PART VI

PRE-FEASIBILITY STUDY

CHAPTER 28

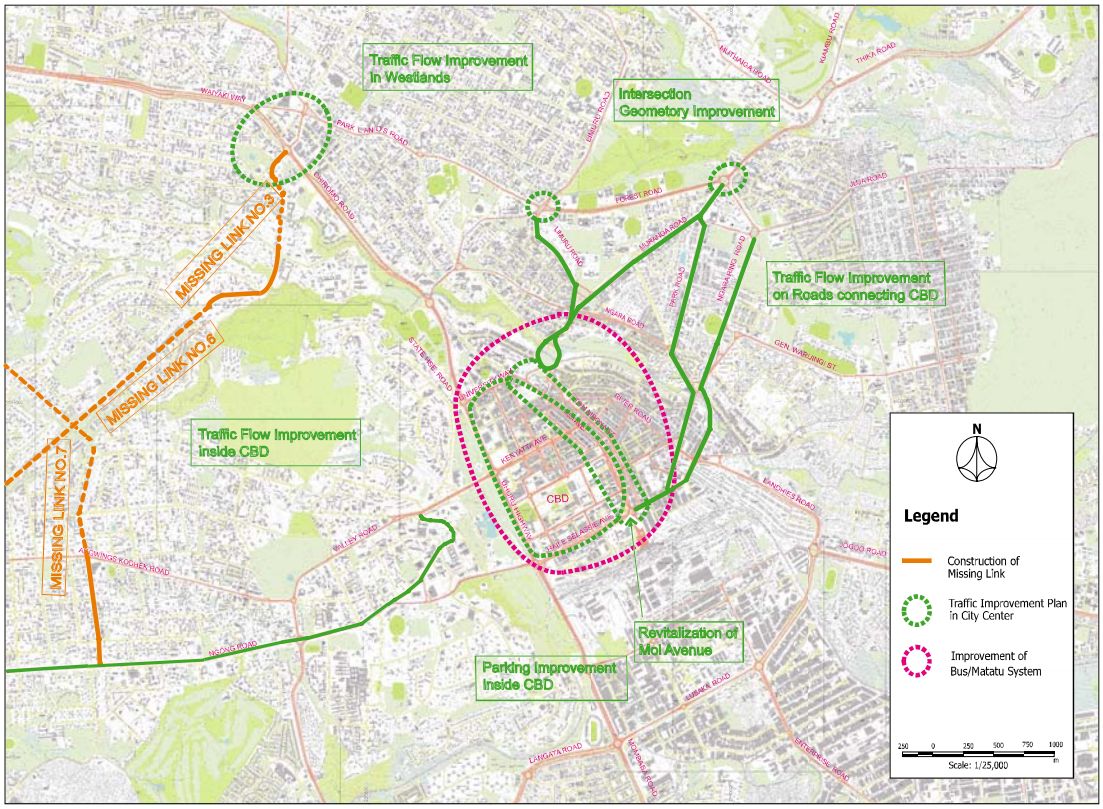
CONSTRUCTION OF MISSING LINKS NO.3, 6 AND 7

CHAPTER 28 CONSTRUCTION OF MISSING LINKS NO.3, 6 AND 7

SELECTION OF PRE-FEASIBILITY STUDY PROJECTS

The Master Plan proposed various projects and measures in the field of urban transport sector with implementation of three (3) stages. Among the projects under the Short-Term, the following were selected for the Pre-Feasibility Study to be implemented.

Selected Project	Objectives
Construction of Missing Links No.3, No.6 and No.7	• Formation of R/C road network • Encouragement of NMT • Promotion of area development
Traffic Improvement Plan in City Centre	• Improvement of traffic flow and circulation in the City Centre, particularly in CBD • Improvement of parking system inside CBD • Improvement of major arterials for traffic and urban scenery • Improvement of traffic flow in special commercial areas
Improvement of Bus and matatu System	• Restructuring of public transport system, particularly rerouting of Bus/Matatu routes • Improvement of small-scale facilities for effective public transport operation



LOCATION OF PRE-FEASIBILITY STUDY PROJECTS

28.1 STUDY APPROACH

(1) Study Flow

The Study approach is shown in the form of a flowchart in Figure 28.1-1.

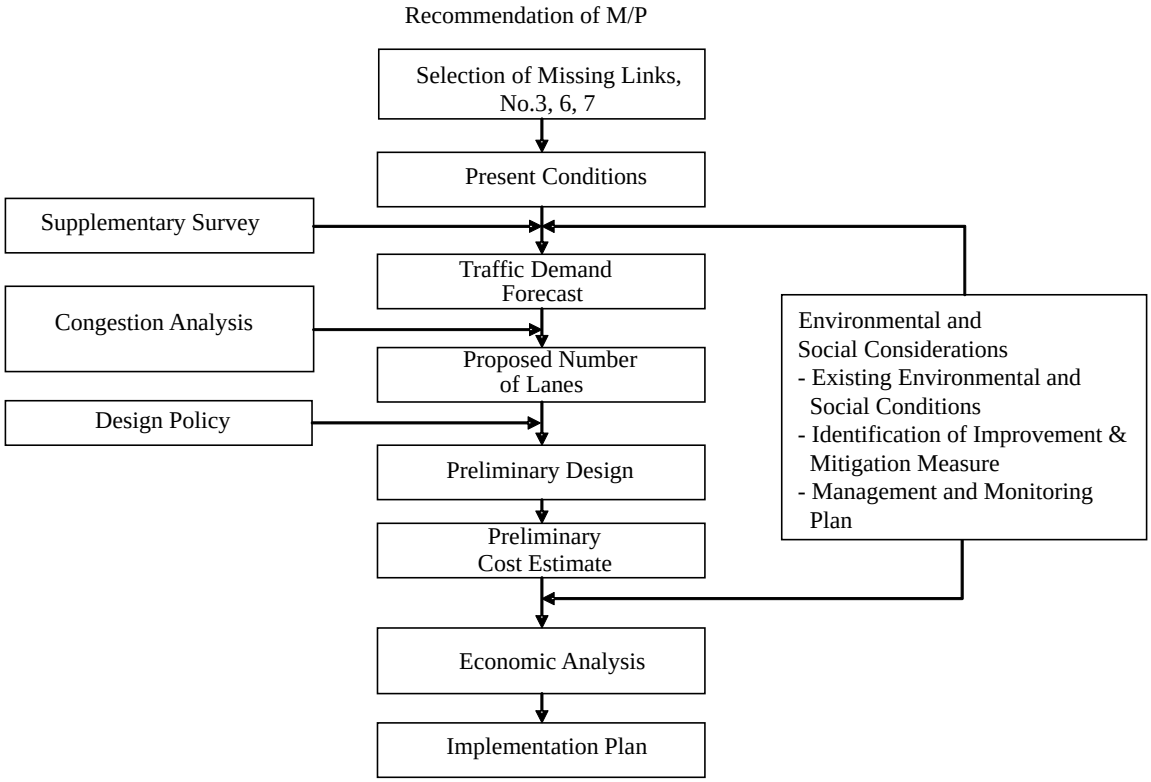


FIGURE 28.1-1 STUDY FLOW OF MISSING LINKS No. 3, 6, AND 7

(2) Objectives of Missing Links Construction

Missing Links No.3, No.6 and No.7 are non-existing roads at present and will become the most fundamental components of the road network in the western part of Nairobi City when completed. The objectives of the project are as follows:

Objectives of the Project

- To formulate a radial and circumferential road network(C-3) in order to provide an effective and economical road transport.
- To encourage non-motorized transport by providing safe and comfortable facilities.
- To promote area development and community cohesion by connecting zones divided by rivers.

(3) Selection of Study Missing Links

Priority of Missing Links was evaluated in Table 18.3-1 of Chapter 18. The Missing Links No.3, No.6, and No.7 were selected as the highest priority projects out of the 16 main missing links. The project location map is shown in Fig.28.1-2 and the components of selected Missing Links in Table 28.1-1.

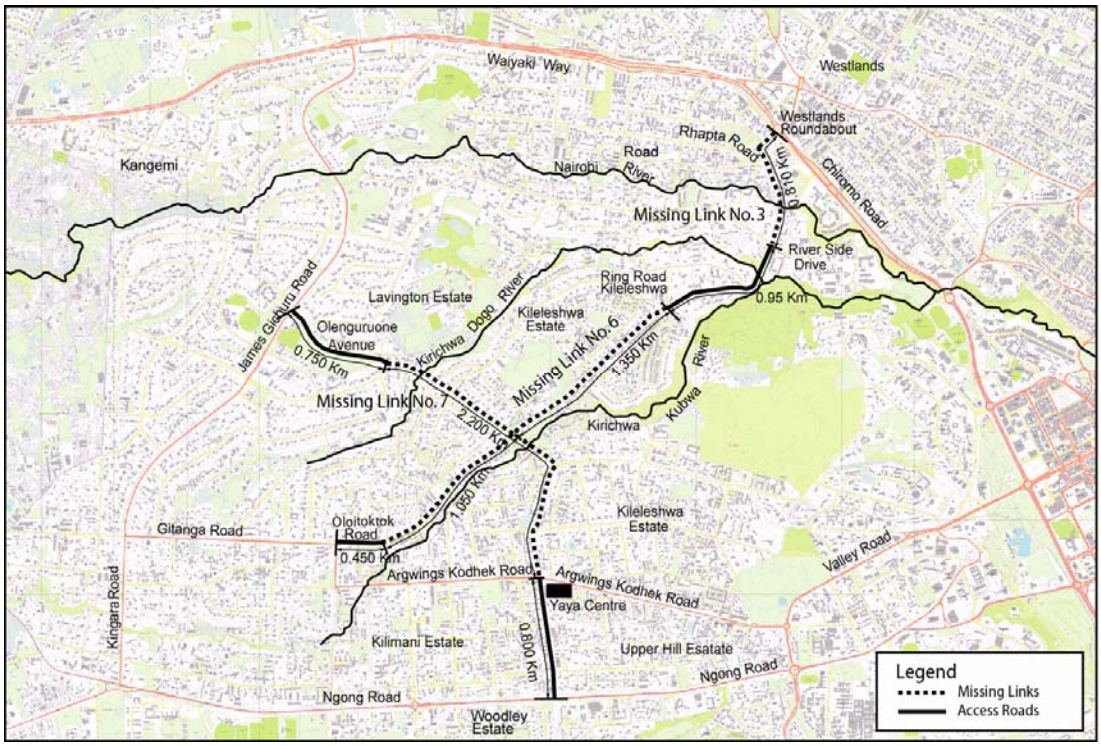


FIGURE 28.1-2 LOCATION OF STUDY MISSING LINKS

TABLE 28.1-1 STUDY MISSING LINKS

Section	From	To	Road Condition (Right of way)	Length (Km)
MISSING LINK NO 3 (Ring Road Kileleshwa / Riverside Drive to Rhapta Road/West Lands)				
1	0+000	0+950	Existing Road to be improved (Ring Road Kileleshwa to Riverside Drive)	0.950
2	0+950	1+760	ROW=30 m. New construction (Riverside Drive to Westlands Roundabout)	0.810
			Total Length of Link No. 3	**1.760**
MISSING LINK NO. 6 (Argwings Kodhek Road/Oloitoktok Road to Ring Road Kileleshwa)				
1	0+000	0+450	Existing Road to be improved (Oloitoktok Road)	0.450
2	0+450	1+500	ROW=24 m. New construction (Oloitoktok Road to Link No.7)	1.050
3	1+500	2+850	ROW=30 m. New construction (Link No.7 to Ring Road Kileleshwa)	1.350
			Total Length of Link No. 6	**2.850**
MISSING LINK NO 7 (James Gichuru Rd/Olenguroune AV. to Argwings Kodhek Road /Ngong Road)				
1	0+000	0+750	Existing Road to be improved (James Gichuru Road/Olenguroune Av.)	0.750
2	0+750	2+950	ROW=30 m. New construction (Olenguroune Av. To Argwings Kodhek Road)	2.200
3	2+950	3+750	Existing Road to be improved (Argwings Kodhek Road /Ngong Rd)	0.800
			Total Length of Link No.7	**3.750**
			TOTAL LENGTH	**8.360**

Note: A section of Rhapta Road and Westlands RB need widening to 4-lane road.

28.2 PRESENT CONDITIONS

28.2.1 Present Conditions

(1) Influence Areas

The area of influence and the corresponding population are shown in Table 28.2-1.

TABLE 28.2-1 AREAS OF INFLUENCE

Missing Link	Area of influence			
	Direct influence		Indirect influence	
	Area (km^2)	Population	Area (km^2)	Population
No.3	7.3 (Kileleshwa, Westlands)	18,398	11.0 (Lavington)	18,966
No.6	5.2 (Kileleshwa)	11,969	20.1 (Lavington, Kilimani)	50,796
No.7	20.1 (Lavington, Kilimani, Kileleshwa, Woodley)	59,233	2.7 (Kangemi, Kibera)	81,410
Total	32.6	89,600	33.8	151,172

Note: Indirect area of influence is defined as that area which is adjacent to the direct area of influence where the Missing Links pass. However, there is reduction in traffic volume in nearly the whole western part of the city.

The predominant land use is mainly categorized into subdivision and residential areas. Temporary kiosks are found along the routes of the Missing Links. The area of influence of the project also includes the commercial areas shown in Table 28.2-2, while the detailed land use at the influence areas is described in Section 28.6 of this Chapter.

TABLE 28.2-2 COMMERCIAL & BUSINESS CENTRES

No.3	Westlands Commercial Centres
No.7	Yaya Centre Commercial Centre /Nakumatt and Uchumi Supermarkets

(2) Present Conditions of the Project Area

The present conditions of the project area are identified from the Master Plan and summarized below.

- Lack of circumferential roads to connect each radial collector in the residential zones.(Figure 28.2-1)
- Separation of the residential zones by the rivers and separation of the environmental zones by the river. (Figure 28.2-2)
- Lack of NMT routes, characterized by earthen foot paths and few temporary bridges.

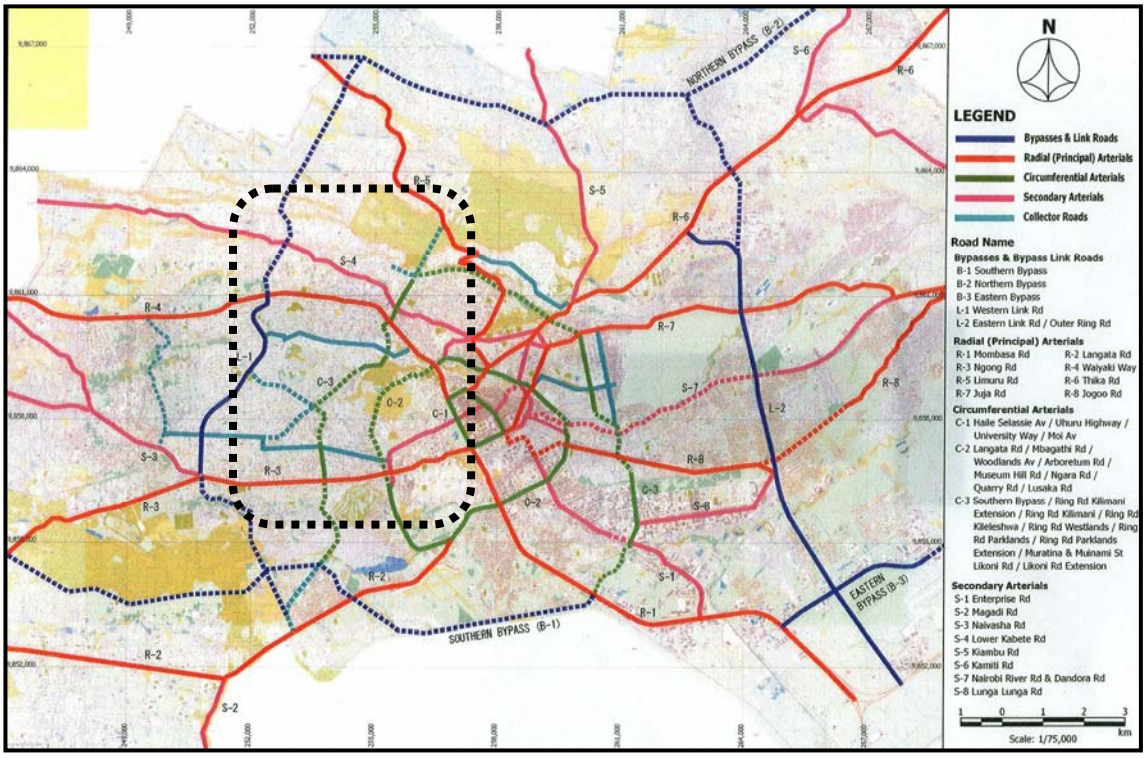


FIGURE 28.2-1 PROPOSED RADIAL AND CIRCUMFERENTIAL ROAD SYSTEM IN THE PROJECT AREA

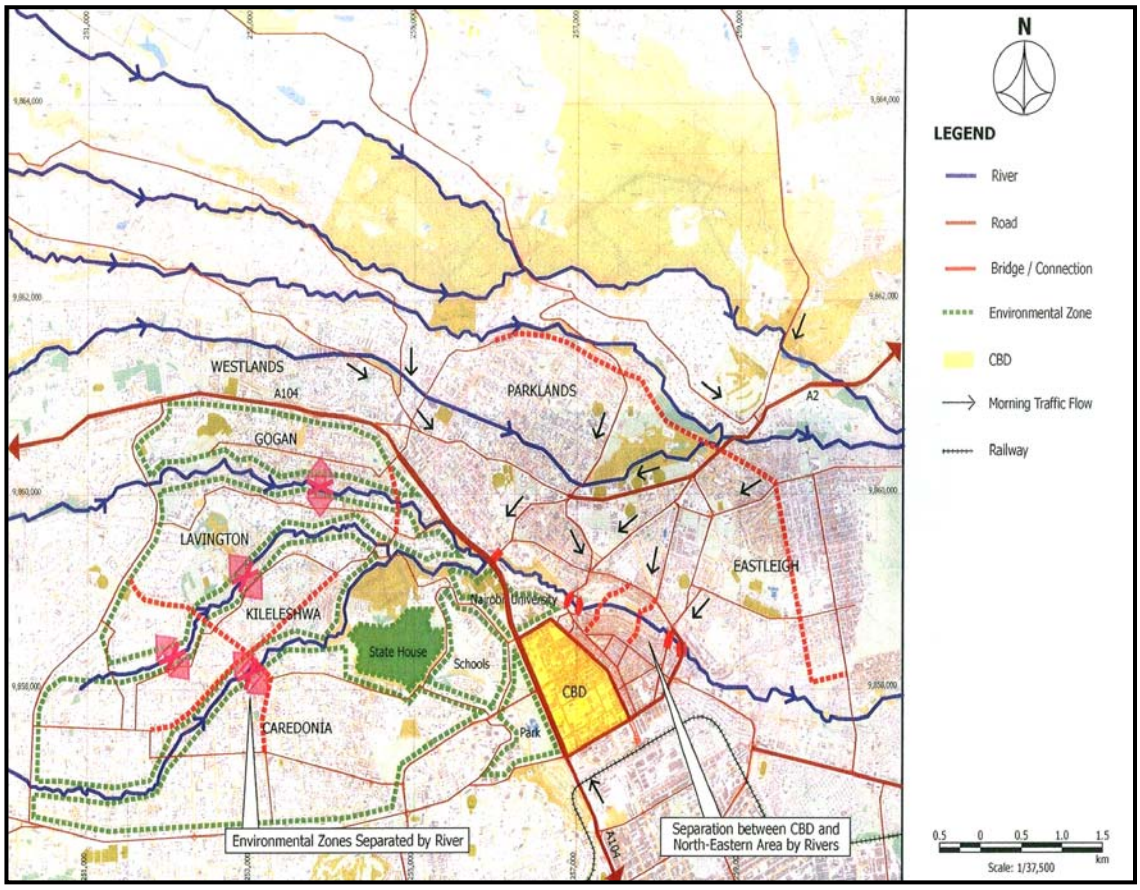


FIGURE 28.2-2 THE PROJECT AREA DIVIDED BY THE RIVERS

(3) Present Conditions of the Roads

The present conditions of the existing roads are summarized and shown in the photographs below.

- All existing roads are made up of earth and gravel, and are disconnected by the river and stream crossings. Hence, no vehicle can pass through these roads except for a few sections of these roads that are approaches to the residential apartments. However, the whole of Missing Link No.6 is generally passable by vehicles.
- Only a concrete foot bridge at Nairobi River on Missing Link No.3 is constructed for pedestrians. No bridges are constructed at other river crossings and streams.
- The present Missing Links are merely pedestrian routes to connect their residence and working places.
- During rainy seasons, some areas become impassable due to muddy surface and flooding of the river crossings.
- Many temporary kiosks (licensed by the CCN) and open air vendors occupy road reserves, in particular at the intersections, and encroachments are found along the Missing Links and the river reserves.
- Many utilities use the road reserves; high power electric lines, main water supply conduits, and telephone lines. In Missing Link No.7, clearance of the high power electric line is very low and crosses the road reserve.

Missing Link No.3

Missing Link No.6

Missing Link No.7

28.2.2 Supplementary Survey

(1) Topographic Survey

Topographic survey was carried out as follows.

- Control points survey
- Centre line survey (50m interval)
- Profile survey(50m interval)
- Cross-Section survey (50m interval, Width=50m)
- River Profile/Cross section survey (Three Rivers)
- Results are shown in the Drawing Book

(2) Geological Survey

Since detailed geological survey or soil investigation will be carried out by Feasibility Study, only site observation and the existing data review were carried out for geological and soil conditions. Hard rocks bed of the Nairobi River are observed, and brown laterite gravel with a covering of black cotton soils extend along the missing link routes.

(3) Hydrological Study

River Hydrological Conditions

There are four rivers in the project sites, out of which the Arboretum River is located on the existing road, where a box culvert (h=2m, w=2m) exists. Table 28.2-3 presents the river hydrological conditions.

TABLE 28.2-3 RIVER HYDROLOGICAL CONDITIONS

Missing Link	River	Chainage (m)	Existing Condition	Catchment Area(km^2)	High* Water Level	Riverbed Conditions
No.3 (A)	Nairobi River	1+208.8	Concrete foot bridge	48.6	1688.2	Hard Rock
	Arboretum River	0+698.8	Box culvert	-	-	-
No.7 (B)	Kirichwa Kubwa River	1+927.4	No river Crossing	15.2	1734.0	Not found
(C)	Kirichwa Ndogo River	1+050.0	No river Crossing	3.8	1742.0	Hard Rock

Note: *High water levels were determined during the October 1997 El Niño. (Elevation above the sea level)

Data Collection

The following data was collected and reviewed.

1. Map: NAIROBI & ENVIRONS, S=1/100,000, Published by Survey of Kenya, 1978
2. Water Flow Record of Nairobi River: (ID=3BA29: near the International Casino), Ministry of Water and Irrigation. (May 1960 to October 1992: 32 years)
3. Rainfall of Dagoretti Corner: Kenya Meteorological Department in the Ministry of Transport and Communication. (1970 to 2004: 34 years)
4. Rainfall of Kabete Campus of Faculty, Agriculture, Nairobi University: Kenya Meteorological Department in the Ministry of Transport and Communication. (1971 to 2004: 33 years)
5. Reference: Rainfall Frequency Atlas of Kenya, January 1978, Ministry of Water Development

Data Review

According to Water Flow Records at the observation points near the International Casino on Museum Hill Road, the maximum flow of Nairobi River (Official catchment area is 75.1km^2) was 294m^3/sec on 16 April 1985. However, the area residents observed that the highest water level and the maximum water flow of the three rivers occurred during the last El Nino between 14 and 16 January 1998. This water flow record of Nairobi River was unavailable because the observation station in Nairobi River was closed in 1993. Therefore, the water flow of Nairobi River during the El Nino was estimated by applying the rainfall records at the two stations, located at Dagoretti Corner and at Kabete Campus, Faculty of Agriculture (FOA), Nairobi University. Table 28.2-4 presents the comparison of maximum rainfall and water flow records.

TABLE 28.2-4 COMPARISON OF RAINFALL AND WATER FLOW

Observation Station	Recorded Time	Total Rainfall during Three Days (mm)	Nairobi River Water Flow (m^3/s)	Remark
Dagoretti Corner	14～16 April 1985	1,057	294*	*maximum water flow of Nairobi River during 30 years.
	14～16 January 1998 （El Nino）	1,750	No record	Three days during El Nino
Kabete Campus, FOA, Nairobi University	14～16 April 1985	776	294*	*maximum water flow of Nairobi River during 30 years.
	14～16 January 1998 （El Nino）	1,891	No record	Three days during El Nino

Two rainfall records of 776 mm and 1,057 mm were observed during 14 to16 April 1985, the water flow of Nairobi River was observed to be 294m^3/sec on 16 April 1985. Hence, the water flow at El Nino was estimated at 583m^3/sec with an average rainfall of 916 mm for the two records. (Detailed data and review are shown in Section 28.2 of Appendix 28).

Estimated Flows at River Crossings

Estimated flows for each analysis point are shown in Table 28.2-5.

TABLE 28.2-5 ESTIMATED FLOW OF RIVER CROSSINGS ON JANUARY 1998

River	Flow	Remark
Nairobi River	377.3 m^3/sec	583 x 48.6/75.1
Kirichwa Kubwa River	118.0 m^3/sec	583 x 15.2/75.1
Kirichwa Ndogo River	29.5 m^3/sec	583 x 3.8/75.1

Note: 75.1km^2 is the catchment area of International Casino observation point of water flow on Nairobi River.

Using the above results, simulation for water level, water velocity and water flow was made, and the results are summarized in Table 28.2-6. (Details are shown in Appendix 28)

TABLE 28.2-6 WATER LEVEL, WATER VELOCITY AND WATER FLOW

Location	Estimation from Rainfall	Site Information	Simulation		
River	Flow at El Nino (m^3/sec)	Water Level (m)	Water Flow (m^3/sec)	Flow Velocity (m/sec)	Water Level (m)
Nairobi River	377.3	3.9	377.0	3.9	3.9
Kirichwa Kubwa River	118.0	2.7	118.8	2.2	2.7
Kirichwa Ndogo River	29.5	2.7	29.2	1.8	2.7

28.3 TRAFFIC DEMAND FORECAST

28.3.1 Traffic Demand Forecast

Vehicular traffic cannot use the present Missing Link roads in their current states. Only NMT can pass through these routes by way of pedestrian bridges and/or temporary wooden bridges at river crossings. Hence, for vehicular traffic forecast the following methodology developed for the Master Plan was adopted.

- Vehicular traffic forecast was carried out based on the road network planned in 2015 with adoption of a two-lane road to Missing Link routes, and using the OD of Master Plan (158 zones).
- For 2025, the traffic volume of the Master Plan Study was used.
- This simulation was conducted by using TRANSCAD software.

28.3.2 Congestion Analysis

(1) Estimated Traffic Volume

The estimated traffic volume along the Missing Links is summarized in Table 28.3-1. The distribution of traffic flows in 2005, 2010, 2015, and 2025 are presented in Figure 28.3-1, Figure 28.3-2, Figure 28.3-3 and Figure 28.3-4, respectively.

TABLE 28.3-1 ESTIMATED TRAFFIC VOLUME

Daily Traffic Demand in PCU by Ln Regression (unit: pcu's per day)

No.	Section	From	To	2005	2010	2015	2025
No.3	1	Westlands R/A	Rhapta Road	13,969	20,550	27,430	31,842
	2	Rhapta Road	Nairobi River	13,969	20,550	27,430	34,624
	3	Nairobi River	Riverside Drive	15,179	19,150	23,120	34,238
	4	Riverside Drive	Ring Road Kileleshwa	20,230	27,484	34,738	41,485
No.6	5	Ring Road Kileleshwa	Mandera Road	20,612	24,564	28,515	57,466
	6	Mandera Road	No.7	20,612	24,564	28,515	40,428
	7	No.7	Oloitoktok Road (End)	10,700	12,974	15,248	17,118
	8	Oloitoktok Road (End)	Oloitoktok Road (Beginning)	10,700	12,974	15,248	25,127
No.7	9	James Gichuru Road	No.6	11,608	13,489	15,370	19,283
	10	No.6	Denis Pritt Road	21,083	23,911	26,739	38,154
	11	Denis Pritt Road	Lenana Rd	11,061	13,886	16,711	35,266
	12	Lenana Road	Argwings Kodhek Road	20,956	23,224	25,491	44,235
	13	Argwings Kodhek Road	Chania Avenue	20,387	27,384	34,380	50,963
	14	Chania Avenue	Ngong Road	13,088	18,770	24,452	42,857
				16,011	20,248	24,528	36,649

Note: 2005 traffic is assumed traffic if the road exists. Traffic volumes are aggregated ones in the Sub-Stations.

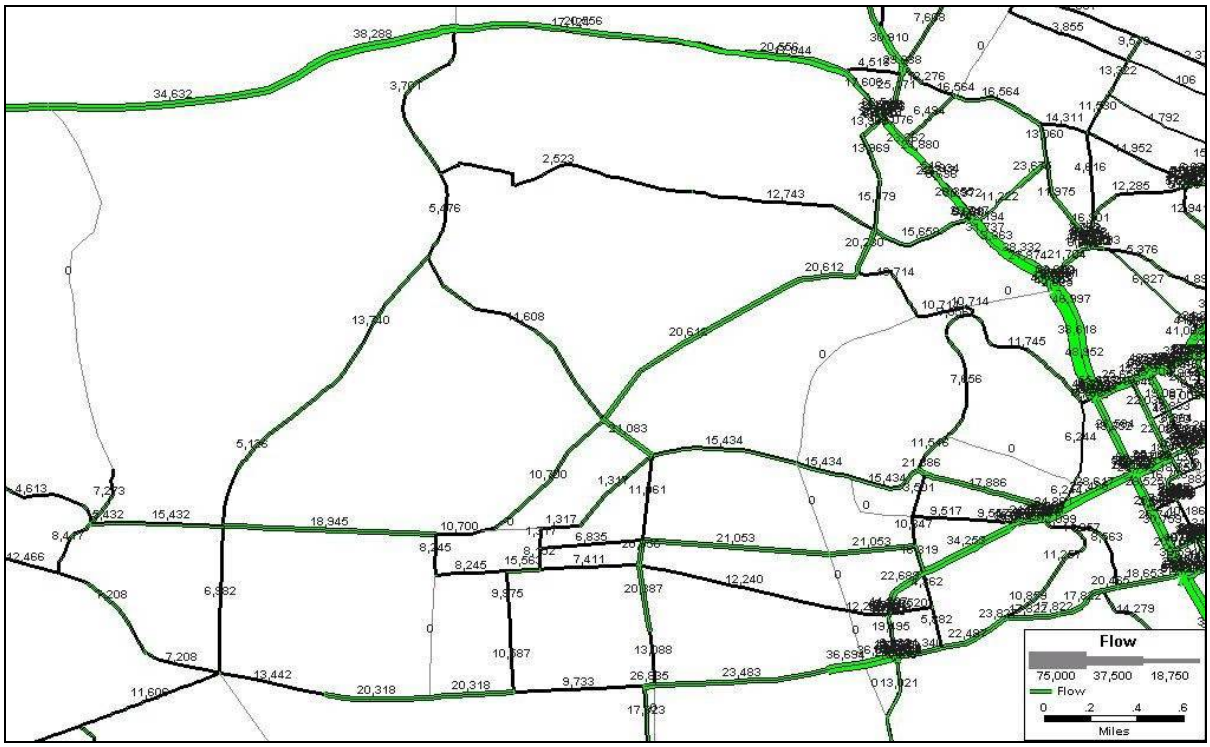


FIGURE 28.3-1 TRAFFIC FLOW IN 2005

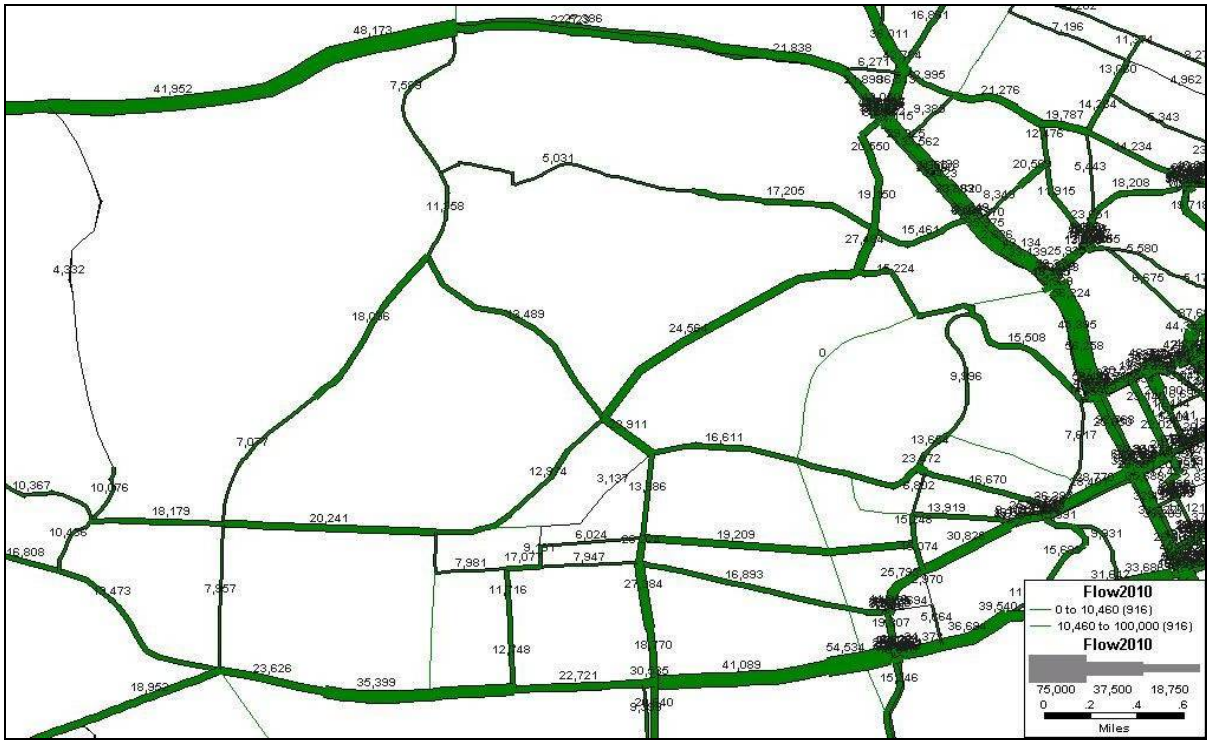


FIGURE 28.3-2 TRAFFIC FLOW IN 2010

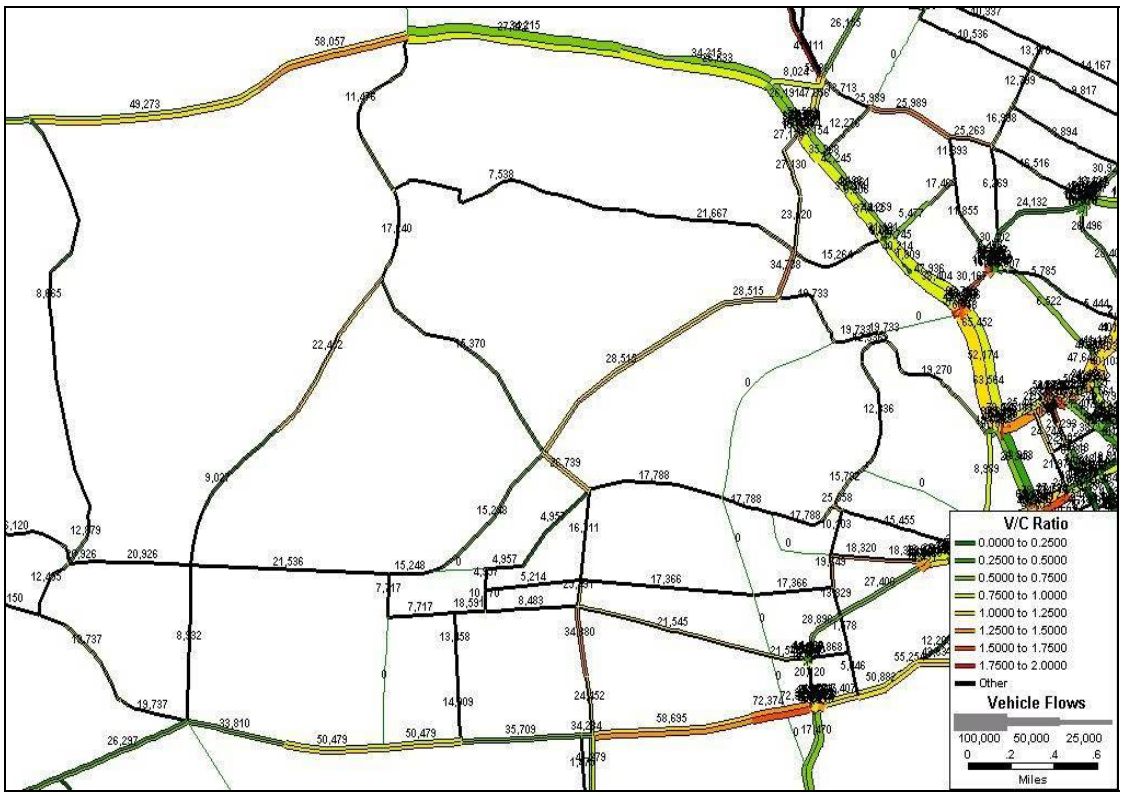


FIGURE 28.3-3 TRAFFIC FLOW IN 2015

FIGURE 28.3-4 TRAFFIC FLOW IN 2020

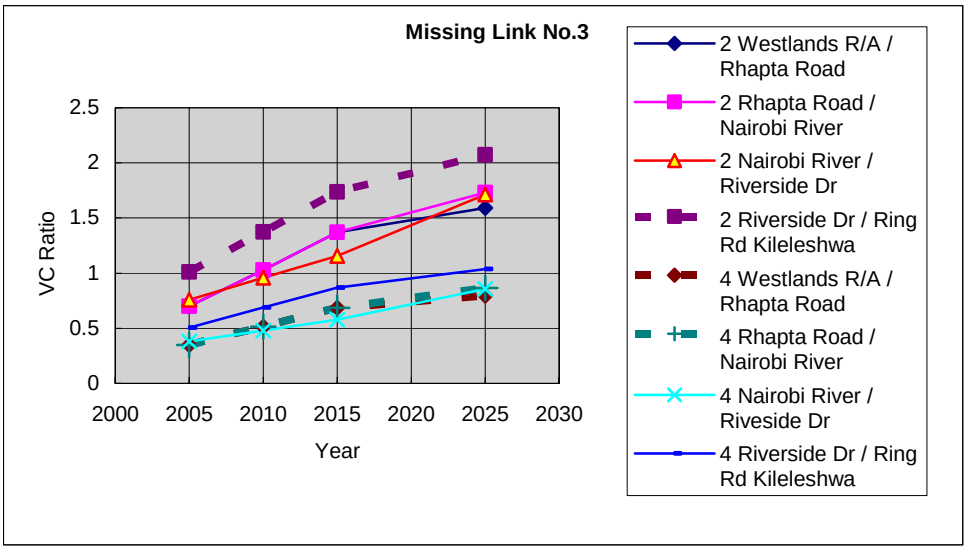
(2) Vehicle/Capacity Ratio (VCR)

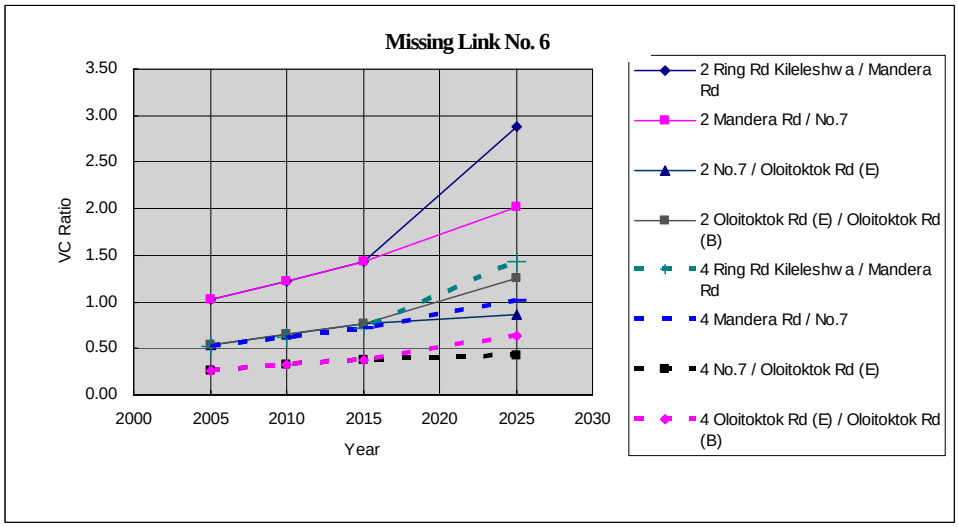
Vehicle/Capacity Ratio (VCR) is calculated and the results are shown in Table 28.3-2 and Figure 28.3-5. VCRs in 2-lane and 4-lane cases by section of each Missing Link are presented in the same figure. Details on the relationships between VCR and degree of congestion are discussed in Section 29.2 of Chapter 29.

TABLE 28.3-2 COMPARISON OF VEHICLE/CAPACITY RATIO (VCR) OF 2 AND 4 LANE ROAD

No.	From	To	2005	2010	2015	2025
No.3	Westlands R/A	Rhapta Road	0.70	1.03	1.37	1.59
(2-lane)	Rhapta Road	Nairobi River	0.70	1.03	1.37	1.73
	Nairobi River	Riverside Drive	0.76	0.96	1.16	1.71
	Riverside Drive	Ring Road Kileleshwa	1.01	1.37	1.74	2.07
No.3	Westlands R/A	Rhapta Road	0.35	0.51	0.69	0.80
(4-lane)	Rhapta Road	Nairobi River	0.35	0.51	0.69	0.87
	Nairobi River	Riverside Drive	0.38	0.48	0.58	0.86
	Riverside Drive	Ring Road Kileleshwa	0.51	0.69	0.87	1.04
No.6	Ring Road Kileleshwa	Mandera Road	1.03	1.23	1.43	2.87
(2-lane)	Mandera Road	No.7	1.03	1.23	1.43	2.02
	No.7	Oloitoktok Road (End)	0.54	0.65	0.76	0.86
	Oloitoktok Road (End)	Oloitoktok Road (Beginning)	0.54	0.65	0.76	1.26
No.6	Ring Road Kileleshwa	Mandera Road	0.52	0.61	0.71	1.44
(4-lane)	Mandera Road	No.7	0.52	0.61	0.71	1.01
	No.7	Oloitoktok Road (End)	0.27	0.32	0.38	0.43
	Oloitoktok Road (End)	Oloitoktok Road (Beginning)	0.27	0.32	0.38	0.63
No.7	James Gichuru Road	No.6	0.58	0.67	0.77	0.96
(2-lane)	No.6	Denis Pritt Road	1.05	1.20	1.34	1.91
	Denis Pritt Road	Lenana Rd	0.55	0.69	0.84	1.76
	Lenana Road	Argwings Kodhek Road	1.05	1.16	1.27	2.21
	Argwings Kodhek Road	Chania Avenue	1.02	1.37	1.72	2.55
	Chania Avenue	Ngong Road	0.65	0.94	1.22	2.14
No.7	James Gichuru Road	No.6	0.29	0.34	0.38	0.48
(4-lane)	No.6	Denis Pritt Road	0.53	0.60	0.67	0.95
	Denis Pritt Road	Lenana Rd	0.28	0.35	0.42	0.88
	Lenana Road	Argwings Kodhek Road	0.52	0.58	0.64	1.11
	Argwings Kodhek Road	Chania Avenue	0.51	0.68	0.86	1.27
	Chania Avenue	Ngong Road	0.33	0.47	0.61	1.07

Note: The section between Westland R/A and Lantana Road is out of the scope of this Study





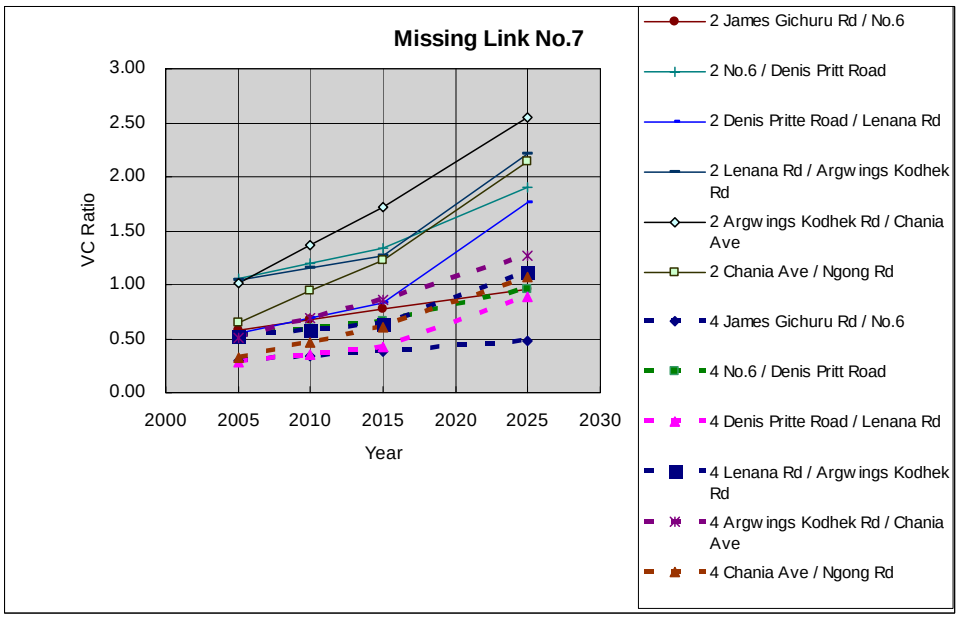


FIGURE 28.3-5 VEHICLE / CAPACITY RATIO (VCR)

(3) Proposed Number of Lanes

As shown in the V/C Ratio above, a two-lane road will be able to carry the traffic through to 2015 within acceptable congestion levels (1.2) except for some sections depicting V/C Ratios greater than 1.7. A 4-lane road will be required through 2015 to 2025. The corresponding Level of Service (LOS) is discussed in Chapter 29.2.

At the initial stage, a 2-lane road construction is considered economical that would be expanded to a 4-lane road after 2015. Thus stage construction will be applied to optimize initial investment based on the progress of traffic increase.

- Initial Stage : A two-lane road will be constructed.
- Ultimate Stage: The two-lane road will be widened to a four-lane road by 2025.

28.4 PRELIMINARY DESIGN

28.4.1 Design Policy and Standards

(1) Design Policy

The following design policies are adopted;

- Introduction of stage construction;
- Maximum utilization of existing road reserves;
- Provision of Non Motorized Transport (NMT) with walk ways and cycle ways on one side;
- Introduction of barrier-free design for the Physically Challenged People;
- Provision of bus stops to harmonize development with public transport;
- Provision of accesses to the road side residents;
- Provision of mitigation measures against negative environmental impacts; and
- Consideration of open spaces temporally for relocation and resettlement of the Project Affected People.

(2) Design Standards

The preliminary design applied the following design standards in consultation with the Engineers of CCN.

- Road Design Guidelines for Urban Roads (2nd Draft), MOLG, August 2001 (RDUG)
- Road Design Manuals, Road Department, Ministry of Transport and Communication, Kenya, August 1987
- Standard Specifications for Road and Bridge Construction, Roads Department, Ministry of Transport and Communication, Kenya, August 1986
- A Policy on Geometric Design of Highways and Streets, the American Association of State Highway and Transportation Officials (AASHTO), Washington D.C.
- Highway Capacity Manual, Fourth Edition, Transportation Research Board, National Research Council, Washington D.C.
- Guide for Design of Pavement Structures, ASSHTO
- Road Structure Guidelines, Japan Association of Road, February 2004
- Guidelines for Pedestrian and Bicycle Traffic in African Cities, version 1.3, World Bank Sub-Saharan Africa Transportation Program (SSATP)
- The Planning and Design of At-Grade Intersections, June 1998, Japan Society of Traffic Engineering
- Guide to Traffic Engineering Practice, PART 6 - Roundabouts, AUSTROADS, Sydney 1993

28.4.2 Road Design

(1) Design Criteria and Cross Section Dimension

Design criteria and cross section dimensions for roadways and intersections are summarized in Table 28.4-1 and Table 28.4-2, respectively.

TABLE 28.4-1 DESIGN CRITERIA AND CROSS SECTION DIMENSION (ROADWAY)

Item	Unit	Design Criteria	
Geometrical Standard			
Number of Lanes	No.	2	4 (Final)
Design Speed	km/h	50	
Stopping Sight Distance	m	55	
Passing Sight Distance	m	250	
Minimum Radius	m	80	
Minimum Radius for Normal Cross Slope	m	100	
Grade	%	0.5 – 8	
Minimum Length of Horizontal Curve	m	100	
Minimum Length of Vertical Curve	m	40	
Minimum K for Crest	m	800	
Minimum K for Sag	m	700	
Maximum Superelevation	%	5	
Normal Cross Slope	%	2.5	
Cross Section Element			
Lane Width	m	3.5	
Median	m	-	2.0
NMT	m	3.0 - 5.0	
Walkway	m	2.0 - 3.0	
Cycle Way	m	2.0 - 3.0	
Green Belt	m	1.0 – 2.5	

TABLE 28.4-2 INTERSECTION DESIGN CRITERIA (INTERSECTION)

Item	Unit	Design Criteria	
Geometrical Standard		Signalized	One Stop
1.Design Speed	km/h	50	
2.Sight Distance	m	130	80
3.Minimum Radius	m	80 – 100	
4.Maximun Grade	%	2.5	
5. Width of Left Turn Lane	m	3.0 – 3.5	
6. Length of Taper	m	50 - 100	
7. Length of Storage Lane	m	30 – 50	
8. Width of Pedestrian Crossing	m	3	

(2) Proposed Road Cross Sections

The proposed road cross sections are summarized in Table 28.4-3. Figure 28.4-1 and 2 show proposed standard cross sections of (1) Final Stage 4-Lane and Initial Stage 2-Lane for a 24m width road, and (2) Final Stage 4-Lane and Initial Stage 2-Lane for 30m width road, respectively.

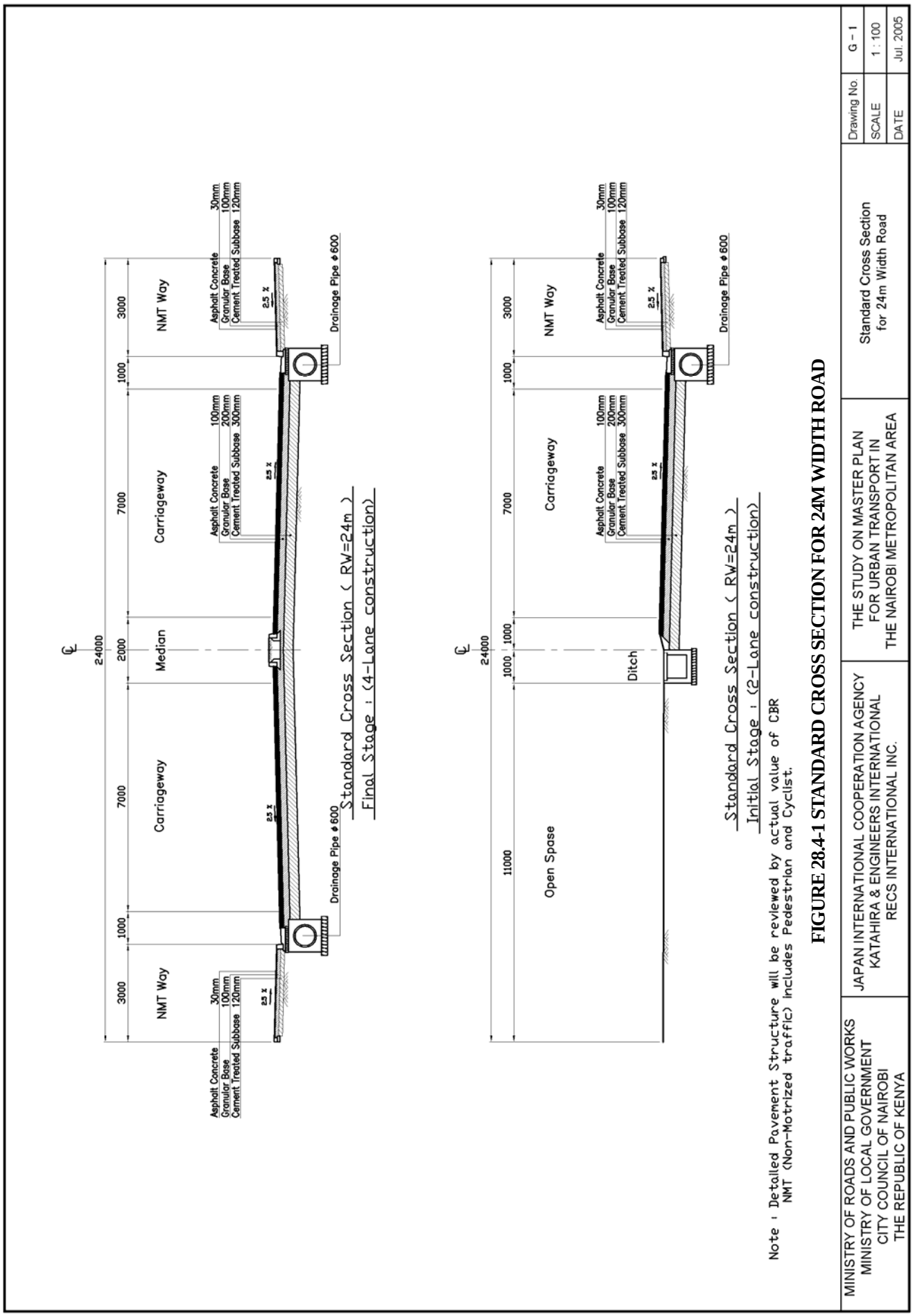
TABLE 28.4-3 PROPOSED ROAD CROSS SECTIONS

Item	Unit	Cross Section Element	
RR=30m		Initial Stage	Ultimate Stage
Number of Lanes	No.	2	4
Carriageway	m	7.0	7.0 x 2 = 14.0
Lane Wide	m	3.5	
Pavement Type		AC	
Median	m	-	2.0
Shoulder	m	1.0	1.0 x 2 =2.0
Green Belt	m	1.0	1.0 x 2 =2.0
Cycle Way	m	2.0	2.0 x 2= 2.0
Pavement Type		AC	
Walk Way	m	3.0	3.0 X 2 =6.0
Pavement Type		Interlocking having 1-m AC surfacing	
Side Ditch (Open)	m	1.0	-
Surface Drainage (Drainage Pipe)	No.	(0.6 dia.)	(0.6 dia x 2)
Open Space	m	14.0	-
Street Lamp	No.	1	2
RR=24m		Initial Stage	Ultimate Stage
Number of Lanes	No.	2	4
Carriageway	m	7.0	7.0 x 2 = 14.0
Lane Width	m	3.5	
Pavement Type		AC	
Median	m	-	2.0
Shoulder	m	1.0	1.0 x 2 =2.0
Green Belt	m	-	-
Cycle Way / Walk Way	m	3.0	3.0 x 2 = 6.0
Pavement Type		Interlocking having 1-m AC surfacing	
Side Ditch (Open)	m	1.0	-
Surface Drainage (Drainage Pipe)	No.	(0.6 dia.)	(0.6 dia x 2)
Open Space	m	11.0	-
Street Lamp	No.	1	2

(3) Selection of Route Alignment of 2- lane Roads

Special consideration for selecting route alignment for 2-lane carriageway roads within Road Reserve (RR) is as follows:

- Generally, the RR is 30m except for part of Missing Link No. 6 (RR=24m). Horizontal alignments and cross sections will be planned within the RR as much as possible in order to avoid new land acquisition.
- The starting points shall be located on the existing roads and/or the existing intersections.
- The end points shall be located on the existing roads
- The control points and constraints in the RR are observed to be as follows:
    a. High power electric lines and poles
    b. Main water supply pipes
    c. River crossings
    d. Access to entrances of residential areas
    e. Topographic conditions such as slopes etc.


Standard Cross Section (RW=24m)
Final Stage : (4-Lane construction)
NMT Way
Carriageway
Median
Carriageway
NMT Way
Asphalt Concrete
Granular Base
Cement Treated Subbase
30mm
100mm
120mm
100mm
200mm
300mm
2.5 %
Drainage Pipe ϕ600
24000
3000
1000
7000
2000
Standard Cross Section (RW=24m)
Initial Stage : (2-Lane construction)
Open Space
Ditch
11000
Note : Detailed Pavement Structure will be reviewed by actual value of CBR
NMT (Non-Motrized traffic) Includes Pedestrian and Cyclist.
FIGURE 28.4-1 STANDARD CROSS SECTION FOR 24M WIDTH ROAD
MINISTRY OF ROADS AND PUBLIC WORKS
MINISTRY OF LOCAL GOVERNMENT
CITY COUNCIL OF NAIROBI
THE REPUBLIC OF KENYA
JAPAN INTERNATIONAL COOPERATION AGENCY
KATAHIRA & ENGINEERS INTERNATIONAL
RECS INTERNATIONAL INC.
THE STUDY ON MASTER PLAN
FOR URBAN TRANSPORT IN
THE NAIROBI METROPOLITAN AREA
Standard Cross Section
for 24m Width Road
Drawing No. G - 1
SCALE 1 : 100
DATE Jul. 2005

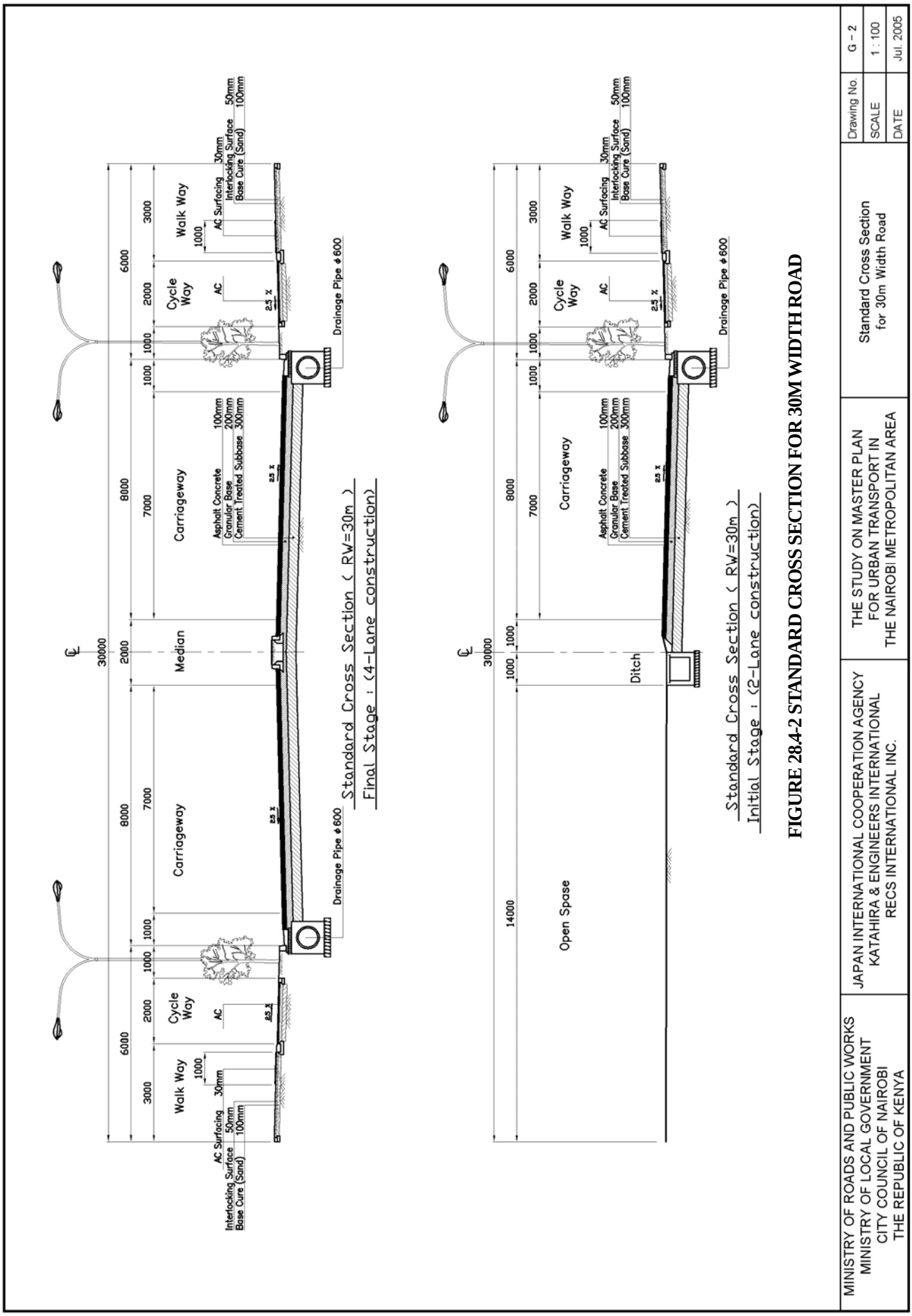


FIGURE 28.4-2 STANDARD CROSS SECTION FOR 30M WIDTH ROAD

28.4.3 Structure Design

(1) Proposed Bridge Cross Section

The proposed details of the bridge cross section are shown in Table 28.4-4.

TABLE 28.4-4 CROSS SECTION DIMENSIONS OF BRIDGE

Item	Unit	Cross Section Element	
		Initial Stage	Ultimate Stage
Width of Bridge	m	11.750	23.500
Number of Lanes	No.	2	4
Carriageway	m	7.0	7.0 x 2 = 14.0
Lane Width	m	3.5	
Pavement Type		AC surfacing	
Bridge Railing	m	W = 0.445 (right)	0.445 x 2
Bridge Railing	m	W = 0.150 (left)	0.150 x 2
Walk Way	m	3.155	3.155 x 2
Pavement Type		AC surfacing	
Guard Rail		1 (H = 0.8)	2
Surface Drainage (Drainage Pipe)	No.	(0.6 dia.)	(0.6 dia x 2)

The vertical clearance of the structure shall be maintained as presented in Table 28.4-5.

TABLE 28.4-5 VERTICAL CLEARANCE (VR)

Location	Min. Vertical Clearance (m)	Remarks
River/ Stream crossing freeboard considering debris passage below bridge	2.0	Max. flow water level to lowest structure member
River/ Stream crossing freeboard without considering debris passage below bridge	1.0	-ditto-

The following parameters are considered for bridge planning.

- Design Flood Flow: Discharges of a 50-year return period
- Bridge Length: to be determined by discharge and max. flood water level

The proposed design for each bridge is summarized below.

Missing Link No. 3: Nairobi River Bridge

- Bridge Length: L=30.8m
- Bridge Width: W=11.75m
- Superstructure: Pre-cast post tensioned PC girder with cast in place cross beams
- Foundation Type: Spread foundation (4.6m x 12.75m x1.0m)
- Pavement: Asphalt Concrete, t=50mm
- Interlocking pavement (Cement block h=100mm) will be applied for the approaches to the bridges where the vertical alignment is equal or greater than 6%.

Missing Link No. 7: Kirichwa Ndogo River Bridge

- Bridge Length: L=30.8m
- Bridge Width: W=11.75m
- Superstructure: Pre-cast post tensioned PC girder with cast in place cross beams
- Foundation Type: Piled spread foundation (4.6m x 12.75m x1.0m)
  RC pile- 24 Nos (400mm x 400mm), Pile length L=4.5m
- Pavement Asphalt Concrete, t=50mm
- Interlocking pavement (Cement block h=100mm) will be applied for the approaches to the bridges where the vertical alignment is equal or greater than 6%.

Missing Link No. 7: Kirichwa Kubwa River Bridge

- Bridge Length: L=30.8m
- Bridge Width: W=11.75m
- Superstructure: Pre-cast post tensioned PC girder with cast in place cross beams
- Foundation Type: Spread foundation (4.6m x 12.75m x1.0m)
- Pavement: Asphalt Concrete, t=50mm.
- Interlocking pavement (Cement block h=100mm) will be applied for the approaches to the bridges where the vertical alignment is equal or greater than 6%.

The Preliminary design of foundation for the above bridges is based on the visual observation of river bed without detailed geological survey. Detailed geological foundation survey including borings is to be undertaken at the detailed design stage. Designs of the three bridges are shown in Figure 28.4-3 to 5.

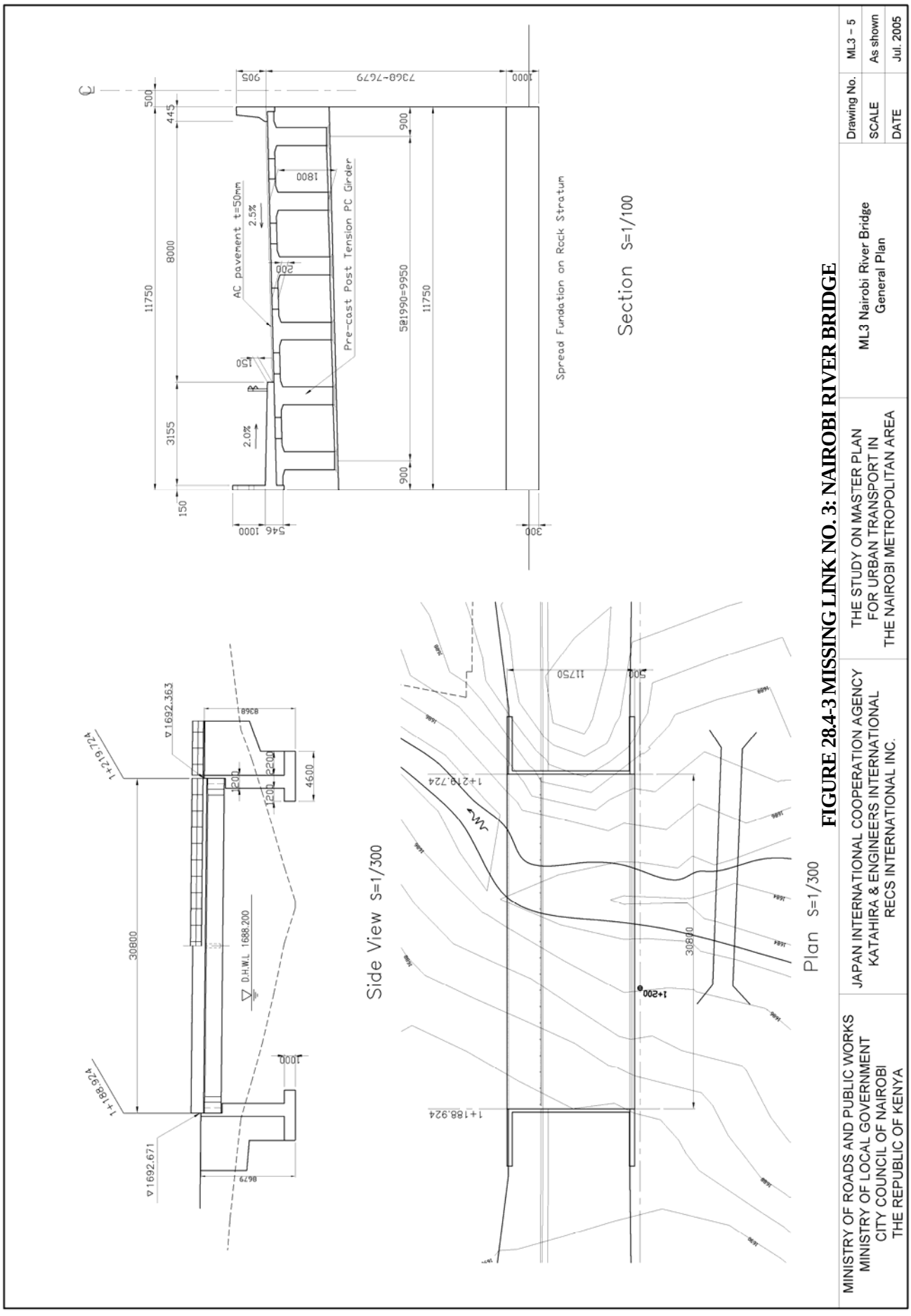


FIGURE 28.4-3 MISSING LINK NO. 3: NAIROBI RIVER BRIDGE

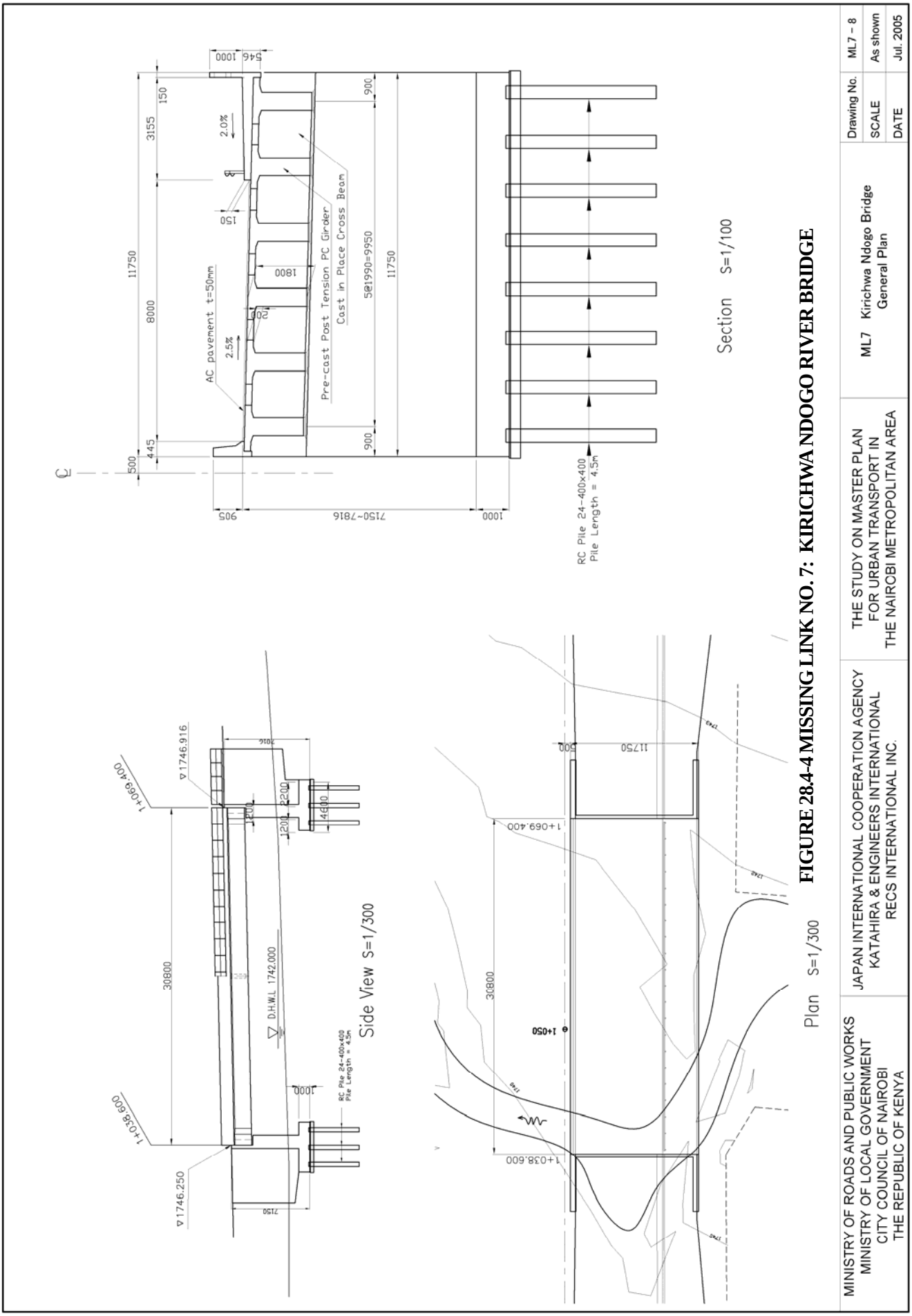


FIGURE 28.4-4 MISSING LINK NO. 7: KIRICHWA NDOGO RIVER BRIDGE

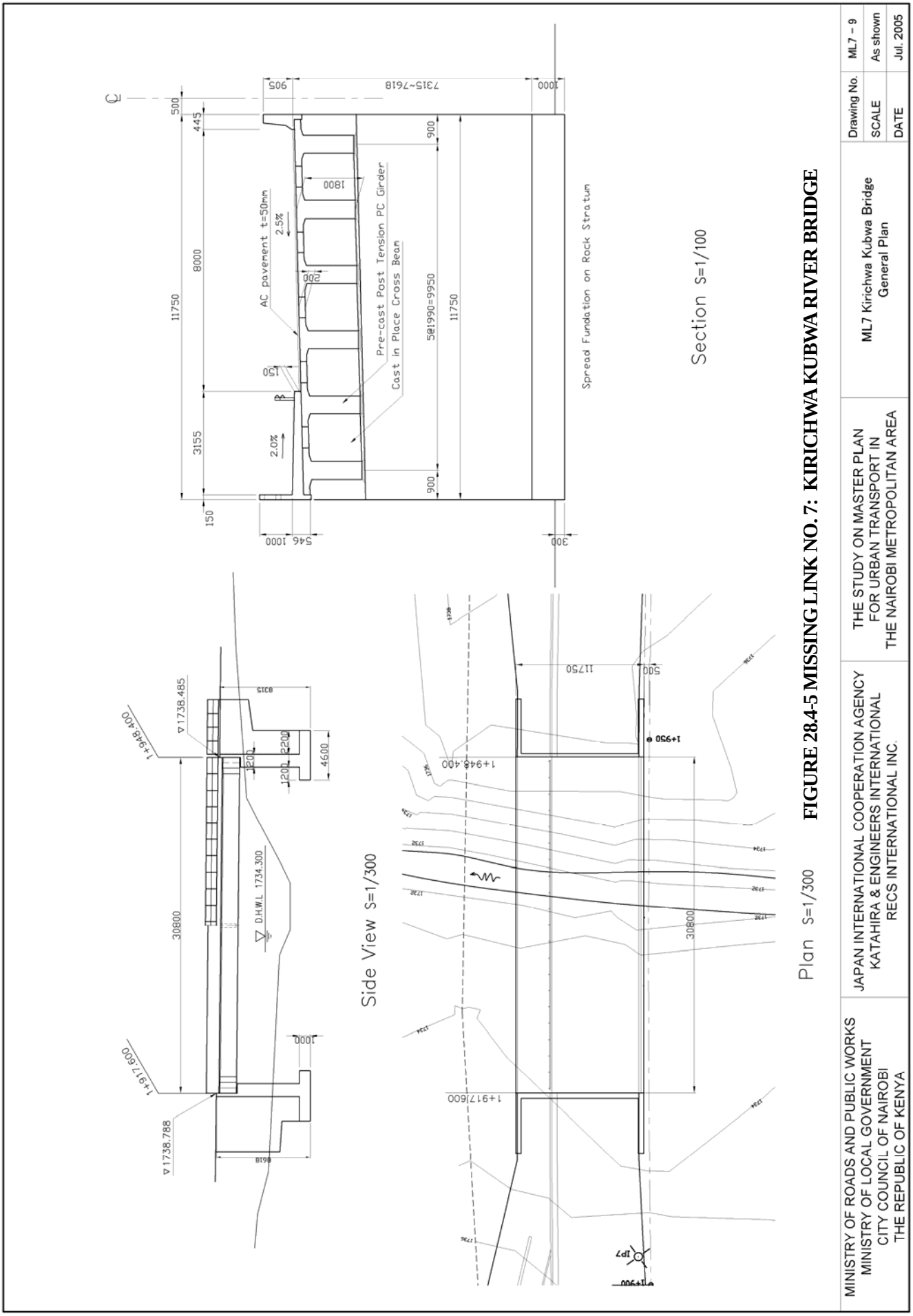


FIGURE 28.4-5 MISSING LINK NO. 7: KIRICHWA KUBWA RIVER BRIDGE

28.4.4 Pavement Design

(1) Carriageway Pavement

Design Procedure

The Preliminary Design had to assume a CBR value of the sub-grade by reviewing other material reports, because a detailed sub-grade survey is to be carried out at the detailed design stage. Consequently, the design procedure of the pavement will be compared with various methods including simple table matrix of Kenya and Road Note to the detailed method of AASHTO. The proposed pavement structure will be reviewed based on the results of the geological survey and material tests during the detailed design stage.

Initial Performance Period

The average initial performance period is 15 years which is based on the minimum performance period of 10 years and maximum performance period of 20 years. For the Pre-Feasibility Study, this 15-year period is considered as analysis period. In the detailed design stage, using the detailed geological survey and pavement structure design, analysis period (design life) will be determined based on life-cycle costs.

Traffic Loading (ESAL)

TABLE 28.4-6 TRAFFIC COMPOSITION ANTICIPATED (2015)

No.	Section	From	To	Light Vehicle	Medium Vehicle	Bus	Medium Truck	Large Truck	A-Truck (Trailer/ Tank Lorry)	Total
No.3	1	Westlands R/A	Ring Rd Kileleshwa	14,599	6,660	524	401	175	89	22,447
	2	Ring Rd Kileleshwa	Nairobi River	14,599	6,660	524	401	175	89	22,447
	3	Nairobi River	Riverside Dr	12,305	5,613	441	338	148	75	18,920
	4	Riverside Dr	Arboretum Dr	18,488	8,434	663	508	222	112	28,428
No.6	5	Arboretum Dr	Mandera Rd	15,176	6,923	544	417	182	92	23,335
	6	Mandera Rd	Ring Rd Kilimani	15,176	6,923	544	417	182	92	23,335
	7	Ring Rd Kilimani	Denis Pritt Rd	8,115	3,702	291	223	97	49	12,478
	8	Denis Pritt Rd	Ole Odume Rd	8,115	3,702	291	223	97	49	12,478
No.7	9	James Gichuru Rd	Ring Rd Kileleshwa	8,180	3,732	293	225	98	50	12,578
	10	Ring Rd Kileleshwa	Denis Pritt Rd	14,231	6,492	510	391	171	86	21,882
	11	Denis Pritt Rd	Lenana Rd	8,894	4,057	319	244	107	54	13,675
	12	Lenana Rd	Argwings Kodhek Rd	13,567	6,189	487	373	163	82	20,860
	13	Argwings Kodhek Rd	Chania Ave	18,298	8,347	656	503	220	111	28,135
	14	Chania Ave	Ngong Rd	13,014	5,937	467	357	156	79	20,010

All traffic was estimated for an equivalent 18-kips single axle load, or ESAL in Table 28.4-7.

TABLE 28.4-7 TRAFFIC LOADING (ESAL)

Traffic	No. of Traffic				Bus	M-truck	L-truck	A-truck
	Bus	M-truck	L-truck	A-truck	1.0	1.0	4.0	4.0
2010	474	363	159	81	1.73E+05	1.32E+05	2.32E+05	1.18E+05
2011	492	377	165	84	1.80E+05	1.38E+05	2.41E+05	1.23E+05
2012	511	392	171	87	1.87E+05	1.43E+05	2.50E+05	1.27E+05
2013	531	407	178	90	1.94E+05	1.49E+05	2.60E+05	1.31E+05
2014	552	423	185	94	2.01E+05	1.54E+05	2.70E+05	1.37E+05
2015	574	440	192	97	2.10E+05	1.61E+05	2.80E+05	1.42E+05
2016	587	450	197	99	2.14E+05	1.64E+05	2.88E+05	1.45E+05
2017	601	461	202	101	2.19E+05	1.68E+05	2.95E+05	1.47E+05
2018	615	472	207	103	2.24E+05	1.72E+05	3.02E+05	1.50E+05
2019	629	483	212	105	2.30E+05	1.76E+05	3.10E+05	1.53E+05
2020	645	494	216	109	2.35E+05	1.80E+05	3.15E+05	1.59E+05
2021	656	502	220	111	2.39E+05	1.83E+05	3.21E+05	1.62E+05
				2010 to 2021		Total for 12 years		9.49E+06
							per lane	4.74E+06

Pavement Structure Analysis

For the pavement structure analysis, the following methods are applied to compare the results.

- AASHTO, Guide for Design of Pavement Structures
- Japan Road Association, Pavement Design and Management Manual
- Kenya, Materials and Pavement Design for New Roads, Part III, Road Design Manual

Calculation of Required SN

In Kenya, all pavement types are asphalt concrete for urban and rural trunk roads or bituminous surface treatment for minor roads. No concrete pavement has been applied because of cost and material limitation, and no maintenance skills exist. Therefore the Study applies the pavement design based on the flexible pavement of asphalt concrete pavement.

For using AASHTO pavement design method, the design structural number (SN) is calculated by the following equation.

$$\begin{aligned} Log_{10}(W_{18}) = {} & Z_R \times S_o + 9.36 \times \log_{10}(SN+1) \\ & - 0.20 + \log_{10}[\Delta PSI/(4.2-1.5)] / (0.40+1094/(SN+1)^{5.9}) \\ & + 2.32 \times \log_{10}(M_R) - 8.07 \end{aligned}$$

where

W_{18} = predicted number of 18-kip equivalent single axle load applications,
Z_R = standard normal deviation,
S_o = combined standard error of the traffic prediction and performance prediction,
ΔPSI = difference between the initial design serviceability index, p_o, and the design terminal serviceability index, p_t , and
M_R = resilient modulus (psi)

SN is equal to the structural number indicative of the total pavement thickness required.

Selection of Layer Thickness

Once the design structural number (SN) for an initial pavement structure is determined, a set of pavement layer thickness is necessary which, when combined, will provide the load-carrying capacity corresponding the design SN. The following equation provides the basis for convering SN into actual thickness of surfacing, base and subbase.

$$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

where

a_i = i^{th} layer coefficient,
D_i = i^{th} layer thickness (inchs), and
M_i = i^{th} layer drainage coefficient.

Layer	Pavement Materials	Layer coefficient	Thickness (cm)	Thickness (inch)	Drainage coefficient	SN
Surface	Asphalt Concrete	0.390	10	3.937	-	1.535
Base	Granular (crushing run)	0.108	20	7.874	1.00	0.850
Subbase	Cement –treated	0.160	30	11.811	1.00	1.890
	Total	-	60	23.622	-	4.275

Note: In the experiences on Kenya, a cement/lime treated- sub base course is applied in case of unfavourable subgrade soils (ex. Black cotton soils). The following detailed geological survey of subgrade in the detailed design stage, pavement structure will be reviewed.

Comparison of Pavement Design

The followings are comparison of pavement design among AASHTO, Japan, and Kenya methods.

AASHTO

AASHTO		Subgrade: CBR=7
Surface	100	AC
Base	200	Granular CBR=30
Subbase	300	Cement treated base
SN	4.276	

Japan & Kenya

Japan	Traffic Classification : C		Kenya		
Surface	100	AC	Surface	50	AC
Base (A)	90	Bituminous treated	Base	150	Graded Crushed Stone (Class B)
(B)	150	Granular CBR=80	Subbase	200	Graded Crushed Stone (Class B)
Subbase	150	Granular CBR=30	SN	2.69	
SN	4.03				

Note*: Each SN were calculated in accordance with the layer coefficient proposed by AASHTO

Proposed Pavement Structure

The proposed pavement structure is shown in Table 28.4-8.

Carriageway

TABLE 28.4-8 PROPOSED PAVEMENT STRUCTURE

Layer Structure	Layer Coefficient	Depth (cm)	Depth (inch)	Drainage Coefficient	SN
AC elasticity coefficient 350,000psi	0.390	10	3.937	-	1.535
Crusher Run CBR=30	0.108	20	7.874	1.000	0.850
Cement Stabilization 30kgf/cm^2	0.16	30	11.811	1.000	1.890
		t=60cm		Total	4.276

Note: CBR of existing road foundation is assumed at 7.0 for the preliminary design.
Detailed CBR investigation will be required at the detailed design.

The proposed pavement structure of the carriageway is presented as follows.

- Asphalt Wearing course t1 = 3cm
- Asphalt Binder course t2 = 7cm
- Base course (Crusher run) t3 = 20cm
- Sub-base (Lime or Cement Stabilized) t4 = 30cm

NMT Pavement

The width of walkway of NMT is 3.0m, and cycle way is 2.0m. The proposed pavement structure and specification of materials are as follows:

Walk Way

- Concrete Interlocking t1 = 50mm
- Asphalt surfacing: AC (for Wheel Chair) t2 = 30mm, W = 1,000mm
- Base course (Sand) t3 = 100mm
- Subgrade treatment (compaction) t4 = 300

Cycle Way

- Asphalt concrete t1 = 30mm
- Base course (crusher Run) t2 = 100mm
- Sub-base (Lime or Cement Stabilized, if required) t3 = 120mm

28.4.5 Intersection

(1) Procedure of Selection of the Types of Intersection

Figure 28.4-6 presents a procedure for selection of the types of intersections.

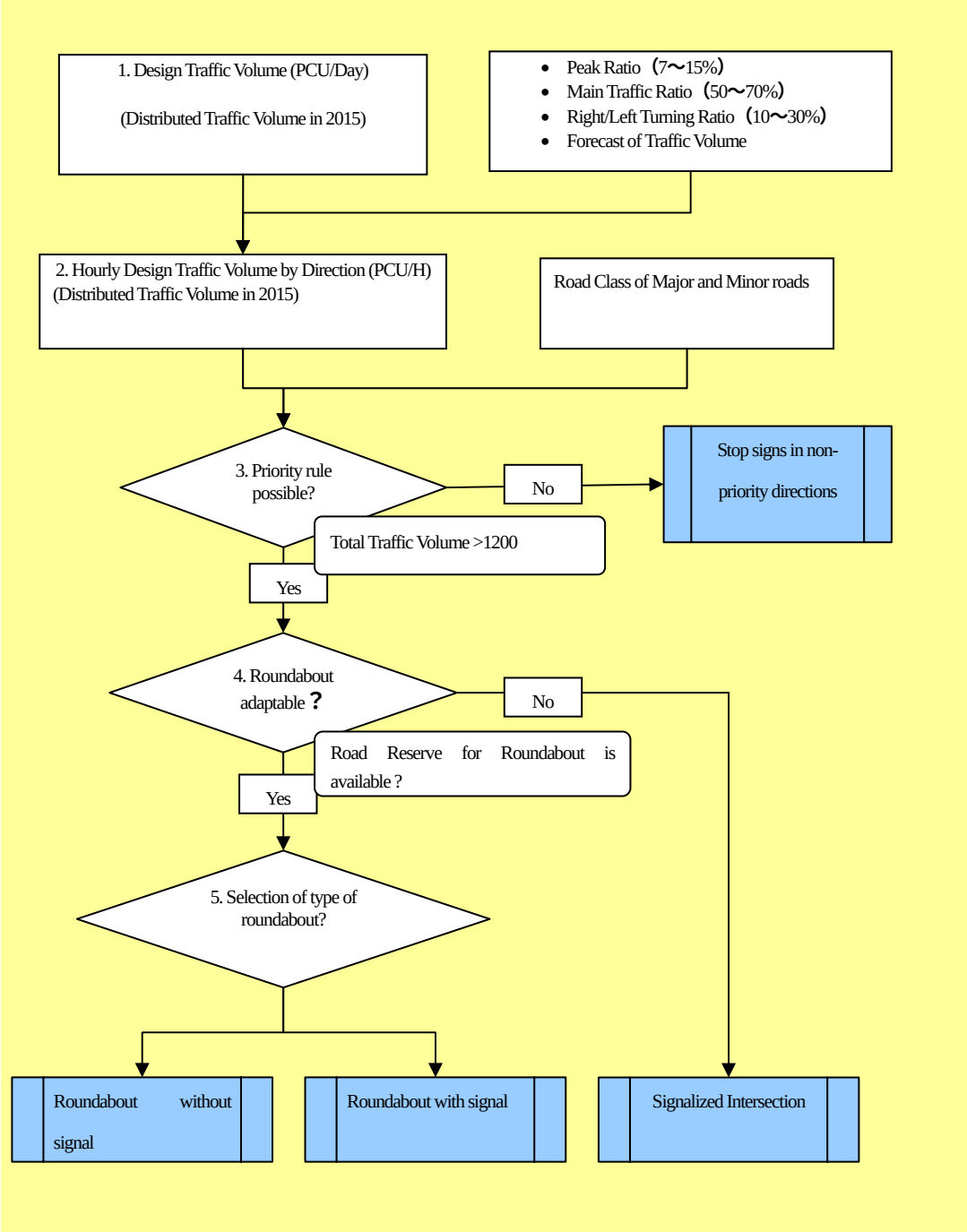


FIGURE 28.4-6 PROCEDURE OF SELECTION OF TYPES OF INTERSECTIONS

(2) Application of Type of Intersection

1) Type of Intersection Applied

The operation method of intersections can be divided into four major control methods, namely (i) basic rule without traffic signal, (ii) priority rule with stop signs, (iii) rotary traffic with roundabouts and (iv) roundabout with signalization. The Study applied the following types of an intersection at grade.

1. Crossing Intersection
2. Crossing Intersection with Signal
3. Roundabout
4. Roundabout with Signal

2) Traffic Capacity of Conventional Intersection

The capacity of unsignalized intersection is the sum of the following two traffic volumes:

- The general traffic volume of the major or priority roads, and
- The maximum traffic volume of the minor or non-priority roads that at the same time can possibly pass through the intersection according to the priority rule.

Basic Rule Without Traffic Signal

When traffic volume is less than 1,000 veh/h, this control will be applied.

Stop Sign Intersection

In general, traffic capacity at a stop sign intersection ranges between 1,000 veh/h and 1,300veh/h. Therefore, when traffic increases more than this capacity, a roundabout or signalization will be applied.

3) Traffic Capacity of Roundabouts

Planning guides for use of roundabouts at intersections of various classes of roads are presented in Table 28.4-9.

TABLE 28.4-9 PLANNING GUIDES FOR THE USE OF ROUNDABOUTS AT INTERSECTIONS OF VARIOUS CLASSES OF ROAD

	Arterial	Sub-Arterial	Collector	Local
Arterial	B	B	C	C
Sub-Arterial		B	B	C
Collector			A	B
Local				A
Notation:	A. Likely to be an appropriate treatment B. May be an appropriate treatment C. Not likely to be an appropriate treatment			

Source: Guide to Traffic Engineering Practice Roundabouts, AUSTROADS, 1993

The traffic capacity of roundabout is a sum of entry traffic volumes and circulating flow. Table 28.4-10 presents the traffic capacity of roundabouts by size.

TABLE 28.4-10 TRAFFIC CAPACITY OF ROUNDABOUTS BY SIZE

Roundabout Inscribed Diameter (m)	Traffic Capacity (vehicle/hour)
20	< 1,500
40	< 3,500
60	< 4,000
80	< 4,500

Note: Edited from *Guide to Traffic Engineering Practice Roundabouts, AUSTROADS, 1993*

When the road reserves for the above diameter is not available and traffic volumes exceed the traffic capacity, signalization will be required.

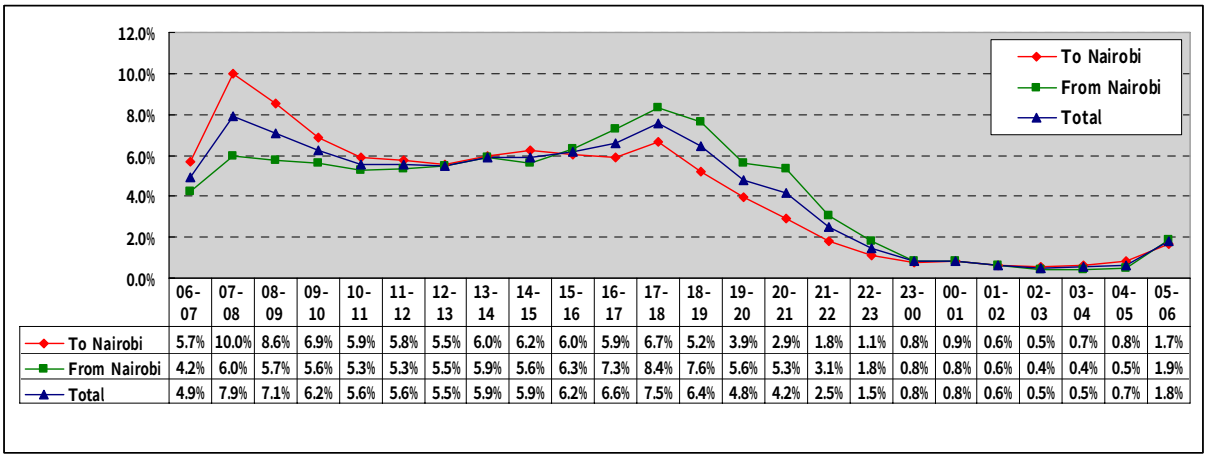
(3) Evaluation of Type of Intersection

Estimated Peak Hour Traffic

Peak ratio for 24 hours (by Screen Survey) is shown in Figure 28.4-7.

The peak ratio for 24 hours is calculated as follows.

- Morning Peak Hours (7-8): To Nairobi 10.0% From Nairobi 6.0% **Average 7.9%**
- Evening Peak Hours (17-18): To Nairobi 6.7% From Nairobi 8.4% **Average 7.5%**



	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-00	00-01	01-02	02-03	03-04	04-05	05-06
To Nairobi	5.7%	10.0%	8.6%	6.9%	5.9%	5.8%	5.5%	6.0%	6.2%	6.0%	5.9%	6.7%	5.2%	3.9%	2.9%	1.8%	1.1%	0.8%	0.9%	0.6%	0.5%	0.7%	0.8%	1.7%
From Nairobi	4.2%	6.0%	5.7%	5.6%	5.3%	5.3%	5.5%	5.9%	5.6%	6.3%	7.3%	8.4%	7.6%	5.6%	5.3%	3.1%	1.8%	0.8%	0.8%	0.6%	0.4%	0.4%	0.5%	1.9%
Total	4.9%	7.9%	7.1%	6.2%	5.6%	5.6%	5.5%	5.9%	5.9%	6.2%	6.6%	7.5%	6.4%	4.8%	4.2%	2.5%	1.5%	0.8%	0.8%	0.6%	0.5%	0.5%	0.7%	1.8%

FIGURE 28.4-7 PEAK RATIO FOR 24 HOURS

Design Volume at Peak Hour

Design volume at peak hour is shown in Figure 28.4-8.

Evaluation of Type of Intersection

Table 28.4-11 presents results of evaluation of proposed type of intersection and Figure 28.4-9 depicts alternative designs of roundabout type and conventional type at the intersection of Link No.6 and Link No.7.

Figure 28.4-10 presents the locations of proposed types of intersection.

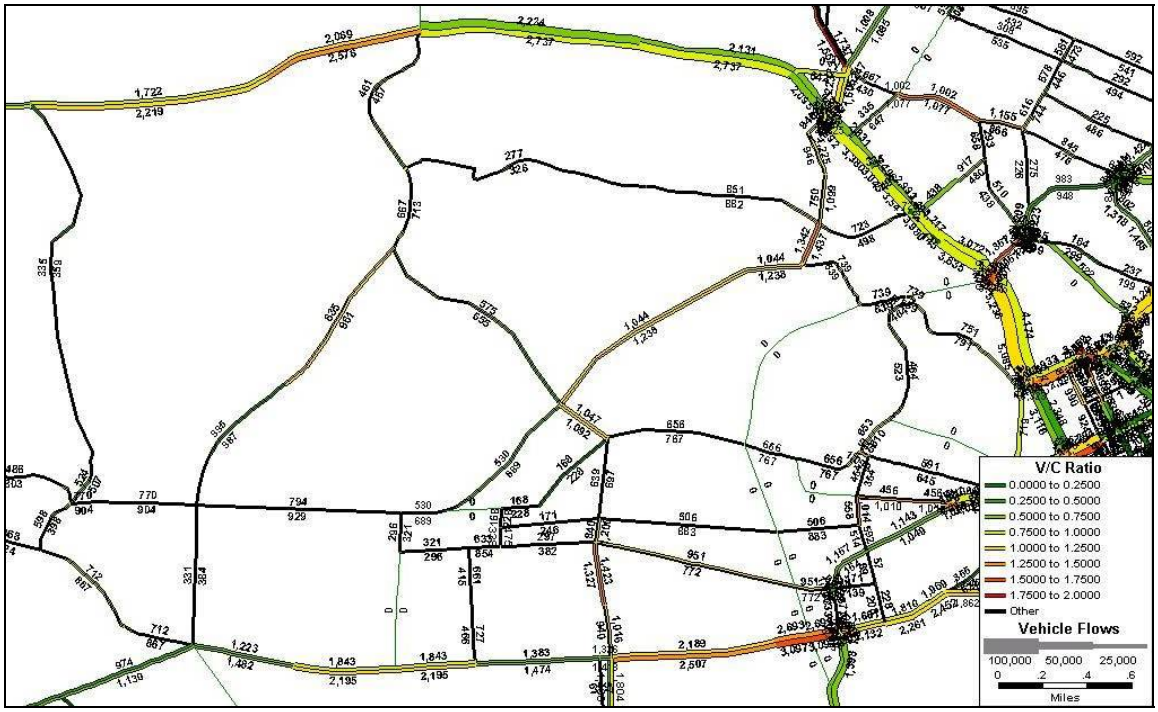


FIGURE 28.4-8 DESIGN VOLUME AT PEAK HOUR IN 2015 (UNIT PCU/HOUR)

FIGURE 28.4-9 PROPOSED INTERSECTION ALTERNATIVES FOR MISSING LINK NO. 6&7 (ROUNDABOUT AND CONVENTIONAL TYPES)

TABLE 28.4-11 EVALUATIONS AND PROPOSED TYPE OF INTERSECTIONS

Node ID	Road Name	Main Flow (Both Dir., Straight only) (PCU/hour)	Sub Road Flow (PCU/hour)	Circulation Flow * (Max) (PCU/hour)	Road Reserve for RB	One Stop Control	Roundabout (No Signal)	Roundabout (Signaled)	Intersection with Signalization
No.1	Missing Link 3: 1+611km Road to Westlands RB	3823	2549	3650	No	Initial	No	No	Ultimate
1183	Total of traffic volume		6968	10,618					
No.2	Missing Link 3: 0+950km Riverside Dr	1598	1605	1862	No	Initial	No	No	Ultimate
1246	Total of traffic volume		3203	5065					
(No.3)	Missing Link 6: 0 +000km: Arboretum Dr	1741	739	1600	If	(Initial)	D=60~80m, If RR available	(Ultimate) Alternative	(Ultimate) (Recommended)
1176	Total of traffic volume		2480	4080					
(No.4)	Missing Link 7 James Gichuru Rd	973 575	575	1083	If	(Initial)	D=40~60m, If RR available	(Ultimate) Alternative	(Ultimate) (Recommended)
13906	Total of traffic volume		2123	3206					
(No.5)	Missing Link 7: 1+800km No.6 & No.7	1002 936	1702 1733	1590	Yes	-	(Initial Stage) D=60m	Ultimate Stage	-
13905	Total of traffic volume		5473	6968					
No.6	Missing Link 7: 2+150km Denis Pritt Rd	1111 486	1581	1647	No.	Initial	No	No	Ultimate
946	Total of traffic volume		3178	4825					
No.7	Missing Link 7: 2+600km Lenana Rd	1101	506 246	1234	If	Initial	D=40~60m, If RR available	(Ultimate) Alternative	Ultimate Recommended
14083	Total of traffic volume		1853	3087					
No.8	Missing Link 7: 2+950 km Argwings Kodhek Rd	1702	1333	1733	No	No	No	No	Initial/ Ultimate
756	Total of traffic volume		3035	4768					
(No.9)	Missing Link 7: Ngong Rd	1304 2392	2744	3374	-	(Initial)	-	-	(Ultimate)
666	Total of traffic volume		6440	9814					

Note: * Circulation flow occurs in case of a roundabout type. ( ): Intersections are located out of the scope of Preliminary Design.

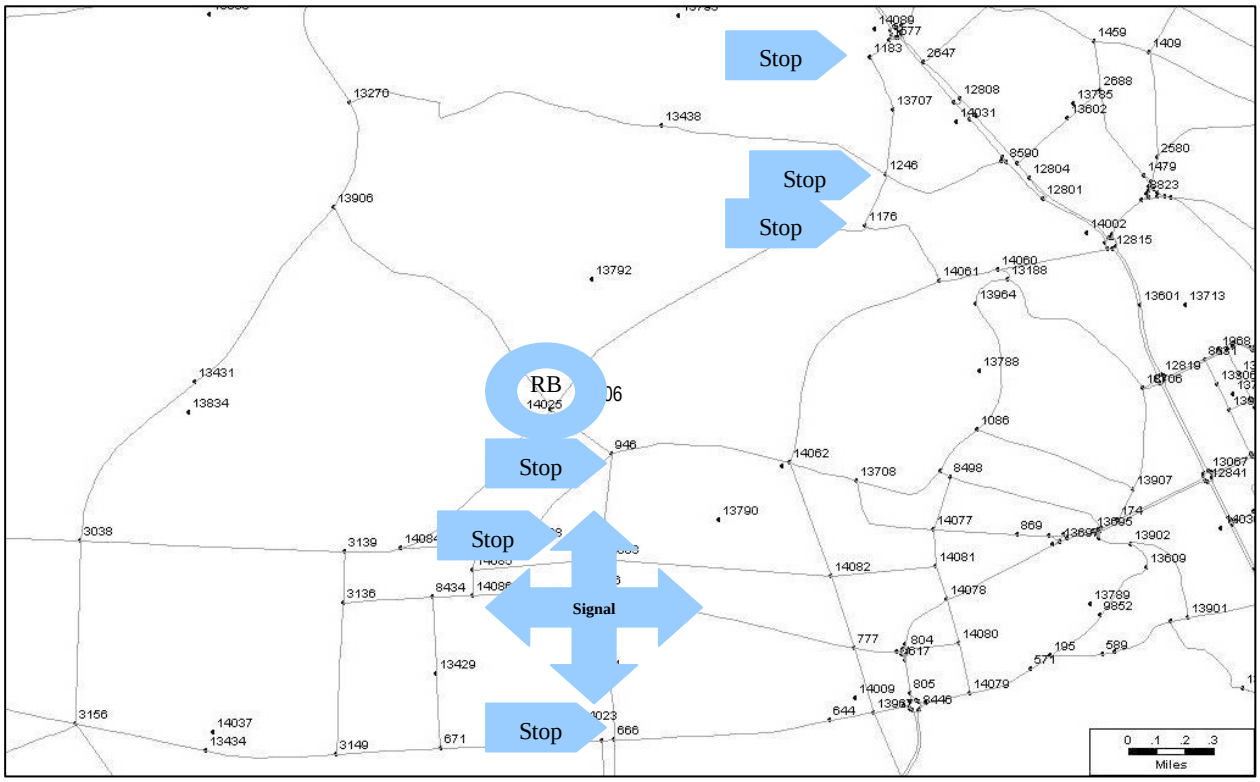


FIGURE 28.4-10 TYPE OF INTERSECTION

(4) Summary of Proposed Intersection

From the experience of the pilot project in Westlands Roundabout Improvement, the traffic congestion is likely to occur at the peak hour. Police control is quite efficient during the peak hour traffic. Therefore, in the initial stage, one stop control will be applied with police traffic control at major intersections. At the intersection of No.6 and No.7 where road reserve for a roundabout is available, a roundabout type will be proposed, while at Intersection of No.7 and Argwings Kodhek Road, a signalized conventional type intersection will be proposed.

Proposed intersection types are summarized in Table 28.4-12.

TABLE 28.4-12 PROPOSED INTERSECTION TYPE

No.	Intersection	Initial Stage	Ultimate Stage
1	Missing Link 3/Riverside Dr	One Stop Control	Signalization
2	Missing Link 3/Arboretum Dr	One Stop Control	Signalization
3	Missing Link No.6 /No.7	Roundabout	Signalization
4	Missing Link 6/Ole Odume Rd	One Stop Control	Signalization
5	Missing Link 7/James Gichuru Rd	One Stop Control	Signalization
6	Missing Link 7/Denis Pritt Rd	One Stop Control	Signalization
7	Missing Link 7/Lenana Rd	One Stop Control	Signalization
8	Missing Link 7/Argwings Kodhek Rd	Signalized Conventional	-ditto-
9	Missing Link 7/Ngong Rd	One Stop Control	Signalization

28.4.6 Drainage Design

During the preliminary design stage, road side ditches of U-shaped concrete drainage (700mm x 700mm) and surface drainages of L-shaped gutter type with collecting pipe (dia. 600mm) are applied. The detailed design for the drainage structure is shown in Preliminary Design Drawings.

28.5 PRELIMINARY COST ESTIMATE

28.5.1 Construction Quantity and Cost Estimate

(1) Construction Quantities

Major works and work quantities are summarized in Table 28.5-1 and Table 28.5-2, respectively.

TABLE 28.5-1 MAJOR WORKS

Major Works	Unit	No.3	No.6	No.7
1. Road				
(1) Improvement (Overlay +NMT)	km	0.95	0.45	1.55
(2) New Construction 2-lane (RR=30m)	km	0.81	1.35	2.20
(3) New Construction 2-lane (RR=24m)	km	0	1.05	0
Total		1.76	2.85	3.75
2. Bridge	No.	1	0	2
3. Intersection	No.	2	0	2
4. Roundabout	No.	0	0	1
5. Signalized Intersection	No.	0	0	1
6. Road Furniture/Bus Stops	Ls	1	1	1
7. Miscellaneous Works	Ls	1	1	1

TABLE 28.5-2 WORK QUANTITIES

Work Item	Description	Spec.	Unit	Total	ML 3	ML 6	ML 7
					Sub-Total	Sub-Total	Sub-Total
1 Road Construction Area							
(1) Earth Works							
1) Soil Excavation	Soil		m3	38,332	6,964	10,930	20,438
2) Embankment	Excavated Soil		m3	7,762	1,027	0	6,735
(2) Pavement Works							
1) Sub Base Course	with Cement Mix	t=300mm	m2	45,985	6,885	20,400	18,700
2) Base Course	Crushed Stone	t=200mm	m2	43,280	6,480	19,200	17,600
3) Asphalt Concrete		t=100mm	m2	62,700	13,200	21,375	28,125
2 NMT Area							
(1) Earth Works							
1) Soil Excavation	Soil		m3	3,903	529	1,599	1,776
2) Embankment	Excavated Soil		m3	8,476	1,162	579	6,735
(2) Pavement Works							
1) Interlocking (Walk Way)	ILB	t=50	m2	25,080	5,280	8,550	11,250
2) Asphalt Concrete (Cycle way)	W=2m	t=30	m	16,720	3,520	5,700	7,500
3) Asphalt Surface (Wheel Chair)	W=1m	t=30	m	8,360	1,760	2,850	3,750
3 Drainage Works							
(1) Earth Works							
1) Soil Excavation	Soil		m3	11,609	1,827	6,496	3,286
2) Embankment	Excavated Soil		m3	262	87	0	175
(2) Drainage Works							
1) Drain Piping	L-Gutter	φ600	m	4,902	775	2,200	1,927
4 Incidental Works							
(1) Guard Rail	Galvanized	H=800	m	307.0	307	117	0
(2) Road Marker	Hot Paint		m2	2,957.4	2,957	897	1,035
(3) Sign Bord			Place	147.0	147	28	23
(4) Street Light			nos	120.0	120	27	31
5 Bridge Construction							
(1) Foundation	RC Pile	400x400x4500	nos	48.0	48	0	0
(2) Substructure			m3				
1) Soil Excavation	Soil		m3	1,177	1,177	0	0
2) Rock Excavation	Rock		m3	3,228	294	0	2,934
3) Embankment	Excavated Soil		m3	3,864	0	0	3,864
(3) Superstructure							
1) T-Post Tension Beam			m2	1,031	344	0	687
2) Asphalt Surface	Surface Course		m2	739	246	0	493
6 Traffic Signal							
(1) Signal Lights and Controller							
1) Signal		H=7.5m	Set	8	0	0	8

(2) Cost Estimate

Unit Price

The list of unit prices is shown in Tables 28.5-3.

TABLE 28.5-3 (1) UNIT PRICE (LABOUR)

Labour Category	Hourly Rate (Ksh)	Daily Rate (Ksh)
Foreman	750.00	6,000.00
Operator	150.00	1,200.00
Driver	90.00	720.00
Carpenter/ Re-Bar Worker/ Masonry	120.00	960.00
Blaster	1200.00	9,600.00
Welder/ Painter	120.00	960.00
Mechanic/ Electrician	300.00	2,400.00
Skilled Labour	120.00	960.00
Unskilled Labour	60.00	480.00

TABLE 28.5-3 (2) UNIT PRICE (MATERIALS/ EQUIPMENT)

Material / Equipment	Specification	Unit	Price (Ksh)
Drainage Concrete Pipe	Dia. 600mm	No.	2,500
Asphalt	Hot Mix Asphalt	ton	9,750
Ready Mixed Concrete	σ 28 21N	m^3	10,400
Cement	Grade 41.5	ton	16,640
Reinforced Steel Bar	D25	ton	65,000
Crushed Stone	40-0	m^3	1,872
Sand		m^3	2,080
Interlocking Block		m^2	1,365
Diesel Fuel		L	65
Gasoline		L	75
Bulldozer	15 ton	hr	7,200.00
Bulldozer	21 ton	hr	8,400.00
Backhoe, hydraulic crawler	$0.61m^3$	hr	7,200.00
Backhoe, hydraulic crawler	$0.83m^3$	hr	7,800.00
Dump Truck	$4.6 \sim 9.3m^3$	hr	5,400.00
Motor Grader	3.71m	hr	9,600.00
Vibratory Tandem Smooth Drum 10.6t	10.6 ton	hr	6,000.00
Four Tamping Foot Wheels (Tire Roller)	16 ton	hr	7,200.00
Water Wagon/Pump Truck	500-1000gal.	hr	4,800.00
Asphalt Pavers/Finisher	4.7m	hr	7,800.00
Truck Mixer	5.0-6.0 cu-yds	hr	6,000.00
Concrete Batch Plant	$40m^3$/hr with silo	hr	10,200.00
Crawler Drill		hr	6,000.00
Concrete Vibrator	(operator not included)	day	9,600.00
Concrete Cutter	(operator not included)	day	12,000.00
Concrete Pavers/Finisher		hr	3,360.00

Construction Cost

Construction cost is summarized in Tables 28.5-4.

TABLE 28.5-4 CONSTRUCTION COST ESTIMATE Unit: Thousand Ksh

Major Work Item	Unit Cost	No.3	No.6	No.7	Total
1. Road					
(1) Improvement of existing road	17,347	16,480	7,810	26,890	51,180
(2) New Construction (RR=30m)	46,582	37,730	62,890	102,480	203,100
(3) New Construction (RR=24m)	35,424	0	37,200	0	37,200
2. Bridge	110,160	110,160	0	220,320	330,480
3. Roundabout	31,790	0	0	31,790	31,790
4. Signalized Intersection	6,060	0	0	6,060	6,060
5. Road Furniture/Bus Stops	LS	49,310	1,619	81,382	132,311
6. Miscellaneous	LS	41,940	1,521	64,418	107,879
Total		255,620	111,040	533,340	900,000

Note: Construction cost of a conventional-type of intersection is included in road construction cost.
1US$ = 75Ksh = 112 Japanese Yen. 1Ksh = 1.50Yen

Foreign Exchange Component

The foreign exchange component in financial terms has been estimated to be on the average, 78% of the total project cost. This estimate has mainly been based on the recent economic report. The details are discussed in Section 28.7. A breakdown of foreign and local components is given in Tables 28.5-5.

TABLE 28.5-5 BREAKDOWN OF FOREIGN AND LOCAL COMPONENTS

Unit: Thousand Ksh

Link	Total (100%)	Foreign (78%)	Local* (22%)
No.3	255,620	199,384	56,236
No.6	111,040	86,611	24,429
No.7	533,340	416,005	117,335
Total	900,000	702,000	198,000

Note: * including taxes and duties

28.5.2 Engineering Cost

Detailed engineering and supervision cost is assumed at 4% and 6% of the construction cost, respectively.

28.5.3 ROW Acquisition Cost

Cost of ROW acquisition, compensation and relocation cost are estimated in Tables 28.6-4. This includes administration costs of these activities.

28.5.4 Summary of Preliminary Cost Estimate

The summary of the project cost is shown in Table 28.5-6. Figure 28.5-1 and Figure 28.5-2 show the perspective of the projects when completed.

TABLE 28.5-6 SUMMARY OF THE PRELIMINARY COST ESTIMATE

Item	Amount (Ksh)	Amount (Japanese Yen equivalent)
Construction Cost	900,000,000	1,350,000,000
ROW/Relocation/Administration Cost	9,000,000	13,500,000
Detailed Design and Tender Services	36,000,000	54,000,000
Supervision Service	54,000,000	81,000,000
Total	999,000,000	1,498,500,000

Note: 1US$ = 75Ksh = 112 Japanese Yen. 1Ksh = 1.50Yen

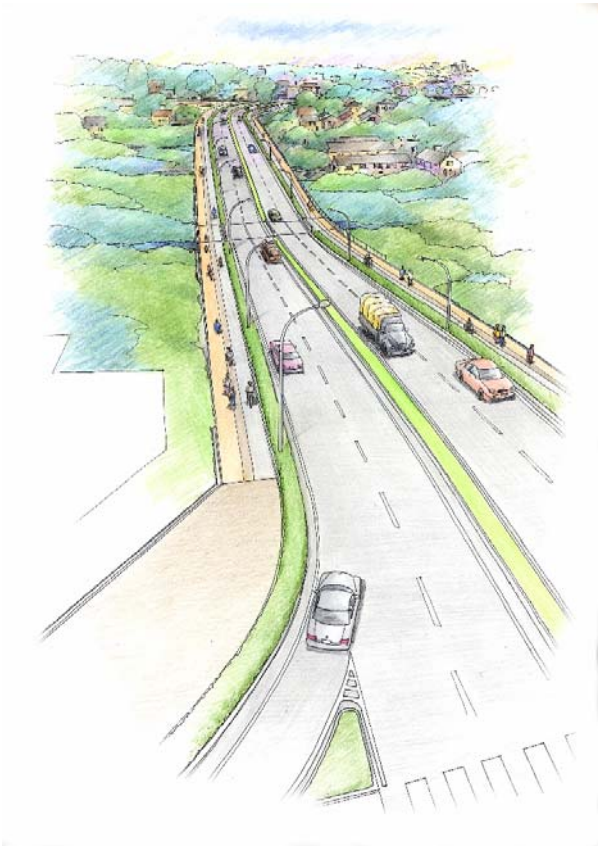


FIGURE 28.5-1 KIRICHWA KUBWA RIVER BRIDGE

KIRICHWA KUBWA RIVER

TYPICAL MISSING LINK

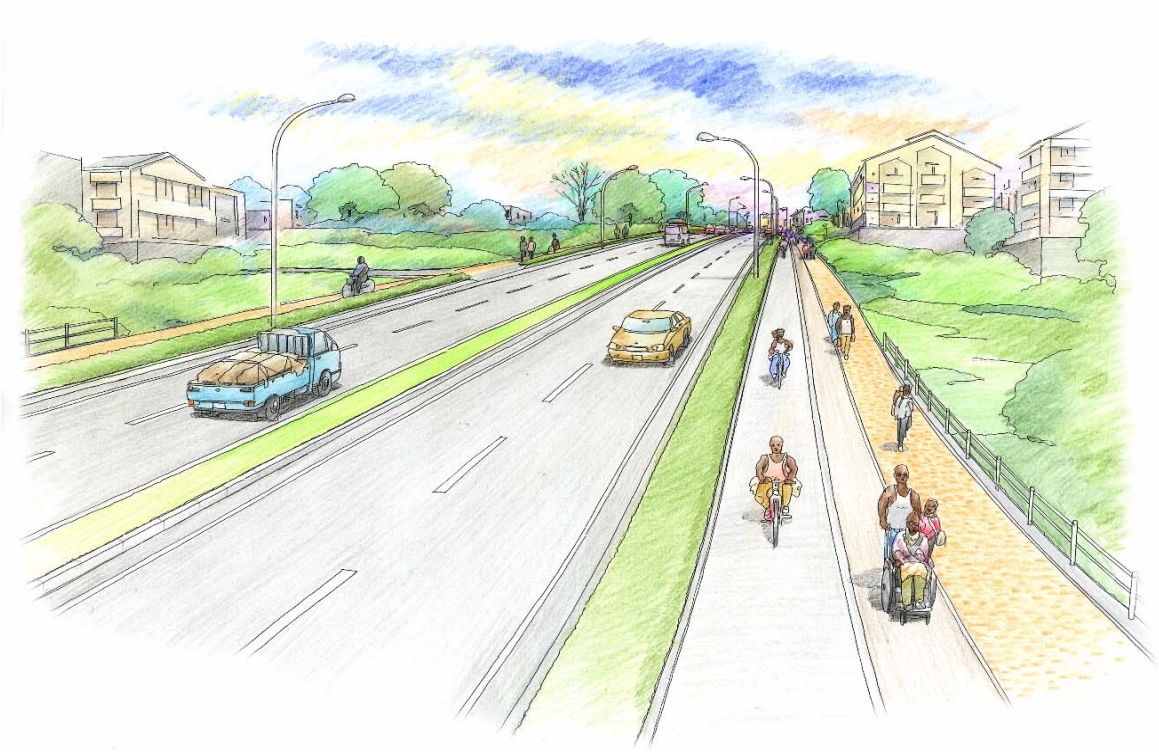


FIGURE 28.5-2 TYPICAL SECTION (ULTIMATE STAGE: 4-LANE ROAD / NMT)

28.6 ENVIRONMENTAL AND SOCIAL CONSIDERATION

28.6.1 Existing Environmental Conditions

(1) Missing Link No.3

Natural Environment

- The altitude of the Missing Link No.3 is approximately 1,680 m to 1,720 m.
- This route crosses Nairobi River in the northern section and Kirichiwa Ndogo River in the southern section. Details of the water flow of these rivers are shown in the Section 28.2.
- Basic rock formation of this area is Nairobi Trachytes that belong to the Tertiary Age. Bed rock consists of Lower Kirichwa Valley Tuffs, which belong to the Middle Trachyte Division.
- Principal soils overlying the trachytic rock of this area include dark red-friable clays (latosolic soils) with high humus layer.
- There is no significant natural forest area or habitat of wildlife or wetland affected by the Project.

Social Environment

- The section from the Westlands roundabout to the northern end of Missing Link No.3 is considered as an access road. It is a part of the Lantana Road.
- Similarly, the roadside areas of the northern section of Missing Link No.3, from Lantana Road to Riverside Drive, are currently occupied by various gardening areas created by the property owners fronting the section.
- There are 10 units of kiosks and 5 units of Jua Kali Artisans Operating garages occupying the road.
- There are a few small patches of farming areas along the river.
- There are gardening areas developed by the property owners fronting the road of the access road, which links the Missing Link No.3 to the Missing Link No.6, currently known as Kileleshwa Ring Road. It is in these areas that thick forest- species of trees have grown presumably since the creation of the road reserve.

(2) Missing Link No.6

Natural Environment

- The Altitude of this route is approximately 1,720 m to 1770 m.
- This route deviates about 200m to 800m west of Kirichwa Kubwa River. Details of its water flow are shown in Section 28.2.
- Basic rock and tuffs covering the bed rock of this area are Nairobi Trachytes and Middle

and Upper Kirichwa Valley Tuffs, which are the same as those of the Missing Link No.3.
- Soils of this area are latosolic, which are the same as those of Missing Link No.3.
- There is a thick grass area occupying the eastern section of the Missing Link No.6 with a few patches of woodlands, considered the remnants of woods which began to grow at the time of the road reserve designation during the colonial period.
- There is no significant natural forest area or habitat of wildlife or wetland affected by the Project.

Social Environment

- In the middle to the western end of the route, gardening areas are created by property owners fronting the road reserve.
- A few large size trees are growing in the gardening areas created by property owners fronting the road reserve. These trees presumably began growing at the time of the creation of the road reserve.
- Kiosk owners and vendors are relatively few, 23 units of kiosks and 20 units of Jua Kali garage operators were counted at the time of the survey in June 2005.

(3) Missing Link No.7

Natural Environment

- The altitude of this route is approximately 1,730 m to 1,767 m.
- This route crosses over Kirichwa Ndogo River in the western section and Kirichwa Kubwa River in the middle of the route. Details of water flows of these rivers are explained in Section 28.2.
- Basic rock and tuffs covering the bed rock of this area are Nairobi Trachytes and Middle and Upper Kirichwa Valley Tuffs, which are the same as those of Missing Link No. 3.
- Soils of this area are latosolic, which is the same as Missing Link No. 3.
- The section between Gatundu Road to Kirichwa Kubwa River is covered with thick growth of grass.
- There is no significant natural forest area or habitat of wildlife or wetland affected by the Project.

Social Environment

- There are gardening areas on the roadside areas in the western section of the Missing Link No.7.
- Farming areas have been developed in the section between Kirichwa Ndogo River and Gatundu Road.
- The section between Kirichwa Kubwa River and Argwings Kodhek Road is bare ground heavily occupied by kiosks and temporary garages interspersed by roadside gardening areas. There are 101 units of kiosks and 39 units of Jua Kali garage operators.

28.6.2 Identification of the Environmental Impacts

(1) Natural Environment

Tree Cutting within the Road Reserve

- There are a number of trees subject to cutting and disposal within the framework of the Project. Those trees, some of which are as large as 1 m in diameter, have grown over years since the road reserves for Missing Links were created by the British Colonial Government of Kenya. None of them form a significant part of the natural forest. Thus, unless otherwise specifically designated, those trees are subject to felling for disposal.

Construction of Bridges for Crossing Rivers

- Missing Link No.3 should cross over Nairobi River and its access road to Missing Link No.6 should cross over Kirichwa Ndogo River. Both rivers are at present heavily polluted with solid waste as well as household discharges. Upon bridge construction, surrounding areas will be improved with the introduction of trees and flowers for beautification of the abutment of the bridges.

- Missing Link No.7 should cross over Kirichwa Kubwa River and Kirichwa Ndogo River. Both rivers are at present heavily polluted with solid waste as well as household discharges. Upon bridge construction, surrounding areas will be improved with the introduction of trees and flowers for beautification of the abutment of the bridges.

(2) Social Environment

Construction of Road Over Heavily Occupied Areas

- Missing Link No.3, No.6 and No.7 are at present heavily occupied by kiosks and garages allowed to be created and operated under the "Jua Kali Project" within the jurisdiction of the Ministry of Labour. All of them are subject to relocation.

- Kiosk owners and garage operators are requesting for assistance in relocation, to continue present operations unless otherwise employment opportunities are provided for them.

Removal of Farming and Gardening Areas

- There are a number of farming areas developed in a few sections in the Missing Link No.3, No.6 and No.7 as follows:

  - Gardening areas fronting the apartment blocks and business establishments in the north and south sections of Missing Link No.3;
  - Gardening areas fronting the apartment blocks in the southern half of Missing Link No.6; and

- Farming areas between Gatundu Road and Kirichwa Ndogo River on the Missing Link No.7.

Other Potential Impacts of the Project

Table 28.6-1 presents a list of potential positive and negative impacts which may occur as a result of the implementation of the Project.

TABLE 28.6-1 OTHER POTENTIAL IMPACTS OF THE PROJECT

Positive Impacts	Negative Impacts
• Comfortable riding of vehicles • Faster time for commuting to work for both MT and NMT • Reduced dust and exhaust fumes • Introduction of bus/matatu routes to the area • Promotion of business • Increase of economic productivity of the society as a whole • Increase of employment opportunities for the construction works • Enhancement of the road side area aesthetics with landscaping • Increase of land value • Facilitation of movement of pedestrians and cyclists including Physically Challenged People.	• Increase of traffic volume • Increase of vehicles causing air/noise pollution. • Eviction/ displacement of the Missing Links occupiers • General traffic congestions • Lose of business/jobs of the missing Links occupiers • Lose of income of the Missing Links occupiers • Lose of customers of the Missing Links occupiers • Insecurity • Lose of farmland • Damage to the natural environment

28.6.3 Mitigation Measures of the Environmental Impacts

(1) Mitigation Measures on the Natural Environment

Trees grown on the road reserve are counted before the construction works begin. The same number of trees is then grown as follows:

- Plant trees on the green belt along the Missing Link road;
- Plant a number of trees elsewhere if the number of trees felled down does not tally whereby the number of trees planted on the green belt along the missing link road are determined to be less.

(2) Resettlement Action Plan as Socio-Economic Mitigation Measures

A socio-economic survey of the area affected by the Project was carried out from June – August 2005. This survey investigated the social impacts of the Missing Links Nos. 3, 6 and 7 roads improvement projects in Kileleshwa, Kilimani and Lavington areas of Nairobi City. It is a baseline data of the expected social impacts of the project particularly to the communities and environment directly affected by the Project. Data was collected from temporary

residents, temporary/informal business owners, permanent residents, permanent business owners, institutions and key informants using questionnaires and the results are attached in Appendix 28.

(3) Stakeholders Consultation and Participation

There have been a series of stakeholders meetings held in May, July and August 2005. Details of the programs and minutes of discussions including follow-up discussions with individual stakeholder groups are shown in Appendix 28. The following is a summary of the discussions:

- In general any road project implemented in Nairobi is welcomed;
- Kiosks and temporary garages are subject to removal. However, before removal, the City Council of Nairobi should extend their concerns over poor people and find them places to move to; and
- Garages in operation on a section of Missing Link No.7 form a part of "Jua Kali Project" under the jurisdiction of the Ministry of Labour. All of them, including kiosk owners, should be considered to form a part of the Project. Instead of excluding them, a way to include them should be sought at the Master Plan Study level.

Discussions on Resettlement

Further discussions on resettlement have been held on site during the socio-economic survey. Details of the discussions are shown in Appendix 28. The following is a summary of the discussions:

- In general, any road project implemented in Nairobi is welcomed. However, poor people should be considered as an integral part of the Project;
- The City Council of Nairobi was requested to discuss with the local residents and kiosk owners for cooperation of the Project; and
- Income generation and shelter provision of garages in operation on a section of Missing Link No.7 form a part of "Jua Kali Project" under the jurisdiction of the Ministry of Labour. MOL will coordinate with them for Project involvement.

Gender Distribution of Respondents

The social-demographic results are described in terms of gender, age, marital status, parental status, economic status, and residential status. A total of 282 respondents were interviewed during the survey, out of which 75, 21, and 186 were interviewed in the area along the Missing Links No.3, No.6 and No.7 respectively. In total 225 males and 57 females were interviewed. There are a large number of male respondents because of the dominance of

male-oriented automobile garage operation created by "Jua Kali Project" in the middle section of Missing Link No. 7 and a few in No.3.

Ages of Respondents

Generally, the respondents can be described as youthful workforce i.e. over 70% fell within the age brackets of 20-29 and 30-39.

Marital Status

Over 70% of the respondents were married, while only one respondent was divorced.

Parental Status and the Number of Children of the Respondents

Approximately 70 – 90 % of the respondents have children. This compared fairly well with their marital status where almost all the married respondents had children. More than 10 % of the respondents have between one and four children. This does not, however, mean that they live together. The number of people living together with their families varied across the missing link areas. In Missing Link No.3, more than 56 % of respondents have from four to six or more people living together. In Missing Link No.6, 47 % have three to four people living together, while in Missing Link No. 7, 28% of respondents have more than six people living together. This implies that the local residents leave their own children at Home to some extent, while they share their house with others like sisters and brothers or relatives.

Residential Status of Respondents

There are a few respondents owning houses in the project area. In the Missing Link No.3, 89.3 % of them live outside the project area. This implies that they commute to run kiosks in the area. In the Missing Link No. 6 and No.7, there are 42.9 % and 61.3 % of them respectively living outside the project area. Compared to this, there are a fraction of the respondents that live in the work place i.e. kiosks.

Location of Schools Attended by Children

The majority of the respondents across the Missing Links send their children to schools outside the project area but within Nairobi City with the exception of Missing Link No.6 where 33.3 % of them have their children attending schools outside Nairobi City i.e. their homeland area. Less than 10% of the respondents in the three Missing Links have children attending schools within the project area. This implies that they have their children left in the rural area and also that they are not residents of the local areas.

Occupations of the Respondents

The respondents in the Missing Links engage in informal employments/businesses. They operate kiosks and engage in other occupations such as street vending, laundry, construction works, hairdressing, mechanics, farming, carpentry, marketing, tailoring, shoe-shining, among others. 10 % of the respondents in Missing Links No. 3 and No.7, and 47.6 % in Missing Link No.6 operate kiosks with daily permits. Those operating kiosks with annual permits were less than 10% across the three Missing Links. Further, there are a few cases where respondents engaged in more than one occupation.

Dependants on the Respondent's Occupation

Out of the respondents in all the three Missing Links, 78.7% in Missing Link No.3, 23.8% in Missing Link No.6 and 76.9% in Missing Link No.7 have more than 5 people depending on their occupations. Those with less than 5 dependants were less than 10 % across the Missing Links. This compared fairly well with the respondents living together with people other than their own children.

Vehicle Ownership

A few respondents, 10 – 30 %, in all the three Missing Links own vehicles. Bicycles are a common means of transport compared to cars in the three Missing Link areas.

Information on the Missing Link Improvement Project

Approximately 70 % of respondents are aware of the existence of the missing link roads. They also knew very well about the existence of the road reserves. However, more than half of them were not aware of the existence of the Missing Link Improvement Project and a majority of them knew about it by way of rumours. As they responded to the interview survey, they now come to accept the Project.

Acceptance of Resettlement

Approximately 90% of the respondents accept resettlement as a result of project implementation. Those who do not accept resettlement stated that:

- They have nowhere else to go;
- The current place is their source of livelihood;
- The new place might not have electricity and water;

- They are used to the current place; and
- They fear losing their work places and customers.

Areas Preferred by the Respondents for Resettlement

Most respondents across the three Missing Links prefer to resettle in a near-by area within the location. Very few of them stated that they intend to move out of Nairobi.

Requests of the Respondents for Resettlement

A majority of respondents requested the government to find a place to resettle them, preferably before the project is implemented, while 30 % of them made other requests such as financial support for resettlement, employment or job opportunity, and provision of permanent trading licences.

Value of the Existing Road

More than 80% of the respondents stated that they find the existing road useful because these roads provide access to shopping places, provide farmland, promote business, and are residential areas. However, the respondents do not find the existing roads valuable because their conditions are deteriorated; the dusty conditions of the road do not allow bus/matatus to enter; the deteriorated road condition causes low economic productivity; and excessively long time to reach the places of work.

Contributions of the Existing Roads to Socio-economic Environment

A considerably large number of respondents agreed that the existing roads contribute to the residential, business and sports/educational development of the area. These roads are not considered as boosting tourism, factories and agriculture.

Social Impacts of the Missing Links Road Improvement Project

Approximately half of respondents on the Missing Links No.3 and No.7 stated that the Project will bring about positive socio-economic impacts to the surrounding areas. A majority of respondents in Missing Link No.6 also stated that there will be positive development with the implementation of the Project. Comfortable ride in buses, faster commuting time, introduction of buses and matatus, promotion of business, and improvement of job opportunities, to name a few, are anticipated developments among others. However, some respondents did not foresee any value contribution of the Project due to resultant increase in

traffic volume and air/noise pollution. Some of the respondents stated that the Project would not contribute anything to the local society and even fear that some would lose their jobs.

Effects of Missing Link Improvement Project

These will be essentially the same as those contributed by the existing roads to the local society. The Project is looked upon as a contributor to residential, business and educational/sport development. Tourism development brought about by the Project is rated slightly higher than the effect of the existing roads. In general, improvement of economic development, comfort of commuting and direct employment at the time of project implementation are anticipated as reasons of acceptance of the Project.

Major Undesirable Development Brought About by the Missing Link Improvement Project

76 % of respondents in the Missing Link No.3 and 94 % of respondents in the Missing Link No.7 stated that they fear loss of shelter, farmland, jobs, business, general insecurity, eviction/displacement of families, increase in road accidents, and increase in poverty and destruction of natural environment.

Preferred Type of Road for Positive Development of the Project Area

A majority of respondents stated that a road with sidewalks is a must-development. They do not mind if the road is with or without greenbelts/landscaping areas.

Number of Project Affected People (PAP)

The number of PAPs directly affected by the Project is summarized in Table 28.6-2.

TABLE 28.6-2 NO. OF PAP AFFECTED BY THE PROJECT.

No.	Descriptions	Area of Missing Link Road			
		No.3	No.6	No.7	Total
01	Kiosks	10	23	101	134
02	Vendors without shelter	5	20	39	64
03	Automobile garages	3	0	21	24
04	Temporary Residents	0	1	3	4
05	Social Facilities	1	0	0	1
06	Gardening areas	2	10	8	20
07	Tree nurseries	2	0	1	3
08	Religious Buildings/Offices	1	0	0	1
09	Car Parks	0	0	3	3
	Total	24	54	176	254

Preferred Type of Intersection

While the local residents are positive about a road with sidewalks, their preference on the type of intersection differs from roundabouts with or without signals, or conventional intersections with or without signals. In general, roundabouts with signals is the local preference.

Valuation of Losses of PAPs

The approximate costs of kiosks/garages occupying the road reserve is shown in Table 28.6-3 (1) to (4). It is a broad categorization of structures ranging from wooden to iron sheets with or without cemented floors.

TABLE 28.6-3 (1) ESTIMATED UNIT COST OF KIOSKS/GARAGES

Category	Size	Cost (Ksh)/unit
1. Small	Up to 16m^2	58,450
2. Medium	25-100 m^2	89,660
3. Large	100-225m^2	365,340

Source: Professional Carpenter. The above is on the higher estimate among the sources.

TABLE 28.6-3 (2) ESTIMATED COST OF KIOSKS/GARAGES OF LINK NO.3

No.	Descriptions	Unit Cost (Ksh)	No.	Total (Ksh)
01	Kiosk			
	a. Small (Up to 16m^2)	58,450	3	175,350
	b. Medium(25-100 m^2)	89,660	5	448,300
	c. Large(100-225m^2)	365,340	2	730,680
02	Automobile Garage	365,340	3	1,096,020
03	Social Facilities	365,340	1	365,340
04	Religious Buildings/Offices	365,340	1	365,340
	Total		15	3,181,030

Source: Professional Carpenter. The above is on the higher estimate among the sources.

TABLE 28.6-3 (3) ESTIMATED COST OF KIOSKS/GARAGES OF LINK NO.6

No.	Descriptions	Unit Cost (Ksh)	No.	Total (Ksh)
01	Kiosk			
	a. Small (Up to 16m^2)	58,450	8	467,600
	b. Medium(25-100 m^2)	89,660	12	1,075,920
	c. Large(100-225m^2)	365,340	3	1,096,020
	Total		23	2,639,540

Source: Professional Carpenter. The above is on the higher estimate among the sources.

TABLE 28.6-3 (4) ESTIMATED COST OF KIOSKS/GARAGES OF LINK NO.7

No.	Descriptions	Unit Cost (Ksh)	No.	Tota l (Ksh)
01	Kiosk			
	a. Small (Up to 16m^2)	58,450	79	4,617,550
	b. Medium(25-100 m^2)	89,660	12	1,075,920
	c. Large(100-225m^2)	365,340	10	3,653,400
02	Automobile Garage	365,340	21	7,672,140
	Total		122	17,019,010

Source: Professional Carpenter. The above is on the higher estimate among the sources.

From the above mentioned, the grand total of the value of structures directly affected by the Project would be estimated at Ksh 22,839,580 for kiosks, garages and other buildings. However, the unit cost differs from one source to the other. It is subject to official estimation applying official figures for each item subject to compensation that has to be valued, determined and applied at the time of valuation. Owners of gardening areas, farming areas and tree nurseries have agreed to give up their possessions without any compensation.

Resettlement Policy

The primary objective of the resettlement action plan is to provide policy and procedural guidelines for land acquisition, compensation, resettlement and income and livelihood restoration for the PAPs. Theoretically, the following are the essential elements for the resettlement policy despite the fact that kiosk owners and garage operators occupying the road reserves in Nairobi are not considered as residents with permanent permits. However, it would be sensible to develop a resettlement policy as follows:

- Clarify the organizational responsibilities related to the Project;
- Encourage community participation and dialogues at stakeholder meetings;
- Implement integration of the PAPs with host populations, if any;
- Carry out in-depth and 100% of sampling of the PAPs in terms of socio-economic survey;
- Clarify the existing legal framework including entitlement for resettlement, mechanisms for resolution of conflicts and appeal procedures of the PAPs who are kiosk owners and Jua Kali Project's garage operators;
- Identify alternative resettlement sites;
- Observation and agreement of the resettlement site by the representatives of PAPs;
- Elaborate the valuation and compensation for lost assets;
- Identify permission of micro-enterprises and classify the PAPs according to their status of permission for the entitlement of resettlement;
- Provide access to training, employment, and credit as appropriate;
- Provide shelter, infrastructure, and social services for the PAPs;
- Review the measures on environmental protection and management;
- Elaborate implementation schedule and budget allocation; and
- Elaborate Monitoring and Evaluation Plan.

Entitlement of the PAPs

There are laws and regulations which explicitly state the entitlement of the PAPs directly affected by the Project if they have land or buildings title as the owner. For the PAPs who have no clear title, such as temporary kiosks and vendors, there is no entitlement by law; however, appropriate compensation should be considered based on the constitutional rights of the PAPs. EIA regulations state that Kenyan citizens have a right to be given an appropriate environment for living and that they have various properties at present. As such, they are considered to be given resettlement assistance in lieu of compensation for the land they

occupy and properties they possess and any other assistance for losses incurred during the resettlement operation. This should only apply to those who occupy the Missing Links prior to the deadline which the GOK is to set out in due course.

The criteria of eligibility may be determined by the loss of property such as business or residential structures, crops, trees, and any other possessions or improvements made on their properties. The following entitlement matrix outlines the types of losses such as land, shelter, and livelihood which may be applied to the PAPs. However, this is subject to further study and survey to be implemented by the GOK in order to reach an agreement between the GOK as the project proponent and the PAPs.

The proposed survey should mainly review documentary evidence such as permits for assets to be lost as a result of implementation of the Project. It is also important to hold stakeholder meeting(s) with the PAPs and review whether the assets are individually owned or belong to a group under the currently valid permit for kiosk or garage operations as well as social and religious organizations. Thereby, both sides should agree to establish a criteria by which the PAPs will be deemed eligible for compensation and other resettlement assistance as Kenyan citizens. The proposed entitlement of the PAPs is shown in Section 28.4 of Appendix 28.

Resettlement/ Relocation Sites

Missing Links No. 6 and No.7 would be subject to implementation of half of the width of the existing road reserve at the initial stage. Essentially therefore the other half of the road reserve of approximately 30m, would be allocated as a resettlement site. There is no other available resettlement/relocation site identified at present. Thus, the following suggestions which are subject to further study and mutual agreement arrived at as a result of the stakeholder meetings, are proposed:

- Allocation of the designated areas should be determined based on the agreement reached by a series of stakeholder meetings;
- A new licensing system should be elaborated i.e. a limited period of a maximum five years could be an option;
- Licensees should evacuate the designated areas upon expiration of the maximum licensing period without compensation costs for resettlement/relocation;
- Structures built as kiosks or garages should clear the minimum building code requirements of the GOK for temporary structures;
- Uniform design of kiosks may be determined by the City Council of Nairobi based on enhanced aesthetics as a basic criterion.
- Explicit new licensing conditions should be stated in the license; and
- No daily license should be issued.

Assistance for Resettlement/Relocation

Assistance for resettlement/relocation could be considered ranging from compensation to the income restoration programme. However, actual assistance for resettlement/ relocation may be limited to the following:

- Dismantling but conserving the materials currently being used to a re-usable state; and
- Transportation of materials from the present location of the structures to the allocated destination.

Income Restoration Programme

Kiosks and garages to be re-allocated to the un-paved portion of the road reserve of the Missing Link No.6 and No.7, without a particular income restoration programme as they would sustain their current customers to some extent.

On the other hand, if they are moved to other areas, it would be sensible to provide short term and long term income restoration programmes, which are considered necessary to be implemented within the framework of the Project. Details are shown in Appendix 28.

Grievance Redress Measures

Kiosk owners and garage operators are usually not adequately protected when they are relocated from the location of operating their businesses. As a consequence it would be sensible to establish measures within the framework of the Project as follows:

- The City Council of Nairobi to be responsible to establish a unit of grievance redress within the City Inspectorate or Social Services;
- The unit to be specifically established for receiving complaints related to the resettlement so exercised by the resettlement scheme of the Project; and
- Officers with a background of sociology, human psychology, social anthropology or any background of human oriented activities to be assigned.
- The unit should notify the PAPs that the grievance redress unit is the sole agent of dealing with such matters on behalf of the City Council of Nairobi.

Cost of Resettlement Action Plan

The overall cost of the resettlement action plan is estimated at Ksh. 35,244,580 as is shown in Table 28.6-4. However, the unit cost differs from one source to the other. It is subject to official estimation applying official figures for each item subject to compensation that has to be valued, determined and applied at the time of valuation.

TABLE 28.6-4 OVERALL COST OF RESETTLEMENT

No.	Item	Unit Cost (Ksh)	No. of Units	Total Cost (Ksh)
01	a. Kiosks-Demolition	75,000	134	10,050,000
	b. Kiosks-Rebuilding*	LS	134	13,340,740
02	Vendors without shelter	LS	-	0
	a. Automobile garages-Demolition	12,500	24	300,000
03	b. Automobile garages-Rebuilding*	LS	24	8,768,160
04	Temporary Residents	LS	-	0
05	a. Social Facilities-Demolition	75,000	1	75,000
	b. Social Facilities-Rebuilding*	LS	1	365,340
06	Gardening areas-demolition	75,000	20	1,500,000
07	Tree nurseries – demolition	50,000	3	150,000
08	a. Religious Buildings-Demolition	75,000	1	75,000
	b. Religious Building-Rebuilding*	LS	1	365,340
09	Car Parks	85,000	3	255,000
	Total			35,244,580
	Saving cost by usable materials for rebuilding		50%	17,622,290
	Actual Cost for 4-lane road			17,622,290
	Actual Cost for Initial Stage (2-lane road)		50%	8,811,145
	Budget for ROW Acquisition Cost			9,000,000

Note: * - Refer to Table 28.6-3
Demolition includes loading, transportation and off-loading of materials.

28.6.4 Environmental Management and Monitoring Plan

Environmental Management Plan

No specific Environmental Management Plan for the natural environment is considered necessary as restoration of the natural environment is embedded in the green belt construction works of the Missing Link Improvement Project. Green belt on the sidewalks, roundabouts and abutment areas of the road bridges constructed as part of the Project are subject to routine maintenance works carried out by the City Council of Nairobi.

For the social consideration, the resettlement Action Plan is considered as an overall environmental management plan.

Environmental Monitoring Plan

It is imperative that the internal and external monitoring plans are carried out as follows:

- Internal Monitoring
  - Within the government organization responsible for the implementation of the resettlement action plan as well as the natural environment management plan, a

monitoring unit is to undertake the monitoring plan.

- Monitoring Units will look into the conventional indicators such as assistance provided to the PAPs, level of infrastructure facilities allocated, level of the restoration of livelihood and other relevant environmental components directly impacted by the Project.
- Monitoring Units will also assess the financial aspects, which include payment of compensation, grants, income restoration programme, and other aspects of resettlement including restoration of the natural environment.
- Regular progress reports shall be prepared and submitted to the implementation organization of the Project on a timely basis.

- External Monitoring
  - In order to verify the results of the internal monitoring carried out by the implementation organization of the Project, it is mandatory that external monitoring works are carried out.
  - NGOs or consulting companies licensed to undertake EIA studies by the GOK to be employed as external monitoring units for periodical monitoring works.
  - External monitoring units will assess whether resettlement objectives have been met. Specifically, whether livelihoods and living standards have been restored or enhanced after every 6 months over a 3 year period as a minimum requirement.
  - External monitoring units will assess the efficiency of the resettlement operation, effectiveness, impact and sustainability, so as to be able to draw lessons for future resettlement activities in terms of whether the resettlement entitlements were appropriate to meet the objectives of the resettlement action plan, and whether the objectives were suitable to the PAPs conditions.
  - External monitoring units to submit reports of the results of the monitoring works and make recommendations on various aspects to the implementation organization of the Project.

28.7 ECONOMIC ANALYSIS

28.7.1 Evaluation Flow

A flow of economic evaluation procedure is presented in Figure 28.7-1.

In order to achieve the objective of the Study, the following steps are carried out:

Step 1: Traffic demand forecast with and without the Project

Step 2: Estimation of economic benefits based on the traffic demand on the Project Road and unit vehicle operating cost

Step 3: Estimation of economic costs based on the estimated financial cost mentioned in the previous section.

Step 4: Economic evaluation using economic benefits and economic costs

Step 5: Sensitivity analysis to be made by varying factors of influence to the economic indicators

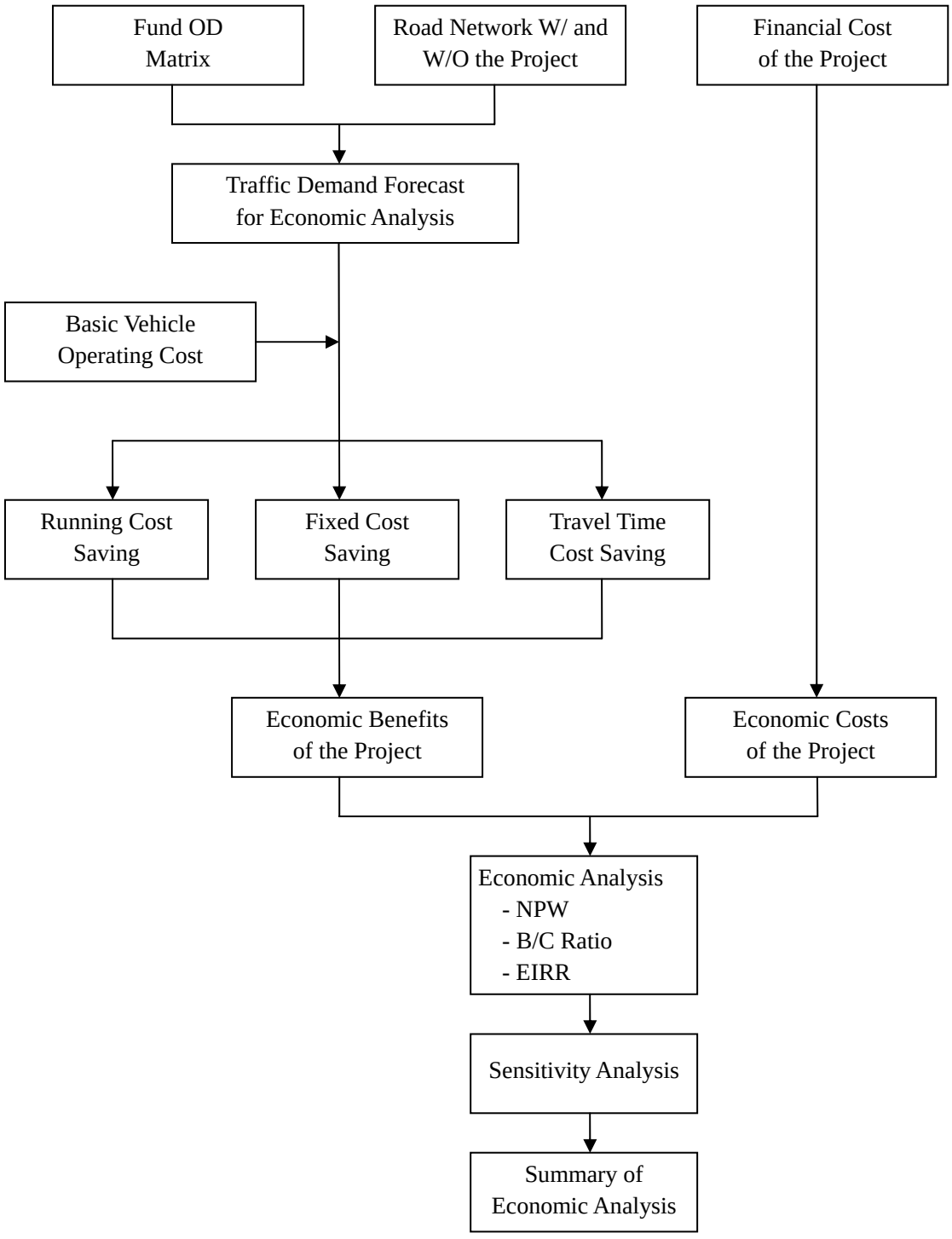


FIGURE 28.7-1 FLOW OF PROCEDURE FOR PROJECT EVALUATION.

28.7.2 Traffic Demand Forecast for Economic Evaluation

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 along the Missing Links. The estimated traffic volume on the Roads for the case of "with" the project is summarized in Table 28.7-1.

TABLE 28.7-1 TRAFFIC VOLUME ALONG MISSING LINKS

Unit: PCU / day

	2005	2010	2015	2025
Missing Link No. 3 (Ring Rd Kileleshwa/Riverside Drive to Raphta Rd /West lands)	13,969	20,550	27,430	31,862
Missing Link No.6 (Argwings Kodhek Road – Ring Road Kileleshwa)	20,612	24,564	28,515	40,428
Missing Link No. 7 (James Gichuru Road / Olenguroune Av. to Argwings Kodhek Road / Ngong Road)	20,956	23,224	25,491	44,235

Note: In 2011, all Missing Links to be in operation

The estimated vehicle-kilometres and vehicle-hours in Nairobi are shown in Tables 28.7-2 and 28.7-3, respectively. These tables form the base of the benefit calculation.

TABLE 28.7-2 TOTAL VEHICLE KILOMETERS IN NAIROBI WITH AND WITHOUT MISSING LINK IMPROVEMENT PROJECT

Unit: PCU Km / day

	W/O Project	W/ Project	W/O – W/
2005	9,972,492	9,912,280	60,212
2010	14,192,261	14,059,890	132,371
2015	17,864,676	17,709,510	155,166
2025	28,080,673	27.489,635	591,038

Note: Same notes as in Table 28.7-1

TABLE 28.7-3 TOTAL VEHICLE HOURS IN NAIROBI WITH AND WITHOUT MISSING LINK IMPROVEMENT PROJECT

Unit: PCU Hour / day

	W/O Project	W/ Project	W/O – W/
2004	273,254	268,828	4,426
2010	513,384	502,393	10,991
2016	814,351	774,298	40,053
2022	2,180,786	2,090,674	90,112

Note: Same notes as in Table 28.7-1

28.7.3 Vehicle Operating Cost

The basic vehicle operating cost (BVOC) was estimated during the Master Plan stage. (See Table 28.7-1)

TABLE 28.7-4 BASIC VEHICLE OPERATING COST (EXCLUDING TAX)

Vehicle Type	Running (Ksh/1000km)	Fixed (Ksh/Hour)	Time (Ksh/Hour)
Car /Taxi / Jeep	7,573	29.83	33.1
Bus	10,939	62.70	31.1
Truck	19,005	53.49	0

Note: All costs are expressed based on 2004 prices

The vehicle operating costs by travel speed was adopted since it varies by surface type and travel speed.

28.7.4 Economic Benefits of the Project

The savings in vehicle operating costs and travel time costs were estimated and are shown in Table 28.7-5.

TABLE 28.7-5 ESTIMATION OF BENEFITS

Unit: Thousand Ksh/Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2005	116,624	37,469	154,093	26,541	180,544
2010	231,734	93,048	324,782	65,685	390,467
2015	300,538	142,429	442,967	100,545	543,512
2025	1,144,772	231,893	1,376,665	163,700	1,540,365

Note: Same notes as in Table 28.7-9

28.7.5 Economic Costs of the Project

(1) Economic Cost

The project cost, which was already calculated in the previous section, is expressed as the financial 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 the Northern Corridor Transport project, the transfer element was calculated as 22% of the total construction and maintenance cost. In this study therefore, it is assumed that the economic costs are calculated by deducting 22% from the financial costs. It is therefore to be converted from financial cost

to economic cost. In this Study, the economic cost was estimated as a resultant of deducting government taxes and prices of unskilled labour from financial costs as shown in Table 28.7-6.

TABLE 28.7-6 ECONOMIC COST ESTIMATE

Unit: Thousand Ksh

Description		Economic Cost	Financial Cost
1	Construction Cost	702,000	900,000
2	RoW Acquisition/ Resettlement	7,020	9,000
3	Consultancy	70,200	90,000
3-1	Detailed Design	28,080	36,000
3-2	Construction Supervision	42,120	54,000
	Total	779,220	999,000

(2) Maintenance Cost

The maintenance cost, which consists of routine maintenance and periodic maintenance, was estimated in Table 28.7-7. The maintenance cost is converted to the economic cost as follows:

TABLE 28.7-7 MAINTENANCE COST

Unit: Thousand Ksh

	Economic Cost	Financial Cost
Routine maintenance Cost	7,020	9,000
Periodic Maintenance Cost	17,705	22,699

28.7.6 Benefit Cost Analysis

(1) Presumptions of the Economic Analysis

1) Evaluation Period

The evaluation period is assumed to be 20 years from 2011 to 2030 taking into account the service life of the Missing Links.

2) Implementation Schedule

The implementation schedule is assumed as follows:

2007	Detailed design
2007	Land acquisition
2008 – 2010	Construction
2011	Open to public

3) "With and "Without" the Project

Economic benefits are calculated as the difference 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 when the proposed Missing Link Construction Project is implemented.

(2) Economic Indicators

The economic evaluation method principally employed is the 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)

(3) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimates, the economic analysis of the Project was made. Table 28.7-8 shows the benefit – cost analysis of the Missing Link Construction Project during a project life period of 20 years while Table 28.7-10 on the following page presents the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of Ksh 2,273 million and BCR of 5.70 over 20 years service life of the road will be realized using a discount rate of 12% which is designated by the Ministry of Planning and National Development. The Economic Internal Rate of Return (EIRR) was compiled at 40.1%.

TABLE 28.7-8 ECONOMIC INDICATIONS OF BENEFIT COST ANALYSIS

Net Present Value	Ksh 2,273 million
BCR	5.77
EIRR	40.1 %

Notes: 1) Project life is assumed to be 20 years
2) Discount rate is 12%

(4) Sensitivity Analysis

The sensitivity analysis is conducted under a worst case scenario incorporating increase and/or decrease of the estimation of costs and benefits. Table 28.7-9 shows the results of the sensitivity analysis.

TABLE 28.7-9 SENSITIVITY ANALYSIS REGARDING COSTS AND BENEFITS OF MISSING LINKS

		Indicator	Benefits		
			20% down	Base Case	20% up
Costs	20% down	NPV (KSh million)	1,819	2,369	2,919
		B/C Ratio	5.77	7.20	8.66
		EIRR (%)	40.1	46.0	51.4
	Base Case	NPV (KSh million)	1,723	2,273	2,823
		B/C Ratio	4.62	5.77	6.93
		EIRR (%)	34.9	40.1	44.9
	20% up	NPV (KSh million)	1,628	2,178	2,728
		B/C Ratio	3.85	4.81	5.77
		EIRR (%)	31.1	35.8	40.1

Note: Project life is assumed to be 20 years

28.7.7 Summary of Economic Analysis

The implementation of the Missing Link construction project can be justified from the national economic view point since the economic indicators in all cases are more than the over cut-off level which can be considered as 12% of EIRR.

TABLE 28.7-10 BENEFIT - COST STREAM OF MISSING LINK 3, 6 AND 7 ROAD CONSTRUCTION PROJECT

Undiscounted Benefit Cost Stream

Unit: Thousand 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	0	0	0			0	0
4	2007	7,020	0	7,020			0	-7,020
5	2008	217,620	0	217,620			0	-217,620
6	2009	365,040	0	365,040			0	-365,040
7	2010	189,540	0	189,540			0	-189,540
8	2011	0	7,020	7,020	292,455	76,286	368,741	361,721
9	2012	0	7,020	7,020	309,604	83,076	392,680	385,660
10	2013	0	7,020	7,020	328,580	90,469	419,050	412,030
11	2014	0	7,020	7,020	349,650	98,521	448,171	441,151
12	2015	0	7,020	7,020	401,702	107,290	508,992	501,972
13	2016	0	7,020	7,020	443,652	107,290	550,942	543,922
14	2017	0	7,020	7,020	497,019	112,654	609,673	602,653
15	2018	0	7,020	7,020	557,512	118,287	675,799	668,779
16	2019	0	7,020	7,020	626,128	124,201	750,329	743,309
17	2020	17,705	7,020	24,725	704,000	130,411	834,411	809,686
18	2021	0	7,020	7,020	792,424	136,932	929,356	922,336
19	2022	0	7,020	7,020	892,880	143,778	1,036,659	1,029,639
20	2023	0	7,020	7,020	1,007,059	150,967	1,158,027	1,151,007
21	2024	0	7,020	7,020	1,136,891	158,516	1,295,406	1,288,386
22	2025	0	7,020	7,020	1,293,600	174,662	1,468,262	1,461,242
23	2026	0	7,020	7,020	1,335,741	176,846	1,512,587	1,505,567
24	2027	0	7,020	7,020	1,379,337	179,056	1,558,394	1,551,374
25	2028	0	7,020	7,020	1,424,440	181,295	1,605,735	1,598,715
26	2029	0	7,020	7,020	1,471,103	183,561	1,654,664	1,647,644
27	2030	0	7,020	7,020	1,519,381	185,855	1,705,236	1,698,216
28	2031	0	7,020	7,020	1,569,331	188,178	1,757,509	1,750,489
Total		796,925	147,420	944,345	18,332,490	2,908,131	21,240,621	20,296,276

Discounted Benefit Cost Stream

Unit: Thousand 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	0	0	0
4	2007	1.405	4,997	0	-4,997
5	2008	1.574	138,301	0	-138,301
6	2009	1.762	207,134	0	-207,134
7	2010	1.974	96,027	0	-96,027
8	2011	2.211	3,176	166,800	163,624
9	2012	2.476	2,835	158,597	155,762
10	2013	2.773	2,532	151,114	148,582
11	2014	3.106	2,260	144,299	142,039
12	2015	3.479	2,018	146,323	144,305
13	2016	3.896	1,802	141,413	139,611
14	2017	4.363	1,609	139,721	138,112
15	2018	4.887	1,436	138,282	136,846
16	2019	5.474	1,283	137,082	135,800
17	2020	6.130	4,033	136,111	132,077
18	2021	6.866	1,022	135,355	134,333
19	2022	7.690	913	134,807	133,894
20	2023	8.613	815	134,455	133,640
21	2024	9.646	728	134,291	133,563
22	2025	10.804	650	135,902	135,252
23	2026	12.100	580	125,004	124,424
24	2027	13.552	518	114,991	114,473
25	2028	15.179	463	105,789	105,327
26	2029	17.000	413	97,333	96,920
27	2030	19.040	369	89,560	89,192
28	2031	21.325	329	82,416	82,087
		Total	476,241	2,749,644	2,273,402

NPV (Million)	2,273
B/C Ratio	5.77
EIRR	40.09%

28.8 PROJECT IMPLEMENTATION PLAN

28.8.1 Implementating Organization

The Missing Links are classified as city roads belonging to City Council of Nairobi (CCN) under the Ministry of Local Government (MOLG). Implementation of the construction of Missing Links will be under the responsibility of the MOLG. Since the Missing Link Roads, No. 3, No. 6, and No.7 fall under the status of urban roads, MOLG/CCN is the implementing organization for constructing these roads as stated in Section 7.1.1. Actual construction works including detailed design have to be contracted out to contractors as well as consulting engineers since MOLG/CCN does not embrace a proper work and engineering forces for road construction works.

28.8.2 Implementation Schedule

(1) Detailed Design and Tender Preparation

Detailed design and tender of the Contractor including procurement of the Consultant will take one (1) year after financing is pledged.

(2) Construction

Table 28.8-1 presents the construction schedule. The construction period is two years. After issuing Notice to Proceed to the Contractor, the construction will start.

TABLE 28.8-1 CONSTRUCTION SCHEDULE

	Year	1st Year				2nd Year			
	Major Work	I	II	III	IV	I	II	III	IV
1	Mobilization								
2	Clearance								
3	Earthwork								
4	Pavement								
5	Drainage								
6	Bridge (1) Foundation								
	Super structure								
7	Bridge (2) Foundation								
	Super structure								
8	Bridge (3) Foundation								
	Super structure								
9	Road Facilities								
10	Demobilization								

(3) Project Implementation Schedule

The Project implementation schedule is shown in Table 28.8-2.

TABLE 28.8-2 PROJECT IMPLEMENTATION SCHEDULE

Major Work	Cost (million Ksh)	Year (Cal.)	2006	2007	2008	2009	2010
		Year (Fiscal)	2006	2007	2008	2009	2010
Fund Preparation							
Consultant Selection							
Detailed Design/Tender Services	36			36			
ROW/Resettlement	9		9				
Contractor Tender							
Construction	900				450	450	
Construction Supervision	54				27	27	
Total	**999**		**9**	**36**	**477**	**477**	

Note: Fiscal year of GOK starts in July and end in June.

28.8.3 Fund Preparation

(1) Funding Possibilities

The following are possible sources for funding the construction:

- CCN's own revenue source
- LATF allocated from the Central Government to CCN
- Private Funds, and
- Special Arrangement by the Central Government including Foreign Assistance.

Comparing the construction cost amounting to Ksh 900,000 million and CCN's current financial position which could expend approximately Ksh 70 million/ year for the current 2 years as shown in Table 28.8-3, the first option cannot be realistic allocations. Utilizing the LATF is also unrealistic comparing the allocated amount to CCN of Ksh 600 million and the construction cost stated above.

Again the private funds option cannot be expected due to difficulty in earning returns through the utilization of the constructed roads. The only option which can be expected among the above stated possibilities is the special arrangement for construction budget allocation including foreign assistance. Procuring by foreign assistance may be the only practical choice to realize the construction of the Missing Links in the near future considering that these roads

are not directly under the responsibility of the Central Government whose budgetary margin is quite limited. A preferable form of the assistance is grant for this small size project.

TABLE 28.8-3 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	693	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	3,605	4,578	4,152	8,737	4,218	4,079
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 Surplus/ 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
Uncommitted Surplus/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

(2) Responsible Organization for Fund Procurement

Since the Local Authorities are not eligible organizations to acquire official foreign assistance, the MOLG is the eligible central government organization to undertake the responsibility of project implementation under such assistance. The Roads and Transport Unit of the UDD is particularly responsible.

28.8.4 Maintenance Requirement

(1) Maintenance Requirement

After the completion of the missing link construction, the road maintenance is required as shown in Table 28.8-4.

TABLE 28.8-4 MAINTENANCE requirement

Requirement	Period	Work required	Cost Estimate	Agency
Routine Maintenance	Daily	Patching/Crack Sealing Drainage Clearance Small drainage repair Grass cutting Small signal repair etc.	Every year at 1.0% of the construction cost	CCN force account Length man base Contractor
Periodic Maintenance	10 year interval	Overlay Large drainage repair etc.	Overlay of carriageway	Contractor
Rehabilitation	After project life	Reconstruction	Pavement / Road structure reconstruction	Contractor

Maintenance costs are estimated based on the construction unit cost as follows:

Item	Interval period	Cost
Routine maintenance	1 year interval	Ksh 9,000,000
Periodic maintenance	10- year interval	Ksh 22,699,000

(2) Responsible Organization for Maintenance

After the completion of the construction, CCN under MOLG will have responsibility of management and maintenance. CCN will prepare a Road Maintenance Programme in accordance with guidelines of KRB for maintenance budget purposes. CCN also has responsibility for signal operation and maintenance.

(3) Finance Source of Maintenance

Following the Road Maintenance Programme accepted by KRB, the budget of road maintenance will be provided to CCN by KRB.