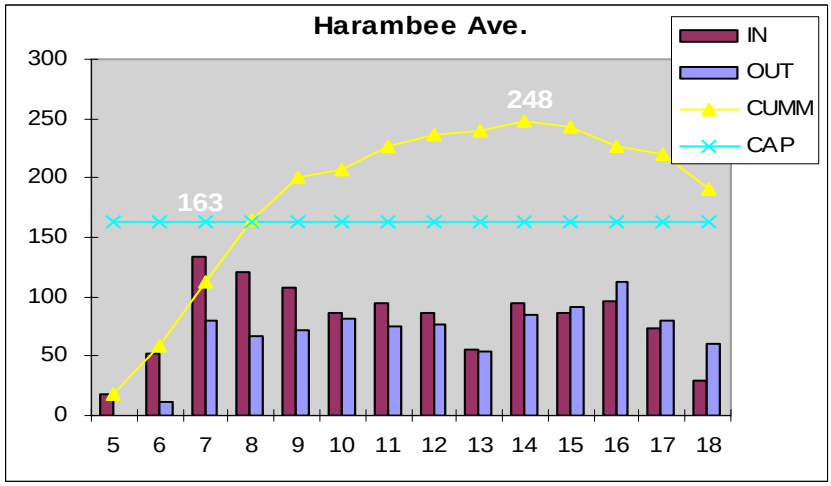


FIGURE 29.4-3 (1) CAR PARKING DEMAND AND SUPPLY AT HARAMBEE AVENUE (ON-STREET PARKING)

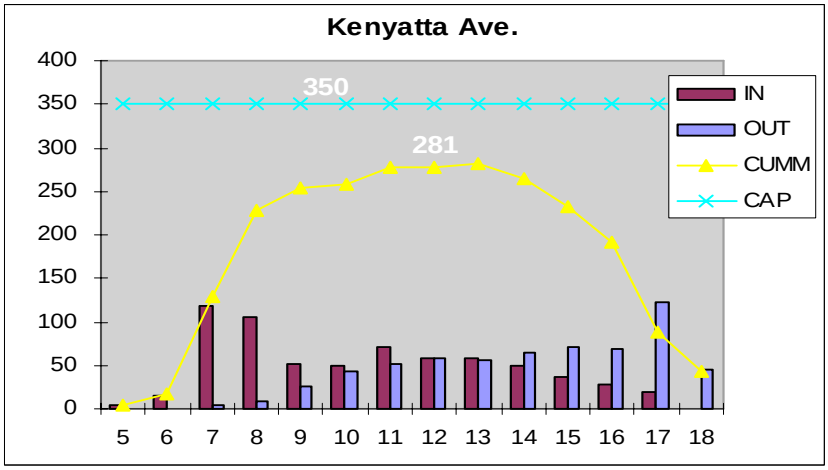


FIGURE 29.4-3 (2) CAR PARKING DEMAND AND SUPPLY AT KENYATTA AVENUE-NORTH (OFF-STREET PARKING)

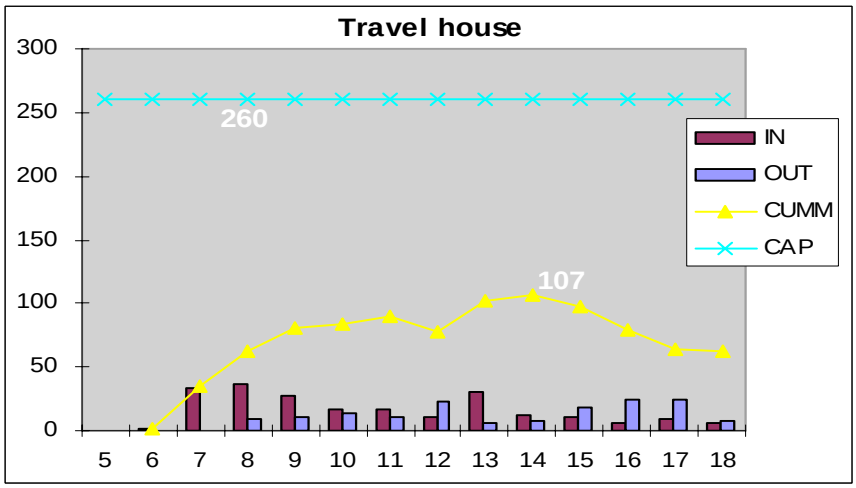


FIGURE 29.4-3 (3) CAR PARKING DEMAND AND SUPPLY AT TRAVEL HOUSE (CAR PARKING IN THE BUILDING)

(2) Average Parking Time

Plate number matching was carried out to determine the average parking time by parking type as shown in Table 29.4-1.

The average parking time of the total cars recorded is approximately 3 hours. The average parking time of on-street parking is 1 hour and 40 minutes, which is relatively shorter than the other types of parking. On the other hand, the average parking time of off-street parking and parking in the buildings is more than 4 hours.

TABLE 29.4-1 AVERAGE PARKING TIME BY PARKING TYPE

	On-street	Off-street	Building	Total Average
Average Parking Time (min.)	100.0	246.7	245.1	178.7

(3) Parking Interview Survey

Approximately 2,000 samples were collected from 12 parking locations. The survey results are summarized below.

1) Parking user's age, occupation and trip purpose
On average, 75% of parking users range from 30 to 50 years old and 83% of them are working (Figure 29.4-4).

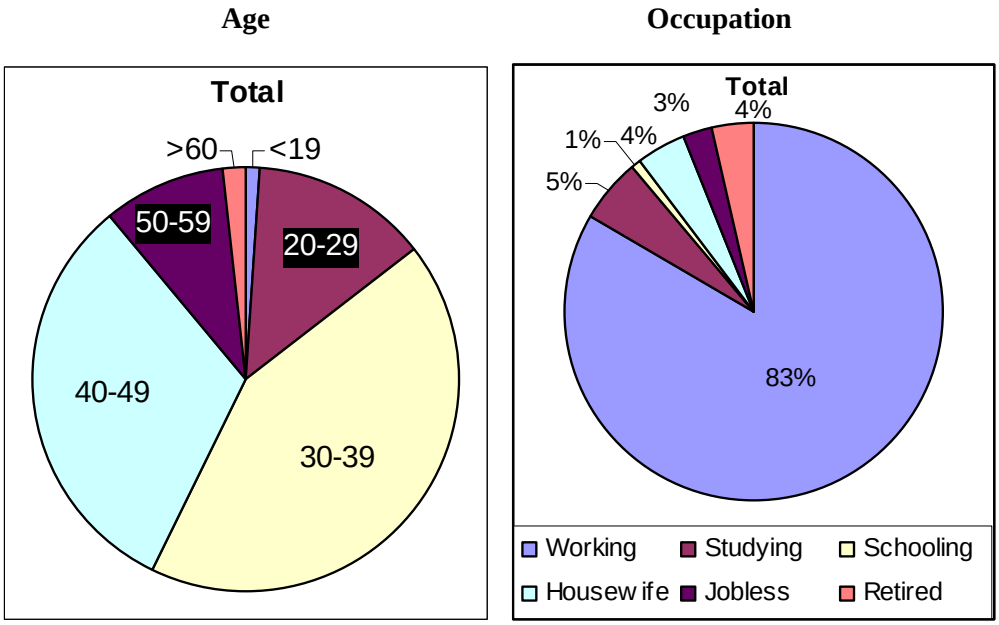


FIGURE 29.4-4 AGE AND OCCUPATION

2) Parking user's trip purpose by type of car parking

The trip purpose of 46% of parking users is to go to work with building parking having the lowest percentage (41%) among the three types of parking. Business is the second highest with an average of 29%. Building parking has the highest percentage (32%) of users whose trip purpose is to go for business as compared to on-street and off-street parking (Figure 24.4-5).

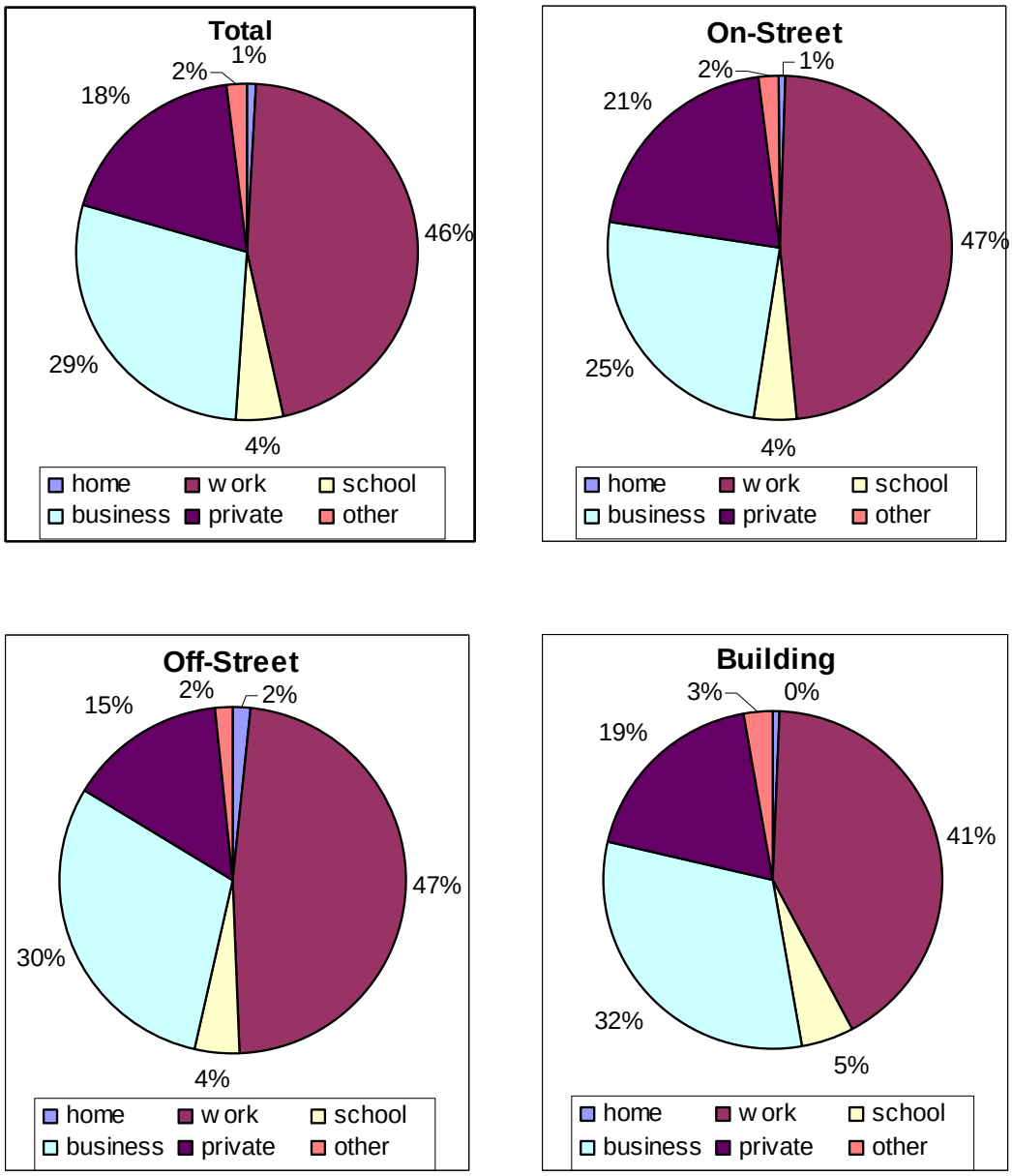


FIGURE 29.4-5 TRIP PURPOSE BY TYPE OF CAR PARKING

3) Walking time from parking lot to user's destination

The walking time for off-street parking is the longest with an average time of 5.8 minutes, while the walking time for on-street parking and building is 4.8 minutes and 4.7 minutes respectively. The average walking time for all types of parking is 5.1 minutes (Figure 29.4-6).

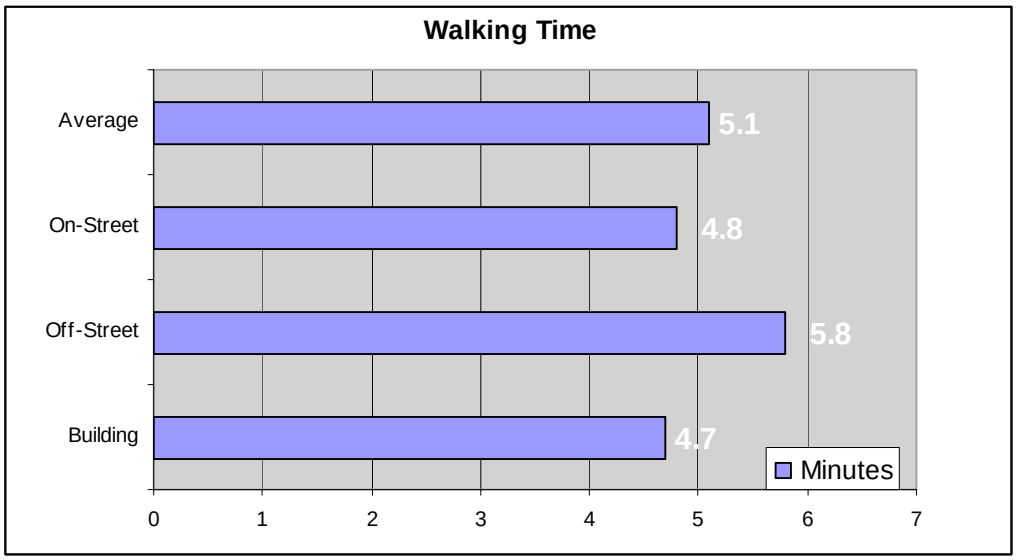


FIGURE 29.4-6 WALKING TIME BY TYPE OF CAR PARKING

4) Reason of selection of the parking location

From the surveyed samples, the two major reasons for parking at the selected locations are proximity to their destination (47% on average) and simply that, "they always park there (31%)" (Figure 29.4-7).

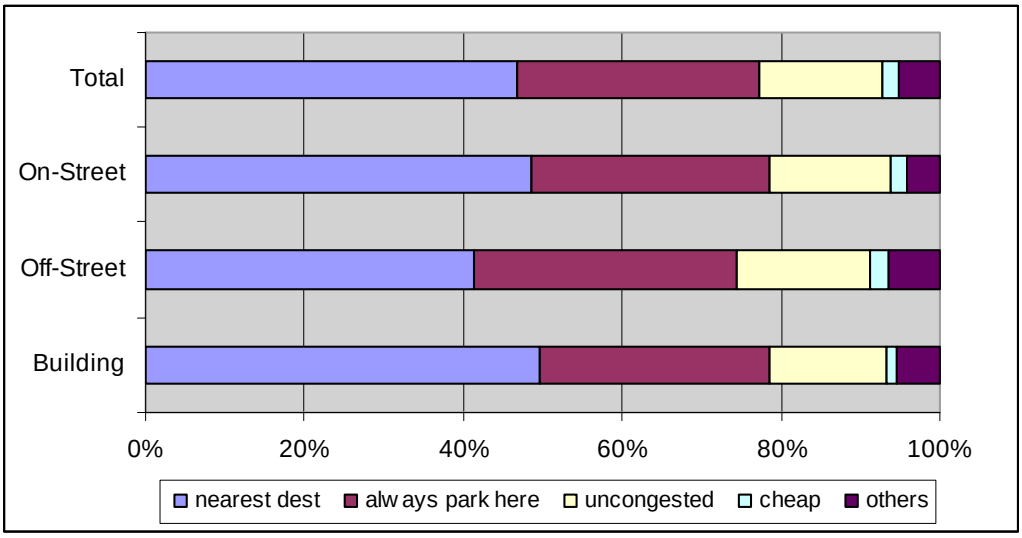


FIGURE 29.4-7 PARKING REASON

5) Increase of parking fees

From the parking interviews, it was found that more than 50% of private car users would change from their mode of transport if on-street parking fees were increased from the current Kshs. 70 to Kshs. 175 (Figure 29.4-8).

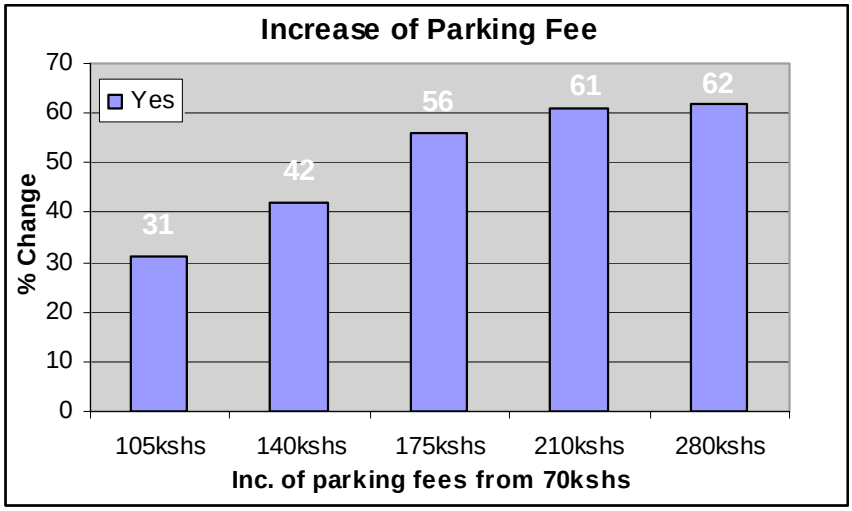


FIGURE 29.4-8 INCREASE OF PARKING FEE

6) Countermeasures to decrease traffic jam

The parking interview survey results revealed that the most effective way to reduce traffic jams is by improving public transport (50%) while car sharing also ranks high among other countermeasures to reduce the same problem (Figure 29.4-9).

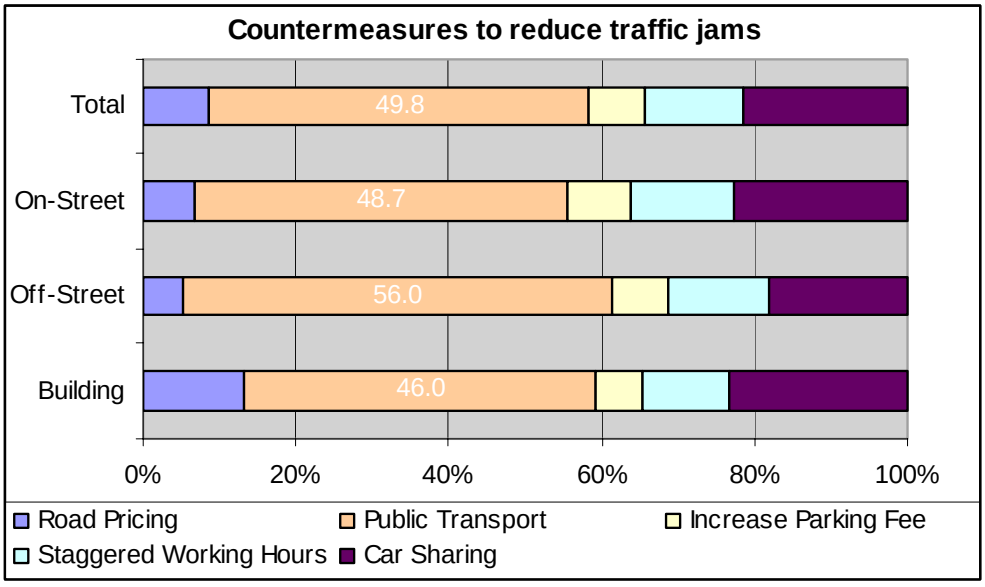


FIGURE 29.4-9 COUNTERMEASURES TO DECREASE OF TRAFFIC JAM

(4) Parking Inventory Survey

To obtain data on parking capacity in the CBD by parking type (on-street, off-street and buildings), a parking inventory survey was conducted based on the 11 zones into which the study area has been subdivided, considering the road network and building use in the CBD (Figure 29.4-10). Major findings of the survey results are as follows.

1) The total car parking space in the CBD is 14,864, of which 3,941 are on-street parking (26.5% of the total), 3,834 are off-street parking (25.8%) and 7,089 are building parking (47.7%) (Table 29.4-2).
2) The zone which has the highest car parking space is zone 5 with 2,756 slots (Table 29.4-2).
3) The total area in the CBD is approximately 106 ha. Based on the total number of car parking slots and the area in CBD, the number of parking slots per $100m^2$ is 1.4 (Table 29.4-2).
4) The highest and lowest parking density can be seen in zone 9 (3.1) and zone 7 (0.6) respectively (Table 29.4-2).
5) The average fee for off-street and building car parking is Kshs.3,880 per month.

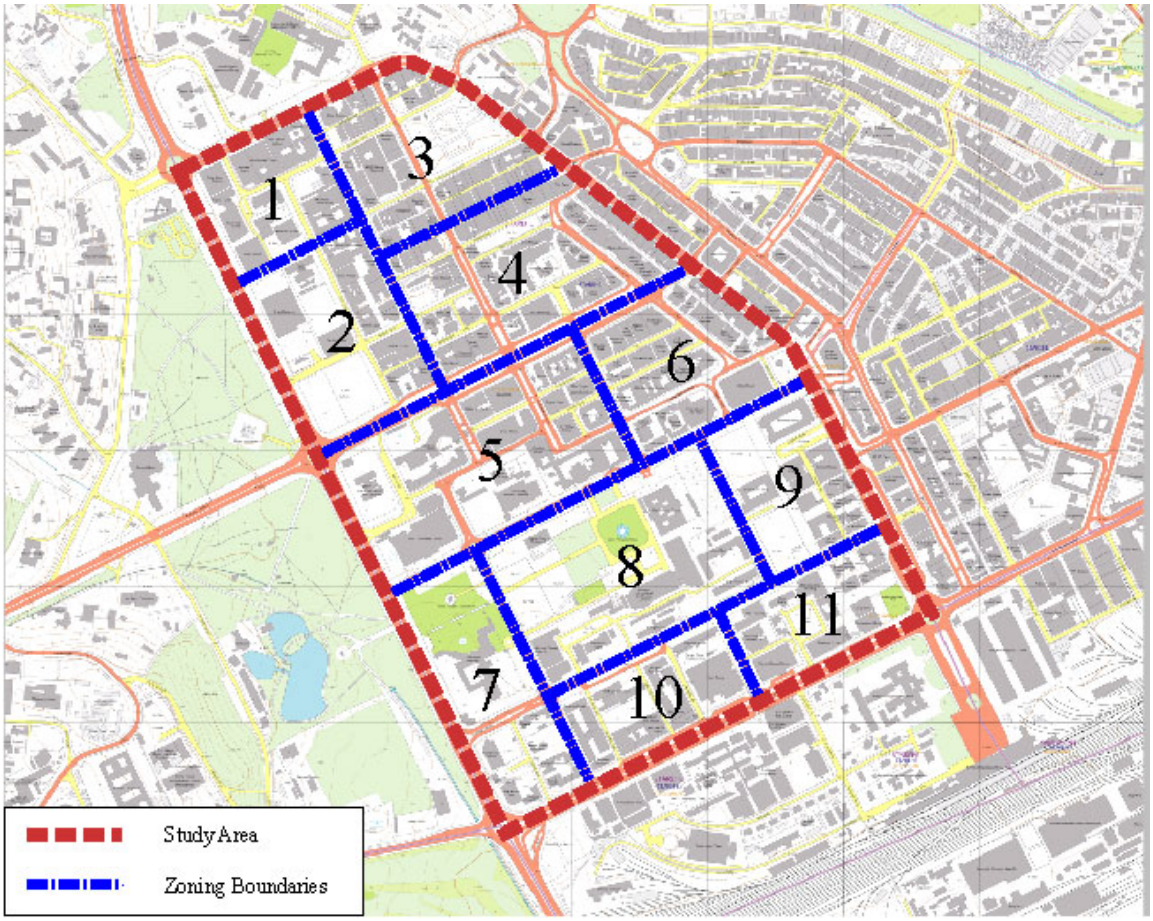


FIGURE 29.4-10 LOCATION OF PARKING ZONES

TABLE 29.4-2 PARKING CAPACITY BY ZONE

	On-street	Off-street	Building	Capacity		Area (ha)	Car parking slots/100m^2
1	173	75	1,316	1,564		6.23	2.5
2	54	914	285	1,253		9.51	1.3
3	483	147	584	1,214		9.43	1.3
4	1,036	88	289	1,413		12.41	1.1
5	416	195	2,145	2,756		15.01	1.8
6	391	62	520	973		8.86	1.1
7	25	206	338	569		9.41	0.6
8	137	949	293	1,379		14.33	1.0
9	615	650	916	2,181		7.11	3.1
10	354	427	154	935		6.65	1.4
11	257	121	249	627		6.72	0.9
Total	3,941	3,834	7,089	14,864		105.67	1.4

TABLE 29.4-3 TYPE OF OPERATION OF CAR PARK

Operation	Type of parking			Total (slots)	Percentage
	On-street (slots)	Off-street (slots)	Building (slots)		
CCN	3,892	1,135	207	5,234	35.2
Private	49	2,169	6,168	9,630	64.8
Total	3,941	3,834	7,089	14,864	100.0
Percentage	26.5	25.8	47.7	100.0	

29.4.3 Analysis of Existing Conditions

(1) Parking Characteristics

1) Normally, on-street parking is popularly used by the short-time car parking users such as businessmen and shoppers. However, these users in Nairobi's CBD are forced to double and triple park on streets because many of on-street car parking slots are occupied by commuter cars.

2) Many car user commuters prefer to park on-street because of the cheap parking fee (Ksh 70 /day) as compared with off-street and building car parking (Ksh 3,880 /month).

3) Sixty-five percent (65%) of the total car parking facilities are operated privately. Therefore, it is necessary to coordinate with the private sector for the development of the countermeasures of car parking policies and facilities (Table 29.4-3).

(2) Supply and Demand

Supply and demand of car parking in the CBD is analyzed based on the results of car parking inventory survey and car parking traffic count survey.

The total parking demand in the CBD is approximately 12,700 as shown in Table 29.4-7. Of these, 5,500 cars are on-street and 7,200 cars are both demand from off-street and building parking. The utilization of on-street and off-street is 140% and 95% respectively. This shows that the demand for on-street parking extremely exceeds the supply. On the other hand, the utilization of building parking is extremely low (50%) (Table 29.4-4).

TABLE 29.4-4 EXISTING CONDITIONS OF CAPACITY AND USAGE IN SURVEYED CAR PARKING LOCATIONS

Type	Parking Name	Capacity (slots)	Demand (usage)	Utilization
On-street	Koinange	125	157	139.2%
	Biashara	68	70	
	Harambee	163	248	
	Wabera	83	136	
	Total	439	611	
Off-street	Loita	60	68	94.6%
	KICC	450	346	
	RE-Insurance	270	374	
	Kenyatta	350	281	
	Total	1,130	1,069	
Building	Chester	133	59	49.1%
	Nakumatt	480	178	
	Travel House	260	107	
	Times Tower	121	144	
	Total	994	488	

TABLE 29.4-5 CAR PARKING SUPPLY AND DEMAND IN CBD IN 2005

	Total	On-street	Off-street	Building
Capacity	14,864	3,941	3,834	7,089
% Share	100.0%	26.5%	25.8%	47.7%
Demand D=(Cap*Percentage)	Percentage	140%	95%	50%
	12,704	5,517.4	3,642.3	3544.5
	13,255	3,941	3,642.3	5,671.2

29.4.4 Future Car Parking Demand (Short-term in Year 2010)

Based on the Person Trip Survey Data, the estimated generated/attracted car traffic from / to the CBD by year 2004 and 2010 is shown in Table 29.4-6.

TABLE 29.4-6 GENERATED AND ATTRACTED TRAFFIC BY YEAR

Year	2004	2010
Cars	231,948	236,583
Increase Rate	-	1.02

From the survey results and the above data, and assuming that the increased rate of generated/attracted traffic and car parking demand is the same, the future parking demand is shown as follows.

TABLE 29.4-7 FUTURE PARKING DEMAND

Item	2004	2010
Parking Demand (lot)	12,700	13,000

29.4.5 Car Parking Plans/Countermeasures

(1) Maximum Use of Car Parking Space in CBD

Theoretically, the total car parking demand in the CBD is within the available supply even though some imbalance by type of car park exists, i.e. over demand for on-street and low usage for building parking.

On the other hand, the proposed maximum usage of car parks by type is shown in Table 29.4-8. The maximum usage of building car park is approximately 80% considering that it takes time to look for a vacant parking slot within building car parks. The current usage of off-street car park of 95% seems efficient. The double and/or triple on-street parking should be strictly prohibited to maintain the smooth traffic flow in the CBD. The maximum use of on-street parking shall be 100%. Based on this, the car park capacity in the CBD under maximum use is 13,260 slots. This can accommodate the short-term car park demand. More concrete measures however are necessary to shift the car parking practice from on-street to building.

TABLE 29.4-8 POSSIBLE MAXIMUM USE OF CAR PARKING SPACE BY TYPE IN THE CBD

	Total	On-street	Off-street	Building
Capacity	14,864	3,941	3,834	7,089
Demand (Year 2010)	13,000			
Possible usage		100%	95%	80%
	13,255	3,941	3,642	5,671

(2) Increase of On-Street Car Parking Fee

The increase of on-street car parking fee is one of the effective measures to make car users shift from on-street parking to building car parking.

Currently, the average monthly parking expenses of a commuter who parks on-street is Ksh 1,575 (=Ksh 70×22.5 working days/month); on the other hand, the average monthly parking fee in the building car park is Ksh 3,880 based on the parking inventory survey data. This shows that the monthly parking fee of building car parking users is 150% higher than on-street parking users. Furthermore, the cheap flat rate parking fee of Ksh 70 is generating more on-street parking users. As a consequence, there is a need to immediately implement an on-street parking fee hike and possibly consider a fee of Ksh 175, which is the equivalent of the daily car parking fee of building car park. This idea is rooted from the users' response that if the parking fee is increased more than 150% (Ksh 175), they would consider options such as change of mode from private car to other modes or look for an alternative parking locations other than on-street car park.

(3) Car Park Sharing Scheme

To increase the utilization of building car parks and to reduce the illegal on-street car parking, it is deemed effective to adopt the car park sharing scheme which allows the use of building car parks within designated zones (within walking distance; approximately 200m based on interview surveys). In this scheme, the car park user is allowed to park in any building within a particular zone and the management of the buildings share the income generated from parking fees.

(4) Flexible Usage of Car Parking Spaces of Large-scale Developments such as a Supermarket

Utilization of Nakumatt Lifestyle car park during weekdays is relatively low (a maximum occupancy of only 178 cars against a capacity of 480 slots; 37% utilization factor). Most of the users of this car parking space are shoppers and they tend to concentrate during the weekend.

One idea is to have a part of the parking space be opened to the public during weekdays (from Monday to Friday), which in essence transfers the illegal on-street parking by commuters to this space.

(5) Introduction of Parking Guide System

A suitable parking guide system could maximize the parking space utilization and could decrease the traffic congestion caused by drivers looking for vacant parking spaces in the busy CBD. The parking guide system is usually installed at the entrance of the CBD, say, at the intersection of Kenyatta Avenue and Uhuru Highway. This is an electric panel that displays information on the parking status (see photos below) – whether it is fully occupied or there is available space and shows the shortest access route to the vacant parking space.

For the short-term, existing large-scale car parks such as Nakumatt Lifestyle and KICC are the potential candidates for installation of the electric panel.

Bluewater Shopping Centre – England

Phoenix Sky Habor International Airport

Source: www.tcsint.com

(6) Improvement of Public Transport System

The most important key to solve the car parking problems such as illegal double/triple on-street parking is to prepare a safe, comfortable and convenient public transport system. Introduction of comfortable public transport modes and convenient operational system such as luxury bus and express bus, and new coaches for commuter train can stimulate the shift from private cars to public transport. The modal shift can be advanced further by the development of park-and-ride parking at terminals/large-scale bus stops or commuter train station plazas at urban fringe.

(7) Off-Street Parking Plan in CBD

1) Location of Off-street Parking

There are some vacant lands in the CBD to construct off-street parking facilities. Among these vacant lands, the following sites to construct the off-street parking are proposed:

(a) Vacant land located at west of the City Market (City Market Parking)
(b) Existing parking located at west of Electricity House (Electricity House Parking)

2) Scale of Parking

The proposed off-street parking plan in CBD which takes into accounts the magnitude of parking demands, land area, and access road to the land is shown in Table 29.4-9.

TABLE 29.4-9 PROPOSED OFF-STREET PARKING PLAN IN CBD

		Land Area (m^2)	Construction Plan	Capacity
1	City Market Parking	3,000	At-grade parking	100
2	Electricity House Parking	6,500	3-story parking	600
	Total	9,000		700

3) Cost Estimates

Based on the preliminary designs of the parking facilities and unit cost analyzed, the construction cost of both parking facilities is estimated and shown in Table 29.4-10. Construction cost for two (2) parking facilities is estimated at Ksh 150 million.

TABLE 29.4-10 COST ESTIMATES FOR PARKING FACILITIES IN CBD

No.	Description of Work	Unit	Unit Cost (Ksh)	Quantity	Cost (x1000 Ksh)
City Market Parking					
1	Road Pavement	m^2	3.74	3,000	11,220.00
2	Sidewalk Pavement	m^2	2.47	0	0.00
3	Landscaping	m^2	0.35	150	52.20
4	Road Marking	m^2	2.64	60	158.40
5	Traffic Sign	Nos	36.00	10	360.00
6	Street Light	Nos	317.25	20	6,345.00
	Sub-Total				18,135.60
	Contingency	ls			2,720.34
	Total				20,855.94
Electricity House Parking					
1	Construction of Parking Build	m^2	10.00	13,000	130,000.00
	Grand Total				**150,855.94**

4) Financial Analysis

The financial analysis of the proposed parking facilities is made and shown below;

(a) Assumptions

For financial evaluation, the following assumptions are employed in this study;

- The financial costs are estimated at mid-2005 constant prices.
- Regarding to the implementation schedule, the following implementation schedule is assumed;
  - Start of the project: 2006
  - Open to public: 2007
- The evaluation period is assumed to be 10 years of a period between 2007 and 2016.
- A parking charge system is adopted based on the present fare level, that is, Ksh 70. The increment of fare during 10 year period will not be considered in the financial analysis.
- Residual value of parking facilities is assumed to be 10 % of initial investment cost.

(b) Input Data

Based on the parking survey conducted in this study and cost estimates, the following input data are prepared for financial analysis as shown in Table 29.4-11.

TABLE 29.4-11 INPUT DATA FOR FINANCIAL ANALYSIS

	Input Data	Notes
1. Parking Capacity	700	
2. Turn-around Time	3.5	
3. Total Parking Demands	2,450	
4. Parking Fee (Ksh)	70	Present level of parking fee
5. Total Revenue (Ksh)	1,171,500	
6. Day to Year Multiplier	330	
7. Annual Revenue (Ksh '000)	56,595	
8. Growth Rate of Parking (%)	2 %	
9. Investment Cost (Ksh '000)	150,856	
10. Operating and maintenance Cost	8,700	Including land rent, operating cost, and maintenance cost

(c) Financial Analysis

The results of the financial analysis are summarized in Table 29.4-12. The FIRR for the Off-Street Parking Project is computed at 25.0 %, which implies that the project will be highly viable from the financial point of view.

TABLE 29.4-12 FINANCIAL INDICATORS OF OFF-STREET PARKING PROJECT

FIRR	24.97 %
B/C Ratio	1.39
NPV	Ksh 82.7 million

Note: 1) Evaluation period is assumed to be 10 years
2) Discount rate is assumed to be 12 % per annum

Table 29.4-13 shows the cash flow of the off-street parking construction project.

TABLE 29.4-13 CASH FLOW OF THE OFF-STREET PARKING PROJECT

Unit: Million Ksh

Year	Investment	O&M	Total Cost	Revenue	Net Cash Flow	Discount Cash Flow (at 15%)		
						Cost	Revenue	Net
	(1)	(2)	(3)=1+2	(4)	(5)=4-3	(6)	(7)	(8)=7-6
2005	0					0.0		
2006	150.9		150.9		-150.9	134.7		-134.7
2007	0	15.1	15.1	54.2	39.1	12.0	43.2	31.2
2008	0	15.1	15.1	55.3	40.2	10.7	39.3	28.6
2009	0	15.1	15.1	56.4	41.3	9.6	35.8	26.2
2010	0	15.1	15.1	57.5	42.4	8.6	32.6	24.1
2011	0	15.1	15.1	58.6	43.5	7.6	29.7	22.1
2012	0	15.1	15.1	59.8	44.7	6.8	27.1	20.2
2013	0	15.1	15.1	61.0	45.9	6.1	24.6	18.5
2014	0	15.1	15.1	62.2	47.1	5.4	22.4	17.0
2015	0	15.1	15.1	63.5	48.4	4.9	20.4	15.6
2016	0	15.1	15.1	63.5	48.4	4.3	18.2	13.9
Total	150.9	150.9	301.7	591.9	290.2	210.8	293.5	82.7

29.5 REVITALIZATION OF MOI AVENUE

29.5.1 Existing Conditions along the Corridor of Moi Avenue

(1) Historical Background of Moi Avenue

Moi Avenue originated as a Station Road in the early 20th century. This was the main road from Nairobi Railway Station to the Nairobi CBD. At that time, rail transport was the most modern transport system. Subsequently, when city planning was done in the mid 20th century, the name was changed from Station Road to Government Road and later to Moi Avenue. When it was improved, Moi Avenue was the most beautiful and prestigious street in the CBD of Nairobi. However, due to lack of proper maintenance and repair works of roads within the CBD in particular Moi Avenue has deteriorated drastically.

(2) Present Land Use along the Corridor of Moi Avenue

Figure 29.5-1 shows the land use along the corridor of Moi Avenue. It is in the western area of the CBD, where the western side of Moi Avenue is located. The land use is characterized by modern or formal business sector, while the land use in CBD Area B, where the eastern side is located, is predominantly designated for traditional or informal business.

In addition to the above mentioned land uses, public transport terminals for Matatus and Buses are located along the corridor of Tom Mboya Street. A lot of Buses and Matatus are concentrated inside the CBD Area B. Consequently, most passengers boarding and alighting from public transport system are generated and attracted within CBD Area B.

(3) Current Issues

1) Concentration of urban activities along the corridor of Moi Avenue
   Most urban activities are predominantly concentrated along the corridor of Moi Avenue. These activities generate high traffic in terms of demand of commuting to work, school, business, shopping, and amusement trips.

2) Most of Bus / Matatu terminals are concentrated along the corridor of Moi Avenue
   In addition to many urban activities, most of the Bus and Matatu routes terminate inside the CBD. Due to the large number of Bus/Matatu passengers, many informal sector's economic activities are concentrated along the corridor of Moi Avenue.

3) Constraint to Economic Development
   Moi Avenue is seriously congested due to the existence of many illegally parked vehicles and Bus / Matatu traffic. As a result, economic development has stagnated.

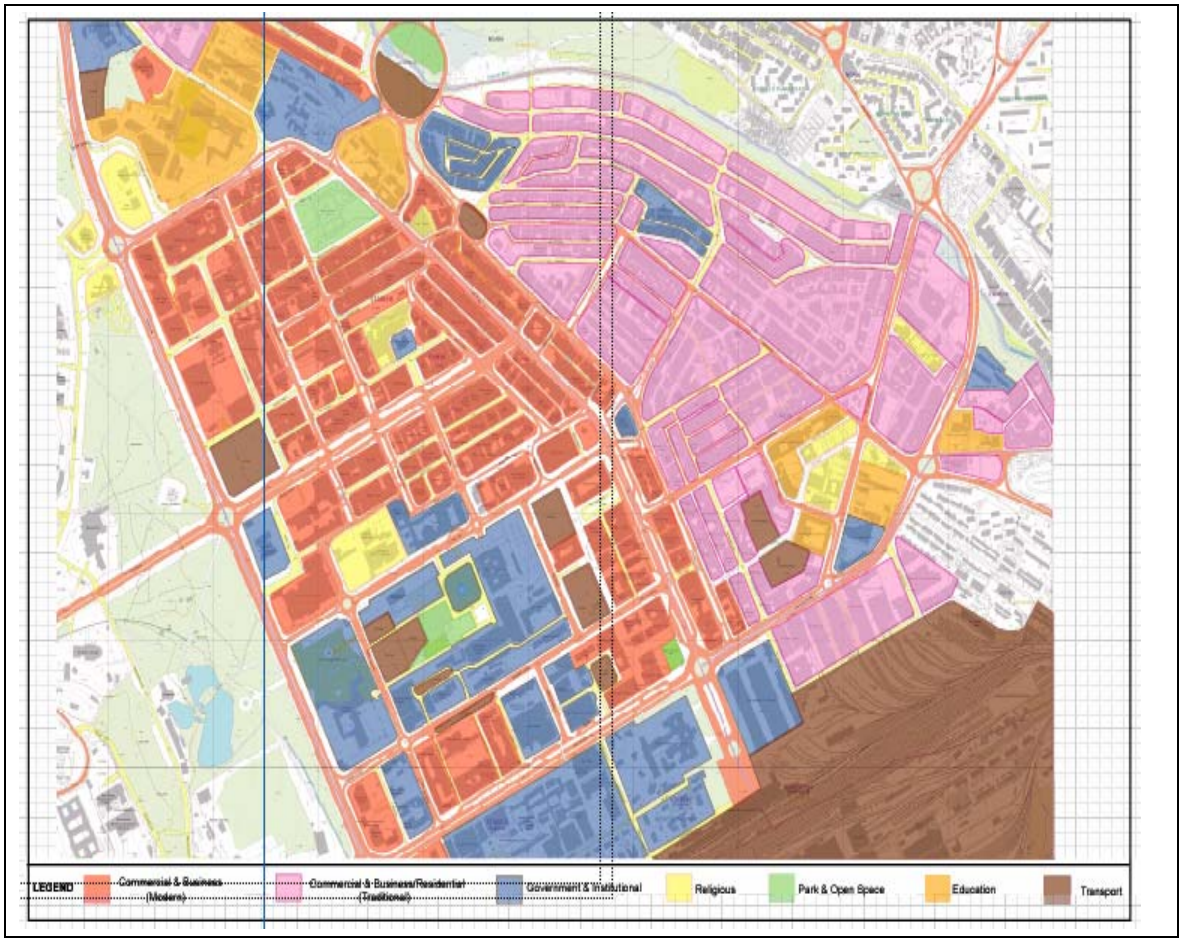


FIGURE 29.5-1 EXISTING LAND USES OF THE CORRIDOR OF MOI AVENUE

(4) Existing Road Network and its Conditions

The road network condition along the corridor of Moi Avenue seems to be developed. However, the road network configuration in relation to other arterials, collectors, and local roads is not appropriate. Traffic from the north-eastern area is forced to pass only through Slips Road, while that from / to the eastern area is forced to pass through Haile Selassie Avenue. Some connections to Tom Mboya Street exist, but connections between these roads are limited.

On Moi Avenue, the road section between Haile Selassie Avenue and City Hall Way is enough having a road width of 60 meters; however that between City Hall Way and Slip Road only ranges from 28 meters to 30 meters of width. The section between Mama Ngina Street and Kenyatta Avenue is only 28 meters of width.

29.5.2 Traffic Demand

(1) Present Traffic Condition

1) Vehicle Traffic

A traffic survey was conducted at some major sections of Moi Avenue during the weekdays of the month of August 2005. Table 29.5-1 and Figure 29.5-2 show the results of the traffic survey along Moi Avenue.

From these tables and figures, the following observations are made;

- Traffic volume along Moi Avenue ranges from 13,000 PCU/12-hour to 21,200 PCU/12-hour.
- Although there are some fluctuations of traffic volume, a little traffic variation can be noticed at the four survey stations.
- As for the vehicle composition presented in Figure 29.5-3, the share of light vehicles is predominant at all survey stations. However, the share of the heavy vehicles in the southern section is larger than that in northern section. This is due to the fact that bus routes mainly exist on the southern section of Moi Avenue.

TABLE 29.5-1 VEHICLE TRAFFIC VOLUME ON MOI AVENUE IN 2005

		Light Vehicle	Medium Vehicle	Heavy Vehicle	Motor Cycle	Total	
						Vehicles	PCU
RS16 Muranga Road -Kenyatta Ave.	Inbound	5,005	184	294	205	5,688	6,119
	OutBound	5,866	249	229	219	6,563	6,922
	Total	10,871	433	523	424	12,251	13,040
RS17 Kenyatta Ave. - City Hall Way	Inbound	6,752	531	723	245	8,251	9,479
	OutBound	6,376	260	173	231	7,040	7,314
	Total	13,128	791	896	476	15,291	16,793
RS18 City Hall Way - Ronald Ngala Street	Inbound	8,434	507	1,384	273	10,598	12,791
	OutBound	5,074	704	875	221	6,874	8,428
	Total	13,508	1,211	2,259	494	17,472	21,219
RS19 Ronald Ngala Street - Harambee Avenue	Inbound	6,238	586	790	191	7,805	9,188
	OutBound	5,776	772	765	230	7,543	8,962
	Total	12,014	1,358	1,555	421	15,348	18,149

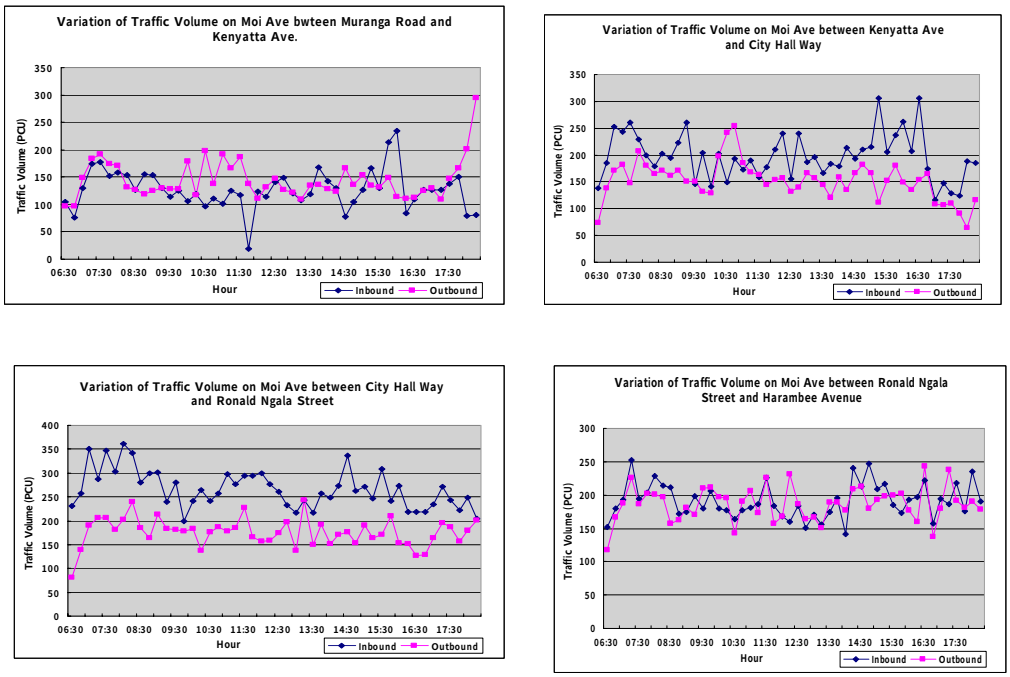


FIGURE 29.5-2 HOURLY VARIATION OF TRAFFIC VOLUME ON MOI AVENUE

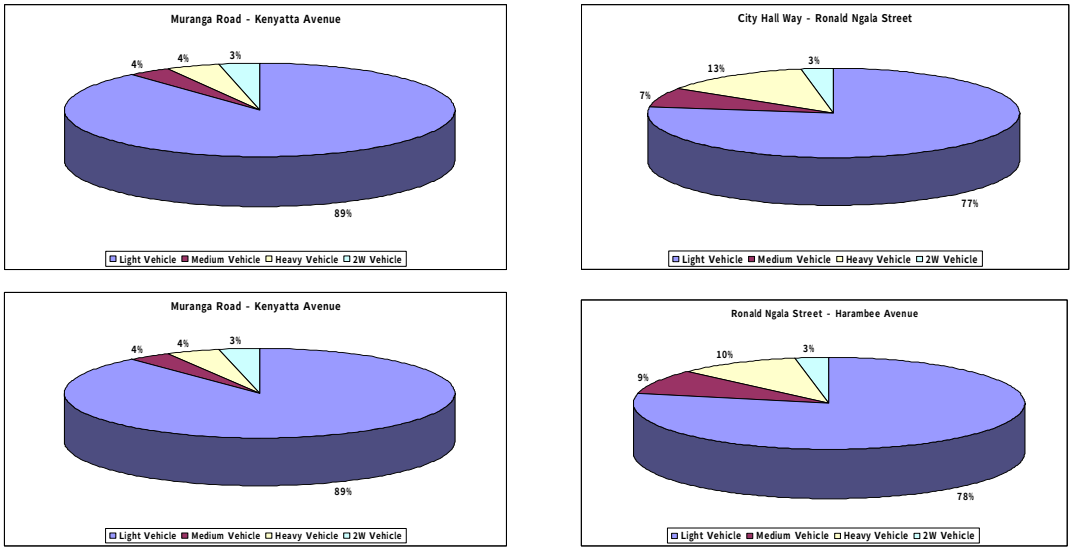


FIGURE 29.5-3 VEHICLE COMPOSITION ON MOI AVENUE

2) Pedestrian Traffic

A pedestrian traffic survey was conducted simultaneously on the same days of the traffic survey during weekdays of the month of August 2005. Table 29.5-2 and Figure 29.5-4 show the pedestrian traffic volume on Moi Avenue, together with Figure 29.5-5 of hourly variation of pedestrian traffic on Moi Avenue.

From these tables and figures, an observation is made:

- Compared with the vehicle traffic on Moi Avenue, pedestrian traffic is much larger.

TABLE 29.5-2 PEDESTRIAN TRAFFIC VOLUME ON MOI AVENUE IN 2005

Sta. No.	Section	South Bound	North Bound	Total
RS16	Muranga Road – Kenyatta Avenue	19,567	21,357	40,924
RS17	Kenyatta Avenue - City Hall Way	25,163	22,262	47,425
RS18	City Hall Way - Ronald Ngala Street	36,981	33,402	70,383
RS19	Ronald Ngala Street - Harambee Avenue	37,853	42,124	79,977
	Total	119,564	119,145	238,709

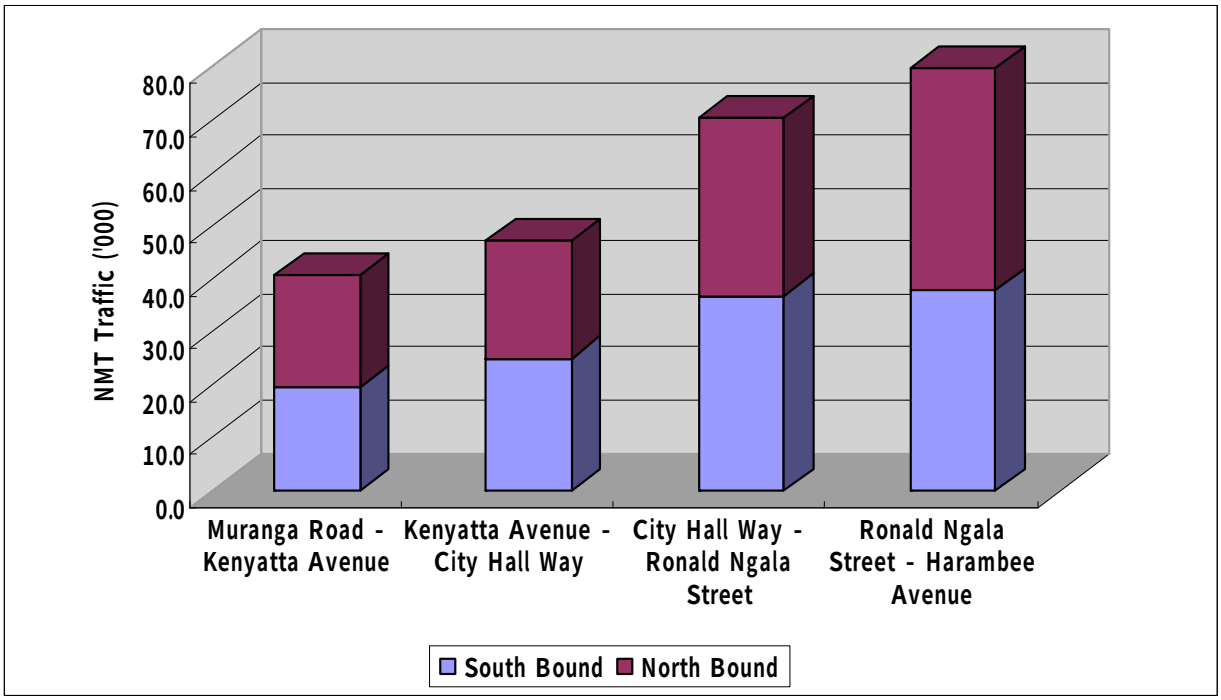


FIGURE 29.5-4 PEDESTRIAN TRAFFIC VOLUME ON MOI AVENUE

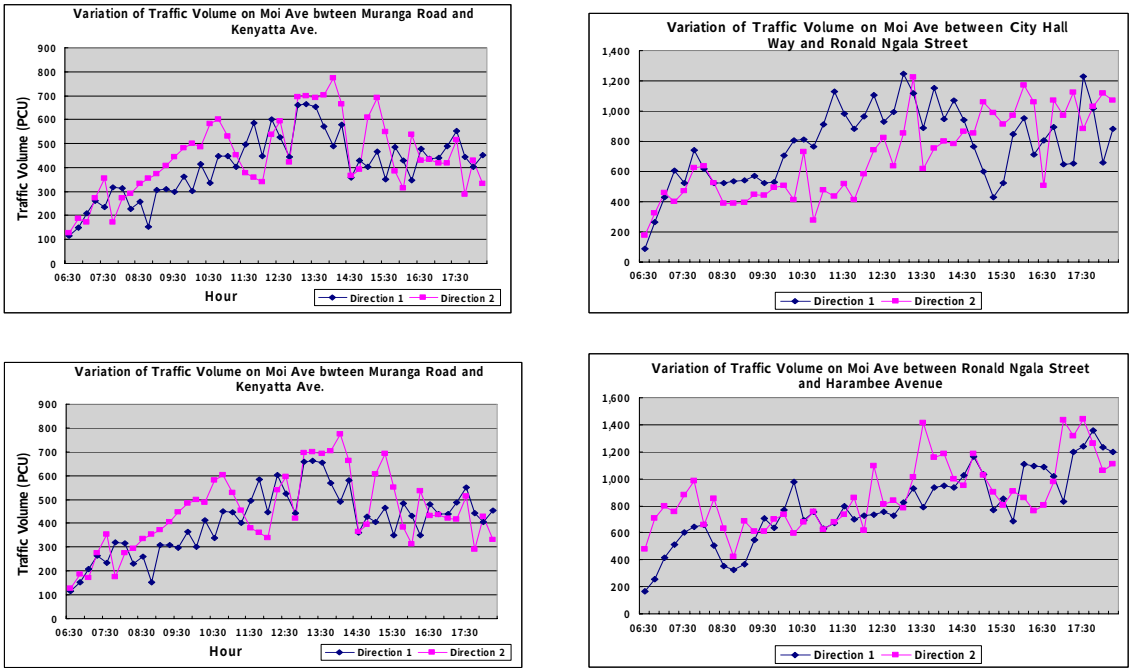


FIGURE 29.5-5 HOURLY VARIATION OF PEDESTRIAN TRAFFIC VOLUME ON MOI AVENUE

3) Analysis of Congestion and Level of Service (LOS) on Moi Avenue

Based on the traffic survey data and road condition data, the traffic congestion and LOS are analyzed for both vehicle traffic and pedestrian traffic. The results are presented in Tables 29.5-3 and 29.5-4.

TABLE 29.5-3 VEHICLE TRAFFIC CONGESTION AND LOS ANALYSIS

St. No	Road Name	Direction	Capacity / 15 Min	Peak 15 Min Traffic Volume	V/C Ratio	LOS
RS16	Muranga Road - Kenyatta Avenue	South Bound	175	234	1.34	F
		North Bound	175	295	1.68	F
RS17	Kenyatta Avenue - City Hall Way	South Bound	175	306	1.75	F
		North Bound	175	255	1.46	F
RS18	City Hall Way - Ronald Ngala Street	South Bound	350	306	0.87	E
		North Bound	350	244	0.70	D
RS19	Ronald Ngala Street - Harambee Avenue	South Bound	350	248	0.71	D
		North Bound	350	244	0.70	D

TABLE 29.5-4 NMT TRAFFIC CONGESTION AND LOS ANALYSIS

		Direction	NMT Traffic / 15 Min	Sidewalk (m)	Capacity	V/C	LOS
RS16	Muranga Road - Kenyatta Avenue	South Bound	663	5.2	1,083	0.612	D
		North Bound	774	5.8	1,208	0.641	D
RS17	Kenyatta Avenue - City Hall Way	South Bound	903	7.5	1,563	0.578	D
		North Bound	719	5.0	1,042	0.690	D
RS18	City Hall Way - Ronald Ngala Street	South Bound	1,245	8.0	1,667	0.747	E
		North Bound	1,222	9.2	1,917	0.638	D
RS19	Ronald Ngala Street - Harambee Avenue	South Bound	1,356	8.0	1,667	0.814	E
		North Bound	1,443	9.2	1,917	0.753	E

Junctions (Schematic Diagram / Location)

Station	Schematic Diagram	Location	Intersection Type	Signal Control Type
0	RA		Roundabout	No Signal
~2.6	SO	Koinange St.	T junc	Signalized
4	RA	Harry Thuku Road / Muindi Mbingu St.	Roundabout	No Signal
~5.6	WS	Slip Road / Monrovia St.	T junc	No Signal
~7.2	SO	Muranga n Road / Biashar a St.	T junc	Signalized
~8	WS	River Road. / Kimathi St.	T junc	
11	SO	Kenyatt aAve.	4-legged	Signalized
~13.7	SO	City Hall	T junc	Signalized
15	SO	Ronald Ngala St.	T junc	Signalized
~16.4	WS	Harambe e Ave.	T junc	
~18.4	RA	Haile Sellasie	Roundabou	Signalized

Road sections

Item		Sec. 1	Sec. 2	Sec. 3	Sec. 4	Sec. 5	Sec. 6	Sec. 7	Sec. 8	Sec. 9	Sec. 10
Section Length (m)		263	135	160	175	65	5	250	275	250	180
Carriage Width (m)	Left	9.5	7.6	12.4	14.8	7.3	4.9	5.6	5.7	6.5	6.5
	Right	7.9	8.0			12.4	5.1	3.3	4.3	6.5	6.5
Median (m)		1.2	15.2	0.0	0.0	1.5	1.5	1.1	1.5	1.5	1.5
Parking Bay	Left	0.0	0.0	0.0	0.0	0.0	4.5	4.5	0.0	0.0	0.0
	Right	0.0	0.0	0.0	0.0	0.0	4.5	4.5	4.5	0.0	0.0
Sidewalk (m)	Left	2.5	2.5	8.4	5.4	4.0	5.7	5.2	7.5	8.0	8.0
	Right	2.7	2.7	7.1	3.5	3.7	3.8	5.8	5.0	9.2	9.2
Green Reserve (m)	Left	16.5	8.5	0.0	4.0	0.5	0.0	0.0	0.0	0.0	0.0
	Right	3.5	0.7	0.0	2.3	0.6	0.0	0.0	0.0	0.0	0.0
Service Road Width (m)	Left	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	5.8
	Right	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.5
Side Median	Left	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	4.5
Side Median	Right	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5
Parking Bay in Service Road	Left	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	4.5
	Right	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	4.5
Road Reserve (m)		43.8	45.2	27.9	30.0	30.0	30.0	30.0	28.5	60.0	60.0
No. of Lanes		D 4-L	D 4-L	W 2-L	W 2-L	D 4-L	D 2-L	D 4-L	D 4-L	D 4-L	D 4-L
Pavement Condition		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Sidewalk Condition	Left	Bad	Bad	Bad	Fair	Fair	Fair	Fair	Bad	Fair	Fair
	Right	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Bad	Fair	Fair
Roadside Drainage Condition		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Illigal On-Street Parking Condition	Left	A few	A few	A few	A few	Many	Many	Many	Many on SR	Many on SR	Many on SR
	Right	A few	A few	A few	A few	Many	Many	Many	Many on SR	Many on SR	Many on SR
Bus/Matatu Stop Condition		No	No	No	No	No	No	No	No	No	No
Traffic Signa and Pavement Marking		No	No	No	No	No	No	No	No	No	No
Street Lighting		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair

FIGURE 29.5-6 RESULTS OF ROAD CONDITION SURVEY ON MOI AVENUE

29.5.3 Identification of Problems

As examined in the analysis in the previous section, the problems identified were shown in Figure 29.3-9 in Section 29.3. The following is the summary of the problem:

(1) Road Network and Conditions

The road network connecting Moi Avenue and the eastern part of Nairobi is limited to Slip Road / Muranga road, River Road, and Ronald Ngala Street only. The connecting roads between them are generally poor.

(2) Many Illegal Parkings

One of the major problems on Moi Avenue is on-street parking.

- On-street parking policy of CCN
- Illegal double parking between Kimathi Street and City Hall Way
- Illegal parking near the intersection of Moi Avenue with Kenyatta Avenue and Cabral Street.

(3) Large Pedestrian Traffic

- Pedestrian flow is also one of the major issues on Moi Avenue. Moi Avenue is the corridor of pedestrians between Bus/Matatu terminals where most of them are located along the corridor of Tom Mboya Street. Pedestrian traffic volume on Moi Avenue is quite large.

(4) Poor Pedestrian Facilities

- The sidewalks along Moi Avenue are generally well developed, however pedestrian crossing facilities at intersections are sometimes improper due to lack of consideration of pedestrian flow.
- Without proper pedestrian fence at mid-block, pedestrians cross this road anywhere.
- Without pedestrian signals being installed or not working at all, pedestrians cannot follow the traffic signals.

29.5.4 Proposed Improvement Measures

(1) Proposed Basic Policy

As pointed out in the analysis of the previous section, traffic engineering and management problems and issues were identified.

From the viewpoint of the revitalization of Moi Avenue, three (3) planning policies are envisioned and highlighted:

1) to promote orderly and smooth traffic flow
2) to promote orderly and smooth NMT traffic flow
3) to mitigate traffic congestion

(2) Improvement Measures for Revitalization of Moi Avenue

In order to address the strategies and measures of revitalization of Moi Avenue, the following improvement measures are proposed:

- Improvement of carriageway
- Control of on-street parking
- Improvement of Bus / Matatu terminals and stops
- Improvement and widening of sidewalks and pedestrian crossings
- Improvement of intersections and installation of traffic signals and CCTV
- Pavement marking and traffic control signs
- Tree planting

(3) Alternative Revitalization Concepts

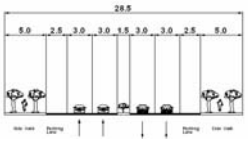
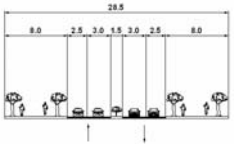
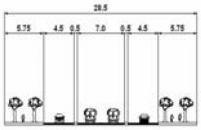
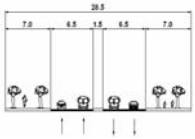
1) Provision of Alternative Concepts
   The following alternative concepts can be considered:

Alternative Plan 1: Revitalization by Smooth Vehicular Traffic Flow Improvement Concept
Alternative Plan 2: Revitalization by Introduction of Pedestrian Mall Concept
Alternative Plan 3: Revitalization by Introduction of Bus / Matatu Exclusive Lane Concept
Alternative Plan 4: Revitalization by Integrated Improvement Concept

2) Evaluation Criteria
   The alternative revitalization concepts of Moi Avenue are compared from the following items:
   - Traffic functionality
   - Social-environmental aspect
   - Economic aspect

3) Selection of Alternative Plans
   Table 29.5-5 shows the comparative study on the proposed revitalization concepts.

TABLE 29.5-5 COMPARISON OF ALTERNATIVE CONCEPTS FOR REVITALIZATION OF MOI AVENUE

	Alternative 1 Smooth Vehicle Traffic Improvement Concept	Alternative 2 Pedestrian Mall Concept	Alternative 3 Bus/Matatu Exclusive Lane Concept	Alternative 4 Integrated Improvement Concept
Typical Cross Section				
Main Features	• Provision of dual carriageway • Parallel on street parking be allowed • Maintain existing sidewalk.	• Pedestrian mall be provided • Provision of divided single carriageway • On-street parking shall not be allowed, but only stopping will be allowed	• Bus exclusive lane be provided • Provision of divided single carriageway • Both on-street parking and stopping will not be allowed. • Sidewalk will be provided slightly wider than Plan 1.	• Provision of divided dual carriageway • Provision of wider side walk • On-street parking shall not be allowed, but only stopping will be allowed
Traffic Functionality	• Smooth traffic flow can be achieved • Traffic capacity is assumed to be much higher than present one. • Due to allowance of on-street parking, traffic capacity of 4-lane road cannot be assured B	• Due to provision of single carriageway, it can not lead achievement of smooth traffic flow • Traffic capacity is the lowest among the other plans D	• Due to provision of single carriageway, Alternative 3 can not lead achievement of smooth traffic flow • Alternative 3 is effective if Bus/Matatu traffic volume is big, but the traffic on Moi Avenue is small D	• Plan 1 can be achieved smooth traffic flow • Traffic capacity is assured to be much higher than present one. • Due to not allowance of on-street parking, traffic capacity of 4-lane road can be assured A
Social-Environmental Aspect	• Due to provision of sidewalk being the same as the present ones, smooth NMT traffic will not be achieved • Due to increase of road capacity, public level transport users can receive favorable effect. D	• Pedestrian mall can be provided so as to provide equitable transport system for NMT users • Due to maintenance of road capacity, public transport users will not receive any benefits. B	• Lanes so as to provide equitable transport system for public transport users, but Bus / Matatu routes on Moi Ave. are very few. C	• Plan 4 can be provided wider sidewalk so as to achieve the equitable transport system for NMT users • Due to increases of road capacity, public transport users can receive favorable effect. A
Economic Aspect	• Due to allowance of parallel on-street parking, commercial activities will not be affected • Benefits derived from the plan will be highest than the other plans A	• Due to control of on-street parking, commercial activities will be affected • Benefits derived from this plan will be lower than the other plans D	• Due to not allowance of on-street parking, commercial activities will be affected • Benefits derived from this plan will be lower than the other plans D	• Due to not allowance of on-street parking, commercial activities will be affected • Benefit derived from this plan will be higher than Plans B and C. B
Recommendation	Not recommended	Not recommended	Not recommended	Recommended

According to the study, Alternative 4 was selected as the best scheme. The merit of each alternative is elaborated below.

- Alternative 1: Although alternative 1 is preferable for vehicle users, traffic demand on Moi Avenue is predominantly pedestrian. Taking into account the social–environmental considerations, this plan is not recommended to be employed in the future.
- Alternative 2: This plan regards pedestrians as the most important factor. Although this plan is preferable for pedestrian, functionality of vehicle traffic is the lowest in comparison to other alternative plans. It is therefore not recommended.
- Alternative 3: This plan regards bus transport as the most important factor. Although this is a convenient plan for bus users, bus routes on Moi Avenue are not many. Furthermore, this plan does not follow the CCN policy. It is therefore not recommended.
- Alternative 4: It is recommended because the plan integrates pedestrian traffic and vehicle traffic.

(4) Proposed Improvement Measures

1) Road Improvement

Design Concept and Criteria

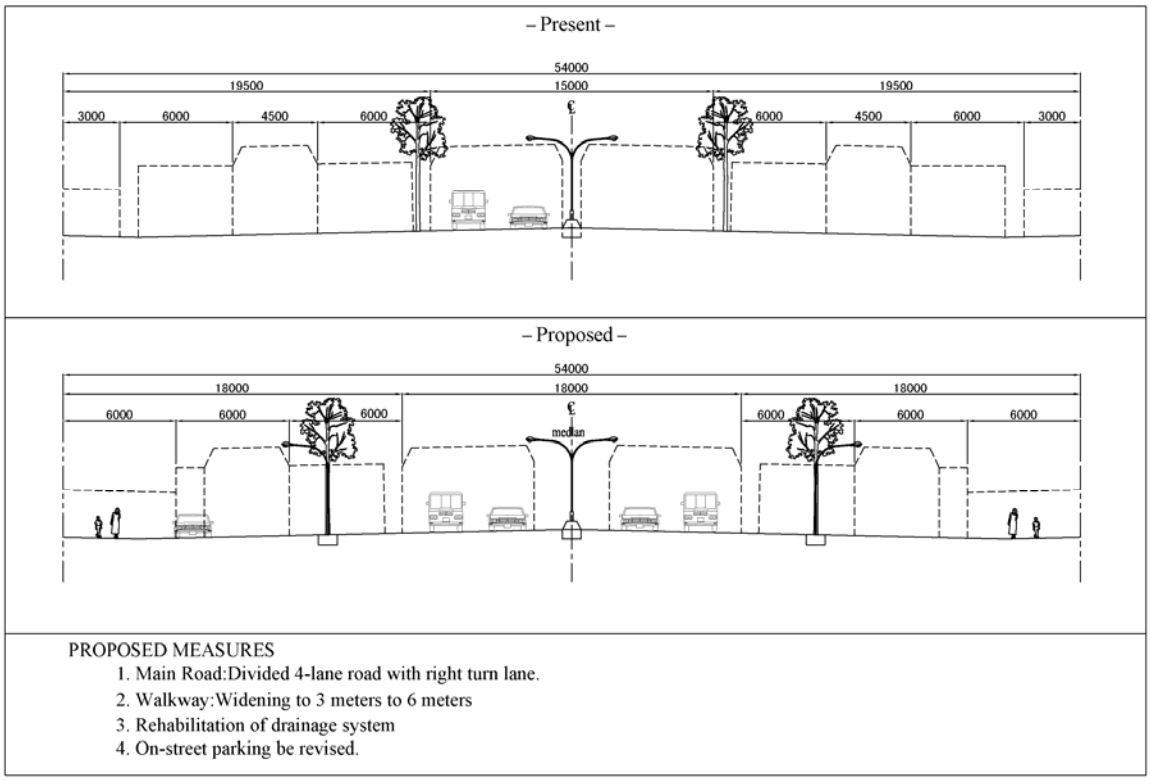
Moi Avenue functions as the primary distributor in the CBD of Nairobi and forms the Inner Ring Road together with University Way, Uhuru Highway, and Haile Selassie Avenue. The design concept is set up as follows:

Design Concept

- Moi Avenue functions as the primary distributor road in the CBD of Nairobi. A design speed of 50 km/hour is therefore selected.
- Right-turn lane is principally provided when necessary.
- Sidewalks and pedestrian crossings be well designed so that they can function as pedestrian malls.
- Integrated design of road, intersection and traffic management be made.

Road and Intersection Design

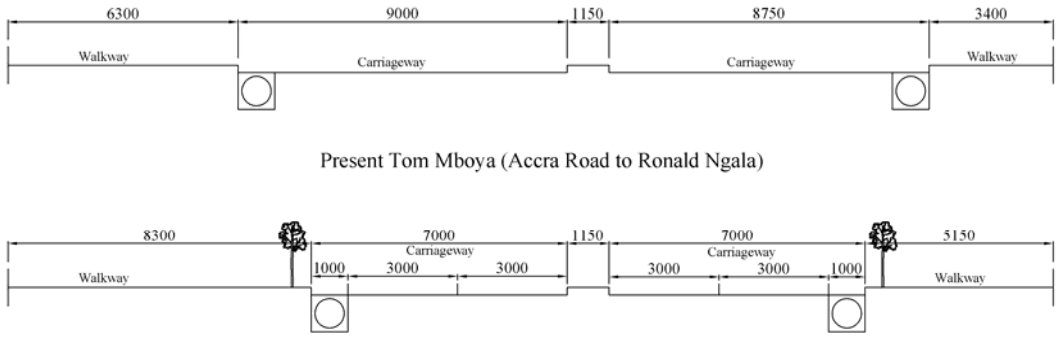
1) Typical Cross-section
   Based on the above mentioned criteria, existing and proposed typical cross-sections are illustrated in Figure 29.5-7(1) and (2).
2) Proposed Road and Intersection Design
   Based on the above mentioned typical cross sections, proposed road and intersection designs are made and shown in Figure 29.5-8 (1) and (2).



PROPOSED MEASURES

1. Main Road:Divided 4-lane road with right turn lane.
2. Walkway:Widening to 3 meters to 6 meters
3. Rehabilitation of drainage system
4. On-street parking be revised.

FIGURE 29.5-7(1) TYPICAL CROSS-SECTION OF MOI AVENUE BETWEEN SLIP ROAD AND KENYATTA AVENUE



Present Tom Mboya (Accra Road to Ronald Ngala)

Proposed Tom Mboya (Accra Road to Ronald Ngala)

PROPOSED MEASURES

1. Carriageway: Divided 4-Lane
2. Walkway: To Globe Cinema-Widening from 6.00m to 10.00m
   To Haile Selasie AVenue-Widening from 3.40m to 5.15m
3. Rehabilitation of drainage system
4. Prohibition of on-strrt parking
5. Landscaping: Greenbelt W=Approx.1.00m

FIGURE 29.5-7 (2) TYPICAL CROSS-SECTIONS OF MOI AVENUE BETWEEN CITY HALL WAY AND HAILE SELASSIE AVENUE (2)

FIGURE 29.5-8 (1) ROAD AND INTERSECTION IMPROVEMENT PLAN ON MOI AVENUE (1)

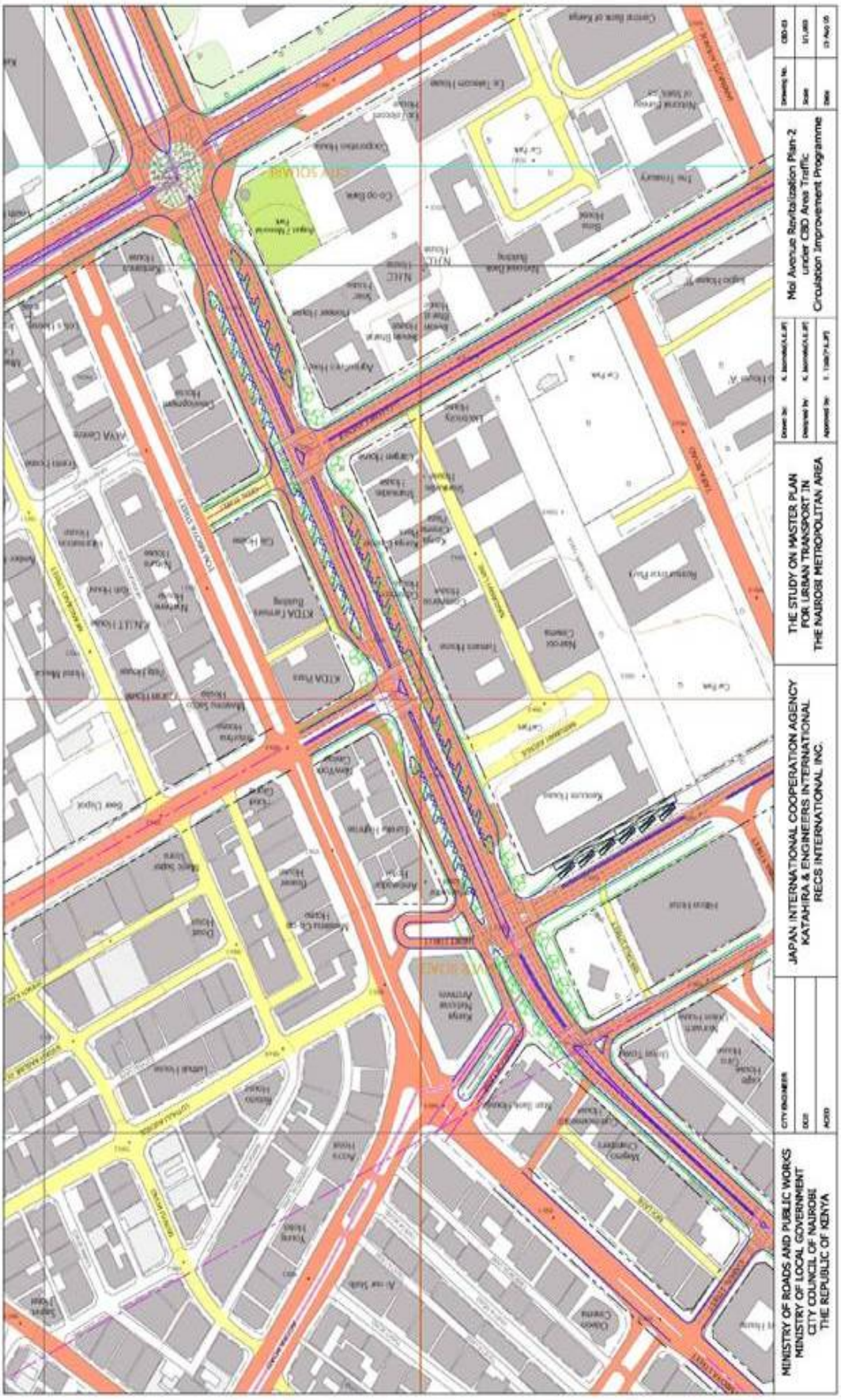


FIGURE 29.5-8 (2) ROAD AND INTERSECTION IMPROVEMENT PLAN ON MOI AVENUE (2)

3) Traffic Management Measures

Basic Considerations

A traffic management plan that takes into account the following basic considerations is envisioned for Moi Avenue.

- In order to increase the road capacity, on-street parking is to be prohibited on Moi Avenue between Muranga Road and City Hall Way. Two (2) kinds of parking measures will be recommended:
  - prohibition of on-street parking; and
  - permission of on-street parking in case service road is provided.
- A traffic signal system can be effectively operated as a traffic management tool. The high number of damaged traffic signals are recommended to be restored in order to control both motor vehicles and pedestrian traffic effectively.
- Around the area of Moi Avenue between City Hall Way and Ronald Ngala Street, intercity and intra-city bus stops/terminals be separated.
- Since the facilities for pedestrian for going to/coming from Bus / Matatu terminals / stops are very poor, pedestrian facilities need to be provided for boarding and alighting passengers and transfer.
- Traffic safety facilities are not sufficient, such as sidewalks and pedestrian crossings. The widening of sidewalks, pedestrian crossing, pedestrian fence, and other safety facilities must be improved to ensure pedestrian safety and to rectify disorderly pedestrian movement.

Based on the above-mentioned considerations, the plan of traffic management on Moi Avenue is shown in Table 29.5-6. The locations for traffic management improvement are determined based on the road condition survey and traffic analysis.

TABLE 29.5-6 PLAN FOR TRAFFIC MANAGEMENT PLAN ON MOI AVENUE

	On-street Parking system	Pedestrian Facilities	Traffic Signal with Intersection Improvement	Traffic Safety Devices
Slip Road – River Road	• Allowed	• Pavement of sidewalk	• Slip Road intersection • Muranga Road intersection • Mokhtar Daddah Intersection	• Pavement marking • Traffic sign
River Road – Kenyatta Avenue	• Prohibited	• Widening of sidewalk	• Kenyatta Avenue intersection	• Pavement marking • Traffic sign
Kenyatta Avenue-City Hall way	• Prohibited	• Widening of sidewalk	• Mama Ngina Street Intersection • City Hall Way intersection	• Pavement marking • Traffic sign
City Hall Way – Ronald Ngala Street	• Allowed on service road	• Widening of sidewalk	• Ronald Ngala Street intersection	• Pavement marking • Traffic sign
Ronald Ngala Street – Haile Selassie Avenue	• Allowed on service road	• Widening of sidewalk	• Harambee Avenue intersection • Haile Selassie Avenue Intersection	• Pavement marking • Traffic sign

Parking System

The parking system study has been discussed in the previous section. In this section, only the on-street parking system will be described.

On-street parking will be prohibited from 8:00 AM to 8.00 PM along Moi Avenue between Muranga Road and City Hall Way. The prohibition of on-street parking will be adopted at the section which has high parking and illegal parking occupancy.

- *Section between Muranga Road and Kenyatta Avenue*: Width of this section is 30m, comprising of 2-lanes with parking spaces on both sides. Parking of this section will be principally prohibited for both sides.
- *Section between Kenyatta Avenue and City Hall Way*: Width of this section is 28 to 28.5 meters width. Parking of this section will be prohibited for both sides.
- Vehicles must be prohibited from both stopping and parking at least 100 meters from intersection.
- *Section between City Hall Way and Haile Sellassie Avenue*: Width of this section is 60 meters. In the service roads, parking will be permitted.

Pedestrian Facilities

Pedestrian behavior in Nairobi is observed as negligence of traffic regulation at present; in some cases, pedestrians cross inside intersections, they cross the street at the middle section of the road, they walk along vehicle lanes to reduce their travel distances. While in bus waiting areas, pedestrians and passengers overflow onto vehicle lanes.

This attitude must be changed, with pedestrian traffic being considered as important as vehicle traffic through provision of safe and convenient facilities for pedestrians. In particular, facilities for pedestrian crossings should be provided on Moi Avenue.

In order to improve the above pedestrian behavior, pedestrian facilities together with pedestrian control measures shall be employed. The aims are:

- To enhance traffic regulation for pedestrian behaviors,
- To create pedestrian-friendly facilities,
- To ensure a safe pedestrian environment, and
- To prepare facilities to inhibit disorderly pedestrian movement.

The following sidewalk facilities must be provided for the whole section of Moi Avenue.

- Rehabilitation and widening of sidewalk
- Pedestrian crossing at intersections

- Pedestrian fence to inhibit disorderly crossing

Restoration of Traffic Signal

As mentioned in Chapter 29.3, it was recommended that traffic signals be reinstalled in the following locations:

- Intersection of Slip Road
- Intersection of Muranga Road
- Intersection of Kenyatta Avenue
- Intersection of Mama Ngina Street
- Intersection of City Hall Way
- Intersection of Ronald Ngala Street
- Intersection of Harambee Avenue
- Intersection of Haile Selassie Avenue

Regarding the system's function, it is necessary to coordinate and synchronize adjacent traffic signals to have their functions harmonize in order to avoid unnecessary delay on the vehicles.

Improvement of Bus stops and Pedestrian Facilities

Improvement plan of the Bus /Matatu stops and terminals is discussed in detail in Chapter 30.

Installation of Traffic Safety Devices

a) Present Conditions

As mentioned under the Master Plan Study and through the inventory survey carried out on Moi Avenue, Moi Avenue does not conform to any standard of road marking and grossly suffers from shortage of traffic signs. The survey shows also that there are some markings which have almost disappeared.

b) Traffic Signs

For Moi Avenue under the traffic flow improvement project, the estimated numbers of required signs during the short term period are shown in Table 29.5-7.

TABLE 29.5-7 TRAFFIC SIGNS REQUIREMENTS

Sign Type	Required Number
Warning	120
Regulatory	60
Informatory	120

c) Pavement Marking

There are some pavement markings on Moi Avenue but their maintenance is poor. Most of the pavement markings have disappeared at present.

For the pavement marking, the following marking types have been considered:

- Lane markings
- Cross-walk markings
- On-street parking
- Off-street parking
- Channelization

Table 29.5-8 shows the estimated number of required markings during the short-term period necessary for Moi Avenue.

TABLE 29.5-8 ROAD MARKING REQUIREMENTS

Type of Marking	Required Number
Lanes	240
Cross-walks	120
Edges	240
On-Street parking	120

29.5.5 Preliminary Cost Estimate

Based on the work quantities and unit cost analyzed, the preliminary cost is estimated and presented in Table 29.5-9.

TABLE 29.5-9 PRELIMINARY COST ESTIMATE

Unit: Million Ksh

Road	Length (km)	Foreign Component	Local Component	Total
Revitalization of Moi Avenue	1.47	65.5	18.5	84.0

29.6 TRAFFIC FLOW IMPROVEMENT IN WESTLANDS

29.6.1 Present Conditions of Traffic Flow in Westlands

Background

As described in Chapter 27, GOK has decided to take follow-up actions to alleviate traffic conditions in Westlands with financial allocation under fiscal year 2005/06 after completion of the Pilot Project Experiment. Actions expected to be carried out by GOK within this fiscal year 2005/06 are follows:

- Widening of Ring Road Westlands between Westlands Roundabout and Lower Kabete Road (from undivided 2-lane to divided 4-lane road)
- Relocation of bus/matatu bays on Chiromo Road (both inbound and outbound stages) to off-street of down stream sides along Waiyaki Way and Chiromo Road

In addition to the above, under the short term projects described in Chapter 28 as "Missing Link No.3, 6, and 7", Missing Link 3 (extension of Ring Road Kilelelshwa) shall be constructed within next 5 years. Therefore the following action is also to be expected in line with the construction of Missing Link No.3:

- Widening of Rhapta Road at the section between Westlands Roundabout and the proposed Missing Link No.3 (from undivided 2-lane to divided 4-lane road)

FIGURE 29.6-1 WESTLANDS AREA KEY MAP

Requirement of Area Traffic Assessment

Typical procedure of "Area Traffic Impact Assessment" which is widely applied into most of major cities in Japan is shown in Figure 29.6-2.

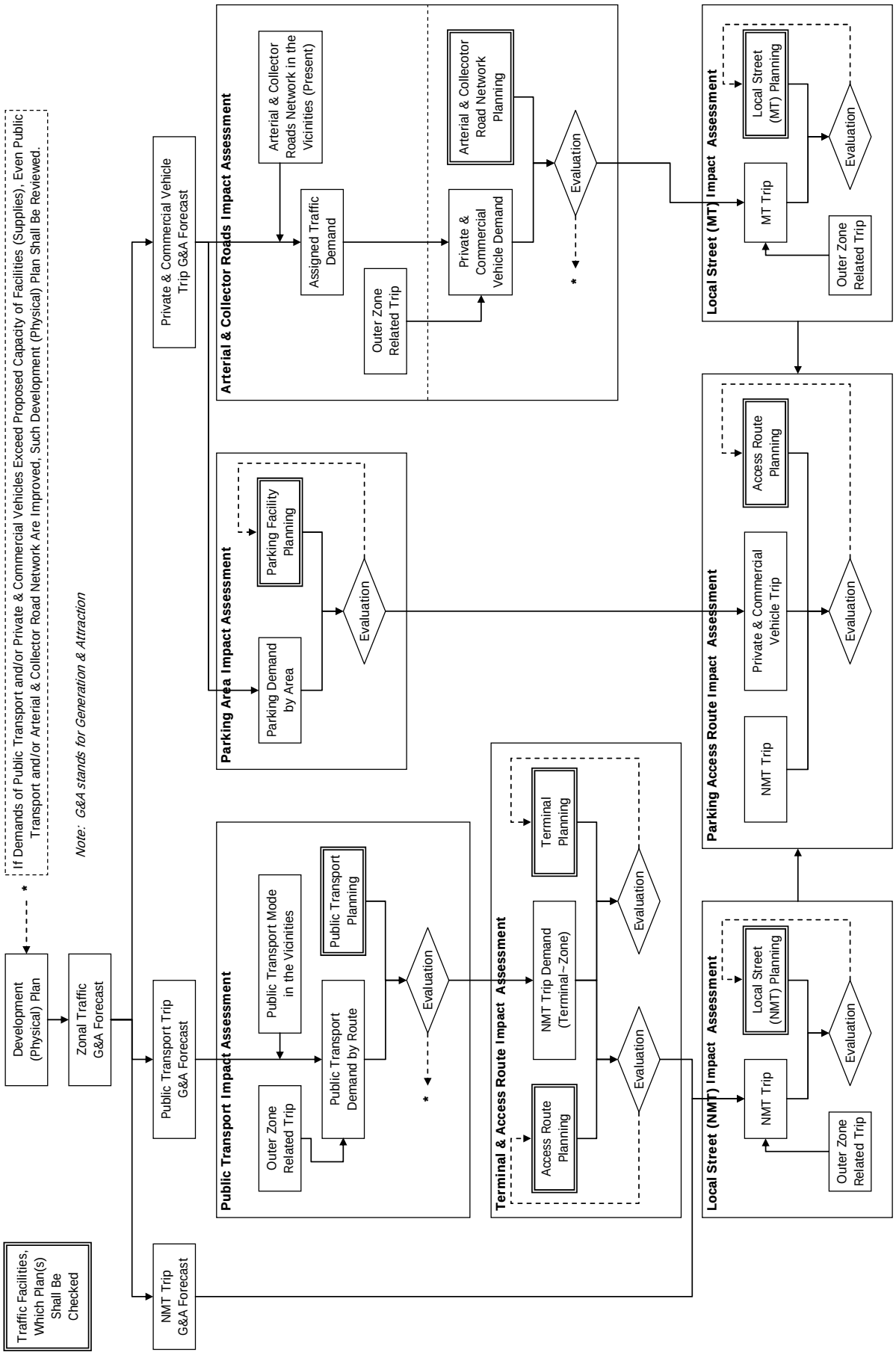


FIGURE 29.6-2 PROCEDURE OF AREA TRAFFIC IMPACTS ASSESSMENT

Based on this procedure, "Arterial & Collector Roads Impact" and "Parking Area Impact" are major components that were supposed to be taken into account by both public and private sectors prior to a large scale developments in any places in the City of Nairobi, particularly in Westlands.

On the same manner, "Public Transport Impact" as well as "Local Street (both NMT and NMT) Impact" and "Parking Access Route Impact" should be considered in this area for Waiyaki Way and Chiromo Road that is one of the major public transport corridor connecting northwest part of NMA (i.e. Kikuyu and Limuru Town) and CBD, and for Lower Kabete Road and Parklands Road that are detour routes connecting same area as well as City's fashionable residential district like Gigiri (where United Nation Complex and other major western country's embassies are also located) with City's sub-core district like Parklands and Westlands (where business, commercial, and medical services, are well concentrated).

It is recommended that the Area Traffic Impact Assessment be prepared prior to the development to be taken place in Westlands to avoid occurrence of serious traffic problems.

29.6.2 Traffic Demand Forecast

Table 29.6-1 and Figure 29.6-3 to 5 show traffic demand forecast at Westlands Roundabout in "Do-Nothing" and "50% Increased Capacity" cases. The "50% Increased Capacity Case" case tries to improve the roundabout traffic capacity through geometrical improvement and traffic control and management that will be proposed in the Section 29.6.3. The results are elaborated below.

<u>Do-Nothing Case</u>

- Traffic demand on Westlands Roundabout is expected to increase by 60% from 66 thousand pcu per day (present level) to 104.
- Saturation degree of Westlands Roundabout is expected to deteriorate from 0.82 (present) to 1.11 in 2010, and 1.31 in 2015, in case of "Do-Nothing".

<u>50% Increased Capacity</u>

- Traffic demand will increase by 50% from 73 thousand pcu per day to 110.
- The saturation degree will change from 1.17 in 2010 to 1.37 in 2015.

TABLE 29.6-1 TRAFFIC DEMAND AT WESTLANDS ROUNDABOUT

(Present Capacity = 80[1])

Case	Present	2010	2015	Index ('10/'04)	Index ('15/'10)
Do-Nothing	65.6 [0.82]	88.5 [1.11]	104.4 [1.31]	1.35	1.18
50% Increased Capacity	73.2 [0.92]	93.2 [1.17]	109.9 [1.37]	1.27	1.18

Note; Top: Traffic Demand ('000 pcu per day), Bottom: Saturation Degree

FIGURE 29.6-3 TRAFFIC DEMAND AT WESTLANDS-1 (PRESENT)

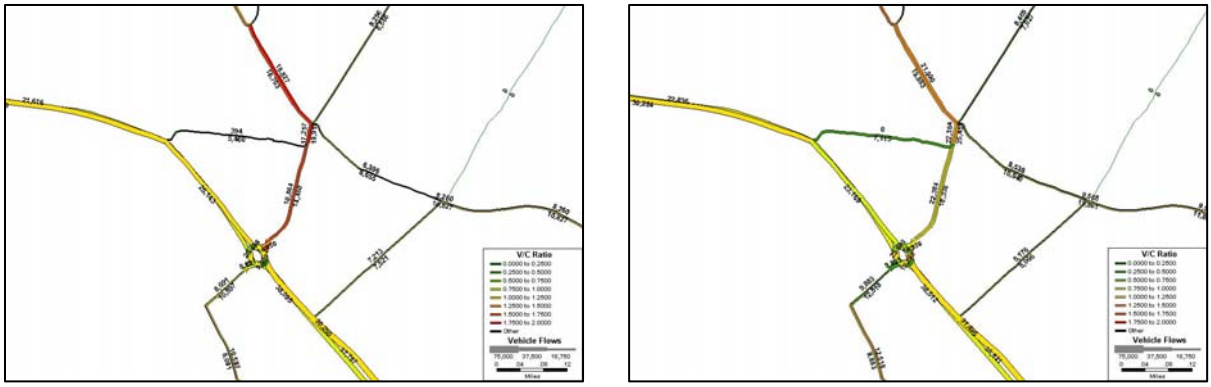


FIGURE 29.6-4 TRAFFIC DEMAND AT WESTLANDS-2 (YEAR 2010)

FIGURE 29.6-5 TRAFFIC DEMAND AT WESTLANDS-3 (YEAR 2015)

Note: Left: "Do-Nothing" Case, Right: "50% Increased Capacity" Case

[1] 90 percentile volumes at Westlands Roundabout marked around 1,600 pcu per 15-minute after re-activation of traffic signal from 21-June-2005, and peak hour ratio against 12-hr volume in that time was 0.10. When 24/12-hr ratio is assumed to be 1.25, estimated daily capacity becomes 80,000 (=1,600x4/0.10x1.25) pcu per day.

Arterial Roads

Table 29.6-2 shows traffic demand along arterial roads of Waiyaki Way and Chiromo Road. Volume capacity ratio (VCR) of these roads are expected to increase from 0.79 (present) and 0.97 (present), to 1.26 and 1.27 in 2010, and 1.61 and 1.45 in 2015, if the present capacity is maintained ("Do-Nothing").

On the other hand, if the capacity would be increased by 50% ("50% Increased Capacity"), even demand along these arterial roads would increase, VCR would remain at 0.77 and 0.86 in 2010, and 0.86 and 0.99 in 2015 respectively.

TABLE 29.6-2 TRAFFIC DEMAND ALONG ARTERIAL ROADS

Arterial Road	Waiyaki Way (Present Capacity = 40)					Chiromo Road (Present Capacity = 60)				
Case	Present	2010	2015	Index '10/'04	Index '15/'10	Present	2010	2015	Index '10/'04	Index '15/'10
Do-Nothing	31.4 [0.79]	50.3 [1.26]	64.3 [1.61]	1.60	1.28	57.9 [0.97]	76.2 [1.27]	86.7 [1.45]	1.32	1.14
50% Increased Capacity	36.8 [0.61]	46.3 [0.77]	51.4 [0.86]	1.26	1.11	63.4 [0.70]	77.0 [0.86]	88.7 [0.99]	1.21	1.15

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: Volume Capacity Ratio

Collector Roads

Table 29.6-3 shows traffic demand along collector roads. VCR of collector roads of Rhapta Road and Ring Road Westlands are expected to be from 0.69 and 1.47 (present) to 0.97 and 1.57 in 2010, and 1.18 and 1.71 in 2015 respectively ("Do-Nothing").

On the other hand, in case of "50% Increased Capacity", even if the demand increases, VCR would remain at 0.75 in 2010, and 0.87 in 2015 along Rhapta Road, and 1.36 in 2010 along Ring Road Westlands. Attempts to increase the capacity of Ring Road Westlands may induce much more demand; hence VCR might deteriorate slightly than "Do-Nothing" to 1.78 in 2015[2].

TABLE 29.6-3 TRAFFIC DEMAND ALONG COLLECTOR ROADS

Collector Road	Rhapta Road (Present Capacity = 20)					Ring Rd Westlands (Present Capacity = 20)				
Case	Present	2010	2015	Index '10/'04	Index '15/'10	Present	2010	2015	Index '10/'04	Index '15/'10
Do-Nothing	13.7 [0.69]	19.3 [0.97]	23.6 [1.18]	1.41	1.22	28.3 [1.42]	31.3 [1.57]	34.2 [1.71]	1.11	1.09
50% Increased Capacity	14.5 [0.48]	22.4 [0.75]	26.2 [0.87]	1.54	1.17	31.7 [1.06]	40.7 [1.36]	53.5 [1.78]	1.28	1.31

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: Volume Capacity Ratio

[2] If capacity of collector roads increased by 100% as proposed by GOK and demand remained as same level as 50% increased case, VCR of collector roads remained 0.56 or 1.02 in 2010, and 0.67 or 1.34 in 2015.

29.6.3 Identification of Problems and Improvement Measures

Junction

Westlands Roundabout was improved under the Pilot Project Experiment recently and the remaining counter measures to alleviate future traffic conditions will be as follows;

- Provision of additional approaching and/or exiting lanes along arterials, such as Waiyaki Way and Chiromo Road.
- Improvement of junction in front of Sarit Centre by providing additional go-around lane as well as traffic channels.
- Introduction of "Yellow Box" to avoid unnecessary driver's habit to block other traffic flows at designated crossing points.

Segment

The followings are other soft counter measure of traffic control and management.

- Prohibition of right turning and crossing along collector roads, especially Ring Road Westlands between Westlands Roundabout and junction in front of Sarit Centre.
- Prohibition of right turn entrance from Parklands Road, and promoting left turn entrance from Lower Kabete Road to Sarit Centre.
- Provision of clear road marking (preferably thermal plastic) as well as traffic sign.

Physical improvement to alleviate traffic conditions along arterial as well as collector roads are proposed as follows and expected to be completed within a year.

- Widening of collector roads (i.e. Lower Kabete Road between Ring Road Parklands and Peponi Road, Ring Road Parklands between Lower Kabete Road and General Mathenge Drive)
- Construction of Missing Link No.4 (extension of Mpaka Road between Parklands Road and Second Parklands Avenue)

NMT

In addition to the above counter measures for vehicles, the following measures shall be applied, especially for non-motorized transport (i.e. pedestrian, cyclist, physically challenged people, etc.).

- Provision of wide walk way and cycle path together with greenbelt along both sides of collector roads (i.e. Ring Road Westlands, Rhapta Road, Parklands Road, Lower Kabete Road, Ring Road Parklands, etc.).
- Provision of zebra crossings along the same collector roads.

29.6.4 Present Improvement Measures

Followings are proposed layout and cross section design of widening works of Ring Road Westlands[3].

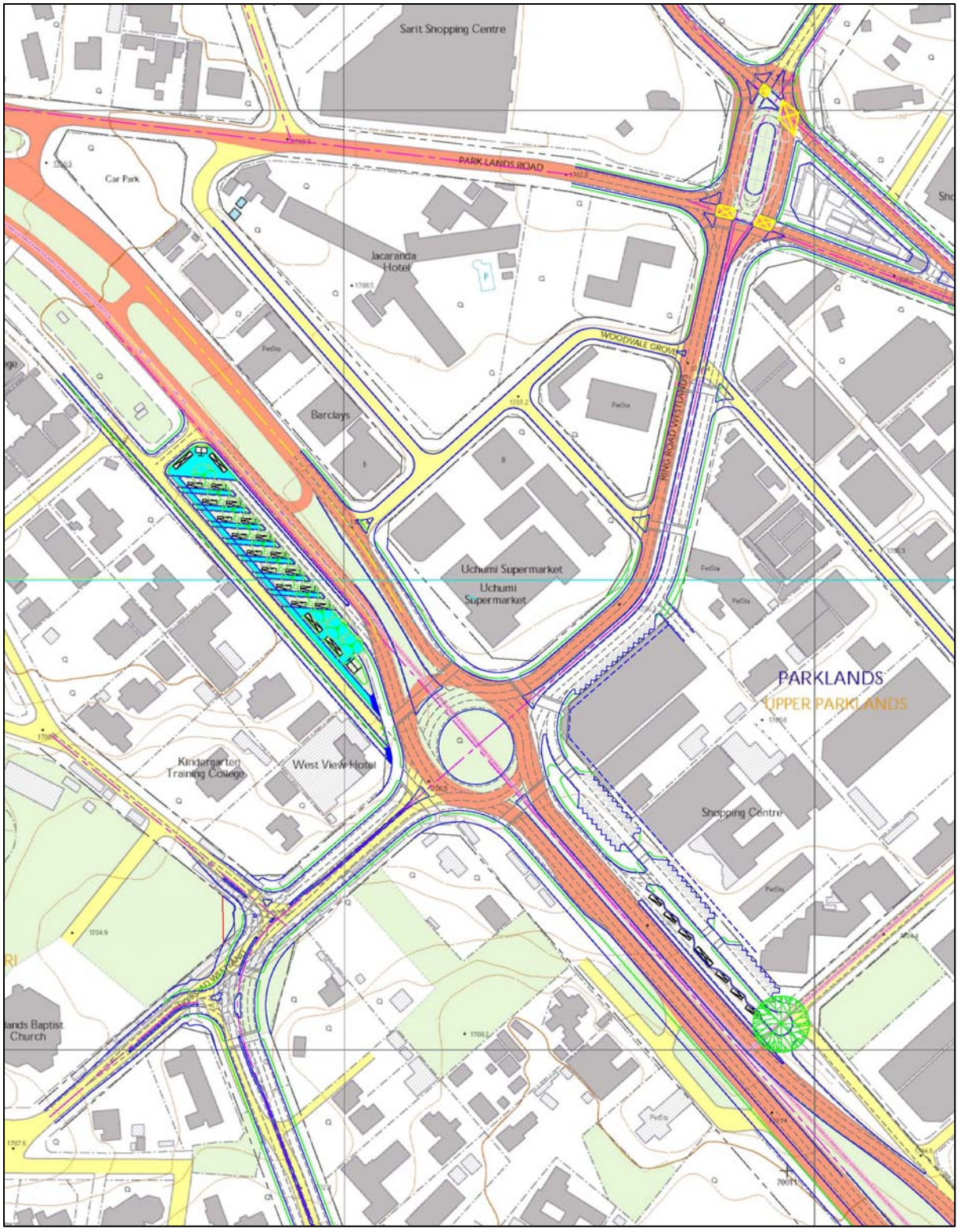


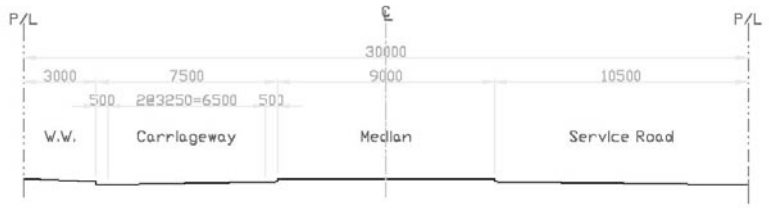
FIGURE 29.6-6 WESTLANDS AREA TRAFFIC CIRCULATION IMPROVEMENT PLAN

[3] Layout drawing for bus/matatu bay relocation plan is provided as example only.

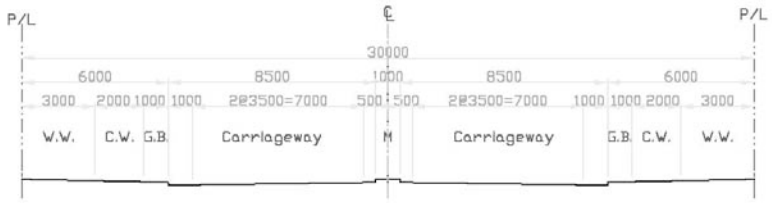
Section ;	From : Chiromo Road	To : Parklands Road	Width : 30m	Length : 0.26 km

Cross Section ;

Present :



Proposed :



Proposed Works ;	Contents ;	Remarks ;
1. Widening:	Undivided 2-Lane to Divided 4-Lane	
(1) Carriageway :	W = 8.5m (=1.0m Shoulder + 2@3.50m Lane + 0.5m Shoulder) x 2	
(2) Median :	W = 1.0m x 1	
2. Overlay / AC Surfacing :	W = 8.5m x 2	(t=50mm)
3. NMT Facility Construction :	W = 5.0m (= 3.0m Walk Way + 2.0m Cycle Way) x 2	
4. Pipe Drainage :	D = 600mm x 2	
5. Landscaping (Green Belt) :	W = 1.0m x 2	

Photo ;

From Chiromo Rd side to Parklands Road side

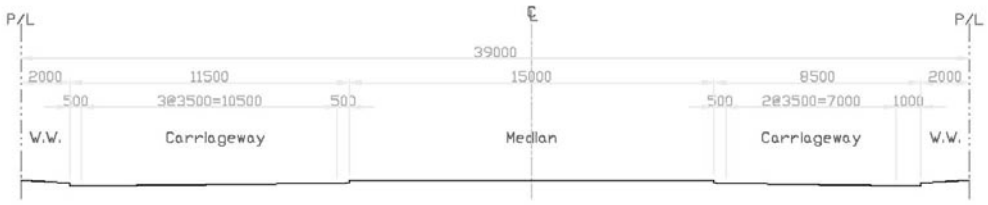
From Chiromo Rd side to Parklands Rd side

FIGURE 29.6-7 IMPROVEMENT OF RING ROAD WESTLANDS-1

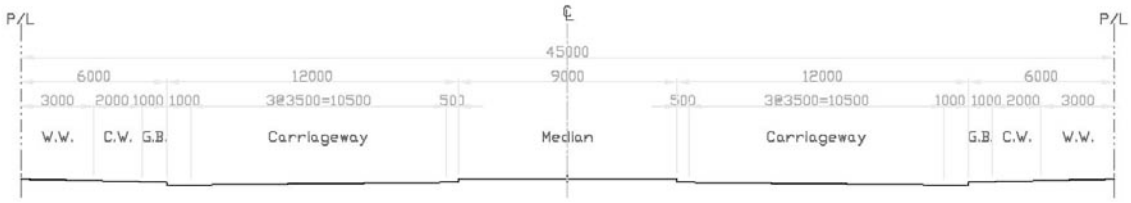
Section ;	From : Park lands Road	To : Lower Kabete Road	Width : 45m	Length : 0.13 km

Cross Section ;

Present :



Proposed :



Note: Expansion of NMT Facilities towards the East side (Westlands Market)

Proposed Works ;	Contents ;	Remarks ;
1. Widening:	Divided 4-Lane to Divided 6-Lane	
(1) Carriageway :	W = 12.0m (= 1.0m Shoulder + 3@3.50m Lane + 0.5m Shoulder) x 2	
(2) Median :	W = 9.0m x 1	
2. Overlay / AC Surfacing :	W = 12.0m x 2	(t=50mm)
3. NMT Facility Construction :	W = 5.0m (= 3.0m Walk Way + 2.0m Cycle Way) x 2	
4. Pipe Drainage :	D = 600mm x 2	
5. Landscaping (Green Belt) :	W = 1.0m x 2	

Photo ;

From Parkland Rd side to Lower Kabete Rd side

From Lower Kabete Rd side to Parklands Rd side

FIGURE 29.6-8 IMPROVEMENT OF RING ROAD WESTLANDS-2

29.6.5 Preliminary Cost Estimate

Preliminary cost estimate for construction is presented in Table 29.6-4.

TABLE 29.6-4 COST ESTIMATE

Unit: Million Ksh

Road & Section Name	Length (km)	Foreign Component	Local Component	Total
Ring Road Westlands -1	0.26	16.0	4.5	20.5
Ring Road Westlands -2	0.13	7.7	2.2	9.9
Total	0.39	23.7	6.7	30.4

29.7 IMPROVEMENT PLAN OF NGONG ROAD

29.7.1 Present Condition of Ngong Road

Background

Ngong Road is 2-lane undivided road which connects west side of Nairobi CBD with NMA's western sub-core called Ngong Town. The Ngong Town is located at the east side of Ngong Hill consisting of eastern fringe of Rift Valley.

The Ngong Road starts at junction with extension of Kenyatta Avenue/ Valley Road, then climb up to Nairobi Hill, where institutional complex is concentrated, and merged with extension of Haile Selassie Avenue.

This road is passing through medical service district at west side of Nairobi Hill, then crossing Valley Road / Mbagathi Way, Ring Road Kilimani (which is extension of Missing Link No.7 from Kileleshwa and beginning point of Missing Link No. 12 toward Kibera) where newly developed shopping centre is located.

After this point, it passes Elgeyo Market Road at Adams Arcade, and branch off with Naivasha Road at Dagoretti Corner, and then proceed toward Ngong Town by crossing Karen Roads and Dagoretti Road.

This road plays the roll of one of the major public transport corridors in NMA as described in Chapter 30, and nowadays also play the roll of major corridor for commuters of private car users, because residential developments take place in Dagoretti and Karen as well as Ngong Town along this road.

Existing Plan

Although widening plan (dualing from undivided 2-lane to divided 4-lane) of this road was proposed by KUTIP of World Bank in October 2000, this project was suspended shortly after the

completion of design work, and any implementation work is not done since then.

The followings are summary of the widening plan of this road.

- Beginning Point: Junction near National Library Service at Nairobi Hill
- Ending Point: Junction with Naivasha Road at Dagoretti Corner
- Length: Approximately 5.6 km
- Road Reserve: Approximately 60m (Actually 200 feet)
- Type of Junction: Roundabout (Provision of 2 or 3 Circular Lanes)
- Access Control: Provision of U-Turn Bay, where Roundabout is not provided
- Standard Width:
  - Carriage Way: 2@3.50m x 2
  - Walk Way: 2m x 2
  - Bicycle Path: 2m x 2
  - Median: 10~16m (varied)

29.7.2 Traffic Demand Forecast

Junction

As shown in Table 29.7-1, present traffic demands at major junctions along Ngong Road varied from 17 to 71 thousand pcu per day. Therefore, when 40 (in case of City Mortuary Roundabout, it will be 56) thousand pcu per day is applied for capacity level at present[4], saturation degrees are also varied from 0.42 at Dagoretti Corner to 1.27 at City Mortuary Roundabout.

TABLE 29.7-1 JUNCTION TRAFFIC DEMANDS ALONG NGONG ROAD

(Capacity = 56 at Present, 80 in 2010 & 2015 for City Mortuary,
Capacity = 40 at Present, 56 in 2010 & 2015 for Other Junctions)

Junction	Present	2010	2015	Index ('10/'04)	Index ('15/'10)
National Library Service (Haile Selassie Avenue)	41.6 [1.04]	44.9 [0.80]	55.5 [0.99]	1.08	1.24
Police H.Q. (Ralph Bunche Rd / Hospital Rd)	40.7 [1.02]	42.3 [0.76]	51.9 [0.93]	1.04	1.23
City Mortuary (Valley Road / Mbagathi Way)	71.1 [1.27]	74.9 [0.94]	86.1 [1.08]	1.05	1.15
Ring Road Kilimani (Missing Link No.7 & No.12)	50.5 [1.26]	59.8 [1.07]	80.8 [1.44]	1.18	1.35
Adams Arcade (Elgeyo Market Road)	19.2 [0.48]	32.6 [0.58]	50.5 [0.90]	1.70	1.55
Dagoretti Corner (Naivasha Road)	16.9 [0.42]	26.0 [0.46]	44.4 [0.79]	1.54	1.71
Average	40.0 [1.00]	46.7 [0.83]	61.5 [1.10]	1.17	1.32

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: Saturation Degree

[4] Assumed capacity of 2-circular lane operation is 56, and capacity of 3-circular lane operation is 80 thousand pcu per day as same figures as achieved by Pilot Project Experiment at Westlands Roundabout. And assumed capacity of 1-circular lane operation is 40 as 70% of 2-circular lane or 50% of 3-circular lane operation.

As proposed by KUTIP, when 2 circular lanes (in case of City Mortuary Roundabout, it will be 3 circular lanes) are provided, saturation degrees may be decreased by 17% in average, varied 0.46 (at Dagoretti Corner) to 1.17 (at Ring Road Kilimani), even traffic demand would be increased by 17% in average by 2010.

These conditions will deteriorate gradually from 0.79 (at Dagoretti Corner) to 1.44 (at Ring Road Kilimani) by 2015 if further actions are not made.

In particular, Junction in Ring Road Kilimani shall have 3-circular lane from the beginning.

Section

As shown in Table 29.7-2 and Figure 29.7-1 to 3, average traffic demand between National Library Service (NLS) and Dagoretti Corner (Naivasha Road Turn Off) is expected to increase by around 45% (from the present level of 35 to the future level of 51 thousand pcu per day in average).

On the other hand, VCR is expected to decrease by 45%, with the present 0.75 to 2.85 (average 1.79) to 0.46 to 1.59 (average 0.98) by 2010, after widening of the sections as proposed by KUTIP even if traffic demand would increase by 10% in average by 2010.

TABLE 29.7-2 SECTIONAL TRAFFIC DEMANDS ALONG NGONG ROAD

(Capacity = 20 at Present, 40 in 2010 & 2015)

Section		Present	2010	2015	Index ('10/'04)	Index ('15/'10)
National Library Service	Police H.Q. (Ralph Bunche Rd / Hospital Rd)	42.0 [2.10]	45.5 [1.14]	56.0 [1.40]	1.08	1.23
Police H.Q. (Ralph Bunche Rd / Hospital Rd)	Valley Road / Mbagathi Way (City Mortuary)	35.2 [1.76]	40.9 [1.02	50.9 [1.27]	1.14	1.24
Valley Road / Mbagathi Way (City Mortuary)	Mucai Drive	57.1 [2.85]	63.7 [1.59]	72.4 [1.81]	1.12	1.14
Mucai Drive	Ring Road Kilimani	46.7 [2.33]	52.0 [1.30]	58.7 [1.47]	1.11	1.13
Ring Road Kilimani	Elgeyo Market Road (Adams Arcade)	17.0 [0.85]	19.8 [0.50]	35.7 [0.89]	1.16	1.80
Elgeyo Market Road (Adams Arcade)	Ole Odume Road	28.1 [1.40]	32.7 [0.82]	50.5 [1.26]	1.16	1.54
Ole Odume Road	Naivasha Road (Dagoretti Corner)	15.1 [0.75]	18.4 [0.46]	33.8 [0.85]	1.22	1.84
Average		35.7 [1.79]	39.2 [0.98]	51.2 [1.28]	1.11	1.30

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: VCR [Volume Capacity Ratio]

These figures will deteriorate gradually from 0.85 to 1.81 (average 1.28) by 2015 if further action is not made.

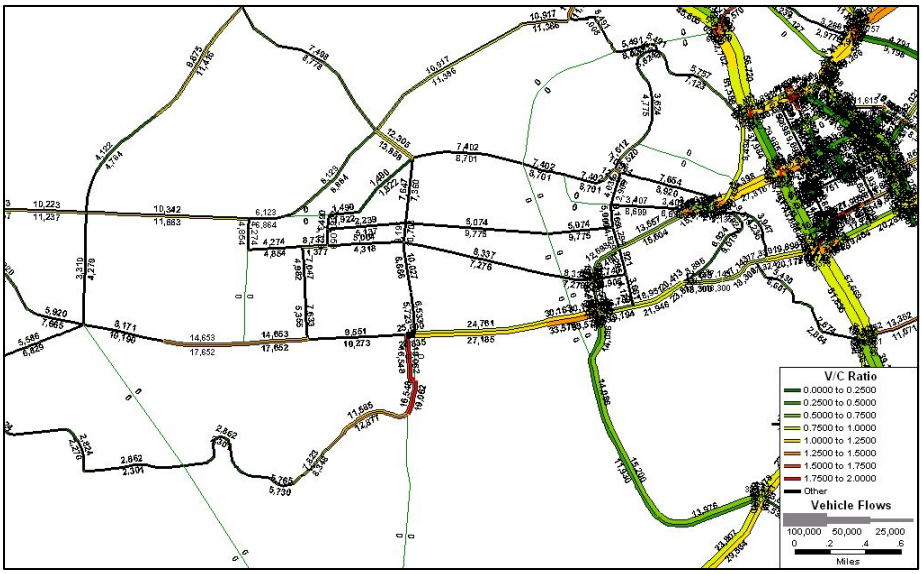


FIGURE 29.7-1 TRAFFIC DEMANDS ALONG NGONG ROAD-1 (YEAR 2010)

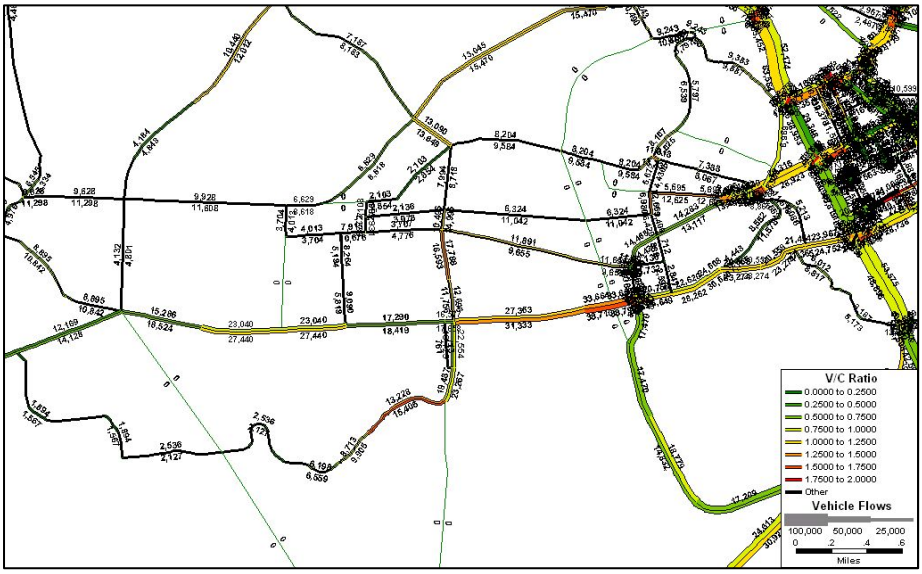


FIGURE 29.7-2 TRAFFIC DEMANDS ALONG NGONG ROAD-2 (YEAR 2015)

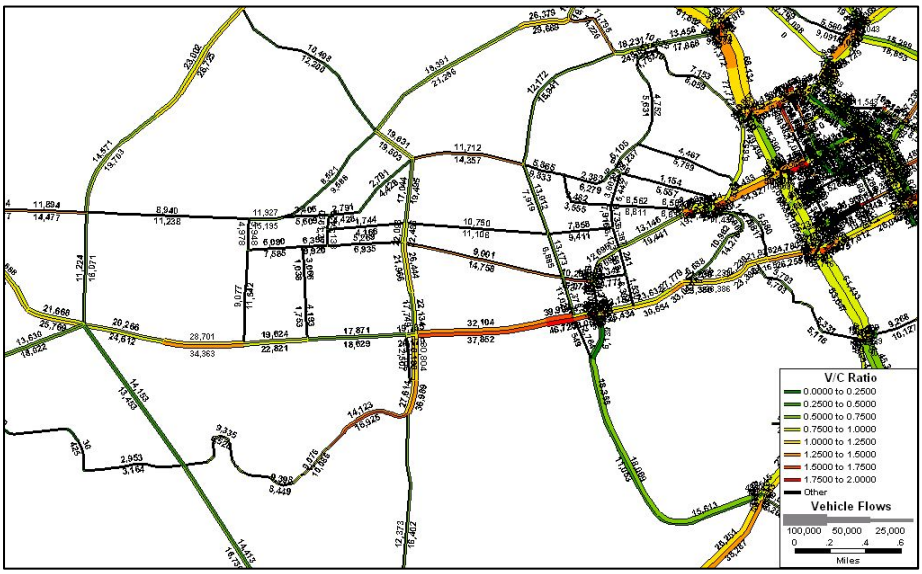


FIGURE 29.7-3 TRAFFIC DEMANDS ALONG NGONG ROAD-3 (YEAR 2025)

Section between NLS and Ring Road Kilimani and section between City Mortuary and Ring Road Kilimani will face severe traffic jam in the near future, even after dualing project is implemented. Therefore, construction of triple carriage way or implementation of other counter measures are recommended for these sections.

29.7.3 Identification of Problems

According to the traffic demand forecast, the following counter measures shall be applied to alleviate traffic problems.

Junction

- Immediate Action
  - Providing additional circular lane to the existing roundabout, especially National Library Service Roundabout and City Mortuary Roundabout
  - Providing Exclusive Right Turn Lane at Existing Intersection, especially Junctions with Hospital Road and Ring Road Kilimani
- Short Term Action
  - Converting existing intersection (especially junction with Ring Road Kilimani) to Roundabout, and/or
  - Installing traffic signal system to existing and/or proposed Junction
- Medium Term Action
  - Converting existing and/or proposed roundabout to conventional and/or compromised type intersection with traffic signal system
- Long Term Action
  - Construction of overpass or underpass according to the future traffic demand

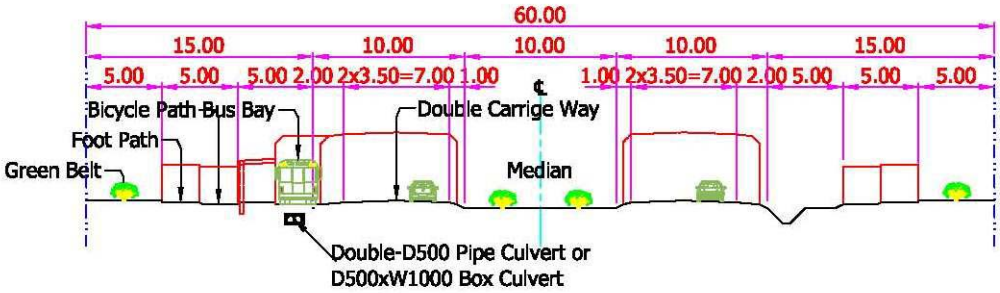
Section

- Short Term Action
  - Widening of existing undivided 2-lane road to divided 4-lane road, as proposed by KUTIP
  - Converting present matatu oriented public transport to bus oriented public transport system
- Medium Term Action
  - Providing service roads to both sides of proposed dual carriage way, or
  - Providing additional carriageways beside the proposed dual carriage way (tripling), or
  - Reserving existing carriage way for reversible use
- Long Term Action
  - Converting existing or additional carriage way to bus priority or exclusive lane then reserving for LRT operation beyond 2025

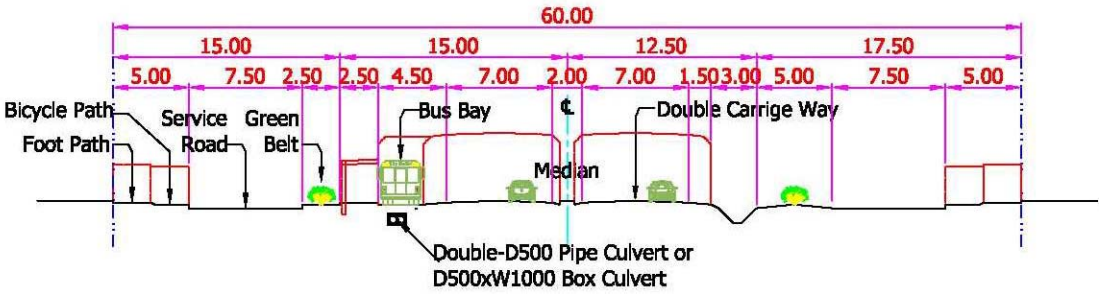
29.7.4 Proposed Improvement Measure

For proposed improvement measures the following alternative design is proposed based on an original cross section proposed by KUTIP.

Original Cross Section



Alternative Cross Section



29.8 EXAMPLE OF IMPROVEMENT OF JUNCTION GEOMETRY

29.8.1 Present Condition

Background

Other radial roads, beside Ngong Road, proposed to be widened under the short term programme are Limuru Road and Muranga Road that are major transport corridors and connect CBD with NMA's northern sub cores, such as Limuru, Kiambu, Ruiru, and Thika Towns.

Junctions located at the fringe of central area along these two roads with Forest Road are for early improvement, since traffic demands passing these points are increasing rapidly and their geometrical configurations are inappropriate to handle such demands.

29.8.2 Traffic Demand Forecast

Limuru Road w/ Forest Road

As shown in Table 29.8-1 and Figure 29.8-1, traffic demands crossing this junction will increase by 34 % from 38 (present) to 51 in 2010 and by 28 % in 2015. Thus total volume will reach to 65 thousand pcu per day.

If geometrical configuration improvement works is made at this junction, then capacity level will increase by about 40%[5], saturation degree will decrease slightly from 0.68 (present) to 0.64 in 2010, even if traffic demands will increase as described above.

TABLE 29.8-1 TRAFFIC DEMAND AT JCT LIMURU RD W/ FOREST RD

(Capacity = 56 at Present, 80 in 2010 & 2015)

Junction	Present	2010	2015	Index ('10/'04)	Index ('15/'10)
Limuru Road w/ Forest Road	38.0 [0.68]	50.9 [0.64]	65.0 [0.81]	1.34	1.28

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: Saturation Degree

[5] Assumed present capacity of 4-lane operation as 56, and future capacity of 6-lane operation along Limuru Rd (both inbound and out-bound) as 80 thousand pcu per day, as same figures as achieved by Pilot Project Experiment at Westlands Roundabout.

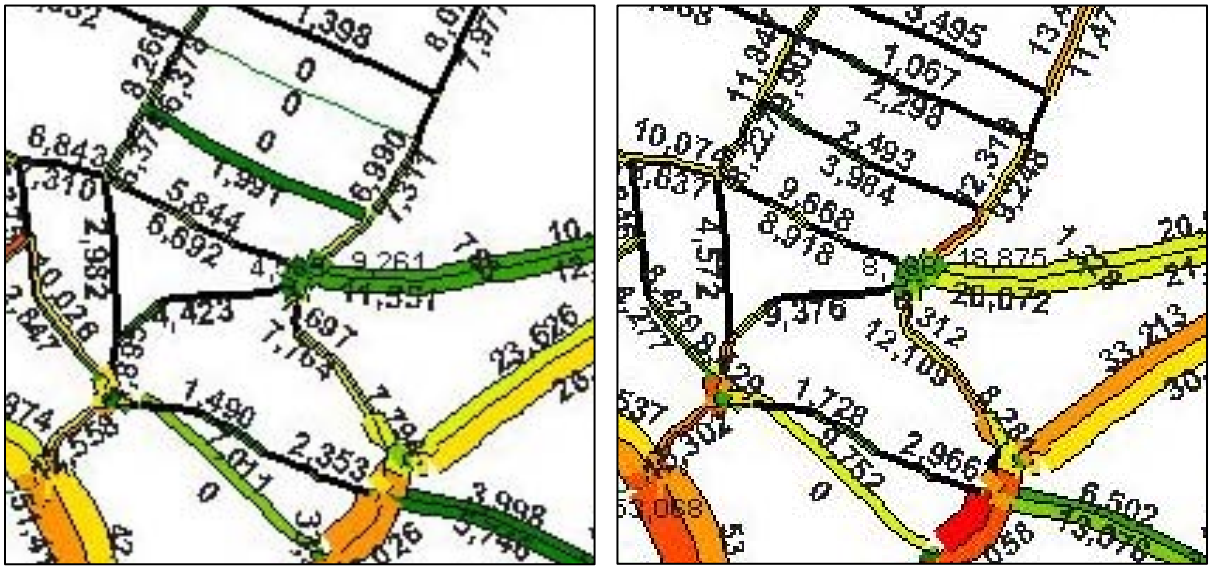


FIGURE 29.8-1 TRAFFIC DEMAND AT JCT LIMURU RD W/ FOREST RD

Note: Left: "Present", Right: "Year 2010"

Muranga Road and Forest Road

As shown in Table 29.8-2 and Figure 29.8-2, traffic demands crossing this subject junction will increase by 34 % from 67 (present) to 90 thousand pcu per day in 2010, and by 28 % in 2015. Therefore total traffic demand passing this subject junction will reach 115 thousand pcu per day in the next decade.

If geometrical configuration improvement works is made at this junction, then capacity will increase by about 40%[6], saturation degree will decrease slightly from 1.20 (present) to 1.12 in 2010, even if traffic demands will increase as described above.

TABLE 29.8-2 TRAFFIC DEMAND AT JCT MURANGA RD W/ FOREST RD

(Capacity = 56 at Present, 80 in 2010 & 2015)

Junction	Present	2010	2015	Index ('10/'04)	Index ('15/'10)
Muranga Road w/ Forest Road	67.1 [1.20]	89.9 [1.12]	114.7 [1.43]	1.34	1.28

Note; Top: Traffic Demand (unit: '000 pcu per day), Bottom: Saturation Degree

[6] Assumed present capacity of 2-circular lane operation is 56, and future capacity of 3-circular lane operation is 80 thousand pcu per day as same figures as achieved by Pilot Project Experiment at Westlands Roundabout

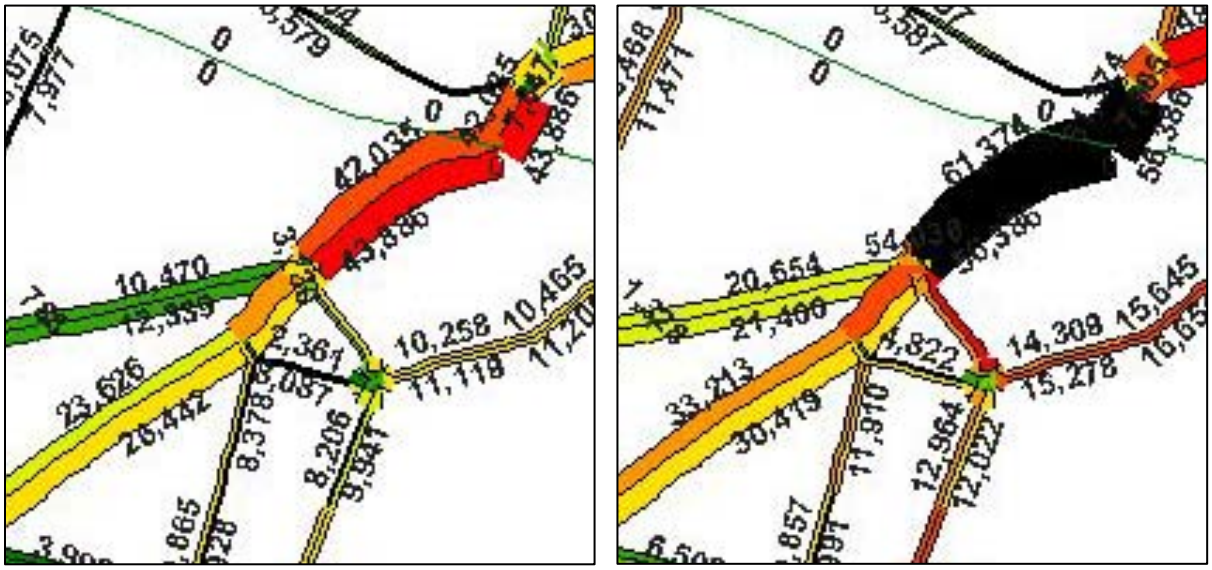


FIGURE 29.8-2 TRAFFIC DEMAND AT JCT MURANGA RD W/ FOREST RD

Note: Left: "Present", Right: "Year 2010"

29.8.3 Identification of Problems

To alleviate traffic problems at these junctions, the following counter measures shall be applied;

- Immediate Action
  - Providing additional lane to existing junction
  - Installing traffic signal system to the above
- Short Term Action
  - Converting present matatu oriented public transport to bus oriented public transport system
- Medium Term Action
  - Converting existing junction to conventional or compromised type intersection with traffic signal system
- Medium ~ Long Term Action
  - Construction of diversion routes (such as extension of Ring Road Parklands between Mpaka Road and Juja Road, crossing Limuru Road and Muranga Road as Circumferential Road No.3, and Northern & Eastern Bypass together with Western & Eastern Bypass Link Roads as proposed in the Master Plan)

29.8.4 Proposed Improvement Example of Geometrical Improvement Design

The followings are example of geometrical improvement design for subject junctions.

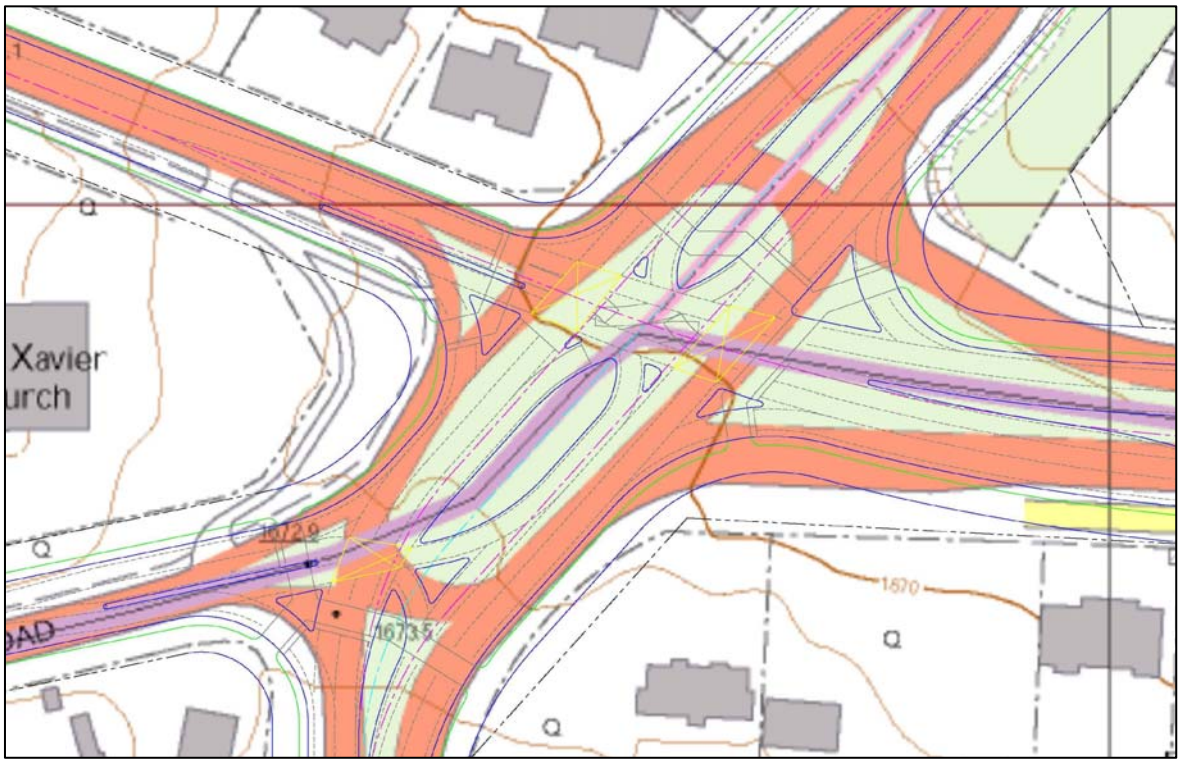


FIGURE 29.8-3 JUNCTION IMPROVEMENT PLAN AT LIMURU RD. W/ FOREST RD.

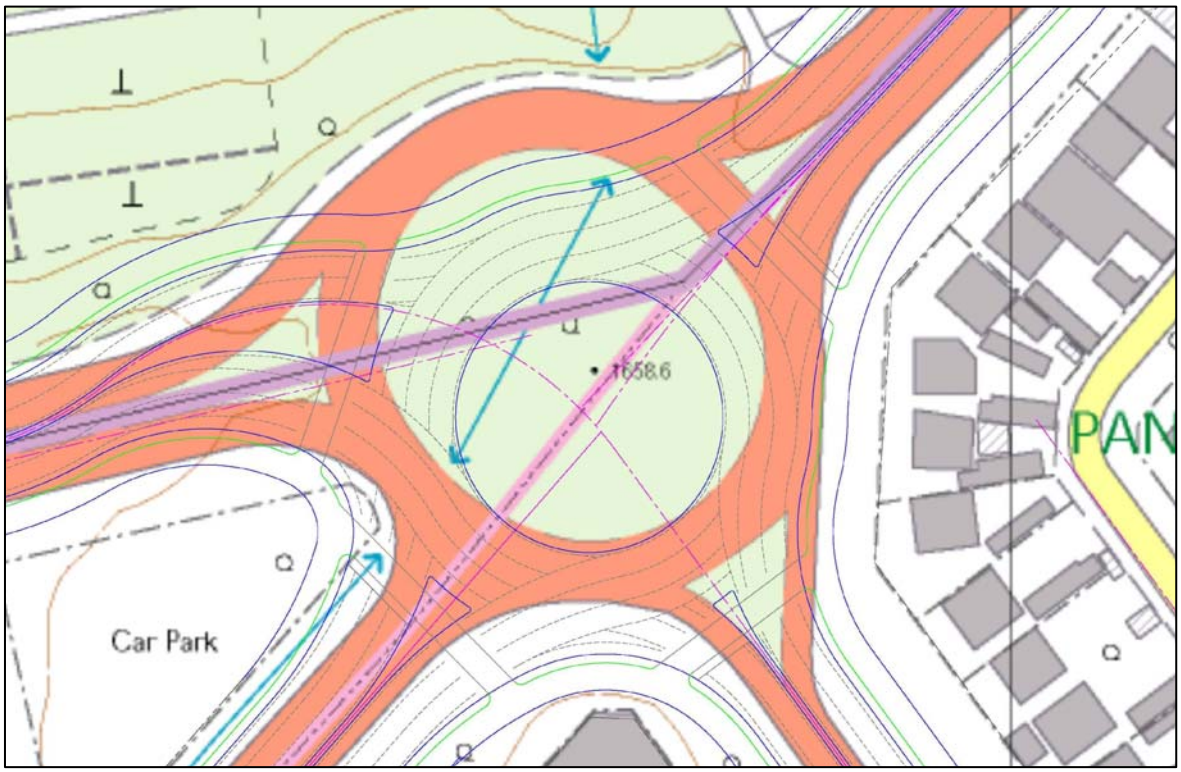


FIGURE 29.8-4 JUNCTION IMPROVEMETN PLAN AT MURANGA RD. W/ FOREST RD.-1

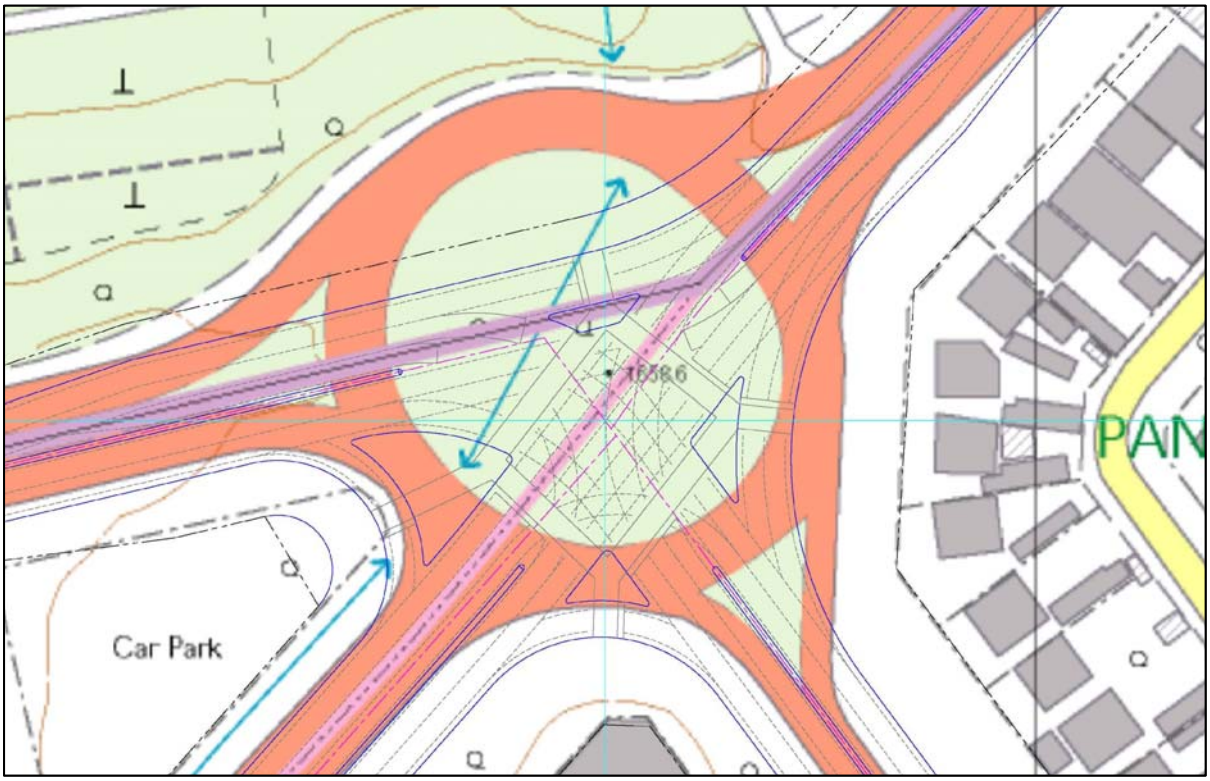


FIGURE 29.8-5 JUNCTION IMPROVEMENT PLAN AT MURANGA RD. W/ FOREST RD.-2

29.9 ENVIRONMENT AND SOCIAL CONSIDERATIONS

29.9.1 Present Environmental Conditions

(1) Roads Connecting to CBD

Natural Environment

The following roads are identified as the roads connecting to the CBD within the framework of the Pre-feasibility Study of the Traffic Flow Improvement of Roads connecting to CBD.

- Limuru Road leading to Muranga Road;
- Pangani Area's Roundabout to Muranga Road leading to Globe Cinema's Roundabout;
- Park Road leading from Muranga Road to River Road;
- Ngara Ring Road leading from Juja Road to River Road; and
- Landhies Road leading from Jogoo Road to River Road.

The above roads pass through areas developed in the vicinity of the CBD. Except for roundabouts and greenbelts, trees as well as flowering bushes and grass, there is no significant flora and fauna or a habitat significant for fauna, insects and aquatic life. There is also no significant water body in this area.

On the other hand, traffic noise, vibration and air pollution emanating from vehicles, which are speeding, or slowly moving, or on the stop-and-go motion depending on the volume of traffic, are considered to significantly affect the natural environment as well as urban amenity of these areas and public health of the local residents and working force.

Social Environment

The roads connecting to the CBD are heavily congested during the morning and evening peak hours, while the buildings fronting these roads are a mixture of office buildings, apartment blocks as well as commercial and industrial. Thus, passengers and pedestrians passing through this area during the day appears to be more than 450,000 persons, which would be larger than the population living along these roads.

(2) Traffic Flow Improvement Inside CBD

Natural Environment

The following small areas are identified as CBD within the framework of the Pre-feasibility Study of the Traffic Flow Improvement inside CBD:

- Moi Avenue leading from Nairobi's Railway Station to University Way;
- Tom Mboya Street from Haile Selassie Avenue to Globe Cinema Roundabout;

- River Road from Ring Road Pumwani to Tom Mboya Street; and
- University Way to Globe Cinema Roundabout.

These areas have been developed as urban centres of the CBD. Except for greenbelt's trees and flowering bushes, there is no significant flora and fauna or habitat significant for fauna, insects and aquatic life. There is also no significant water body in this area. On the other hand, traffic noise, vibration and air pollution emanating from vehicles slowly moving, or on the stop-and-go motion depending on the volume of traffic is considered to significantly affect the amenity and public health of the local residents and the working force.

Social Environment

The CBD within the framework of the Project consists of Stage 1 and 2 of the Medium Zoning System of Nairobi. The number of people permanently living within the CBD is around 48,000 and it appears to be less than those commuting to the CBD, which would be estimated to be more than three-quarters of a million as it is one of the largest commercial and administrative centre of Nairobi. Large volume of commercial activities prevailing in the CBD than home-based community activities.

(3) Traffic Flow Improvement in Westlands

Natural Environment

The Westlands area has been developed as an urban sub-centre outside the CBD. Except for greenbelt's trees and flowering bushes, there is no significant flora and fauna or habitat significant for fauna, insects and aquatic life. There is also no significant water body in this area. On the other hand, traffic noise, vibration and air pollution emanating from the vehicles moving slowly, or on the stop-and-go motion depending on the volume of traffic, is considered to significantly affect the amenity and public health of the local residents and working force.

Social Environment

The population permanently living within Westlands area appears to be less than that commuting to the City Centre and other areas of Nairobi. It appears that more than 300,000 people pass through Westlands every day except on Saturdays and Sundays to participate in socio-economic activities. At present, the area is one of the most heavily developed commercial centres of Nairobi. Thus, through traffic as well as commuting traffic to work and shopping would heavily congest in this area.

29.9.2 Initial Environmental Impact Assessment

(1) Roads Connecting to the CBD

Impacts on Natural Environment

There is no significant natural environment affected by the Project in any way.

Impacts on Social Environment

Comparison of the size of local residents, commuting to the offices, shops, and any other industries and trades to work along these roads, and those of through traffic in terms of demographic and socio-economic activities are subject to further study. Thereby social impacts of these areas are not explicitly analyzed. Comparison of the commuting population as work force and permanently living local population in terms of social impact study in these areas is also a subject for further study.

Traffic Safety as a Result of Roundabout Improvement

There are a mixture of old rotaries and traffic circles with modern roundabouts in Nairobi. Thus this Study report discusses and argues that modern roundabouts should provide more safety and larger traffic flow in urban areas than those of the old fashioned system. Improvement of roundabouts in Nairobi's urban centre that are not appropriately operated in relation to the increased traffic flow since their construction is considered important in terms of enhancement of the overall urban-oriented economic activities. Thus the following environmental factors and impacts, both positive and negative, are noted in relation to the improvement of roundabouts in Nairobi's city centre area.

- Vehicular traffic to be better controlled by application of a mandatory "give-way" rule, i.e. no high-speed entering, merging and weaving of vehicles. This can be achieved by strict orientation of drivers in various ways, such as media campaigns, driving schools, etc., which are essential although training of the drivers should be separately implemented from the above plan.
- Separation of vehicular traffic and pedestrians with the provision of facilities such as splitter islands and road-markings for crossing. These should provide higher safety to the pedestrians who are controlled to move from sidewalks to splitter islands, and then from splitter islands to sidewalks.
- Separation of non-motorized vehicles from the motorized vehicles with roundabout improvement plan would provide enhanced safety to the users of non-motorized vehicles, who are usually low income class of citizens.
- Since the geometry of roundabouts and its approach roads is known to function as a mode of slowing down speeding traffic, vehicular traffic on roads between roundabouts would naturally slow down to some extent.

Air Pollution, Noise and Vibration

- Up-coming vehicular traffic is not brought to a complete stop but continued slow movement is achieved with the modern roundabout system. This will provide reduction of idling time i.e. vehicular fumes are reduced. Hence, reduction of CO^2 emission can be achieved to some extent. Quantitative analysis of the reduction of pollution at any given roundabout improvement section is subject to further study.
- Continuous slow movement of vehicular traffic does not require stop-and-go of vehicles, which normally would cause noise and vibration as they use a lower ratio of gear setting. Without stop-and-go, noise and vibration emanating from vehicles entering the roundabouts are reduced to a large extent than they are at present.

Landscaping and Increase of Aesthetic Value

- There is a wide area required for effective configuration of roundabouts. If improvement works should take a wider spatial requirement, landscaping areas of the existing sidewalks would be reduced.
- On the other hand, the improved roundabout itself would provide more aesthetic value to the local area with landscaping in the roundabout.
- Centre island and splitter islands created for modern roundabout systems are used for various purposes such as to create green areas with trees and flowers, which would absorb CO^2 emissions from vehicles to some extent which in particular is environmentally friendly to the human mind in general.

Road Facilities as Urban Amenity

- Approach areas of modern roundabout systems require less space than signalized intersections provided that multiple turn lanes are not required i.e. width of sidewalks is reduced. This would mean modern roundabout systems can provide more wider sidewalks, or parking spaces, plant strips/boxes on the road between two roundabouts.
- Without signals, there is no cost of maintenance in terms of electricity consumption and maintenance works. Thus there is no breakdown of the signals that might cause heavy traffic congestion, which would in turn cause temporary disruption of economic activities.
- Centre and splitter islands would be used to erect commercial signboards. Depending of the materials and the way they are erected, urban amenity as well as general economic activities in Nairobi could be enhanced to some extent. On the other hand, such commercial signboards could contribute to the revenue of the City Council of Nairobi.

Disruption of Traffic During the Construction Period

- While large scale roundabout improvement works would require carefully planned construction works for minimizing traffic disruption, it is not possible to eliminate 100% of traffic disruption during the construction works. Over several months to a year, traffic

disruption could therefore take place.

- As a result of the construction works for roundabout improvement works, dust and vibration at the construction site would increase over time. Pedestrians should therefore be safeguarded from such environmental hazards throughout the construction period.

(2) Traffic Flow Improvement Inside CBD

Natural Environment

There is no significant natural environment in any way affected by the Project.

Traffic Safety as a Result of Traffic Flow Improvement

Improvement of the existing intersections, three-way crossing and four-way or more, without traffic signals, road markings and signs, or those with traffic signals, road marking and signs but not appropriately operated and used while traffic flow has increased since their construction in Nairobi's city centre, are considered important in terms of overall urban-oriented economic activities. Thus, the following environmental factors and impacts, both positive and negative, are noted.

- Signalized intersections are generally a very safe way of controlling traffic provided that everyone obeys the traffic rules. Pedestrians would particularly benefit from the signalisation of intersections in Nairobi.

Air Pollution, Noise and Vibration

- Depending on the duration of traffic signals, vehicles that are brought to a complete stop would continue to idle their engines. Vehicles in Nairobi would also discharge excessive amounts of exhaust fumes. Thus, this practice would be a contributor to air pollution, noise and vibration to some extent.
- Signalized intersections would contribute to less delay, less fuel consumption and less CO^2 emission, noise and vibration as traffic volume is low. This would not be the case during the busy hours as fuel consumption of each vehicle would increase to some extent at each intersection as fixed time signals force vehicles to a complete stop. This would further mean that noise and vibration emanating from vehicles would increase.

Landscaping and Increase of Aesthetic Value

- Spatial requirement of intersections would be less than that of roundabouts. Thus, there would be no space for landscaping, i.e. urban amenity would not be enhanced to some extent.

Road Facilities and Urban Amenity

- During the breakdown of the signals, or at the time of disrupted supply of electricity, there would be heavy traffic congestion i.e. urban amenity is drastically reduced.

- Maintenance cost of signals including electricity consumption would be required i.e. lack of appropriate maintenance works would cause significant lack of urban amenity to the drivers and pedestrians.

Disruption of Traffic During the Construction Period

- While large scale roundabout improvement works would require carefully planned construction works for minimizing traffic disruption, it is not possible to eliminate 100% of traffic disruption during the construction works. Over several months to a year of traffic disruption could therefore take place.
- In association with the construction works for roundabout improvement works, dust and vibration at the construction site would increase over time. Pedestrians should therefore be safeguarded from any inconveniences throughout the construction period.

(3) Traffic Flow Improvement of Westlands

Natural Environment

There is no significant natural environment in any way affected by the Project.

Social Environment

- Debate with the local residents and other stakeholders is continuously necessary and important in terms of information dissemination on the contents of the works in relation to the improvement of traffic flow in Westlands area.
- A series of improvement works around the Westlands roundabout would temporarily disrupt traffic but it would be over a limited period of time and not cumulative. There is no irreversible and adverse effect anticipated to occur.
- Comparison of the commuting population as work force and permanently living local population in terms of socio-economic analysis and social impact study in the CBD is subject to further study.

29.9.3 Environmental Management and Monitoring Plan

(1) Roads Connecting to CBD

During the construction period, traffic congestion would be worsened due to various blockages and road barriers. Normal measures of construction works would solve most of the issues. Statues on the roundabout in Pangani area would have to be protected during the construction period.

(2) Traffic Flow Improvement Inside CBD

Depending on the way the project is implemented, small shops and kiosks are directly affected. Thus, dialogue at the stakeholder meetings should be encouraged as much as possible to address the demands by the local business operators regarding the contents of the project.

(3) Traffic Flow Improvement of Westlands

Since the implementation of the Pilot Project, there have been a large number of complaints on the way it was implemented. Thus, continuous dialogues with the stakeholders regarding the demands by the local business operators should be held to discuss the contents of the project.

29.9.4 Contributing Factors of the Traffic Flow Improvement Plan to Behavioral Changes of the Drivers and Pedestrians

Psycho-physical Comfort

- Modern roundabouts would better outperform signalised intersections in terms of travel time and short queuing of vehicular traffic, factors which usually lead to psychological irritation of the drivers, would be drastically reduced.
- Controlled traffic at signalized intersections would mean that the drivers would be dissuaded from blocking up-coming traffic in trying to take the advantage of congested traffic i.e. traffic order at intersections would affect the attitude of drivers in a more positive way.
- Increased flow of vehicular traffic at the improved roundabout would benefit the pedestrians, who are at present affected due to the lack of traffic safety facilities as they cross the road at roundabouts, or signalized intersections.
- As above, smooth flow of traffic would affect the psychological attitude more positively. In return, the drivers and pedestrians would experience physical comfort. Psychological accumulation of such comfort should eventually positively affect family life as a whole.

Increase of Economic Productivity

- As irritating traffic congestion is reduced at various points in the city centre of Nairobi, general travelling time of goods and people would be reduced to a large extent i.e.

economic productivity over time would be improved.

- Continuous slow movement of vehicular traffic at roundabouts does not require stop-and-go motion of vehicles i.e. not only noise and vibration emanating from vehicles entering the roundabouts would be reduced but also less consumption of fuel would be realized. In view of the increasing number of not-so-well serviced vehicles and higher fuel costs in the future in Kenya, improved roundabout systems, would contribute to the prevention of increasing air pollution and cost of fuel.

29.10 ECONOMIC EVALUATION

29.10.1 Presumption of Economic Analysis

The economic evaluation is carried out from view of whether or not the investment for the Traffic Flow Improvement in City Centre will be feasible in terms of national economy by the benefit-cost analysis.

Prior to carry out the economic analysis, the following presumptions are set up:

(1) Evaluation Period

The evaluation period is assumed to be 10 years from 2010 to 2019 taking into account the nature of the Traffic Flow Improvement Project. This period includes the construction period.

(2) Implementation Schedule

The assumed implementation schedule is shown in Table 29.10-1:

TABLE 29.10-1 IMPLEMENTATION SCHEDULE

	2006	2007	2008	2009	2010
1. Road connecting to CBD					
2. Traffic flow improvement in CBD					
3. Parking improvement inside CBD					
4. Revitalization of Moi Avenue					
5. Traffic flow improvement in Westlands					

(3) "With" and "Without" the Project

Economic benefits are calculated as differences between "With the Project" and "Without the project". For the calculation of economic benefits, the situation of "Without the Project" is defined as "Do Nothing" is made, while "With the Project" is defined as the proposed Traffic Flow Improvement Project is implemented.

(4) Economic Benefits

Economic benefits in the economic analysis are assumed to be the following three:

- Vehicle operating cost
  - Vehicle running cost (VRC) (distance related running cost)
  - Vehicle fixed cost (VFC) (time related running cost)
- Travel time cost (TTC) by vehicle users

(5) Economic Cost

The economic costs of the Project can be calculated from the financial costs deducting transfer elements such as import duties, taxes and tariffs, subsidies and other price distortion to trade. According to the recent feasibility study of Northern Corridor Transport project, the transfer element was calculated at 22 % to the total construction and maintenance cost. In this study therefore, it is assumed that the economic costs are calculated to deduct 22 % of the financial costs.

(6) Economic Indicators

The economic evaluation method is principally employed benefit cost analysis. The economic indicators used in this study are as follows:

- Net Present Value (NPV)
- Benefit Cost Ratio, (BCR), and
- Economic Internal Rate of Return (EIRR)

29.10.2 Traffic Demand Forecast

Future traffic demand forecasted in a form of OD matrix (years 2010, 2015 and 2025) was assigned on the road network to estimate traffic volume in the city centre. The estimated vehicle kilometers and vehicle hours of the road network in Nairobi for the case of "with" and "without" the project is summarized in Table 29.10-2 and Table 29.1-3 respectively.

TABLE 29.10-2 TOTAL VEHICLE KILOMETERS IN NAIROBI WITH AND WITHOUT TRAFFIC FLOW IMPROVEMENT PROJECT IN CBD IMPROVEMENT PROJECT

Unit: '000 PCU Km / day

	W/O Project	W/ Project	W/O – W/
2010	14,192.3	14,079.3	112.9
2015	17,864.7	17,732.3	132.4
2025	28,080.7	27,576.5	504.1

Note: All traffic flow implementation measures are implemented by 2008

TABLE 29.10-3 TOTAL VEHICLE HOURS IN NAIROBI WITH AND WITHOUT TRAFFIC FLOW IMPROVEMENT PROJECT IN CBD IMPROVEMENT PROJECT

Unit: '000 PCU Hour / day

	W/O Project	W/ Project	W/O – W/
2010	513.4	502.4	11.0
2016	814.4	797.5	16.8
2022	2,180.8	2,153.4	27.4

Note: Same notes as in Table 29.10-1

29.10.3 Estimation of Benefit

(1) Basic Vehicle Operating Cost

The basic vehicle operating cost (BVOC) was estimated in the master plan stage. (See Table 29.10-4)

TABLE 29.10-4 BASIC VEHICLE OPERATING COST (EXCLUDING TAX)

Vehicle Type	Running (Ksh/1000km)	Fixed (Ksh/Hour)	Time (Ksh/Hour)
Car	7.3	27.2	33.1
Matatu	10.7	66.3	25.3
Bus	22.4	86.8	83.2
Medium Truck	19.2	65.3	0.0
Heavy Truck	28.3	83.1	0.0

Note: All costs are expressed as 2004 prices

(2) Estimation of Benefits

The saving in vehicle operating costs and travel time cost were estimated and are shown in Table 29.10-5.

TABLE 29.10-5 ESTIMATION OF BENEFITS

Unit: Thousand Ksh/Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TTC	Total Saving
2010	329,532	100,320	429,852	108,471	538,323
2015	427,301	153,615	580,916	166,155	747,071
2020	833,613	186,720	1,020,333	201,962	1,222,296

Note: Same notes as in Table 29.10-1

29.10.4 Economic Cost Estimate

(1) Economic Cost

The project cost, which was already calculated in the previous section, is expressed as the financial cost. It is therefore to convert from financial cost to economic cost. In this study the economic cost is estimated to deduct from financial cost to government taxes and shadow prices of unskilled labor and shown in Table 29.10-6.

TABLE 29.10- 6 ECONOMIC COST ESTIMATE

Unit: Million Ksh

Description		Economic Cost	Financial Cost
1	Road Connecting to CBD	304	390
2	Traffic Flow Improvement in CBD	428	549
3	Parking Improvement inside CBD	117	150
4	Revitalization of Moi Avenue	66	84
5	Traffic Flow Improvement in Westlands	23	29
	Total	938	1,202

(2) Maintenance Cost

The maintenance cost, which consists of routine maintenance, was estimated in 29.10.6. The maintenance cost is converted to the economic cost as follows:

TABLE 29.10-7 ECONOMIC COST ESTIMATE

Unit: Million Ksh

	Economic Cost	Financial Cost
Routine maintenance Cost	19	24

29.10.5 Economic Evaluation

(1) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimates, the economic analysis of the Project was made. Table 29.10-8 shows the benefit – cost analysis of Traffic Flow Improvement Project in CBD during project life period of 20 years and Table 29.10-9 shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of Ksh 1,851 million and BCR of 3.49 over 10 years life of the road using a discount rate of 12% which is designated by the Ministry of Planning and Economic Development. The Economic Internal Rate of Return (EIRR) was compiled at 45.8%.

TABLE 29.10-8 ECONOMIC INDICATIONS OF BENEFIT COST ANALYSIS

Net Present Value	Ksh 1,851 million
BCR	3.49
EIRR	45.8%

Notes: 1) Project life is assumed to be 10 years
2) Discount rate is 12%

(2) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of costs and benefits. Table 29.10-9 shows the results of the sensitivity analysis.

TABLE 29.10-9 SENSITIVITY ANALYSIS REGARDING COSTS AND BENEFITS OF TRAFFIC FLOW IMPROVEMENT PROJECT IN CBD (NAIROBI CONSTRUCTION PROJECT)

		Indicator	Benefits		
			20% down	Base Case	20% up
Costs	20% down	NPV (Ksh million)	1,481	2,000	2,518
		B/C Ratio	3.49	4.37	5.24
		EIRR (%)	45.8	55.3	64.4
	Base Case	NPV (Ksh million)	1,332	1,851	2,370
		B/C Ratio	2.79	3.49	4.19
		EIRR (%)	37.8	45.8	53.5
	20% up	NPV (Ksh million)	1,184	1,702	2,221
		B/C Ratio	2.33	2.91	3.49
		EIRR (%)	32.1	39.2	45.8

Note: Project life of the project is assumed to be 10 years

(3) Summary of Economic Analysis

The implementation of the Traffic Flow Improvement Project in CBD can be justified from view of national economic point since the economic indicators of all cases are more than the over cut-off level which can be considered as 12% of EIRR in Kenya.

TABLE 29.10-10 BENEFIT COST-STREAM OF TRAFFIC FLOW IMPROVEMENT PROJECT IN CBD

Unit: Thousand Ksh

Undiccounted BenefiT Cost Stream

000 KSh

Sq	Year	Construction Cost	O & M Cost	Cost Total	VOC	TTC	Benefit	Cost-Benefit
1	2004	0	0	0			0	0
2	2005	0	0	0			0	0
3	2006	289,800	0	289,800			0	-289,800
4	2007	332,800	5,796	338,596	77,329	17,181	94,510	-244,086
5	2008	208,300	12,452	220,752	177,043	39,998	217,040	-3,712
6	2009	107,000	16,618	123,618	239,485	64,534	304,019	180,401
7	2010	0	18,758	18,758	429,852	108,471	538,323	519,565
8	2011	0	18,758	18,758	424,045	118,141	542,186	523,428
9	2012	0	18,758	18,758	448,614	128,656	577,270	558,512
10	2013	0	18,758	18,758	475,763	140,106	615,869	597,111
11	2014	0	18,758	18,758	505,865	152,576	658,441	639,683
12	2015	0	18,758	18,758	580,916	166,155	747,071	728,313
13	2016	0	18,758	18,758	642,019	166,155	808,174	789,416
14	2017	0	18,758	18,758	719,542	174,463	894,005	875,247
15	2018	0	18,758	18,758	807,436	183,186	990,622	971,864
16	2019	0	18,758	18,758	907,149	192,345	1,099,494	1,080,736
	Total	937,900	222,446	1,160,346	6,435,058	1,651,967	8,087,024	6,926,678

Diccounted BenefiT Cost Stream

000 KSh

Sq	Year	Discounted	Cost Total	Benefit	Cost-Benefit
1	2004	1.000	0	0	0
2	2005	1.120	0	0	0
3	2006	1.254	231,027	0	-231,027
4	2007	1.405	241,006	67,271	-173,735
5	2008	1.574	140,292	137,933	-2,359
6	2009	1.762	70,144	172,509	102,364
7	2010	1.974	9,503	272,731	263,228
8	2011	2.211	8,485	245,258	236,772
9	2012	2.476	7,576	233,150	225,574
10	2013	2.773	6,764	222,089	215,324
11	2014	3.106	6,040	212,000	205,961
12	2015	3.479	5,393	214,765	209,372
13	2016	3.896	4,815	207,438	202,624
14	2017	4.363	4,299	204,883	200,584
15	2018	4.887	3,838	202,701	198,863
16	2019	5.474	3,427	200,874	197,447
		Total	742,609	2,593,600	1,850,991

NPV (Million)	1,851
B/C Ratio	3.49
EIRR	45.8%

29.11 CONSIDERATIONS FOR IMPLEMENTATION

29.11.1 Implementing Organization

All the physical improvement measures for the traffic management in the city centre are under CCN's responsibility. The financial burden of their implementation is light enough to be absorbed by the CCN's annual budget shown in Table.28.11-1.

29.11.2 Consideration for Coordination with Schemes for Public Transport and Parking

City centre traffic involves a significant degree of roads based on public transport which comprise of buses and matatus and is affected by its parking system. Bus/ matatu terminals and stops have serious impacts on traffic flow especially when they are operated in a disorderly manner. Their movement must be controlled and taken into account in regard to the traffic management plan and improvement activities.

In this regard, close coordination between personnel relating to public transport and traffic management is necessary. Special arrangements for such coordination are required even though they may be in the same organisation.

29.11.3 Importance of Coordination between Driver and Public Education and Enforcement

(1) Coordination between Driver and Public Education

Although these physical measures are vital for better traffic flow in the city centre, attitudinal changes of drivers and pedestrians are crucial for the realisation of better traffic flow. In this regard proper education and training including publicity for compliance with traffic rules and regulation are indispensable. CCN in collaboration with MOT is recommended to prepare specific information materials regarding city centre traffic rule and regulations to be utilized for education and training of drivers and public. Furthermore promotion and facilitation of these practices by general education, drivers training, and publicizing entities are required for diffusion of preferable behaviours for good city centre traffic condition.

(2) Coordination with Enforcement and Traffic Control

It is also important to harmonize these measures with enforcement and traffic control activities conducted by the Traffic Police. For this purpose too collaborated action with MOT is required for CCN to attain correct understanding of the measures by the Traffic Police for their enforcement activities regarding traffic rules and regulations in the city centre.

29.11.4 Organizational Arrangement

Since preferable arrangement for the traffic management in city centre has common characteristics and relating organisations with the public transport sector, the arrangement is better to be a collective one. Details of an organisational issue are described in the Section 30.8 of the following chapter.

TABLE 29.11-1 ESTIMATED AND ACTUAL REVENUE AND EXPENSE OF CCN

Unit: Million Ksh

	2000/01		2001/02		2002/03		2003/04		04/05
	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.
Revenues									
Central Gov. Transfers									
LATF	485	485	607	607	607	519	642	642	692
RMLF	150	208	168	32	0	60	32	197	160
Sub Total	635	694	775	639	607	579	674	839	852
Local Revenues									
CILOR	100	0	100	0	102	0	110	91	110
Property Rates	1,110	934	983	994	1,050	1,541	1,420	1,273	1,430
Singel Business Permit	459	382	600	381	543	394	454	514	600
Market Fees	122	94	95	90	154	99	0	102	150
Others	2,818	2,134	3,253	2,140	2,729	2,118	6,753	2,238	1,789
Sub Total	4,609	3,544	5,031	3,604	4,578	4,152	8,737	4,218	4,078
Total Revenues	5,244	4,237	5,806	4,244	5,185	4,731	9,411	5,057	4,930
Expenditure									
Civic	0	42	35	45	0	42	83	46	94
LA Personnel	2,213	2,083	2,112	2,126	2,070	3,078	3,132	2,548	2,824
LA Operations	1,657	1,582	1,787	1,389	1,343	1,605	1,695	1,455	1,065
LA Maintenance	193	135	196	294	210	77	167	83	82
Total Recurrent Expenditures	4,064	3,843	4,130	3,855	3,623	4,802	5,077	4,131	4,065
Recurrent Surplus/Deficit	1,181	394	1,676	389	1,562	-71	4,334	926	865
Capital Expenditures	113	162	617	160	621	70	1,867	66	530
Loan Repayments	0	0	0	33	0	57	0	0	80
Net Surpuls/Deficit	1,068	233	1,059	196	941	-197	2,467	860	255
Debt Resolution Repayments	160	0	952	318	623	360	2,856	214	200
Uncommited Surpulus/Deficit	908	233	107	-122	318	-557	-389	646	55

Source: Local Authorities Transfer Fund (LATF) Annual Reports
2000/2001 - 2003/2004 by LATF Advisory Committee/ MOLG