6.4 Road Network Development Project

6.4.1 Project Long List

(1) Selection Criteria for Projects

The following selection criteria for individual projects are applied in this study, in line with the results of the recommended future road network and road network configuration :

a Construction of the Super highway
Improvement the roads from Mombasa to Uganda as a super highway, in order to keep high mobility and safety for the traffic passing through this section.

b Construction of bypasses and dual carriage way roads where justified by the future traffic demand.

c All those roads, which have a having minimum necessity to be developed in the future as part of the fundamental road network are selected as projects. Judgment and justification is provided by the quantitative parameter, which are shown in Figure 6.2.4&5 Integrated Future Road Network Plan in the Chapter 6.2 Recommended Future Road Network.

d Roads of which the surface condition and structure has deteriorated, but which are required to keep traffic movement smooth and safe. It is being noted, however, that it will be difficult to select some of these roads, because an exact assessment cannot be done at this stage without a precise analysis. Notwithstanding this fact, they are added in the following section 6.4.5 Implementation Policy and Programme by examining the period and type of improvement and the cost estimation of the projects.

e Roads, for which MOPWH has on-going improvement plans, or for which funds are already allocated by donors.

(2) Main Projects

The application of these selection criteria leads to the following main projects :

-Plan of a Super Highway

Mombasa-Nairobi-Kisumu/Eldoret-Uganda (Route A109, 104 and B1)

-Bypass

Mombasa bypass

Nairobi bypass (south and north)

Nakuru bypass

-New dual carriage way roads

Machakos-Nairobi-Nakuru-B1 (Route A109 and 104)

Mombasa-Mariakani (Route A109)

A104-Londiani (Route B1)

Mombasa-Kilifi (Route B8)

Kabati-B6 (Route A2)

-Others

The following development items are taken into account but recurrent items, such as routine maintenance, are omitted for projects in this study. This implies that only development budget on road class A, B, and C is examined in this study to cope with development type projects. This also means that recurrent budget and routine maintenance works are out of consideration.

New construction

Reconstruction

Rehabilitation

Upgrading(to AC/SD)

Overlay

Resealing

A special attention has to be paid to Likoni bridge. Although importance of this bridge has been widely known, huge amount of the cost for construction and such external condition as military matters makes a decision difficult. Only desirable period and approximate cost are additionally mentioned in this report.

(3) Project Long List

According to the above mentioned criteria, the project long list is summarized and the results are tabulated in the Appendix 4 in this report.

6.4.2 Environmental Consideration in the Further Study

Environmental considerations must be taken into account in the further stages, such as a feasibility study and/or the detail design stage. In this section, environmental items to be paid attention in the further stage are mentioned.

The environmental items are presented from a point of view of two categories. Projects, which could cause larger environmental degradation, and the sensitive areas for environmental impact. The projects and areas to be considered are identified below.
Detailed environmental matters for all proposed projects, however, should be studied in the further study stages.

(1) Proposed Projects which Could Cause Environmental Degradation

In this context, two types of projects are considered, namely:

-Newly Planned Roads
-Road Widening at a Large Scale.

(2) Sensitive Areas for Environmental Impacts

In this context, five areas shown below are considered.

-Near and Inside the National Parks/Reserves
-Forest Areas
-Critical Areas of Soil Erosion
-Highly Populated Areas
-Rivers and Coasts.

Environmental considerations taken in the further stages are described in the following context.

1) Newly Planned Roads

In this study, newly planned roads to be considered are :

Nairobi Bypass (North),
Nairobi Bypass (South),
Nakuru Bypass, and
Mombasa Bypass.

2) Road Widening at a Large Scale

The 3 routes below are planned for widening the present two carriage ways to dual carriage ways, although some parts of the routes have already dual carriage ways. This improvement is bound to change the width of the road from approximately 10m to 30m.

A104 (Junction with B1 ~ Junction with C97)
A109 (Mombasa ~ Mariakani)
B8 (Mombasa ~ Kilifi).

With regard to the above mentioned projects, the relationship between the impacts of the projects and environmental items are shown in the matrix of Table 6.4.1.

Table 6.4.1 Relationship of Impacts of the Projects

Planned Project \ Environmental Items		Soil Erosion	Deforestation	Wildlife Conservation	Water Pollution	Air Pollution in Construction Stage	Issues concerning Local Communities
Newly Planned Roads	Nairobi Bypass (North)					○	○
	Nairobi Bypass (South)		○	○		○	○
	Nakuru Bypass	○	○			○	○
	Mombasa Bypass		○		○	○	○
Roads Widening in Large Scale	A 109 (Junction with B1 - Junction with C97)	○	○	○	○	○	○
	A 109 (Mombasa - Mariakani)		○		○	○	○
	B8 (Mombasa - Kilifi)				○	○	○

Possible impacts of each proposed project are described below.

a Nairobi Bypass (North)

The route of this project passes through the northern part of Nairobi. In this area, attention for residential areas will be called for. Karura Forest, one of the largest forests in Nairobi, will be avoided by the route. Attention for air pollution in the construction stage is also necessary.

b Nairobi Bypass (South)

The route is designed to pass through the southern part of Nairobi and the detail design for this project has already been finished. In the original plan, the project involved some environmental problems, such as the impact for Nairobi National Park and Ngong Road Forest. However, the impacts was tried to be reduced by the latest plan. According to the latest plan, the route passes just on the border of the National Park to minimize the impact for wildlife. In the forest, the tree cutting area was reduced and the areas are planted forest land.
Careful attentions to residential areas and air pollution in the construction stage will be needed.

c Nakuru Bypass

The route passes through the Nakuru & Menengai Forest on the slopes of Menengai Crater. Since all the forest is composed of eucalyptus, pines, cedar, etc., the ecological impact on this forest is smaller than on an indigenous forest. However, measures against the reduction of forest area, such as replanting is necessary. Also a measure against soil erosion should be taken in consideration. A careful attention for residential areas and air pollution in the construction stage will be necessary.

d Mombasa Bypass

The route passes near and/or along swamp areas and inlets where mangrove forests grow. Therefore, careful attentions for the forest conservation and water pollution will be necessary. Attention for residential areas and for air pollution in the construction stage in needed.

e A109 (Junction with B1 ~ Junction with C97)

This route passes near ecologically important lakes, such as Naivasha, Elmenteita and Nakuru. Therefore, attention for water pollution caused by eroded soil in the construction stage should be paid.

Environmental considerations for forest areas, air pollution in the construction stage, and residential areas, especially near big cities and towns, such as Nairobi and Nakuru, are necessary.

f A109 (Mombasa - Mariakani)

Attention to mangrove forests in inlets should be paid. Since there would be various types of ecosystem in the mangrove, large scale cutting and water pollution should be avoided. Environmental consideration for residential areas will be necessary.

g B8 (Mombasa - Kilifi)

This is a sea side route. Therefore, environmental consideration for water pollution, which would cause degradation of marine ecosystem will be necessary. Attention for residential areas should be paid.

(2) Sensitive Areas for Environmental Impacts

1) Near and Inside the National Parks/Reserves

The concerned national parks/reserves in this study are: Nairobi National Park, Masai Mara National Reserve, Amboseli National Park, Tsavo West National Park, Tsavo East National Park, Losai National Reserve, Marsabit National Park/Reserve, and Samburu National Reserve and its adjacent National Reserves. Environmental considerations to be taken for this areas are described below.

a Nairobi N. P. (Nairobi bypass to be constructed)

According to the detailed design for the Nairobi Bypass, the route passes on the northern border of the Park. Therefore, there is no big impact such as

disappearance and/or split of animal's habitats in the Park. However, environmental considerations against influences for wildlife by traffic noise and light should be paid.

b Masai Mara (C13 and C12) and Amboseli (C103 and C102)

According to the Plan, the access roads C13 and C12 will be improved, from gravel road to paved road. The roads inside the National Park and Reserve will be improved but remain still gravel.

A direct impact for wildlife by road improvement will be to increase car collisions with wild animals, especially in the access roads to be improved because of high speed tourist vehicles. Some regulations and measures for this should be set up.

As an indirect impact, overuse of the Park and Reserve by increased numbers of tourists, who could visit easier because of improved access roads, would have be considered. To reduce this influence, a management plan based on the 'Tourism Master Plan under preparation at this moment should be set up.

c Tsavo West (A 23 and A109), Tsavo East (C103), Losai (A2), Marsabit N.P./N.R. (A2), and Samburu N.R. and its adjacent N.R. (A2)

The routes A23, A109, C103 and A2 pass inside the National Parks and a Reserve. A23, C103 and A2 will be improved from gravel road to paved road. The A2 route passes near or on the border of the Parks and Reserves. This route will be improved from gravel to paved road.

The impact for wildlife by the road improvement should be considered, because of potential increase in car collisions with wild animals due to vehicles driving at higher speeds. Some regulations and measures for this should be set up.

It is important for wild animals to keep their migration routes to conserve their habitats. Therefore, the road designs, such as a deep ditches and large slopes, which obstruct animal migration should be avoided.

2) Forest Areas

Tree cutting in forest areas causes environmental impacts, such as distinction of wildlife habitats and recreation areas for people, increase of soil erosion and so on In the Plan, the forest areas of concern are Ngong Road Forest and Nakuru and Menengai Forest. Environmental considerations for these forests were described in (1), (a) in this section.

3) Critical Areas of Soil Erosion

Heavy soil erosion occurs generally in an area of steep slopes, much rainfall, sandy soil and less vegetation, although critical areas of soil erosion in Kenya are not yet completely and in detail grasped at the present. Therefore, attention on soil erosion should be paid for the road projects, which pass areas with the characteristics mentioned.

4) Highly Populated Areas

In highly populated areas, that is big cities, such as Nairobi, Mombasa and so on, and their outskirts, attention for matters concerning local communities, such as resettlement, loss of public facilities, such as schools and hospitals, and split of communities, should be paid. Also, precautions against noise and air pollution in the construction stage should be taken.

The problem of air pollution is getting bigger in big cities as time goes by. This problem would be reduced by the construction of bypasses, which serve to disperse the concentration of vehicles into the city center. However, a forecast and evaluation of potential air pollution concerning the planning roads with high traffic volume should be done in the feasibility study stage.

5) Rivers and Coasts

Environmental considerations for water pollution and change of wildlife habitats, i.e. mangrove and swamp forest, due to road construction should be taken.

6.4.3 Estimated Investment Requirements

This sections deals with the estimation of investment requirements, in order to establish an investment program for the road network development projects discussed and proposed in this study.

The system of the individual cost items of road works is designed in correspondence to input requirements for operating the "The Highway Design and Maintenance Standards Model (HDM-III), IBRD, 1987". The HDM-III in turn will output economic indicators, such as internal rate of return (IRR) and benefit by cost ratio (B/C) and so on of the respective candidate projects.

(1) Itemization of Road Works for the Cost Estimation

1) Classification of Road Works

The road works are principally classified into two groups. Firstly, the capital investment works covered by a development budget and, secondly, maintenance expenditure works covered by a recurrent budget. The cost items of classified works are practically categorized by the World Bank into construction work items and maintenance work items for both, the paved and unpaved roads. They are listed in detail in Table 6.4.2 and 6.4.3, respectively.

2) Establishment of Cost Items applied to HDM-III Model

The cost items, which serve as inputs into the HDM-III Model, are classified into "Construction Strategies" and "Maintenance Strategies" for both, the paved roads and unpaved roads as summarized in Table 6.4.4.

Figure 6.4.1 demonstrates phased relationships of the respective construction and maintenance strategies.

(2) Analysis of Current Road Work Costs Level

The following data have been collected in order to evaluate the current road work costs levels and to prepare the input cost requirements for operating the HDM-III Model.

Table 6.4.2 Classification of Road Maintenance and Improvement Works for Paved Roads

Mode	Activity
1. Routine Maintenance	Localized repairs of pavement and shoulder defects, and regular maintenance of road drainage, side slopes, verges and furniture including pothole patching, reshaping side drains, repairing and cleaning culverts and drains, vegetation control, dust control, erosion control, sand removal from traveled way, repainting pavement strips and markings, repairing or replacing traffic signs, guardrails, signals, lighting standards, etc., roadside cleaning and maintenance of rest areas.
2. Resurfacing (Resealing/ Overlay)	Full-width resurfacing or treatment of the existing pavement or roadway inclusive of minor shape correction, surface patching or restoration of skid resistance to maintain surface characteristics and structural integrity for continued serviceability including slurry seals, fog seals, or enrichment treatments; surface treatments (chip seal); friction courses; thin asphalt surfacing typically 25mm or less in thickness. The terms "preventive maintenance" and "periodic maintenance" had approximately synonymous meaning in previous usage.
3. Rehabilitation	Full-width, full-length surfacing with selective strengthening and shape correction of existing pavement or roadway inclusive of repair required for continued serviceability including asphalt concrete overlays, selective deep patching and overlays, granular overlay and surfacing, surface treatment with major shape correction, recycling of one or more pavement layers. The term "strengthening" is sometimes used for a particular category of rehabilitation works.
4. Improvement	Geometric improvements related to width, curvature or gradient of roadway, pavement, shoulders, or structures, to enhance traffic capacity, speed or safety; and inclusive of associated "rehabilitation" or "resurfacing" of the pavement.
5. Reconstruction	Full-width, full-length reconstruction of roadway pavement and shoulders mostly on existing alignment, including rehabilitation of all drainage structures generally to improved roadway, pavement and geometric standards.
6. New Construction	Full-width, full-length construction of a road on a new alignment, upgrading of a gravel or earth road to paved standard, and provision of additional lanes or carriage ways to existing roads.

Source: "Road Deterioration and Maintenance Effects", IBRD/The World Bank, 1987

Table 6.4.3 Classification of Road Maintenance and Improvement Works for Unpaved Roads

Mode	Activity	
1. Routine Maintenance	Spot regravelling	Fill potholes and small depressions; reduce roughness, exclude surface water.
	Drainage and verge maintenance	Control runoff of surface water, reduce erosion and material loss, improve surfacing and subgrade strengths by lowering moisture contents.
	Dragging	Redistribute surface gravel, fill minor depressions, improve safety.
	Shallow blading	Redistribute surface material, fill minor depressions, reduce roughness.
	Dust control	Control depth of loose fine material and dust loss.
2. Resurfacing	Full regravelling	Restore required thickness of surfacing.
	Deep blading with reprofiling and/or recompaction	Reshape road profile, reduce roughness, and rate of deterioration, improve crown and drainage.
3. Rehabilitation	Major regravelling after ripping, recompaction and drainage rehabilitation	Improve strength shape, drainage and performance.
4. Improvement	Rehabilitation and geometric improvement, drainage rehabilitation	Improve the geometric and structural standards.
	Upgrading earth road to gravel road	Improve structural standards, performance and all-weather possibility.

Source: "Road Deterioration and Maintenance Effects", IBRD/The World Bank, 1987

Table 6.4.4 Itemization of Construction and Maintenance Strategies

Item	Strategies
Construction Strategies	
(a) Asphaltic Concrete (AC) Paved Roads (2-lane Roads)	
ACN1	Widening from 2-lane to 4-lane roads (V=9700 ADT)
ACN2	Reconstruction (Year 1994) <Input extrapolated data>
ACN3	Reconstruction (T≧1500)
(b) Surface Dressing (SD) Paved Roads (2-lane Roads)	
DCN1	Upgrading from SD to AC paved roads (V=1500 ADT)
ACN1	Widening from 2-lane to 4-lane roads (V=9700 ADT)
DCN2	Reconstruction (Year 1994) <Input extrapolated data>
DCN3	Reconstruction (T≧370)
(c) Gravel Roads	
GCN1	Upgrading from Gravel to SD paved roads (V=370 ADT)
DCN1	Same with the above
ACN1	Same with the above
(d) Earth Roads	
ECN1	Upgrading from Earth to Gravel roads (V=110 ADT)
GCN1	Same with the above
DCN1	Same with the above
(e) Asphaltic Concrete (AC) Paved Roads (Existing 4-lane Artery, Super Highway (HWY), By-Pass	
SCN1	Improvement/widening from 2-lane Artery to 4-lane Super HWY (ADT=5200)
SCN2	Widening from 2-lane Super HWY to 4-lane Super HWY (ADT=5200)
SCN3	New construction of 4-lane By-pass, additional to either existing 2-lane Artery or 4-lane Artery
SCN4	Improvement from 2-lane Artery to 2-lane Super HWY
SCN5	Improvement from 4-lane Artery to 4-lane Super HWY
SCN6	Reconstruction of 4-lane Artery Reconstruction of 4-lane Artery
Maintenance Strategies	
(a) Asphaltic Concrete (AC) Paved Roads (2-lane Roads)	
STA0	"Do nothing" except for routine maintenance
STA1	Overlay at IRI=6.0 (for 2-lane and 4-lane in a same code)
STA2	Rehabilitation at IRI=8.0
STA3	Overlay at IRI=6.0 and t T≧1500
STA4	Rehabilitation at IRI=8.0 and T≧1500
(b) Surface Dressing (SD) Paved Roads(2-lane Roads)	
STD0	"Do nothing" except for routine maintenance
STD1	Resealing at IRI=6.0 (for 2-lane and 4-lane in a same code)
STD2	Rehabilitation at IRI=8.0
STD3	Resealing at IRI=6.0 and T≧370
STD4	Resealing at IRI=8.0 and T≧370
(c) Gravel - Unpaved Roads	
STG0	"Do nothing" except for routine maintenance
STG1	Regravelling at 5-year interval
STG2	Grading twice/Year
STG3	Regravelling at 5-year interval, if T>110
STG4	Grading twice/Year, if T>110
(d) Earth - Unpaved Roads	
STE0	"Do nothing" except for routine maintenance
STE1	Grading twice/Year
STE2	Grading twice/Year, if T>50
(e) Asphaltic Concrete (AC) Paved Roads (Existing 4-lane Artery, Super HWY, By-pass)	
STS0	"Do nothing" for 4-lane Artery except for routine maintenance
STS1	Improvement (Reconstruction) from 2-lane Artery to 2-lane Super HWY at IRI=8.0
STS2	Improvement (Reconstruction) from 4-lane Artery to 4-lane Super HWY at IRI=8.0
STS3	Overlay for 4-lane/2-lane Super HWY, 4-lane Artery and 4-lane By-pass at IRI=6.0
STS4	Rehabilitation of 4-lane Artery

Source: JICA Study Team

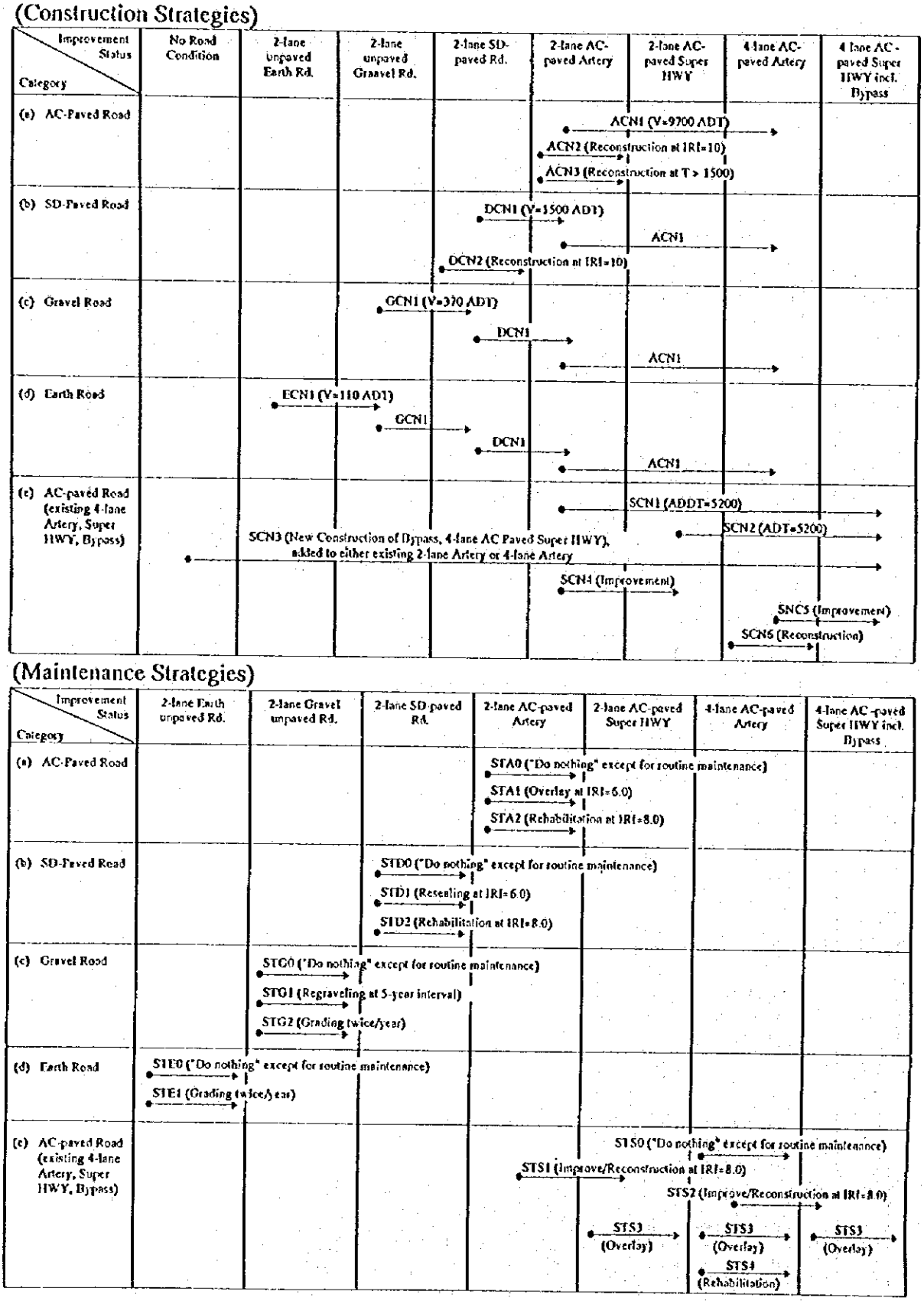


Fig. 6.4.1 Phased Construction and Maintenance Strategies by Road Category

a Development Expenditures/Programme, Review and Forward Budget 1991/92 - 1993/94, Office of the Vice President and MOF, February, 1991

b Status of roads projects under contract, MOPW&H, October 1994

c Summary of roads development programme 1992/2000, MOPW&H

d Engineer's estimates of specified projects

- Nairobi Bypass Project Engineering report including Cost Estimate, MOPWH/JICA September, 1992
- Nakuru Bypass Road, MOTC/JBG Gauf Ingenieure, June 1982

e Expenditure priorities report as part of the Strategic Plan for the roads sector, MOPW&H/NORCONSULT, (EPR) June 1994, and

f Kenya's Third Highway Sector Project Study of Expenditure and Funding Needs in the Road Sector, Draft Final Report, (SEF) MOPW&H/ KITORORO CONSULTANTS, October 1994.

1) Cost Level of Road Works

a Road Projects under Contract of MOPW&H

Table 6.4.5 gives the outline, dimension and contract amount of the projects, which have been already completed and open to traffic or are currently under construction. These projects are selected from the "Development Expenditure/ Programme, Review and Forward Budget 1991/92 - 1993/94, Office of the Vice President and MOF, February 1991" and have been primarily financed by bilateral or multilateral donor agencies.

The work components contained in those projects shown in the table are analyzed comparatively. They are classified into the itemized works for HDM-III operation indicated in Table 6.4.6, which summarizes the current costs level for unit length of itemized road works both, in Kenya Shillings and equivalent U.S. Dollars.

The cost of each road work fluctuates widely as seen in Table 6.4.6. However, it will give a rough knowledge of the realistic level and range of costs of the road projects financed by foreign donors.

Table 6.4.5 Status of Road Projects under Contract (MOPW&H,October 1994)

No	Project Section	Length (Km)	Work Description	Width Carriage -Way (M)	Starting Year and Const Period (yrs)	Financial Source	Actual Disbursement		Cost per Unit Leng(Km)		Remarks
							US$ Portion ('000)	Ksh Portion ('000)	Ksh /Km ('000)	Equivalent US$/Km*1 ('000)	
1	Kabete-Limuru	18.1	Construction to dual carriageway and associated structures	7	1989/90 3	EEC 100%	29,682	613,538	33,897	1,640 @=20.67	Completed & open to traffic
2	Thika-Makutano	12	Construction to dual carriageway and associated structures	7	1991/92 2	ADF 72.1% GOK 27.9%	21,245	588,492	49,041	1,770 @=27.7	Completed 31/8/1994
3	Machakos Turn-Off Ulu	29.3	Overlay and reconstruction of shoulders	7	1989/90 3	IBRD 80% GOK 20%	13,512	279,296	9,532	461,165 @=20.67	Completed
4	Molo-Olenguruone	44	Upgrading from earth to bitumen standard	6	1991/92 3	ODA 100%	13,067	361,953	8,226	296,975 @=27.7	Completed October 1994
5	Kalanga Corner-Laga Hamaris	125	Construction to bitumen standard and alignment of the existing A3 road	6.5	1987/88 5	Saudi Fund 65% BADEA 13% GOK 22%	33,490	551,909	4,415	267,916 @=16.48	80Km completed and open to traffic
6	Sotik-Amala River	56	Upgrading to bitumen standard	6.5	1989/90 3	IDA 80% GOK 20%	19,328	399,505	7,134	345,173 @=20.67	Completed
7	Mukuyu-Isebania	29	Upgrading from earth to bitumen standard	6	1993/94 3	EEC	4,063	276,956	9,550	140,114 @=68.16	On-going
8	Narok-Mau Narok	63	Upgrading from earth to bitumen standard	6.5	1993/94 4	ADB 100%	1,699	115,803	1,838	26,968 @=68.16	On-going Progress good
9	Rodi Kopany-Karugu Bay	49	Upgrading to bitumen standard	6	1993/94 4	ADD ADF	2,964	202,069	4,125	60,502 @=68.16	On-going Progress good
10	Kericho-Sotik	51	Repair and overlay	6.5	1991/92 3	EEC 100%	22,201	614,964	12,058	435,309 @=27.7	Completed
11	Kisii-Kil Goris	53	Repair and resealing	6.5	1992/93 1	GOK Toll Fund	30,592 *1	99,457	1,877	57,723 @=32.51	On-going, Substantially completed
12	Timboroa-Eldoret	73.2	Rehabilitation repair and overlay	6.5	1992/93 2	KFW 68% GOK 32%	22,958	528,956	7,226	314 @=31.51	Completed
13	Eldoret-Turbo	21.9	Rehabilitation repair and overlay	6.5	1991/92 1	EEC 100%	4,640	128,546	5,855	211 @=27.7	Completed
14	Webuye-Malaba	61	Rehabilitation of entire route A104 and construction of border post facilities at Malaba	7	1990/91 2	EEC 100%	23,023	531,622	8,715	378 @=23.04	Completed 30/8/1992
15	Ahero-Kisii	87	Repair and recarpeting	6	1993/94 2		387	26,445	304	4 @=68.16	On-going, Progress good
16	Kiganjo-Nanyuki	48	Overlay and recarpeting	6.5	1987/88 3	EEC 100%	13,992	230,589	4,804	292 @=16.48	Completed
17	Thika-Garissa	333	Upgrading to bitumen standard			GOK 100%	Project undertaken by the office of the president through the national youth service (D)				
18	Arwos-Lessos	23	Construction to bitumen standard	6	1988/89 4	GOK 100%	4,430	78,904	3,431	193 @=17.81	Stalled due to lack of funds
19	Ndori-Owimbi	22.8	Construction to bitumen standard	6	1989/90 3	GOK 100%	2,133	44,093	1,934	94 @=20.67	Stalled due to lack of funds
20	Muranga-Gitugi	26	Upgrading to bitumen standard	6	1988/89	GOK 100%	3,032	54,005	2,077	117 @=17.81	Stalled due to lack of funds
21	Saos-Tenges-Emening	29.5	Construction from earth to bitumen standard	6	1988/89 3	GOK 100%	16,507	294,003	9,966	560 @=17.81	Expected to be completed by June 1995
22	Kabartonjo-Kipsarman	19.5	Upgrading to bitumen standard	6	1989/90 2	GOK 100%	5,469	113,057	5,798	280 @=20.67	On-going
23	Rironi-Mai Mahiu	19.5	Upgrading to bitumen standard	6	1992/93 2	GOK 100%	5,469	113,057=	5,798	280 @=20.67	On-going
24	Ziwa-Kwale	33.6	Rehabilitation repair and overlay	6.5	1992/93 3	GOK 100%	5,931	192,836	5,739	177 @=32.51	Progressing well
25	Bomet-Litein	42.1	Reconstruction and overlay	6.5	1990/91 2	ADB 100%	8,853	203,988	4,845	210 @=23.04	Completed Dec. 1992
26	Busia-Mumias	50	Rehabilitation	6	1992/93 3	ADD 100%	4,183	136,000	2,720	84 @=32.51	Progressing well

Source: MOPW&H, November 1994
Note *1 Conversion rate of U.S. Dollars to Kenyan Shillings are an annual mean rate of the year when construction works started.

Table 6.4.6 Cost Level of Road Projects under Contract with MOPW&H

Responsiveness with Itemized Works in Study	Project No.	Cost per Unit Length	
		1,000 KSh./Km	Equivalent 1,000 US$/Km
ACN1	1	33,900	1,640
	2	49,040	1,,770
	Average	41,470	1,710
ACN2	3	9,530	461
	10	12,060	435
	12-1	7,230	314
	13-1	5,850	211
	14-1	8,720	378
	16-1	4,800	292
	25-1	4,850	210
	Average	7,580	330
DCN2	12-1	7,230	314
	13-1	5,850	211
	14-1	8,720	378
	16-1	4,800	292
	25-1	4,850	210
	Average	6,290	280
GCN1	4	8,230	297
	5	4,420	268
	6	7,130	345
	7	9,550	140
	18	3,430	193
	21	9,970	560
	22	5,800	280
	23	11,860	365
	Average	7,550	310
STA2	24-1	5,740	177
	26-1	2,720	84
	Average	4,2230 (605 KSh./sq.m)	130
STA3	15-1	300	5
	Average	300 (43 KSh./sq.m)	5
STD2	24-2	5,740	177
	26-2	2,720	84
	Average	4,230 (604 KSh./sq.m)	130
STD3	15-2	300	5
	Average	300 (43 KSh./sq.m)	5

Source: JICA Study Team

b Road Works Contained in the Road Development Programme 1992/2000

Table 6.4.7 summarizes the development and recurrent expenditures required for the road works estimated by the MOPW&H for the establishment of the Road Development Programme 1992/2000.

The unit cost for the itemized road works are shown in Table 6.4.8 conforming to the input requirements for HDM-III operations.

c Nairobi East Bypass and Nakuru Bypass

The following costs for unit length of the new construction of a bypass are estimated by the relevant consultants.

- Nairobi East Bypass (dual, 29.2km)

  - Estimated cost (Sept. 1992): KSh. 1,634.44 million
    = equivalent US$ 56.36 million (assumed US$ 1.0 = KSh. 29.0)
  - Cost per Km: KSh. 56.0 million/Km/dual lanes
    = equivalent US$ 1.9 million/Km/dual lanes

- Nakuru Bypass (2-lane, 19.5km)

  - Estimated cost (June 1982);
    KSh. 129.54 million = equivalent US$ 12.86 million (assumed US$ 1.0 = Ksh. 10.07)
  - Cost per Km: KSh. 6.64 million/Km/2-lane
    = (KSh. 13.28 million/Km/dual lanes)
    = equivalent US$ 0.66 million/Km/2-lane
    = (US$ 1.32 million/Km/dual lanes)

    Although there seems to be a large difference between the unit cost of Nairobi East Bypass and that of Nakuru, the cost level adjusted on dualization basis and expressed in equivalent US Dollars remain within an allowable range.

Table 6.4.7 Estimated Average Cost in "Summary of Roads Development Programme 1992/2000", Planning Division of MOPW&H, 1991/92

	Item	Average Cost (1,000 KSh./Km)
1.	Proposed new projects	
(1)	Strengthening and reconstruction	
	(a) International trunk roads, 16 projects, L=737 km	11,500
	(b) National trunk roads, 5 projects, L=440 km	6,800
	(c) Primary roads, 4 projects, L=141 km	11,300
	25 projects, L=1,318 km	9,900
(2)	Upgrading to Bitumen	
	(a) International trunk roads 6 projects, L=537 km	6,950
	(b) National trunk roads, 3 projects, L=239	8,030
	(c) Primary roads, 25 projects, L=1,439 km	7,450
	(d) D class roads, 25 projects, L=688 km	6,470
	61 projects, L=2,903 km	7,170
(3)	All weather gravel roads, 6 projects, L=65 km	1,620
2.	Recurrent Programme	
(1)	Resealing/recarpeting for 7 provinces, L=3,823 km	740
(2)	Regravelling for 7 provinces, L=10,108 km	320
(3)	Equipment	
	(a) For 7 provinces, resealing/recarpeting, L=3,823 km, S=19,085 ('000 Kh)	100
	(b) For 7 provinces, regravelling, L=3,823 km, S=44,209 ('000 Kh)	230
	(c) Bridges for 7 provinces, 338 bridges, road length=3,823 km, S=12,744 (Kh)	70 754 (bridge)

Source: MOPW&H, 1991/92

Table 6.4.8 Cost Level of Road Works Planned in "Roads Development Programme 1992/2000" and Responsiveness with Itemized Works in this Study

Responsive Itemized Works	Cost per Unit Length	
	1,000 KSh./Km	Equivalent 1,000 US$/Km
1. Capital Investment		
(1) ACN2, DCN2, STA2, STD2	9,900	357
(2) GCN1	7,170	259
(3) ECN1	1,20	58
2. Recurrent Expenditure		
(1) STA1, STD1	740	27
(2) STG3	320	12
(3) Provision of equipment for (STA1 + STD1)	70	3
(4) Provision of equipment/materials for construction of bridges	754 (bridges)	27

Source: JICA Study Team

A rate, ß = Unit Cost for Nairobi Bypass (US$ 1.90 million/Km/dual lanes) / Unit Cost for Nakuru Bypass (US$ 1.32 million/ Km/dual lanes) = 1.43, could be reasonably regarded as an inflation rate for 10 years (1982 to 1992) of the construction prices expressed in equivalent US Dollars.

d Cost level estimated in "Expenditure Priorities Report as Part of the Strategic Plan for the Roads Sector (EPR), June 1994, MOPW&H/ NORCONSULT"

The study aimed:

- to prepare a list of capital projects ranked in order of economic desirability for possible submission of funding by MOPW&H to the World Bank, and
- to make recommendations to MOPW&H on the appropriate balance between capital and maintenance expenditure to be adopted for its own budget.

For those purposes, an evaluation of the current costs of road works was thoroughly made on the basis of ample cost data during the study, and the resultant road work costs level as summarized in Table 6.4.9 should be very reasonable and realistic.

Also, Table 6.4.10 gives the cost level of maintenance of roads being derived from "Kenya's Third Highway Sector Project, Study of Expenditure and Funding Needs in the Roads Sector (SEF), MOPW&H/KITOLOLO CONSULTANTS, October, 1994", and basically follows the results of the study of the EPR.

2) Inflation Factor

According to EPR, the inflation trends of market construction costs have corresponded to those for consumer goods. Table 6.4.11 indicates that inflation rates for consumer goods have continued to rise as of the beginning of 1993, reaching its peak value of 58.3% in January 1994. However, they have started to decrease gradually from February through September 1994.

The average inflation factor for the recent 9 months (January to September, 1994) is 37.6%, showing a 8.2% point reduction as compared to the annual average inflation rate of 1993.

The average inflation factor for the recent 4 months (June to September, 1994) was 22.6%.

As the EPR anticipates an annual average inflation factor for 1994 of some 25%, this study also employs the figure of 25% for the adjustment of costs level of road works of 1993 toward the current price level of 1994.

Table 6.4.9 Summary of Costs used in the Analysis of Road Projects in EPR 1994 and Responsiveness with the Itemized Works in this Study

Responsive Itemized Works	Works Description in EPR 1994	Financial Prices	
		KSh/km (millions)	Equiv. US$/km (000s)
	Paved Roads		
ACN1, DCN1, GCN1, SCN1/2/3/4/5/6, STS1/2	New Construction	13.00	191.18
ACN2/3, DCN2/3	Reconstruction or Upgrading to Bitumen	6.50	95.59
STA1/3, STD1/2/3//4, STS3	Rehabilitation and Resealing	2.50	36.76
	Resealing only	1.00	14.71
STA2/4, STS4	Rehabilitation and Recarpeting	4.30	63.24
	Recarpeting only	2.80	41.18
	Patching only	0.29	4.26
STA0,STD0	Full Routine Maintenance	0.31	4.56
STG0	Simple Routine Maintenance	0.02	0.29
	Gravel Roads		
ECN1	Construction of a New Gravel Road	2.10	30.88
STG1/3	Rehabilitation and Regravelling	1.50	22.06
	Regravelling only	0.90	13.24
STG2/4, STE1/2	Grading only (twice p.a.)	0.03	0.44
	Full Routine Maintenance	0.05	0.74
STE0, STS0	Simple Routine Maintenance	0.02	0.29

Source: Expenditure Priority Report as part of the Strategic Plan for the Roads Sector (EPR) MOPW&H/Norconsult, June 1994

Table 6.4.10 Summary of Base Rates and Derivation of 1994 Costs

Item	Unit	Source	Base Year	Cost (KSh.000)	Inflation Factor applied	1994 Cost (KSh. 000)
Sealed						
Reh./DSD	km	MOPWH	1992	1420	1.749	2480
Reseal	km	TRS	1992	600	1.649	990
		KPER	1993	840	1.15	970
Rehab./Overlay	km	MOHPW	1993/4	3520	1.225	4300
Overlay	km	MOHPW	1994	2790	1.000	2790
Patching	m^2	PRU	1993	1.8	1.225	2.2
Routine	km	KPER	1993	III	1.15	15.3
Unsealed						
Rehab.	km	NORC	1993	1000	1.45	1450
Regravelling	km	KMDP	1992	550	1.649	900
		TRS	1992	455	1.649	750
		KPER	1993	700	1.15	805
		NORC	1993	620	1.45	900
		Average				840
Grading	pass	KPER	1993	13.4	1.15	15.4
Routine	km	KPER	1993	13.4	1.15	15.4

Source: "EPR", Norconsult, June 1994 and Draft Final "SEF", TITORORO CONSULTANTS October 1994

Table 6.4.11 Inflation Trends

(Base: Feb./Mar. 1986=100)

Year	Month	Annual Weighted Average Index	Annual Inflation Factor (%)	
1980			12.8	
1981			12.6	
1982			22.3	
1983			14.5	
1984			9.1	
1985			10.7	
1986			5.7	
1987			8.7	
1988			12.3	
1989			13.3	
1990		163.82	15.8	
1991		195.11	19.6	
1992		248.45	27.5	
1993	Jan.	276.83	32.4	
	Feb.	299.02	41.8	
	Mar.	308.47	34.4	
	Apr.	329.48	42.3	
	May	341.43	43.7	
	June	367.33	41.2	Monthly average = 45.8%
	July	374.05	43.4	
	Aug.	386.87	47.7	
	Sep.	410.10	53.9	
	Oct.	408.95	57.5	
	Nov.	418.77	56.7	
	Dec.	424.70	54.4	
1994	Jan.	438.15	58.3	
	Feb.	452.06	51.2	Monthly average (Jan./Sep.) = 37.6%
	Mar.	461.56	49.6	
	Apr.	486.78	47.7	
	May	481.76	41.1	
	June	472.87	28.7	Monthly average (Jun./Sep.) = 22.6%
	July	476.34	27.3	
	Aug.	470.00	21.5	
	Sep.	462.79	12.8	

Source: Central Bureau of Statistic, Ministry of Planning and National Development

(3) Establishment of Unit Cost as Input into the HDM-III Model

What follows are estimations of the unit costs for roadworks, which are to be applied for the operation of the HDM-III model. They are summarized in Table 6.4.12.

1) Construction Strategies

a Asphaltic Concrete (AC) - Paved Roads (2-lane Roads)

- ACN1: Widening from 2-lane to 4-lane roads (V=9700 ADT)

This calculation is to make threshold formulation of the basic unit rate, which is to be employed for this study. The cost levels discussed in the "Expenditure Priorities Report" as part of the "Strategic Plan for the Roads Sector", MOPW&H and NORCONSULT, June 1994 (EPR), will be used as the basic rates for the determination of the unit costs for this study.

The cost level, "Co = Ksh. 13.0 million/Km" for the new construction of a 2-lane paved road in the EPR is considered equivalent to the cost level of surface dressing(SD) of paved road at the beginning of 1994.

Hence, adding an assumption that a cost increasing rate, a=AC/SD, of an asphaltic concrete (AC) pavement for a surface dressing (SD) pavement be 1.1 (10% up) and adding an annual average inflation factor, ß, for construction prices in 1994 as against those of 1993 estimated to be 1.25 (25% p.a.), the unit cost for ACN1 (CACN1) will be obtained as follows :

CACN1 = KSh. 13,000,000/Km/2-lane x a(1.1) x ß(1.25) x g_1 {1+(1-0.2)}
= KSh. 32,200,000/Km/4-lane.

Here, g_1 = {1+(1-0.2)} means that a new "2-lane" road construction, which is in addition to the existing "2-lane" road, costs totally the level mentioned above. An improvement of the existing "2-lane" road into a new "2-lane" road would be equivalent to 80% of the existing residual value, that is, g_1 = {1+(1-0.2)}.

- ACN2: Reconstruction (year 1994), <Input extrapolated data>

Table 6.4.12 Estimated Unit Cost for Road Works

Item	Cost			
	Financial Cost (1,000 Ksh/Km)	Financial Cost equivalent (1,000US$/Km)	Conversion Factor	Economic Cost (1,000 Ksh/Km)
Construction Strategies				
(a) AC - Paved Roads (2-lane Roads)				
• ACN1 - Widening from 2-lane to 4-lane roads (V=9700 ADT)	32,200	535	0.82	26,400
• ACN2 - Reconstruction (Year 1994) <Input expolulated data>	8,940	149	0.82	7,330
• ACN3 - Reconstruction (T≧1500)	8,940	149	0.82	7,330
(b) SD - Paved Roads (2-lane Roads)				
• DCN1 - Upgrading from SD to AC roads (V=1500 ADT)	16,100	268	0.82	13,200
• ACN1 - Widening from 2-lane to 4-lane roads (V=9700 ADT)	32,200	535	0.82	26,400
• DCN2 - Reconstruction (Year 1994) <Input expolulated data>	8,130	135	0.82	6,670
• DCN3 - Reconstruction (T≧370)	8,130	135	0.82	6,670
(c) Gravel Roads				
• GCN1 - Upgrading from Gravel to SD paved roads (V=370 ADT)	15,400	256	0.82	12,600
• DCN1 - shown above	16,100	268	0.82	13,200
• ACN1 - ditto	32,200	535	0.82	26,490
(d) Earth Roads				
• ECN1 - Upgrading from Earth to Gravel roads (V=110 ADT)	2,400	40	0.82	2,000
• GCN1 - shown above	15,400	256	0.82	12,600
• DCN1 - ditto	16,100	268	0.82	13,200
(e) AC - Paved Roads (Existing 4-lane Artery, Super HWY, Bypass)				
• SCN1 - Improvement/widening from 2-lane Artery to 4-lane Super HWY (V=5200 ADT)	48,300	803	0.82	39,600
• SCN2 - Widening from 2-lane Super HWY to 4-lane Super HWY (V=5200 ADT)	40,200	668	0.82	33,000
• SCN3 - New construction of 4-lane Bypass, additional to either existing 2-lane Artery or 4-lane Artery	53,600	891	0.82	44,000
• SCN4 - Improvement from 2-lane Artery to 2-lane Super HWY	21,450	356	0.82	17,590
• SCN5 - Improvement from 4-lane Artery to 4-lane Super HWY	42,900	713	0.82	35,200
• SCN6 - Reconstruction of 4-lane Artery	17,880	297	0.82	14,660
Maintenance Strategies				
(a) AC -Paved Roads (2-lane Roads)				
• STA0 - "Do nothing" except for routine maintenance	215/year	3.57/year	0.76	163/year
• STA1 - Overlay at IRI=6.0 (for 2-lane and 4-lane in a same code)	3,440	57	0.82	2,820
• STA2 - Rehabilitation at IRI=8.0	(Ksh.840/sq.m)	(US$13.96/sq.m)	0.82	(Ksh.690/sq.m)
• STA3 - Overlay at IRI=6.0 & T≧1500	(Ksh.490/sq.m)	(US$8.14/sq.m)	0.82	(Ksh.400/sq.m)
• STA4 - Rehabilitation at IRI=8.0 & T≧1500	(Ksh.840/sq.m)	(US$13.96/sq.m)	0.82	(Ksh.690/sq.m)
(b) SD - Paved Roads (2-lane Roads)				
• STD0 - "Do nothing" except for routine maintenance	195/year	3.24/year	0.76	150/year
• STD1 - Resealing at IRI=6.0 (for 2-lane and 4-lane in a same code)	(Ksh.450/sq.m)	(Ksh.7.48/sq.m)	0.82	(Ksh.630/sq.m)
• STD2 - Rehabilitation at IRI=8.0	(Ksh.770/sq.m)	(Ksh.12.80/sq.m)	0.82	(Ksh.630/sq.m)
• STD3 - Resealing at IRI=6.0 & T≧370	(Ksh.450/sq.m)	(Ksh.7.48/sq.m)	0.82	(Ksh.370/sq.m)
• STD4 - Resealing at IRI=8.0 & T≧370	(Ksh.450/sq.m)	(Ksh.7.48/sq.m)	0.82	(Ksh.370/sq.m)
(c) Gravel - Unpaved Roads				
• STG0 - "Do nothing" except for routine maintenance	12.5/year	0.20/year	0.76	9.5/year
• STG1 - Regravelling at 5-year interval	1,310/5 year	21.80/5 year	0.80	1,050/5 year
• STG2 - Grading twice/year	37.5/year	0.62/year	0.78	29.3/year
• STG3 - Regravelling at 5-year interval, if T≧110	1,310	21.8/5 year	0.80	1,050/5 year
• STG4 - Grading twice/year, if T≧110	37.5/year	0.62/year	0.78	29.3/year
(d) Earth - Unpaved				
• STE0 - "Do nothing" except for routine maintenance	12.5/year	0.208/year	0.76	9.5/year
• STE1 - Grading twice/year	37.5/year	0.623/year	0.78	29.3/year
• STE2 - Grading twice/year, if T≧50	37.5/year	0.623/year	0.78	29.3/year
(e) AC - Paved Roads (Existing 4-lane Artery, Super HWY, Bypass)				
• STS0 - "Do nothing for 4-lane Artery except for routine maintenance	430/year	7.10/year	0.76	330/year
• STS1 - Improvement (Reconstruction) from 2-lane Artery to 2-lane Super HWY at IRI=8.0	21,450	356	0.78	17,590
• STS2 - Improvement (Recoonstruction) from 4-lane Artery to 4-lane Super HWY at IRI=8.0	42,900	713	0.82	35,200
• STS3 - Overlay for 4-lane/2-lane Super HWY, 4-lane Artery & 4-lane Bypass at IRI=6.0	(Ksh.490/sq.m)	(US$8.14/sq.m.)	0.82	(Ksh.400/sq.m)
• STS4 - Rehabilitation of 4-lane Artery	(Ksh.1680/sq.m)	(US$27.92/sq.m)	0.82	(Ksh.1380/sq.m)

Source: This study
Note: As for the conversion factor of Financial Cost to Economic Cost, the figure discussed in the "EPR" are to be employed.

This cost shall correspond to the cost level, "C_1 = KSh. 6.5 million/Km" for the reconstruction of a 2-lane paved road in PER, therefore :

CACN2 = KSh. 6,500,000/Km/2-lane x a(1.1) x ß(1.25)
= KSh. 8,940,000/Km/2-lane.

- ACN3: Reconstruction (T≥1500)

CACN3 = CACN2
= KSh. 8,940,000/Km/2-lane.

b Surface Dressing (SD) - Paved Roads (2-lane Roads)

- DCN1: Upgrading from SD to AC roads (V=9700 ADT)

This cost shall reflect the cost level, "Co = KSh. 13.0 million/Km" for the new construction of 2-lane of paved roads in the EPR study, therefore :

CACN1 = KSh. 13,000,000/Km/2-lane x a(1.1) x ß(1.25) x g_2(0.9)
= KSh. 16,100,000/Km/2-lane.

Here, g_2 = 0.9 means that 90% of the existing structures value of the 2-lane SD paved roads can be used in improvement works prescribed in this study.

- DCN2: Reconstruction (year 1994), <Input extrapolated data>

This cost shall be derived from the cost level, "C_1 = KSh. 6.5 million/Km/2-lane" in the EPR study.

CDCN2 = KSh. 6,500,000/Km/2-lane x ß(1.25)
= KSh. 8,130,000/Km/2-lane.

- DCN3: Reconstruction (T≥370)

CACN3 = CACN2 = KSh. 8,130,000/Km/2-lane.

c Gravel Roads

- GCN1: Upgrading from gravel to SD-paved roads (V=370ADT)

CGCN1 = KSh. 13,000,000/Km/2-lane x ß(1.25) x g_3(0.95)
= KSh. 15,400,000/Km/2-lane.

Here, g_3 = 0.95 means the use rate of the existing value of the structure for the upgrading works.

d Earth Roads

- ECN1: Upgrading from Earth to Gravel Roads (V=110ADT)

The cost shall correspond to the cost level, "C_2 = KSh. 2,400,000/Km/2-lane" for the "Construction of new gravel road" in the EPR study, therefore :

CECN1 = KSh. 2,100,000/Km/2-lane x ß(1.25) x g_2(0.9)
= KSh. 2,400,000/Km/2-lane.

e Asphaltic Concrete (AC) Paved Roads {Existing 4-lane Artery, Super Highway (HWY), Bypass}

- SCN1: Improvement/Widening from 2-lane artery to 4-lane Super HWY (V=5200ADT)

CSCN1 = KSh. 32,200,000/Km/2-lane (CACN1) x g_4(1.5) x g_1 {1+(1-0.2)}
= KSh. 48,300,000/Km/4-lane.

Here, g_4 = 1.5 means that an improvement of the existing 2-lane artery to a full-access controlled 4-lane Super HWY shall cost 1.5 times the cost of a new construction.

- SCN2: Widening from 2-lane Super HWY to 4-lane Super HWY (V=5200ADT)

(Cost for a new construction of 2-lane Super Highway)
= (Cost for a new construction of 2-lane AC Road, Artery) x g_4(1.5)
= KSh. 13,000,000/Km/2-lane (Co) x a(1.1) x ß(1.25) x g_4(1.5)
= KSh. 17,875,000/Km/2-lane x g_4(1.5)

= KSh. 26,812,500/Super HWY/2-lane.

CSCN2 = KSh. 26,812,500/Super HWY/2-lane x g4(1.5)
= KSh. 40,200,000/Super HWY/4-lane.

- SCN3: New construction of 4-lane Bypass, additional to either existing 2-lane artery or 4-lane artery roads.

CSCN3 = (Cost for a new construction of 2-lane Super Highway) x 2
= KSh. 26,812,500/Super HWY/2-lane x 2
= KSh. 53,624,000/Km/4-lane.

- SCN4: Improvement from 2-lane artery to 2-lane Super HWY

CSCN4 = (Cost for a new construction of 2-lane Super Highway) x g5(1-0.2)
= KSh. 26,812,000/Km/2-lane x g5(0.8)
= KSh. 21,450,000/Km/2-lane.

- SCN5: Improvement from 4-lane artery to 4-lane Super HWY

CSCN5 = CSCN4 x 2 = KSh. 21,450,000/Km/2-lane x 2
= KSh. 42,900,000/Km/4-lane.

- SCN6: Reconstruction of 4-lane artery

CSCN6 = CSCN2 x 2
= KSh. 8,940,000/Km/2-lane x 2
= KSh. 17,880,000/Km/4-lane.

2) Maintenance Strategies

a Asphaltic Concrete (AC) - Paved Roads (2-lane Roads)

- STA0: "Do nothing" except for routine maintenance

The cost level for "Full Routine Maintenance" of 2-lanes of paved roads, C_3 = KSh. 310,000/Km, consists of costs for "Patching" (KSh. 290,000/Km) and "Simple Routine Maintenance (KSh. 20,000/Km), as discussed in the EPR. This

level seems too high to be employed for comparative cost estimates in this study. A reduction rate g6(0.5) shall be, therefore, applied :

CSTA0 = KSh. 310,000/Km/2-lane x a(1.1) x ß(1.25) x g6(0.5)
= KSh. 215,000/Km/2-lane.

- STA1: Overlay at IRI=6.0 (2-lane and 4-lane roads are dealt with in a single code)

The cost level "KSh. 2,500,000/Km/2-lane covering resealing plus rehabilitation, as discussed in the EPR, shall be taken into consideration :

CSTA1 = KSh. 2,500,000/Km/2-lane x a(1.1) x ß(1.25)
= KSh. 3,440,000/Km/2-lane.
Here, width of pavement is assumed to be at 7.0 m.

CSTA1 = KSh. 3,440,000/Km/2-lane + (1000 m x 7 m)
= KSh. 490/sq.m.

- STA2: Rehabilitation at IRI=8.0

The cost level, "KSh. 4,300,000/Km/2-lane covering rehabilitation and recarpeting", as identified in the EPR, will be basically applied :

CSTA2 = KSh. 4,300,000/Km/2-lane x a(1.1) x ß(1.25)
= KSh. 5,910,000/Km/2-lane
= KSh. 840/sq.m.

- STA3: Overlay at IRI=6.0 and T≥1500

CSTA3 = CSTA1 = KSh. 490/sq.m.

- STA4: Rehabilitation at IRI=8.0 and T≥1500

CSTA4 = CSTA2 = KSh. 840/sq.m.

b Surface Dressing (SD) - Paved Roads (2-lane Roads)

- STD0: "Do nothing" except for routine maintenance

CSTD0 = KSh. 310,000/Km/2-lane/year (full routine maintenance cost in EPR) x ß(1.25) x g_6(0.5)
= KSh. 195,000/Km/2-lane/year.

- STD1: Resealing at IRI=6.0 (2-lane and 4-lane roads are dealt with in a single code)

CSTD1 = KSh. 2,500,000/Km/2-lane x ß(1.25) = KSh. 3,130,000/Km/2-lane
= KSh. 450/sq.m.

- STD2: Rehabilitation at IRI=8.0

CSTD2 = KSh. 4,300,000/Km/2-lane
(Rehabilitation and recarpeting cost in the EPR) x ß(1.25)
= KSh. 5,370,000/Km/2-lane
= KSh. 770/sq.m.

CSTD2 = KSh. 4,300,000/Km/2-lane
(Rehabilitation and recarpeting cost in the EPR) x ß(1.25)
= KSh. 5,370,000/Km/2-lane
= KSh. 770/sq.m.

- STD3: Resealing at IRI=6.0 and T≥370

CSTD3 = CSTD1 = KSh. 450/sq.m.

- STD4: Resealing at IRI=8.0 and T≥370

CSTD4 = CSTD3 = CSTD1
= KSh. 450/Km/2-lane.

c Gravel - Unpaved Roads

- STG0: "Do nothing" except for Routine Maintenance

CSTG0 = KSh. 20,000/Km/2-lane
(Simple routine maintenance cost of gravel roads in the EPR) x 1.25(ß) x g6(0.5)
= KSh. 125,000/Km/2-lane.

- STG1: Regravelling at 5-year interval

CSTG1 = KSh. 1,500,000/Km/2-lane
(Rehabilitation and regravelling cost of gravel roads in the EPR) x ß(1.25) x g7(0.7) = KSh. 1,310,000/Km/2-lane/5-year.

- STG2: Grading, twice/year

CSTG2 = KSh. 30,000/Km/2-lane
(Grading cost of gravel roads in the EPR) x ß(1.25)
= KSh. 37,500,000/Km/2-lane/Year.

- STG3: Regravelling at 5-year interval, if T≥110

CSTG3 = CSTG1 = KSh. 1,310,000/Km/5-year.

- STG4: Grading, twice/year, if T≥110

CSTG4 = CSTG2 = KSh. 37,500/Km/2-lane/Year.

d Earth - Unpaved Roads

- STE0: "Do nothing" except for routine maintenance

CSTE0 = KSh. 20,000/Km/2-lane/Year
(Simple maintenance cost discussed in EPR) x ß(1.25) x g6(0.5)
= KSh. 12,500/Km/2-lane/year.

- STE1: "Grading, twice/year

CSTE1 = CSTG2 = KSh. 37,500/Km/2-lane/year.

- STE2: Grading, if T≥50

CSTE2 = CSTE1 = KSh. 37,500/Km/2-lane/year

e Asphaltic Concrete (AC) - Paved Roads {Existing 4-lane artery, Super Highway (HWY), bypass}

- STS0: "Do nothing" except for routine maintenance for 4-lane artery

CSTS0 = CSTA0 x 2 = Ksh. 215,000/Km/2-lane/year x 2
= KSh. 430,000/Km/2-lane/year.

- STS1: Improvement (Reconstruction) from 2-lane artery to 2-lane Super HWY at IRI=8.0

CSTS1 = CSCN4 = KSh. 21,450,000/Km/2-lane.

- STS2: Improvement (Reconstruction) from 4-lane artery to 4-lane Super HWY at IRI=8.0

CSTS2 = CSCN5 = KSh. 42,900,000/Km/4-lane.

- STS3: Overlay for 4-lane/2-lane Super HWY, 4-lane Artery and 4-lane Bypass at IRI=6.0

CSTS3 = CSTA3 = KSh. 490/sq.m.

- STS4: Rehabilitation of 4-lane artery

CSTS4 = CSTA2 x 2
= KSh. 5,910,000/Km/2-lane
= KSh. 11,820,000/Km/4-lane
= KSh. 1,680/sq.m.

6.4.4 Economic Evaluation

(1) General Overview

The purpose of the economic evaluation is to arrive at a measure of viability for each designated project section (that is "super link"). This measure, which is essentially a benefit-cost ratio (B/C), will be utilized subsequently as one of the major determinants for project prioritization purposes.

While such an approach may be self-evident, underlying techniques and methodologies are complex. The adopted approach is realistic as well as logical and it maximizes the use of domestic and foreign resources which may become available for the implementation of this Master Plan Study. Details are presented in subsequent paragraphs of this section.

(2) Method of Evaluation

a The Super Link System

The arterial road network (comprising class A, B and C roads) associated with transport modeling consists of about 1,700 simulated links. While this is entirely appropriate for modeling purposes, it must be recognized that meaningful economic analyses are not possible at such a level of detail. Hence, selected network components were aggregated into bigger units called "super links" (refer to Chapter 5, Road Transport Modeling and Demand Forecast). The principal consideration influencing super link designation was traffic volume. Thus, super link terminus points are generally formed by nodes (junctions) or zone centroid connectors. The super link numbering system is depicted in Annex 1, which also summarizes the equivalencies of the super link numbering system to that of the Kenya MOPW road.

The super link represents therefore a base of reference, which is utilized consistently for the traffic demand forecast, calculation of project costs, economic analysis and the prioritization processes. However, this does not necessarily mean that project implementation must also be on a super link basis.

b Analysis Environment

The analysis tool employed for the economic evaluation was the HDM-PC, a refined personal computer version of the Highway Design and Maintenance Standard Model (HDM-III) developed by IBRD. The input data required by the

HDM-PC were mostly obtained through the traffic survey and engineering surveys conducted during the early phase of this master plan study. Data of several categories, which could not be obtained through the surveys, were judged from other relevant studies as well as through general site observations which covered almost all of the study roads.

c Analytical Approach

For economic analysis purposes projects are categorized broadly into "Capital Investment Projects" and "Maintenance Projects". The former category, as its name indicates, refers to those super links, which require capital investment in the form of widening, upgrading or special projects (super highway and by-pass construction) in addition to routine and periodic maintenance. The latter category refers to super links, which require only periodic and routine maintenance works.

The economic analysis is structured so as to assess the costs and savings accruing as a result of implementing the road improvement/maintenance action ("with" case) versus without implementing the improvement/maintenance action ("without" case). The general scenario adopted for the economic evaluation is as follows :

Table 6.4.13 General Scenario for Economic Evaluation

Project Type	"With" case	"Without" case
Capital Investment	-Construction -Periodic Maintenance -Routine Maintenance	-Routine Maintenance
Maintenance	-Periodic Maintenance -Routine Maintenance	-Routine Maintenance

Source : JICA Study Team

Rehabilitation and reconstruction projects are categorized as capital investment, even if they take the form of a maintenance action. Consequently, evaluation of these types of projects was done in line with the following scheme :

Table 6.4.14 Evaluation Scenario of Rehabilitation/Reconstruction

Project Type	With Case	Without Case
Rehabilitation/ Reconstruction	-Rehabilitation/ Reconstruction -Routine Maintenance	-Routine Maintenance

Source : JICA Study Team

In order to maintain consistency of approach and to minimize any potential bias, a series of procedures was adopted uniformly as follows :

- Any "Capital Investment" action is assumed to take place in the year 1994 (economic analysis year-1), which is followed later by appropriate periodic maintenance action, whenever the critical IRI threshold has been reached

- In the case of a "Maintenance" project, it is also assumed that periodic maintenance has to be conducted in year-1, which is then followed by other necessary maintenance action

- Only one type of capital investment action may be selected for a particular super link (project) during its economic analysis period. Hence, for example, an upgrading of S/D to A/C may not be followed by widening of A/C. This, to some extent, underlines the importance of the first immediate action

- All costs associated with the economic analysis are discounted in the year 1994

- Unconstrained demand forecasts are derived from the transport modeling process. Thus, the "generated traffic" option within the HDM-PC is not available.

Note: * Rehabilitation/reconstruction takes precedence over any other capital investment action. For example, an A/C widening may not be conducted, if in the first year, the super link needs a rehabilitation or reconstruction.

d Economic Analysis for "Representative Cases"

The total number of potential projects (that is the super links) enumerated for the future development amounted to around 350 cases. It is difficult, within the

limited time frame of this study, to evaluate individually all the projects. A typological analysis has therefore been made initially, with a view to selecting the most suitable model to represent the existing as well as the future situation of the project roads.

The study roads have been grouped into several "representative cases" to best suit the existing and future road conditions. The categories employed are as follows :

- Existing Traffic Level

Table 6.4.15 ExistingTraffic Level

Road Type/ Traffic Level	Traffic Volume (vehicles/day)		
	Minimum	Maximum	Average
Paved Road			
High	3,000		5,500
Medium/High	1,500	2,999	2,300
Medium/Low	370	1,499	650
Low	0	369	150
Unpaved Road			
High	1,500		2,000
Medium/High	370	1,499	650
Medium/Low	110	369	150
Low	0	109	50

Source : JICA Study Team

The categories of traffic levels and traffic volumes were determined with reference to the current design standard and the results of the traffic survey conducted by the Study Team.

- Traffic Growth

In order to obtain representative figures, economic evaluation was conducted for four different vehicular traffic growths assumptions, namely : 3%, 6%, 10% and 15% per annum.

- Surface Type

i) Asphalt concrete (A/C) paved roads were further categorized into :
- 2-lane carriage way

- 4-lane carriage way
- Super Highway candidates (A higher design standard will be applied)
- By-pass candidates

ii) Surface dressing (S/D) paved roads

iii) Gravel roads

iv) Earth roads.

- Surface Conditions

The surface conditions were classified as follows :

Table 6.4.16 Surface Conditions

Road Type	Condition	IRI Range
Paved Road	Good	2 £ IRI < 4
	Fair	4 £ IRI < 6
	Poor	6 £ IRI < 8
	Bad	8 £ IRI < 10
	Very Bad	IRI 3 10
Unpaved Road	Gravel	n/a
	Earth	n/a

Source : JICA Study Team
Note : n/a = not applicable

Construction and maintenance options for the HDM-PC runs were designated as follows :

- Construction Options

The following four types have been considered :

i) Widening from 2-lanes to 4-lanes A/C paved roads
ii) Upgrading from S/D to A/C paved roads
iii) Upgrading from Gravel to S/D paved roads
iv) Upgrading from earth to Gravel roads

- Maintenance Options (including rehabilitation/reconstruction)

- Maintenance options have been set as follows :

Table 6.4.17 Maintenance Options by Road Type

Road Type	Work Item
A/C Paved Road	Routine maintenance : - Overlay at IRI = 6 - Rehabilitation at IRI = 8 - Reconstruction at IRI = 10
S/D Paved Road	Routine maintenance : - Resealing at IRI = 6 - Rehabilitation at IRI = 8 - Reconstruction at IRI = 10
Gravel Road	Routine Maintenance : - Regravelling at 5-years interval - Grading twice a year
Earth Road	Routine Maintenance : - Grading twice a year

Source : JICA Study Team

The economic analyses for the combinations of the above elements have been conducted through modeling of the HDM-PC. Two measures of economic viability are furnished by the program for each representative case : The Net Present Value (NPV) and, in most of the cases, the Internal Rate of Return (IRR). However, it must clearly be pointed out that NPV and IRR measures can produce conflicting conclusions. The IRR is, for example, very sensitive to the temporal allocation of costs or benefits, and particularly so during the early years of the economic evaluation period. Furthermore, if negative and positive cash flows alternate over the life of the project, multiple IRR solutions, or even no solution, are possible, as is frequently found in this Master Plan Study.

The preferred approach is to use a benefit-cost ratio, that is the relationship of the discounted cost saving stream to the discounted investments. The B/C ratio is, compared to the NPV and the IRR, more sensitive to the required capital investment. The B/C ratio for representative cases was subsequently developed using a 15 percent discount rate. The results are summarized in Table 6.4.18.

e B/C Ratio Calculation for an Individual Super Link

Once the B/C ratio for representative cases is available, the B/C ratio for an individual super link can be calculated conveniently by pigeon-holing the super

link's specific characteristics (its traffic level, traffic growth, surface type, surface condition and the expected road maintenance action) to the appropriate representative condition. The detailed report on the B/C ratio for each super link is presented in Annex III.

6.4.5 Implementation Policy and Program

(1) Policy

1) General

As regards the future projects examined in the previous section 6.4.1, the bypasses in three cities and widening are listed and as new construction projects. The other main projects are classified as maintenance work items on existing roads, though widening and reconstruction are included. This classification has been taken, because the existing roads network itself is suitable even in future, as has been established through the analysis and examination in this study. From these points of view, the following items are taken into consideration for implementation of the projects.

2) Dual Carriage Way

The widening from two lane roads to dual carriage way roads depends on the future estimated traffic volume. The following two levels of capacity, which are based on Kenya's Road Design Manual, are applied under this criteria :

-8,000 pcu are applied for the traffic capacity of the Super Highway Mombasa-Nairobi-Kisumu/Eldoret-Uganda (exactly 7000 pcu is applied considering intra zonal traffic to that of forecasted).
-15,000 pcu are applied for the traffic capacity of other roads (13,000 pcu is applied same as above).

The timing of the implementation period will be decided by the year, when the future estimated traffic volume is beyond this capacity.

3) Road Maintenance Works

As is mentioned above, the present road network configuration system itself is sufficient. However, the surface conditions have deteriorated, due to insufficient road maintenance. The most of the total width of cross section does not fully meet the standards prescribed by the design criteria, though this shortage does not seem to seriously affect the present traffic capacity of these roads. This indicates that periodical maintenance works, including reconstruction, have to be selected and done on basis of the surface conditions of the existing roads, as has been mentioned in Chapter 6.3, Maintenance Requirement. According to a selected maintenance work depending on the IRI (International Roughness Index) of the existing road surface condition, the implementation period will be decided automatically, though some adjustments may have to be taken into account, due to budgetary and other reasons.

4) Cost Benefit Ratio (B/C)

The maintenance works, including reconstruction, are to be decided by such items as traffic volume, type of surface, and B/C ratio. The HDM model is applied to calculate the B/C ratio according to conditions in line with the projects. This implicates that B/C ratio of projects will be utilized only for the purpose of revising the implementation period, which has been decided as described above. The detailed method to calculate B/C ratio is described in the later section.

5) Regional Development Aspects

Some items are already analyzed to make the project list of the future road network as follows:

-Mobility
-International Road
-Missing Link
-Super Highway
-Agricultural Development
-Access to Important Facility, and
-Support to Tourism.

The above items is respectively taken into account to decide on the priority of the projects, based on the necessary maintenance works and other conditions to be done in the future (Appendix 4 refers).

(2) Implementation Criteria

1) Geometric Improvement

The road geometry for each road link is to be rearranged for the future traffic volume, which the road will have to accommodate.

The criteria for such improvement and the standard cross section to be applied for class A, B, and C roads are shown below:

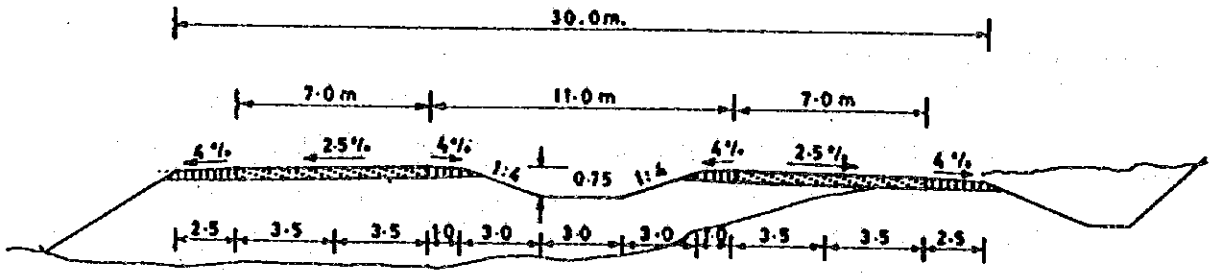


Figure 6.4.2 Cross Section Type I-Dual Carriage Way

For PCU > 8,000/day for SUPER HIGHWAY
PCU > 15,000/day for ORDINARY HIGHWAY

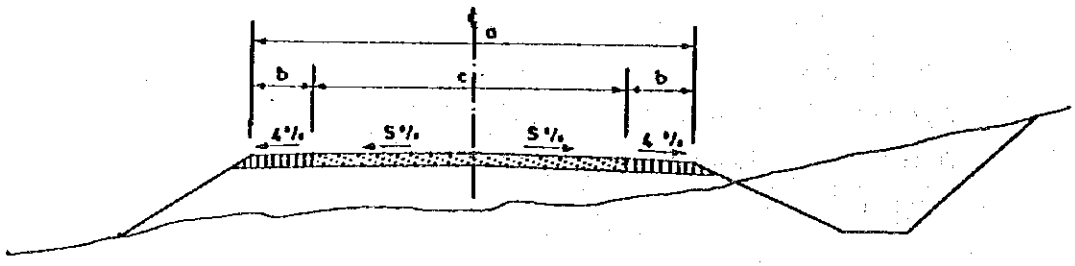


Figure 6.4.3 Cross Section Type II-VIII- Single Carriage Way

Table 6.4.18 Cross Section Type

Cross-Section			Dimensions in Meters			Traffic Volume
Type	Lanes	Surfacing	a	b	c	PCU/day
II	2	bitumen	10.00	1.50	7.00	2000 ≤ T (SUP. HWY)
III	2	bitumen	8.50	1.00	6.50	2000 ≤ T (Others)
IV	2	bitumen	7.00	0.50	6.00	500 ≤ T ≤ 2000
VII	2	gravel	8.00	-	-	100 ≤ T ≤ 500
VIII	1	earth/gravel	6.00	-	-	T < 150

SOURCE : JICA Study Team.

The improvement diagram is shown in Figure 6.4.4.

2) Maintenance Program

a Earth Roads

Only routine maintenance, including regular maintenance of drainage, side slopes, verges. furniture, grading, vegetation control, erosion control, and so on, is to be programmed for every 6 months.

b Gravel Roads

In addition to the above spot regravelling of potholes and small depressions with granular material, routine maintenance is to be carried out every 6 months.

For periodic maintenance purposes, full surface regravelling of 10 cm thickness is to be programmed.

c Bitumen Roads

Routine maintenance, including pothole and raveling patching, is to be undertaken every year. The method of periodic maintenance depends on the surface roughness measured by IRI as follows:

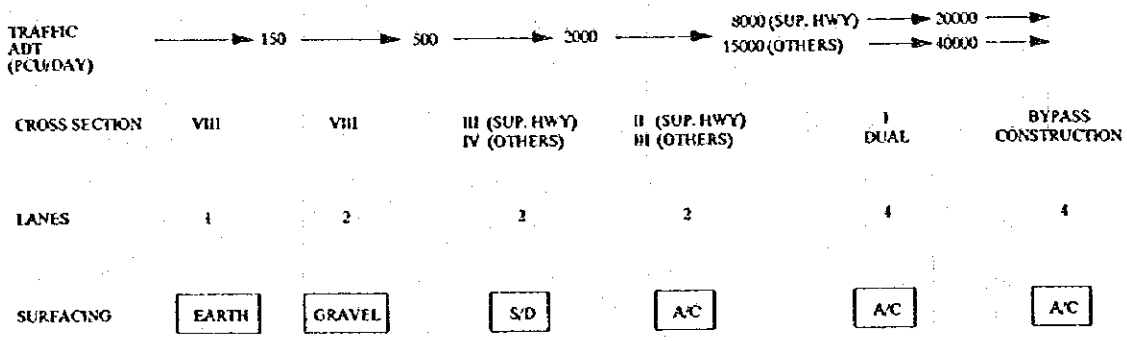


Figure 6.4.4 Geometric Improvement Diagram

$2 \leq IRI < 6$	no periodic maintenance
$6 \leq IRI < 8$	- overlay of 5 cm thick premixed asphalt concrete for A/C paved roads; IRI recover to 3 - resealing of double surface dressing for S/D paved roads; IRI recover to 3
$8 \leq IRI < 10$	- full-width, full length surfacing: IRI recover to 2
$10 \leq IRI$	- full-width, full-length reconstruction of roadway pavement including base and shoulders to appropriate structure number to accommodate with future 20 years axle load; IRI recover to 2

The maintenance diagram is shown on Figure 6.4.5.

3) Widening

The timing of widening to dual carriage way is decided by the period, when the estimated future traffic volume exceeds a traffic capacity on each road as is described before.

4) Implementation of Maintenance Work

Maintenance options have been examined and analyzed depending on the existing situation of the roads and the types of maintenance works have been decided by such existing road conditions as IRI and surface conditions as follows :

Table 6.4.19 Maintenance Options

Surface	Grading	Regraveling	Resealing	Overlay	Rehabilitation	Reconstruction
A/C Paved Road				IRI 6	IRI 8	IRI 10
SD Paved Roads			IRI 6		IRI 8	IRI 10
Gravel Roads	Twice a Year	5 Years Interval				
Earth Roads	Twice a Year					

IRI:International Roughness Index

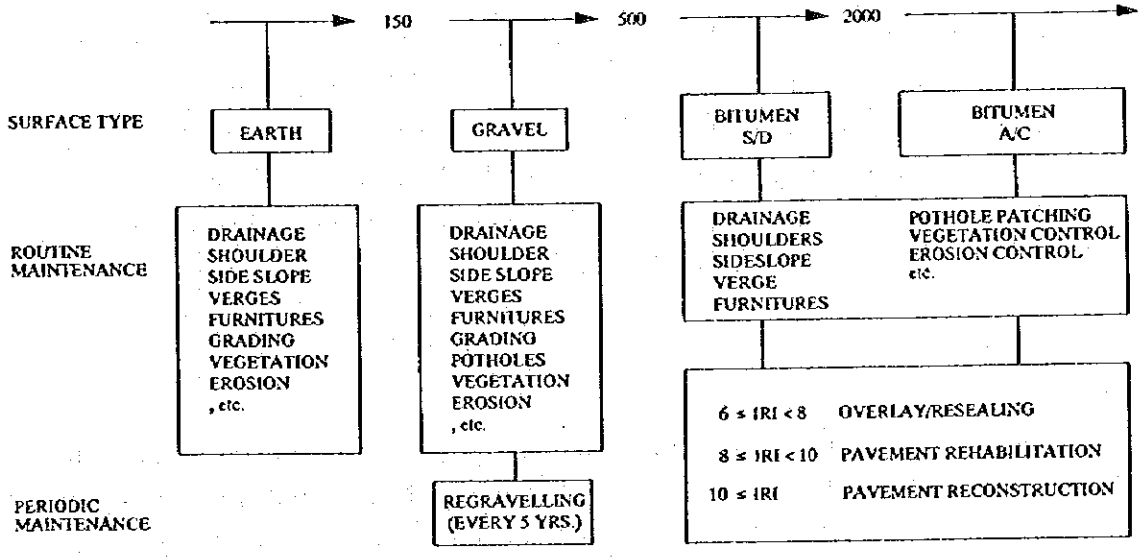


Figure 6.4.5 Road Maintenance Diagram

The implementation periods are decided by the timing, when necessary maintenance work options have to be done.

(3) Implementation Programme

1) Implementation Priority

Some important and significant projects have been selected through this study. They are tabulated in the project list in Appendix 4. These projects have to be realized on a high priority basis, provided that some budgetary limitation are foreseen in the future. However, it should be noted that this does not necessarily mean to implement early construction. For instance, although dual carriage way of roads is important to keep smooth traffic operations, the actual implementation period will be decided by the timing of the future traffic volume and traffic capacity of that section of roads. Moreover, the implementation programme covers all projects, not only those on the project list, but also all of those projects, which need necessary maintenance works on road classes A, B and C. The key points of the implementation programme on major projects are as follows :

a Super Highway (Two Lane)

- Route A 104 and A 109

The implementation period of the super highway shall be decided by judging the timing of the necessary maintenance work with the implementation criteria used in this study. Taking into consideration both the B/C ratio and total budget limitation, however, it seems desirable to shift the west part of the road sections from Nakuru into the next five year planning period 2000-2004, though early maintenance works are expected in this period.

-Route B 1

For the main part of this section, grading up from surface dressing to asphalt concrete and rehabilitation of surface dressing are recommended in the planning period 1995-1999. Although improvement to a super highway is also recommendable in the same period, almost all part of such improvement would have to be shifted to the 2000-2005 period, due to budgetary limitations.

b Super Highway Dualization

According to the implementation policy mentioned in item (1) policy in this chapter, the implementation period of the super highway dualization is initially

decided by the future traffic volume and road capacity. However, the budget necessary for such dualization reaches a rather large amount when compared to other improvement costs. As a result, postponement is taken into consideration, but paying attention to the B/C ratio and continuity of the road sections to be improved. The finally recommended implementation period is shown in Appendix 5 of this report.

c By-pass and Likoni Bridge

It is somewhat difficult to decide the most appropriate implementation periods for by-passes, since the actual timing of implementation depends mainly on the intra city traffic situation, while the present study is focusing on the " enter city " trunk road network. However, the following implementation periods are recommended :

-The East Nairobi By-pass should be implemented in the 1995-1999 period, taking into account the traffic congestion and environmental conditions created by through traffic in Nairobi City

-The Mombasa By-pass should be implemented at a second stage, taking into account the traffic congestion in Mombasa City and Mombasa's conurbation development

-The West Nairobi By-pass should be implemented in the period 2005-2009, taking into account the future traffic congestion, population increase and the enlargement of the residential area in Nairobi City

-It seems that the Nakuru By-pass should be implemented at the last stage, mainly due to the relatively small city size and future traffic volume

-With respect to the Likoni Bridge, the necessity to construct this bridge seems undoubted. However, its early implementation will be difficult, since construction costs are very high in order to provide high clearance under the bridge for large ships to pass. Hence, the implementation period is recommended at the last planning stage. Moreover, although total construction cost is estimated at 15,000 MKSh, only a minimum portion of total cost is appropriated as the initial undertaking cost.

The recommended implementation period for by-passes is shown in Appendix 5.

d Other Dualization Roads

The recommended implementation period for dual carriage way projects, namely those from two lane road to dual carriage way, have been decided based on the timing when the traffic volume reaches the capacity on respective road sections. The implementation period is shown in Appendix 5.

e Implementation Priority based on Major Regional Development Aspects

Quite a few projects have been selected as tabulated in the project list in Appendix 4 from the view point of regional development aspects. Necessary maintenance works such as overlay, resealing and others are proposed in accordance with the maintenance programme as per implementation criteria on paved roads. The following are some of the important projects :

- Priority from a Point of View of Missing Links and Alternative Routes

According to the economic evaluation of the projects tabulated in the project list-2 in Appendix 4, and from the view point of missing links and alternative routes (project type 5 in the project list), the priority of major projects is as follows :

Route	B/C	Remarks
C 64/70	4.80	Estimation
A3	2.3	On going
B6	1.4	Paved
A2	1.05	Paved
B7	1.05	
C81	0.59	
C103	0.47	
B8	0.45	On going

Source : JICA Study Team

Excluding the routes and sections covered by on-going improvement works, upgrading to bitumen of B7, C81 and C103 is proposed by this study as important projects from the view point of missing links and alternative routes. The implementation period should be decided based on the future traffic volume as per implementation criteria.

- Priority from Agricultural Development Aspects

Under this prioritization view point, major projects are as follows :

Route	B/C	Remarks
C97	13.01	Paved
C64	11.2	
C66	8.15	Paved
C62	6.74	Paved
B3	5.23	Paved
C70	4.8	
B5	4.77	Paved
C67	2.57	
A2	2.19	Paved
C98	1.78	Paved
C68	1.54	Paved
B7	1.05	Refer to missing links
C13	0.41	Refer to tourism
C100	0.37	
C101	0.30	Traffic is small

Source : JICA Study Team

Excluding the routes and sections covered by on-going improvement works, upgrading to bitumen of C 64, C70, C67 and C100 is proposed by this study as important projects from the view point of agricultural development. The implementation period is decided based on the future traffic volume as per implementation criteria.

- Priority from a Point of View to Support Tourism Development

Under this prioritization criteria, major projects are as follows :

Route	B/C	Remarks
B3	5.23	Paved
B4	1.41	
B6	1.40	Paved
A23	1.09	Paved
C13	0.98	
C77	0.50	
C103	0.47	
C112	0.44	On going
C102	0.07	Traffic is small
	0.03	Traffic is small

Source : JICA Study Team

Excluding the routes and sections covered by on-going improvement works, upgrading to bitumen of B4, C13, C77 and C103 is proposed by this study as important projects from the view point of supporting tourism development. The implementation period is decided based on the future traffic volume as per implementation criteria.

- Priority from a Point of View of Accessing Important Facilities

Routes C19 and C110, which access Homa Bay from Kendu Bay and Mombasa Airport, respectively, are listed as essential projects to support tourism development. The implementation period is decided based on the future traffic volume and necessary maintenance works as per implementation criteria.

(4) Development Project Expenditure

Appendix 6 shows the adjusted implementation program by five years cycles and broken down by type of improvement and maintenance works, types of work and required investment cost. The summary is presented in the following Table 6.4.20.

Table 6.4.20 Implementation Plan of Major Projects (1/3)

Project ID No.	[1] S/L No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
(I) SUPER HIGHWAY													
1	8	620	A	1	31	20.0	SD	Type-2	429.0	---	---	---	429.0
2	10	620	A	1	31	17.5	SD	Type-2	375.4	---	---	---	375.4
3	11	620	A	1	31	5.0	SD	Type-2	107.3	---	---	---	107.3
4	75	740	A	104	41	13.5	AC	Type-2	289.6	---	---	---	289.6
5	79	770	A	104	51	43.0	AC	Type-2	922.4	---	---	---	922.4
6	80	770	A	104	51	24.4	AC	Type-2	523.4	---	---	---	523.4
7	80	770	A	104	51	7.1	AC	Type-2	---	---	---	152.3	152.3
8	81	770	A	104	51	16.0	AC	Type-2	---	---	---	343.2	343.2
9	82	770	A	104	51	16.8	AC	Type-2	---	---	---	360.4	360.4
10	83	770	A	104	51	37.6	AC	Type-2	---	806.5	---	---	806.5
11	84	930	A	104	61	34.0	AC	Type-2	---	---	---	729.3	729.3
12	85	910	A	104	71	30.0	AC	Type-2	---	643.5	---	---	643.5
13	86	910	A	104	71	20.8	AC	Type-2	---	446.2	---	---	446.2
14	87	910	A	104	71	1.0	AC	Type-2	---	21.5	---	---	21.5
15	88	920	A	104	81	14.1	AC	Type-2	---	302.4	---	---	302.4
16	89	340	A	109	11	6.2	AC	Type-2	---	---	---	133.0	133.0
17	90	310	A	109	21	23.1	SD	Type-2	435.5	---	---	---	435.5
18	90	320	A	109	31	54.2	SD	Type-2	1,162.6	---	---	---	1,162.6
19	90	350	A	109	41	49.0	AC	Type-2	---	1,051.1	---	---	1,051.1
20	91	310	A	109	21	25.0	SD	Type-2	---	536.3	---	---	536.3
21	92	350	A	109	41	36.0	AC	Type-2	---	---	772.2	---	772.2
22	93	350	A	109	41	14.0	AC	Type-2	---	---	300.3	---	300.3
23	94	350	A	109	41	6.0	AC	Type-2	---	---	128.7	---	128.7
24	95	440	A	109	51	21.5	AC	Type-2	---	---	461.2	---	461.2
25	95	470	A	109	52	64.4	SD	Type-2	---	---	1,381.4	---	1,381.4
26	97	470	A	109	52	88.0	SD	Type-2	---	---	1,887.6	---	1,887.6
27	98	470	A	109	52	68.0	SD	Type-2	---	---	1,458.6	---	1,458.6
		Sub-total				713.7			4,305.2	3,807.5	6,390.0	1,718.2	16,220.9
28	2	120	B	1	10	12.5	SD	Type-2	---	268.1	---	---	268.1
29	4	120	B	1	10	19.0	SD	Type-2	---	407.6	---	---	407.6
30	5	120	B	1	10	6.9	SD	Type-2	---	148.0	---	---	148.0
31	6	620	B	1	21	16.6	SD	Type-2	---	356.1	---	---	356.1
32	7	620	B	1	21	5.5	SD	Type-2	---	118.0	---	---	118.0
33	8	620	B	1	22	6.9	AC	Type-2	---	---	148.0	---	148.0
34	8	620	B	1	23	13.1	SD	Type-2	---	---	---	281.0	---
35	9	620	B	1	23	4.3	AC	Type-2	---	---	---	92.2	---
36	10	620	B	1	23	8.8	AC	Type-2	---	---	188.8	---	188.8
37	11	940	B	1	31	3.0	AC	Type-2	---	---	64.4	---	---
38	12	940	B	1	31	6.5	AC	Type-2	---	---	---	139.4	---
39	13	940	B	1	31	3.0	AC	Type-2	---	---	---	64.4	64.4
40	13	630	B	1	41	29.0	SD	Type-2	---	---	622.1	---	622.1
41	14	630	B	1	41	4.0	SD	Type-2	---	85.8	---	---	85.8
42	15	630	B	1	41	2.0	SD	Type-2	---	42.9	---	---	42.9
43	15	630	B	1	41	14.5	SD	Type-2	---	311.0	---	---	311.0
44	15	920	B	1	51	2.0	SD	Type-2	---	42.9	---	---	42.9
45	16	920	B	1	51	20.0	SD	Type-2	---	---	429.0	---	429.0
46	17	920	B	1	51	5.0	SD	Type-2	---	---	107.3	---	107.3
		Sub-total				182.6			0	1,780.4	1,559.6	577.0	3,917.0
		Total				896.3			4,305.2	5,587.9	7,949.8	2,295.2	20,137.9
(II) SUPER HIGHWAY DUAL CARRIAGEWAY CONSTRUCTION													
1	9	620	A	1	31	20.0		Type-1	---	---	966.0	---	966.0
2	63	440	A	104	10	15.3		Type-1	---	---	739.0	---	739.0
3	65	210	A	104	31	4.8		Type-1	---	---	231.8	---	231.8
4	68	210	A	104	31	10.0		Type-1	---	---	483.0	---	483.0
5	69	210	A	104	31	14.0		Type-1	---	---	676.2	---	676.2
6	70	210	A	104	31	22.0		Type-1	---	---	1,062.6	---	1,062.6
7	71	240	A	104	32	4.3		Type-1	---	---	207.7	---	207.7

Table 6.4.20 Implementation Plan of Major Projects (2/3)

Project ID No.	[1] S.L. No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
8	71	740	A	104	41	26.0		Type-1	---	---	1,255.8	---	1,255.8
9	72	740	A	104	41	32.0		Type-1	---	---	1,545.6	---	1,545.6
10	73	740	A	104	41	5.0		Type-1	---	241.5	---	---	241.5
11	74	740	A	104	41	45.3		Type-1	---	2,188.0	---	---	2,188.0
12	74	740	A	104	42	7.4		Type-1	---	---	357.4	---	357.4
13	76	740	A	104	41	27.5		Type-1	---	1,328.3	---	---	1,328.3
14	77	740	A	104	41	7.0		Type-1	---		338.1	---	338.1
15	78	740	A	104	43	5.2		Type-1	---	251.2	---	---	251.2
16	89	340	A	109	11	17.8		Type-1	---	---	---	859.7	859.7
17	89	340	A	109	12	6.2		Type-1	---	---	---	299.5	299.5
18	96	440	A	109	51	26.0		Type-1	---	---	1,255.8	---	1,255.8
19	1	120	B	1	10	45.0		Type-1	---	---	2,173.5	---	2,173.5
20	3	120	B	1	10	7.0		Type-1	---	338.1	---	---	338.1
21	18	740	B	1	61	2.9		Type-1	---	140.1	---	---	140.1
		Sub-total				350.7			.0	4,487.2	11,292.5	1,159.2	16,938.9
(III) BYPASS CONSTRUCTION													
1		Mombasa Bypass				50.0	---	Type-1	---	2,680.0	---	---	2,680.0
2		East Nairobi Bypass				27.0	---	Type-1	1,447.2	---	---	---	1,447.2
3		West Nairobi Bypass				49.0	---	Type-1	---	---	2,626.4	---	2,626.4
4		Nakuru Bypass				26.0	---	Type-1	---	---	---	1,393.6	1,393.6
5		Likoni Bridge First Stage							---	---	---	4,200.0	4,200.0
		Sub-total				152.0			1,447.2	2,680.0	2,626.4	5,593.6	12,347.2
													.0
(IV) DUAL CARRIAGEWAY ROADS CONSTRUCTION													.0
1	33	230	A	2	20	13.5	AC	Type-1	---	---	652.1	---	652.1
2	34	230	A	2	30	10.0	AC	Type-1	---	---	---	483.0	483.0
3	34	220	A	2	20	26.5	SD	Type-1	---	---	---	1,280.0	1,280.0
4	52	310	B	8	20	30.0	SD	Type-1	---	---	---	1,449.0	1,449.0
		Sub-total				80.0			.0	.0	652.1	3,212.0	3,864.1
(V) MISSING LINK/ALTERNATIVE ROUTE													
1	47	430	B	7	20	114.8	E	Type-4	---	1,767.9	---	---	1,767.9
2	47	470	B	7	10	24.8	G	Type-4	---	---	---	381.9	381.9
3	48	430	B	7	20	3.0	SD	Type-3	24.4	---	---	9.5	33.9
4	47	470	B	7	10	3.0	SD	Type-3	---	---	---	46.2	46.2
5	49	430	B	7	20	13.4	E	Type-3	---	---	206.4	---	206.4
6	50	430	B	7	20	26.0	E	Type-3	---	---	400.4	---	400.4
7	51	410	B	7	40	45.5	SD	Type-3	143.3	---	---	---	143.3
8		210,230	C	64/70		60.0		Type-4	2,213.0	---	---	---	2,213.0
9	133	510	C	61	1	157.5	E	Type-4	---	---	---	242.6	242.6
10	160	310	C	103	30	136.0	G	Type-4	---	---	---	209.4	209.4
11	161	310	C	103	10	32.0	G	Type-4	492.8	---	---	---	492.8
12	161	310	C	103	10	80.0	G	Type-4	1,232.0	---	---	---	1,232.0
13	161	310	C	103	20	38.0	G	Type-4	585.2	---	---	---	585.2
		Sub Total				774.1			4,690.7	1,767.9	606.8	889.6	7,955.0
(VI) SUPPORT TO AGRICULTURAL DEVELOPMENT													
1	98	210	C	64	10	5.5	SD	Type-2	88.6	---	---	17.5	106.1
2	99	210	C	64	20	6.2	SD	Type-2	99.8	---	---	19.7	119.5
3	99	210	C	64	20	13.2	G	Type-2	203.3	---	---	---	203.3
4	1	210	C	64	20	15.5	SD	Type-4	249.6	---	---	---	249.6
5	8	740	C	67	30	11.0	SD	Type-4	89.4	---	---	---	89.4
6	8	740	C	67	30	6.9	SD	Type-4	56.1	---	---	---	56.1
7	13	230	C	70	10	23.0	G	Type-3	354.2	---	---	---	354.2
8	14	230	C	70	10	33.0	SD	Type-3	268.3	---	---	---	268.3
9	14	250	C	70	20	23.0	SD	Type-3	187.0	---	---	---	187.0
10	153	440	C	100	1	27.2	G	Type-4	---	---	---	41.9	41.9
11	154	440	C	100	1	27.2	G	Type-4	437.9		---		437.9
12	154	440	C	100	1	5.0	G	Type-4	25.0	---	---	---	25.0
		Sub Total				169.5			2,059.2	.0	.0	79.1	2,138.3

Table 6.4.20 Implementation Plan of Major Projects (3/3)

Project ID No.	[1] S.L. No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2033(m.ksh)	TOTAL COST (m.ksh)
(VII) SUPPORT TO TOURISM DEVELOPMENT													
1	1	750	C	13	10	29.0	E	Type-4	---	---	446.6	---	446.6
2	1	750	C	13	10	44.0	G	Type-4	677.6	---	---	---	677.6
3	1	750	C	13	10	21.0	G	Type-4	323.4	---	---	---	323.4
4	28	730	C	77	30	15.6	G	Type-4	240.2	---	---	---	240.2
5	128	730	C	77	30	57.7	G	Type-4	888.6	---		---	888.6
6	59	710	C	103	10	52.0	G	Type-4	800.8	---	---	---	800.8
7	59	350	C	103	20	70.0	G	Type-4	1,078.0	---	---	---	1,078.0
		Sub Total				334.4			4,009.6	0	446.6	0	4,455.2
(VIII) IMPROVEMENT OF ACCESS TO MAJOR PORTS													
1	12	620	C	19	10	25.3	SD	Type-4	74.0	---	---	74.0	148.0
2	12	640	C	19	20	20.6	SD	Type-4	60.3	---	---	60.3	120.6
3	13	640	C	19	20	27.5	G	Type-4	423.5	---		442.8	866.3
4		340	C	110	1	4.9	AC	Type-4	27.0	---	---	---	27.0
		Sub Total				78.3			584.8	0	0	577.1	1,161.9
(IX) OTHER EXISTING ROADS						6367.6			693.0	11,170.4	12,938.0	26,991.9	51,793.3
		GRAND TOTAL				9,202.9			17,788.7	25,693.4	36,512.0	40,737.7	120,791.8

Note : [1] S.L.No. : Link Numbers which are provided for the convenience of traffic demand analysis and projection.

[2] Existing Road Surface Type

AC : Asphalt Concrete

SD : Surface Dressing

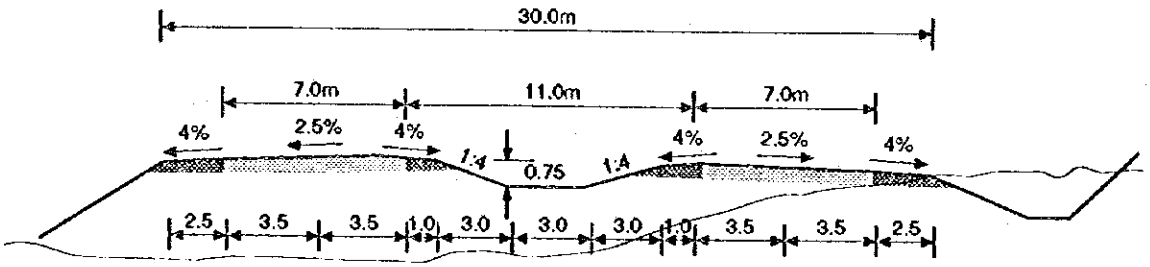
G : Gravel

E : Earth

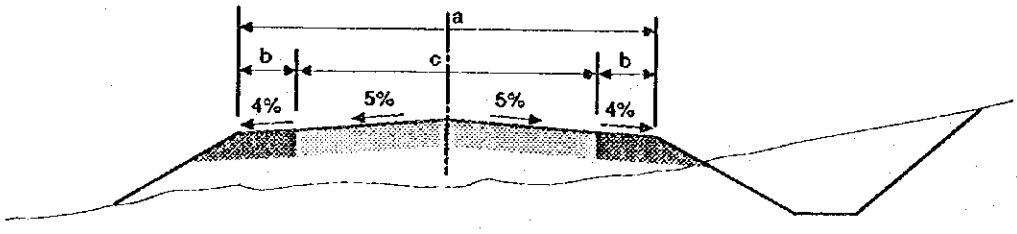
[3]Planned Cross Section Type

Project Category	Planned Cross Section Type*	Pavement Design **	Dimensions in Meters a	b	c
I. Super Highway	Type-2	(A)	10.0	1.5	7.0
II. Super Highway (Dual)	Type-1	(A)	As Shown below		
III.By pass	Type-1	(A)	As Shown below		
IV. Dual Carriageway (Arterial) Road	Type-1	(B)	As Shown below		
V. Missing Link / Alternative Route	Type-3/ Type-4	(B)	8.5/7.0	1.0/0.5	6.5/6.0
VI. Support to Agricultural Development	Type-2,/Type-3, Type-4	(B)	10.0/8.5 7.0	1.5/1.0 0.5	7.0/6.5 6.0
VII. Support to Tourism Development	Type-4	(B)	7.0	0.5	6.0
VIII. Improvement of Access to Major Ports	Type-4	(B)	7.0	0.5	6.0

* Cross Section Type:



Cross Section Type 1 (Dual Carriage Way)

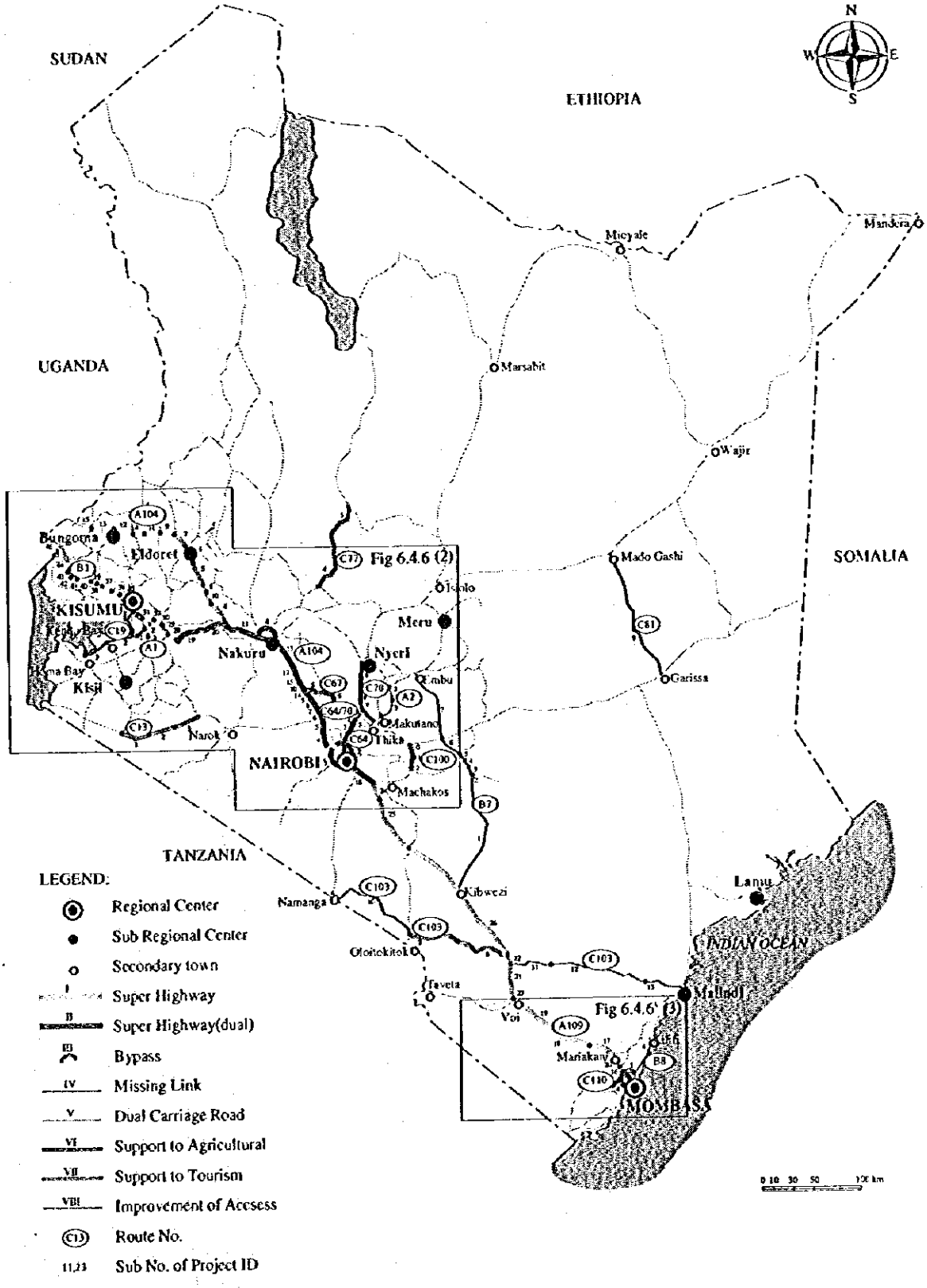


Cross Section Type 2~4 (Single Carriage Way)

** Pavement Design

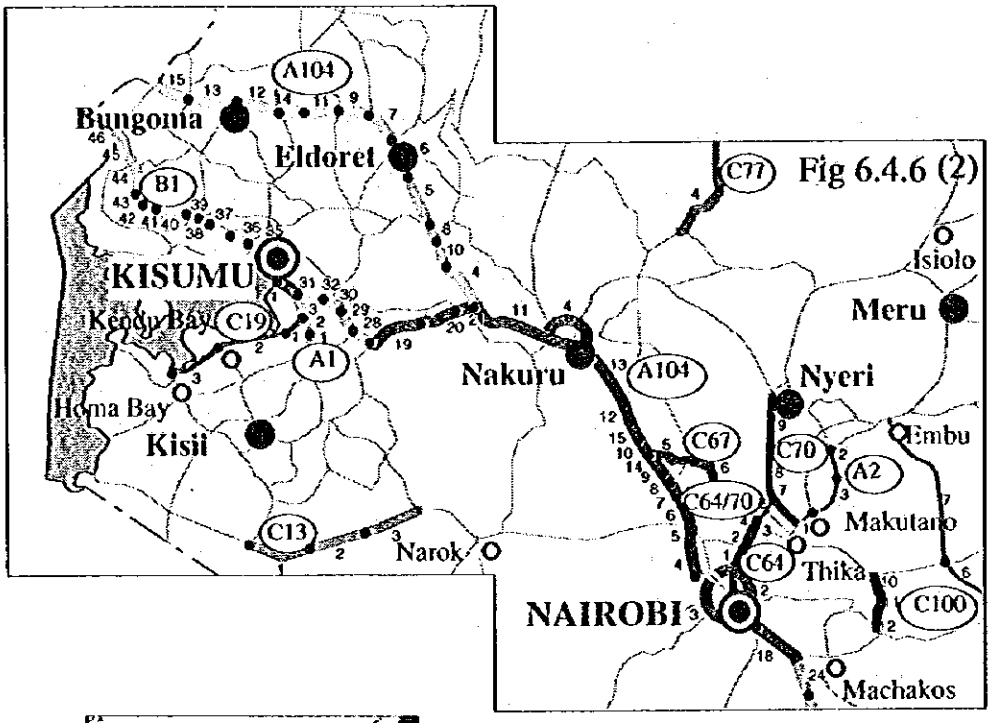
(A) Super Highway : Initial pavement life is designed to be 20 years, provided that routine and periodic maintenance is dully executed as necessary.

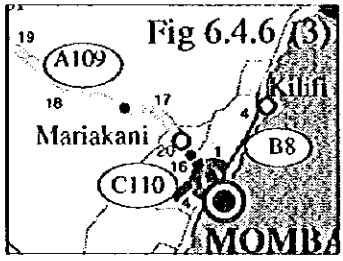
(B) Arterial AC : Initial pavement life is designed to be 10 to 15 years, provided that routine and periodic maintenance is dully executed as necessary.



Road Network Development Master Plan in Kenya

Figure 6.4.6(1)
Major Projects





LEGEND:

- Regional Center
- Sub Regional Center
- Secondary town
- I Super Highway
- II Super Highway(dual)
- III Bypass
- IV Missing Link
- V Dual Carriage Road
- VI Support to Agricultural
- VII Support to Tourism
- VIII Improvement of Accsess
- C19 Route No.
- 11,23 Sub No. of Project ID

Road Network Development Master Plan in Kenya

Figure 6.4.6(2) and (3)
Major Projects

6.4.6 Estimated Budgetary Implications

(1) Gross Expenditure over the Past Period

Kenya's budget for road network development and maintenance is broken down into the recurrent and development budgets as shown in Table 6.4.21. Both budgets comprise the domestic net budget and aid appropriations. Overall, the total recurrent and development budget has increased from about 26.4 million current K £ in FY 1975/76 to some 253.2 million current K £ in FY 1994/95. The pattern of total gross recurrent and development budget over the 20 years period under consideration reveals the following major trends :

a Aid appropriations have played no role in the recurrent and development budgets up to FY 1977/78, but have started to play an important role in the development budget over the FY 1982/83 to 1984/85 and again since FY 1987/88. In the current FY 1994/95 aid appropriation account for some 49.6 % of the total gross recurrent and development budget. Kenya's dependence on aid appropriations in the development and maintenance of the road network has increased considerably.

b If measured in current terms, about 20-30 % of gross expenditures have been sourced from the recurrent and about 80-70 % from the development budget. In other words, over the 20 years period and in terms of trend, out of every 10 current K£ of gross expenditures on roads, some 7 to 8 current K£ went into road development and some 2-3 current K£ were used to cover recurrent expenditures, including road maintenance, which is a budget item in the recurrent budget.

c Although some of the activities, which should normally be budgeted under periodic maintenance, are budgeted in Kenya under the development budget (for example complete rehabilitation and/or upgrading to a higher standard), it may be observed that the overwhelming part of total gross expenditures have been allocated for road network development with minor portions going to routine and periodic maintenance activities.

d It may also be fair to conclude that routine and periodic road maintenance have not received the attention and funds needed to preserve a well maintained road network. This would typically have increased transportation costs for road users. It is estimated by the World Bank that a

Table 6.4.21 (1) Total Budget Appropriations and Gross Expenditure Estimations for Roads over The Period 1974/75 to 1994/95

[UNIT : as indicated]

BUDGET ITEM	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	1986/ 1987	1987/ 1988	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
										[in current "000" K £]									
A) RECUR. BUDGET																				
DOM. NET BUDGET	8,955	9,021	9,696	10,564	13,431	13,347	15,760	15,937	17,950	18,184	22,903	22,900	21,147	24,342	23,491	25,232	26,097	33,054	73,773	52,054
AID APPROPRIAT.	0	0	0	0	0	0	0	227	230	420	0	120	0	0	0	0	15	0	0	75,000
GROSS EXPEND. RB	8,955	9,021	9,696	10,564	13,431	13,347	15,760	16,164	18,180	18,604	22,903	23,020	21,147	24,342	23,491	25,232	26,112	33,054	73,773	127,054
B) DEVEL. BUDGET																				
DOM. NET BUDGET	17,401	19,679	24,524	30,759	30,018	32,405	36,475	40,148	35,033	31,912	38,298	31,200	43,551	54,858	61,549	44,840	48,365	47,155	60,641	75,616
AID APPROPRIAT.	0	0	0	2,889	4,692	1,990	3,220	25,240	18,742	26,401	6,206	12,900	41,331	58,651	45,445	64,941	70,754	71,743	56,151	50,519
GROSS EXPEND.DB	17,401	19,679	24,524	33,648	34,710	34,395	39,695	65,389	53,775	58,312	44,504	44,100	84,882	113,509	106,994	109,781	119,119	118,898	116,792	126,135
C) TOTAL BUDGET																				
DOM. NET BUDGET	26,356	28,700	34,220	41,323	43,448	45,752	52,235	56,085	52,983	50,096	61,201	54,100	64,698	79,200	85,040	70,072	74,461	80,209	134,413	127,670
AID APPROPRIAT.	0	0	0	2,889	4,692	1,990	3,220	25,467	18,972	26,821	6,206	13,020	41,331	58,651	45,445	64,941	70,769	71,743	56,151	125,519
TOTAL GROSS RB+DB	26,356	28,700	34,220	44,212	48,141	47,742	55,455	81,553	71,955	76,916	67,407	67,120	106,029	137,851	130,485	135,013	145,231	151,952	190,564	253,189
										[Percent of total]									
A) RECUR. BUDGET																				
DOM. NET BUDGET	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.6	98.7	97.7	100.0	99.5	100.0	100.0	100.0	100.0	99.9	100.0	100.0	41.0
AID APPROPRIAT.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.3	2.3	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0	59.0
GROSS EXPEND. RB	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
B) DEVEL. BUDGET																				
DOM. NET BUDGET	100.0	100.0	100.0	91.4	86.5	94.2	91.9	61.4	65.1	54.7	86.1	70.7	51.3	48.3	57.5	40.8	40.6	39.7	51.9	59.9
AID APPROPRIAT.	0.0	0.0	0.0	8.6	13.5	5.8	8.1	38.6	34.9	45.3	13.9	29.3	48.7	51.7	42.5	59.2	59.4	60.3	48.1	40.1
GROSS EXPEND.DB	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C) TOTAL BUDGET																				
DOM. NET BUDGET	100.0	100.0	100.0	93.5	90.3	95.8	94.2	68.8	73.6	65.1	90.8	80.6	61.0	57.5	65.2	51.9	51.3	52.8	70.5	50.4
AID APPROPRIAT.	0.0	0.0	0.0	6.5	9.7	4.2	5.8	31.2	26.4	34.9	9.2	19.4	39.0	42.5	34.8	48.1	48.7	47.2	29.5	49.6
TOTAL GROSS RB+DB	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE : "DEVELOPMENT ESTIMATES ", VARIOUS ISSUES FOR THE FISCAL YEARS 1975/76 TO 1994/95; VOLS. I AND II.

NOTE : 1) FIGURES ARE ROUNDED AT THE "000" LEVEL.

2) n.a. = not applicable.

Table 6.4.21 (2) Total Budget Appropriations and Gross Expenditure Estimations for Roads over The Period 1974/75 to 1994/95

[UNIT : as indicated]

BUDGET ITEM	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	1986/ 1987	1987/ 1988	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
										[Share in total gross budget in %]										
A) RECUR. BUDGET																				
DOM. NET BUDGET	34.0	31.4	28.3	23.9	27.9	28.0	28.4	19.5	24.9	23.6	34.0	34.1	19.9	17.7	18.0	18.7	18.0	21.8	38.7	20.6
AID APPROPRIAT.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.6
GROSS EXPEND. RB	34.0	31.4	28.3	23.9	27.9	28.0	28.4	19.8	25.3	24.2	34.0	34.3	19.9	17.7	18.0	18.7	18.0	21.8	38.7	50.2
B) DEVEL. BUDGET																				
DOM. NET BUDGET	66.0	68.6	71.7	69.6	62.4	67.9	65.8	49.2	48.7	41.5	56.8	46.5	41.1	39.8	47.2	33.2	33.3	31.0	31.8	29.9
AID APPROPRIAT.	0.0	0.0	0.0	6.5	9.7	4.2	5.8	30.9	26.0	34.3	9.2	19.2	39.0	42.5	34.8	48.1	48.7	47.2	29.5	20.0
GROSS EXPEND.DB	66.0	68.6	71.7	76.1	72.1	72.0	71.6	80.2	74.7	75.8	66.0	65.7	80.1	82.3	82.0	81.3	82.0	78.2	61.3	49.8
C) TOTAL BUDGET																				
DOM. NET BUDGET	100.0	100.0	100.0	93.5	90.3	95.8	94.2	68.8	73.6	65.1	90.8	80.6	61.0	57.5	65.2	51.9	51.3	52.8	70.5	50.4
AID APPROPRIAT.	0.0	0.0	0.0	6.5	9.7	4.2	5.8	31.2	26.4	34.9	9.2	19.4	39.0	42.5	34.8	48.1	48.7	47.2	29.5	49.6
TOTAL GROSS RB+DB	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
										[Growth rate in %]										
A) RECUR. BUDGET																				
DOM. NET BUDGET	Base year	0.74	7.48	8.96	27.13	-0.62	18.08	1.12	12.63	1.30	25.95	-0.01	-7.66	15.11	-3.49	7.41	3.43	26.66	123.19	-29.44
AID APPROPRIAT.	Base year	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.32	82.61	-100.00	n.a.	-100.00	n.a.	n.a.	n.a.	n.a.	-100.00	n.a.	n.a.
GROSS EXPEND. RB	Base year	0.74	7.48	8.96	27.13	-0.62	18.08	2.56	12.47	2.33	23.11	0.51	-8.14	15.11	-3.49	7.41	3.49	26.59	123.19	72.22
B) DEVEL. BUDGET																				
DOM. NET BUDGET	Base year	13.09	24.62	25.42	-2.41	7.95	12.56	10.07	-12.74	-8.91	20.01	-18.53	39.59	25.96	12.20	-27.15	7.86	-2.50	28.60	24.70
AID APPROPRIAT.	Base year	n.a.	n.a.	n.a.	62.42	-57.59	61.81	683.85	-25.75	40.87	-76.49	107.85	220.40	41.90	-22.52	42.90	8.95	1.40	-21.73	-10.03
GROSS EXPEND.DB	Base year	13.09	24.62	37.20	3.16	-0.91	15.41	64.73	-17.76	8.44	-23.68	-0.91	92.48	33.73	-5.74	2.61	8.51	-0.19	-1.77	8.00
C) TOTAL BUDGET																				
DOM. NET BUDGET	Base year	8.89	19.23	20.76	5.14	5.30	14.17	7.37	-5.53	-5.45	22.17	-11.60	19.59	22.42	7.37	-17.60	6.26	7.72	67.58	-5.02
AID APPROPRIAT.	Base year	n.a.	n.a.	n.a.	62.42	-57.59	61.81	690.00	-25.51	41.37	-76.86	109.78	217.44	41.90	-22.52	42.90	8.97	1.38	-21.73	123.54
TOTAL GROSS RB+DB	Base year	8.89	19.23	29.20	8.89	-0.83	16.16	47.06	-11.77	6.90	-12.36	-0.43	57.97	30.01	-5.34	3.47	7.57	4.63	25.41	32.86

SOURCE : "DEVELOPMENT ESTIMATES" AND "RECURRENT EXPENDITURE ESTIMATES", VARIOUS ISSUES FOR THE FISCAL YEARS 1975/76 TO 1994/95; VOLS. I AND II.

NOTE : 1) FIGURES ARE ROUNDED AT THE "000" LEVEL.

2) n.a. = not applicable.

dollar reduction in road maintenance increases vehicle operating cost in the order of 2 US$ to 3 US$.

However, in order to make the current expenditures more compatible with other economic data, they have been converted, firstly, into 1982 constant price base and, secondly, into US $ using the mean annual exchange rate for the FY under consideration (Table 6.4.22 refers). The US $ numbers are likely to be somewhat overestimated, since no shadow exchange rate has been employed for conversion. They do give, however, a feeling for order of magnitude.

In terms of mega trend over the 20 years under consideration the following may be summarized :

a Total gross expenditures measured in constant 1982 K£ and comprising recurrent and development budget expenditures have fluctuated over the years in an up and down rhythm. They have increased from FY 1975/76 (50.9 million K£) to FY 1982/83 (81.6 million K£), falling in absolute terms over the FY 1983/84 to 1987/88, peaked in FY 1988/89 at a 82.1 million K£ level, fallen somewhat thereafter and reached a level of 81.8 million K£ in FY 1994/95 again.

b If one disregards the individual annual budgetary allocations, which are determined by many factors, the GOK has spent some 1,261 million K£ (in constant 1982 prices) for road network development and maintenance, equivalent to an annual average of some 63.1 million K£ per year over the 20 years time horizon (Table 6.4.23 refers).

Table 6.4.22 (1) Total Budget Expenditures for Roads over The Period 1975/76 to 1994/95 in Constant 1982 Prices

[UNIT : as indicated]

BUDGET ITEM	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	1986/ 1987	1987/ 1988	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
								[IN "000" CURRENT K €]												
A) RECUR. BUDGET																				
DOM. NET BUDGET	8,955	9,021	9,696	10,564	13,431	13,347	15,760	15,937	17,950	18,184	22,903	22,900	21,147	24,342	23,491	25,232	26,097	33,054	73,773	52,054
AID APPROPRIAT.	0	0	0	0	0	0	0	227	230	420	0	120	0	0	0	0	15	0	0	75,000
GROSS EXPEND. RB	8,955	9,021	9,696	10,564	13,431	13,347	15,760	16,164	18,180	18,604	22,903	23,020	21,147	24,342	23,491	25,232	26,112	33,054	73,773	127,054
B) DEVEL. BUDGET																				
DOM. NET BUDGET	17,401	19,679	24,524	30,759	30,018	32,405	36,475	40,148	35,033	31,912	38,298	31,200	43,551	54,858	61,549	44,840	48,365	47,155	60,641	75,616
AID APPROPRIAT.	0	0	0	2,889	4,692	1,990	3,220	25,240	18,742	26,401	6,206	12,900	41,331	58,651	45,445	64,941	70,754	71,743	56,151	50,519
GROSS EXPEND.DB	17,401	19,679	24,524	33,648	34,710	34,395	39,695	65,389	53,775	58,312	44,504	44,100	84,882	113,509	106,994	109,781	119,119	118,898	116,792	126,135
C) TOTAL BUDGET																				
DOM. NET BUDGET	26,356	28,700	34,220	41,323	43,448	45,752	52,235	56,085	52,983	50,096	61,201	54,100	64,698	79,200	85,040	70,072	74,461	80,209	134,413	127,670
AID APPROPRIAT.	0	0	0	2,889	4,692	1,990	3,220	25,467	18,972	26,821	6,206	13,020	41,331	58,651	45,445	64,941	70,769	71,743	56,151	125,519
TOTAL GROSS RB+DB	26,356	28,700	34,220	44,212	48,141	47,742	55,455	81,553	71,955	76,916	67,407	67,120	106,029	137,851	130,485	135,013	145,231	151,952	190,564	253,189
D) GDP DEFLATOR	51.8	60.0	71.1	71.9	76.0	82.6	90.2	100.0	110.6	122.9	133.5	146.2	154.0	168.0	182.3	198.4	220.6	256.2	282.9	309.6
E) AVERAGE EXCHANGE RATE TO US $	7.41	8.37	8.26	7.69	7.47	7.42	9.13	11.01	13.39	14.54	16.39	16.21	16.48	17.81	20.67	23.04	27.70	32.51	68.16	44.4

Table 6.4.22 (2) Total Budget Expenditures for Roads over The Period 1975/76 to 1994/95 in Constant 1982 Prices

[UNIT : as indicated]

BUDGET ITEM	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	1986/ 1987	1987/ 1988	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
[IN CONSTANT 1982 "000" K $]																				
A) RECUR. BUDGET																				
DOM. NET BUDGET	17,288	15,035	13,637	14,693	17,672	16,159	17,472	15,937	16,230	14,796	17,156	15,663	13,732	14,489	12,886	12,717	11,819	12,902	26,077	16,813
AID APPROPRIAT.	0	0	0	0	0	0	0	227	208	342	0	82	0	0	0	0	7	0	0	24,225
GROSS EXPEND. RB	17,288	15,035	13,637	14,693	17,672	16,159	17,472	16,164	16,438	15,138	17,156	15,746	13,732	14,489	12,886	12,717	11,826	12,902	26,077	41,038
B) DEVEL. BUDGET																				
DOM. NET BUDGET	33,593	32,798	34,493	42,780	39,497	39,231	40,436	40,148	31,676	25,966	28,687	21,340	28,280	32,654	33,762	22,601	21,904	18,406	21,435	24,424
AID APPROPRIAT.	0	0	0	4,018	6,174	2,409	3,570	25,240	16,945	21,481	4,649	8,824	26,839	34,911	24,929	32,732	32,045	28,003	19,848	16,318
GROSS EXPEND.DB	33,593	32,798	34,493	46,798	45,671	41,641	44,008	65,389	48,621	47,447	33,336	30,164	55,118	67,565	58,691	55,333	53,949	46,408	41,284	40,741
C) TOTAL BUDGET																				
DOM. NET BUDGET	50,880	47,833	48,130	57,473	57,169	55,390	57,911	56,085	47,905	40,761	45,843	37,004	42,012	47,143	46,648	35,319	33,723	31,307	47,513	41,237
ID APPROPRIAT.	0	0	0	4,018	6,174	2,409	3,570	25,467	17,153	21,823	4,649	8,906	26,839	34,911	24,929	32,732	32,051	28,003	19,848	40,542
TOTAL GROSS RB+DB	50,880	47,833	48,130	61,491	63,343	57,799	61,480	81,553	65,059	62,584	50,492	45,909	68,850	82,054	71,577	68,051	65,775	59,310	67,361	81,779
[IN CONSTANT 1982 PRICES AND CONVERTED INTO US $]																				
A) RECUR. BUDGET																				
DOM. NET BUDGET	46,660.3	35,925.9	33,019.4	38,213.4	47,314.9	43,554.2	38,274.4	28,950.0	24,241.5	20,351.8	20,934.5	19,325.7	16,664.8	16,271.0	12,468.5	11,039.5	8,533.7	7,937.0	7,651.8	7,573.6
AID APPROPRIAT.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	412.4	310.6	470.1	0.0	101.3	0.0	0.0	0.0	0.0	4.9	0.0	0.0	10,912.1
GROSS EXPEND. RB	46,660.3	35,925.9	33,019.4	38,213.4	47,314.9	43,554.2	38,274.4	29,362.4	24,552.1	20,821.9	20,934.5	19,427.0	16,664.8	16,271.0	12,468.5	11,039.5	8,538.6	7,937.0	7,651.8	18,485.6
B) DEVEL. BUDGET																				
DOM. NET BUDGET	90,668.5	78,371.3	83,517.9	111,262.1	105,748.1	105,745.2	88,583.2	72,930.5	47,312.4	35,716.0	35,005.9	26,329.9	34,320.3	36,669.0	32,667.9	19,618.9	15,815.4	11,323.1	6,269.7	11,001.7
AID APPROPRIAT.	0.0	0.0	0.0	10,450.1	16,530.6	6,493.9	7,820.1	45,849.7	25,310.5	29,547.9	5,673.0	10,886.5	32,571.0	39,204.2	24,120.7	28,413.5	23,136.8	17,227.1	5,824.1	7,350.2
GROSS EXPEND.DB	90,668.5	78,371.3	83,517.9	121,712.3	122,278.7	112,239.1	96,403.3	118,780.3	72,622.9	65,263.9	40,678.9	37,216.4	66,891.3	75,873.2	56,788.6	48,032.4	38,952.2	28,550.3	12,113.8	18,351.9
C) TOTAL BUDGET																				
DOM. NET BUDGET	137,328.8	114,297.2	116,537.3	149,475.5	153,063.0	149,299.3	126,857.6	101,880.6	71,553.9	56,067.8	55,940.4	45,655.6	50,985.1	52,940.0	45,136.4	30,658.4	24,349.1	19,260.1	13,941.5	18,575.3
ID APPROPRIAT.	0.0	0.0	0.0	10,450.1	16,530.6	6,493.9	7,820.1	46,262.1	25,621.1	30,018.0	5,673.0	10,987.8	32,571.0	39,204.2	24,120.7	28,413.5	23,141.7	17,227.1	5,824.1	18,262.3
TOTAL GROSS RB+DB	137,328.8	114,297.2	116,537.3	159,925.7	169,593.6	155,793.3	134,677.7	148,142.7	97,174.9	86,085.8	61,613.4	56,643.4	83,556.1	92,144.2	69,257.1	59,071.9	47,490.8	36,487.3	19,765.6	36,837.6

SOURCE : "DEVELOPMENT ESTIMATES", VARIOUS ISSUES FOR THE FISCAL YEARS 1975/76 TO 1994/95; VOLS. I AND II.

Table 6.4.23 Cumulative and Average Annual Gross Expenditures 1975/76 to 1994/95

Unit: Million K£ (constant 1982 price base)

Item	Cumulative: 1975/76 to 1994/95	Annual Average	% of Total Average
Recurrent Budg.			
A) Dom. Net. B.	313,173,551.2	15,658,677.6	24.8 %
B) Aid Approp.	25,090,376.9	1,254,518.8	2.0 %
Gross Exp. RB	338,263,928.1	16,913,196.4	26.8 %
Development B.			
A) Dom. Net. B.	614,114,089.4	30,705,704.5	48.7 %
B) Aid Approp.	308,934,843.4	15,446,742.2	24.5 %
Gross Exp. DB	923,048,932.8	46,152,446.6	73.2 %
Total Budget			
A) Dom. Net. B.	927,287,640.6	46,364,382.0	73.5 %
B) Aid Approp.	334,025,220.3	16,701,261.0	26.5 %
Total Gross Exp.	1,261,312,860.9	63,065,643.0	100.0 %

Source:Computation based on values in Table 6.4.20

a Typically over the period, the domestic net budget in total gross expenditures accounted for some 73.5 % with a share in aid appropriations of some 26.5 % in total gross expenditure. This represents a ratio of roughly 3 : 1.

b Taken gross expenditures for the development budget alone, this ratio is roughly 2 : 1, meaning that some 30 % of gross development expenditures have typically been funded from foreign sources, while the balance of 70 % was funded from domestic sources.

The above gross expenditures are converted into US $ at the official annual mean exchange rate for the current year (Table 6.4.22 refers). Not surprisingly, gross expenditures measured in US $ have decreased quite considerably over the 20 years horizon, inter alia, due to exchange rate adjustments. However, accumulated total gross expenditures over 20 years have amounted to some 5,080.8 million US $, equivalent to an annual average over the period of about 254 million US $ (table 6.4.24 refers).

Table 6.4.24 Cumulative and Average Annual US Dollar Gross Expenditures 1975/76 to 1994/95

Unit: Million US$ (constant 1982 price base)

Item	Cumulative: 1975/76 to 1994/95	Annual Average	% of Total Average
Recurrent Budg.			
A) Dom. Net. B.	1,308,787,750.4	65,439,387.5	25.8 %
B) Aid Approp.	32,958,940.9	1,647,947.0	0.6 %
Gross Exp. RB	1,341,746,691.3	67,087,334.6	26.4 %
Development B.			
A) Dom. Net. B.	2,831,031,090.0	141,551,554.5	55.7 %
B) Aid Approp.	907,988,944.3	45,399,447.2	17.9 %
Gross Exp. DB	3,739,020,034.3	186,951,001.7	73.6 %
Total Budget			
A) Dom. Net. B.	4,139,818,840.4	206,990,942.0	81.5 %
B) Aid Approp.	940,947,885.2	47,047,394.3	18.5 %
Total Gross Exp.	5,080,766,725.6	254,038,336.3	100.0 %

Source:Computations based on Table 6.4.20

Major features of the pattern may be summarized as follows :

a On average, total gross expenditures were financed to some 81.5 % from national resources through the domestic net budget and the remainder of some 18.5 % through foreign sources in form of aid appropriations. This reflects a ratio of 4.4 domestic to 1 foreign.

b If one looks at the development budget alone, which accounted on average for 73.6 % of total gross expenditures, this ratio is 3.1 financed through domestic net budget to 1 financed through aid appropriations.

(2) Expenditure Structure and Pattern of the Recurrent Budget

The recurrent budget over the 20 years period FY 1975/76 to FY 1994/95 (provisional estimations) are summarized in Table 6.4.25. For the sake of simplicity, the recurrent budget is broken down into three major expenditure categories, namely personnel expenditures, road maintenance expenditures and all other recurrent expenditures.

The summary suggests that as of FY 1984/85 resources have been shifted to partly finance the personnel build up described earlier. While road maintenance expenditures accounted typically for some 80 % to 90 % of recurrent expenditures over the period FY 1975/76 to FY 1983/84, this share dropped to 56.0 % in FY 1984/85 and below 38 % over the FY's 1986/87 to 1992/93. Since the introduction of the fuel levy, however, the share of the road maintenance budget has gone up to some 78.5 % in the current FY.

Table 6.4.25 Expenditure Structure and Pattern of The Recurrent Budget for Roads over The Period Fiscal Year 1975/76 to 1994/95

[UNIT : as indicated]

ITEM	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979	1979/ 1980	1980/ 1981	1981/ 1982	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	1986/ 1987	1987/ 1988	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
[in current '000' K.£]																				
TOTAL REC. BUDGET	8,955	9,021	9,696	10,564	13,431	13,347	15,760	15,937	17,950	16,184	22,903	22,900	21,147	24,342	23,491	25,232	26,097	33,054	73,773	127,054
A) PERSONNEL EXP.	591	735	752	887	918	1,039	1,387	1,524	1,134	7,091	12,604	15,717	16,196	16,614	15,211	15,295	15,505	19,646	24,828	24,673
B) ROAD MAIN. EXP.	8,110	7,889	8,600	9,400	12,025	11,826	14,056	14,195	15,128	10,182	9,185	6,312	4,113	6,544	6,730	8,573	8,736	12,494	47,234	99,740
C) ALL OTHER EXP.	254	397	344	278	488	482	315	218	1,689	311	914	872	837	1,184	1,550	1,363	1,856	914	1,710	2,640
[Shares in %]																				
TOTAL REC. BUDGET	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
A) PERSONNEL EXP.	6.6	8.1	7.8	8.4	6.8	7.8	8.8	9.6	6.3	42.3	55.0	68.6	76.6	68.3	64.8	60.6	59.4	59.4	33.7	19.4
B) ROAD MAIN. EXP.	90.6	87.5	88.7	89.0	89.5	88.5	89.2	89.1	84.3	56.0	40.1	27.6	19.5	26.9	28.6	34.0	33.5	37.8	64.0	78.5
C) ALL OTHER EXP.	2.8	4.4	3.6	2.6	3.6	3.6	2.0	1.4	9.4	1.7	4.0	3.8	4.0	4.9	6.6	5.4	7.1	2.8	2.3	2.1
[Growth rate in %]																				
TOTAL REC. BUDGET Base year		0.74	7.48	8.96	27.13	-0.62	18.08	1.12	12.63	1.30	25.95	-0.01	-7.66	15.11	-3.50	7.41	3.43	26.66	123.19	72.22
A) PERSONNEL EXP. Base year		24.35	2.29	17.95	3.56	13.17	33.48	9.89	-25.64	578.46	66.49	22.75	3.05	2.58	-8.45	0.56	1.37	26.71	26.38	-0.62
B) ROAD MAIN. EXP. Base year		-2.72	9.01	9.30	27.92	-1.65	18.87	0.97	6.57	-32.69	-9.80	-31.28	-34.83	59.09	2.84	27.39	1.90	43.02	278.05	111.16
C) ALL OTHER EXP. Base year		56.13	-13.19	-19.36	75.66	-1.17	-34.59	-30.73	673.19	-81.56	193.58	-4.65	-3.99	41.53	30.88	-12.07	36.18	-50.76	87.08	54.40

SOURCE : "ESTIMATES OF RECURRENT EXPENDITURES OF THE GOVERNMENT OF KENYA " ISSUES 1975/76 TO 1994/94, VOLS. I AND II

NOTE : 1) FIGURES FOR THE FY's 1975/76 TO 1993/94 REFLECT "NET APPROVED EXPENDITURE", FIGURES FOR THE FY 1994/95 ARE "ESTIMATES"

2) FIGURES FOR FY 1993/94 FOR ROAD MAINTENANCE CONTAIN K£ 1,000,000 FOR THE HIRE OF CASUALS, BUDGET ITEM NUMBER 090 UNDER BUDGET HEADLINE "392 HADQUARTERS ROAD BRANCH"

3) ESTIMATES FOR FY 1994/95 CONTAIN K£ 1,040,000 FOR HIRE OF CASUALS, BUDGET ITEM 090 UNDER "392 HEADQUARTERS ROADS BRANCH. LIKEWISE, K£ 75,000,000 ARE INCLUDED HERE ORIGINATING FROM THE ROAD USE LEVY. THOSE ALLOCATIONS ARE BUDGETED UNDER "APPROPRIATIONS IN AID", THE REGULAR BUDGET ALLOCATION IS THEREFORE CONSIDERABLY SMALLER THAN THE AMOUNT IDENTIFIED IN THE TABLE.

4) PERSONNEL EXPENDITURES = A) PERSONAL EMOLUMENTS; B) GRATUITY AND PENSION CONTRIBUTIONS; C0 HOUSE ALLOWANCES; D) PASSAGE AND LEAVE EXPENSES; E) REFUND OF MEDICAL EXPENSES - IN PATIENT.

5) ROAD MAINTENNACE EXPENDITURES = AS IDENTIFIED BY TITLE IN THE BUDGET.

(3) Foreign Aid

1) General Tendency of Aid

The Republic of Kenya has had, in terms of aid, a close relationship with European countries, especially with the United Kingdom due to historical circumstances. After 1986, however, Japan has become the top donor. The donors decided to freeze their official development assistance in accordance with the consensus reached at the Paris meeting in 1991, but they have also agreed to support on-going projects.

2) Bilateral Aid

The United Kingdom has occupied an important position as the principal donor since the independence of Kenya. However, the importance of her role and position in the field of official development assistance has decreased, while the United States, Germany and Japan have expanded their ODA.

IDA has occupied a key position in the World Bank Group in terms of assistance, emphasizing sectors such as agriculture, family planning and such utilities as city water and sewerage systems. The African Development Fund is also an important agency in this field.

Japan is beginning to occupy an essential role and function in the field of official development assistance. In terms of grants and loans Japan has become the top donor in Kenya.

3) Aid Appropriation Trend

As is shown in Table 6.4.19(1), the total amount of aid appropriations is spent mainly on the development budget, except for the period from 1982/83 to 1984/85, during which small amounts were spent under the recurrent budget. The recent aid amount is almost equal to that of the domestic budget. These figures show how important ODA support has become for the road sector budget in Kenya.

4) Actual Support to the Road Sector

Table 6.4.26 shows the road sections presently supported by donors in Kenya. However, some parts have been suspended at present and some of them have only the status of proposals/requests made by Kenya.

Table 6.4.26 Road Sections Supported by Donor

No.	Location	Route	Status	Fund
1	Rodi Kopany/Karungu Road		Construction from gravel to bitumen	ADB*1
2	Busia/Mumias Road	C31	Constructed	ADB
3	Narok/Mau Narok Road	C57	Constructed	ADB
4	Rumuruti-Malaral Road	C77	F/s,B/D completion proposed D/D	ADB*2
5	Thika-Makutano Road	A2	Recarpeting	ADB*1
6	Ziwa/Kitale Road	A1	Construction from gravel to bitumen	ADB
7	Kabete/Limuru Road		Constructed	EC
8	Webuye/Malaba Road	A104	New road	EC
9	Kericho/Sotik Road	C23	Completed	EC
10	Mukuyu-Isebania Road	A1	Under construction	EC
11	Isiolo/Moyale Road	A2	F/s, D/D(136Km)	EC
12	Tana River Basin Road	B8	Japan funding/OECF	Japan/OECF
13	Bonet-Litein	B3	Construction	UK grant
14	Limuru/Naivasha Road	A104	Seeking Donors	
15	Molo-Olenguruone Road		Construction	UK
16	Rirori-Mai Mahiu Road	B3	Construction from gravel to bitumen	Italy
17	Naivasha-Lanet	A104	F/S, Design	EC
18	Buchuma-Mombasa	A109	IBRD	IBRD
19	Narok-Amala River	B3		Germany
20	Isiolo-Garbatulla	B9		IBRD
21	Wajir-Erwak	B9		IBRD
22	Biretwo-Tot	C52	F/S completion	Dutch
23	Mwatate-Taveta	A23	TOR for F/S, D/D	EC*2
24	Kibwezi-Emali	A109	Reconstruction	EC*2
25	Naivasha-B3	C88	F/S, D/D, Construction	EC*2
26	Londiani-B1	C35		ADB*2

*1 To be completed in 93/94

*2 Proposed

Source : JICA Study Team

This table also shows that the EC and ADB occupy a dominant position in the support of the road sector and that such individual countries as the United Kingdom, Italy, Germany, Dutch and Japan play an important role.

5) Prospective View

The past trend and expected road projects shown in this study surely indicate necessity of foreign aids for the time being, though the fuel levy and increase of the levy ratio will reduce thier contribution to the budget in Kenya in future.

(4) Budget Projection

The following methodological steps have been applied to project a future budget for the road sector.

a Base Data for Projection

As much fluctuation can be observed in the past trend of the budget of the Road Department of MOPWH depending on many factors in and outside Kenya, the tendency of the budget over the period 1985 to 1995 (though 1995 is provisional) has been used as base data to project a future budget.

b The Amount excluding Fuel Levy

The amount of the road budget, from which the fuel levy is excluded, is estimated based on the relationship with the economic growth rate.

c Fuel Levy

The fuel levy system is applied in Kenya since 1994. The total amount of 75 million K£ is estimated for fiscal year 1995 (provisional number). Although the rate of one KSh per liter has been adopted on ordinary gasoline, this rate looks rather low in comparison with that of other African countries, which have introduced a fuel levy system. It seems, however, very difficult to anticipate the exact future rate of fuel levy, since this will be mainly decided by political considerations. Taking this into account, the following assumptions are introduced to forecast the future revenue from the fuel levy :

-Two times of the current rate for fuel levy is applied in 2005.
-Three times of current rate for fuel levy is applied in 2013

Moreover, it is assumed that the total fuel consumption depends on the growth of vehicle -Km in the future.

d Allocation of Development and Recurrent Budget

The past trend shows the allocation rate of 61.2 % for the development budget in fiscal year 1993. On the other hand, the results of the cost estimation show that 59 % of the total required cost is attributable to the development article. Taking these facts into account, the ratio of 59 % is applied for the allocation on development item.

e Budgetary Amount

According to the assumption mentioned above, Table 6.4.27~6.4.28 shows the budgetary projection for the road sector in Kenya.

Table 6.4.27 Estimated Future Budget

Unit: Million KSh

Year	Excluding Fuel	Fuel Levy	Total
1995	3,564	1,500	5,064
1996	3,702	1,869	5,571
1997	3,842	2,238	6,081
1998	3,988	2,608	6,595
1999	4,139	2,977	7,116
2000	4,305	3,346	7,651
2001	4,478	3,715	8,193
2002	4,657	4,084	8,742
2003	4,844	4,454	9,298
2004	5,039	4,823	9,861
2005	5,226	5,192	10,418
2006	5,421	6,002	11,424
2007	5,623	6,813	12,436
2008	5,833	7,623	13,456
2009	6,050	8,434	14,484
2010	6,275	9,244	15,520
2011	6,509	10,055	16,564
2012	6,752	10,865	17,617
2013	7,003	11,676	18,679
Total	97,249	107,520	204,769

Table 6.4.28 Five Years Periods Budget

Unit: Million KSh

	1995 - 1999	2000 - 2004	2005 - 2009	2010 - 2013
Development	17,952	25,809	36,708	40,344
Recurrent	12,475	17,935	25,509	28,036
Total	30,427	43,744	62,217	68,380

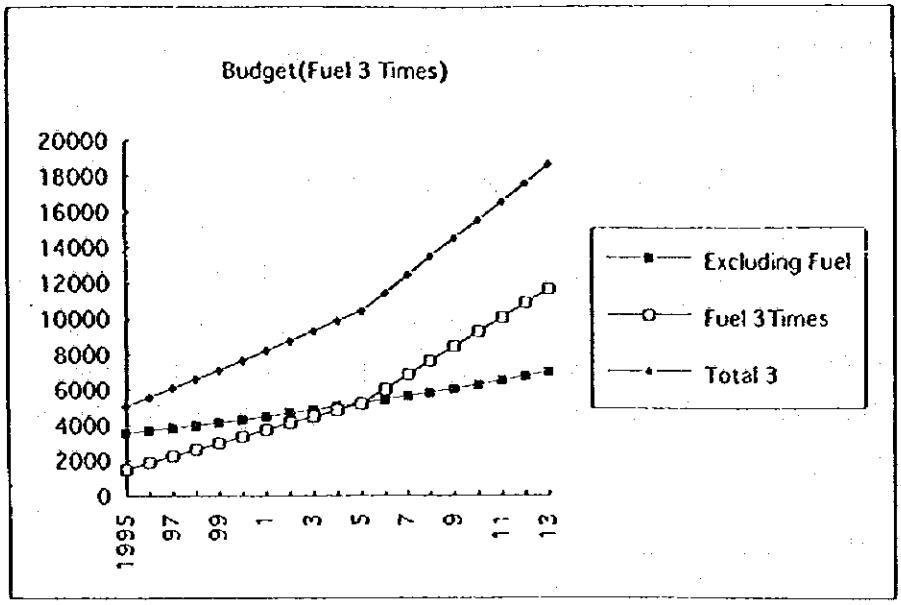


Figure 6.4.7 Composition and Growth of the Budget

(5) Comparison between Budget and Required Cost

Table 6.4.29 shows a comparison between the investment amount required for the development of Kenya's road network and the possible budget amount on a five years planning basis.

Table 6.4.29 Budget and Investment Requirements

[Unit:MKSh]

	1995-1999	2000-2004	2005-2009	2010-2013	Total
Required Investment	17,788	25,693	36,512	40,798	120,791
Development Budget	17,952	25,809	36,708	40,344	120,813

Source : JICA Study Team

The above amounts are calculated under the assumption that, according to the past trend of the budget allocation to the road sector, the development budget will be allocated continuously mainly to roads of classes A, B and C even in future. The recurrent budget, however, has to be distributed over all roads, i.e. those of classes A to E. The definition of development budget comprises all works for capital investment and road maintenance, except those works falling under routine maintenance according to the classification of MOPWH.

6.4.7 Institutional and Organizational Aspects

(1) Existing Institutional Set-Up

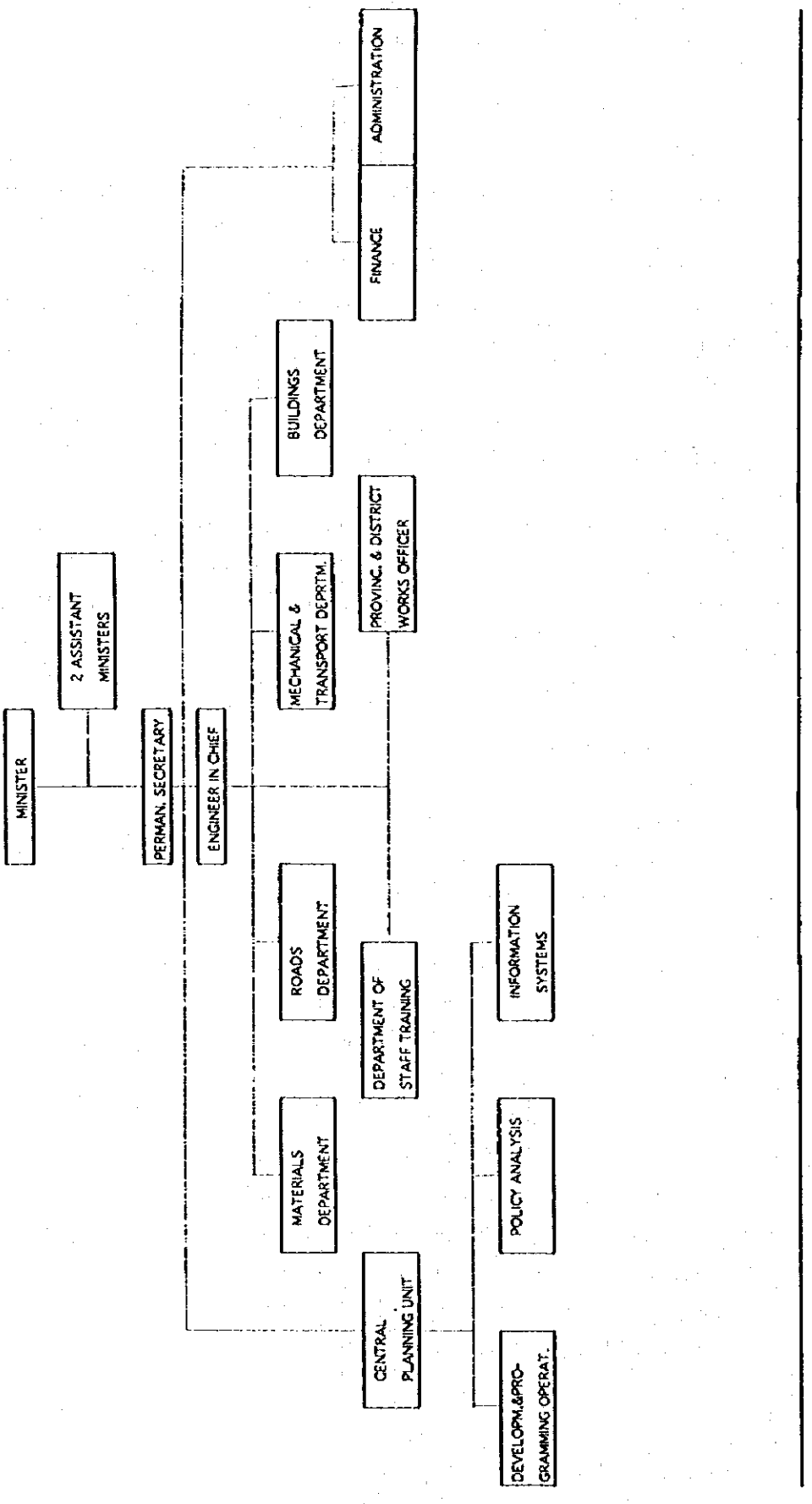
Generally speaking, the development and maintenance of any road network is a social function. The responsibility for planning, design, construction and maintenance of public roads in Kenya has changed over the past 20 years. It was within the mandate of the Ministry of Works up to fiscal year (FY) 1978/79, then changed as of FY 1979/80 to the Ministry of Transport And Communications and changed back as of FY 1987/88 to the Ministry of Public Works and Housing (MOPW&H). MOPW&H is currently responsible for some 63,260 km of classified roads, that is about 42 % of the total road network, which is estimated at about 150,600 km.

The above responsibilities are currently being carried out by the "Roads Department" within MOPW&H (Figures 6.4.8 and 6.4.9 refer). The Roads Department, which is headed by a Chief Engineer, is divided into three hierarchical layers and comprises one major division and four branches, namely (Figure 6.4.9 refers) :

- Planning division
- Construction branch
- Design branch
- Maintenance branch (other roads), and
- Maintenance branch (paved roads).

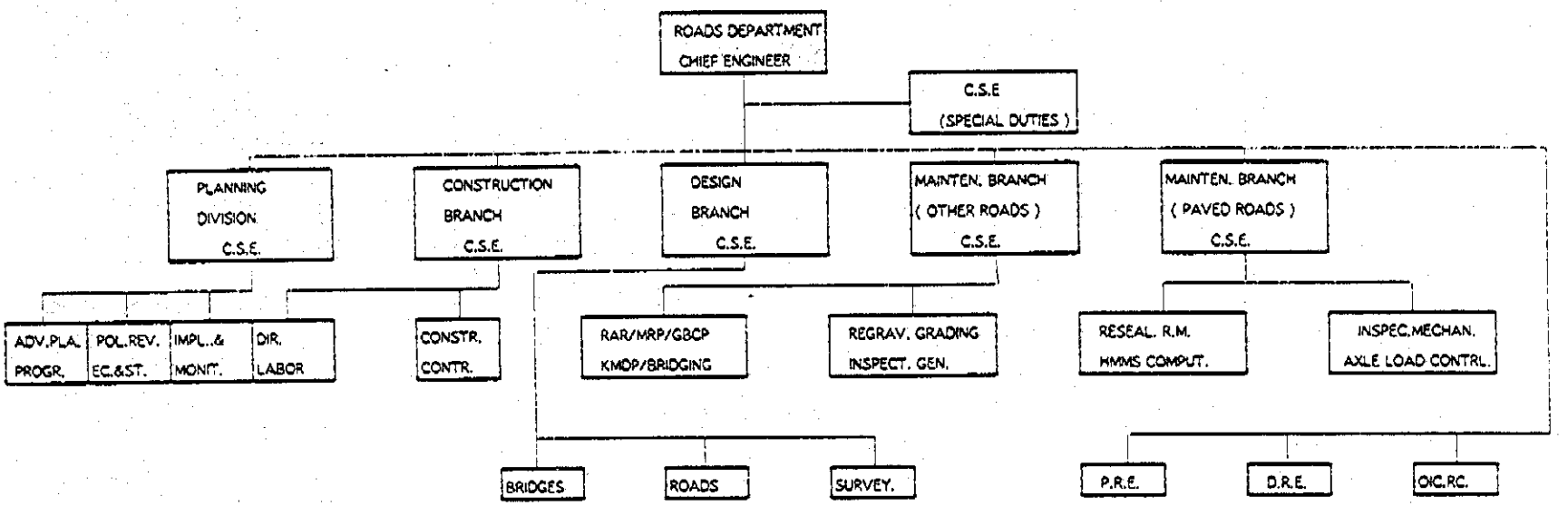
While the adequacy of this organizational set-up cannot be assessed without an in-depth institutional analysis (which is beyond the terms-of-reference of this master plan study), an outstanding and obvious point is the remarkable personnel build up, which has taken place over the years. Up to FY 1982/83, the " Roads Headquarters Administrative Services " undertook the planning, design, construction and maintenance of classified public roads with a total staff at headquarters of some 1,002 people. Up to that time, the organizational functions were centralized at headquarters level in Nairobi and no broad provincial and/or district level organizational infrastructure existed. In addition, the build up of personnel has been relatively modest, from a total of 708 civil servants in FY 1975/76 to 1,002 in FY 1982/83 (Table 6.4.30 refers).

Figure 6.4.8 Existing Organizational Structure of MOPW&H



SOURCE : MINISTRY OF PUBLIC WORKS & HOUSING, February 1992

Figure 6.4.9 Existing Organizational Structure of the Road Department in MOPW&H



LEGEND :

C.S.E. = CHIEF SUPERINTENDING ENGINEER
GBCP = GRAVELLING, BRIDGING AND CULVERTING PROGRAMME
HMMS = HIGHWAY MAINTENANCE MANAGEMENT SYSTEM
MRP = MINOR ROADS PROGRAMME
RARP = RURAL ACCESS ROADS PROGRAMME
KMDP = KENYA MARKET DEVELOPMENT PROGRAMME
ADV.PLA. & PROGR. = ADVANCE PLANNING & PROGRAMMING
POL.REV.; EC.&ST. = POLICY REVIEW; ECONOMICS & STATISTICS
IMPL.& MONIT. = IMPLEMENTATION & MONITORING
RESEAL.R.M. = RESEALING ROAD MARKING
P.R.E. = PROVINCIAL ROAD ENGINEER
D.R.E. = DISTRICT ROAD ENGINEER
OIC.RC. = OFFICER IN CHARGE OF ROAD CAMP

SOURCE : MINISTRY OF PUBLIC WORKS & HOUSING, February 1992

Table 6.4.30 Personnel Development

Unit:Person

1975/76	1980/81	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1994/95
708	903	1,002	2,710	2,691	14,592	16,334	15,369	14,906	15,982	12,057

With the beginning of the district focus policy in FY 1983/84, however, a considerable organizational infrastructure was built up at both, provincial and particular district levels, which resulted eventually in an increase of total personnel from some 1,002 people in FY 1982/83 to about 12,057 people in FY 1994/95. The gradual but continued personnel build-up is reflected in table 6.4.27. Total personnel in post increased sharply by a factor of 5.5, from 2,633 people in FY 1984/85 to some 14,592 people in FY 1985/86 and reached its peak with 16,334 people on the manning table in FY 1986/87. Total personnel fluctuated somewhat over the years thereafter and has been reduced somewhat to a level of 12,057 in the current FY 1994/95.

This remarkable increase in total personnel seems not to have been accompanied by any considerable widening of the overall responsibilities and functions of the Ministry. Likewise, the distribution of total personnel over the three principal administrative layers, that is national, provincial and district levels does not reveal any streamlining and/or transfer of functions among these three layers. For example, while in FY 1982/83 a total of 1,002 people carried out all tasks at national (that is headquarters) level, a manifold of these staff numbers carried out the same functions split over national, provincial and district levels in subsequent years. Table 6.4.31 identifies the total number of staff at all three levels as well as the distribution of staff over the three principal administrative layers.

Table 6.4.31 : Distribution of Total Staff Over Administrative Layers

Unit: Person

	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90	94/95
HQ's	1002	457	451	891	2850	1470	1475	3302	3050
%	100.0	16.9	16.8	6.1	17.4	9.6	9.9	20.7	25.3
PRO.	0	531	563	1986	1844	1195	927	1430	916
%	0.0	19.6	20.9	13.6	11.3	7.8	6.2	8.9	7.6
DIS.	0	1722	1677	11715	11640	12704	12504	11250	8091
%	0.0	63.5	62.3	80.3	71.3	82.7	83.9	70.4	67.1
TOT.	1002	2710	2691	14592	16334	15369	14906	15982	12057
%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Compiled from Table 6.4.30.

The pattern identified in the above table is erratic with strong fluctuations even from FY to FY. No consistent pattern can be identified. Such a consistent pattern should, for example, reflect a gradual delegation of functions to either provincial and/or district level, indicated by a gradual personnel build up at provincial and district level, parallel to which the number of personnel at headquarters would be reduced. However, in FY 1983/84 some 16.9 % of total personnel was assigned at headquarters level, 19.6 % at the provincial and 63.5 % at the district level. This distribution has been shifted considerable in favor of the district level, which absorbed in FY 1988/89 about 83.9 % of the total roads personnel. In that very year 9.9 % of total personnel was assigned at headquarters and 6.2 % at the provincial level. In the current FY 1994/95 this picture has been turned again, with 67.1 % of total roads personnel being assigned at the district, 7.6 % at the provincial and 25.3 % at headquarters levels.

(2) Future Direction

Administrative reform activities have been examined in correspondence to the structural adjustment measures that are being applied in Kenya. The major direction is to reduce the total number of governmental employees and to transfer public functions to private firms. It can be said that this privatization trend looks like the main stream in all the administrative reform. In this context, the number of staffs is anticipated to be gradually reduced in MOPWH as well as in all the other governmental administrative offices.

In line with this administrative reform process, the important point is what roles should MOPWH keep and attain under this situation. Functions such as overall policy making, planning of future roads , coordination with the relevant governmental agencies should be maintained by the Ministry.

(3) Countermeasures on Privatization

In accordance with the trend for privatization and administrative reform, the establishment of private firms should be fostered, which can actually carry out road maintenance and improvement works. It appears at present, that there are not so many private contractors capable to conduct actual works. Judging from this point of view, the establishment of some semi governmental agencies as public corporation system seems to be necessary in rural regions, where it is rather difficult to find competent private contractors. this has been proposed as a realistic

difficult to find competent private contractors. this has been proposed as a realistic intermediate countermeasure in Chapter 6.3, Maintenance Requirements. After the establishment of a mature private sector environment, these semi governmental agencies or public corporation can be shifted to be pure private contractors.

(4) Establishment of a Budgetary System

One of the major problems for road maintenance and construction are the shortages in budgetary funds. This indicates that MOPWH has to obtain own resources for road construction and improvement. The fuel levy system has been introduced in Kenya as well as in some other developing and developed countries in 1994. Revenues collected through the fuel levy are to be allocated for road maintenance and for future road construction. However, the rate of the levy appears to be rather low , when compared to that of other countries. As is mentioned in section 6.4.5, Budgetary Implications, a raise in the fuel levy rate is of great importance.

(5) Reapplication of the Toll System

A Toll system has been applied for a long time to secure a part of the road maintenance cost on such major arterial roads as the Mombasa road. However, this toll system was abolished in 1994 with the introduction of fuel the levy system.

Although it is anticipated that the rate of the fuel levy will be increased to approximately three times of the present level, a toll system should be reintroduced on roads, which will furnish such high level of service as the super highway and the provision of a dual carriage way.

6.4.8 Major Assumptions and Risk Analysis

This report has been prepared, as is usual, by making several assumptions, which naturally influence the output of the report. In this context the following should be noted.

(1) Future Socio-economic Framework

Kenya's past economic performance has been unstable and fluctuated, due to external and inner conditions such as the oil crisis and natural disasters. In addition, structural adjustment measures are being implemented for around ten years. Given so many uncertainties, it is very difficult to assess an affirmative future framework at present. This implies that the future framework applied in this report is formulated as a future target. However, economic growth indicates only one element in the establishment of prospective future road network.

(2) Road Inventory

The first detailed road inventory survey on classified roads, which is now available for HDM processing, has been conducted by this JICA. Considering that a long term road maintenance and improvement plan covering all Kenyan roads will be established, it is also obvious that more detailed and precise road inventory data will have to be gathered. Notwithstanding the above, the road inventory information compiled by this study forms a very useful basis for MOPWH, donors, consultant firms and other interested parties. It has to be kept in mind that this survey was only a first step for establishing integrated data and information on road inventory.

(3) Future Traffic Volume

Future traffic volumes are naturally forecasted on basis of many assumptions. The risk in the output of this study rests on the fact that future traffic volume on small links of classified road A, B, and C have to be understood to some extent as having accidental tolerances, because of methodological limitations. Considering the traffic volume on short and small links , some revisions may become necessary in certain cases.

(4) Implementation Programme

A combination of regional development aspects and such economic aspects as the IRR have been applied to evaluate the road maintenance and improvement projects in this study. This means that qualitative ideas have been introduced in the evaluation. Especially, tourism development has a rather important implication for road development in this country, because there of such special tourism resources as wild life and natural resources. Although such tourism development aspects have been taken into account in the evaluation for implementation of road projects, the weight of the importance of tourism development has to be decided on a case-by case basis. Thus, amendments may be necessary fro time to time and case-by-case.

In summary, the implementation programme proposed in this report forms a most fundamental programme for the country. Under changing economic conditions and circumstance, revisions will have to be undertaken in future.

Appendix

Appendix 1 Materials for Road Construction

Appendix 1 Materials for Road Construction

(1) Distribution and Engineering Properties of Rocks for Road Construction

1) Distribution

The overall distribution of rocks in Kenya can best be described by dividing the country into the following four major regions.

a Western Kenya

In the Rift Valley, pyroclastics cover the basalt flows and the trachytes. Pyroclastic rocks consist of fragmented volcanic material, which has been blown into the atmosphere by explosive activity. There are different types of pyroclastic rocks formed by the different stages of an eruption. The most useful one is consolidated ash called tuff, which is commonly used as crushed subbase or stabilized basecourse. Over the geological past, welded tuffs have transformed into rhyolites, which have been used as graded crushed stone basecourse. This rock is, however, not of the same quality as basalts and trachytes.

There is predominance of phonolites, trachytes and olivine basalts on the eastern and western sides of the Rift Valley. Phonolites are extensively used in Kenya as graded crushed stone subbase, base, surface dressing aggregates, or in asphalt concrete and as aggregates for concrete.

Quartzites, rhyolites, andesites and basalts with intrusives of granites are abundant around Lake Victoria. Granite is extensively used in road construction in this area and being in intrusive form, it stands out from the rest of the rocks. Some granites are extremely hard and impose a heavy toll on the jaws of a crushing machine.

b Eastern Kenya

This part of the country is notably deficient of rock sources. The area is covered with colluvial deposits and sands. The Ewaso Ngiro and Tana Rivers have deposited alluvium on the low lying land.

Calcrete was used in basecourse and surface dressing chippings for the recently constructed road from Thika to Garissa - calcrete is superficial gravel cemented together. The ACV and LAA of the material is within the specified limits of MOPW's specification, but the SSS is above the limit of 12. Due to the scarcity

of better quality rock in the project area, calcrete was used in the construction of the road. The area covered by calcrete is vast, but only up to one meter in depth.

c North Eastern Kenya

The north east corner of Kenya is covered with sandstones and limestones. Sandstones have usually high LAA values, but are suitable for subbase in crushed form. If the particles of the rock are well cemented, the sandstone is usually good for basecourse, asphalt concrete and surface dressing chippings.

d Mombasa Area

The most useful rocks for road construction in the south eastern corner of Kenya are the Mariakani sandstones, Mazerras sandstones, Kambe limestones and the Freretown limestones. They are frequently used as subbase together with an appreciable quantity of coral.

2) Engineering Properties

The properties of rocks from various quarries all over the country are summarized in tabular form as shown in Table A1.1. The country is divided into rectangles numbered 1 to 49 shown in Figure A1.1. The properties are taken from records kept by the Materials Branch of MOPW. In some locations there are a large number of quarries, but only representative results are taken.

It can be noted from the table that some properties of the rocks are marked as being unsuitable for some type of pavement layers. It is emphasized, however, that this does not imply that the quarries are rejected for road construction. More testing, especially of rocks deeper down, would be required, as it is possible that only the top weathered rock has been tested.

(2) Soils and Gravel

The solids and gravels of Kenya vary greatly. An important factor to note is that the greatest variety of soils is found west of the 38° east meridian. A number of major factors have interacted to bring about this great variety of soils found within the country. These factors are geological formations, relief and topography, altitude, moisture or the amount of rainfall available, aridity and human land activities. These factors operate both, singularly and in combination to create many different types of soils from various areas.

However, for road construction purposes the soils and gravel can be generalized as belonging to the four major geographical regions of Kenya, namely :

a The Coast
b The NYC and the Dry Lowlands
c The Rift Valley and its associated Highlands, and
d The Lake Victoria Basin.

1) The Coastal Region

The soils and gravels of the coastal region have been developed from the major geological rocks that are found in the area. Most soils at the coast are therefore derived from sediments of limestones or sandstones. On the whole, the soils in this area are highly porous and can be categorized into three types :

a Coral

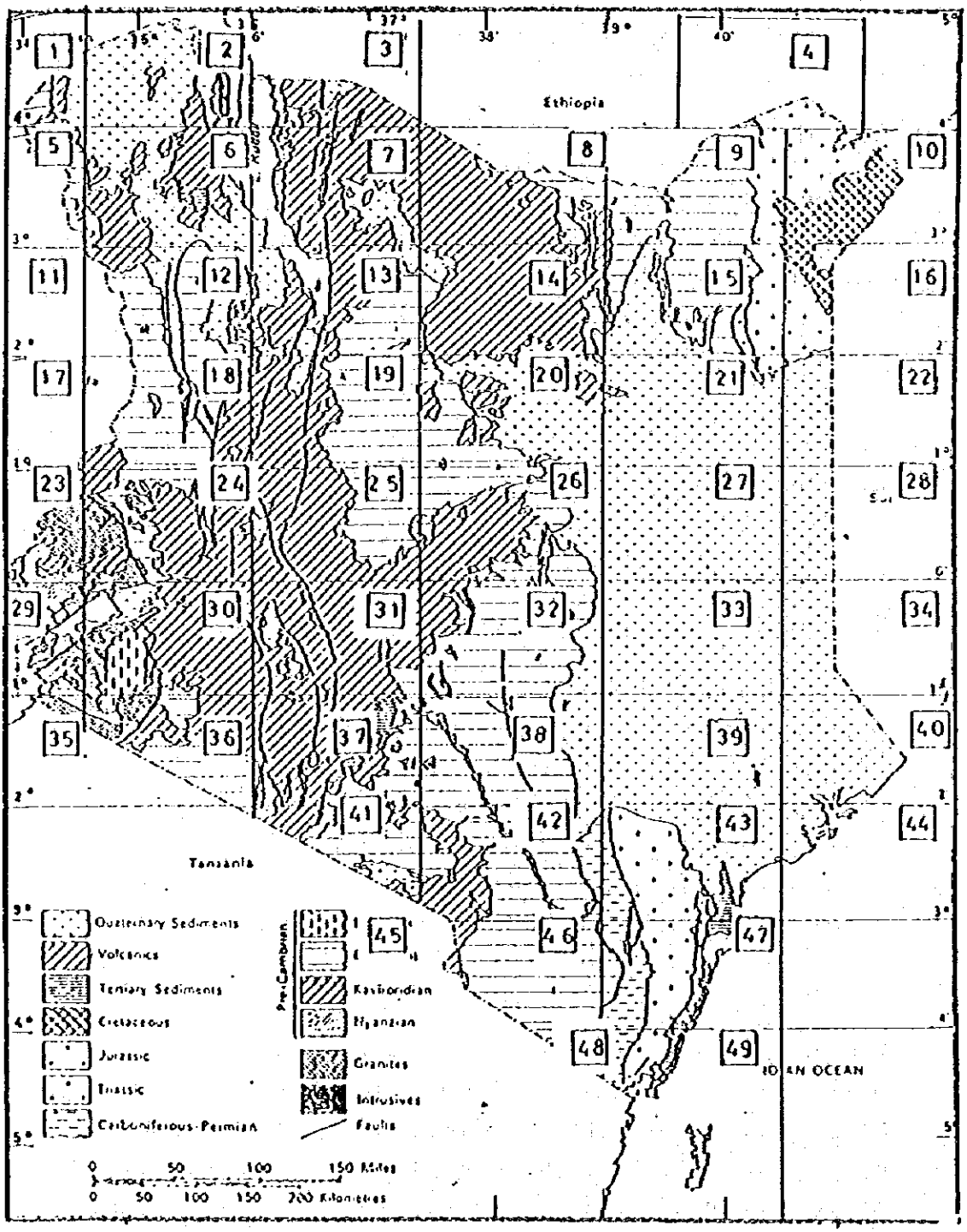
Coral occurs in shallow depths, with patches of sand intermixed with outcrops of hard and jutting rugged pieces of the coral rock. This material is suitable as subbase, either in crushed or uncrushed form. Typical CBR values range between 25 and 60, with plasticity indices varying between 12 and 20.

b Sands

Sands occur abundantly either in uncontaminated form or mixed with clays and silts. The material can be used as fillings to build road embankments or as subgrade; but for subgrade, selection of better quality material is necessary. The CBRs vary from 6 to 25, depending on the quantity of sand present in the material; plasticity indices vary from non plastic up to 35. Grading of the material usually shows 100% passing 2.36 mm sieve with 40% to 90% passing 425 micron sieve. The sands can be used to provide an s4 subgrade.

c Alluvial Soils.

Lying in a large belt, which extends beyond the Tanzania - Kenya border in the south to the Tana River delta, are alluvial soils, lacustrine soils and soils derived from peaty swamps. Alluvial soils are derived from deposited sediments that have been weathered from the outlying areas. Alluvial soils at the coast are nearly always associated with the river estuaries at the mouths of the Tana and Athi, as



Road Network Development Master Plan in Kenya

Figure A.1.1
Quarry Distribution in Kenya

Table A1.1 Properties of Rocks from Quarries in Kenya

AREA NO.	LOCATION	TYPE OF ROCK	ACV	LAA	SSS	BITUMEN 80/100 AFFINITY
6	Kakuma Lockichokio Road	Basalt	15	20	0.6	Good
6	"	Rhyolite	15	20	0.6	"
12	Lodwar Kakuma Road	Basalt	12	15	0.8	"
12	"	Rhyolite	18	12	0.8	"
12	"	Phonolite	12	17	1.5	"
14	Marsabit	Phonolite	17	23	0.8	"
16	Elwak	Limestone	23	27	9.0	"
16	"	Sandstone	39*	71*	6.7	"
18	Kapenguria - Endebbes	Lava	14	21	1.0	"
18	"	Agglomerate	18	21	1.9	"
18	"	Gneiss	24	34	2.2	"
20	Laisami	Phonolite	13	17	0.2	"
23	Busia Mumias Bungoma Road	Granite	25	32	0.3	"
23	Mumias	Lava	13	12	0.4	"
23	Siaya	Lava	10	13	1.0	"
24	Eldoret - Bungoma	Granite	20	30	0.6	"
24	Luanda Township	Granite	21	28	0.5	Good
24	"	Lava	15	16	1.5	"
24	Kakamega	Granite	18	25	0.8	"
24	Webuye	Granitic Gneiss	18	21	0.4	"
24	Mt. Elgon	Lava	18	24	2.2	"
24	Moi's Bridge	Lava	21	26	2.0	"
24	Kapsotik	Quartz	29++	38++	3.8	"
24	Eldorete	Lava	17	21	0.3	"
24	Eldoret Chepkorio Road	Phonolite	15	19	1.0	"
24	Eldoret Mau Summit Road	Lava	32+	50**	3.2	"
24	Eldama Ravine Nakuru Road	Lava	25	35	5.0	"
24	Kitale Webye Road	Gneiss	21	31	0.9	"
25	Rumuruti Nakuru Solai Road	Lava	23	29	3.1	"
25	Nanyuki Timau Road	Lava	16	19	3.0	"
25	Timau Isiolo Road	Lava	20	20	1.7	"
25	Nakuru Thomsons Falls Road	Tuff	35**	59*	5.3	"
26	Mery Kengeta Road	Lava	21	19	1.0	Good
26	Meru	Tuff/Lava	29++	29	3.5	"
26	Meru Maua Road	Basalt	16	25	1.6	"
29	Homa Bay - Ndori Nhiya Road	Granite	14	17	0.7	"
30	Luanda Township	Granite	18	22	1.0	"
31	Nakuru Solai Road	Tuff	21	30	2.0	"
31	Kijabe Narok Road	Trachyte	27++	34	1.5	"
31	Kijabe Narok Road	Granite	25	30	1.5	"
31	Karatina Embu Road	Lava	12	14	1.6	"
31	Makuyu Tana River	Gneiss	29++	27	2.8	"
31	Nyeri	Lava	13	15	2.0	"

* Not suitable for graded crushed stone subbase, basecourse, surface dressing, asphalt concrete.
** Not suitable for graded crushed stone basecourse, surface dressing, asphalt concrete.
+ Not suitable for surface dressing, asphalt concrete.
++ Not suitable for surface dressing

Table A1.1 Properties of Rocks from Quarries in Kenya (Cont'd-1)

AREA NO.	LOCATION	TYPE OF ROCK	ACV	LAA	SSS	BITUMEN 80/100 AFFINITY
32	Chuka - Mutonga Quarry	Gneiss	19	18	1.0	*
32	Embu Meru Road	Granite	14	19	0.5	*
33	Garissa	Limestone	28++	27	1.2	*
36	Kijabe Narok Road	Tuff	26	30	3.0	*
36	"	Lava	21	22	0.6	*
37	Nairobi	Phonolite	28++	50**	8.0	Good
37	Kano Rock Road	"	15	18	2.5	*
37	Outer Ring Road	"	17	21	2.5	*
37	Kiambu	Tuff	27++	35	2.0	*
37	Athi River Machakos Road	Gneiss	34**	60*	0.6	*
38	Kitui Yatta Road	Gneiss	29++	45+	1.0	*
41	Nairobi Mombasa Road	Gneiss	32+	60*	1.0	*
41	Nairobi Mombasa	Lava	10	16	1.0	*
42	"	Limestone	40*	72*	2.0	*
42	"	Gneiss	30++	53*	1.5	*
46	Taita Taveta Road	Diorite	32+	70*	2.8	*
46	"	Gneiss	37*	63*	1.3	*
46	"	Gabbro	29++	41+	0.8	*
46	"	Tuff	28++	43+	1.0	*
46	"	Lava	16	18	1.5	*
46	"	quartzite	29++	48**	0.8	*
47	Kilifi - Taru	Sandstone	26	40+	1.0	Good
47	Mariakani Mazeras	"	21	36+	3.0	*
47	Utange	Limestone	23	25	3.8	*
47	Kambe	"	23	28	0.8	*
47	Mbuyuni	"	28++	30	0.1	*
47	Mwambawakaya	"	24	24	1.0	*
47	Kilifi	Coral	39*	50**	2.6	*
47	Matsangoni	Coral	25	34	1.7	*
49	Mombasa	Sandstone	27++	45+	6.0	*
49	"	Limestone	20	24	1.0	*
49	South Coast	Syenite	24	30	1.5	*

* Not suitable for graded crushed stone subbase, basecourse, surface dressing, asphalt concrete.
** Not suitable for graded crushed stone basecourse, surface dressing, asphalt concrete.
+ Not suitable for surface dressing, asphalt concrete.
++ Not suitable for surface dressing.

well as the other smaller rivers. These soils are usually suitable for lower parts of the embankment only, due to their high PIs and low CBRs.

2) The Nyika and the Dry Lowlands Region

This region consists of the Duruma - Wajir Low Belt, The Low Foreland Plateau and the Dry Northern Plainlands as depicted in Figure 2.5.1, Physiographic regions, of the main report.

There are five soil types in this region, but only three are suitable for road construction purposes.

a Laterites

These soils are usually found in areas that receive low rainfall and experience high rates of evaporation. They are often leached soils. They are rich in iron and aluminum oxides and acquire a reddish or brick red color. They are also known as "murrum". Within the region, lateritic soils extend from the Tanzania border to the south and to the areas east of Mount Kenya.

Laterites are excellent road building materials. They are usually good for natural subbase, if they occur naturally mixed with gravel. Otherwise they can be used as subgrade or improved subgrade. CBRs of pure laterite varies between 16 and 20 and CBRs of lateritic gravel reach as much as 50. PIs range between 20 and 30 and the grading of pure laterite gives about 95% passing 6.35 mm sieve, 60% passing 425 micron and about 55% passing 75 micron sieve.

b The Red Desert Soils

These soils bear to a certain extent resemblance to laterites. They are dark reddish, chalky (calcareous) sandy loams and are mainly found in the north west corner of the country near Lake Turkana. They can be used as subgrade level in the pavement.

c Volcanic Soils

There are clay and loam soils, the color of which ranges form dark brown to orange brown. The soils are found in two main places of volcanic activity :

- They extend from Lake Bogal westwards to the east of Lake Turkana.
- They occupy most of north - western Kenya to the Uganda border.

These soils are good for fill and, from selected areas, as subgrade. CBRs vary between 4 and 10, PIs vary between 15 and 30, of which 90% of the soil passes through 425 micron sieve.

3) Rift Valley and Associated Highlands

In the Rift Valley and the Highlands, various types of soils are found. They can be categorized into four types for road construction purposes :

a Volcanic Ash and Pumice Soils

These are dark, grayish-brown soils derived from recent unconsolidated volcanic ashes that were poured out of the volcanoes during eruptions. They are found in a large zone that includes Mount Suswa to the west of Nairobi, the Longonot area and around Lake Naivasha. They are also found around Lake Nakuru and the Menengai Crater area, in the Yatta Plateau, in the area north of Mount Kenya and also north-east of the Nyandarua Range.

Pumice has a very light density (it floats on water) and is to be completely avoided in road construction. Volcanic ash has consolidated well in some areas and in this form it can be used for subbase and on low traffic roads, where it has also been used as stabilized basecourse. As a natural gravel it has a CBR of between 30 and 50 and is non plastic.

Unconsolidated volcanic ash can be used as fill and subgrade, but the very fine grained ash should be avoided. The CBRs of the coarser grained ash can go up to 20.

b Dark Red and Dark Brown Sandy Clays

These soils are widespread in the southern section of the eastern highlands, on high slopes of escarpments, such as the Kikuyu Escarpment of the Nyandarua Range, in the area around Limuru, in the Kinangop plateau overlooking the Rift Valley, around Mount Elgon, from the Ngong Hills to the Tanzanian border, in the southern Rift Valley, in the area between Eldoret and Kitale and in parts of the western and central Highlands.

The dark red soils, locally known as red coffee soils, are slightly better than the dark brown soils, due to their higher CBRs, which range between 8 to 15 and PIs, which range between 25 to 40. Both types of soils are quite commonly used for fill and subgrade.

c Shallow Stony Soils

In the northern Rift Valley, small pockets of dark-brown to orange-brown clay loams intermixed with rock outcrops and lava boulders occur in the form of gravels, which are normally good for subbase.

d Black Cotton Soils

These are sticky clay soils, which become highly waterlogged during the rainy days, but dry and crack up very quickly after the rains disappear. Black cotton soils are found to the south of Nairobi extending to Konza and Kajiado, and east and north-east of Nairobi towards Athi River and Thika. These soils are basically soils of the plains such as the Athi - Kapiti Plains east and south-east of Nairobi.

Due to their high swelling and shrinking characteristics these soils are generally avoided in road construction. However, in areas where better quality soils are not available, the black cotton soils are used in embankment construction together with the incorporation of a geotextile, which counteracts the effect of cracking from traveling up to the pavement layers. In areas where the cost of importing good soils would be prohibitive, the black cotton soils can be used without a geotextile in the lower layers of an embankment and the better quality soils in the upper layers.

4) Lake Victoria Basin

The soils in this region can be categorized into three main simplified groups :

a Black Cotton Soils

These soils are found in major plain areas, such as the Kano Plains and to the east of the Kisii District. The engineering properties of these soils are similar to the black cotton soils of the Rift Valley and associated highlands.

b Dark Red and Red Brown Soils

The dark red clays cover the largest areas of the basin and the red brown soils occupy large areas to the north and south of Winam Gulf.

These soils are suitable for fill and subgrade in road construction. The CBRs vary between 8 and 12 and PIs between 30 and 40.

c Light-Yellow Sandy Soils

These are partly lateritic soils and cover the remaining areas of the lake region. Similar soils with a yellow to red color are found to the extreme south of the lake area. They are coarse grits, which have been derived from granites and from inselbergs. They are suitable for use in fill and subgrade and sometimes for subbase, if a source containing coarse homogeneous material is found.

Appendix 2 Regional Development Framework by District

Appendix 2 Future Framework by District

Table A2.1 Estimated Future Population by District

ESTIMATED TOTAL POPULATION BY DISTRICT									
Dist. No.	DISTRICT	PROV.	Total Pop. by Dist. '79	Total Pop. by Dist. '89	Total Pop. by Dist. '94	Total Pop. by Dist. '95	Total Pop. by Dist. '00	Total Pop. by Dist. '05	Total Pop. by Dist. '10
1	Kilifi	Coa	430,986	610,546	695,578	712,302	795,439	842,451	875,938
2	Kwale	Coa	288,363	395,118	444,546	454,189	501,795	526,328	542,472
3	Lamu	Coa	42,299	58,571	66,160	67,644	74,987	78,893	81,538
4	Mombasa	Coa	341,148	471,858	532,764	544,674	603,584	740,480	898,599
5	Taita	Coa	147,597	213,801	245,628	251,921	283,353	302,063	315,936
6	Tana River	Coa	92,401	132,471	151,600	155,373	174,177	185,117	193,086
	SUB-TOTAL		1,342,794	1,882,365	2,136,276	2,186,103	2,433,334	2,675,332	2,907,569
7	Garissa	NE	128,633	128,464	128,203	128,163	127,997	127,877	127,789
8	Mandera	NE	106,407	127,385	134,607	135,777	140,909	144,967	148,218
9	Wajir	NE	138,747	126,338	122,551	121,998	119,714	118,139	117,039
	SUB-TOTAL		373,787	382,187	385,361	385,938	388,620	390,983	393,046
10	Embu	Eas	261,273	380,898	438,599	450,019	507,113	563,701	618,651
11	Isiolo	Eas	43,164	72,115	87,413	90,541	106,639	123,435	140,604
12	Kitui	Eas	460,930	671,574	773,137	793,236	893,704	993,260	1,089,912
13	Machakos	Eas	568,127	793,517	899,135	919,826	1,022,332	1,122,310	1,217,843
14	Makueni	Eas	466,654	649,241	734,575	751,277	833,952	914,468	991,292
15	Marsabit	Eas	95,521	133,020	150,556	153,989	170,986	187,545	203,350
16	Meru	Eas	633,008	895,179	1,019,067	1,043,410	1,164,323	1,282,804	1,396,547
17	Tharaka Nithi	Eas	191,174	282,689	327,254	336,105	380,484	424,706	467,878
	SUB-TOTAL		2,719,851	3,878,232	4,429,736	4,538,403	5,079,533	5,612,229	6,126,076
18	Kiambu	Cen	686,182	940,994	1,058,527	1,081,425	1,194,297	1,303,588	1,407,388
19	Kirinyaga	Cen	291,508	402,897	454,549	464,631	514,409	562,751	608,798
20	Muranga	Cen	648,172	883,007	990,840	1,011,815	1,115,064	1,214,789	1,309,268
21	Nyandarua	Cen	233,364	355,461	415,913	427,991	488,865	550,186	610,773
22	Nyeri	Cen	486,606	624,946	685,972	697,675	754,574	808,327	858,137
	SUB-TOTAL		2,345,833	3,207,305	3,605,800	3,683,537	4,067,209	4,439,640	4,794,364
23	Nairobi	NBO	827,775	1,363,075	1,805,695	1,903,443	2,455,826	3,116,658	3,855,307
24	Baringo	Rif	205,143	358,106	440,042	456,856	543,628	634,135	726,209
25	Elgeyo Marakwet	Rif	150,064	222,780	257,739	264,638	299,034	332,778	365,066
26	Kajiado	Rif	149,840	266,178	329,221	342,212	409,508	480,168	552,529
27	Kericho	Rif	325,625	528,460	631,972	652,844	758,892	856,493	972,976
28	Bomet	Rif	310,921	398,664	436,857	444,132	479,301	511,949	541,510
29	Laikipia	Rif	135,278	225,322	272,076	281,563	330,031	379,695	429,929
30	Nakuru	Rif	525,336	873,779	1,054,533	1,091,196	1,278,457	1,470,235	1,661,794
31	Nandi	Rif	300,675	446,218	516,172	529,976	598,794	666,299	730,881
32	Narok	Rif	211,486	409,850	523,679	547,628	674,052	811,253	956,477
33	Samburu	Rif	77,339	112,049	128,464	131,685	147,659	163,186	177,907
34	Trans Nzoia	Rif	260,957	405,126	476,549	490,797	562,511	634,063	703,694
35	Turkana	Rif	143,801	189,411	209,631	213,508	232,356	250,030	266,196
36	Uasin Gishu	Rif	284,391	458,482	546,931	564,737	655,081	746,517	836,776
37	West Pokot	Rif	159,545	232,003	266,355	273,100	306,584	339,178	370,122
	SUB-TOTAL		3,240,402	5,126,429	6,090,221	6,284,871	7,275,889	8,285,979	9,291,466
38	Kisii	Nya	568,588	783,972	883,699	903,411	999,785	1,093,459	1,182,789
39	Nyamira	Nya	300,823	386,136	423,837	431,072	466,277	499,588	530,511
40	Kisumu	Nya	482,354	683,391	778,393	797,064	889,819	980,903	1,068,656
41	Siaya	Nya	474,545	658,027	743,481	760,190	842,816	923,299	1,000,215
42	Homa Bay	Nya	471,080	614,649	678,805	691,167	751,520	808,977	862,644
43	Migori	Nya	346,566	482,939	546,665	559,140	620,895	681,159	738,859
	SUB-TOTAL		2,643,956	3,609,115	4,055,081	4,142,044	4,571,112	4,987,385	5,383,674
44	Bungoma	Wes	495,136	698,889	795,020	813,898	907,622	999,375	1,087,374
45	Busia	Wes	292,640	413,334	470,303	481,492	537,051	591,454	643,644
46	Kakamega	Wes	690,465	1,024,127	1,186,902	1,219,249	1,381,542	1,543,415	1,701,590
47	Vihiga	Wes	354,421	481,942	540,605	552,022	608,261	662,549	713,890
	SUB-TOTAL		1,832,663	2,618,292	2,992,830	3,066,661	3,434,477	3,796,794	4,146,498
	KENYA TOTAL	TOTAL	15,327,061	22,067,000	25,501,000	26,191,000	29,706,000	33,305,000	36,898,000

Table A2.2 Estimated Future Urban Population by District

ESTIMATED TOTAL POPULATIC	ESTIMATED URBAN POPULATION BY DISTRICT								
Dist. No.	DISTRICT	PROV.	Urban Pop. 1979	Urban Pop. 1989	Urban Pop. 1994	Urban Pop. 1995	Urban Pop. 2000	Urban Pop. 2005	Urban Pop. 2010
1	Kilifi	Coa	35,552	60,101	97,230	105,572	153,602	237,150	345,912
2	Kwale	Coa	9,988	14,490	22,527	24,278	34,097	49,927	69,200
3	Lamu	Coa	10,682	12,347	18,893	20,297	28,067	36,881	45,906
4	Mombasa	Coa	341,148	471,858	532,764	544,674	603,584	740,460	898,599
5	Taita	Coa	9,598	24,694	40,448	44,018	64,733	90,073	118,260
6	Tana River	Coa	6,359	11,224	18,280	19,872	29,079	40,281	52,671
	SUB-TOTAL		413,327	594,714	730,142	758,712	913,162	1,194,792	1,530,548
7	Garissa	NE	15,795	28,852	33,631	34,843	40,141	45,748	51,342
8	Mandera	NE	13,126	7,010	8,736	9,085	10,917	12,859	14,820
9	Wajir	NE	15,030	22,045	25,083	25,716	29,061	32,659	36,274
	SUB-TOTAL		43,951	57,907	67,649	69,643	80,118	91,266	102,436
10	Embu	Eas	17,552	20,521	24,742	25,617	30,276	39,900	51,423
11	Isiolo	Eas	12,714	24,687	32,568	34,296	43,918	55,222	67,806
12	Kitui	Eas	6,705	15,543	19,705	20,599	25,492	31,063	37,052
13	Machakos	Eas	100,853	154,012	186,428	193,208	229,553	304,295	394,619
14	Makueni	Eas	4,749	5,283	6,249	6,447	7,495	9,730	12,369
15	Marsabit	Eas	23,109	27,938	33,060	34,112	39,669	45,622	51,566
16	Meru	Eas	74,758	87,876	104,644	108,098	126,390	164,947	210,678
17	Tharaka Nithi	Eas	1,361	5,181	6,623	6,934	8,642	11,967	16,153
	SUB-TOTAL		244,801	341,041	414,019	429,310	511,436	662,746	841,666
18	Kiambu	Cen	54,917	100,880	159,433	173,762	263,487	361,743	481,750
19	Kirinyaga	Cen	7,874	17,677	28,057	30,603	46,579	64,164	85,711
20	Muranga	Cen	24,398	59,228	93,265	101,579	153,547	210,207	279,222
21	Nyandarua	Cen	1,911	9,143	15,318	16,875	26,906	38,655	53,643
22	Nyeri	Cen	40,892	100,271	152,890	165,530	243,327	324,805	421,686
	SUB-TOTAL		129,992	287,198	448,965	488,350	733,847	999,575	1,322,011
23	Nairobi	NBO	827,775	1,363,075	1,805,695	1,903,442	2,455,826	3,116,657	3,855,307
24	Baringo	Rif	11,007	16,255	22,803	24,294	32,977	40,758	49,298
25	Elgeyo Marakwet	Rif	1,423	5,384	7,449	7,918	10,647	13,057	15,692
26	Kajiado	Rif	14,179	32,509	49,726	53,838	78,837	104,369	134,398
27	Kericho	Rif	37,429	46,326	63,101	66,858	88,459	106,785	126,374
28	Bomet	Rif	1,335	5,283	6,751	7,072	8,881	10,242	11,649
29	Laikipia	Rif	31,750	41,348	56,915	60,421	80,674	98,204	117,118
30	Nakuru	Rif	133,299	246,866	350,993	374,948	515,917	646,082	791,420
31	Nandi	Rif	7,985	21,740	30,073	31,965	42,974	52,692	63,316
32	Narok	Rif	7,530	16,661	24,919	26,869	38,617	50,344	64,013
33	Samburu	Rif	12,486	23,874	32,591	34,558	45,939	55,759	66,393
34	Trans Nzoia	Rif	28,327	53,843	76,355	81,531	111,968	139,933	171,063
35	Turkana	Rif	0	0	0	0	0	0	0
36	Uasin Gishu	Rif	51,541	116,830	169,190	181,358	253,553	322,008	399,381
37	West Pokot	Rif	4,873	12,293	16,815	17,836	23,751	28,873	34,428
	SUB-TOTAL		343,154	639,211	907,680	969,466	1,333,198	1,669,106	2,044,543
38	Kisii	Nya	30,808	47,951	62,162	65,267	82,582	115,146	156,335
39	Nyamira	Nya	8,003	10,261	12,386	12,830	15,222	17,862	20,567
40	Kisumu	Nya	163,156	213,036	267,688	279,346	343,096	464,990	614,412
41	Siaya	Nya	6,315	23,772	30,914	32,477	41,205	51,458	62,784
42	Homa Bay	Nya	10,852	30,884	38,842	40,553	49,993	68,054	90,427
43	Migori	Nya	6,236	16,559	21,593	22,696	28,863	36,122	44,158
	SUB-TOTAL		225,370	342,463	433,586	453,170	560,951	753,632	988,683
44	Bungoma	Wes	45,267	68,574	95,246	101,297	136,495	167,656	201,650
45	Busia	Wes	5,266	14,426	20,753	22,220	30,917	39,125	48,385
46	Kakamega	Wes	33,069	74,669	110,388	118,787	169,202	218,712	275,728
47	Vihiga	Wes	3,594	7,721	10,877	11,601	15,851	19,732	24,043
	SUB-TOTAL		87,196	165,390	237,264	253,905	352,464	445,225	549,806
	KENYA TOTAL	TOTAL	2,312,576	3,790,999	5,045,000	5,326,000	6,941,000	8,933,000	11,235,000

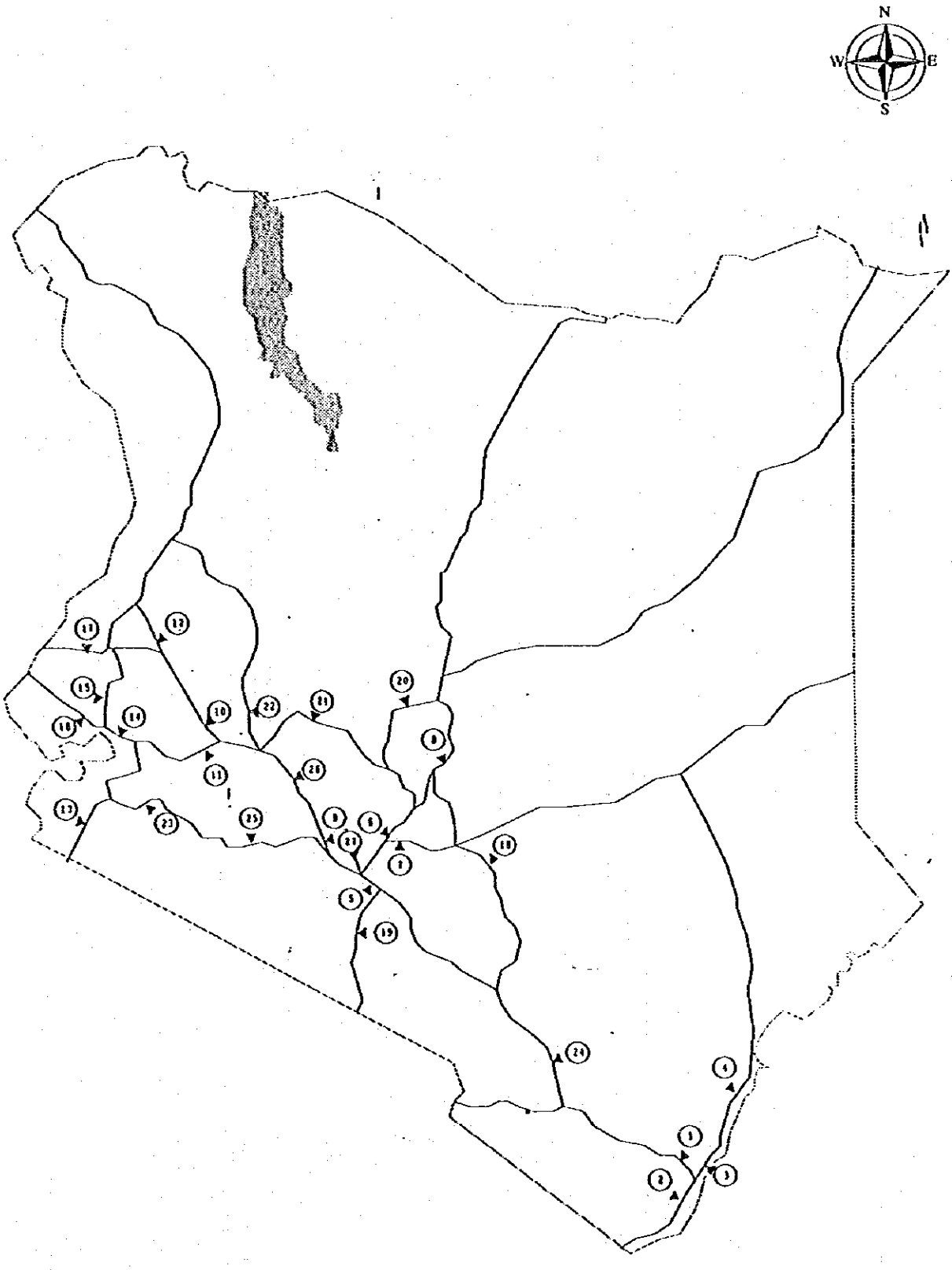
Table A2.3 Estimated Future Rural Population by District

ESTIMATED TOTAL POPULATIC	ESTIMATED RURAL POPULATION BY DISTRICT								
Dist. No.	DISTRICT	PROV.	Rural Pop. 1979	Rural Pop. 1989	Rural Pop. 1994	Rural Pop. 1995	Rural Pop. 2000	Rural Pop. 2005	Rural Pop. 2010
1	Kilifi	Coa	395,434	550,444	598,348	606,729	641,836	605,301	530,026
2	Kwale	Coa	278,375	380,628	422,019	429,912	467,699	476,401	473,272
3	Lamu	Coa	31,617	46,225	47,266	47,346	46,920	42,012	35,632
4	Mombasa	Coa	0	0	0	0	0	0	0
5	Taita	Coa	137,999	189,108	205,181	207,903	218,619	211,990	197,676
6	Tana River	Coa	86,042	121,247	133,321	135,501	145,098	144,836	140,415
	SUB-TOTAL		929,467	1,287,651	1,406,134	1,427,391	1,520,172	1,480,540	1,377,021
7	Garissa	NE	112,838	99,612	94,372	93,321	87,856	82,129	76,447
8	Mandera	NE	93,281	120,376	125,872	126,692	129,992	132,107	133,398
9	Wajir	NE	123,717	104,293	97,468	96,282	90,654	85,480	80,765
	SUB-TOTAL		329,836	324,280	317,712	316,295	308,502	299,717	290,610
10	Embu	Eas	243,721	360,376	413,857	424,402	476,837	523,801	567,228
11	Isiolo	Eas	30,450	47,429	54,844	56,245	62,721	68,213	72,798
12	Kitui	Eas	454,225	656,031	753,433	772,638	868,211	962,197	1,052,860
13	Machakos	Eas	467,274	639,505	712,706	726,618	792,779	818,015	823,224
14	Makueni	Eas	461,905	643,958	728,326	744,830	826,457	904,738	978,923
15	Marsabit	Eas	72,412	105,082	117,496	119,877	131,317	141,923	151,784
16	Meru	Eas	558,250	807,302	914,423	935,312	1,037,933	1,117,857	1,185,869
17	Tharaka Nithi	Eas	189,813	277,507	320,631	329,171	371,842	412,739	451,725
	SUB-TOTAL		2,478,050	3,537,191	4,015,717	4,109,093	4,568,097	4,949,483	5,284,410
18	Kiambu	Cen	631,265	840,114	899,093	907,663	930,810	941,845	925,638
19	Kirinyaga	Cen	283,634	385,220	426,491	434,027	467,831	498,587	523,087
20	Muranga	Cen	623,774	823,779	897,575	910,236	961,517	1,004,581	1,030,046
21	Nyandarua	Cen	231,453	346,318	400,595	411,115	461,959	511,530	557,130
22	Nyeri	Cen	445,714	524,675	533,082	532,145	511,246	483,522	436,451
	SUB-TOTAL		2,215,841	2,920,107	3,156,835	3,195,187	3,333,362	3,440,065	3,472,353
23	Nairobi	NBO	0	0	0	0	0	0	0
24	Baringo	Rif	194,136	341,852	417,239	432,562	510,651	593,376	676,911
25	Elgeyo Marakwet	Rif	148,641	217,396	250,289	256,719	288,387	319,721	349,375
26	Kajiado	Rif	135,661	233,669	279,495	288,374	330,671	375,799	418,131
27	Kericho	Rif	288,196	482,135	568,871	585,986	670,433	759,708	846,602
28	Bomet	Rif	309,566	393,381	430,106	437,060	470,420	501,707	529,861
29	Laikipia	Rif	103,528	183,975	215,161	221,142	249,357	281,491	312,210
30	Nakuru	Rif	392,037	626,913	703,540	716,248	762,540	824,153	870,373
31	Nandi	Rif	292,690	424,478	486,099	498,011	555,820	613,607	667,565
32	Narok	Rif	203,956	393,189	498,760	520,759	635,435	760,909	892,464
33	Samburu	Rif	64,853	88,175	95,873	97,127	101,720	107,427	111,514
34	Trans Nzoia	Rif	232,630	351,283	400,194	409,266	450,543	494,130	532,631
35	Turkana	Rif	143,801	189,411	209,631	213,508	232,356	250,030	266,196
36	Uasin Gishu	Rif	232,850	341,652	377,741	383,380	401,528	424,509	437,395
37	West Pokot	Rif	154,672	219,710	249,540	255,264	282,833	310,305	335,694
	SUB-TOTAL		2,897,238	4,487,218	5,182,541	5,315,405	5,942,693	6,616,873	7,246,923
38	Kisii	Nya	537,780	736,021	821,737	838,144	917,202	978,313	1,026,454
39	Nyamira	Nya	292,820	375,875	411,451	418,242	451,055	481,726	509,944
40	Kisumu	Nya	319,198	470,355	510,704	517,718	546,723	515,913	454,244
41	Siaya	Nya	468,230	634,255	712,567	727,712	801,611	871,841	937,431
42	Homa Bay	Nya	460,228	583,765	639,964	650,614	701,537	740,923	772,217
43	Migori	Nya	340,330	466,380	525,072	536,444	592,032	645,037	694,701
	SUB-TOTAL		2,418,586	3,266,652	3,621,495	3,688,874	4,010,161	4,233,753	4,394,991
44	Bungoma	Wes	449,869	630,315	699,774	712,601	771,128	831,719	885,724
45	Busia	Wes	287,374	398,908	449,550	459,272	506,134	552,330	595,259
46	Kakamega	Wes	657,396	949,458	1,076,513	1,100,461	1,212,340	1,324,704	1,425,862
47	Vihiga	Wes	350,827	474,221	529,729	540,422	592,411	642,817	689,847
	SUB-TOTAL		1,745,467	2,452,902	2,755,566	2,812,756	3,082,013	3,351,569	3,596,692
	KENYA TOTAL	TOTAL	13,014,485	18,276,001	20,456,000	20,864,999	22,765,000	24,372,000	25,663,000

Table A2.4 Estimated Future Wage Employment by District

Dist. No.	DISTRICT NAME	WAGE EMP. 1989	WAGE EMP. 1994	WAGE EMP. 1995	WAGE EMP. 2000	WAGE EMP. 2005	WAGE EMP. 2010
1	Kilifi	19,975	24,601	25,819	36,935	61,584	96,833
2	Kwale	12,926	15,730	16,303	22,403	34,939	51,705
3	Lamu	3,273	3,951	4,088	5,522	7,596	9,929
4	Mombasa	118,098	124,059	125,153	135,420	165,835	204,425
5	Taita Taveta	12,814	16,010	16,691	24,176	35,848	50,111
6	Tana River	3,014	3,755	3,912	5,633	8,303	11,547
	COASTAL	**170,100**	**188,305**	**191,965**	**230,088**	**314,105**	**424,549**
7	Garissa	6,434	7,189	7,253	8,282	9,704	11,249
8	Mandera	2,870	3,350	3,390	4,044	4,948	5,942
9	Wajir	2,896	3,167	3,191	3,574	4,111	4,699
	NORTH EAST	**12,200**	**13,707**	**13,834**	**15,899**	**18,764**	**21,891**
10	Embu	16,620	19,124	19,338	22,803	31,426	42,755
11	Isiolo	4,382	5,406	5,499	7,068	9,287	11,998
12	Kitui	13,329	15,942	16,174	20,028	25,312	31,546
13	Machakos	43,227	49,891	50,465	59,835	83,041	113,816
14	Makueni	1,483	1,682	1,698	1,969	2,663	3,562
15	Marsabit	3,449	3,912	3,951	4,581	5,394	6,285
16	Meru	27,396	31,225	31,550	36,787	50,084	67,391
17	Tharaka Nithi	1,614	1,943	1,972	2,461	3,607	5,190
	EAST	**111,500**	**129,126**	**130,648**	**155,531**	**210,814**	**282,544**
18	Kiambu	83,002	88,129	94,040	139,352	201,958	284,434
19	Kirinyaga	15,531	16,502	17,623	26,238	38,203	54,016
20	Murang'a	49,235	52,246	55,711	82,227	118,702	166,623
21	Nyandarua	15,299	16,399	17,705	28,008	43,232	64,181
22	Nyeri	36,233	38,256	40,546	57,801	80,601	109,843
	CENTRAL	**199,300**	**211,533**	**225,625**	**333,625**	**482,697**	**679,098**
23	Nairobi	367,800	377,203	393,298	500,984	663,300	863,439
24	Baringo	11,084	11,939	12,511	16,984	22,319	28,720
25	Elgeyo/Marakwet	5,518	5,923	6,194	8,307	10,789	13,758
26	Kajiado	7,470	8,227	8,759	13,099	18,997	26,582
27	Kericho	63,531	67,937	70,837	93,218	118,484	148,017
28	Bomet	7,243	7,629	7,876	9,750	11,627	13,748
29	Laikipia	12,598	13,506	14,108	18,770	24,140	30,475
30	Nakuru	77,522	83,784	88,018	121,463	162,558	212,731
31	Nandi	28,605	30,705	32,106	43,050	55,905	71,273
32	Narok	7,858	8,604	9,122	13,308	18,869	25,956
33	Samburu	3,331	3,564	3,719	4,918	6,296	7,927
34	Trans-Nzoia	25,785	27,850	29,245	40,258	53,722	70,111
35	Turkana(*)	4,096	4,179	4,227	4,534	4,919	5,303
36	Uasin Gishu	38,712	42,035	44,304	62,378	85,182	113,367
37	West Pokot	4,646	4,974	5,191	6,880	8,827	11,135
	RIFT VALEY	**298,000**	**320,856**	**336,216**	**456,918**	**602,633**	**779,103**
38	Kisii	28,576	33,416	34,123	43,002	63,589	92,131
39	Nyamira	6,119	6,843	6,945	8,172	9,842	11,718
40	Kisumu	58,932	67,572	68,804	83,978	119,750	167,813
41	Siaya	9,725	11,394	11,639	14,711	19,160	24,548
42	Homa Bay	15,984	18,338	18,677	22,876	32,799	46,263
43	Migori	8,564	10,052	10,270	13,014	16,997	21,829
	NYANZA	**127,900**	**147,616**	**150,457**	**185,752**	**262,137**	**364,303**
44	Bungoma	32,246	38,633	39,792	53,211	68,849	87,108
45	Busia	8,558	10,470	10,824	15,007	20,203	26,479
46	Kakamega	36,973	45,980	47,675	67,913	94,075	126,325
47	Vihiga	3,823	4,619	4,765	6,471	8,523	10,961
	West	**81,600**	**99,703**	**103,057**	**142,602**	**191,650**	**250,874**
	kenya Total	**1,368,400**	**1,486,049**	**1,545,100**	**2,021,400**	**2,746,100**	**3,665,800**

Appendix 3 Supplemental Survey



Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure A3.1
OD Traffic Survey Stations

REPUBLIC OF KENYA
MINISTRY OF PUBLIC WORKS

JICA STUDY TEAM / SPAN ENGINEERS

ROAD NETWORK DEVELOPMENT MASTER STUDY

CLASSIFIED TRAFFIC COUNTS

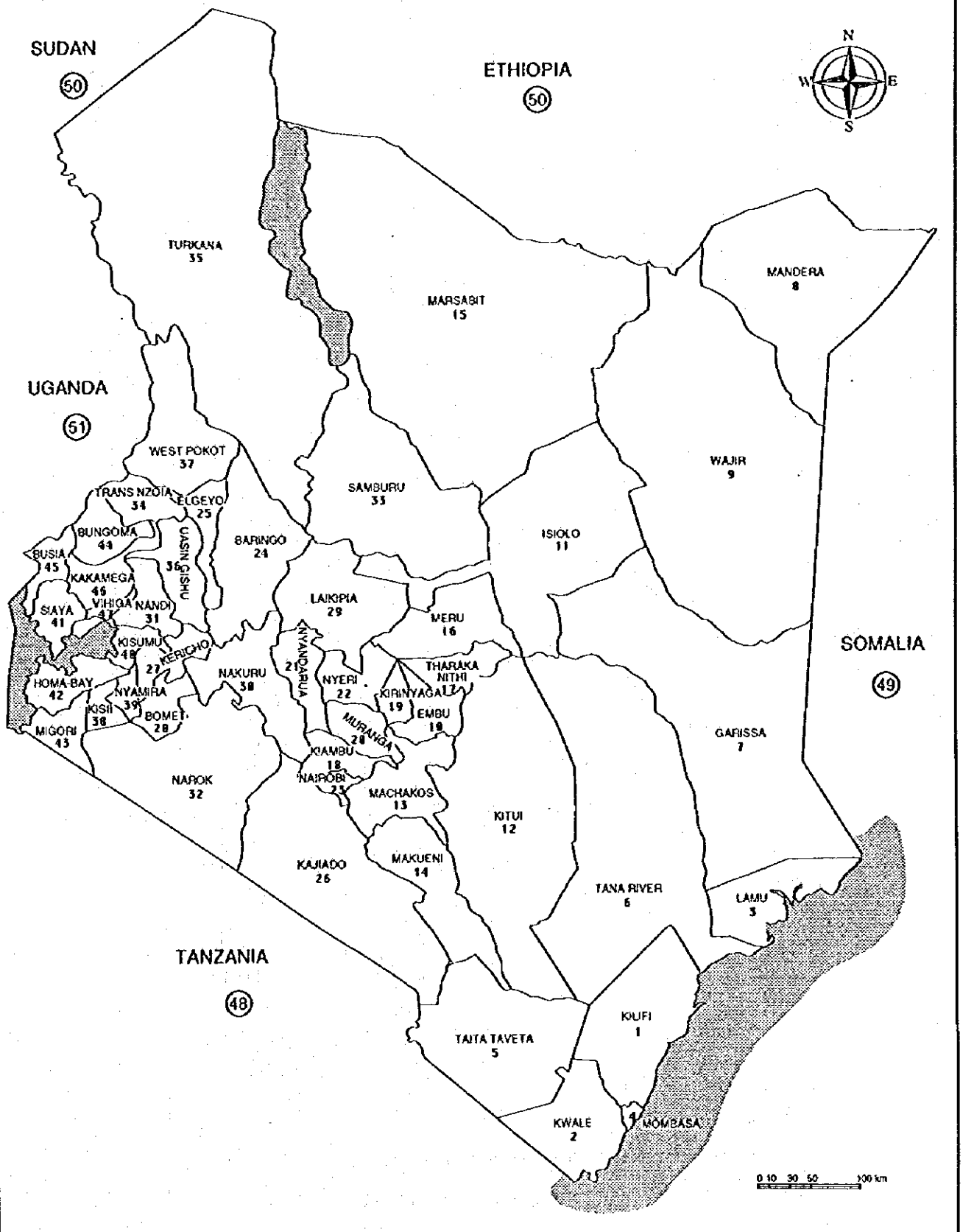
TEAM LEADER		SITE CODE No.	
NAME OF INTERVIEWER		ROAD No.	
DAY		NAME OF LOCATION	
DATE		DISTRICT	
SHEET No.		PROVINCE	

HOUR ENDING	FROM / TO											FROM / TO										
	MOTOR CYCLES	CARS	LIGHT GOODS VEHICLES		MEDIUM GOODS VEHICLES		HEAVY GOODS VEHICLES		BUSES	MATATUS		MOTOR CYCLES	CARS	LIGHT GOODS VEHICLES		MEDIUM GOODS VEHICLES		HEAVY GOODS VEHICLES		BUSES	MATATUS	
			VANS	OTHERS	TANKERS	OTHERS	TANKERS	OTHERS						VANS	OTHERS	TANKERS	OTHERS	TANKERS	OTHERS			

Source : JICA Study Team

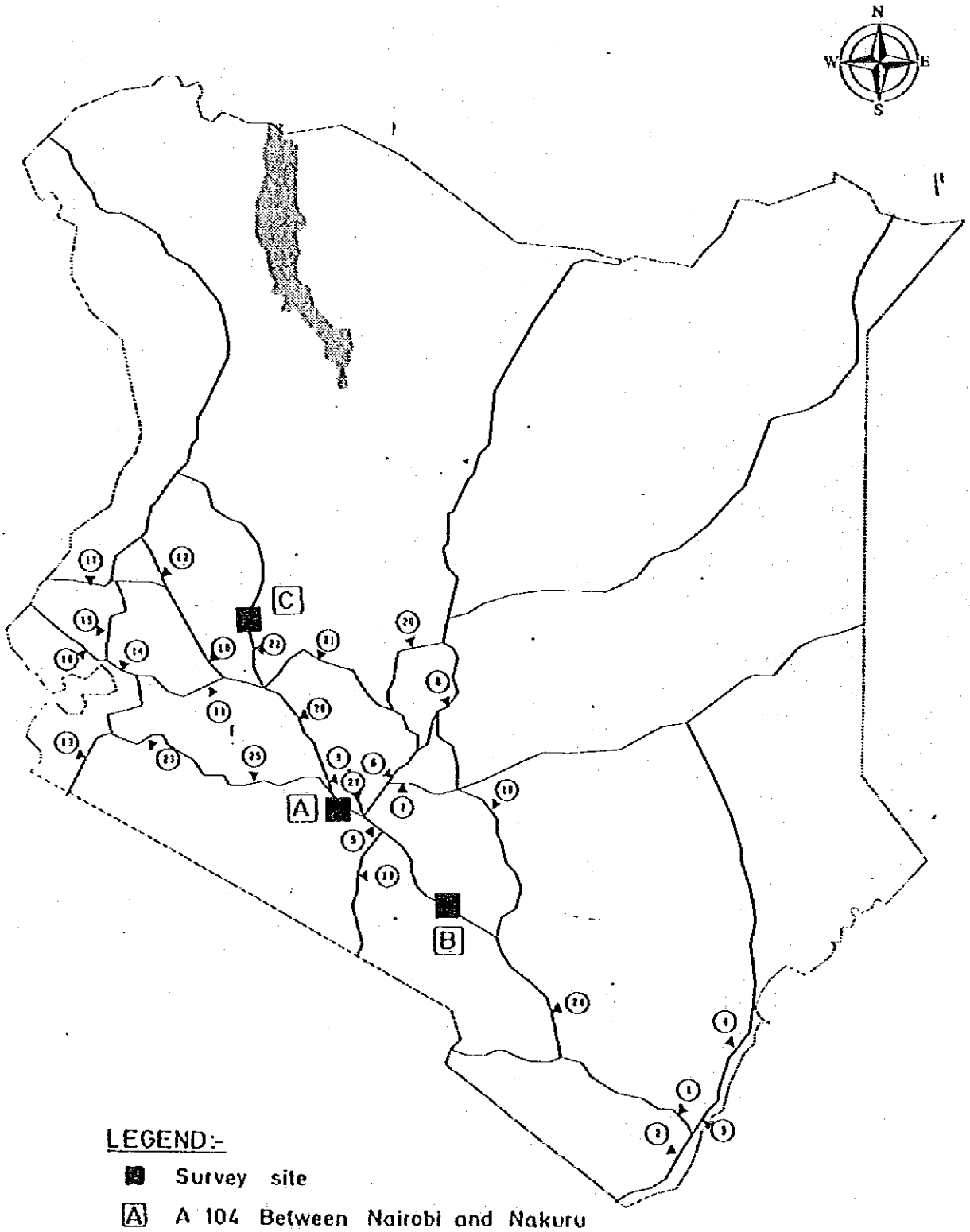
Road Network Development Master Plan in Kenya

Figure A3.2
Traffic Count Survey Form



Road Network Development Master Plan in Kenya

Figure A3.3
Zoning Map



Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure A3.4
Axle Load Survey Stations

Table A3.1 Traffic Count and Number of Samples by Direction (1/3)

(Unit : Vehicle & %)

No.	Survey Station	Direction	Count	Sample	Rate
1	A109 Mariakani Toll	Nairobi -> Mombasa	498	209	42.0
		Mombasa -> Nairobi	530	268	50.6
		Nairobi <-> Mombasa	1028	477	46.4
2	A14 Likoni	Lunga Lunga -> Mombasa	1196	399	33.4
		Mombasa -> Lunga Lunga	1608	443	27.5
		Lunga Lunga <-> Mombasa	2804	842	30.0
3	B8 Mtwapa	Malindi -> Mombasa	1967	408	20.7
		Mombasa -> Malindi	2049	410	20.0
		Malindi <-> Mombasa	4016	818	20.4
4	B8 Sabaki River Bridge	Malindi -> Lamu	310	260	83.9
		Lamu -> Malindi	286	253	88.5
		Malindi <-> Lamu	596	513	86.1
5	A104 Athi River Toll	Nairobi -> Mombasa	2541	1075	42.3
		Mombasa -> Nairobi	2436	801	32.9
		Nairobi <-> Mombasa	4977	1876	37.7
6	A2 Thika High Level Res.	Thika -> Muranga	2072	666	32.1
		Muranga -> Thika	1948	582	29.9
		Thika <-> Muranga	4020	1248	31.0
7	A3 Thika	Garissa -> Thika	1453	554	38.1
		Thika -> Garissa	1450	763	52.6
		Garissa <-> Thika	2903	1317	45.4
8	B6 Ena Toll	Meru -> Embu	433	358	82.7
		Embu -> Meru	449	300	66.8
		Meru <-> Embu	882	658	74.6
9	A104 Rironi	Nairobi -> Nakuru	2358	614	26.0
		Nakuru -> Nairobi	1972	485	24.6
		Nairobi <-> Nakuru	4330	1099	25.4
10	A104 Timoroa Toll	Nakuru -> Eldoret	614	304	49.5
		Eldoret -> Nakuru	498	294	59.0
		Nakuru <-> Eldoret	1112	598	53.8
11	B1 Londiani Toll	Nakuru -> Kericho	971	421	43.4
		Kericho -> Nakuru	703	403	57.3
		Nakuru <-> Kericho	1674	824	49.2
12	B2 Soy	Eldoret -> Kitale	573	402	70.2
		Kitale -> Eldoret	565	300	53.1
		Eldoret <-> Kitale	1138	702	61.7

Table A3.1 Traffic Count and Number of Samples by Direction (2/3)

(Unit : Vehicle & %)

No.		Survey Station	Direction	Count	Sample	Rate
13	A1	Awendo	Kisii -> Migori	471	297	63.1
			Migori -> Kisii	474	416	87.8
			Kisii <-> Migori	945	713	75.4
14	A1	Ahero	Kisumu -> Kericho	842	541	64.3
			Kericho -> Kisumu	790	539	68.2
			Kisumu <-> Kericho	1632	1080	66.2
15	A1	Kakamega	Kisumu -> Kakamega	1182	449	38.0
			Kakamega -> Kisumu	1191	574	48.2
			Kisumu <-> Kakamega	2373	1023	43.1
16	B1	Korando	Kisumu -> Busia	966	270	28.0
			Busia -> Kisumu	.948	323	34.1
			Kisumu <-> Busia	1914	593	31.0
17	A104	Webuye	Bungoma -> Eldoret	400	290	72.5
			Eldoret -> Bungoma	370	292	78.9
			Bungoma <-> Eldoret	770	582	75.6
18	B7	Kitui	Embu -> Kitui	312	137	43.9
			Kitui -> Embu	299	143	47.8
			Embu <-> Kitui	611	280	45.8
19	A104	Kajiado	Athi River -> Kajiado	364	284	78.0
			Kajiado -> Athi River	285	270	94.7
			Athi River <-> Kajiado	649	554	85.4
20	A2	Nanyuki	Isiolo -> Nanyuki	486	289	59.5
			Nanyuki -> Isiolo	540	219	40.6
			Isiolo <-> Nanyuki	1026	508	49.5
21	B5	Manguo	Nyahururu -> Nyeri	575	273	47.5
			Nyeri -> Nyahururu	590	320	54.2
			Nyahururu <-> Nyeri	1165	593	50.9
22	B4	Mogotio	Nakuru -> Kabarnet	121	119	98.3
			Kabarnet -> Nakuru	123	107	87.0
			Nakuru <-> Kabarnet	244	226	92.6
23	B3	Bobaracho	Kericho -> Kisii	368	235	63.9
			Kisii -> Kericho	417	270	64.7
			Kericho <-> Kisii	785	505	64.3

Table A3.1 Traffic Count and Number of Samples by Direction (3/3)

(Unit : Vehicle & %)

No.		Survey Station	Direction	Count	Sample	Rate
24	A109	Manyani	Nairobi -> Mombasa	374	180	48.1
			Mombasa -> Nairobi	482	244	50.6
			Nairobi <-> Mombasa	856	424	49.5
25	B3	Narok	Nairobi -> Narok	192	166	86.5
			Narok -> Nairobi	222	183	82.4
			Nairobi <-> Narok	414	349	84.3
26	A104	Gilgil Toll	Nairobi -> Nakuru	1522	976	64.1
			Nakuru -> Nairobi	1328	877	66.0
			Nairobi <-> Nakuru	2850	1853	65.0
27	C64	Muthaiga	Nairobi -> Kiambu	3159	551	17.4
			Kiambu -> Nairobi	3319	533	16.1
			Nairobi <-> Kiambu	6478	1084	16.7
		Total	Direction 1	26320	10727	40.8
			Direction 2	25873	10612	41.0
			Both Directions	52192	21339	40.9

Table A3.2 Zone Code Table (1/5)

No.	Code	Name	District	Province
1	011	Kilifi		
2	012	Malindi		
3	013	Mariakani		
4	014	Watamu		
5	015	Mambrui	Kilifi	
6	016	Kaloleni		
7	017	Kakoneni		
8	018	Bamba		
9	019	Shimo la Tewa		
10	021	Kwale		
11	022	Masambweni	Kwale	
12	023	Lungalunga		
13	024	Kinango		Coast
14	031	Lamu	Lamu	
15	032	Witu		
16	033	Mokowe		
17	041	Mombassa	Mombassa	
18	051	Voi		
19	052	Taveta		
20	053	Wundanyi	Taita Taveta	
21	054	Manyani		
22	055	Tsavo		
23	061	Hola		
24	062	Garsen	Tana River	
25	063	Kipini		
26	071	Garissa		
27	072	Dadaab		
28	073	Bilifiu		
29	074	Ijara	Garissa	
30	075	Libol		
31	076	Bura		
32	077	Masalani		
33	078	Kitere		Norther Eastern
34	081	Mandera		
35	082	Rhamu	Mandera	
36	083	El Wak		
37	091	Wajir		
38	092	Habaswein	Wajir	
39	093	Bute		
40	094	Buna		

Table A3.2 Zone Code Table (2/5)

No.	Code	Name	District	Province
41	101	Embu	Embu	Eastern
42	102	Runyenjes		
43	103	Siakago		
44	111	Isiolo	Isiolo	
45	112	Garbatula		
46	113	Modogashi		
47	114	Merti		
48	115	Ol Doinyo Nyiro		
49	121	Kitui	Kitui	
50	122	Mwingi		
51	123	Mutomo		
52	131	Machakos	Machakos	
53	132	Athi River		
54	133	Mitaboni		
55	134	Kangundo		
56	141	Emali	Makueni	
57	142	Mtito Andei		
58	143	Kibwezi		
59	151	Marsabit	Marsabit	
60	152	Moyale		
61	153	Sololo		
62	154	North Horr		
63	155	Kargi		
64	156	Korr		
65	161	Meru	Meru	
66	162	Maua		
67	163	Nkubu		
68	171	Chuka	Tharaka-Nithi	
69	172	Chogoria		
70	181	Thika	Kiambu	Central
71	182	Kiambu		
72	183	Ruiru		
73	184	Limuru		
74	185	Githunguri		
75	186	Kikuyu		
76	187	Karuri		
77	188	Gatundu		
78	191	Kerugoya	Kirinyaga	
79	192	Sagana		
80	193	Wanguru		
81	194	Kutus		
82	195	Kianyaga		

Table A3.2 Zone Code Table (3/5)

No.	Code	Name	District	Province
83	201	Murang'a	Murang'a	Central
84	202	Kandara		
85	203	Kangema		
86	204	Maragwa		
87	205	Makuyu		
88	211	Nyahururu	Nyahururu	
89	212	Olkalou		
90	213	Oljororok		
91	221	Nyeri	Nyeri	
92	222	Karatina		
93	223	Kinganjo		
94	224	Othaya		
95	231	Nairobi	Nairobi	Nairobi
96	241	Kabarnet	Baringo	Rift Valley
97	242	Eldama Rabine		
98	243	Marigat		
99	244	Loruk		
100	245	Maji Mazuri		
101	246	Mogotio		
102	251	Iten	Elgeyo Marakwet	
103	252	Tot		
104	253	Tambach		
105	254	Kaamwosor		
106	261	Ngong	Kajiado	
107	262	Kajiado		
108	263	Namanga		
109	264	Magadi		
110	265	Oloitokitok		
111	271	Kericho	Kericho	
112	272	Sotik		
113	273	Londiani		
114	274	Kipkelion		
115	281	Bomet	Bomet	
116	291	Nanyuki	Laikipia	
117	292	Rumuruti		
118	301	Nakuru	Nakuru	
119	302	Naivasha		
120	303	Molo		
121	304	Gilgil		
122	305	Elburgon		
123	306	Njoro		

Table A3.2 Zone Code Table (4/5)

No.	Code	Name	District	Province
124	311	Kapsabet	Nandi	Rift Valley
125	312	Nandi Hills		
126	313	Lessos		
127	314	Kabiyet		
128	321	Narok	Narok	
129	322	Kilgoris		
130	323	Lolgorian		
131	324	Nairagie Ngare		
132	325	Keekorok		
133	331	Maralal	Samburu	
134	332	Wamba		
135	333	Baragoi		
136	341	Kitale	Trans-Nzoia	
137	342	Endebess		
138	343	Kiminini		
139	351	Lodwar	Turkana	
140	352	Lokichar		
141	353	Kakuma		
142	354	Lokitaung		
143	361	Eldoret	Uasin Gishu	
144	362	Turbo		
145	363	Moi's Bridge		
146	364	Burnt Forest		
147	365	Soy		
148	371	Kapenguria	West Pokot	
149	372	Chepareria		
150	373	Sigor		
151	381	Kisii	Kisii	Nyanza
152	382	Keroka		
153	383	Ogenbo		
154	384	Manga		
155	391	Nyamira	Nyamira	
156	401	Kisumu	Kisumu	
157	402	Ahero		
158	403	Maseno		
159	404	Sondu		
160	405	Muhoroni		
161	411	Siaya	Siaya	
162	412	Ukwala		
163	413	Yala		
164	414	Bondo		
165	415	Rangala		

Table A3.2 Zone Code Table (5/5)

No.	Code	Name	District	Province
166	421	Homa Bay	Homa Bay	Nayanza
167	422	Kendu Bay		
168	423	Oyugis		
169	424	Rongo		
170	425	Sere/Awendo	Migori	
171	431	Migori		
172	432	Kehancha		
173	433	Nyabikaya		
174	434	Muhuro		
175	441	Bungoma	Bungoma	Western
176	442	Webuye		
177	443	Kimilili		
178	444	Sirisia		
179	445	Kapsakwany		
180	446	Malakisi		
181	451	Busia	Busia	
182	452	Malaba		
183	453	Nambale		
184	454	Nangina		
185	461	Kakamega	Kakamega	
186	462	Mumias		
187	463	Butere		
188	471	Vihiga	Vihiga	
189	472	Kaimosi		
190	473	Luanda		
191	481	Tonga	Tanzania	South
192	482	Moshi		
193	483	Arusha		
194	484	Mwanza		
195	491	Kismayu	Somalia	East
196	501	Mega	Ethiopia	North
197	502	Juba	Sudan	
198	511	Jinja	Uganda	East

Table A3.3 24/12 Hours Ratio Applied in This Study

Car	Motor -cycle	Light Goods	Medium Goods	Heavy Goods	Tanker	Bus	Matatu
1.236	1.236	1.204	1.220	1.333	1.352	1.459	1.198

Source:MOPWH,Traffic count survey at toll gates in 1994.
MOPWH,The annual 60-point traffic census.
MOPWH,The annual ADT counts.
MOPWH,Permanently-sited automatic traffic counters.