



Kenya Roads Board



KENYA TRANSPORT SECTOR SUPPORT PROJECT
CREDIT No. 4926-KE/5410-KE

Provision of Consultancy Services to undertake Road Inventory and Condition Survey for Central Zone in Kenya

Contract No.: KRB/721/2015-2016

VOLUME 1: FINAL ROAD REGISTER REPORT

November 2018



TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION AND PROJECT BACKGROUND	1-1
1.1. Introduction	1-1
1.2. Project Background	1-1
1.3. Project Objectives.....	1-2
1.4. Contract Details.....	1-2
1.5. Description of the services.....	1-2
1.6. Deliverables under the Contract	1-5
1.7. Purpose of the Final Road Register Report	1-7
2. APPROACH AND METHODOLOGY	2-8
2.1. Approach.....	2-8
2.1.1. General.....	2-8
2.1.2. Planning.....	2-8
2.2. Methodology.....	2-10
2.2.1. Preparation for Data Collection.....	2-10
2.2.2. Field data collection.....	2-11
2.2.3. Data collection for Classified Gravel Roads.....	2-15
2.2.4. Data collection for Classified Earth Roads	2-15
2.2.5. Rating of Earth roads	2-15
2.2.6. Classified Paved Roads.....	2-16
2.3. Challenges encountered during the data collection	2-19
2.3.1. Determination of Road Reserve Width.....	2-19
2.3.2. Road Naming	2-19
2.3.3. Security	2-19
3. FINAL ROAD REGISTER	3-20
3.1. Fieldwork	3-20
3.2. Key Findings	3-22
3.2.1. Road Surface Type and Condition	3-22
3.2.2. Road Surface Type and Condition per Road Class.....	3-24
3.2.3. Road Reserve Width	3-34
3.2.4. Road Register	3-35
3.2.5. Drainage Structures	3-35
3.3. Data collection on paved roads.....	3-40
3.3.1. International Roughness Index (IRI)	3-40
3.3.2. Falling Weight Deflectometer	3-41
3.4. Salient Issues.....	3-43
3.4.1. Road Names	3-43
3.4.2. Data Verification and Validation.....	3-43
3.5. Book of Maps	3-43
4. WORKING PAPER ON RURAL POPULATION LIVING WITHIN 2KM OF ALL WEATHER ROADS..	4-44

4.1.	Introduction	4-44
4.2.	Definition of Rural Access Index (RAI)	4-44
4.3.	Methodology	4-45
4.4.	RAI Results	4-46
4.5.	Conclusions	4-47
5.	RICS DATA COLLECTION AND UPDATE FRAMEWORK.....	5-48
5.1.	Introduction	5-48
5.2.	Current Approaches to RICS and Findings	5-48
5.3.	Framework and Implementation Recommendations	5-49
5.4.	Cost of Implementing The Framework	5-50
6.	RICS MANUALS FOR CLASSIFIED AND NARROW ROADS	6-51
6.1.	Introduction	6-51
6.2.	Conclusions and Recommendations.....	6-51
7.	CONCLUSION AND WAY FORWARD.....	7-52
7.1.	Conclusion.....	7-52
APPENDIX 1	: SUMMARIES OF THE ROAD REGISTER.....	53
APPENDIX 2	: BOOK OF MAPS.....	67

LIST OF TABLES

Table 0.1:	Abbreviations and Acronyms.....	iv
Table 1.1:	<i>Contract Details</i>	1-2
Table 1.2:	<i>Central Zone and lengths of inventoried roads in 2009</i>	1-3
Table 1.3:	Deliverables under the Contract.....	1-5
Table 2.2:	<i>Typical FWD Data File</i>	2-17
Table 2.3:	<i>Deflection geophone Details</i>	2-18
Table 3.1:	<i>Summary of the Road Length Surveyed</i>	3-21
Table 0.2:	<i>Summary of Recommendations</i>	5-50

ABBREVIATIONS AND ACRONYMS

Table 0.1: Abbreviations and Acronyms

Abbreviation/Acronym	Description
m	Metres
KRB	Kenya Roads Board
KeNHA	Kenya National Highways Authority
KURA	Kenya Urban Roads Authority
KeRRA	Kenya Rural Roads Authority
MoTIHUD	Ministry of Transport, Infrastructure, Housing and Urban Development
MTRD	Material Testing and Research Department
RICS	Road Inventory and Condition Survey
Km	Kilometre
GIS	Geographical Information System
GPS	Global Positioning System
GOK	Government of Kenya
IDA	International Development Association
ToR	Terms of Reference
FWD	Falling Weight Deflectometer
IRI	International Roughness Index
RR	Road Register
RD	Road

EXECUTIVE SUMMARY

E1 Scope of Assignment

Kenya Roads Board (KRB), under the World Bank funded Kenya Transport Sector Support Project (KTSSP), undertook a countrywide Road Inventory and Condition Survey. The project involved mapping of newly constructed and upgraded roads and also updating road condition data for the classified road network. KRB packaged the country into three Zones, Western (21 Counties), Central (13 Counties) and Coastal (13 Counties) Zones.

SMEC International Pty Ltd in association with KIRI Consult Ltd. was commissioned by Kenya Roads Board (KRB) to undertake the Road Inventory and Condition Survey (RICS) Project in 2016 for the Central Zone.

The project commenced on 15th August 2016 and had a 15 months contract period. Soon after commencement, a Kick-off meeting was held with the Client followed by a Regional Workshop in September 2016 for all the key stakeholders in the Central Zone.

The objectives of the study were as follows:

- Establish an inventory and condition of the narrow roads network in Kenya which is currently not captured in the KRB Road Inventory and Condition Survey (RICS) database.
- Have these roads assigned numbers and integrate the new data into the existing Road Inventory and Condition database.
- Collect road condition data for the classified road network and update the KRB Road Inventory and Condition geo-database.

E2 Methodology for Data Capture

Data capture was carried out by specially trained field personnel using the state-of the art survey equipment. The Consultant recruited and trained a total of 12 Field personnel. They were deployed as follows;

- 5 No. for Road Inventory and condition survey of Narrow Roads with Right of Way between 4 – 9m.
- 5 No. for Road Inventory and Condition Survey of Classified gravel and earth roads.
- 2 No. for inventory and condition survey of structures.

The Teams used Spectra Precision Mobile Mapper 50, 4G with Mobile Mapper Field software, loaded with the data dictionary approved by the Client. The data was captured and transmitted to the Head office on a daily basis for processing by the Consultants GIS Team.

In addition the Consultant sub-contracted the Materials Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure, Housing and Urban Development (MoTIHUD) to carry out the inventory and condition survey of all classified paved roads and selected gravel roads in good and

fair condition using the Road Laser Profiler, Falling Weight Deflectometer and Roughometer equipment.

E3 Summary of the Road Network Surveyed

After a vigorous one month training of the staff, the fieldwork commenced on 28th September 2016 with a Pilot study in Kiambu County. This was carried out to ensure uniformity and accuracy of data collection amongst all the fieldwork Raters. This was then followed by a detailed fieldwork covering all the 13 counties in Central Zone as listed in the Table below:

A Summary of the road network surveyed in the Central Zone;

No.	COUNTY	LENGTH OF ROADS SURVEYED (Km)						Total Network Surveyed
		CLASSIFIED ROADS			NARROW ROADS			
		Planned	Actual	%	Planned	Actual	%	
1	Kiambu	5,374.00	5372.798	99.98%	2,687.00	2555.071	95.09%	7,927.87
2	Nakuru	9,618.00	9606.377	99.88%	4,809.00	6296.465	130.93%	15,902.84
3	Nyandarua	3,624.60	3613.294	99.69%	1,812.30	1242.6	68.56%	4,855.89
4	Nyeri	4,010.90	3991.832	99.52%	2,005.45	1364.412	68.04%	5,356.24
5	Kirinyaga	2,311.60	2304.766	99.70%	1,155.80	841.297	72.79%	3,146.06
6	Embu	3,204.90	3200.439	99.86%	1,602.45	789.072	49.24%	3,989.51
7	Tharaka Nithi	1,735.70	1716.056	98.87%	867.85	990.561	114.14%	2,706.62
8	Meru	4,840.60	4835.172	99.89%	2,420.30	3735.723	154.35%	8,570.89
9	Muranga	3,957.55	3939.366	99.54%	1,978.77	1540.778	77.87%	5,480.14
10	Laikipia	3,205.64	3166.542	98.78%	1,602.82	1466.487	91.49%	4,633.03
11	Isiolo	2,819.45	2723.649	96.60%	1,409.73	309.765	21.97%	3,033.41
12	Wajir	5,236.53	5168.028	98.69%	2,618.27	2267.607	86.61%	7,435.64
13	Mandera	3,082.96	3082.923	100.00%	1,541.48	566.831	36.77%	3,649.75
	Sub-Total (Km)	53,022.43	52,721.24	99.43%	26,511.22	23,966.67	90.40%	76,687.91

All the planned fieldwork activities was achieved, except two Constituencies in Mandera county namely Lafey and Mandera South due to insecurity. The two Constituencies border Somali and have reported numerous insecurity incidences.

E4 Data handling and validation

On receipt of the data from the field, processing and cleaning the data was carried out using QGIS software. This was then compared with the original geo-data base received from the Client and Google Earth imagery. Where gaps were noted, the Consultant tasked a special team to revisit the

areas to ensure the missing information was captured. In addition the Consultant prepared and printed hardcopy maps and the list of all the roads per county and shared with the various road agencies including KeNHA, KeRRA, KURA, KWS and County Governments to assist in data validation. The feedback from the data validation exercise have been incorporated in to the final data presented in this report.

E5 Working paper on Rural population living within 2Km of All-weather roads

The Terms of Reference (ToR) called for the Consultant to prepare a Working paper on the percentage of Rural population living within 2Km of all Weather roads. This has been presented in terms of Rural Access Index (RAI)

Rural Access Index (RAI) has been established by the World Bank as a key transport headline indicator with a focus on the critical role of access and mobility in the reduction of poverty in developing countries.

A separate report has prepared and submitted to the Client. A summary of the findings have been incorporated in this report. In summary, the overall Rural Access Index determined for the Central Zone was 73%.

Wajir County reported the lowest RAI with 16% while Kirinyaga had the highest at 99%. Out of the 13 counties grouped under the Central Zone, only 3 counties recorded an RAI less than 50% namely Isiolo, Mandera and Wajir.

It was noted that counties which are less populated with nomadic form of agriculture and low road network density tended to show low RAI compared to counties rich in agriculture with high population density and dense road network.

E6 RICS Data collection and Update Framework

The Consultant was also required to prepare a RICS data collection and Update framework for future reference when further RICS projects are defined.

A separate report has been submitted addressing current approaches to RICS studies and proposed new framework and a number of recommendations touching on the following;

- (a) Policies and guidelines
- (b) Protocols and standards
- (c) Equipment, processes and procedures

E7 RICS Manual for Classified and Narrow roads

A separate RICS Manual for Classified and Narrow roads has also been prepared covering the following;

- Introduction to RICS
- Rationale for RICS data collection
- Logistics for RICS
- RICS fieldwork

- *Data transmission and storage*
- *Unpaved roads data processing and analysis*
- *Paved roads data processing and analysis*
- *RICS data output*

E8 Overall Findings

A total of 52,721 Km of Classified Paved, Gravel and Earth roads have been mapped comprising of 99.4 % of the road network captured during the 2009 RICS assignment 16.8% were found to be in Good Condition, 43.0% in Fair, while 39.8% and 0.3% were in Poor and Under Construction respectively.

23,966 Km of Narrow roads have also been mapped during the same period. 10.5% were found to be in Good condition, 40.3% in Fair while 49.1% and 0.2% were in Poor and Under Construction respectively. Of the Narrow roads surveyed 4,113 km amounting to 17.2% were found to have Road Reserve less than 6m. This is less than 30% as noted in the Terms of Reference.

E9 Project Challenges and Lessons Learnt

A number of challenges were encountered during the course of the assignment as follows:

- *Heavy rains experienced in most parts of the Country especially in November and early December 2016 slowed the fieldwork. The Consultant's field teams however managed to redeploy to areas which were motorable despite the heavy rains before returning to the muddy and impassable sections when the weather improved.*
- *Non-Motorable roads: These were very common especially for the Narrow roads. The Consultant provided motorbikes for the field teams capturing the narrow roads. The motorbikes enabled greater and faster accessibility. Additional local staff from the areas being studied were employed to accompany the field staff and provided better local knowledge. Some Narrow roads were also surveyed on foot.*
- *Late receipt of Payment: The Consultant experienced cash flow challenges due to late receipt of the Advance and Inception report payments. The Consultant was however able to mobilize resources from other projects to enable the project to proceed. Payment was however finally received sometime in mid-December 2016.*
- *Security Challenges in Laikipia and Isiolo Counties: The Consultant was able to liaise closely with the security personnel within the county especially the County Commissioner, the Deputy County Commissioners and the local Chiefs who were very helpful.*
- *Security Challenges in Wajir and Mandera Counties: The Consultant arranged for meetings with the county stakeholders in the month of February 2017 accompanied by the Client (KRB) to assess the security situation. The Consultant then trained the regional KeRRA and County personnel who then assisted in collecting the fieldwork data. This proved very successful and the Consultant was able to survey the road network in the two counties apart from Lafey and Mandera South constituencies which had more severe insecurity as they border Somali.*

The fieldwork was successfully completed in all the 13 counties in the Central Zone. All the additional information captured during the data validation have been included in this final road register report.

1. INTRODUCTION AND PROJECT BACKGROUND

1.1. Introduction

Kenya Roads Board (KRB), under the World Bank funded Kenya Transport Sector Support Project (KTSSP), is undertaking Road Inventory and Condition Survey. The project involves mapping of newly constructed and upgraded roads and also updating road condition data for the classified road network.

SMEC International Pty Ltd in association with KIRI Consult Ltd, hereinafter referred to as the Consultant, was commissioned by Kenya Roads Board (KRB) to undertake the Road Inventory and Condition Survey. For the purpose of the assignment, KRB packaged the country into three Zones, Western (21 Counties), Central (13 Counties) and Coastal (13 Counties) Zones. This is the Final Road Register report on the RICS study carried out in the Central Zone.

The report has been prepared in fulfilment of contractual obligations of the Consultant provided under Item 8 of Clause 8 of the Terms of Reference.

This Final Road Register report comprises:

- Chapter 1: Introduction and Project background (this section)
- Chapter 2: RICS Approach and Methodology
- Chapter 3: Final Road Register
- Chapter 4: Working paper on the Rural population living within 2km of all-weather roads
- Chapter 5: RICS data collection and update framework
- Chapter 6: RICS Manual for Classified and Narrow roads
- Chapter 7: Conclusion and Recommendations
- Appendices

1.2. Project Background

The road network in Kenya constitutes the most important mode of transport, estimated to be transporting more than 95% of all freight and passenger traffic. The overall road network in the whole country is estimated to be 250,000 km. However, only 160,886 km of the country's road network has been mapped and inventoried, and it is held in a consolidated GIS database at Kenya Roads Board (KRB).

Between 2007 and 2009 all roads in the inventory were reclassified and numbered using newly developed classification system. This inventoried network covers roads with way-leave reserves of 9.0m and above. A large component of network consisting of narrow roads and tracks with road reserves between 4m and 9m are not mapped. These narrow roads provide important access which eases transportation in both rural and urban areas and are estimated to be between 60,000 km and 90,000 km.

Subsequent inventory changes to the road network, caused by recently constructed and upgraded roads, are not fully captured in the existing KRB geodatabase and the road condition data of these roads needs to be updated in the KRB geodatabase.

1.3. Project Objectives

The specific objectives of the study are to:

- Establish an inventory and condition of the narrow roads network in Kenya which is currently not captured in the KRB Road Inventory and Condition Survey (RICS) database.
- Have these roads assigned numbers and integrate the new data into the existing Road Inventory and Condition database.
- Collect road condition data for the classified road network and update the KRB Road Inventory and Condition geo-database.

1.4. Contract Details

The Contract Details for the Consultancy Services are as tabulated below.

Table 1.1: Contract Details

No.	ITEM	DETAILS
1	Study Title	Road Inventory and Condition Survey for Central Zone
2	Financier	Kenya Transport Sector Support Project funded by World Bank and Government of Kenya
3	Client	Kenya Roads Board
4	Consultant	SMEC International PTY Ltd in Association with KIRI Consult Ltd (Kenya)
5	Date of Notification of Award	27 June 2016
6	Date of contract signing	01 August 2016
7	Commencement date	15 August 2016
8	Original Contract Period (months)	15
9	Original Completion date	14 November 2017
10	Revised Contract Period (months)	26.5
11	Revised Completion date	30 November 2018
12	%age Contract Period elapsed	100%
13	%age Work done (13 out of 13 counties)	100%

1.5. Description of the services

According to the Terms of Reference and the Consultancy Contract, the scope of the assignment is broadly classified into:

- Road Inventory and Condition Survey of Narrow Roads
- Condition Survey of the Classified Road Network

This contract covers the Central Zone and includes a total of 13 counties, 78 Constituencies and approximately 52,875 km of currently mapped roads. A total of 23,915 km of narrow roads were mapped on the ground.

The counties that were to be covered in the Central Zone and the respective lengths of inventoried roads are shown in Table 1.2 below.

Table 1.2: Central Zone and lengths of inventoried roads in 2009

S. No.	County Name	Road Length (km)
1	Kiambu	5,355.80
2	Muranga	3,963.90
3	Kirinyaga	2,310.00
4	Embu	3,205.40
5	Nyeri	4,018.00
6	Nyandarua	3,618.60
7	Nakuru	9,647.50
8	Laikipia	3,127.30
9	Meru	4,834.50
10	Tharaka Nithi	1,760.30
11	Isiolo	2,749.60
12	Wajir	5,174.80
13	Mandera	3,109.40
	Total	52,875.10

The demarcation of the zones together with the counties is as indicated in Figure 1-1 below.

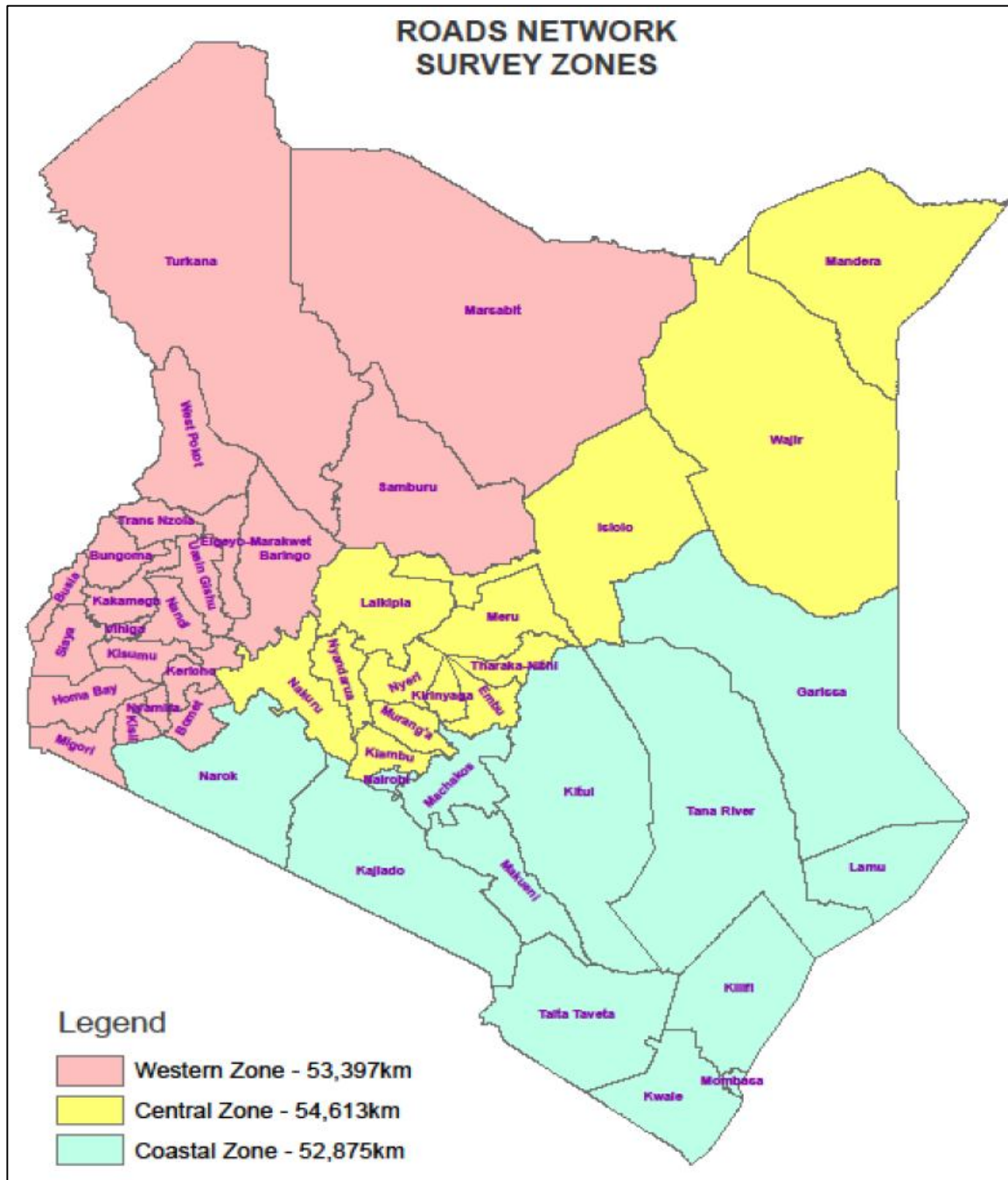


Figure 1-1: Road Network Survey Zones

1.6. Deliverables under the Contract

The table below shows the deliverables indicated in the Consultant's Technical proposal and as called for in the Terms of Reference.

Table 1.3: Deliverables under the Contract

No	Report Description	Submittal Date (Months)	
		Duration after contract effectiveness	Number of Copies
1	Inception Report	1.0 months	30
2	Monthly Progress Reports	By 5 th of every month	5
3	1st Interim Road Register for at least 10,000 km of Narrow Roads	4.0 months	1
	1st Interim Road Register with updated road conditions for at least 18,000 km of Classified Roads in the Zone	4.0 months	1
4	2 nd Interim Road Register for at least 20,000 km of Narrow Roads	8.0 months	1
	2 nd Interim Road Register with updated road conditions for at least 36,000 km of Classified Roads in the Zone	8.0 months	1
5	Working Paper on Rural population living within 2 km of all-weather roads	9.0 months	30
	Draft Road Condition and Inventory data collection and update framework for Classified Roads	9.0 months	30
6	Final Road Condition and Inventory data collection and update framework for Classified Roads	11.0 months	30
7	Final Roads Register for entire Narrow Roads Network in the Zone	12.0 months	1
	Final Road Register with updated road conditions for all Classified Roads in the Zone	12.0 months	1
8	Draft Road Inventory and Condition Report	12.0 months	30
9	A set of book of Maps (hard copy) for Narrow Roads covering the entire Zone, at appropriate scales for the roads and other content as agreed with the Client	12.0 months	100
10	Road Inventory and Condition Data Collection Manual for Narrow Roads	12.0 months	80
	Road Inventory and Condition Data Collection Manual for Classified Roads	12.0 months	80

No	Report Description	Submittal Date (Months)	Number of Copies
11	Final Roads Inventory and Condition Report	14.0 months	30

However, following further consultations with the Client, the Consultant proposed a revision of the deliverables listed under Items No. 7 to 11 as shown in the Table 1.4 Below. This was reviewed and approved by the Client vide a letter Ref. KRB/PP/32.32/A VOL. I(10) dated 6th June 2017.

Table 1.4: Revised Schedule of Deliverables

No.	Content in the TOR	Deadline in TOR	Consultant's Proposed Amendments
2	Monthly Progress Report	By 5 th of following month	No amendments.
6	Final Road Condition and Inventory data collection and update framework for Classified Roads This report shall incorporate the Client's comments	15.07.2017	No amendments.
7	7.1 Final Roads Register for entire Narrow Roads Network in the Zone 7.2 Final Road Register with updated road conditions for all Classified Roads in the Zone	15.08.2017	To be replaced with a Draft Final Road Register Report with the set of book of maps for all roads (not Narrow Roads only) as an Annex of the report. (The report to document the data collection process used in the study and summarize the data collected including overall road conditions for the entire Narrow Roads and Classified roads in the zone)
8	Draft Road Inventory and Condition Report. The report shall document the data collection process used in the study and summarize the data collected including overall road conditions for the entire Narrow Roads and Classified Roads in the Zone	15.08.2017	
9	A set of book of maps (hard copy) for Narrow Roads covering the entire zone, A3 size at appropriate scales for the roads and other content as agreed with client. Soft copies to be provided in ArcGIS map format and PDF format	15.08.2017	
10	10.1 Roads Inventory and Condition Data Collection Manual for Narrow Roads 10.2 Roads Inventory and Condition Data Collection Manual for Classified Roads NB: The manuals will be based on the	15.08.2017	No amendments.

		actual data collection methods used and lessons learnt. The manual shall detail step by step guidelines and procedures for undertaking future road condition and inventory surveys for both classified roads and narrow roads		
11		Final Road Inventory and Condition Report.	30.04.2018	No amendment.

1.7. Purpose of the Final Road Register Report

The purpose of this report is to:

- Document the approach and methodology used to undertake Road Inventory and Condition Survey for Western Zone,
- Provide the Client with full details of the Consultant's final report;
- Provide a detailed Road Register for all the Narrow Roads captured in the entire Zone.
- Provide a detailed Road Register with updated road conditions for all Classified Roads in the Zone
- Document any challenges encountered and mitigation measures considered by the Consultant and a summary of the Road condition as collected.
- Provide the road lengths of Narrow Roads, Gravel Roads and Earth Roads
- Provide the condition of the Narrow Roads, Gravel Roads and Earth Roads
- Provide Lengths of Narrow Roads for various widths of road reserve, and to
- Provide details of drainage structures in terms of their location and condition.
- Provide statement on other deliverables included Rural Access Index, RICS Data Collection and Update Framework for Classified Roads and RICS Data Collection Manual for Classified and Narrow Roads.

2. APPROACH AND METHODOLOGY

2.1. Approach

This chapter outlines the approach and methodology adopted by the Consultant for the Road Inventory and Condition Survey (RICS) and the subsequent data processing and analysis that culminated in the reporting and development of maps as required by the Terms of Reference.

2.1.1. General

The Road Inventory and Condition Survey work was carried out concurrently in three zones all over the country with SMEC being responsible for the Western and Central Zones. This chapter outlines the approach used for the Central Zone.

The existing GIS data for the zone includes some 50,000 GIS records, one record for each road link. The unique identifier for each road link is a sequential GIS OBJECTID.

The data collected included the following:

- (a) Narrow Roads (Roads with road reserve less than 9m. Additional to the current Classified road network) – new road geometry to be added to the exiting KRB GIS data. The estimated length of additional Narrow Roads in the Central Zone was 30,000 km.
- (b) Gravel Roads – these are existing classified gravel roads. It also includes roads that were formerly Earth Roads that have been upgraded to gravel roads as well as new “Narrow Roads” that were not previously included on the classified road network but that have been constructed since 2009.
- (c) Paved Roads - these are existing classified paved roads. It also includes roads that were formerly earth or gravel roads that have been upgraded to paved roads as well as new “Narrow Roads” that were not previously included on the classified road network but they have been constructed since 2009.

2.1.2. Planning

2.1.2.1. Personnel

The data collection team was established comprising the following:

- (a) A Team Leader for the zone.
The Team Leader provided overall coordination of the data collection exercise as well as Client liaison.
- (b) Mapping/GIS/GPS Expert for the Zone
The duties of this Expert were to manage data quality and to ensure production.
- (c) RICS expert who provided technical assistance and advice.
- (d) Senior Engineer who provided technical assistance and coordination to the field raters and ensured quality of data collection process.

- (e) GIS Specialist whose duty was to process the data received from the field and advise the Mapping/GIS/GPS Expert about the quality of the data as received and processed.
- (f) Two Supervisors who coordinated the data collection exercise and return data to Head Office on a daily basis.
- (g) Ten (10) Field raterers who were assigned the duty of data collection using Mobile Mappers and relaying the information to the Supervisors at the end of each day.
- (h) About ten (10) field workers recruited locally in each county to assist in the identification of locations of Narrow Roads provisions of road names as obtained from the local population.
- (i) Four (4) GIS Operators with the duties of processing and consolidating the data received to meet the ultimate project requirements.

The data was collected per County based on the constituencies in order to manage progress.

2.1.2.2. Equipment and Maps

The team used the Mobile Mapper Office Software to preview and prepare background maps which were then loaded onto the Mobile Mapper data loggers, Constituency by Constituency and County by County. The back-ground maps once loaded onto the Mobile Mapper data loggers were then opened using the on-board Mobile Mapper Field software. The Mobile Mappers had Open Street Maps (OSM) and Satellite Imagery on which the loaded shapefile maps appeared as overlays.

The field teams also had printed Maps showing all the RICS 2009 classified roads and towns, Constituency by Constituency or County by County as need be. Together with the pre-loaded background maps on the Mobile Mappers, gave complete guidance and assistance for self-location of the field survey teams during site inspections when identifying Narrow roads, classified gravel and earth roads.

2.1.2.3. Correspondence

Kenya Roads Board issued introduction letters to County Officials, including the Police, County Commissioners, County Secretaries, KeNHA, KURA and KeRRA County Leaders, and KWS directors in each county informing them of the assignment given to the Consultant in Central Zone. In these letters, KRB asked the County Officials to assist the Consultant team members during the data collection assignment. These letters were supplemented by the Consultant's letters written to the same county leaders emphasizing the same need.

2.1.2.4. Meetings

Under the guidance of the Team Leader and prior to commencement of data collection in each county, the field team held Entry Meetings to inform the County Leaders and other stakeholders of the data collection assignment and to seek their cooperation and local knowledge.

At the end of the scheduled field activities in each county, the Consultant's team convened an Exit Meeting to thank the County Officials for their assistance and also report on the

status of the data collection exercise, as well as any challenges faced during the assignment in the county.

2.1.2.5. Progress Monitoring

The Team Leader, prepared a programme showing the activities to be undertaken in each County, Constituency by Constituency, and over specific periods. This programme was handed over to the Field Supervisors for their logistics and planning. The supervisors, at the end of each county, reported back to the Team Leader with details of the achievements against the programme.

During the initial stages of the assignment, the Client invited all the RICS Consultants for a number of meetings to discuss and harmonize the Data dictionary to be adopted for the project. This was done to ensure that all the parameters/attributes collected during the fieldwork are uniform across the three Zones. Data attributes were collected for the following features, Road, Bridges, Pipe Culverts, Box Culverts, Slab Culverts, Drifts, Rivers, Towns, Facilities, Institutions, Railway Crossings and Maintenance Problems

At a meeting held on 8th September 2016, the harmonized Data Dictionary was reviewed and finalized for adoption.

2.2. Methodology

2.2.1. Preparation for Data Collection

The survey team carried out the detailed Inventory and Condition Survey for narrow roads using Spectra Precision Mobile-Mapper 50 4G (MM50) with Mobile-Mapper Field software, with the defined data dictionary approved by the Client.

Geo-referenced background maps showing the classified road network, towns, facilities and any other features that were collected during the previous RICS study were loaded onto the Mobile-Mapper to assist the survey teams to know their actual locations as they collected the data on narrow roads. Additionally, the MM50 had Open Street Maps (OSM) by default and Satellite Imagery in the background for further assistance/guidance to the site staff during inspections, ensuring that there were no gaps in data collection.

Each member of the survey team was assigned a Constituency within the County with the Constituency boundaries also loaded onto the MM50 along with the Classified Roads within the Constituency in order to avoid duplication of data collected in the field. As the survey progressed, the geo-referenced background maps were continuously used as a real-time guide, with the analysed data in the form of overlying lines and attributes ("Shapefiles") stored so as to ensure that the survey team did not leave any narrow roads or surveyed any narrow road twice.

The method, described above, was also applied in the collection of updated Road Condition data for the gravel roads, where the lower version Mobile Mapper 20 (MM20) was sufficient in capturing the existing road conditions of the classified Gravel roads. The MM20 also used

background map data input from the previous RICS Survey 2009 and updated the information in real-time as the data collector moved along the road collecting data.

2.2.2. Field data collection

2.2.2.1. Inspections

During fieldwork, the team members first entered their designated initials onto the Mobile Mappers assigned to each one of them. They also loaded the shapefiles of the classified road network from the RICS 2009 survey Constituency-by-Constituency onto their Mobile Mappers. They then moved to designated beginning junctions of each road link to be rated and began observing conditions of the roads until the end of the road as per its existing length.

A series of attribute information including GPS location data and geo-tagged images were recorded as per the data dictionary, section-by-section, as the road condition changed.

A provision was made for classified roads which had changed status in terms of road lengths or surface types (for example, a road that was previously an earth or gravel road might have become graveled or paved respectively) and such changes were thus recorded. Where a road status (specifically "Surface Type") had changed, a geo-referenced image showing the changed status was also taken and recorded.

The Narrow Roads field rater also took photographs at the beginning and end of each link of road, recording thus their junctions with the classified road network at the turnoff approaches and their ends. In addition, where any exceptional circumstances were observed on the classified road network, geo-referenced photographs were taken under the heading "Maintenance Condition" on the Mobile-Mapper.

For Narrow roads, when the field rater reached the start of a narrow road a Geo-Referenced photograph was taken with the Mobile-Mapper. Field raters ensured that the Mobile-Mapper had obtained a coordinate fix before taking the photograph.

The Field rater then traveled along the road and inspected features including all culverts, bridges, facilities and railway crossings along the way, taking at least two photographs of each culvert and bridge as well as photographs of the road at least one near the midpoint of the road to obtain a clear view of the road. Field raters ensured that photographs showed sufficient context and they were not zoomed too closely to the subject matter.

When the Field Rater approached the end of the road, a photograph was again taken at a distance varying from 25 to 50 m from the end. The photograph showed the road itself as well as the nature for the road ending. In some cases, more than one photograph were taken to show the road end-point and associated reasons for terminating the inspection.

2.2.2.2. Data Flow

At the end of each day, the Field raters returned to the base to transfer the fieldwork data to the Supervisor's computer. At the same time the condition of all roads travelled over were discussed to enable the supervisor get a good indication of the overall conditions of the road network in the area. The print maps were marked to show each classified earth road link based on the inspector's observations of roads over which they travelled. All road type changes, including new gravel roads and new paved roads, on the classified road network were recorded on the Mobile Mappers. The supervisor ensured that all newly graveled classified roads, previously earth roads, were subsequently inspected by the gravel road inspection team, using Mobile Mapper , while all recorded sections of newly paved roads were passed on to the Mapping/GIS/GPS Expert to forward to the Paved Roads inspection team.

The Supervisor sent a ".zip file" of the data to the Head Office for storage on the server as raw data using the 'Constituency', 'County' and 'Date' collectively as the primary identifiers for the collected data on the server.

The GIS operators copied the Raw Data to their local machines and edited the shapefiles to produce a merged and integrated map of all the roads surveyed for each day in each county.

The grid developed by the Consultant's RICS Expert was used to edit the data received from the field to check if any narrow road had been left out for the supervisors to be alerted for correction.

The GIS operators used the Google Earth Satellite imagery as background to check that road intersections were correct and that links had been correctly subdivided. When all the road shapefiles were merged for the day, all the roads in the shapefile were corrected for any outlier kinks in the Quantum-GIS (Q-GIS) software.

The other shapefiles were also merged into single files for each day per county. The result was in separate shapefiles, one for each Category of infrastructure as follows:

- (i) Narrow Earth Roads
- (ii) Narrow Gravel Roads
- (iii) Narrow Paved Roads
- (iv) Bridges
- (v) Culverts
- (vi) Railway Crossings
- (vii) Drifts
- (viii) Facilities
- (ix) Maintenance Problems
- (x) Institutions

The completed consolidated shapefiles were saved on the server and passed to the GIS Database Expert to consolidate with other County Shapefiles for each of the above infrastructure Categories.

When the data was forwarded to the Head Office (HO), the photographs were renamed using the Batch Renaming Utility (BRU). The renaming was made by Date, Month, Year and initials of the rater were appended to make each image unique.

The photographs were also Geo-tagged using EXIF Reader Software to know the location of a particular photograph and relate it to the object that was photographed.

The photographs were resized to "Small 2560 x 1920", before adding them to the county folder in order to reduce their footprint on storage since each image taken was at least 5MB and there were thousands of such images per County.

Finally the output file with the coordinates of each photograph was saved as a shapefile and stored on the same folder as the photographs.

The photographs on the county folder were copied to external drives for the Technical Coordinators to view on their computers together with the other GIS information.

The technical coordinators reviewed the County data on a daily basis to assess the quality of the data and ensured that the photographs provided adequate representation of the inspected features.

The technical coordinators also monitored the progress across the county by daily assessing statistics of the length of new roads added and coverage across the county and reported this to the Team Leaders.

When inspection of a county's roads was complete the Technical Coordinators obtained the Supervisor's previously printed Classified Roads hard-copy maps with all of the Inspectors' and Supervisors' comments on the conditions of the roads as well as details of any newly paved and gravelled roads. In particular, they assessed the conditions of earth roads and filled in Inspection Forms for Classified Roads that had photographs based on the photograph and the Inspector's rating for the road that was marked on the map. They ensured that the resulting length of roads rated was around 5% of the County's earth roads in total. This provided a basis for discussion of the earth road conditions with the county engineers.

During the initial consultative meetings to harmonize the RICS assignment, it was jointly agreed with the Client that the following pattern or formula would be used to assign Road Numbers to Narrow roads and the New Roads;

Road Classification:

- All Roads not in the KRB 2009 Geo-Database with Road Reserves of **9m and above** were considered to be **New Roads**. These were classified by Surface Types and Road Reserve width.

Table 2.1: Classification for New Roads

SURFACE TYPE	RD RESERVE WIDTH (m)	CLASS
Earth	9 - 20	"CLASS G"
	21 - 40	"CLASS F"
Gravel	9 - 40	"CLASS E"
Paved	9 - 40	"CLASS D"

- All Roads not in the KRB 2009 Database but with Road Reserves of below 9m were considered Narrow Roads. THESE WERE ALL GIVEN "**CLASS NR**"

Assigning Road Numbers:

- For New Roads:
Class_County Code_N (new) **_Route Number** (Systematically assigned) for example;
 - "**G_22_N_359**" is a New Earth Road in Kiambu County (County Number 22) with a Road Reserve between (9-20) meters
- For Narrow Roads (Below 9m Road Reserve)
Class_County Code_Route Number for example;
 - "**NR_32_983**" is a Narrow Road in Nakuru County (County number 32) with a road reserve under 9 meters, (regardless of surface type).

2.2.2.3. Final Consolidation

All road shapefiles, merged per County were merged together and this was in turn merged with the KRB roads for the zone. The other infrastructure shapefiles were retained per county.

During the data analysis, the Consultant's personnel assigned numbers to the narrow roads as NR_04_350 where NR referred to Narrow Road, 04 was for the County Number (as given in the National Records) and 350 designated the road numerical value. The new roads and existing roads as well as new inspections were being integrated on existing roads.

2.2.3. Data collection for Classified Gravel Roads

2.2.3.1. Inspections

The Field Raters entered their designated team initials in the Mobile Mappers allocated to them and drove over the allocated routes to the gravel roads scheduled for inspection. Any newly gravelled roads identified along the way were also inspected.

Photographs were taken on all gravel roads at the point when the road section was rated as the road condition changed and at the road end. All inspections were preceded by recording the road numbering into the Mobile Mapper.

2.2.3.2. Data Flow

The Field raters returned to base and transferred the Mobile Mapper data to the Supervisor's computers. They also discussed the roads inspected and marked up the earth roads on the hard copy maps. They also reported on any classified roads that have been newly paved since the 2009 data collection.

The supervisor sent the data to the Head Office as well as a list of newly paved roads that were identified.

The data was reviewed by the GIS team to check consistency with the existing KRB shapefile data and the shapefile for all the roads inspected for that day were merged together by the GIS team and stored on the server. Subsequently, all the daily data was merged County-by-County by the GIS team.

Finally the merged gravel roads data was joined to the KRB roads shapefile using the road numbering.

2.2.4. Data collection for Classified Earth Roads

The team undertook data collection on a representative sample of 5% of the Classified Earth Roads in each County. The length of the 5% was computed on the basis of:

$$L_5 = 5\% \times P$$

Where;

L_5 is the length of the 5% sample and P is the Earth Roads Length for each county from the KRB 2009 data register.

The condition of all the Earth Roads were rated in liaison with the Roads Authorities (KeNHA, KURA, KeRRA and County) personnel based on their knowledge and experience in the localities.

The condition of the 5%, stated above, was compared with the condition rating obtained from the Roads Authorities.

2.2.5. Rating of Earth roads

The Terms of Reference requires the Consultant to carryout Road Inventory and condition survey of at least 5% of the Classified Earth roads. In addition, the Consultant was to liaise with KeRRA Regional Managers and especially the County Road Officers (CROs) to assist in rating the condition of the Earth roads as listed from the Client's Geo-database.

In order for the rating to be carried out in a consistent and accurate manner, the Consultant developed a simplified rating guidelines for the CRO's capturing the following;

1. Road Usage

Road usage to be done based on the average daily traffic flow along the road link.

(i) Earth Roads:

Rare: 0 – 5 vehicles per day

Used: 6 – 20 vehicles per day

Busy: 21 – 200 vehicles per day

Very busy: over 200 vehicles per day

2. Surface Condition

Riding quality and average speed shall be used to rate the Surface Condition. The following shall apply.

- Poor – Generally potholed allowing very slow speeds < 10km/h.
- Fair – Occasional potholes with speeds between 10 – 30 km/h possible.
- Good – Well shaped riding surface with speeds > 30km/h.

3. Drainage Condition

The Drainage Condition to be rated using the following;

- Quality of side drains
- Cross drainage
- Depending on severity, rate as Poor, Fair or Good

4. Remarks/ Maintenance issues

This is to be used to report any other outstanding issue of importance on the road link e.g. Impassability due to heavy erosion, cut-off due to drainage problems, collapsed bridge, upgraded from earth roads to gravel/paved standard etc.

This simplified manual was used in training the CROs to ensure that the rating provided was standardized.

2.2.6. Classified Paved Roads

2.2.6.1. Inspection of Structures

The inventory and condition survey for structures on paved roads was undertaken by one data collection team comprising 2 No. field raters.

Mobile-Mapper 20 was used to record and collect the data for structures as per the data dictionary approved by the Client. Inspection of structures was carried out on County by County basis.

The Mobile Mapper was preloaded with background maps consisting of paved roads of the 2009 RICS. The field raters were also equipped with hard copy county maps consisting of

paved roads to enable them identify their location while undertaking the study and while ensuring that all roads, including newly upgraded paved roads, were surveyed within the county.

While collecting inventory and condition data for structures on paved roads, the field raters took photographs as customized in the Mobile Mapper as detailed below:

- Bridges: Bridge approaches, Bridge inlet and outlet
- Box culverts, drifts and pipe culverts: culvert inlet and outlets.

All inspections were preceded by recording the road numbering into the Mobile Mapper.

2.2.6.2. FWD Data Collection by Profiler

(a) Sub-Contract

Collection of condition data on Paved Roads was sub-contracted to the Materials Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure, Housing and Urban Development (MoTIHUD). This entailed a test method that defined the procedure for measuring the deflection response of road pavements using the Falling Weight Deflectometer (FWD).

Falling Weight Deflectometer is a vehicle-mounted or towed device that records pavement surface deflection bowls at discrete test points on the pavement surface. Surface deflections are measured at distances ranging from 0 mm to a user-defined maximum (to 2,100 mm) from the centre of an impulse test load. The load is applied to the pavement surface through a standard loading plate, normally 300 mm in diameter, by a falling weight with a variable drop height while the FWD was at rest.

(b) FWD Data processing and Calculations

Deflection measurements are conducted using impulse type deflection equipment. The equipment meets requirement of ASTM D4694, 2009 and ASTM D 4695, 1996. Deflection measurements were carried out on outer lanes at intervals of approximately 1.0 km on the outer wheel path (OWP). At each drop point, readings were taken for the nine (9) consecutive geophone points of 0, 20, 30, 60, 90, 120, 150, 180, and 210 cm. The parameter recorded during a FWD test include GPS location, linear reference, deflection readings, test temperature, test load and pulse time as indicated below depicting raw FWD file.

Table 2.1: Typical FWD Data File

\$2															
Chainage[m].....	200														
Lane.....	LHS														
Pavement description...	ASPHALT														
Remarks.....	OAK TREE SCHOOL ON THE LHS														
Position of Drop:	Longitude: East 36°58'0.82",			Latitude: South 1°26'14.44",			Altitude: 0.8 m								
\$3															
Sequence: 1/1	No. of drops: 2		Fallheight: 108		Time: 12:03										
Drop	D(1)	D(2)	D(3)	D(4)	D(5)	D(6)	D(7)	D(8)	D(9)	kPa	kN	Air	Sur.	Man.	Pulse time
1	102	81	72	51	45	41	30	21	17	681	48.14	33.4	31.2	49.5	26.26
2	100	80	71	50	45	41	30	22	18	660	46.63	33.4	31.3	49.5	26.15

The deflection sensor readings of the final loading cycles is adjusted to estimate the deflection readings that would result from a load level exactly equal to the target load

level. This process is usually called 'normalizing'. The normalized deflections were determined using the following equation:

$$d_n = \{d_i \times L_t\} / \{L_i\}$$

Where d_i is the deflection reading for the sensor located i mm from the centre, d_n is the normalized deflection reading for the sensor located i mm from the centre, L_i is the load level applied during the test and L_t is the target load level of 707 KPa based on the standard axle of (50-KN) 10-ton.

Deflection geophone details are labelled as per table below.

Table 2.2: Deflection geophone Details

Geophone by offset	D ₀	D ₂₀₀	D ₃₀₀	D ₆₀₀	D ₉₀₀	D ₁₂₀₀	D ₁₅₀₀	D ₁₈₀₀	D ₂₁₀₀
Geophone by position	D1	D2	D3	D4	D5	D6	D7	D8	D9
Normalized data geophone naming	ND1	ND2	ND3	ND4	ND5	ND6	ND7	ND8	ND9

FWD data in notepad fwd format is opened using xls and then saved in xls format. Basic analysis by normalization is conducted on the collected data in view to report all deflections in a standard pressure of 707 KPa of 50KN load in order to simulate a dual wheel assembly of 10-ton as stated above.

2.2.6.3. Roughness Data Collection by Profiler

(a) Scope

Laser Profiler was used to determine pavement surface roughness. The procedure followed was described in the Operators User Manuals for the Laser Profiler (Hawkeye 2000 Series) published by ARRB Group Ltd.

(b) Data Collection

The speed of operation was set at a speed permitted for that section of road, but not less than 40 km/h and not greater than 95km/h, at a steady rate. The computer was activated at the commencement of the survey zone and any physical features that would affect the ride quality were recorded. The records included any significant intersections, road and reference markers. Adequate lead-in and lead-out were observed at the start and end of each survey e.g. 50m.

(c) Processing and Calculations

The processing of the roughness data survey was handled by the system software detailed in the ARRB Group manual 'Hawkeye Processing Toolkit, Data Viewer.

2.3. Challenges encountered during the data collection

2.3.1. Determination of Road Reserve Width

During the process of determining and measuring the road reserve widths, a number of features were encountered. These included fences, proximity of farm lands to the drainage edges and lines of trees. In most cases, fences were used to define the road reserve edges to arrive at the road reserve width and in a few instances, the cut edge of the drainage side slope was the determining factor for the road reserve especially for Narrow Roads.

There were cases where the road passed through flat open land with no definite edges for the road reserve. The team considered the extreme outer edge of the tyre marks plus about 5 m for what would be the drain as the limit of the road reserve

2.3.2. Road Naming

There were few challenges in naming of Classified Roads as listed in the inventory of 2009. These included consistently one name for the road instead of the start and end to define the road. In order to correct these, the field teams noted permanent features or landmarks at starts and ends of the roads where possible.

Numbering of Narrow Roads had initially proved a challenge. During a meeting held with the Client held on 29 November 2016, it was agreed that the Narrow Roads be numbered as described elsewhere in this report.

2.3.3. Security

Security challenges were encountered especially in Laikipia, Isiolo, Wajir and mandera counties.

The Consultant however managed to carry out RICS exercise in Laikipia and Isiolo by working closely with the local administration including the Deputy County Commissioners, Assistant County Commissioners, Chiefs and Assistant Chiefs during the fieldwork. For Wajir and Mandera, the Consultant engaged the local personnel from KeRRA and the County Government. They were trained in RICS data collection.

3. FINAL ROAD REGISTER

3.1. Fieldwork

The Consultant was able to cover all the 13 counties listed in the Central Zone except two constituencies, Lafey and Mandera South in Mandera county due to the security situation in the area.

Approximately 52,721 km of the Classified Paved, Gravel and Earth Roads was surveyed against the planned length of 53,022 km from the 2009 RICS. 99.4% of the network was therefore covered during the exercise.

The Narrow Roads length achieved in all the thirteen counties was 23,966 km against the estimated (planned) length of 26,511 km making 90.4%. The achieved length of Narrow Roads with the Road Reserve width less than 6m was 4,113 km about 17.2%. This was found to be less than the 30% limit noted in the ToR.

In total 76,687 km of the road network in Central Zone was surveyed.

A summary of the road network covered per county is shown in Table 3.1 below;

Table 3.1: Summary of the Road Length Surveyed

No.	COUNTY	LENGTH OF ROADS SURVEYED (Km)									Total Network Surveyed
		CLASSIFIED ROADS			NARROW ROADS						
		Planned	Surveyed	%	Planned	Surveyed	%	≥6m (km)	<6m (km)	% ≥6m	Actual
1	Kiambu	5,374.00	5372.798	99.98%	2,687.00	2555.071	95.09%	1946.706	608.365	76.19%	7,927.87
2	Nakuru	9,618.00	9606.377	99.88%	4,809.00	6296.465	130.93%	5131.347	1165.118	81.50%	15,902.84
3	Nyandarua	3,624.60	3613.294	99.69%	1,812.30	1242.6	68.56%	1071.666	170.934	86.24%	4,855.89
4	Nyeri	4,010.90	3991.832	99.52%	2,005.45	1364.412	68.04%	1131.075	233.337	82.90%	5,356.24
5	Kirinyaga	2,311.60	2304.766	99.70%	1,155.80	841.297	72.79%	717.93	123.367	85.34%	3,146.06
6	Embu	3,204.90	3200.439	99.86%	1,602.45	789.072	49.24%	550.501	238.571	69.77%	3,989.51
7	Tharaka Nithi	1,735.70	1716.056	98.87%	867.85	990.561	114.14%	707.147	283.414	71.39%	2,706.62
8	Meru	4,840.60	4835.172	99.89%	2,420.30	3735.723	154.35%	2977.941	757.782	79.72%	8,570.89
9	Muranga	3,957.55	3939.366	99.54%	1,978.77	1540.778	77.87%	1154.528	386.25	74.93%	5,480.14
10	Laikipia	3,205.64	3166.542	98.78%	1,602.82	1466.487	91.49%	1405.863	60.624	95.87%	4,633.03
11	Isiolo	2,819.45	2723.649	96.60%	1,409.73	309.765	21.97%	263.64	46.125	85.11%	3,033.41
12	Wajir	5,236.53	5168.028	98.69%	2,618.27	2267.607	86.61%	2260.216	7.391	99.67%	7,435.64
13	Mandera	3,082.96	3082.923	100.00%	1,541.48	566.831	36.77%	534.547	32.284	94.30%	3,649.75
	Sub-Total	53,022.43	52,721.24	99.43%	26,511.22	23,966.67	90.40%	19,853.11	4,113.56	82.84%	76,687.91

3.2. Key Findings

3.2.1. Road Surface Type and Condition

The following chapter is a presentation of the key findings from the analysis of the fieldwork data.

In summary, 54.3% of all the Paved road network in the thirteen counties were found to be in Good condition, 33.8% were in Fair while 9.8% were in Poor condition. Only 2.2% were Under construction.

The fieldwork results also showed that 16.8% of all the Unpaved road network in the thirteen counties were in Good condition, 43.0% was in Fair while 39.8% was in Poor condition. Only 0.3% was under construction.

The fieldwork data have also been analysed and presented in various details as presented hereunder and in the appendices to this report.

Table 1A in Appendix 1 shows the overall summary of the Surface Type and Road Condition for the entire Central Zone.

Table 3.2 below shows a summary of the Paved road condition per county.

Table 3.2: A Summary of the paved road condition per county

COUNTY	SURFACE CONDITION (%)				TOTAL LENGTH (Km)
	Good	Fair	Poor	Under Construction	
Kiambu	52.75%	28.44%	16.03%	2.78%	1158.167
Nakuru	24.81%	55.28%	18.07%	1.84%	1063.891
Nyandarua	67.69%	29.55%	2.76%	0.00%	312.359
Nyeri	63.55%	29.12%	4.75%	2.58%	777.233
Kirinyaga	61.52%	35.47%	3.01%	0.00%	250.376
Embu	84.93%	9.12%	4.63%	1.32%	297.014
TharakaNi	85.23%	2.40%	0.00%	12.38%	108.045
Meru	70.02%	23.57%	5.39%	1.03%	634.904
Muranga	55.90%	34.85%	9.04%	0.21%	762.649
Laikipia	35.71%	59.66%	3.40%	1.23%	326.371
isiolo	92.06%	1.77%	6.16%	0.00%	34.009
Wajir	100.00%	0.00%	0.00%	0.00%	25.233
Mandera	53.32%	6.42%	12.11%	28.15%	87.261
OVERALL (%)	54.29%	33.76%	9.79%	2.16%	5,837.51

Table 3.3 below shows a Summary of the Unpaved road condition per county.

Table 3.3: A Summary of the Unpaved road condition per county

COUNTY	SURFACE CONDITION (%)				TOTAL LENGTH (Km)
	Good	Fair	Poor	Under Construction	
Kiambu	14.33%	41.58%	43.55%	0.53%	6769.373
Nakuru	11.06%	36.08%	52.77%	0.09%	14838.979
Nyandarua	17.95%	58.73%	23.32%	0.01%	4543.535
Nyeri	10.91%	55.68%	33.33%	0.09%	4579.011
Kirinyaga	13.01%	55.80%	31.20%	0.00%	2895.687
Embu	18.68%	47.71%	33.43%	0.18%	3692.497
TharakaNi	14.12%	51.42%	34.02%	0.44%	2598.572
Meru	7.93%	44.40%	47.24%	0.44%	7935.991
Muranga	19.09%	49.19%	31.60%	0.12%	4717.495
Laikipia	19.55%	45.76%	34.35%	0.33%	4308.923
isiolo	9.94%	32.03%	57.65%	0.37%	2999.405
Wajir	9.07%	46.24%	44.69%	0.00%	7410.402
Mandera	29.22%	20.57%	50.20%	0.01%	3562.493
	13.75%	43.80%	42.25%	0.19%	70852.363
OVERALL (%)	16.84%	43.04%	39.78%	0.34%	76,689.88

Figure 3.1 below shows the overall road condition per county.

Fig 3.1: Graph of Overall road condition per county

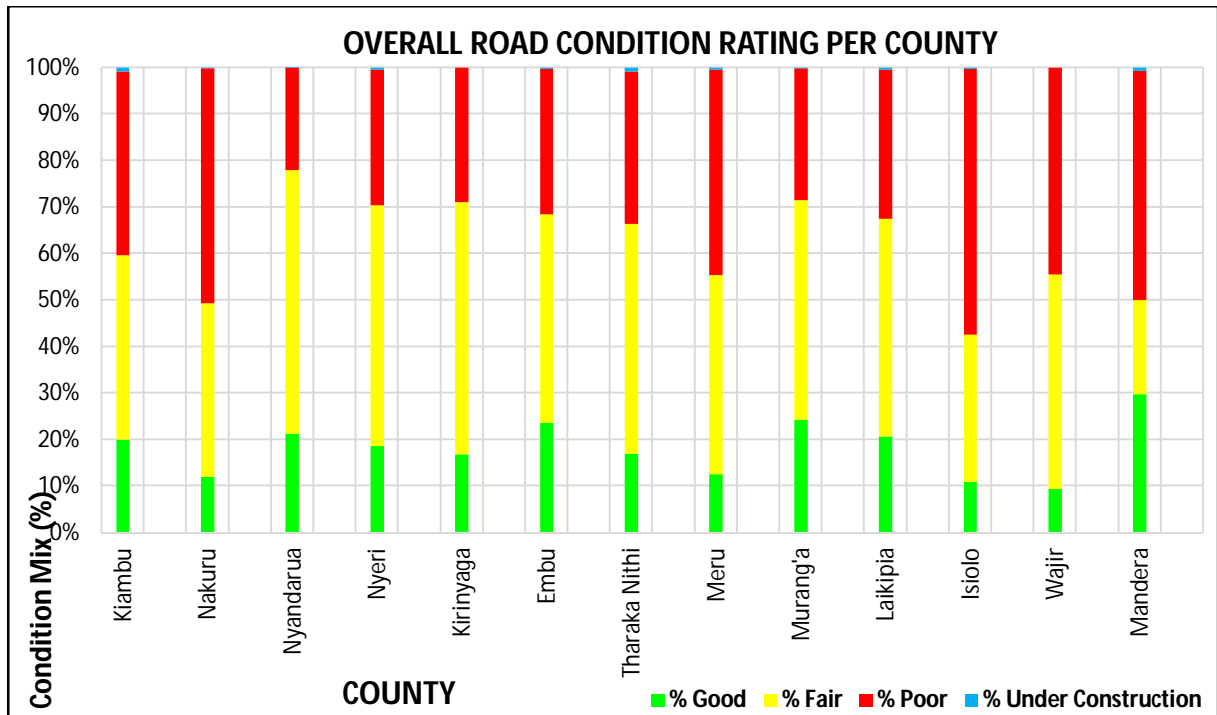


Table 1B in Appendix 1 shows a summary of the Surface Type and Road Condition per county.

3.2.2. Road Surface Type and Condition per Road Class

The fieldwork data has also been analysed and presented in terms of the Surface type and condition per Road class.

a) Overall Surface Condition per Road Class (Classified Roads)

Table 2A in Appendix 1 shows a detailed summary of the Surface type and road condition per road class for the Classified roads in the Central Zone.

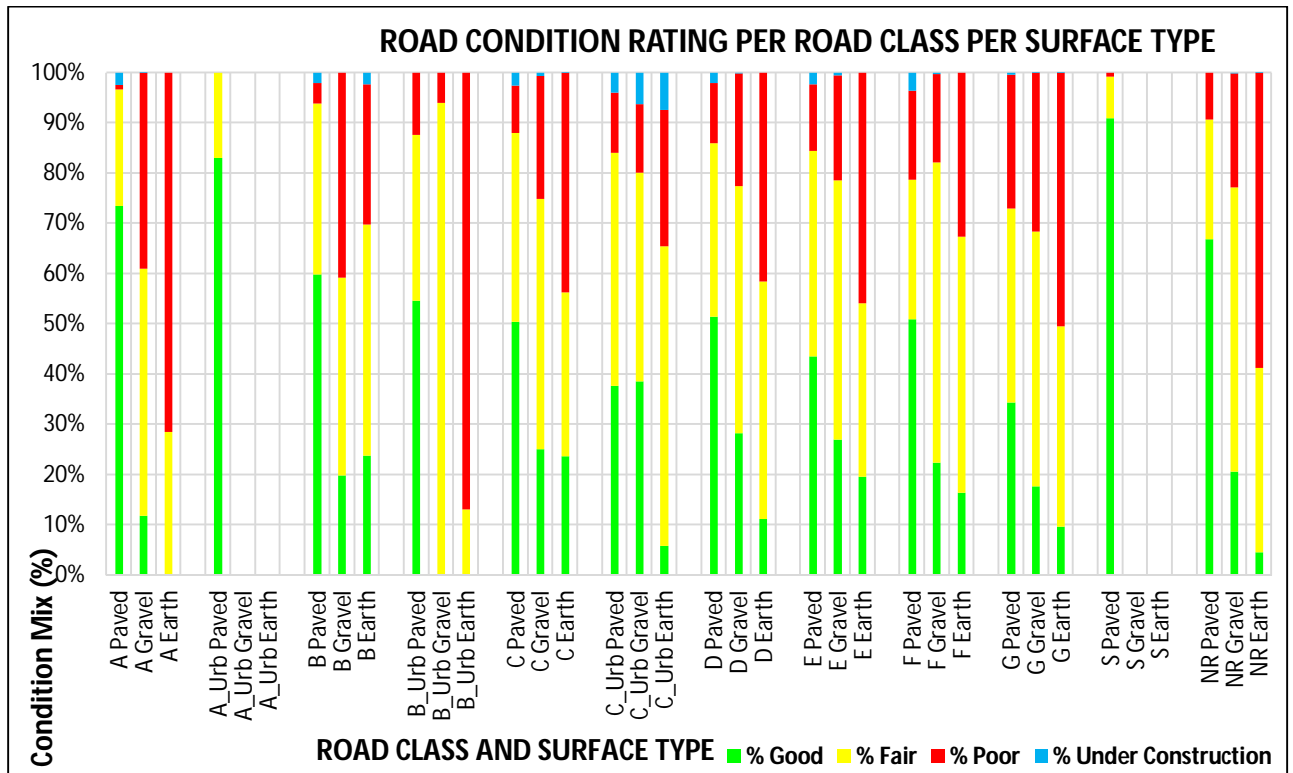
The following Table 3.4 shows the overall road condition per road class for the entire Central Zone.

Table 3.4: A Summary of the Overall road condition per road Class (Classified roads)

ROAD CLASS	Good	Fair	Poor	Under Construction	TOTAL
A	815.025	677.954	542.226	25.09	2060.295
	39.56%	32.91%	26.32%	1.22%	100.00%
A_urb	18.736	3.85			22.586
	82.95%	17.05%	0.00%	0.00%	100.00%
B	1010.92	1128.481	649.31	45.143	2833.854
	35.67%	39.82%	22.91%	1.59%	100.00%
B_urb	33.024	26.737	9.508		69.269
	47.68%	38.60%	13.73%	0.00%	100.00%
C	1874.752	2495.575	1510.403	61.121	5941.851
	31.55%	42.00%	25.42%	1.03%	100.00%
C_urb	110.171	157.946	52.607	19.535	340.259
	32.38%	46.42%	15.46%	5.74%	100.00%
D	907.799	1528.032	870.996	15.812	3322.639
	27.32%	45.99%	26.21%	0.48%	100.00%
E	1406.459	2478.447	1338.338	30.457	5253.701
	26.77%	47.18%	25.47%	0.58%	100.00%
F	945.387	2500.297	1183.501	12.95	4642.135
	20.37%	53.86%	25.49%	0.28%	100.00%
G	4427.427	15295.534	15831.627	42.899	35597.487
	12.44%	42.97%	44.47%	0.12%	100.00%
NR	1280.469	6706.911	8517.969	10.978	16516.327
	7.75%	40.61%	51.57%	0.07%	100.00%
S	78.813	7.128	0.703		86.644
	90.96%	8.23%	0.81%	0.00%	100.00%
TOTAL (Km)	12911.81	33006.892	30507.188	263.985	76689.875
CONDITION %	16.84%	43.04%	39.78%	0.34%	100.00%

Figure 3.2 below shows a graph of the overall road condition rating per road class per surface type.

Fig 3.2: Graph of Overall road condition per road Class per Surface type



Figures 3.3 and 3.4 below shows graphs of the overall road condition rating per road class for Paved and Unpaved roads respectively.

Fig 3.3: Graph of Overall road condition per road Class (Paved Roads)

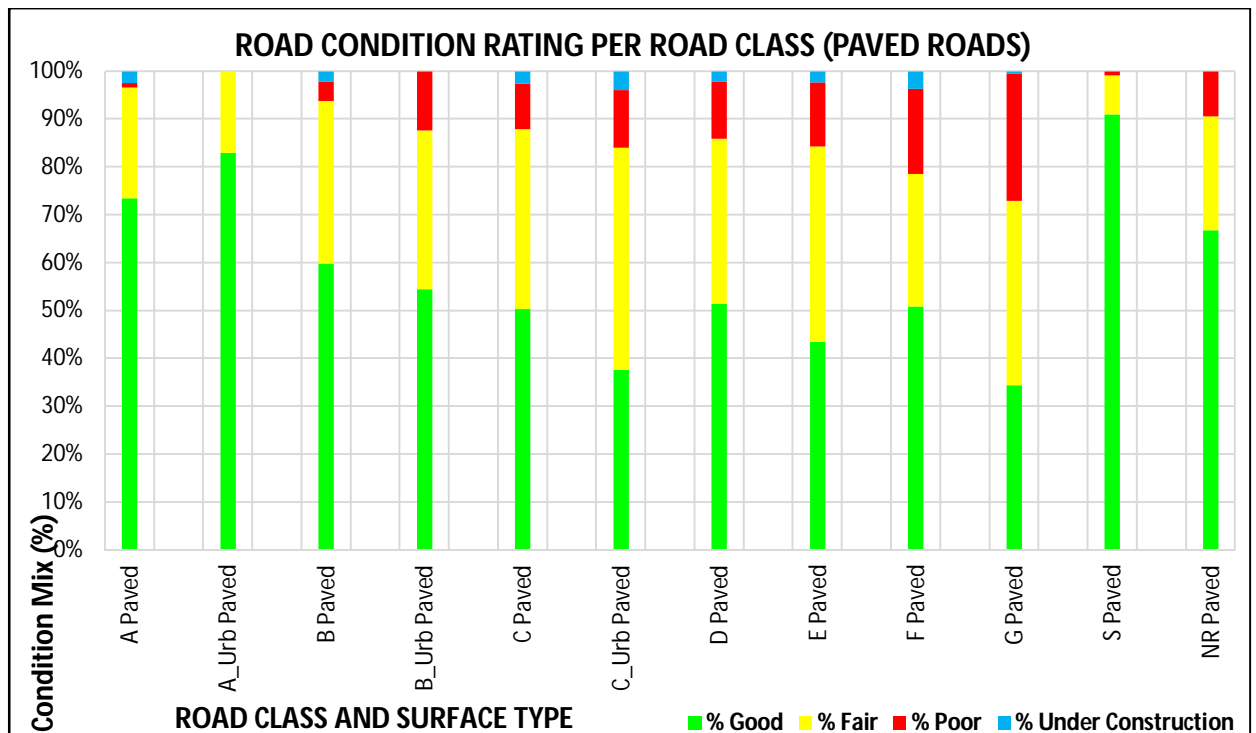
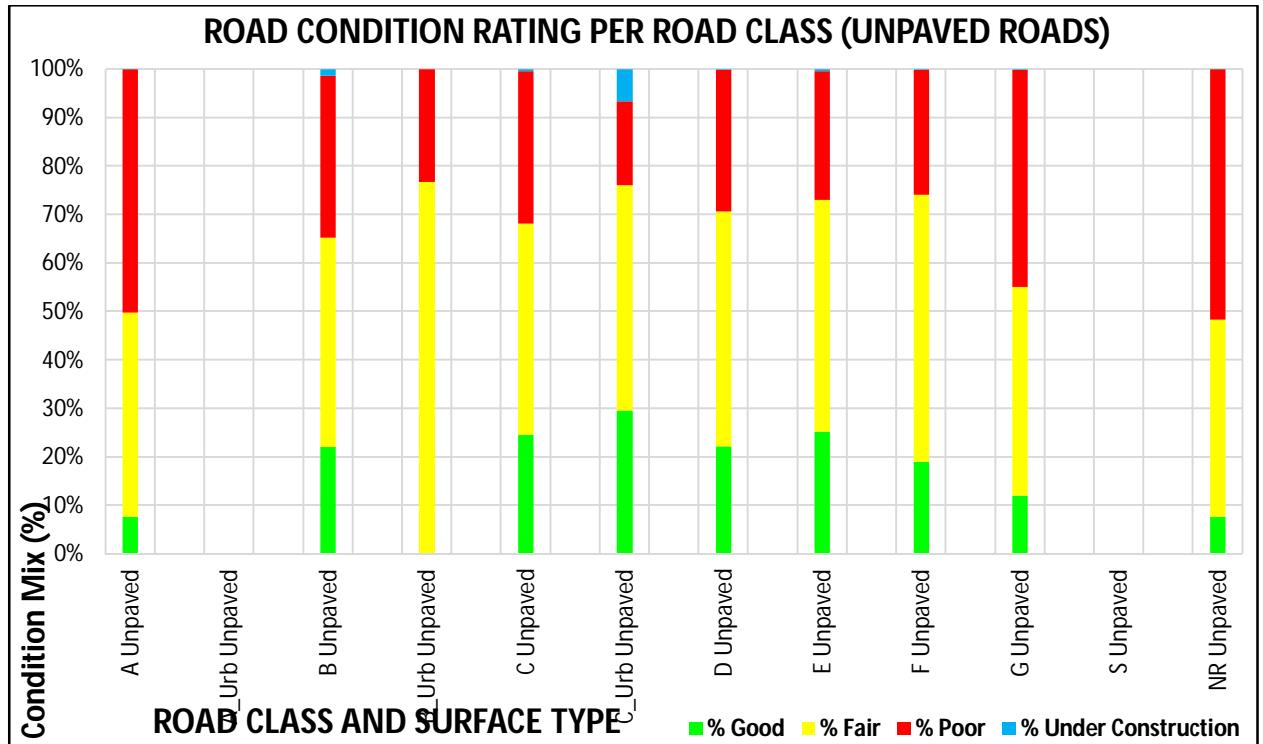


Fig 3.4: Graph of Overall road condition per road Class (Unpaved roads)



b) Road Surface Type and Condition per Road Class per County (Classified Roads)

Table 2B in Appendix 1 shows a detailed summary of the Surface Type and Road Condition per Road Class for Classified Roads per County.

Figures 3.5 and 3.6 below is a presentation of the Surface type and Condition per road Class per County for both Paved and Unpaved roads.

Fig 3.5: Graph of Overall road condition per road Class per County (Paved roads)

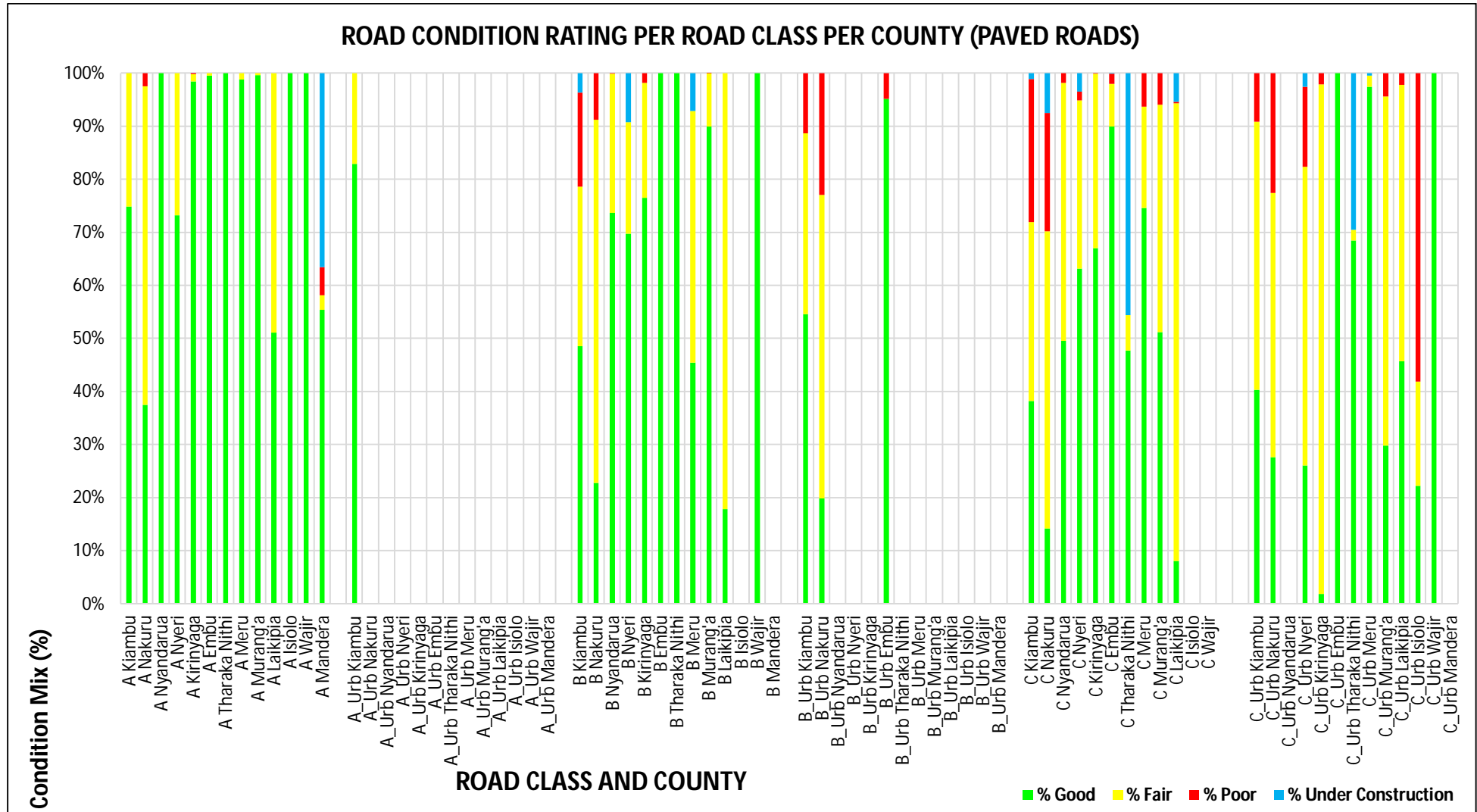


Fig 3.5 (cont'd): Graph of Overall road condition per road Class (Paved roads)

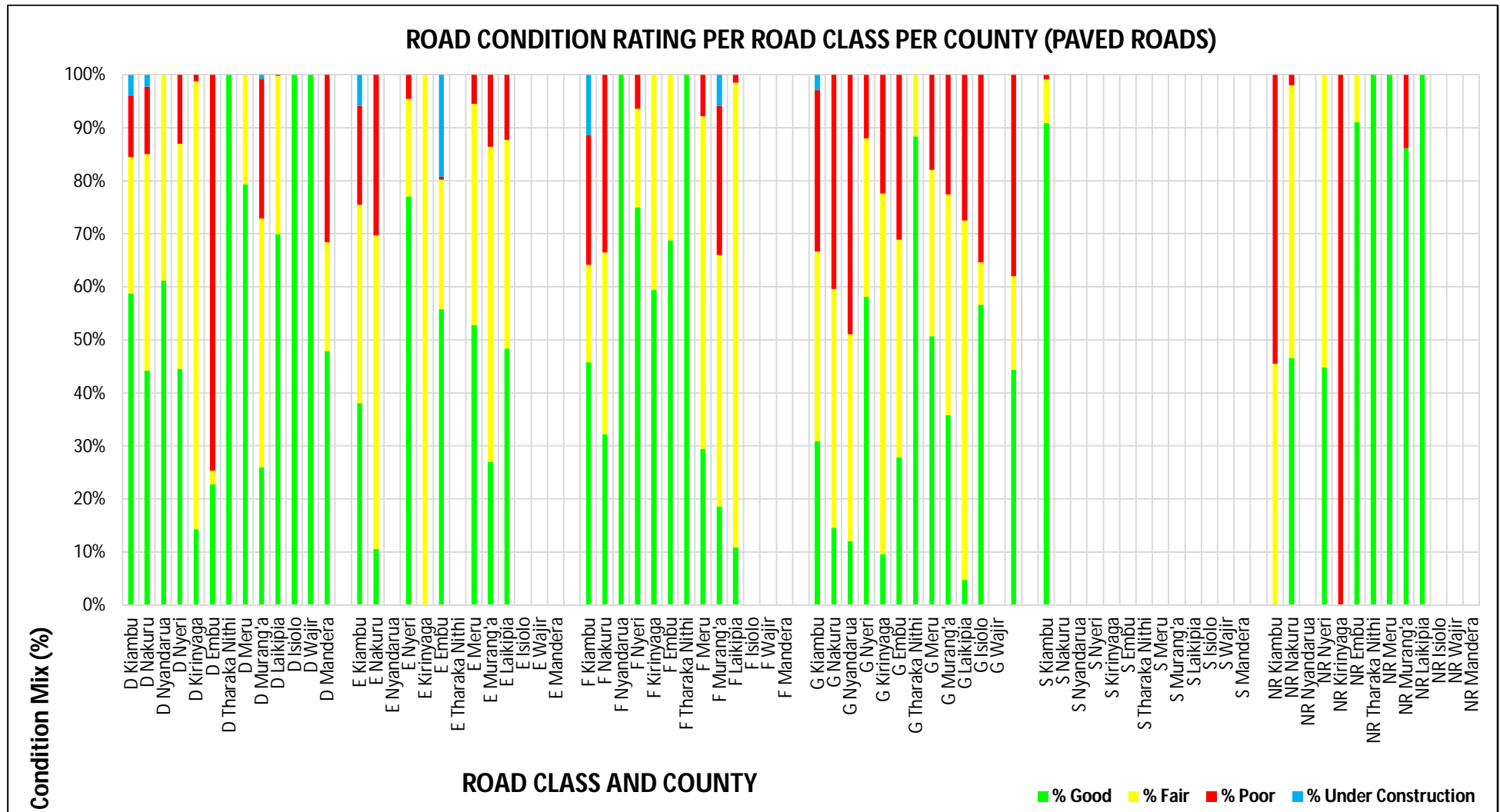


Fig 3.6 : Graph of Overall road condition per road Class (Unpaved roads)

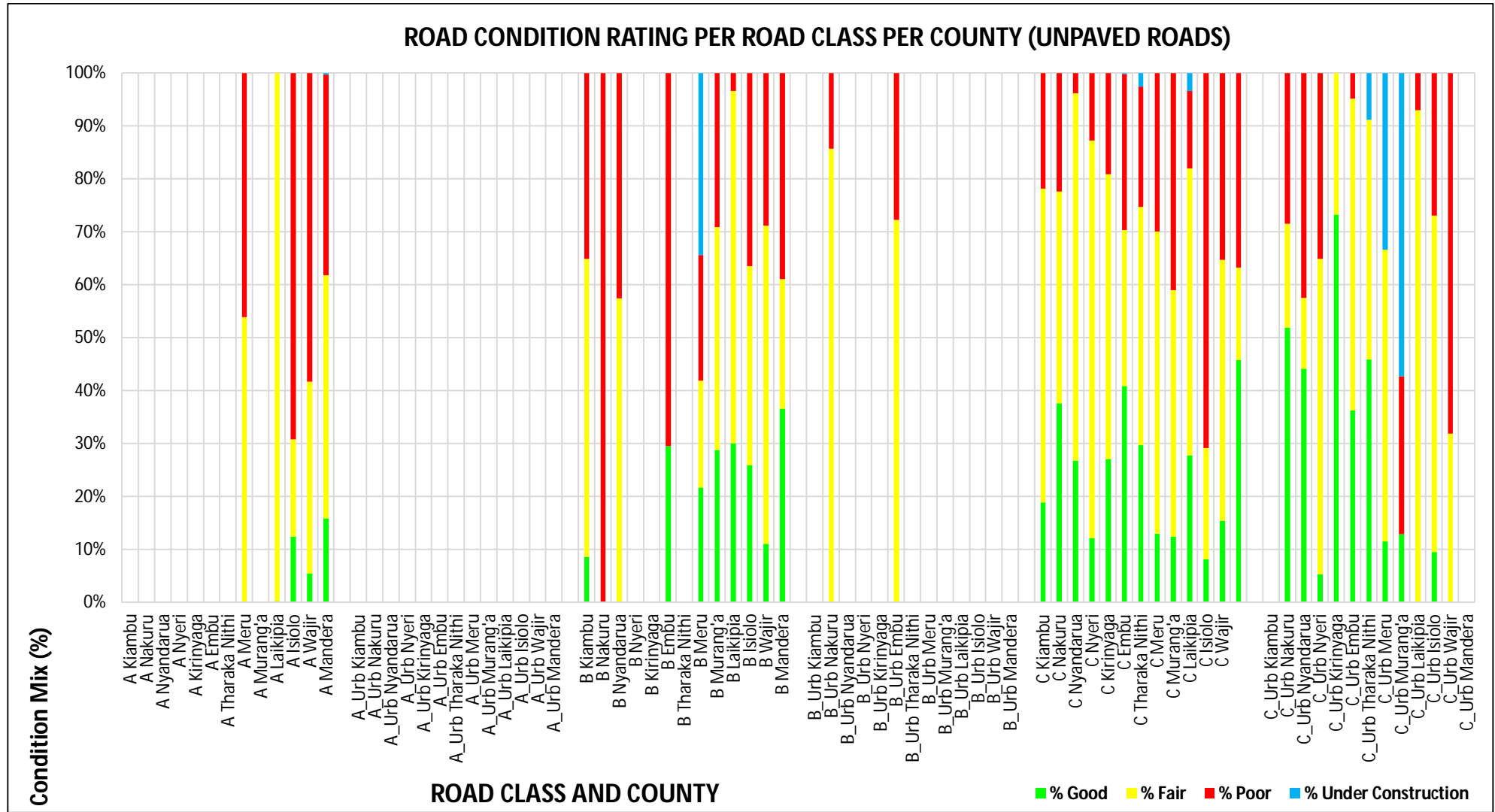
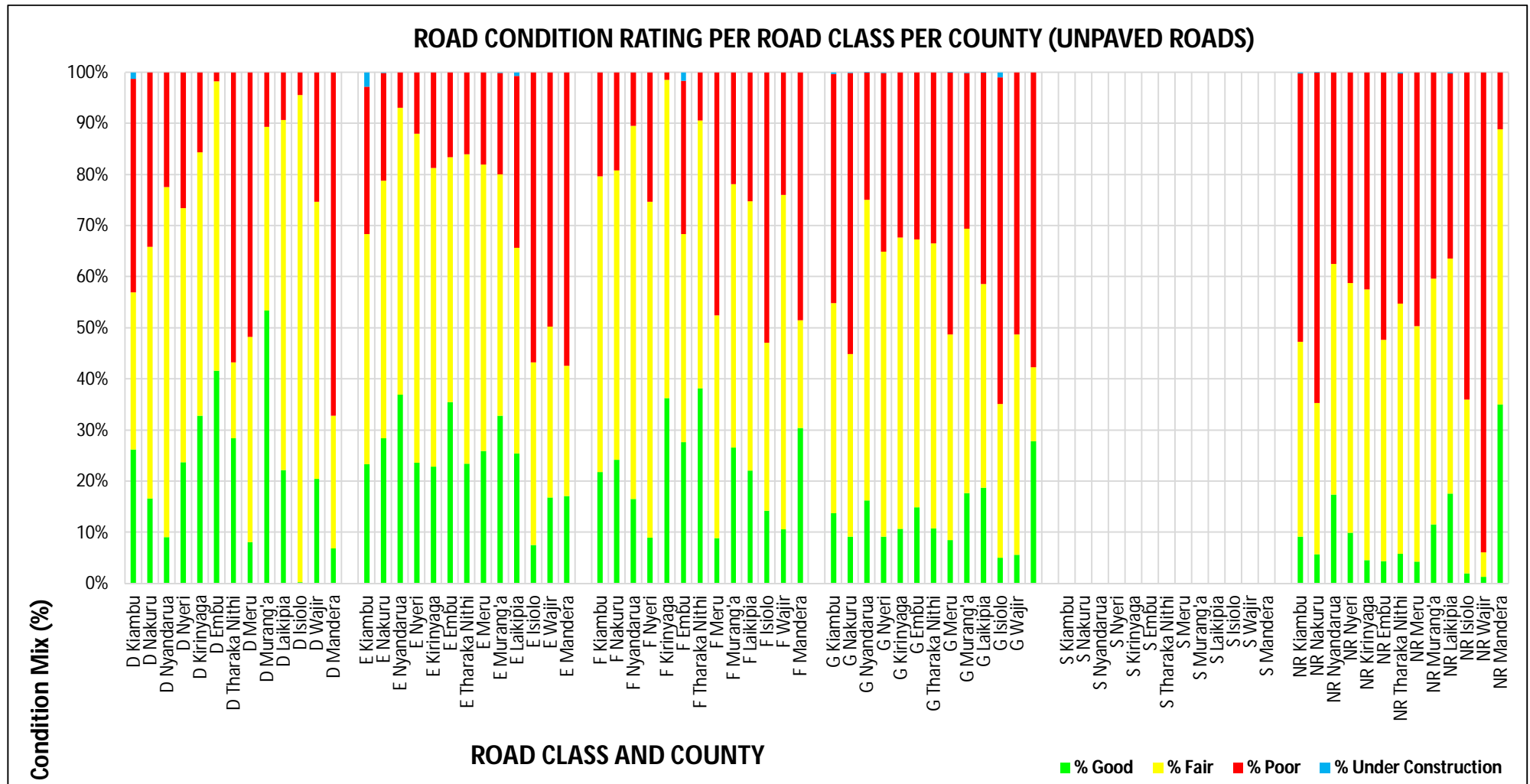


Fig 3.6 (cont'd): Graph of Overall road condition per road Class (Unpaved roads)



c) Summary of Surface Type and Road Condition Per Road Class (Narrow Roads)

Out of the total of 23,966 km of Narrow roads surveyed in the thirteen counties, 19,853 km of had a road reserve more than six (6) meters constituting 82.8% while 4,113 km were below 6m constituting 17.2%. This confirms that the proportion of the Narrow roads with road reserve widths of 4-6m is not more than 30% as noted in Task 3.1 (iv) of the terms of Reference.

10.4 % of the Narrow roads recorded were in good condition, 40.3 % in Fair condition, 49.1% in Poor condition and 0.2% were under construction.

Table 2C in Appendix 1 shows a detailed summary of the Surface Type and Road Condition per Road Class (Narrow Roads).

Figures 3.7 and 3.8 below shows the overall road condition for the Paved and Unpaved Narrow roads per county.

Fig 3.7: Graph of Overall road condition of Paved Narrow Roads per county

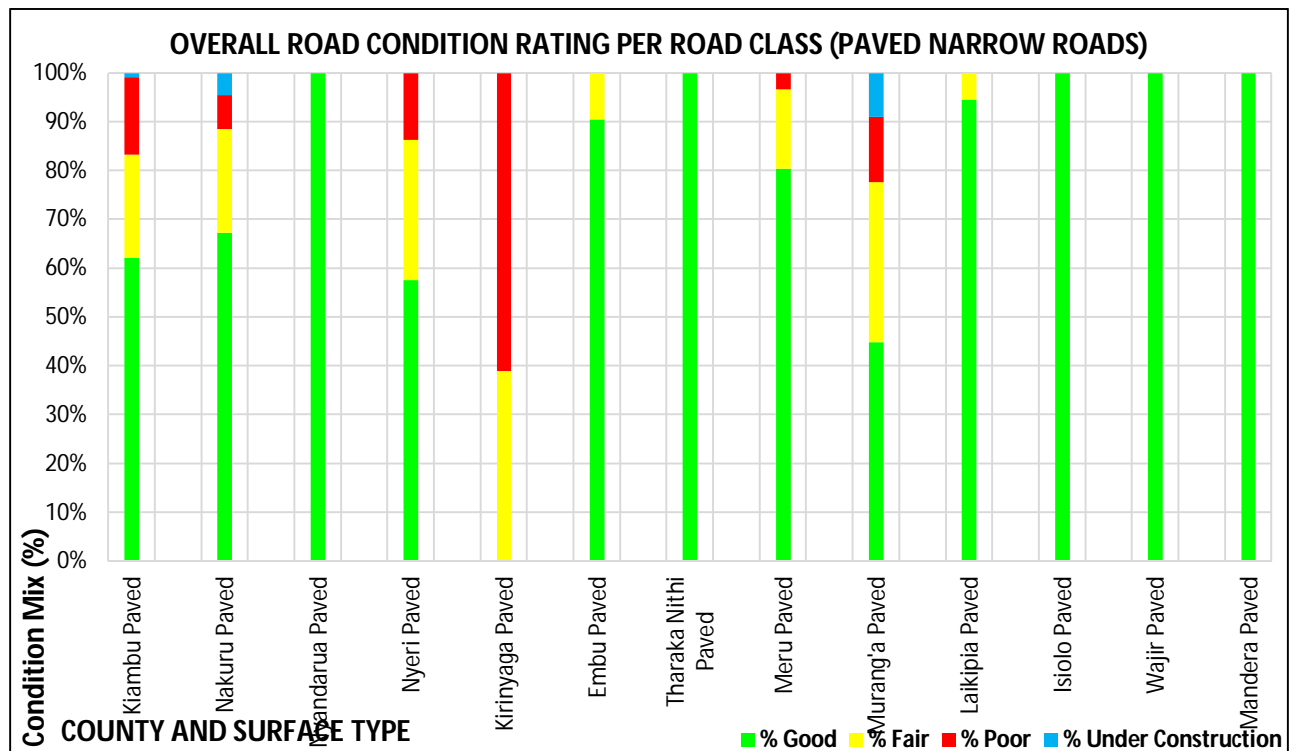
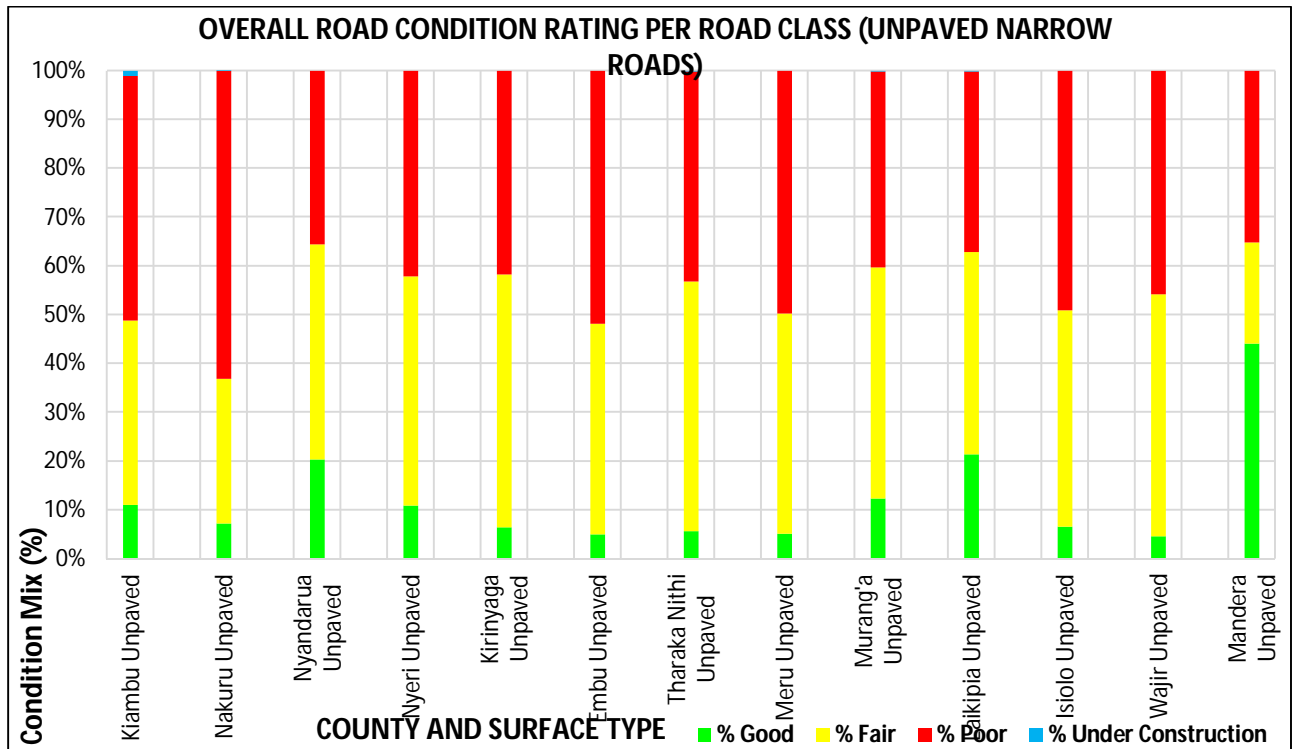


Fig 3.8: Graph of Overall road condition of Unpaved Narrow Roads per county



d) Surface Type and Road Condition Per Road Class per County (Narrow Roads)

Table 2D in Appendix 1 shows a detailed summary of the Surface Type and Road Condition per Road Class (Narrow Roads) per County

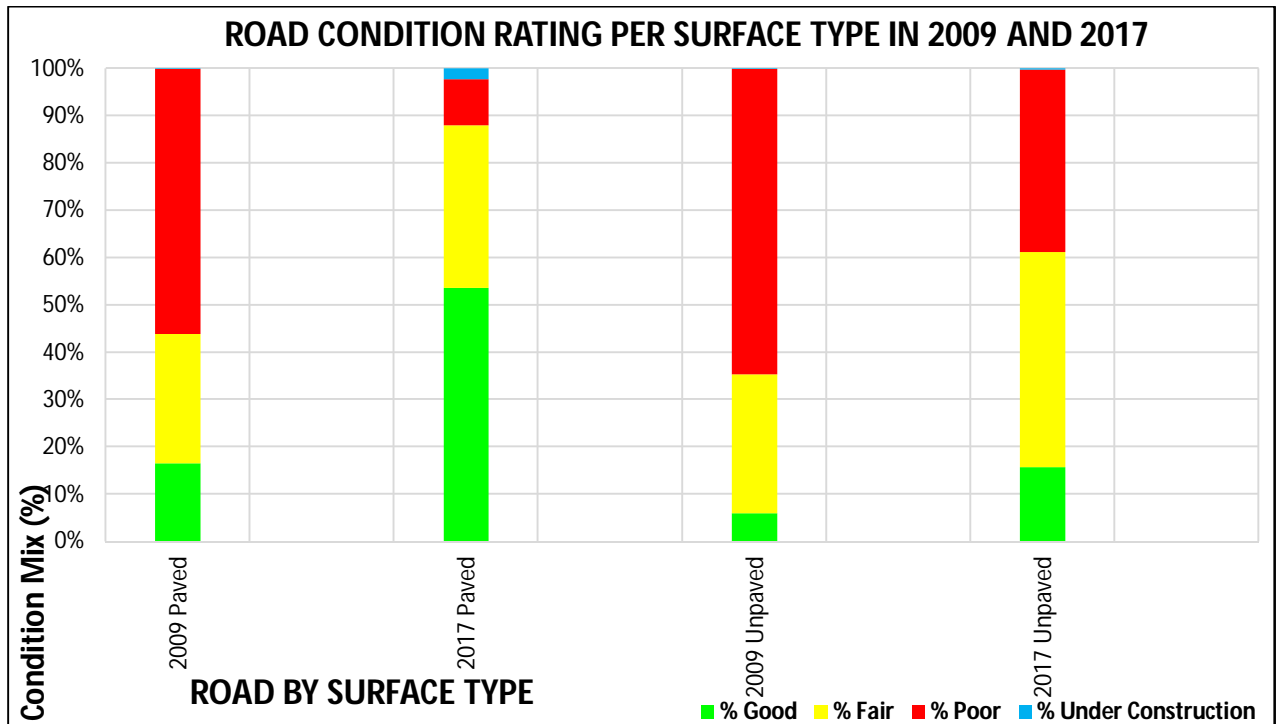
e) Comparison of the Road Surface condition in 2009 and 2017.

In 2017 a total of 5,578 km of paved roads were mapped against 4,092 captured in 2009. Similarly, 47,144 km of Unpaved roads had been captured against 48,919 of 2009. Table 3.5 and Figure 3.8 below shows the data comparison.

Table 3.5: A Summary of the Overall road condition in 2009 vs 2017

SURFACE TYPE	ROAD CONDITION COMPARISON (Km/%)								TOTAL	
	Good		Fair		Poor		Under Construction			
	2009	2017	2009	2017	2009	2017	2009	2017	2009	2017
PAVED	675.58	2989.92	1120.60	1922.67	2295.51	544.13	0.34	122.27	4,092.03	5,578.99
	16.47%	53.59%	27.32%	34.46%	55.96%	9.75%	0.01%	2.19%		
UNPAVED	2910.35	7411.26	14392.90	21432.17	31579.03	18203.19	37.07	97.92	48,919.36	47,144.54
	5.95%	15.72%	29.42%	45.46%	64.55%	38.61%	0.08%	0.21%		

Fig 3.9: Comparison of the overall road condition in 2009 vs 2017



Overall, the road network condition has continued to improve between 2009 and 2017 with the paved roads doubling the coverage in good condition and significantly reducing the network in poor condition. The same is also noted in the Unpaved road network. This can be attributed to the increased investment in the road maintenance under RLMF spearheaded by the Kenya Roads Board (KRB).

3.2.3. Road Reserve Width

a) Road Reserve Width Overall

Out of the 76.689 km of the entire road network captured over the thirteen counties in the Central Zone, 7,123 km were found to have a Road Reserve width below 6m constituting about 9.3% of the entire network. 30,563 km between 6-9m(39.8%), 31,216 km between 9-25m (40.7%), 4,432 km between 25-40m (5.8%) and 3,353 km above 40m (4.4%).

Table 3A in Appendix 1 shows a summary of the Road Reserve Width for all the counties.

b) Road Reserve Width Per County

Table 3.6 below show the road reserve width recorded per county.

Table 3.6: A Summary of the Road Reserve Width per County

COUNTY	ROAD RESERVE WIDTH (m)					SUB-TOTAL
	Below 6 m	6m-9m	9-25m	25-40m	>40	
Kiambu	1207.21	3098.23	3083.73	114.17	424.20	7,927.54
Nakuru	2181.14	6967.42	6117.02	196.64	440.66	15,902.87
Nyandarua	227.94	2288.46	2149.99	143.56	45.94	4,855.89
Nyeri	367.86	2406.29	2345.40	178.66	58.03	5,356.24
Kirinyaga	240.61	1638.39	1128.66	93.49	44.91	3,146.06
Embu	385.96	1923.82	1533.53	106.01	40.19	3,989.51
Tharaka Nithi	395.46	1366.58	859.09	68.75	16.74	2,706.62
Meru	942.81	4690.09	2548.83	168.54	220.62	8,570.89
Murang'a	565.43	2492.07	2200.94	169.61	52.10	5,480.14
Likipia	108.17	1899.75	2329.37	121.65	176.35	4,635.29
Isiolo	243.02	1107.11	1353.18	150.75	179.35	3,033.41
Wajir	190.74	619.10	2995.37	2199.74	1430.68	7,435.64
Mandera	67.06	66.56	2570.90	721.18	224.07	3,649.75
GRAND TOTAL	7,123.42	30,563.88	31,216.00	4,432.74	3,353.84	76,689.88

Table 3B in Appendix 1 shows a summary of the Road Reserve Width per County.

3.2.4. Road Register

The Combined Road Register for the data captured have been prepared and listed in Table 4A and 4B of Appendix 1. The Register contains the Road ID/No., Road Class, Road Name and the Road Length (Km).

The data has been prepared for the following:

- Classified Roads per county
- Narrow roads per county

A soft copy of the register as well as all the shape files have been submitted together with this report.

3.2.5. Drainage Structures

The assignment included the inventory and condition surveys of all structures along the Classified roads as well as the Narrow roads.

The following structures have been captured;

- Bridges (Bailey, Girder, Truss, Tunnel and Arches)
- Pipe Culverts (<600mm dia. >900mm dia. 600-900mm dia., inaccessible)
- Box Culverts
- Drifts

a) Drainage Structures on Classified Road Network

A total of 24,002 structures have been recorded along the Classified Road Network. Of these, 71.7% were found to be in Good condition, 16.7% in Fair conditions while 11.6% were in poor condition.

The Table below shows a summary of the structures surveyed per county along Classified roads.

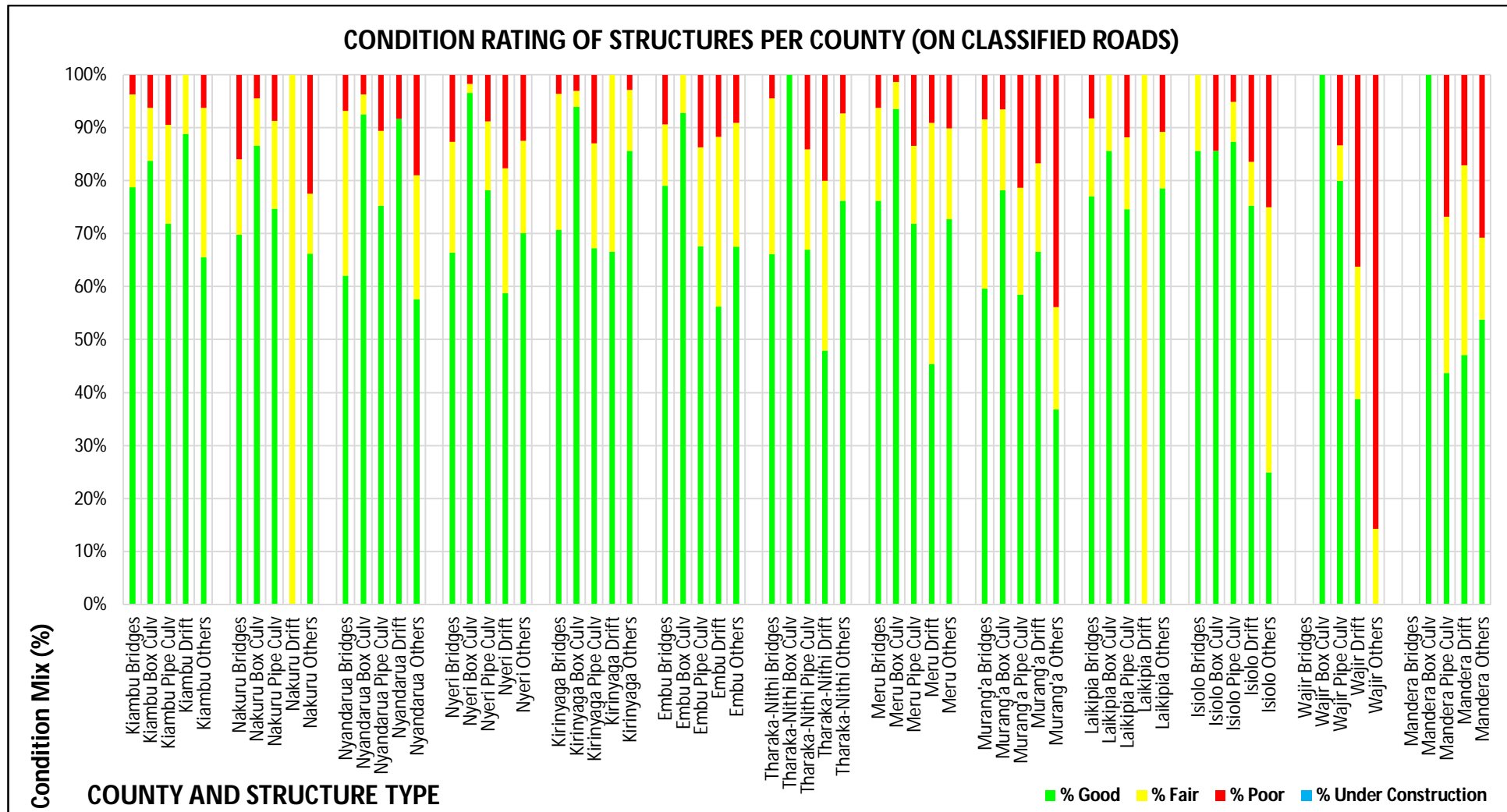
Table 3.7: A Summary of Structures on Classified roads per County

COUNTY	STRUCTURE TYPE (ON CLASSIFIED ROADS)					Total
	Bridges	Box Culverts	Pipe Culverts	Drifts	Other	
Kiambu	245	80	3085	9	32	3451
Nakuru	169	112	2919	1	89	3290
Nyandarua	103	27	2622	12	111	2875
Nyeri	182	59	3661	17	137	4056
Kirinyaga	113	33	1114	3	35	1298
Embu	86	14	1305	128	77	1610
Tharaka Nithi	68	18	406	25	97	614
Meru	160	78	1699	55	99	2091
Murang'a	119	46	2155	6	57	2383
Laikipia	61	7	1380	2	28	1478
Isiolo	14	7	254	73	4	352
Wajir	0	4	90	152	7	253
Mandera	0	3	112	123	13	251
TOTAL	1320	488	20802	606	786	24002

Structure condition on classified roads per county

Fig 3.10 below shows the structure condition per county on Classified roads

Fig 3.10: Graph of Overall structure condition on Classified roads per county



b) Drainage Structures on Narrow Roads

A total of 4,765 structures have been recorded along the Narrow Road network. Of these, 74.4% were found to be in Good condition, 14.3% in Fair conditions while 11.2% were in poor condition.

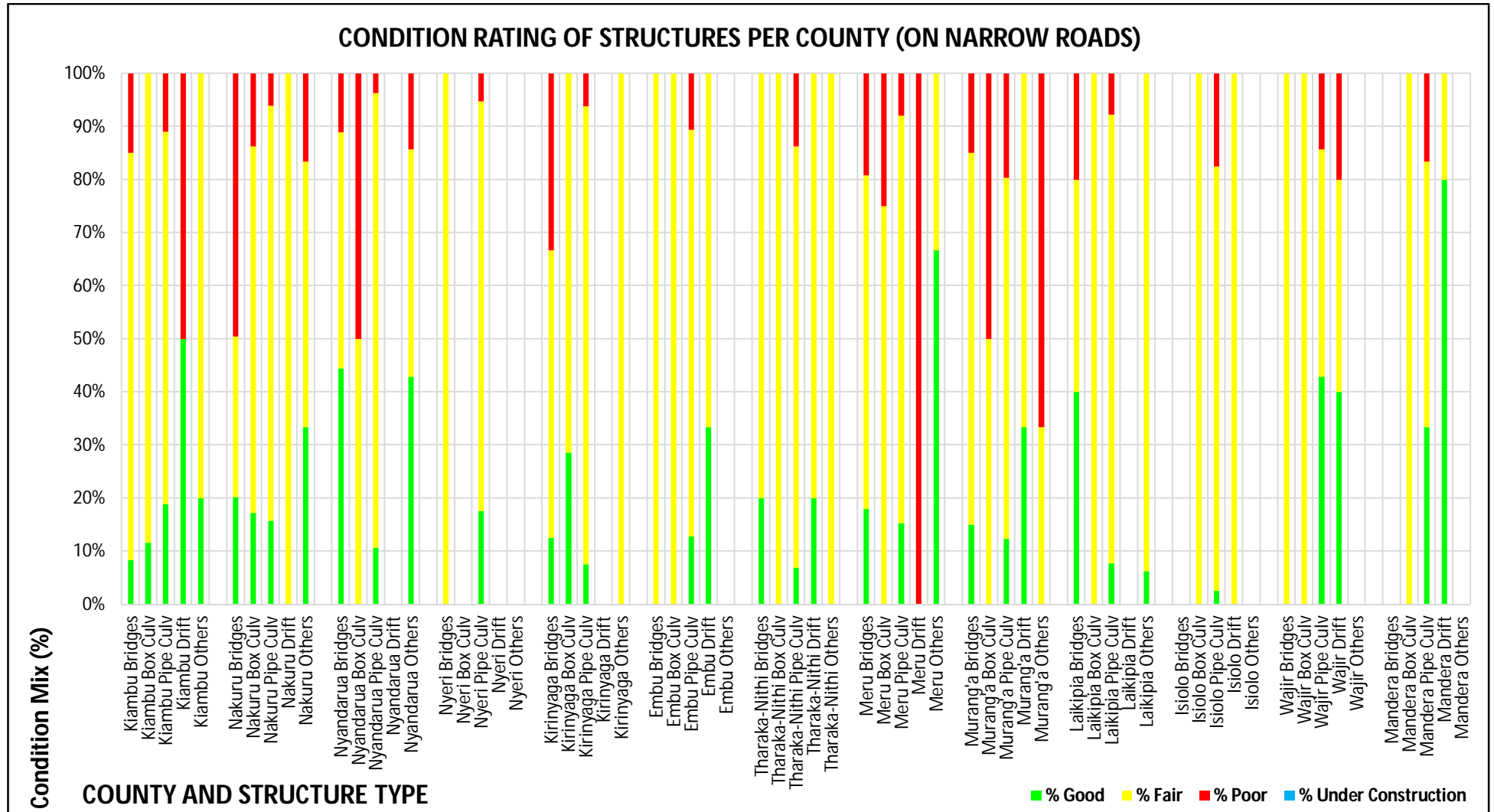
The Table below shows a summary of the structures surveyed per county along Narrow roads.

Table 3.8: A Summary of Structures on Narrow roads per County

COUNTY	STRUCTURE TYPE (ON NARROW ROADS)					Total
	Bridges	Box Culverts	Pipe Culverts	Drifts	Other	
Kiambu	60	26	949	2	5	1042
Nakuru	129	29	880	1	12	1051
Nyandarua	9	2	301	0	7	319
Nyeri	24	7	437	0	2	470
Kirinyaga	7	0	57	0	0	64
Embu	3	1	47	6	0	57
Tharaka Nithi	10	1	87	5	4	107
Meru	78	4	427	1	3	513
Murang'a	20	6	660	6	3	695
Laikipia	10	6	324	0	16	356
Isiolo	0	1	40	2	0	43
Wajir	1	1	21	10	0	33
Mandera	0	4	6	5	0	15
TOTAL	351	88	4236	38	52	4765

Fig. 3.11 below shows the structure condition on Narrow roads per county

Fig 3.11: Graph of Overall structure condition on Narrow roads per county



3.3. Data collection on paved roads

As reported in Chapter 2 of this report, the condition survey of all paved roads was sub-contracted to the Materials Testing and Research Division (MTRD) of the Ministry of Transport and Infrastructure, Housing and Urban Development (MoTIHUD).

The Road Lesser Profiler (RLP) equipment was used to carry out survey the paved roads, while Falling Weight Deflectometer (FWD) was used to measure the pavement strength.

3.3.1. International Roughness Index (IRI)

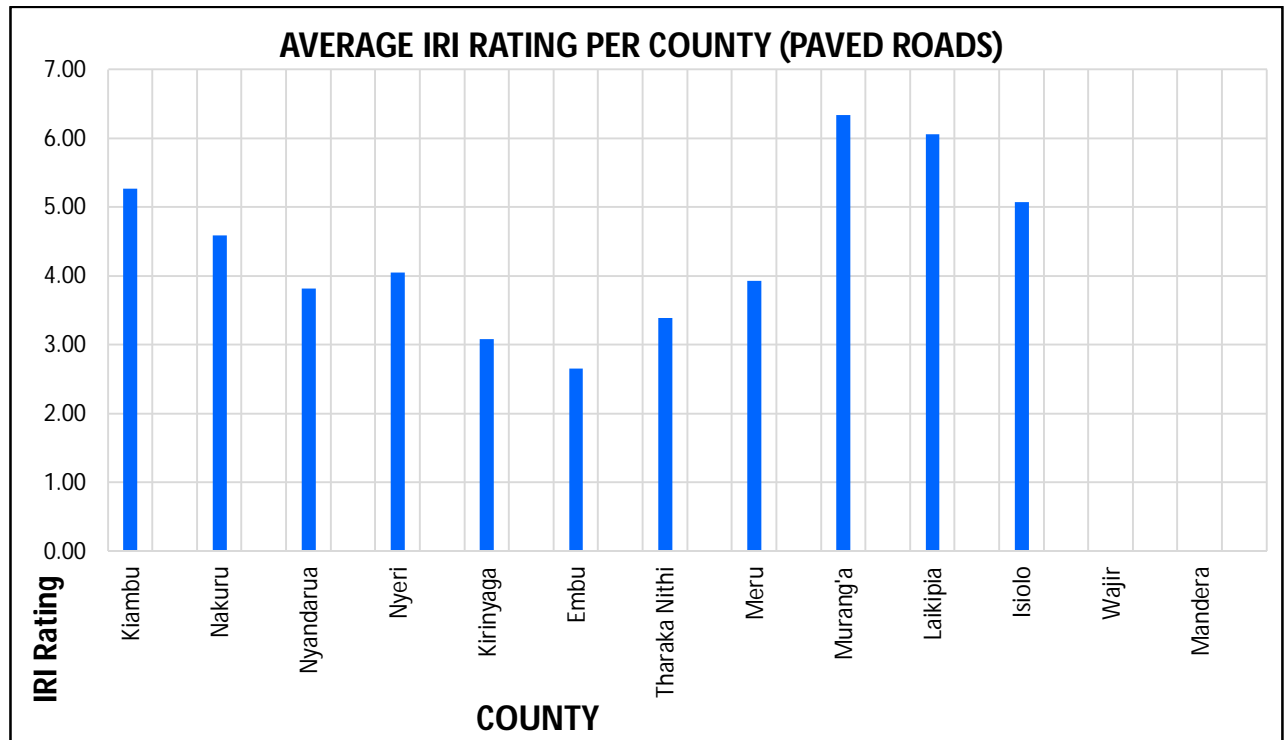
One of the key parameters measured by the Road Lesser Profiler was the righting quality of the paved roads surface. This was recorded in terms of the International Roughness Index (IRI). Table 3,9 below shows the results of the IRI average per county. The paved road network in Wajir and Mandera were not surveyed using the RLP equipment.

Table 3.9: IRI Average per County

County	Total Length (Km)	Avrg, of IRI
Kiambu	957.49	5.27
Nakuru	789.87	4.59
Nyandarua	224.98	3.82
Nyeri	607.20	4.05
Kirinyaga	176.15	3.09
Embu	193.95	2.66
Tharaka Nithi	76.90	3.39
Meru	427.46	3.93
Murang'a	597.51	6.34
Laikipia	261.40	6.06
Isiolo	28.52	5.08
Wajir	25.23	-
Mandera	75.01	-

Figure 3.12 shows a plot of the average IRI measured per county.

Fig 3.12: Graph of Average IRI on Paved roads per county



3.3.2. Falling Weight Deflectometer

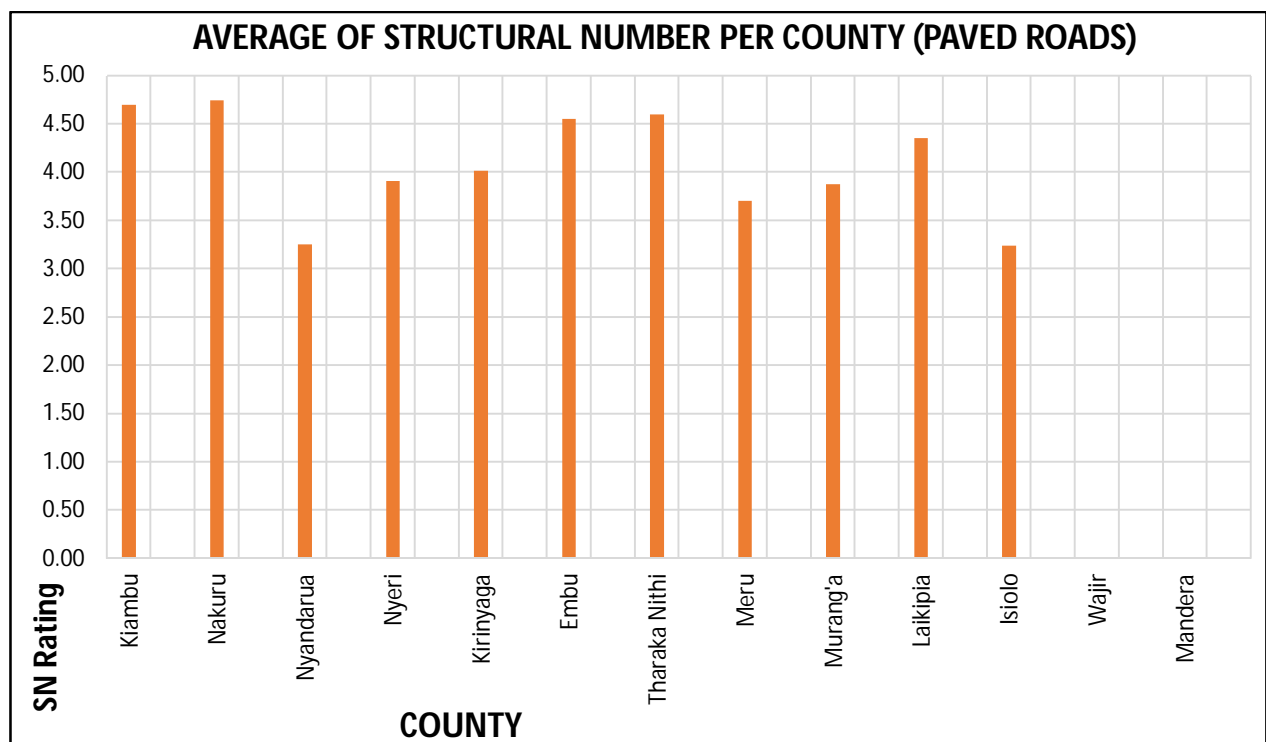
The Pavement strength was surveyed using the Falling Weight Deflectometer (FWD) equipment. This was then recorded in terms of Structural number. Table 3.10 below show the average structural number recorded on the paved road per county. Similarly, MTRD were unable to transport the FWD equipment to Wajir and Mandera due to logistical and security challenges in the two counties.

Table 3.10: Average of Structural Number per County

County	Total Length (Km)	Average Structural
Kiambu	957.49	4.70
Nakuru	789.87	4.75
Nyandarua	224.98	3.25
Nyeri	607.20	3.91
Kirinyaga	176.15	4.02
Embu	193.95	4.55
Tharaka Nithi	76.90	4.60
Meru	427.46	3.70
Murang'a	597.51	3.88
Laikipia	261.40	4.36
Isiolo	28.52	3.24
Wajir	25.23	-
Mandera	75.01	-

Figure 3.13 shows a plot of the average Structural Number (SN) measured on the paved roads per county.

Fig 3.13: Graph of Average IRI on Paved roads per county



3.4. Salient Issues

During the assignment, a number of salient issues were noted. They are summarized as follows;

3.4.1. Road Names

In all the counties mapped, differences were noted in the road names as captured in the KRB Geo-database and the names noted on the ground. A number of roads were also noted to have repetitive names. Names were therefore recorded using local landmarks such as schools, churches, village names to uniquely identify the Narrow roads. Road authorities including the County governments were very useful in the correction of some of the road names.

3.4.2. Data Verification and Validation

Alongside the data analysis, the Consultant carried out a detailed data verification and validation.

The Consultant printed maps in A3 size per county as well as a register of all the roads surveyed. The register had the following details;

- Road Number
- Road Name
- Surface Type
- Road Reserve Width
- Surface Condition
- Road Class and
- Road Length

Data validation was carried out with the assistance of various road agencies such as KeNHA, KURA, KeRRA, KWS and the County Governments. The corrections noted have been implemented in this report.

In addition, the Client also carried out field data verification by visiting selected road networks over a period of two weeks. The comments received from the Client have also been considered in this report.

3.5. Book of Maps

The results of the Road Inventory and condition survey analysis have been presented as a book of maps per county.

This has been presented in Appendix 2 and bound as a separate volume.

4. WORKING PAPER ON RURAL POPULATION LIVING WITHIN 2KM OF ALL WEATHER ROADS

4.1. Introduction

As part of the deliverables, the Consultant was required to prepare a Working Paper on Rural Population living within 2Km of all Weather roads also referred to as the Rural Access Index (RAI) by the World Bank.

4.2. Definition of Rural Access Index (RAI)

Rural Access Index (RAI) has been established by the World Bank as a key transport headline indicator with a focus on the critical role of access and mobility in the reduction of poverty in developing countries.

RAI measures the percentage of the Rural population living within 2km of all paved and gravel roads in Good and Fair condition referred to as “All-weather roads”.

RAI is a good measure of the Sustainable Development Goals (SDGS) and especially the Kenya development agenda which covers national values of equality, inclusiveness etc. SDG Goad 9 provides for the following;

‘Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation’. Transport connectivity is an essential part of the enabling environment for attainment of this goal . The Rural Access Index (RAI) measures the extend of achievement of goal 9 by different countries through development of quality, reliable, sustainable and resilient infrastructure ,including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all (target 9.1).

RAI can also be useful in the determination of different indicators as listed in Table 1.2 below.

Table 4.1: Applications of RAI

No.	Purpose	Description
1	Indicator for the extent of access of rural people	Indicates the degree to which transport and access services reach the entire rural population and extent to which such services are not provided to the rural people.
2	Definition for road policy targets	It can be used by national policy makers to set a country's target for providing road access to its rural people.
		Once a policy target for RAI has been set and the current RAI is known, this information can be used to formulate a road asset development and management strategy. However, additional information, including the

No.	Purpose	Description
3	Formulation of road asset development and management strategies	<p>following, is required about the percentage of rural people living within 2 kilometres of the existing road network to enable the formulation of a road asset development and management strategy.</p> <p>(i) All rural people living within 2 km of a road</p> <p>(ii) A proportion of rural population living within 2 km of a road, equally distributed along the road network</p>
4	Estimation of the required investments in the road sector	Once the road asset management and development strategy has been formulated the required level of investments can be estimated, using unit cost rates. These range from the typical routine maintenance costs per km on a rural road to the typical reconstruction costs per km for a national road. Such unit cost rates serve the purpose for overall budgeting purposes at national level and having approximate value is sufficient for this budgeting purpose.
5	Monitoring the progress and effectiveness of road policies and road investment strategies.	Annually updated information on the RAI provides policy makers and responsible implementing agencies key information about the effectiveness and progress of investments in the roads sector.

4.3. Methodology

The methodology adopted in assessment of the Rural Access Index (RAI) was the use of available household surveys. However, this was found to be cumbersome and costly to carry out as the house surveys did not have sufficient spatial representativeness.

The 2017 projected census data shapefiles were overlaid on road network and condition maps. A 2 km buffer zone was created to calculate the rural population within the buffered zone for roads in good and fair condition.

Population Data

The population records, to the sub-Location level together with corresponding shapefiles, were obtained from the Kenya National Bureau of Statistics (KNBS). These were for 2009 and projections to 2017 were made using growth rates derived from the data obtained from KNBS. Calculation of the Rural Access Index was based on this projected 2017 population data and all-weather roads.

All-Weather Roads

In the assessment of the Rural Access Index (RAI), all paved roads and gravel roads in good and fair condition have been considered as All-weather roads.

4.4. RAI Results

The overall Rural Access Index determined for the Central Zone is 73%.

Wajir County reported the lowest RAI with 16% while Kirinyaga had the highest at 99%. Out of the 13 counties grouped under the Central Zone, only 3 counties recorded an RAI less than 50% namely Isiolo, Mandera and Wajir.

From the above it is noted that counties which are less populated with nomadic form of agriculture and low road network density tend to have less RAI compared to counties rich in agriculture with high population density and dense road network.

While increasing accessibility in these counties, emphasis should be put on the nature of the economic activities in the county that influence the population density.

Table 4.2: Results of RAI

No	County	Total Population	Urban Population	Rural Pop	% Rural Pop	Rural Population Inside 2km	% within 2 km
1	KIAMBU	2,179,209	1,435,253	743,956	34%	723,906	97%
2	NAKURU	2,152,417	536,465	1,615,952	75%	1,396,422	86%
3	NYANDARUA	800,472	12,302	788,170	98%	765,375	97%
4	NYERI	931,081	141,389	789,692	85%	761,596	96%
5	KIRINYAGA	708,897	92,269	616,628	87%	609,630	99%
6	EMBU	693,000	100,622	592,377	85%	454,498	77%
7	THARAKA NITHI	490,445	54,731	435,714	89%	330,796	76%
8	MERU	1,820,794	637,517	1,183,278	65%	857,298	72%
9	MURANG'A	1,265,387	240,579	1,024,809	81%	1,003,585	98%
10	LAIKIPIA	535,951	75,772	460,179	86%	336,513	73%

No	County	Total Population	Urban Population	Rural Pop	% Rural Pop	Rural Population Inside 2km	% within 2 km
11	ISIOLO	192,368	57,832	134,536	70%	29,505	22%
12	WAJIR	888,636	42,160	846,476	95%	137,695	16%
13	MANDERA	1,377,047	167,642	1,209,405	88%	244,026	20%
	CENTRAL	14,035,705	3,594,534	10,441,171	74%	7,650,846	73%

4.5. Conclusions

From the population census results of 2009 projected to 2017, and after removal of the Urban Population from the total population, for Central Zone, the overall percentage of rural population that lives within 2 km of all-weather roads (Paved and Gravel (Good and Fair Condition)) is about 73%.

Isiolo, Wajir and Mandera Counties exhibit low values of RAIs (from 16% to 22%) while high values, ranging from 60% to 99%, are noted for Embu, Kiambu, Kirinyaga, Laikipia, Meru, Murang'a, Nakuru, Nyandarua, Nyeri and Tharaka Nithi Counties.

Kenya has good rural accessibility in most Counties within this zone judging from the analysis made in Central Zone.

The RAI should be re-assessed through more detailed studies in certain counties where the index is low.

A reassessment of the overall percentage (Rural Access Index) of the rural population that lives within 2 km of all-weather roads should be carried out after the next population census (2019), rather than using average population growth rates.

5. RICS DATA COLLECTION AND UPDATE FRAMEWORK

5.1. Introduction

The Contract required the Consultant to propose a RICS Data Collection and Update Framework for future reference when further RICS projects are defined. This report has been compiled in response to that specific requirement of the Contract. This report highlights:

- (a) Recommendation of an approach to updating road inventory and condition data in Kenya,
- (b) Proposal of an implementation plan for the RICS data collection and update framework for classified roads.

5.2. Current Approaches to RICS and Findings

To achieve the contract objectives, a review of current approaches to RICS in all road agencies, including KRB, was undertaken. The main aim of the review was for the consultant to understand data that is collected in each agency, when and how the data is collected, how the data is managed and shared within and between the agencies as well as the challenges agencies face with regard to data collection and management. The review was guided by the following issues considered important to the exercise:

- (a) The extent of inter-agency data sharing and/or with KRB/Other Stakeholders,
- (b) Data management practices,
- (c) Methods and technology employed for RICS data collection,
- (d) Frequency of data collection, and
- (e) The information collected.

The review was based on the consultant's understanding of the operations of the road agencies through interactions with them. Overall, it was found that all road agencies undertake RICS. However, there was little inter-agency data sharing. Besides, there were differences which included data collection methodology and technology, frequency of data collection, type of data collected as well as focus and extent of data collection survey.

Specifically, the following were identified as key limitations to cost-efficient RICS data collection and update in the road sector in Kenya:

- (i) No uniform RICS data collection Procedure exists.
- (ii) No defined data schema or form defining what data to be collected.
- (iii) Road condition surveys and planning are neither harmonized nor coordinated.
- (iv) Data collection methodology is not harmonized across agencies.

- (v) Data collection technology is not harmonized across agencies;
- (vi) Inter-agency data sharing does not exist. Only reports and work plans are submitted to KRB.
- (vii) Road agencies are not obliged to share data.
- (viii) Different versions of data are available.
- (ix) No motivation or incentive for data update and management
- (x) No policy for data sharing and updating.

5.3. Framework and Implementation Recommendations

A data collection and update framework to address the limitations identified were proposed and explained. The framework was defined as comprising:

- (a) Policies and guidelines,
- (b) Protocols and standards, and
- (c) Equipment, processes and procedures.

Specific recommendations are made in this report under each of the components of the framework. Some of the key recommendations are broadly identified as follows:

- (i) Under the component of policies and guidelines it is proposed that KRB should be the lead agency for implementing the proposed framework. It is also proposed that there be a standing committee to define and guide the implementation of the framework. The Standing Committee is to be appointed by the Principal Secretary of the Ministry of Transport, Infrastructure, Housing and Urban Development (MoTIHUD) and should be reporting to the Executive Director of KRB.
- (ii) Under the component of standards and protocols the following are proposed
 - Standard schema for RICS data collection and sharing
 - Communication and data security protocols as well as metadata standards.
- (iii) Under the component of equipment, processes and procedures, it is proposed that there should be:
 - Harmony in QA/QC procedures,
 - Frequency of data collection and update, and
 - The level of precision of equipment used for data collection.

A summary of the recommendations made for the Data Collection and Update Framework are as shown in the tabulation below.

Table 5.1: Summary of Recommendations

No.	Recommendation
1	Data Dictionary implemented for the current RICS study (2016/17) is to be shared with all road agencies and adopted uniformly.
2	There is need for establishment of Road Asset Management System for the entire group of the Road Agencies.
3	Data collection procedures and standards adopted for the current RICS study (2016/17) are to be implemented across all agencies.
4	Data collection equipment, for visual and instrumented collection, adopted for the current RICS study (2016/17) to be implemented as a minimum across all agencies subject to technological advances and availability of superior equipment.
5	Road Agencies to undertake RICS on their respective networks annually and incorporate the data in their respective databases.
6	Each Road Agency should set aside funds for RICS data collection in the work plan.
7	Nodal agency (KRB) to hold the consolidated master database into which updates from each road agency are migrated following their annual RICS update exercise.
8	Nodal agency (KRB) should also get involved with identifying and performing RICS on a representative sample of all agency networks for verification of updated databases instead of KRB undertaking a full-scale RICS study every 5 years.
9	Standing Committee, to be appointed by PS of MoTIHUD), should be established to specifically handle and coordinate RICS related activities, policies and guidelines across all agencies.
10	The Standing Committee should advise on appropriate/emerging technology.
11	KRB is to fund the operations of the Standing Committee.
12	There should be improvement in the GIS representation of the road links, in the database, wherever an IRI point distance to the nearest line is over 20 m.
13	Linear referencing of all roads should be defined and contained in the GIS shapefiles.

5.4. Cost of Implementing The Framework

The cost of implementing the framework was carried out using the cost of the current RICS exercise as a baseline. It was found that the cost of implementing and running the framework over a five-year term would be cheaper than the current approach to RICS and much more cheaper if the RICS are undertaken by the Road Agencies in-house and as such the proposed framework is feasible. Therefore, it should be improved further to make it more concrete for possible adoption and implementation.

6. RICS MANUALS FOR CLASSIFIED AND NARROW ROADS

6.1. Introduction

A RICS manual for Classified and Narrow roads was prepared documenting the actual data collection methods used, during the 2016/2017 RICS assignment, and lessons learnt. It also detailed the step by step guidelines and procedures for undertaking future Road Inventory and Condition Surveys for both Classified and Narrow Roads.

It is anticipated that the manual would be used by Kenya Roads Board, Road Agencies, County Government personnel and Consultants.

The Manual covers the following topics;

- Planning for RICS
- Identification of staff and training
- Preparation for fieldwork
- Carrying out the fieldwork
- Data transmission and storage
- Unpaved roads Data processing and analysis
- Paved roads Data processing and analysis
- RICS data output

6.2. Conclusions and Recommendations

The details contained in the manual are usable for future Road Inventory and Condition Survey including road data collection, using Mobile Mappers, for roads, drainage structures, facilities, institutions and towns.

For any desired or planned output on Paved Roads or Gravel Roads using specialized equipment of Falling Weight Deflectometer and Road Laser Profiler, it is recommended that the services are sourced from the Materials Testing and Research Division (MTRD) of the Ministry of Transport, Infrastructure, Housing and Urban Development as the division is currently the only entity within the country that owns such equipment.

Besides MTRD, possibilities of outsourcing the services from firms with experience in the use of specialized equipment within the region or at international level would need to be explored.

It is also recommended that the manual be reviewed regularly to keep pace with any new developments in technology. By the time of preparation of this manual, the portable tools available and used in the 2016/2017 RICS included Mobile Mapper 20 (MM20), Mobile Mapper 50 (MM50) and Trimble Juno. New equipment, such as LIDAR (Light Detection and Ranging) and RADAR (Radio Detection and Ranging) for efficient data capture are beginning to emerge. Such new technologies, when made available and usable, need to be assimilated in the subsequent manual periodical reviews as may be necessary.

7. CONCLUSION AND WAY FORWARD

7.1. Conclusion

The cumulative road length achieved, including Classified Roads and Narrow Roads Survey in all the thirteen counties namely; Kiambu, Nakuru, Nyandarua, Nyeri, Kirinyaga, Embu, Tharaka Nithi, Meru, Murangá, Laikipia, Isiolo, Wajir and Mandera is 76,687 km against the planned total length of 79,533 km giving about 96.4%.

The actual lengths of the Narrow Roads network was found to be less than earlier estimated during fieldwork planning. About 23,966 km have been mapped over the 13 counties surveyed against a planned total of 26,511 km. This is mostly due to the fact that the previous 2009 RICS exercise captured many roads with RoW less than 9m which are currently being mapped as Narrow roads.

In addition, most of the counties covered under Central Zone have not carried out any recent land sub-divisions and hence no new accesses for settlement. Majority of the Narrow roads recorded are those that were recently opened by the County Governments and Security roads by the National Government.

APPENDIX 1 : SUMMARIES OF THE ROAD REGISTER

TABLE 1A: SUMMARY OF SURFACE TYPE AND ROAD CONDITION

TABLE - 1A: SUMMARY OF SURFACE TYPE AND ROAD CONDITION

	SURFACE TYPE	Length(km)				Grand Total
		Good	Fair	Poor	Under Construction	
OVERALL ACHIEVEMENT FOR CENTRAL ZONE	Paved	3169.06	1970.98	571.65	125.83	5,837.51
	Gravel	5425.66	13135.25	6796.36	74.58	25,431.85
	Earth	4316.04	17900.67	23136.95	63.58	45,417.23
	Other	1.05		2.23		3.28
	SubTotal	12,911.81	33,006.89	30,507.19	263.99	76,689.88
	Condition(%)	16.84%	43.04%	39.78%	0.34%	100.00%

**TABLE 1B: SUMMARY OF SURFACE TYPE AND ROAD
CONDITION (PER COUNTY)**

TABLE - 1B: SUMMARY OF SURFACE TYPE AND ROAD CONDITION (PER COUNTY)

COUNTY	SURFACE TYPE	LENGTH (kms)				Grand Total
		Good	Fair	Poor	Under Construction	
KIAMBU	Paved	610.895	329.435	185.624	32.213	1158.167
	Gravel	859.202	1965.801	1321.948	28.235	4175.186
	Earth	110.79	849.125	1626.39	7.75	2594.055
	Other	0.132				0.132
Subtotal		1581.019	3144.361	3133.962	68.198	7927.54
Condition(%)		19.94%	39.66%	39.53%	0.86%	100.00%
NAKURU	Paved	263.93	588.087	192.294	19.58	1063.891
	Gravel	1055.308	2237.657	1034.018	5.583	4332.566
	Earth	584.669	3116.701	6796.422	7.703	10505.495
	Other	0.918				0.918
Subtotal		1904.825	5942.445	8022.734	32.866	15902.87
Condition(%)		11.98%	37.37%	50.45%	0.21%	100.00%
NYANDARUA	Paved	211.439	92.309	8.611		312.359
	Gravel	548.084	1575.125	434.615	0.357	2558.181
	Earth	267.262	1093.093	624.999		1985.354
	Subtotal		1026.785	2760.527	1068.225	0.357
Condition(%)		21.15%	56.85%	22.00%	0.01%	100.00%
NYERI	Paved	493.928	226.362	36.917	20.026	777.233
	Gravel	403.252	1676.453	497.073	2.761	2579.539
	Earth	96.126	872.936	1029.187	1.223	1999.472
	Subtotal		993.306	2775.751	1563.177	24.01
Condition(%)		18.54%	51.82%	29.18%	0.45%	100.00%
Kirinyaga	Paved	154.042	88.799	7.535		250.376
	Gravel	221.602	675.857	261.007		1158.466
	Earth	154.985	939.922	642.314		1737.221
	Subtotal		530.629	1704.578	910.856	
Condition(%)		16.87%	54.18%	28.95%	0.00%	100.00%
Embu	Paved	252.261	27.087	13.739	3.927	297.014
	Gravel	278.571	375.762	224.505	6.245	885.083
	Earth	411.342	1385.89	1009.869	0.313	2807.414
	Subtotal		942.174	1788.739	1248.113	10.485
Condition(%)		23.62%	44.84%	31.28%	0.26%	100.00%
Tharaka Nithi	Paved	92.085	2.589		13.371	108.045
	Gravel	129.121	361.722	118.495	9.097	618.435
	Earth	237.871	974.367	765.602	2.297	1980.137
	Subtotal		459.077	1338.678	884.097	24.765
Condition(%)		16.96%	49.46%	32.66%	0.91%	100.00%
Meru	Paved	444.55	149.629	34.205	6.52	634.904
	Gravel	220.007	915.198	577.682	8.748	1721.635
	Earth	408.993	2608.006	3171.086	26.271	6214.356
	Subtotal		1073.55	3672.833	3782.973	41.539
Condition(%)		12.53%	42.85%	44.14%	0.48%	100.00%
Muranga	Paved	426.316	265.75	68.963	1.62	762.649
	Gravel	560.246	1121.324	573.998	0.356	2255.924
	Earth	340.558	1199.121	916.609	5.283	2461.571
	Subtotal		1327.12	2586.195	1559.57	7.259
Condition(%)		24.22%	47.19%	28.46%	0.13%	100.00%
Laikipia	Paved	116.54	194.726	11.095	4.01	326.371
	Gravel	473.568	932.208	365.71	12.67	1784.156
	Earth	368.838	1039.688	1114.576	1.665	2524.767
	Subtotal		958.946	2166.622	1491.381	18.345
Condition(%)		20.69%	46.74%	32.17%	0.40%	100.00%

COUNTY	SURFACE TYPE	LENGTH (kms)				Grand Total
		Good	Fair	Poor	Under Construction	
Isiolo	Paved	31.31	0.603	2.096		34.009
	Gravel	107.749	407.943	558.062		1073.754
	Earth	190.526	552.892	1171.162	11.071	1925.651
Subtotal		329.585	961.438	1731.32	11.071	3033.414
Condition(%)		10.87%	31.69%	57.07%	0.36%	100.00%
Wajir	Paved	25.233				25.233
	Gravel	207.369	540.287	566.852		1314.508
	Earth	464.746	2886.017	2745.131		6095.894
Subtotal		697.348	3426.304	3311.983		7435.635
Condition(%)		9.38%	46.08%	44.54%	0.00%	100.00%
Mandera	Paved	46.527	5.601	10.568	24.565	87.261
	Gravel	361.585	349.909	262.4	0.525	974.419
	Earth	679.334	382.911	1523.6		2585.845
	Other			2.229		2.229
Subtotal		1087.446	738.421	1798.797	25.09	3649.754
Condition(%)		29.80%	20.23%	49.29%	0.69%	100.00%
Grand Subtotal		12911.81	33006.892	30507.188	263.985	76689.875
Condition(%)		16.84%	43.04%	39.78%	0.34%	100.00%

**TABLE 2A: SUMMARY OF SURFACE TYPE AND ROAD
CONDITION PER ROAD CLASS (CLASSIFIED
ROADS)**

TABLE - 2A: SUMMARY OF SURFACE TYPE AND ROAD CONDITION PER ROAD CLASS (CLASSIFIED ROADS)

ROAD CLASS	SURFACE TYPE	LENGTH (kms)				TOTAL LENGTH (Kms)
		Good	Fair	Poor	Under Construction	
A	Paved	733.00	231.13	9.50	24.57	998.20
	Gravel	82.03	342.89	272.00	0.53	697.45
	Earth		103.93	260.72		364.65
A Sum Length		815.02	677.95	542.23	25.09	2060.30
A Condition(%)		39.56%	32.91%	26.32%	1.22%	100.00%
A_urb	Paved	18.74	3.85			22.59
A_urb Sum Length		18.74	3.85			22.59
A_urb Condition(%)		82.95%	17.05%	0.00%	0.00%	100.00%
B	Paved	610.59	346.46	41.42	21.61	1020.09
	Gravel	155.56	309.74	320.71		786.01
	Earth	244.77	472.28	287.18	23.53	1027.76
B Sum Length		1010.92	1128.48	649.31	45.14	2833.85
B Condition(%)		35.67%	39.82%	22.91%	1.59%	100.00%
B_urb	Paved	33.02	20.06	7.48		60.56
	Gravel		6.44	0.41		6.85
	Earth		0.24	1.62		1.86
B_urb Sum Length		33.02	26.74	9.51		69.27
B_urb Condition(%)		47.68%	38.60%	13.73%	0.00%	100.00%
C	Paved	809.09	604.78	151.58	42.33	1607.79
	Gravel	700.91	1388.66	686.01	18.48	2794.06
	Earth	364.75	502.14	672.81	0.31	1540.01
C Sum Length		1874.75	2495.58	1510.40	61.12	5941.85
C Condition(%)		31.55%	42.00%	25.42%	1.03%	100.00%
C_urb	Paved	43.88	54.17	13.93	4.64	116.62
	Gravel	62.72	67.45	22.11	10.33	162.61
	Earth	3.57	36.33	16.56	4.57	61.03
C_urb Sum Length		110.17	157.95	52.61	19.54	340.26
C_urb Condition(%)		32.38%	46.42%	15.46%	5.74%	100.00%
D	Paved	169.53	169.86	48.01	9.79	397.19
	Gravel	499.59	862.80	392.07	3.42	1757.88
	Earth	108.80	462.15	406.69		977.64
D Sum Length		777.92	1494.81	846.77	13.20	3132.70
D Condition(%)		24.83%	47.72%	27.03%	0.42%	100.00%
E	Paved	187.10	175.16	56.08	9.17	427.51
	Gravel	587.10	1154.73	434.73	2.20	2178.76
	Earth	213.88	370.13	497.05		1081.06
E Sum Length		988.07	1700.03	987.86	11.37	3687.33
E Condition(%)		26.80%	46.10%	26.79%	0.31%	100.00%

ROAD CLASS	SURFACE TYPE	LENGTH (kms)				TOTAL LENGTH (Kms)
		Good	Fair	Poor	Under Construction	
F	Paved	96.20	52.29	33.47	6.91	188.86
	Gravel	448.13	1201.34	352.06	6.04	2007.57
	Earth	345.67	719.49	671.59		1736.75
F Sum Length		890.00	1973.12	1057.11	12.95	3933.18
F Condition(%)		22.63%	50.17%	26.88%	0.33%	100.00%
G	Paved	233.42	264.91	182.66	3.26	684.24
	Gravel	1789.15	5154.16	3228.01	11.50	10182.82
	Earth	1804.64	8277.27	9680.85	17.02	19779.79
G Sum Length		3827.21	13696.34	13091.53	31.78	30646.85
G Condition(%)		12.49%	44.69%	42.72%	0.10%	100.00%
S	Paved	55.35				55.35
S Sum Length		55.35				55.35
S Condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
Total Sum Length		10,401.18	23,354.84	18,747.32	220.19	52,723.54
Total Condition(%)		19.73%	44.30%	35.56%	0.42%	100.00%

**TABLE 2B: SUMMARY OF SURFACE TYPE AND ROAD
CONDITION PER ROAD CLASS (CLASSIFIED
ROADS) PER COUNTY**

TABLE - 2B: SUMMARY OF SURFACE TYPE AND ROAD CONDITION PER ROAD CLASS (CLASSIFIED ROADS) - PER COUNTY

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
Kiambu	A	Paved	92.10	30.85			122.95
	A Subtotal		92.103	30.847			122.95
	A Conditional%		74.91%	25.09%	0.00%	0.00%	100.00%
	A_urb	Paved	18.736	3.85			22.586
	A_urb Subtotal		18.736	3.85			22.586
	A_urb Conditional%		82.95%	17.05%	0.00%	0.00%	100.00%
	B	Paved	64.394	39.896	23.513	4.799	132.602
		Gravel	4.187	16.378	15.355		35.92
		Earth		11.001	1.744		12.745
	B Subtotal		68.581	67.275	40.612	4.799	181.267
	B Conditional%		37.83%	37.11%	22.40%	2.65%	100.00%
	B_urb	Paved	22.663	14.171	4.701		41.535
	B_urb Subtotal		22.663	14.171	4.701		41.535
	B_urb Conditional%		54.56%	34.12%	11.32%	0.00%	100.00%
	C	Paved	84.317	74.214	59.44	2.41	220.381
		Gravel	35.943	113.172	30.508		179.623
		Earth			11.13		11.13
	C Subtotal		120.26	187.386	101.078	2.41	411.134
	C Conditional%		29.25%	45.58%	24.59%	0.59%	100.00%
	C_urb	Paved	3.672	4.588	0.832		9.092
	C_urb Subtotal		3.672	4.588	0.832		9.092
	C_urb Conditional%		40.39%	50.46%	9.15%	0.00%	100.00%
	D	Paved	96.271	47.295	12.933	9.787	166.286
		Gravel	67.787	80.31	61.96	3.415	213.472
		Earth	0.8		47.234		48.034
	D Subtotal		164.858	127.605	122.127	13.202	427.792
	D Conditional%		38.54%	29.83%	28.55%	3.09%	100.00%
	E	Paved	39.553	38.026	18.041	5.32	100.94
		Gravel	49.175	125.552	67.877		242.604
		Earth		4.024	11.635		15.659
	E Subtotal		88.728	167.602	97.553	5.32	359.203
	E Conditional%		24.70%	46.66%	27.16%	1.48%	100.00%
	F	Paved	23.114	9.251	12.373	5.687	50.425
		Gravel	53.348	138.441	50.53		242.319
		Earth	1.523	6.711	0.521		8.755
	F Subtotal		77.985	154.403	63.424	5.687	301.499
	F Conditional%		25.87%	51.21%	21.04%	1.89%	100.00%
	G	Paved	34.963	40.455	34.142	3.255	112.815
		Gravel	431.214	1008.851	816.225	4.249	2260.539
		Earth	57.917	393.882	615.236		1067.035
	G Subtotal		524.094	1443.188	1465.603	7.504	3440.389
	G Conditional%		15.23%	41.95%	42.60%	0.22%	100.00%
	S	Paved	55.351				55.351

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	S Subtotal		55.351				55.351
	S Conditional%		100.00%	0.00%	0.00%	0.00%	100.00%
Kiambu Sum of Length			1237.031	2200.915	1895.93	38.922	5372.798
Kiambu Condition %			23.02%	40.96%	35.29%	0.72%	100.00%

Nakuru	A	Paved	89.53	143.52	5.83		238.88
	A Subtotal		89.534	143.517	5.833		238.884
	A Conditional%		37.48%	60.08%	2.44%	0.00%	100.00%
	B	Paved	42.269	127.271	16.236		185.776
		Gravel			26.228		26.228
		Earth			3.775		3.775
	B Subtotal		42.269	127.271	46.239		215.779
	B Conditional%		19.59%	58.98%	21.43%	0.00%	100.00%
	B_urb	Paved	2.038	5.887	2.356		10.281
		Gravel		2.465	0.411		2.876
	B_urb Subtotal		2.038	8.352	2.767		13.157
	B_urb Conditional%		15.49%	63.48%	21.03%	0.00%	100.00%
	C	Paved	32.977	130.573	51.894	17.367	232.811
		Gravel	115.917	119.814	66.152		301.883
		Earth	8.307	12.34	7.796		28.443
	C Subtotal		157.201	262.727	125.842	17.367	563.137
	C Conditional%		27.92%	46.65%	22.35%	3.08%	100.00%
	C_urb	Paved	7.887	14.243	6.44		28.57
		Gravel	22.879	9.278	3.647		35.804
		Earth	2.26	0.241	10.111		12.612
	C_urb Subtotal		33.026	23.762	20.198		76.986
	C_urb Conditional%		42.90%	30.87%	26.24%	0.00%	100.00%
	D	Paved	14.936	33.066	9.12		57.122
		Gravel	67.713	152.439	94.957		315.109
		Earth	4.425	53.658	46.801		104.884
	D Subtotal		87.074	239.163	150.878		477.115
	D Conditional%		18.25%	50.13%	31.62%	0.00%	100.00%
	E	Paved	6.103	36.103	18.445		60.651
		Gravel	166.777	176.109	64.212	1.009	408.107
		Earth	27.924	111.259	88.653		227.836
	E Subtotal		200.804	323.471	171.31	1.009	696.594
	E Conditional%		28.83%	46.44%	24.59%	0.14%	100.00%
	F	Paved	11.733	12.481	12.212		36.426
		Gravel	79.691	155.983	39.697		275.371
		Earth	36.713	116.267	52.603		205.583
	F Subtotal		128.137	284.731	104.512		517.38
	F Conditional%		24.77%	55.03%	20.20%	0.00%	100.00%
	G	Paved	23.952	73.879	66.271		164.102
		Gravel	368.655	1029.507	546.396	3.883	1948.441

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
		Earth	288.006	1559.383	2844.164	3.277	4694.83
	G Subtotal		680.613	2662.769	3456.831	7.16	6807.373
	G Conditional%		10.00%	39.12%	50.78%	0.11%	100.00%
Nakuru Sum of length			1420.696	4075.763	4084.41	25.536	9606.405
Nakuru Condition(%)			14.79%	42.43%	42.52%	0.27%	100.00%

Nyandarua	A	Paved	51.132				51.132
	A Subtotal		51.132				51.132
	A Conditional%		100.00%	0.00%	0.00%	0.00%	100.00%
	B	Paved	89.955	32.041	0.055		122.051
		Gravel		14.55	10.786		25.336
	B Subtotal		89.955	46.591	10.841		147.387
	B Conditional%		61.03%	31.61%	7.36%	0.00%	100.00%
	C	Paved	50.096	49.104	1.775		100.975
		Gravel	60.753	182.096	9.97		252.819
		Earth	9.872	1.016			10.888
	C Subtotal		120.721	232.216	11.745		364.682
	C Conditional%		33.10%	63.68%	3.22%	0.00%	100.00%
	C_urb	Gravel	4.288	0.166	2.34		6.794
		Earth		1.14	1.782		2.922
	C_urb Subtotal		4.288	1.306	4.122		9.716
	C_urb Conditional%		44.13%	13.44%	42.42%	0.00%	100.00%
	D	Paved	7.767	5.773			13.54
		Gravel	14.223	90.375	18.612		123.21
		Earth		17.576	16.664		34.24
	D Subtotal		21.99	113.724	35.276		170.99
	D Conditional%		12.86%	66.51%	20.63%	0.00%	100.00%
	E	Gravel	30.371	82.048			112.419
		Earth		5.062			5.062
	E Subtotal		30.371	87.11			117.481
	E Conditional%		25.85%	74.15%	0.00%	0.00%	100.00%
	F	Paved	9.474				9.474
		Gravel	110.091	429.586	50.03		589.707
		Earth	5.991	83.867	23.909		113.767
	F Subtotal		125.556	513.453	73.939		712.948
	F Conditional%		17.61%	72.02%	10.37%	0.00%	100.00%
	G	Paved	1.685	5.391	6.781		13.857
		Gravel	190.005	573.265	289.617	0.357	1053.244
		Earth	136.513	641.216	194.128		971.857
	G Subtotal		328.203	1219.872	490.526	0.357	2038.958
	G Conditional%		16.10%	59.83%	24.06%	0.02%	100.00%
Nyandarua Sum of Length			772.216	2214.272	626.449	0.357	3613.294
Nyandarua Condition %			21.37%	61.28%	17.34%	0.01%	100.00%

Nyeri	A	Paved	53.147	19.439			72.586
--------------	----------	-------	--------	--------	--	--	--------

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	A Subtotal		53.147	19.439			72.586
	A Conditional%		73.22%	26.78%	0.00%	0.00%	100.00%
	B	Paved	78.147	23.493		10.307	111.947
	B Subtotal		78.147	23.493		10.307	111.947
	B Conditional%		69.81%	20.99%	0.00%	9.21%	100.00%
	C	Paved	164.375	82.4	4.338	8.927	260.04
		Gravel	15.788	149.137	21.488		186.413
		Earth	9.159	5.338	4.764		19.261
	C Subtotal		189.322	236.875	30.59	8.927	465.714
	C Conditional%		40.65%	50.86%	6.57%	1.92%	100.00%
	C_urb	Paved	8.067	17.431	4.647	0.792	30.937
		Gravel	1.794	20.023	11.38		33.197
		Earth			0.436		0.436
	C_urb Subtotal		9.861	37.454	16.463	0.792	64.57
	C_urb Conditional%		15.27%	58.01%	25.50%	1.23%	100.00%
	D	Paved	19.805	21.225	5.359		46.389
		Gravel	37.231	78.437	13.719		129.387
		Earth	0.271		28.164		28.435
	D Subtotal		57.307	99.662	47.242		204.211
	D Conditional%		28.06%	48.80%	23.13%	0.00%	100.00%
	E	Paved	63.598	15.358	3.84		82.796
		Gravel	28.103	112.387	16.618		157.108
		Earth		13.022	0.559		13.581
	E Subtotal		91.701	140.767	21.017		253.485
	E Conditional%		36.18%	55.53%	8.29%	0.00%	100.00%
	F	Paved	28.759	7.106	2.454		38.319
		Gravel	5.583	61.023	17.87		84.476
		Earth	3.621	6.24	8.087		17.948
	F Subtotal		37.963	74.369	28.411		140.743
	F Conditional%		26.97%	52.84%	20.19%	0.00%	100.00%
	G	Paved	71.136	36.462	14.644		122.242
		Gravel	208.434	941.675	337.826	2.761	1490.696
		Earth	41.995	527.001	495.419	1.223	1065.638
	G Subtotal		321.565	1505.138	847.889	3.984	2678.576
	G Conditional%		12.01%	56.19%	31.65%	0.15%	100.00%
Nyeri Sum of Length			839.013	2137.197	991.612	24.01	3991.832
Nyeri Condition %			21.02%	53.54%	24.84%	0.60%	100.00%

Kirinyaga	A	Paved	35.061	0.471	0.058		35.59
	A Subtotal		35.061	0.471	0.058		35.59
	A Conditional%		98.51%	1.32%	0.16%	0.00%	100.00%
	B	Paved	66.162	18.735	1.593		86.49
	B Subtotal		66.162	18.735	1.593		86.49
	B Conditional%		76.50%	21.66%	1.84%	0.00%	100.00%
	C	Paved	42.952	21.093	0.033		64.078

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
		Gravel	34.803	77.684	28.519		141.006
		Earth	5.717	2.961			8.678
	C Subtotal		83.472	101.738	28.552		213.762
	C Conditional%		39.05%	47.59%	13.36%	0.00%	100.00%
	C_urb	Paved	0.073	3.735	0.082		3.89
		Gravel	2.407	0.879			3.286
	C_urb Subtotal		2.48	4.614	0.082		7.176
	C_urb Conditional%		34.56%	64.30%	1.14%	0.00%	100.00%
	D	Paved	4.01	22.608			26.618
		Gravel	47.789	78.994	11.318		138.101
		Earth	5.822	5.301	14.162		25.285
	D Subtotal		57.621	106.903	25.48		190.004
	D Conditional%		30.33%	56.26%	13.41%	0.00%	100.00%
	E	Paved		6.808			6.808
		Gravel	19.975	34.764	16.555		71.294
		Earth	6.99	22.754			29.744
	E Subtotal		26.965	64.326	16.555		107.846
	E Conditional%		25.00%	59.65%	15.35%	0.00%	100.00%
	F	Paved	4.215	2.875			7.09
		Gravel	19.266	64.669			83.935
		Earth	27.475	15.6	1.856		44.931
	F Subtotal		50.956	83.144	1.856		135.956
	F Conditional%		37.48%	61.16%	1.37%	0.00%	100.00%
	G	Paved	1.569	11.131	3.663		16.363
		Gravel	70.735	290.346	166.516		527.597
		Earth	81.389	587.513	315.08		983.982
	G Subtotal		153.693	888.99	485.259		1527.942
	G Conditional%		10.06%	58.18%	31.76%	0.00%	100.00%
	Kirinyaga Sum of Length		476.41	1268.921	559.435		2304.766
	Kirinyaga Condition %		20.67%	55.06%	24.27%	0.00%	100.00%

Embu	A	Paved	78.118	0.34			78.458
	A Subtotal		78.118	0.34			78.458
	A Conditional%		99.57%	0.43%	0.00%	0.00%	100.00%
	B	Paved	42.201				42.201
		Earth	3.576		8.543		12.119
	B Subtotal		45.777		8.543		54.32
	B Conditional%		84.27%	0.00%	15.73%	0.00%	100.00%
	B_urb	Paved	8.323		0.423		8.746
		Gravel		3.972			3.972
		Earth		0.242	1.617		1.859
	B_urb Subtotal		8.323	4.214	2.04		14.577
	B_urb Conditional%		57.10%	28.91%	13.99%	0.00%	100.00%
	C	Paved	95.312	8.509	1.999	0.077	105.897
		Gravel	43.915	62.188	40.823	0.205	147.131

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
		Earth	53.045	7.677	28.854	0.313	89.889
	C Subtotal		192.272	78.374	71.676	0.595	342.917
	C Conditional%		56.07%	22.86%	20.90%	0.17%	100.00%
	C_urb	Paved	0.923				0.923
		Gravel	19.716	16.163	2.27		38.149
		Earth		15.892	0.361		16.253
	C_urb Subtotal		20.639	32.055	2.631		55.325
	C_urb Conditional%		37.31%	57.94%	4.76%	0.00%	100.00%
	D	Paved			3.726		3.726
		Gravel	16.179	26.323	1.562		44.064
		Earth	42.904	54.056	0.875		97.835
	D Subtotal		59.083	80.379	6.163		145.625
	D Conditional%		40.57%	55.20%	4.23%	0.00%	100.00%
	E	Paved	11.2	4.911	0.115	3.85	20.076
		Gravel	83.626	95.918	18.761		198.305
		Earth	16.609	42.524	28.202		87.335
	E Subtotal		111.435	143.353	47.078	3.85	305.716
	E Conditional%		36.45%	46.89%	15.40%	1.26%	100.00%
	F	Paved	7.03	3.185			10.215
		Gravel	45.085	71.859	37.44	6.04	160.424
		Earth	53.582	72.957	69.335		195.874
	F Subtotal		105.697	148.001	106.775	6.04	366.513
	F Conditional%		28.84%	40.38%	29.13%	1.65%	100.00%
	G	Paved	4.711	9.886	7.476		22.073
		Gravel	47.887	77.213	95.651		220.751
		Earth	226.558	875.213	492.393		1594.164
	G Subtotal		279.156	962.312	595.52		1836.988
	G Conditional%		15.20%	52.39%	32.42%	0.00%	100.00%
Embu Sum of Length			900.5	1449.028	840.426	10.485	3200.439
Embu Condition %			28.14%	45.28%	26.26%	0.33%	100.00%

Tharaka Nithi	A	Paved	29.11				29.11
	A Subtotal		29.11				29.11
	A Conditional%		100.00%	0.00%	0.00%	0.00%	100.00%
	B	Paved	29.12				29.12
	B Subtotal		29.12				29.12
	B Conditional%		100.00%	0.00%	0.00%	0.00%	100.00%
	C	Paved	9.98	1.39		9.54	20.91
		Gravel	52.343	105.957	47.777	7.518	213.595
		Earth	36.296	28.09	20.023		84.409
	C Subtotal		98.619	135.437	67.8	17.058	318.914
	C Conditional%		30.92%	42.47%	21.26%	5.35%	100.00%
	C_urb	Paved	8.899	0.257		3.831	12.987
		Gravel	8.221	8.111		1.579	17.911
	C_urb Subtotal		17.12	8.368		5.41	30.898

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	C_urb Conditional%		55.41%	27.08%	0.00%	17.51%	100.00%
	D	Earth	17.679	9.25	35.298		62.227
	D Subtotal		17.679	9.25	35.298		62.227
	D Conditional%		28.41%	14.86%	56.72%	0.00%	100.00%
	E	Gravel	41.403	94.578	6.013		141.994
		Earth	16.959	47.627	34.632		99.218
	E Subtotal		58.362	142.205	40.645		241.212
	E Conditional%		24.20%	58.95%	16.85%	0.00%	100.00%
	F	Paved	5.815				5.815
		Gravel		14.474	7.414		21.888
		Earth	37.521	36.986	1.862		76.369
	F Subtotal		43.336	51.46	9.276		104.072
	F Conditional%		41.64%	49.45%	8.91%	0.00%	100.00%
	G	Paved	7.211	0.942			8.153
		Gravel	14.888	76.577	43.365		134.83
		Earth	85.106	409.594	262.82		757.52
	G Subtotal		107.205	487.113	306.185		900.503
	G Conditional%		11.91%	54.09%	34.00%	0.00%	100.00%
TharakaNithi Sum of Length			400.551	833.833	459.204	22.468	1716.056
TharakaNithi Condition %			23.34%	48.59%	26.76%	1.31%	100.00%

Meru	A	Paved	136.429	1.571			138
		Gravel		32.96	28.166		61.126
	A Subtotal		136.429	34.531	28.166		199.126
	A Conditional%		68.51%	17.34%	14.14%	0.00%	100.00%
	B	Paved	41.636	43.467		6.506	91.609
		Gravel	1.019	13.694	16.255		30.968
		Earth	13.855	0.113		23.531	37.499
	B Subtotal		56.51	57.274	16.255	30.037	160.076
	B Conditional%		35.30%	35.78%	10.15%	18.76%	100.00%
	C	Paved	167.191	42.742	14.045		223.978
		Gravel	29.878	117.12	71.036		218.034
		Earth	14.465	77.822	30.881		123.168
	C Subtotal		211.534	237.684	115.962		565.18
	C Conditional%		37.43%	42.05%	20.52%	0.00%	100.00%
	C_urb	Paved	3.284	0.07		0.014	3.368
		Gravel	2.163	2.738		8.748	13.649
		Earth	1.31	13.837		1.288	16.435
	C_urb Subtotal		6.757	16.645		10.05	33.452
	C_urb Conditional%		20.20%	49.76%	0.00%	30.04%	100.00%
	D	Paved	8.676	2.386			11.062
		Gravel	10.798	66.792	10.703		88.293
		Earth	2.675		75.532		78.207
	D Subtotal		22.149	69.178	86.235		177.562
	D Conditional%		12.47%	38.96%	48.57%	0.00%	100.00%

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	E	Paved	33.205	26.116	3.436		62.757
		Gravel	43.652	147.097	36.389		227.138
		Earth	55.903	78.593	25.73		160.226
	E Subtotal		132.76	251.806	65.555		450.121
	E Conditional%		29.49%	55.94%	14.56%	0.00%	100.00%
	F	Paved	1.66	3.538	0.439		5.637
		Gravel	14.819	62.99	43.915		121.724
		Earth	13.644	76.324	107.994		197.962
	F Subtotal		30.123	142.852	152.348		325.323
	F Conditional%		9.26%	43.91%	46.83%	0.00%	100.00%
	G	Paved	46.065	28.398	16.285		90.748
		Gravel	61.07	233.021	227.092		521.183
		Earth	169.946	919.021	1221.982	1.452	2312.401
	G Subtotal		277.081	1180.44	1465.359	1.452	2924.332
	G Conditional%		9.48%	40.37%	50.11%	0.05%	100.00%
Meru Sum of Length			873.343	1990.41	1929.88	41.539	4835.172
Meru Condition %			18.06%	41.17%	39.91%	0.86%	100.00%

Muranga	A	Paved	53.02	0.199			53.219
	A Subtotal		53.02	0.199			53.219
	A Conditional%		99.63%	0.37%	0.00%	0.00%	100.00%
	B	Paved	144.098	15.973	0.023		160.094
		Gravel	6.69	30.819	21.274		58.783
		Earth	14.338				14.338
	B Subtotal		165.126	46.792	21.297		233.215
	B Conditional%		70.80%	20.06%	9.13%	0.00%	100.00%
	C	Paved	155.884	130.598	17.884		304.366
		Gravel	25.622	77.846	87.133		190.601
		Earth	1.628	24.149	2.77		28.547
	C Subtotal		183.134	232.593	107.787		523.514
	C Conditional%		34.98%	44.43%	20.59%	0.00%	100.00%
	C_urb	Paved	3.861	8.518	0.57		12.949
		Gravel	0.736		1.711		2.447
		Earth				3.283	3.283
	C_urb Subtotal		4.597	8.518	2.281	3.283	18.679
	C_urb Conditional%		24.61%	45.60%	12.21%	17.58%	100.00%
	D	Paved	12.467	24.04	13.741		50.248
		Gravel	110.203	64.859	20.874		195.936
		Earth	4.252	11.961	2.029		18.242
	D Subtotal		126.922	100.86	36.644		264.426
	D Conditional%		48.00%	38.14%	13.86%	0.00%	100.00%
	E	Paved	15.152	33.263	7.572		55.987
		Gravel	86.784	137.854	57.67		282.308
		Earth	20.283	15.246	3.783		39.312
	E Subtotal		122.219	186.363	69.025		377.607

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	E Conditional%		32.37%	49.35%	18.28%	0.00%	100.00%
	F	Paved	3.918	9.998	5.921	1.223	21.06
		Gravel	55.521	98.637	41.66		195.818
		Earth	0.357	9.65	4.395		14.402
	F Subtotal		59.796	118.285	51.976	1.223	231.28
	F Conditional%		25.85%	51.14%	22.47%	0.53%	100.00%
	G	Paved	35.926	41.704	22.616		100.246
		Gravel	184.981	440.814	269.987		895.782
		Earth	199.644	681.853	359.901		1241.398
	G Subtotal		420.551	1164.371	652.504		2237.426
	G Conditional%		18.80%	52.04%	29.16%	0.00%	100.00%
Muranga Sum of Length			1135.365	1857.981	941.514	4.506	3939.366
Muranga Condition %			28.82%	47.16%	23.90%	0.11%	100.00%

Laikipia	A	Paved	34.477	32.928			67.405
		Gravel	0.248	90.584			90.832
	A Subtotal		34.725	123.512			158.237
	A Conditional%		21.94%	78.06%	0.00%	0.00%	100.00%
	B	Paved	9.932	45.587			55.519
		Gravel	23.949	46.739	2.686		73.374
		Earth		6.366			6.366
	B Subtotal		33.881	98.692	2.686		135.259
	B Conditional%		25.05%	72.97%	1.99%	0.00%	100.00%
	C	Paved	6.01	64.153	0.176	4.01	74.349
		Gravel	50.064	118.757	46.255	10.754	225.83
		Earth	39.996	56.545	1.119		97.66
	C Subtotal		96.07	239.455	47.55	14.764	397.839
	C Conditional%		24.15%	60.19%	11.95%	3.71%	100.00%
	C_urb	Paved	4.343	4.94	0.207		9.49
		Gravel		6.913			6.913
		Earth		3.813	0.812		4.625
	C_urb Subtotal		4.343	15.666	1.019		21.028
	C_urb Conditional%		20.65%	74.50%	4.85%	0.00%	100.00%
	D	Paved		11.506	0.097		11.603
		Gravel	48.168	139.286	8.641		196.095
		Earth		9.674	11.691		21.365
	D Subtotal		48.168	160.466	20.429		229.063
	D Conditional%		21.03%	70.05%	8.92%	0.00%	100.00%
	E	Paved	18.287	14.577	4.63		37.494
		Gravel	0.197	38.468	10.526	1.192	50.383
		Earth	8.451	4.08	44.05		56.581
	E Subtotal		26.935	57.125	59.206	1.192	144.458
	E Conditional%		18.65%	39.54%	40.98%	0.83%	100.00%
	F	Paved	0.482	3.854	0.066		4.402
		Gravel	9.543	25.749	9.612		44.904

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
		Earth	4.068	6.655	5.904		16.627
	F Subtotal		14.093	36.258	15.582		65.933
	F Conditional%		21.37%	54.99%	23.63%	0.00%	100.00%
	G	Paved	0.098	14.63	5.919		20.647
		Gravel	188.244	306.228	223.152	0.247	717.871
		Earth	165.791	522.72	589.961		1278.472
	G Subtotal		354.133	843.578	819.032	0.247	2016.99
	G Conditional%		17.56%	41.82%	40.61%	0.01%	100.00%
Laikipia Sum of Length			612.348	1574.752	965.504	16.203	3168.807
Laikipia Condition %			19.32%	49.70%	30.47%	0.51%	100.00%

isiolo	A	Paved	27.586				27.586
		Gravel	18.855	20.838			39.693
		Earth		7.104	104.968		112.072
	A Subtotal		46.441	27.942	104.968		179.351
	A Conditional%		25.89%	15.58%	58.53%	0.00%	100.00%
	B	Gravel	31.15	101.035	122.046		254.231
		Earth	100.961	91.168	64.105		256.234
	B Subtotal		132.111	192.203	186.151		510.465
	B Conditional%		25.88%	37.65%	36.47%	0.00%	100.00%
	C	Gravel	23.668	69.126	185.205		277.999
		Earth	14.439	29.732	147.644		191.815
	C Subtotal		38.107	98.858	332.849		469.814
	C Conditional%		8.11%	21.04%	70.85%	0.00%	100.00%
	C_urb	Paved	0.441	0.39	1.154		1.985
		Gravel	0.519	3.178	0.763		4.46
		Earth		0.301	0.709		1.01
	C_urb Subtotal		0.96	3.869	2.626		7.455
	C_urb Conditional%		12.88%	51.90%	35.22%	0.00%	100.00%
	D	Gravel	0.183	10.981	2.999		14.163
		Earth		66.795	0.591		67.386
	D Subtotal		0.183	77.776	3.59		81.549
	D Conditional%		0.22%	95.37%	4.40%	0.00%	100.00%
	E	Gravel		24.269	49.401		73.67
		Earth	0.28	6.535	67.862		74.677
	E Subtotal		0.28	30.804	117.263		148.347
	E Conditional%		0.19%	20.76%	79.05%	0.00%	100.00%
	F	Gravel	0.488	36.277	39.126		75.891
		Earth	28.954	31.485	70.031		130.47
	F Subtotal		29.442	67.762	109.157		206.361
	F Conditional%		14.27%	32.84%	52.90%	0.00%	100.00%
	G	Paved	1.509	0.213	0.942		2.664
		Gravel	13.753	75.765	133.153		222.671
		Earth	44.831	249.657	589.413	11.071	894.972
	G Subtotal		60.093	325.635	723.508	11.071	1120.307

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	G Conditional%		5.36%	29.07%	64.58%	0.99%	100.00%
isiolo Sum of Length			307.617	824.849	1580.112	11.071	2723.649
isiolo Condition %			11.29%	30.28%	58.01%	0.41%	100.00%

Wajir	A	Paved	15.953				15.953
		Gravel	29.825	120.389	208.815		359.029
		Earth		78.951	111.647		190.598
	A Subtotal		45.778	199.34	320.462		565.58
	A Conditional%		8.09%	35.25%	56.66%	0.00%	100.00%
	B	Paved	2.676				2.676
		Gravel	5.712	51.683	104.41		161.805
		Earth	60.46	308.79	68.053		437.303
	B Subtotal		68.848	360.473	172.463		601.784
	B Conditional%		11.44%	59.90%	28.66%	0.00%	100.00%
	C	Gravel	77.481	91.643	41.682		210.806
		Earth	31.362	255.391	206.746		493.499
	C Subtotal		108.843	347.034	248.428		704.305
	C Conditional%		15.45%	49.27%	35.27%	0.00%	100.00%
	C_urb	Paved	2.428				2.428
		Earth		1.101	2.353		3.454
	C_urb Subtotal		2.428	1.101	2.353		5.882
	C_urb Conditional%		41.28%	18.72%	40.00%	0.00%	100.00%
	D	Paved	1.244				1.244
		Gravel	63.297	51.013	6.162		120.472
		Earth	29.612	195.304	108.788		333.704
	D Subtotal		94.153	246.317	114.95		455.42
	D Conditional%		20.67%	54.09%	25.24%	0.00%	100.00%
	E	Gravel	0.412	49.642	72.985		123.039
		Earth	60.477	19.405	93.945		173.827
	E Subtotal		60.889	69.047	166.93		296.866
	E Conditional%		20.51%	23.26%	56.23%	0.00%	100.00%
	F	Gravel	15.129	25.29			40.419
		Earth	49.964	195.172	149.257		394.393
	F Subtotal		65.093	220.462	149.257		434.812
	F Conditional%		14.97%	50.70%	34.33%	0.00%	100.00%
	G	Gravel	2.405	75.896	74.397		152.698
		Earth	140.267	786.303	1024.111		1950.681
	G Subtotal		142.672	862.199	1098.508		2103.379
	G Conditional%		6.78%	40.99%	52.23%	0.00%	100.00%
Wajir Sum of Length			588.704	2305.973	2273.351		5168.028
Wajir Condition %			11.39%	44.62%	43.99%	0.00%	100.00%

Mandera	A	Paved	37.328	1.819	3.612	24.565	67.324
		Gravel	33.099	78.121	35.021	0.525	146.766
		Earth		17.876	44.106		61.982

COUNTY	ROAD CLASS	Surface Type	LENGTH (kms)				TOTAL
			Good	Fair	Poor	Under Construction	
	A Subtotal		70.427	97.816	82.739	25.09	276.072
	A Conditional%		25.51%	35.43%	29.97%	9.09%	100.00%
	B	Gravel	82.854	34.837	1.671		119.362
		Earth	51.579	54.845	140.959		247.383
	B Subtotal		134.433	89.682	142.63		366.745
	B Conditional%		36.66%	24.45%	38.89%	0.00%	100.00%
	C	Gravel	134.735	104.117	9.463		248.315
		Earth	140.462	1.081	211.081		352.624
	C Subtotal		275.197	105.198	220.544		600.939
	C Conditional%		45.79%	17.51%	36.70%	0.00%	100.00%
	D	Paved	4.355	1.965	3.033		9.353
		Gravel	16.021	22.987	140.567		179.575
		Earth	0.356	38.579	18.856		57.791
	D Subtotal		20.732	63.531	162.456		246.719
	D Conditional%		8.40%	25.75%	65.85%	0.00%	100.00%
	E	Gravel	36.622	36.046	17.727		90.395
		Earth			98		98
	E Subtotal		36.622	36.046	115.727		188.395
	E Conditional%		19.44%	19.13%	61.43%	0.00%	100.00%
	F	Gravel	39.566	16.362	14.763		70.691
		Earth	82.261	61.578	175.834		319.673
	F Subtotal		121.827	77.94	190.597		390.364
	F Conditional%		31.21%	19.97%	48.83%	0.00%	100.00%
	G	Paved	4.593	1.817	3.923		10.333
		Gravel	6.877	25	4.636		36.513
		Earth	166.68	123.918	676.245		966.843
	G Subtotal		178.15	150.735	684.804		1013.689
	G Conditional%		17.57%	14.87%	67.56%	0.00%	100.00%
	Mandera Sum of Length		837.388	620.948	1599.497	25.09	3082.923
	Mandera Condition %		27.16%	20.14%	51.88%	0.81%	100.00%
	Total Sum of Length		10401.182	23354.842	18747.324	220.187	52723.535
	Total Condition %		19.73%	44.30%	35.56%	0.42%	100.00%

**TABLE 2C: SUMMARY OF SURFACE TYPE AND ROAD
CONDITION PER ROAD CLASS (NARROW
ROADS)**

TABLE - 2C: SUMMARY OF SURFACE TYPE AND ROAD CONDITION PER ROAD CLASS (NARROW ROADS)

Road Reserve	Road Class	Surface Type	Length km				TOTAL
			Good	Fair	Poor	Under Constructi	
BELOW 6m	D	Paved	1.937	0.719	0.648		3.304
		Sub Total	1.937	0.719	0.648		3.304
		Condition(%)	58.63%	21.76%	19.61%	0.00%	100.00%
	E	Gravel			1.067		1.067
		Earth		2.683			2.683
		Sub Total		2.683	1.067		3.75
		Condition(%)	0.00%	71.55%	28.45%	0.00%	100.00%
	G	Gravel	0.105	0.764	0.651		1.52
		Earth	0.892	1.082	1.997		3.971
		Sub Total	0.997	1.846	2.648		5.491
		Condition(%)	18.16%	33.62%	48.22%	0.00%	100.00%
	NR	Paved	0.855				0.855
		Gravel	74.42	287.319	143.159		504.898
		Earth	106.944	1010.114	2476.425	1.781	3595.264
		Sub Total	182.219	1297.433	2619.584	1.781	4101.017
	Condition(%)	4.44%	31.64%	63.88%	0.04%	100.00%	
ABOVE 6m	D	Paved	153.183	38.384	22.124	2.61	216.301
		Gravel		1.243	2.159		3.402
		Other	1.05				1.05
		Sub Total	154.233	39.627	24.283	2.61	220.753
	Condition(%)	69.87%	17.95%	11.00%	1.18%	100.00%	
	E	Paved	2.721	2.66	1.915	0.955	8.251
		Gravel	415.067	768.682	340.715	18.131	1542.595
		Earth	0.6	4.726	6.777		12.103
		Sub Total	418.388	776.068	349.407	19.086	1562.949
	Condition(%)	26.77%	49.65%	22.36%	1.22%	100.00%	
	F	Gravel		0.625			0.625
		Earth	55.383	526.552	126.391		708.326
		Sub Total	55.383	527.177	126.391		708.951
		Condition(%)	7.81%	74.36%	17.83%	0.00%	100.00%
	G	Paved	2.942		0.249		3.191
		Gravel	18.367	42.973	7.655		68.995
		Earth	577.912	1554.375	2727.318	11.124	4870.729
		Other			2.229		2.229
	Sub Total	599.221	1597.348	2737.451	11.124	4945.144	
	Condition(%)	12.12%	32.30%	55.36%	0.22%	100.00%	
	NR	Paved	17.5	6.542	2.577		26.619
		Gravel	592.517	1545.773	592.835	3.964	2735.089
		Earth	488.233	3857.163	5302.973	5.233	9653.602
		Sub Total	1098.25	5409.478	5898.385	9.197	12415.31
	Condition(%)	8.85%	43.57%	47.51%	0.07%	100.00%	
Grand Total		Sub Total	2510.628	9652.379	11759.864	43.798	23966.669
Overall Condition (%)		Condition(%)	10.48%	40.27%	49.07%	0.18%	100.00%

**TABLE 2D: SUMMARY OF SURFACE TYPE AND ROAD
CONDITION PER ROAD CLASS (NARROW
ROADS) PER COUNTY**

TABLE - 2C: SUMMARY OF SURFACE TYPE AND ROAD CONDITION PER ROAD CLASS (NARROW ROADS)

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL	
				Good	Fair	Poor	Under Constructio		
Kiambu	<6	D	Paved	1.937	0.719	0.648		3.304	
			Gravel						
			Earth						
		D Grand Total (Km)		1.937	0.719	0.648		3.304	
		D condition(%)		58.63%	21.76%	19.61%	0.00%	100.00%	
		G	Earth	0.892				0.892	
		G Grand Total (Km)		0.892				0.892	
		G condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%	
		NR	Gravel	20.918	78.789	52.611		152.318	
			Earth	9.076	125.673	317.102		451.851	
		NR Grand Total (Km)		29.994	204.462	369.713		604.169	
		NR condition(%)		4.96%	33.84%	61.19%	0.00%	100.00%	
		<6 Grand Total (Km)		32.823	205.181	370.361		608.365	
		<6 condition(%)		5.40%	33.73%	60.88%	0.00%	100.00%	
		>6	D	Paved	72.659	23.639	16.234		112.532
			Gravel			0.141		0.141	
			Other		0.132				0.132
			D Grand Total (Km)		72.791	23.78	16.234		112.805
			D condition(%)		64.53%	21.08%	14.39%	0.00%	100.00%
			E	Paved	1.162	1.98	1.915	0.955	6.012
				Gravel	96.245	151.417	100.749	17.298	365.709
			E Grand Total (Km)		97.407	153.397	102.664	18.253	371.721
			E condition(%)		26.20%	41.27%	27.62%	4.91%	100.00%
			F	Earth			0.079		0.079
			F Grand Total (Km)				0.079		0.079
			F condition(%)		0.00%	0.00%	100.00%	0.00%	100.00%
			G	Paved			0.249		0.249
			Gravel		1.944	2.43		4.374	
			Earth	12.104	101.449	204.837	6.479	324.869	
		G Grand Total (Km)		12.104	103.393	207.516	6.479	329.492	
		G condition(%)		3.67%	31.38%	62.98%	1.97%	100.00%	
		NR	Paved		0.504	0.603		1.107	
			Gravel	100.385	251.135	123.703	3.273	478.496	
			Earth	28.478	206.385	416.872	1.271	653.006	
		NR Grand Total (Km)		128.863	458.024	541.178	4.544	1132.609	
		NR condition(%)		11.38%	40.44%	47.78%	0.40%	100.00%	
	>6 Grand Total (Km)			311.165	738.594	867.671	29.276	1946.706	
	>6 condition(%)			15.98%	37.94%	44.57%	1.50%	100.00%	
	Kiambu Grand Total (Km)			343.988	943.775	1238.032	29.276	2555.071	
	Kiambu Overall Condition(%)			13.46%	36.94%	48.45%	1.15%	100.00%	

Nakuru	<6	E	Gravel			1.067		1.067	
			Earth		2.683			2.683	
			E Grand Total (Km)		2.683		1.067		3.75
		E condition(%)		0.00%	71.55%	28.45%	0.00%	100.00%	
		G	Gravel			0.435		0.435	
			Earth		0.203	1.615		1.818	
		G Grand Total (Km)			0.203	2.05		2.253	
		G condition(%)		0.00%	9.01%	90.99%	0.00%	100.00%	
		NR	Gravel	13.581	62.346	20.739		96.666	
			Earth	7.175	191.389	862.104	1.781	1062.449	
		NR Grand Total (Km)		20.756	253.735	882.843	1.781	1159.115	
		NR condition(%)		1.79%	21.89%	76.17%	0.15%	100.00%	
		<6 Grand Total (Km)		20.756	256.621	885.96	1.781	1165.118	
		<6 condition(%)		1.78%	22.03%	76.04%	0.15%	100.00%	
		>6	D	Paved	28.401	6.988	3.337	2.213	40.939
			Gravel			1.102	2.159		3.261
			Other		0.918				0.918
			D Grand Total (Km)		29.319	8.09	5.496	2.213	45.118
			D condition(%)		64.98%	17.93%	12.18%	4.90%	100.00%
			E	Paved	0.404				0.404
				Gravel	107.962	243.181	63.488		414.631
				Earth		3.555	6.777		10.332
			E Grand Total (Km)		108.366	246.736	70.265		425.367
			E condition(%)		25.48%	58.01%	16.52%	0.00%	100.00%
			G	Gravel	0.584	0.843	0.26		1.687
				Earth	104.306	365.079	1152.591	2.645	1624.621
			G Grand Total (Km)		104.89	365.922	1152.851	2.645	1626.308
		G condition(%)		6.45%	22.50%	70.89%	0.16%	100.00%	
		NR	Paved	3.696	4.079	0.15		7.925	

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL
				Good	Fair	Poor	Under Constructio	
			Gravel	111.549	284.59	104.17	0.691	501
			Earth	105.553	700.644	1719.432		2525.629
		NR Grand Total (Km)		220.798	989.313	1823.752	0.691	3034.554
		NR condition(%)		7.28%	32.60%	60.10%	0.02%	100.00%
	>6 Grand Total (Km)			463.373	1610.061	3052.364	5.549	5131.347
	>6 condition(%)			9.03%	31.38%	59.48%	0.11%	100.00%
Nakuru Grand Total (Km)				484.129	1866.682	3938.324	7.33	6296.465
Nakuru Overall Condition(%)				7.69%	29.65%	62.55%	0.12%	100.00%

Nyandarua	<6	NR	Gravel	12.082	11.733	4.929		28.744
			Earth	7.596	40.805	93.789		142.19
		NR Grand Total (Km)		19.678	52.538	98.718		170.934
		NR condition(%)		11.51%	30.74%	57.75%	0.00%	100.00%
	<6 Grand Total (Km)			19.678	52.538	98.718		170.934
	<6 condition(%)			11.51%	30.74%	57.75%	0.00%	100.00%
	>6	D	Paved	1.33				1.33
		D Grand Total (Km)		1.33				1.33
		D condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
		E	Gravel	55.413	43.397	15.991		114.801
		E Grand Total (Km)		55.413	43.397	15.991		114.801
		E condition(%)		48.27%	37.80%	13.93%	0.00%	100.00%
		G	Gravel		1.926			1.926
			Earth	26.022	56.494	56.26		138.776
		G Grand Total (Km)		26.022	58.42	56.26		140.702
		G condition(%)		18.49%	41.52%	39.99%	0.00%	100.00%
		NR	Gravel	70.858	145.983	32.34		249.181
			Earth	81.268	245.917	238.467		565.652
		NR Grand Total (Km)		152.126	391.9	270.807		814.833
		NR condition(%)		18.67%	48.10%	33.23%	0.00%	100.00%
	>6 Grand Total (Km)			234.891	493.717	343.058		1071.666
	>6 condition(%)			21.92%	46.07%	32.01%	0.00%	100.00%
Nyandarua Grand Total (Km)				254.569	546.255	441.776		1242.6
Nyandarua Overall Condition(%)				20.49%	43.96%	35.55%	0.00%	100.00%

Nyeri	<6	NR	Gravel	11.218	45.07	7.168		63.456
			Earth	9.233	44.032	116.616		169.881
		NR Grand Total (Km)		20.451	89.102	123.784		233.337
		NR condition(%)		8.76%	38.19%	53.05%	0.00%	100.00%
	<6 Grand Total (Km)			20.451	89.102	123.784		233.337
	<6 condition(%)			8.76%	38.19%	53.05%	0.00%	100.00%
	>6	D	Paved	4.247	1.615	1.635		7.497
		D Grand Total (Km)		4.247	1.615	1.635		7.497
		D condition(%)		56.65%	21.54%	21.81%	0.00%	100.00%
		E	Paved	1.155				1.155
			Gravel	43.015	68.673	18.971		130.659
		E Grand Total (Km)		44.17	68.673	18.971		131.814
		E condition(%)		33.51%	52.10%	14.39%	0.00%	100.00%
		G	Earth	2	60.511	124.026		186.537
		G Grand Total (Km)		2	60.511	124.026		186.537
		G condition(%)		1.07%	32.44%	66.49%	0.00%	100.00%
		NR	Paved	1.492	1.833			3.325
			Gravel	52.086	200.028	52.033		304.147
			Earth	29.847	216.792	251.116		497.755
		NR Grand Total (Km)		83.425	418.653	303.149		805.227
		NR condition(%)		10.36%	51.99%	37.65%	0.00%	100.00%
	>6 Grand Total (Km)			133.842	549.452	447.781		1131.075
	>6 condition(%)			11.83%	48.58%	39.59%	0.00%	100.00%
Nyeri Grand Total (Km)				154.293	638.554	571.565		1364.412
Nyeri Overall Condition(%)				11.31%	46.80%	41.89%	0.00%	100.00%

Kirinyaga	<6	NR	Gravel	2.87	12.642	2.958		18.47
			Earth		48.114	56.783		104.897
		NR Grand Total (Km)		2.87	60.756	59.741		123.367
		NR condition(%)		2.33%	49.25%	48.43%	0.00%	100.00%
	<6 Grand Total (Km)			2.87	60.756	59.741		123.367
	<6 condition(%)			2.33%	49.25%	48.43%	0.00%	100.00%
	>6	D	Paved		0.996	0.324		1.32
		D Grand Total (Km)			0.996	0.324		1.32
		D condition(%)		0.00%	75.45%	24.55%	0.00%	100.00%
		E	Paved		0.347			0.347

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL
				Good	Fair	Poor	Under Constructio	
			Gravel	4.375	22.741	9.109		36.225
		E Grand Total (Km)		4.375	23.088	9.109		36.572
		E condition(%)		11.96%	63.13%	24.91%	0.00%	100.00%
		G	Earth	16.044	21.771	27.378		65.193
		G Grand Total (Km)		16.044	21.771	27.378		65.193
		G condition(%)		24.61%	33.39%	42.00%	0.00%	100.00%
		NR	Paved			1.782		1.782
			Gravel	19.382	93.138	26.032		138.552
			Earth	11.548	235.908	227.055		474.511
		NR Grand Total (Km)		30.93	329.046	254.869		614.845
		NR condition(%)		5.03%	53.52%	41.45%	0.00%	100.00%
		>6 Grand Total (Km)		51.349	374.901	291.68		717.93
		>6 condition(%)		7.15%	52.22%	40.63%	0.00%	100.00%
		Kirinyaga Grand Total (Km)		54.219	435.657	351.421		841.297
		Kirinyaga Overall Condition(%)		6.44%	51.78%	41.77%	0.00%	100.00%

Embu	<6	NR	Paved	0.321				0.321
			Gravel	0.053	0.579	3.082		3.714
			Earth	1.057	60.191	173.288		234.536
		NR Grand Total (Km)		1.431	60.77	176.37		238.571
		NR condition(%)		0.60%	25.47%	73.93%	0.00%	100.00%
		<6 Grand Total (Km)		1.431	60.77	176.37		238.571
		<6 condition(%)		0.60%	25.47%	73.93%	0.00%	100.00%
	>6	D	Paved	1.138	0.13			1.268
		D Grand Total (Km)		1.138	0.13			1.268
		D condition(%)		89.75%	10.25%	0.00%	0.00%	100.00%
		E	Gravel	3.113	1.326	1.343		5.782
		E Grand Total (Km)		3.113	1.326	1.343		5.782
		E condition(%)		53.84%	22.93%	23.23%	0.00%	100.00%
		G	Paved	2.008				2.008
			Earth	1.511	15.333	16.928		33.772
		G Grand Total (Km)		3.519	15.333	16.928		35.78
		G condition(%)		9.84%	42.85%	47.31%	0.00%	100.00%
		NR	Paved	0.976	0.126			1.102
			Gravel	18.997	20.221	23.573		62.791
			Earth	12.5	241.805	189.473		443.778
		NR Grand Total (Km)		32.473	262.152	213.046		507.671
		NR condition(%)		6.40%	51.64%	41.97%	0.00%	100.00%
		>6 Grand Total (Km)		40.243	278.941	231.317		550.501
		>6 condition(%)		7.31%	50.67%	42.02%	0.00%	100.00%
		Embu Grand Total (Km)		41.674	339.711	407.687		789.072
		Embu Overall Condition(%)		5.28%	43.05%	51.67%	0.00%	100.00%

TharakaNithi	<6	NR	Gravel		4.626	0.777		5.403
			Earth	7.498	107.802	162.711		278.011
		NR Grand Total (Km)		7.498	112.428	163.488		283.414
		NR condition(%)		2.65%	39.67%	57.69%	0.00%	100.00%
		<6 Grand Total (Km)		7.498	112.428	163.488		283.414
		<6 condition(%)		2.65%	39.67%	57.69%	0.00%	100.00%
	>6	D	Paved	0.896				0.896
		D Grand Total (Km)		0.896				0.896
		D condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
		E	Gravel	2.002	13.954	0.594		16.55
		E Grand Total (Km)		2.002	13.954	0.594		16.55
		E condition(%)		12.10%	84.31%	3.59%	0.00%	100.00%
		G	Earth	0.8	35.592	6.617		43.009
		G Grand Total (Km)		0.8	35.592	6.617		43.009
		G condition(%)		1.86%	82.75%	15.39%	0.00%	100.00%
		NR	Paved	1.054				1.054
			Gravel	10.264	43.445	12.555		66.264
			Earth	36.012	299.426	241.639	2.297	579.374
		NR Grand Total (Km)		47.33	342.871	254.194	2.297	646.692
		NR condition(%)		7.32%	53.02%	39.31%	0.36%	100.00%
		>6 Grand Total (Km)		51.028	392.417	261.405	2.297	707.147
		>6 condition(%)		7.22%	55.49%	36.97%	0.32%	100.00%
		TharakaNithi Grand Total (Km)		58.526	504.845	424.893	2.297	990.561
		TharakaNi Overall Condition(%)		5.91%	50.97%	42.89%	0.23%	100.00%

Meru	<6	G	Gravel		0.16			0.16
			Earth		0.289			0.289

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL
				Good	Fair	Poor	Under Constructio	
		G Grand Total (Km)			0.449			0.449
		G condition(%)		0.00%	100.00%	0.00%	0.00%	100.00%
		NR	Paved	0.272				0.272
			Gravel	2.719	23.226	15.873		41.818
			Earth	18.258	269.258	427.727		715.243
		NR Grand Total (Km)		21.249	292.484	443.6		757.333
		NR condition(%)		2.81%	38.62%	58.57%	0.00%	100.00%
	<6	Grand Total (Km)		21.249	292.933	443.6		757.782
	<6	condition(%)		2.80%	38.66%	58.54%	0.00%	100.00%
	>6	D	Paved	5.537	1.294			6.831
		D Grand Total (Km)		5.537	1.294			6.831
		D condition(%)		81.06%	18.94%	0.00%	0.00%	100.00%
		E	Paved		0.047			0.047
			Gravel	12.694	16.821	15.85		45.365
		E Grand Total (Km)		12.694	16.868	15.85		45.412
		E condition(%)		27.95%	37.14%	34.90%	0.00%	100.00%
		G	Gravel	0.182				0.182
			Earth	36.226	106.859	158.402		301.487
		G Grand Total (Km)		36.408	106.859	158.402		301.669
		G condition(%)		12.07%	35.42%	52.51%	0.00%	100.00%
		NR	Paved	0.595				0.595
			Gravel	41.013	198.579	112.403		351.995
			Earth	82.711	1065.89	1122.838		2271.439
		NR Grand Total (Km)		124.319	1264.469	1235.241		2624.029
		NR condition(%)		4.74%	48.19%	47.07%	0.00%	100.00%
	>6	Grand Total (Km)		178.958	1389.49	1409.493		2977.941
	>6	condition(%)		6.01%	46.66%	47.33%	0.00%	100.00%
Meru Grand Total (Km)				200.207	1682.423	1853.093		3735.723
Meru Overall Condition(%)				5.36%	45.04%	49.60%	0.00%	100.00%

Muranga	<6	G	Gravel	0.105	0.21			0.315
		G Grand Total (Km)		0.105	0.21			0.315
		G condition(%)		33.33%	66.67%	0.00%	0.00%	100.00%
		NR	Paved	0.262				0.262
			Gravel	8.615	45.583	18.359		72.557
			Earth	26.054	95.146	191.916		313.116
		NR Grand Total (Km)		34.931	140.729	210.275		385.935
		NR condition(%)		9.05%	36.46%	54.48%	0.00%	100.00%
	<6	Grand Total (Km)		35.036	140.939	210.275		386.25
	<6	condition(%)		9.07%	36.49%	54.44%	0.00%	100.00%
	>6	D	Paved	1.728	1.457	0.594	0.397	4.176
		D Grand Total (Km)		1.728	1.457	0.594	0.397	4.176
		D condition(%)		41.38%	34.89%	14.22%	9.51%	100.00%
		E	Gravel	4.097	7.123	5.801	0.356	17.377
		E Grand Total (Km)		4.097	7.123	5.801	0.356	17.377
		E condition(%)		23.58%	40.99%	33.38%	2.05%	100.00%
		G	Gravel	16.332	38.098	4.515		58.945
			Earth	21.977	71.318	94.311	2	189.606
		G Grand Total (Km)		38.309	109.416	98.826	2	248.551
		G condition(%)		15.41%	44.02%	39.76%	0.80%	100.00%
		NR	Paved			0.042		0.042
			Gravel	60.56	179.481	45.014		285.055
			Earth	52.025	289.798	257.504		599.327
		NR Grand Total (Km)		112.585	469.279	302.56		884.424
		NR condition(%)		12.73%	53.06%	34.21%	0.00%	100.00%
	>6	Grand Total (Km)		156.719	587.275	407.781	2.753	1154.528
	>6	condition(%)		13.57%	50.87%	35.32%	0.24%	100.00%
Muranga Grand Total (Km)				191.755	728.214	618.056	2.753	1540.778
Muranga Overall Condition(%)				12.45%	47.26%	40.11%	0.18%	100.00%

Laikipia	<6	G	Earth			0.382		0.382
		G Grand Total (Km)				0.382		0.382
		G condition(%)		0.00%	0.00%	100.00%	0.00%	100.00%
		NR	Gravel	1.229	0.718	12.039		13.986
			Earth	10.773	5.246	30.237		46.256
		NR Grand Total (Km)		12.002	5.964	42.276		60.242
		NR condition(%)		19.92%	9.90%	70.18%	0.00%	100.00%
	<6	Grand Total (Km)		12.002	5.964	42.658		60.624
	<6	condition(%)		19.80%	9.84%	70.36%	0.00%	100.00%
	>6	D	Paved	32.29	2.265			34.555

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL
				Good	Fair	Poor	Under Constructio	
		D Grand Total (Km)		32.29	2.265			34.555
		D condition(%)		93.45%	6.55%	0.00%	0.00%	100.00%
		E	Paved		0.286			0.286
			Gravel	51.212	51.9	24.203	0.477	127.792
		E Grand Total (Km)		51.212	52.186	24.203	0.477	128.078
		E condition(%)		39.99%	40.75%	18.90%	0.37%	100.00%
		G	Paved	0.934				0.934
			Earth	93.796	123.408	175.045		392.249
		G Grand Total (Km)		94.73	123.408	175.045		393.183
		G condition(%)		24.09%	31.39%	44.52%	0.00%	100.00%
		NR	Paved	9.687				9.687
			Gravel	100.714	106.866	28.596		236.176
			Earth	45.963	301.181	255.375	1.665	604.184
		NR Grand Total (Km)		156.364	408.047	283.971	1.665	850.047
		NR condition(%)		18.39%	48.00%	33.41%	0.20%	100.00%
		>6 Grand Total (Km)		334.596	585.906	483.219	2.142	1405.863
		>6 condition(%)		23.80%	41.68%	34.37%	0.15%	100.00%
Laikipia Grand Total (Km)				346.598	591.87	525.877	2.142	1466.487
Laikipia Overall Condition(%)				23.63%	40.36%	35.86%	0.15%	100.00%

isiolo	<6	G	Gravel		0.394	0.216		0.61
			Earth		0.59			0.59
		G Grand Total (Km)			0.984	0.216		1.2
		G condition(%)		0.00%	82.00%	18.00%	0.00%	100.00%
		NR	Gravel		1.904	4.624		6.528
			Earth		4.583	33.814		38.397
		NR Grand Total (Km)			6.487	38.438		44.925
		NR condition(%)		0.00%	14.44%	85.56%	0.00%	100.00%
		<6 Grand Total (Km)			7.471	38.654		46.125
		<6 condition(%)		0.00%	16.20%	83.80%	0.00%	100.00%
	>6	D	Paved	1.774				1.774
		D Grand Total (Km)		1.774				1.774
		D condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
		E	Gravel	15.823	44.949	3.077		63.849
		E Grand Total (Km)		15.823	44.949	3.077		63.849
		E condition(%)		24.78%	70.40%	4.82%	0.00%	100.00%
		G	Earth	0.629	25.727	25.706		52.062
		G Grand Total (Km)		0.629	25.727	25.706		52.062
		G condition(%)		1.21%	49.42%	49.38%	0.00%	100.00%
		NR	Gravel	3.31	19.227	17.452		39.989
			Earth	0.432	39.215	66.319		105.966
		NR Grand Total (Km)		3.742	58.442	83.771		145.955
		NR condition(%)		2.56%	40.04%	57.40%	0.00%	100.00%
		>6 Grand Total (Km)		21.968	129.118	112.554		263.64
		>6 condition(%)		8.33%	48.98%	42.69%	0.00%	100.00%
isiolo Grand Total (Km)				21.968	136.589	151.208		309.765
isiolo Overall Condition(%)				7.09%	44.09%	48.81%	0.00%	100.00%

Wajir	<6	NR	Earth		0.811	6.58		7.391
		NR Grand Total (Km)			0.811	6.58		7.391
		NR condition(%)		0.00%	10.97%	89.03%	0.00%	100.00%
		<6 Grand Total (Km)			0.811	6.58		7.391
		<6 condition(%)		0.00%	10.97%	89.03%	0.00%	100.00%
	>6	D	Paved	2.932				2.932
		D Grand Total (Km)		2.932				2.932
		D condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
		E	Gravel	9.709	71.026	43.146		123.881
			Earth	0.6	1.171			1.771
		E Grand Total (Km)		10.309	72.197	43.146		125.652
		E condition(%)		8.20%	57.46%	34.34%	0.00%	100.00%
		F	Gravel	0.625				0.625
			Earth	55.383	520.006	122.332		697.721
		F Grand Total (Km)		55.383	520.631	122.332		698.346
		F condition(%)		7.93%	74.55%	17.52%	0.00%	100.00%
		G	Gravel			0.291		0.291
			Earth	35.171	510.42	534.436		1080.027
		G Grand Total (Km)		35.171	510.42	534.727		1080.318
		G condition(%)		3.26%	47.25%	49.50%	0.00%	100.00%
		NR	Gravel	3.399	3.08	14.964		21.443
			Earth	1.45	13.192	316.883		331.525

COUNTY	RD Reserve	RD Class	Surface Type	SURFACE CONDITION				TOTAL
				Good	Fair	Poor	Under Constructio	
		NR Grand Total (Km)		4.849	16.272	331.847		352.968
		NR condition(%)		1.37%	4.61%	94.02%	0.00%	100.00%
		>6 Grand Total (Km)		108.644	1119.52	1032.052		2260.216
		>6 condition(%)		4.81%	49.53%	45.66%	0.00%	100.00%
Wajir Grand Total (Km)				108.644	1120.331	1038.632		2267.607
Wajir Overall Condition(%)				4.79%	49.41%	45.80%	0.00%	100.00%

Mandera	<6	NR	Gravel	1.135	0.103			1.238
			Earth	10.224	17.064	3.758		31.046
		NR Grand Total (Km)		11.359	17.167	3.758		32.284
		NR condition(%)		35.18%	53.17%	11.64%	0.00%	100.00%
		<6 Grand Total (Km)		11.359	17.167	3.758		32.284
		<6 condition(%)		35.18%	53.17%	11.64%	0.00%	100.00%
	>6	D	Paved	0.251				0.251
		D Grand Total (Km)		0.251				0.251
		D condition(%)		100.00%	0.00%	0.00%	0.00%	100.00%
		E	Gravel	9.407	32.174	38.393		79.974
		E Grand Total (Km)		9.407	32.174	38.393		79.974
		E condition(%)		11.76%	40.23%	48.01%	0.00%	100.00%
		F	Earth		6.546	3.98		10.526
		F Grand Total (Km)			6.546	3.98		10.526
		F condition(%)		0.00%	62.19%	37.81%	0.00%	100.00%
		G	Gravel	1.269	0.162	0.159		1.59
			Earth	227.326	60.414	150.781		438.521
			Other			2.229		2.229
		G Grand Total (Km)		228.595	60.576	153.169		442.34
		G condition(%)		51.68%	13.69%	34.63%	0.00%	100.00%
		NR	Earth	0.446	1.01			1.456
		NR Grand Total (Km)		0.446	1.01			1.456
		NR condition(%)		30.63%	69.37%	0.00%	0.00%	100.00%
		>6 Grand Total (Km)		238.699	100.306	195.542		534.547
		>6 condition(%)		44.65%	18.76%	36.58%	0.00%	100.00%
Mandera Grand Total (Km)				250.058	117.473	199.3		566.831
Mandera Overall Condition(%)				44.12%	20.72%	35.16%	0.00%	100.00%
Total Grand Total (Km)				2510.628	9652.379	11759.864	43.798	23966.669
Total Overall Condition(%)				10.48%	40.27%	49.07%	0.18%	100.00%

**TABLE 3A: SUMMARY OF ROAD RESERVE WIDTH
(OVERALL)**

TABLE 3A: SUMMARY OF ROAD RESERVE WIDTH (OVERALL)

Road Reserve Width(m)	Below 6 m	6m-9m	9-25m	25-40m	>40m	Grand Total
Length(Km)	7123.419	30563.875	31216.004	4432.742	3353.835	76,689.87
Percentage (%)	9.29%	39.85%	40.70%	5.78%	4.37%	100.00%

TABLE 3B: SUMMARY OF ROAD RESERVE WIDTH (PER COUNTY)

TABLE 3B: SUMMARY OF ROAD RESERVE WIDTH (PER COUNTY)

COUNTY	ROAD RESERVE WIDTH (m)					SUB-TOTAL
	Below 6 m	6m-9m	9-25m	25-40m	>40	
Kiambu	1207.21	3098.23	3083.73	114.17	424.20	7,927.54
Nakuru	2181.14	6967.42	6117.02	196.64	440.66	15,902.87
Nyandarua	227.94	2288.46	2149.99	143.56	45.94	4,855.89
Nyeri	367.86	2406.29	2345.40	178.66	58.03	5,356.24
Kirinyaga	240.61	1638.39	1128.66	93.49	44.91	3,146.06
Embu	385.96	1923.82	1533.53	106.01	40.19	3,989.51
Tharaka Nithi	395.46	1366.58	859.09	68.75	16.74	2,706.62
Meru	942.81	4690.09	2548.83	168.54	220.62	8,570.89
Murang'a	565.43	2492.07	2200.94	169.61	52.10	5,480.14
Likipia	108.17	1899.75	2329.37	121.65	176.35	4,635.29
Isiolo	243.02	1107.11	1353.18	150.75	179.35	3,033.41
Wajir	190.74	619.10	2995.37	2199.74	1430.68	7,435.64
Mandera	67.06	66.56	2570.90	721.18	224.07	3,649.75
GRAND TOTAL	7,123.42	30,563.88	31,216.00	4,432.74	3,353.84	76,689.88

**TABLE 4A: ROAD REGISTER – CLASSIFIED ROADS PER
COUNTY**
(BOUND AS VOLUME 2)

**TABLE 4B: ROAD REGISTER – NARROW ROADS PER
COUNTY**
(BOUND AS VOLUME 2)

TABLE 5A: SUMMARY OF DRAINAGE STRUCTURES ON CLASSIFIED ROADS

TABLE - 5A: SUMMARY OF DRAINAGE STRUCTURES ON CLASSIFIED ROADS

COUNTIES	Drainage Structure	Structure Type	STRUCTURE CONDITION				SUB TOTAL	
			Good	Fair	Poor	Under Construction		
Kiambu, Nakuru, Nyandarua, Nyeri, Kirinyaga, Embu, Tharaka Nithi, Meru, Murang'a, Laikipia, Isiolo, Wajir & Mandera	Bridge	Arch	10				10	
		Bailey	14	7	2		23	
		Girder	899	265	103		1267	
		Truss	15	1			16	
		Tunnel	3		1		4	
		Sub Total	941	273	106		1320	
		Condition (%)	71.29%	20.68%	8.03%		100.00%	
		Pipe	<600mm	380	163	165		708
			600-900mm	14240	3179	2236		19655
			>900mm	381	36	22		439
		Sub Total	15001	3378	2423		20802	
		Condition (%)	72.11%	16.24%	11.65%		100.00%	
		Other	Armco	507	141	119		767
			<600mm	3		5		8
			600-900mm	1	1			2
			>900mm	8	1			9
		Sub Total	519	143	124		786	
		Condition (%)	66.03%	18.19%	15.78%		100.00%	
		Box	Box	436	34	18		488
		Sub Total	436	34	18		488	
		Condition (%)	89.34%	6.97%	3.69%		100.00%	
		Drift	Drift	316	172	118		606
		Sub Total	316	172	118		606	
	Condition (%)	52.15%	28.38%	19.47%		100.00%		
	Total Sub-Total		17213	4000	2789		24002	
	Total Condition(%)		71.71%	16.67%	11.62%		100.00%	

**TABLE 5B: SUMMARY OF DRAINAGE STRUCTURES ON
CLASSIFIED ROADS PER COUNTY**

TABLE - 5B: SUMMARY OF DRAINAGE STRUCTURES ON CLASSIFIED ROADS (PER COUNTY)

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
Kiambu							
	Bridge	Arch	5	0	0	0	5
		Bailey	2	1	0	0	3
		Girder	180	42	9	0	231
		Truss	5	0	0	0	5
		Tunnel	1	0	0	0	1
		Sub-Total	193	43	9	0	245
		Condition (%)	78.78%	17.55%	3.67%	0.00%	100.00%
	Pipe	<600mm	168	69	50	0	287
		600-900mm	2020	504	238	0	2762
		>900mm	31	3	2	0	36
		Sub-Total	2219	576	290	0	3085
		Condition (%)	71.93%	18.67%	9.40%	0.00%	100.00%
	Armco	Armco	18	9	2	0	29
	Other	<600	0	0	0	0	
		600-900mm	0	0	0	0	
		>900	3	0	0	0	3
		Sub-Total	21	9	2	0	32
		Condition (%)	65.63%	28.13%	6.25%	0.00%	100.00%
	Box	Box	67	8	5	0	80
		Sub-Total	67	8	5	0	80
		Condition (%)	83.75%	10.00%	6.25%	0.00%	100.00%
	Drift	Drift	8	1	0	0	9
		Sub-Total	8	1	0	0	9
		Condition (%)	88.89%	11.11%	0.00%	0.00%	100.00%
	Sub-Total for Kiambu		2508	637	306	0	3451
	Overall Condition (%)		72.67%	18.46%	8.87%	0.00%	100.00%

Nakuru							
	Bridge	Arch	1	0	0	0	1
		Bailey	0	0	1	0	1

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		Girder	112	23	25	0	160
		Truss	3	1	0	0	4
		Tunnel	2	0	1	0	3
		Sub-Total	118	24	27	0	169
		Condition (%)	69.82%	14.20%	15.98%	0.00%	100.00%
	Pipe	<600mm	35	14	11	0	60
		600-900mm	2018	464	241	0	2723
		>900mm	129	6	1	0	136
		Sub-Total	2182	484	253	0	2919
		Condition (%)	74.75%	16.58%	8.67%	0.00%	100.00%
	Armco	Armco	55	10	20	0	85
	Other	<600mm	2	0	0	0	2
		>900mm	2	0	0	0	2
		Sub-Total	59	10	20	0	89
		Condition (%)	66.29%	11.24%	22.47%	0.00%	100.00%
	Box	Box	97	10	5	0	112
		Sub-Total	97	10	5	0	112
		Condition (%)	86.61%	8.93%	4.46%	0.00%	100.00%
	Drift	Drift	0	1	0	0	1
		Sub-Total	0	1	0	0	1
		Condition (%)	0.00%	100.00%	0.00%	0.00%	100.00%
	Sub-Total for Nakuru		2456	529	305	0	3290
	Overall Condition (%)		74.65%	16.08%	9.27%	0.00%	100.00%

Nyandarua							
	Bridge	Girder	63	32	7	0	102
		Truss	1	0	0	0	1
		Sub-Total	64	32	7	0	103
		Condition (%)	62.14%	31.07%	6.80%	0.00%	100.00%
	Pipe	<600mm	43	13	32	0	88
		600-900mm	1916	355	244	0	2515

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		>900mm	16	3	0	0	19
		Sub-Total	1975	371	276	0	2622
		Condition (%)	75.32%	14.15%	10.53%	0.00%	100.00%
	Armco	Armco	61	26	18	0	105
	Other	<600mm	1	0	3	0	4
		600-900mm	1	0	0	0	1
		>900mm	1	0	0	0	1
		Sub-Total	64	26	21	0	111
		Condition (%)	57.66%	23.42%	18.92%	0.00%	100.00%
	Box	Box	25	1	1	0	27
		Sub-Total	25	1	1	0	27
		Condition (%)	92.59%	3.70%	3.70%	0.00%	100.00%
	Drift	Drift	11	0	1	0	12
		Sub-Total	11	0	1	0	12
		Condition (%)	91.67%	0.00%	8.33%	0.00%	100.00%
	Sub-Total for Nyandarua		2139	430	306	0	2875
	Overall Condition (%)		74.40%	14.96%	10.64%	0.00%	100.00%

Nyeri							
	Bridge	Arch	2	0	0	0	2
		Bailey	4	0	0	0	4
		Girder	113	38	23	0	174
		Truss	2	0	0	0	2
		Sub-Total	121	38	23	0	182
		Condition (%)	66.48%	20.88%	12.64%	0.00%	100.00%
	Pipe	<600mm	44	13	8	0	65
		600-900mm	2792	462	313	0	3567
		>900mm	28	0	1	0	29
		Sub-Total	2864	475	322	0	3661
		Condition (%)	78.23%	12.97%	8.80%	0.00%	100.00%
	Armco	Armco	95	24	17	0	136

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Other	<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	1	0	0	0	1
		Sub-Total	96	24	17	0	137
		Condition (%)	70.07%	17.52%	12.41%	0.00%	100.00%
	Box	Box	57	1	1	0	59
		Sub-Total	57	1	1	0	59
		Condition (%)	96.61%	1.69%	1.69%	0.00%	100.00%
	Drift	Drift	10	4	3	0	17
		Sub-Total	10	4	3	0	17
		Condition (%)	58.82%	23.53%	17.65%	0.00%	100.00%
	Sub-Total for Nyeri		3148	542	366	0	4056
	Overall Condition (%)		77.61%	13.36%	9.02%	0.00%	100.00%

Kirinyaga							
	Bridge	Arch	2	0	0	0	2
		Bailey	2	1	0	0	3
		Girder	75	28	4	0	107
		Truss	1	0	0	0	1
		Sub-Total	80	29	4	0	113
		Condition (%)	70.80%	25.66%	3.54%	0.00%	100.00%
	Pipe	<600mm	25	13	16	0	54
		600-900mm	710	206	128	0	1044
		>900mm	15	1	0	0	16
		Sub-Total	750	220	144	0	1114
		Condition (%)	67.32%	19.75%	12.93%	0.00%	100.00%
	Armco	Armco	29	4	1	0	34
	Other	<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	1	0	0	0	1
		Sub-Total	30	4	1	0	35
		Condition (%)	85.71%	11.43%	2.86%	0.00%	100.00%

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Box	Box	31	1	1	0	33
		Sub-Total	31	1	1	0	33
		Condition (%)	93.94%	3.03%	3.03%	0.00%	100.00%
	Drift	Drift	2	1	0	0	3
		Sub-Total	2	1	0	0	3
		Condition (%)	66.67%	33.33%	0.00%	0.00%	100.00%
	Sub-Total for Kirinyaga		893	255	150	0	1298
	Overall Condition (%)		68.80%	19.65%	11.56%	0.00%	100.00%

Embu							
	Bridge	Girder	67	10	8	0	85
		Truss	1	0	0	0	1
		Sub-Total	68	10	8	0	86
		Condition (%)	79.07%	11.63%	9.30%	0.00%	100.00%
	Pipe	<600mm	19	12	13	0	44
		600-900mm	849	230	165	0	1244
		>900mm	15	2	0	0	17
		Sub-Total	883	244	178	0	1305
		Condition (%)	67.66%	18.70%	13.64%	0.00%	100.00%
	Armco	Armco	52	17	7	0	76
	Other	<600mm	0	0	0	0	
		600-900mm	0	1	0	0	1
		>900mm	0	0	0	0	
		Sub-Total	52	18	7	0	77
		Condition (%)	67.53%	23.38%	9.09%	0.00%	100.00%
	Box	Box	13	1	0	0	14
		Sub-Total	13	1	0	0	14
		Condition (%)	92.86%	7.14%	0.00%	0.00%	100.00%
	Drift	Drift	72	41	15	0	128
		Sub-Total	72	41	15	0	128

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		Condition (%)	56.25%	32.03%	11.72%	0.00%	100.00%
	Sub-Total for Embu		1088	314	208	0	1610
	Overall Condition (%)		67.58%	19.50%	12.92%	0.00%	100.00%

Tharaka-Nithi							
	Bridge	Girder	45	20	3	0	68
		Sub-Total	45	20	3	0	68
		Condition (%)	66.18%	29.41%	4.41%	0.00%	100.00%
	Pipe	<600mm	5	1	0	0	6
		600-900mm	249	75	57	0	381
		>900mm	18	1	0	0	19
		Sub-Total	272	77	57	0	406
		Condition (%)	67.00%	18.97%	14.04%	0.00%	100.00%
	Armco	Armco	74	16	7	0	97
	Other	<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	0	0	0	0	
		Sub-Total	74	16	7	0	97
		Condition (%)	76.29%	16.49%	7.22%	0.00%	100.00%
	Box	Box	18	0	0	0	18
		Sub-Total	18	0	0	0	18
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	12	8	5	0	25
		Sub-Total	12	8	5	0	25
		Condition (%)	48.00%	32.00%	20.00%	0.00%	100.00%
	Sub-Total for Tharaka Nithi		421	121	72	0	614
	Overall Condition (%)		68.57%	19.71%	11.73%	0.00%	100.00%

Meru							
	Bridge	Bailey	2	5	1	0	8
		Girder	120	23	9	0	152

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		Sub-Total	122	28	10	0	160
		Condition (%)	76.25%	17.50%	6.25%	0.00%	100.00%
	Pipe	<600mm	14	4	7	0	25
		600-900mm	1114	232	215	0	1561
		>900mm	94	14	5	0	113
		Sub-Total	1222	250	227	0	1699
		Condition (%)	71.92%	14.71%	13.36%	0.00%	100.00%
	Armco	Armco	72	17	10	0	99
	Other	<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	0	0	0	0	
		Sub-Total	72	17	10	0	99
		Condition (%)	72.73%	17.17%	10.10%	0.00%	100.00%
	Box	Box	73	4	1	0	78
		Sub-Total	73	4	1	0	78
		Condition (%)	93.59%	5.13%	1.28%	0.00%	100.00%
	Drift	Drift	25	25	5	0	55
		Sub-Total	25	25	5	0	55
		Condition (%)	45.45%	45.45%	9.09%	0.00%	100.00%
	Sub-Total for Meru		1514	324	253	0	2091
	Overall Condition (%)		72.41%	15.49%	12.10%	0.00%	100.00%

Murang'a							
	Bridge	Bailey	1	0	0	0	1
		Girder	69	38	10	0	117
		Truss	1	0	0	0	1
		Sub-Total	71	38	10	0	119
		Condition (%)	59.66%	31.93%	8.40%	0.00%	100.00%
	Pipe	<600mm	18	20	19	0	57
		600-900mm	1238	415	439	0	2092
		>900mm	5	0	1	0	6

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		Sub-Total	1261	435	459	0	2155
		Condition (%)	58.52%	20.19%	21.30%	0.00%	100.00%
	Other	Armco	21	11	23	0	55
		<600mm	0	0	2	0	2
		600-900mm	0	0	0	0	
		>900mm	0	0	0	0	
		Sub-Total	21	11	25	0	57
		Condition (%)	36.84%	19.30%	43.86%	0.00%	100.00%
	Box	Box	36	7	3	0	46
		Sub-Total	36	7	3	0	46
		Condition (%)	78.26%	15.22%	6.52%	0.00%	100.00%
	Drift	Drift	4	1	1	0	6
		Sub-Total	4	1	1	0	6
		Condition (%)	66.67%	16.67%	16.67%	0.00%	100.00%
	Sub-Total for Murangá		1393	492	498	0	2383
	Overall Condition (%)		58.46%	20.65%	20.90%	0.00%	100.00%

Laikipia							
	Bridge	Bailey	1	0	0	0	1
		Girder	45	9	5	0	59
		Truss	1	0	0	0	1
		Sub-Total	47	9	5	0	61
		Condition (%)	77.05%	14.75%	8.20%	0.00%	100.00%
	Pipe	<600mm	6	3	8	0	17
		600-900mm	1008	181	153	0	1342
		>900mm	16	4	1	0	21
		Sub-Total	1030	188	162	0	1380
		Condition (%)	74.64%	13.62%	11.74%	0.00%	100.00%
	Other	Armco	22	3	3	0	28
		<600mm	0	0	0	0	
		600-900mm	0	0	0	0	

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		>900mm	0	0	0	0	
		Sub-Total	22	3	3	0	28
		Condition (%)	78.57%	10.71%	10.71%	0.00%	100.00%
	Box	Box	6	1	0	0	7
		Sub-Total	6	1	0	0	7
		Condition (%)	85.71%	14.29%	0.00%	0.00%	100.00%
	Drift	Drift	0	2	0	0	2
		Sub-Total	0	2	0	0	2
		Condition (%)	0.00%	100.00%	0.00%	0.00%	100.00%
	Sub-Total for Laikipia		1105	203	170	0	1478
	Overall Condition (%)		74.76%	13.73%	11.50%	0.00%	100.00%

isiolo							
	Bridge	Bailey	2	0	0	0	2
		Girder	10	2	0	0	12
		Sub-Total	12	2	0	0	14
		Condition (%)	85.71%	14.29%	0.00%	0.00%	100.00%
	Pipe	<600mm	2	0	1	0	3
		600-900mm	210	19	12	0	241
		>900mm	10	0	0	0	10
		Sub-Total	222	19	13	0	254
		Condition (%)	87.40%	7.48%	5.12%	0.00%	100.00%
	Other	Armco	1	1	1	0	3
		<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	0	1	0	0	1
		Sub-Total	1	2	1	0	4
		Condition (%)	25.00%	50.00%	25.00%	0.00%	100.00%
	Box	Box	6	0	1	0	7
		Sub-Total	6	0	1	0	7
		Condition (%)	85.71%	0.00%	14.29%	0.00%	100.00%

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Drift	Drift	55	6	12	0	73
		Sub-Total	55	6	12	0	73
		Condition (%)	75.34%	8.22%	16.44%	0.00%	100.00%
	Sub-Total for Isiolo		296	29	27	0	352
	Overall Condition (%)		84.09%	8.24%	7.67%	0.00%	100.00%

Wajir							
	Pipe	<600mm	0	1	0	0	1
		600-900mm	69	3	3	0	75
		>900mm	3	2	9	0	14
		Sub-Total	72	6	12	0	90
		Condition (%)	80.00%	6.67%	13.33%	0.00%	100.00%
	Other	Armco	0	1	6	0	7
		<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	0	0	0	0	
		Sub-Total	0	1	6	0	7
		Condition (%)	0.00%	14.29%	85.71%	0.00%	100.00%
	Box	Box	4	0	0	0	4
		Sub-Total	4	0	0	0	4
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	59	38	55	0	152
		Sub-Total	59	38	55	0	152
		Condition (%)	38.82%	25.00%	36.18%	0.00%	100.00%
	Sub-Total for Wajir		135	45	73	0	253
	Overall Condition (%)		53.36%	17.79%	28.85%	0.00%	100.00%

Mandera							
	Pipe	<600mm	1	0	0	0	1
		600-900mm	47	33	28	0	108
		>900mm	1	0	2	0	3

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
		Sub-Total	49	33	30	0	112
		Condition (%)	43.75%	29.46%	26.79%	0.00%	100.00%
	Other	Armco	7	2	4	0	13
		<600mm	0	0	0	0	
		600-900mm	0	0	0	0	
		>900mm	0	0	0	0	
		Sub-Total	7	2	4	0	13
		Condition (%)	53.85%	15.38%	30.77%	0.00%	100.00%
	Box	Box	3	0	0	0	3
		Sub-Total	3	0	0	0	3
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	58	44	21	0	123
		Sub-Total	58	44	21	0	123
		Condition (%)	47.15%	35.77%	17.07%	0.00%	100.00%
		Sub-Total for Mandera	117	79	55	0	251
		Overall Condition (%)	46.61%	31.47%	21.91%	0.00%	100.00%

		Grand Total	17213	4000	2789	0	24002
		Condition (%)	71.71%	16.67%	11.62%	0.00%	100.00%

TABLE 5C: SUMMARY OF DRAINAGE STRUCTURES ON NARROW ROADS

TABLE - 5C: SUMMARY OF DRAINAGE STRUCTURES ON UNCLASSIFIED (NARROW) ROADS

COUNTIES	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total	
			Good	Fair	Poor	Under Construction		
Kiambu, Nakuru, Nyandarua, Nyeri, Kirinyaga, Embu, Tharaka Nithi, Meru, Murang'a, Laikipia, Isiolo, Wajir & Mandera	Bridge	Arch	2				2	
		Bailey	1	2			3	
		Girder	175	58	102		335	
		Truss	7	1			8	
		Tunnel	3				3	
		Sub Total	188	61	102		351	
		Condition (%)	53.56%	17.38%	29.06%		100.00%	
		Pipe	<600mm	163	49	35		247
			600-900mm	3007	537	378		3922
			>900mm	63	1	3		67
		Sub Total	3233	587	416		4236	
		Condition (%)	76.32%	13.86%	9.82%		100.00%	
		Other	Armco	35	7	3		45
			<600mm		4	1		5
			600-900mm	1		1		2
		Sub Total	36	11	5		52	
		Condition (%)	69.23%	21.15%	9.62%		100.00%	
		Box	Box	69	10	9		88
		Sub Total	69	10	9		88	
		Condition (%)	78.41%	11.36%	10.23%		100.00%	
		Drift	Drift	20	14	4		38
		Sub Total	20	14	4		38	
		Condition (%)	52.63%	36.84%	10.53%		100.00%	
	Total Sub Total		3546	683	536		4765	
	Total Condition(%)		74.42%	14.33%	11.25%		100.00%	

**TABLE 5D: SUMMARY OF DRAINAGE STRUCTURES ON
NARROW ROADS PER COUNTY**

TABLE - 5D: SUMMARY OF DRAINAGE STRUCTURES ON UNCLASSIFIED (NARROW) ROADS (PER COUNTY)

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
Kiambu							
	Bridge	Arch	1	0	0	0	1
		Bailey		1	0	0	1
		Girder	38	3	9	0	50
		Truss	4	1	0	0	5
		Tunnel	3	0	0	0	3
		Sub-Total	46	5	9	0	60
		Condition (%)	76.67%	8.33%	15.00%	0.00%	100.00%
	Pipe	<600mm	95	30	18	0	143
		600-900mm	551	148	86	0	785
		>900mm	20	1	0	0	21
		Sub-Total	666	179	104	0	949
		Condition (%)	70.18%	18.86%	10.96%	0.00%	100.00%
	Armco	Armco	4	1	0	0	5
		Sub-Total	4	1	0	0	5
		Condition (%)	80.00%	20.00%	0.00%	0.00%	100.00%
	Box	Box	23	3	0	0	26
		Sub-Total	23	3	0	0	26
		Condition (%)	88.46%	11.54%	0.00%	0.00%	100.00%
	Drift	Drift		1	1	0	2
		Sub-Total		1	1	0	2
		Condition (%)	0.00%	50.00%	50.00%	0.00%	100.00%
	Sub-Total for Kiambu		739	189	114	0	1042
	Overall Condition (%)		70.92%	18.14%	10.94%	0.00%	100.00%

Nakuru							
	Bridge	Arch	1	0	0	0	1
		Bailey	1	1	0	0	2
		Girder	35	25	64	0	124
		Truss	2	0	0	0	2
		Sub-Total	39	26	64	0	129

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Armco	Armco	2	2	0	0	4
	Other	<600mm	0	1	0	0	1
		600-900mm	1	0	1	0	2
		>900mm	0	0	0	0	0
		Sub-Total	3	3	1	0	7
		Condition (%)	42.86%	42.86%	14.29%	0.00%	100.00%
	Box	Box	1	0	1	0	2
		Sub-Total	1	0	1	0	2
		Condition (%)	50.00%	0.00%	50.00%	0.00%	100.00%
	Sub-Total for Nyandarua		266	39	14	0	319
	Overall Condition (%)		83.39%	12.23%	4.39%	0.00%	100.00%

Nyeri							
	Bridge	Girder	12	3	8	0	23
		Truss	1	0	0	0	1
		Sub-Total	13	3	8	0	24
		Condition (%)	54.17%	12.50%	33.33%	0.00%	100.00%
	Pipe	<600mm	20	4	4	0	28
		600-900mm	353	29	23	0	405
		>900mm	4	0	0	0	4
		Sub-Total	377	33	27	0	437
		Condition (%)	86.27%	7.55%	6.18%	0.00%	100.00%
	Armco	Armco	2	0	0	0	2
		Sub-Total	2	0	0	0	2
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Box	Box	5	2	0	0	7
		Sub-Total	5	2	0	0	7
		Condition (%)	71.43%	28.57%	0.00%	0.00%	100.00%
	Sub-Total for Nyeri		397	38	35	0	470
	Overall Condition (%)		84.47%	8.09%	7.45%	0.00%	100.00%

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
Kirinyaga							
	Bridge	Girder	7	0	0	0	7
		Sub-Total	7	0	0	0	7
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Pipe	<600mm	3	3	1	0	7
		600-900mm	39	7	2	0	48
		>900mm	2	0	0	0	2
		Sub-Total	44	10	3	0	57
		Condition (%)	77.19%	17.54%	5.26%	0.00%	100.00%
	Sub-Total for Kirinyaga		51	10	3	0	64
	Overall Condition (%)		79.69%	15.63%	4.69%	0.00%	100.00%

Embu							
	Bridge	Girder	3	0	0	0	3
		Sub-Total	3	0	0	0	3
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Pipe	<600mm	0	0	1	0	1
		600-900mm	36	6	4	0	46
		>900mm	0	0	0	0	0
		Sub-Total	36	6	5	0	47
		Condition (%)	76.60%	12.77%	10.64%	0.00%	100.00%
	Box	Box	1	0	0	0	1
		Sub-Total	1	0	0	0	1
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	4	2	0	0	6
		Sub-Total	4	2	0	0	6
		Condition (%)	66.67%	33.33%	0.00%	0.00%	100.00%
	Sub-Total for Embu		44	8	5	0	57
	Overall Condition (%)		77.19%	14.04%	8.77%	0.00%	100.00%

Tharaka-Nithi							
----------------------	--	--	--	--	--	--	--

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Bridge	Girder	8	2	0	0	10
		Sub-Total	8	2	0	0	10
		Condition (%)	80.00%	20.00%	0.00%	0.00%	100.00%
	Pipe	<600mm	1	0	0	0	1
		600-900mm	67	6	12	0	85
		>900mm	1	0	0	0	1
		Sub-Total	69	6	12	0	87
		Condition (%)	79.31%	6.90%	13.79%	0.00%	100.00%
	Armco	Armco	4	0	0	0	4
		Sub-Total	4	0	0	0	4
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Box	Box	1	0	0	0	1
		Sub-Total	1	0	0	0	1
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	4	1	0	0	5
		Sub-Total	4	1	0	0	5
		Condition (%)	80.00%	20.00%	0.00%	0.00%	100.00%
	Sub-Total for Tharaka Nithi		86	9	12	0	107
	Overall Condition (%)		80.37%	8.41%	11.21%	0.00%	100.00%

Meru							
	Bridge	Girder	49	14	15	0	78
		Sub-Total	49	14	15	0	78
		Condition (%)	62.82%	17.95%	19.23%	0.00%	100.00%
	Pipe	<600mm	5	1	0	0	6
		600-900mm	307	64	32	0	403
		>900mm	16	0	2	0	18
		Sub-Total	328	65	34	0	427
		Condition (%)	76.81%	15.22%	7.96%	0.00%	100.00%
	Armco	Armco	1	2	0	0	3

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Sub-Total for Murangá		471	86	138	0	695
	Overall Condition (%)		67.77%	12.37%	19.86%	0.00%	100.00%

Laikipia							
	Bridge	Girder	4	4	2	0	10
		Sub-Total	4	4	2	0	10
		Condition (%)	40.00%	40.00%	20.00%	0.00%	100.00%
	Pipe	<600mm	1	1	2	0	4
		600-900mm	268	24	23	0	315
		>900mm	5	0	0	0	5
		Sub-Total	274	25	25	0	324
		Condition (%)	84.57%	7.72%	7.72%	0.00%	100.00%
	Armco	Armco	15	1	0	0	16
		Sub-Total	15	1	0	0	16
		Condition (%)	93.75%	6.25%	0.00%	0.00%	100.00%
	Box	Box	6	0	0	0	6
		Sub-Total	6	0	0	0	6
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Sub-Total for Laikipia		299	30	27	0	356
	Overall Condition (%)		83.99%	8.43%	7.58%	0.00%	100.00%

isiolo							
	Pipe	600-900mm	32	1	7	0	40
		Sub-Total	32	1	7	0	40
		Condition (%)	80.00%	2.50%	17.50%	0.00%	100.00%
	Box	Box	1	0	0	0	1
		Sub-Total	1	0	0	0	1
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	2	0	0	0	2
		Sub-Total	2	0	0	0	2
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Sub-Total for Isiolo		35	1	7	0	43
	Overall Condition (%)		81.40%	2.33%	16.28%	0.00%	100.00%

Wajir							
	Bridge	Girder	1	0	0	0	1
		Sub-Total	1	0	0	0	1
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Pipe	<600mm	0	0	0	0	
		600-900mm	9	9	3	0	21
		>900mm	0	0	0	0	
		Sub-Total	9	9	3	0	21
		Condition (%)	42.86%	42.86%	14.29%	0.00%	100.00%
	Box	Box	1	0	0	0	1
		Sub-Total	1	0	0	0	1
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%
	Drift	Drift	4	4	2	0	10
		Sub-Total	4	4	2	0	10
		Condition (%)	40.00%	40.00%	20.00%	0.00%	100.00%
	Sub-Total for Wajir		15	13	5	0	33
	Overall Condition (%)		45.45%	39.39%	15.15%	0.00%	100.00%

Mandera							
	Pipe	<600mm		1			1
		600-900mm	3	1	1	0	5
		>900mm	0	0	0	0	
		Sub-Total	3	2	1	0	6
		Condition (%)	50.00%	33.33%	16.67%	0.00%	100.00%
	Box	Box	4	0	0	0	4
		Sub-Total	4	0	0	0	4
		Condition (%)	100.00%	0.00%	0.00%	0.00%	100.00%

COUNTY	Drainage Structure	Structure Type	STRUCTURE CONDITION (No.)				Grand Total
			Good	Fair	Poor	Under Construction	
	Drift	Drift	1	4	0	0	5
		Sub-Total	1	4	0	0	5
		Condition (%)	20.00%	80.00%	0.00%	0.00%	100.00%
	Sub-Total for Mandera		8	6	1	0	15
	Overall Condition (%)		53.33%	40.00%	6.67%	0.00%	100.00%

Total Sub Total			3546	683	536	0	4765
Total Condition(%)			74.42%	14.33%	11.25%	0.00%	100.00%

APPENDIX 2 : BOOK OF MAPS

BOOK OF MAPS

(BOUND IN A SEPARATE VOLUME 3)

DOCUMENT REGISTER

Project Name:	CONSULTANCY SERVICES TO UNDERTAKE ROAD INVENTORY AND CONDITION SURVEY FOR CENTRAL ZONE OF KENYA
Project Number:	5083039
Report Number	FRR-02
Report Title:	FINAL ROAD REGISTER – NOVEMBER 2018

PREPARATION, REVIEW AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
1	30/11/2018	Michael O. Ogola	Aydagne Woldemariam/David Kimingi	David Kimingi

ISSUE REGISTER

Distribution List	Date Issued	Number of Copies
Client: Kenya Roads Board (KRB)	30/11/2018	1
SMEC staff: Project Director		1
Associates: KIRI Consult Ltd.		
Office Library (SMEC Office Location): Nairobi		1
SMEC Project File: Nairobi		1

SMEC COMPANY DETAILS

SMEC INTERNATIONAL PTY LTD	
General Mathenge Gardens 240, Off Lower Kabete Road (Westlands) P.O. Box 14094 - 00800, Nairobi, KENYA	
Tel:	+254-20-444 1541
Email:	kenya@smec.com
Website:	www.smec.com