



## **Analysis of Performance of Previous Low Volume Rural Roads in Mozambique**

**AFCAP/MOZ/001/G**

**Monthly Progress Report No.1**

**By Kenneth Mukura  
TRL Regional Manager for Southern Africa**

*October 2012*

This project was funded by the Africa Community Access Programme (AFCAP) which promotes safe and sustainable access to markets, healthcare, education, employment and social and political networks for rural communities in Africa.

Launched in June 2008 and managed by Crown Agents, the five year-long, UK government (DFID) funded project, supports research and knowledge sharing between participating countries to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

The programme is currently active in Ethiopia, Kenya, Ghana, Malawi, Mozambique, Tanzania, Zambia, South Africa, Democratic Republic of Congo and South Sudan and is developing relationships with a number of other countries and regional organisations across Africa.

This material has been funded by UKaid from the Department for International Development, however the views expressed do not necessarily reflect the department's or the managing agent's official policies.

For further information visit  
<https://www.afcap.org>

## **Preface**

This report covers the work carried out in the month of October, providing information on activities and technical aspects of the project. Sample data and illustrated photographs are provided in the Appendix.

## 1 Introduction

This monthly progress report presents activities carried out during the month of October 2012. This document is intended to give a brief overview of the status of the work done on the study sections and to highlight issues that need resolution.

The activities over the period include:

- Submission and inception of the Inception Report
- Consultations with the client and ANE to get agreement on the field and laboratory tests to be carried out.

## 2 Project Objectives

This report covers the field investigation, sampling and testing of this phase of the overall project. This phase is entitled, '*Analysis of Performance of Previous Low Volume Rural Roads in Mozambique*'. The results of this analysis will provide additional research data to feed into the current development of specifications, work norms and guidelines for the provision of low volume surfaced roads (LVSRs) in Mozambique.

The objectives will be achieved through four main activities:

- Preliminary activities, including site visits and desk study of historical projects.
- Field investigations involving measurements of the current condition of the roads and collection of samples for testing in the laboratory.
- Laboratory testing of materials.
- Analysis of test results and reporting.

## 3 Resources

A project team has been mobilized to carry out the detailed investigation, sampling and testing of the materials. The team consists of Kenneth Mukura, John Rolt, Francis Dangare and Andrew Otto.

## 4 Progress to date

The progress made during October 2012 is presented below:

### 4.1 Submission and approval of inception report

The Inception Report was submitted and approved by the client. Key components of the Inception Report included the following:

1. Overall programme showing all tasks relating to the project
2. Detailed programme of field investigations and materials testing
3. The capacity of ANE and national materials testing laboratories to carry out the materials testing
4. Budget proposals for additional materials testing

## 4.2 Preparation of detailed field investigation and testing programme

A programme for the detailed investigations and materials testing, a copy of which has been included in this report (see Section 7), was submitted to assist in the logistical support relating to the detailed investigation, sampling and testing of materials. The planned order of carrying out the field testing is as follows:

1. Boane-Libombos road, Maputo
  2. Pambara –Rios Save road, Inhambane
  3. Rio Zambezi-Nicoadala road, Zambezia
  4. Nametil Angoche road, Nampula
  5. Oasse-Mocimboa da Praia road, Cabo Delgado
  6. Lichinga-Mandimba road, Niassa
- Travel to and from site
  - Demarcation of study sections
  - Traffic management arrangements for surveys and reinstatement of test pits
  - Visual condition surveys
  - Rut depth measurements
  - Roughness measurements
  - Deflection surveys using the PRIMA light weigh deflectometer
  - Sample traffic and axle loading surveys
  - Transportation of samples to ANE provincial and Maputo and LEM laboratories
  - Testing of samples in ANE, LEM
  - Specialist testing of samples in laboratories outside Mozambique

## 4.3 Visual condition surveys

Visual condition surveys are particularly important because they provide an overview of problems or performance deficiencies in the pavement and they can be used to demarcate sections where the pavement has performed well or poorly. It is therefore important to make sure that the pavement condition assessment is carried out properly because this is a major component of any analysis of the in-service performance. In order to achieve this, several aspects that constitute the performance rating needed to be followed through.

Condition surveys involved the estimation of surface defects such as cracking, patching, potholes, and deformation by estimating quantities and assigning ratings for the severity and extent of the various defects.

## 4.4 Axle load surveys

Axle load surveys were carried out using a portable weighbridge on the Boane-Libombos site to get an indication of traffic loading.

## 4.5 Roughness measurements

Roughness is the integration of irregularities of the road surface in the longitudinal plane and it is measured on the International Roughness Index (IRI) scale. Roughness was measured using a Bump

Integrator. Three runs were made on the designated sections and averages were calculated to determine the roughness levels of the different sections.

#### **4.6 Deflection surveys**

Deflection surveys are a direct measure of pavement thickness. High stiffness levels are associated with lower deflection and this gives an indication of the pavement's resilience to agents of deterioration, especially traffic.

#### **4.7 Dynamic Cone Penetration (DCP) tests**

The DCP is a non-destructive test of the strength and thickness of various pavement layers and foundation. It is possible to correlate the pavement strength generated by the deflection survey with structural number generated by the DCP test

#### **4.8 Progress on study sections**

Surveys have been completed at one site, the Boane-Libombos road in Maputo. The status of this site is presented below:

1. Visual surveys were completed
2. Axle load surveys were carried out. Summary information is included in the Appendix.
3. Roughness measurements were taken using the Bump Integrator and have been completed.
4. Deflection surveys were taken using the PRIMA. However, these were not completed because the machine developed technical problems, which are now being resolved. Information obtained is included in the Appendix.
5. Dynamic Cone Penetration (DCP) tests have been completed
6. Sampling has been completed.

### **5 Programme for the next stage**

It is anticipated that the fieldwork will be completed by the end of December 2012. Samples will be delivered to the laboratories as soon as they are collected from site in order to ensure that the capacities of ANE laboratories and LEM are not exceeded.

It is envisaged that all tests that will be carried out in local laboratories will be completed by the end of January. Specialized tests to be carry out abroad are expected to be completed by the end of February 2013.

### **6 Challenges**

The following challenges have affected commencement of the field surveys:

- The rainy season started much earlier than anticipated, thereby affecting the timing of field surveys

- The PRIMA personal data assistant developed technical problems which resulted in delays in the completion of deflection surveys. However, this matter was being resolved at the time of submitting this progress report.

## **7 Plan for the next reporting period (November)**

Work is planned on the following study sections during November:

1. Boane-Libombos – laboratory testing of samples
2. Pambara –Rio Save – detailed investigation, sampling and laboratory testing of samples
3. Rio Zambezi-Nicoadala – detailed investigation, sampling and laboratory testing of samples
4. Nametil Angoche – detailed investigation, sampling and laboratory testing of samples



## 8 APPENDIX

### PRIMA 100 DEFLECTION SURVEY

PROVINCE: Maputo

ROAD NAME: Boane-Libombos  
Carla Mendita

OPERATOR

RECORDER Francis Dangare

Chainage	Lane Modulus	READING NO. Position	Without sand Deflection	With sand Modulus	Comments Deflection
4+700	Libombos bound	Outer wheel track			
		1	226.34	518.34	267.67 440.54
		2	220.39	533.56	259.26 452.37
		3	221.26	539.63	264.02 445.02
		4			255.19 463.29
		5			
4+700	Libombos bound	Inner wheel track			
		1	213.89	555.8	218.68 538.12
		2	142.27	843.69	209.34 556.61
		3	279.23	421.82	203.55 575.44
		4	1818.2	64.571	201.55 591.72
		5	153.56	774.38	
4+700	Libombos bound	Centre line			
		1	332.17	344.99	258.4 461.44
		2	216.27	545.06	240.74 467.24
		3	225.2	507.13	235.26 509.95
		4	164.29	725.28	229.63 529.84
		5			
4+750	Libombos bound	Centre line			
		1	744.52	156.59	442.97 153.59
		2	590.33	196.38	414.76 196.38
		3	559.24	208.21	414.76 208.21
		4	567.26	205.78	408.22 205.78



	5	538.09	218.03	405.21	218.03		
4+800	Libombos bound	Centre line					
	1	205.86	66.742	296.4	400.93		
	2	198.75	602.38	201.31	593.65		
	3	193.73	617.17	196.37	605.31		
	4	181.38	655.17	193.59	612.15		
	5	179.31	654.18	195.61	604.91		
4+850	Libombos bound	Centre line					
	1	431.72	273.05	566.61	203.71		
	2	429.11	273.7	524.22	225.34		
	3	424.03	277.22	507.21	235.3		
	4	421.43	281.33	514.22	229.35		
	5	424.66	277.25	534.55	222.8		
4+850	Libombos bound	Centre line					
	1	621.24	186.63	480.41	243.13		
	2	528.76	222.12	461.5	255.98		
	3	523.03	222.37	462.4	252.72		
	4	515.19	226.63	459.5	257.77		
	5	528.94	221.24	467.45	249.87		
4+900	Libombos bound	Centre line					
	1	424.91	274.25	435.74	272.2		
	2	383.67	306.85	409.11	285.17		
	3	374.48	310.67	405.73	282.4		
	4	178.74	654.85	404.96	289.86		
	5	370.19	317.56	387.25	302.58		
4+950	Libombos bound	Centre line					
	1	199.86	594.47	230.94	503.48		
	2	230.45	517.51	230.17	517.28		
	3	198.17	600.57	224.4	527.79		
	4	194.5	608.61	218.54	533.59		
	5	202.81	585.99	226.69	520.5		
5+000	Libombos bound	Centre line	1	481.67	239.05	495.21	235.75
	2	420.19	273.94	471.62	246.72		
	3	413.91	280.26	480.04	281.62		
	4	408.75	284.91	475.07	245.62		
	5	402.61	289.39	459.97	254.57		

5+050	Libombos bound	Centre line	1	965.7	118.04	715.73	161.6	
			2	701.25	161.53	702.85	165	
			3	705.7	164.06	670.24	174	
			4	680.96	170.14	685.47	170.56	
			5	683.36	170.14	667.67	173.43	
5+048	Libombos bound	Centre line	1	789.63	141.71	710.37	159.29	pothole
			2	657.44	172.54	690.44	166.07	
			3	631.57	180.97	679.85	170.6	
			4	621.85	182.33	667.85	171.76	
			5	620.13	183.89	681.04	168.67	
5+100	Libombos bound	Centre line	1	216.72	552.1	209.91	553.75	
			2	204.54	570.87	197.85	605.18	
			3	202.8	561.87	204.59	660.76	
			4	194.87	611.22	15.122	784.77	
			5	170.32	696.56	10.169	2267.8	
						220.85	535.69	
						217.59	537.13	
						216.23	543.57	
						207.19	563.79	
						208.34	565.42	
				209.01	532.13			
5+150	Libombos bound	Centre line	1	592.01	250.93	485.74	233.96	shoulder
			2	481.2	441.79	464.83	245.93	
			3	461.11	250.34	464.66	253.87	
			4	473.8	250.07	458.71	248.34	
			5	557.62	255.44	458.61	251.48	
5+500	Libombos bound	Centre line	1	609.67	183.35	385.9	299.55	
			2	430.45	269.91	410.61	281.32	
			3	434.09	267.05	421.08	277.06	
			4	428.02	270.43	407.41	279.46	
			5	413.09	270.41	422.86	277.1	

**PRIMA 100 DEFLECTION SURVEY**

**PROVINCE:** Maputo

**ROAD NAME:** Boane-  
Libombos

**OPERATOR** Carla Mendita

**RECORDER** Francis Dangare

Chainage	Lane	Position	READING NO.	Without sand Deflection	Modulus	With sand Deflection	Modulus	Comments
4+700	Libombos bound	Outer wheel track	1	226.34	518.34	267.67	440.54	
			2	220.39	533.56	259.26	452.37	
			3	221.26	539.63	264.02	445.02	
			4			255.19	463.29	
			5					
4+700	Libombos bound	Inner wheel track	1	213.89	555.8	218.68	538.12	
			2	142.27	843.69	209.34	556.61	
			3	279.23	421.82	203.55	575.44	
			4	1818.2	64.571	201.55	591.72	
			5	153.56	774.38			
4+700	Libombos bound	Centre line	1	332.17	344.99	258.4	461.44	
			2	216.27	545.06	240.74	467.24	
			3	225.2	507.13	235.26	509.95	

			4	164.29	725.28	229.63	529.84
			5				
4+750	Libom bos bound	Centre line					
			1	744.52	156.59	442.97	153.59
			2	590.33	196.38	414.76	196.38
			3	559.24	208.21	414.76	208.21
			4	567.26	205.78	408.22	205.78
			5	538.09	218.03	405.21	218.03
4+800	Libom bos bound	Centre line					
			1	205.86	66.742	296.4	400.93
			2	198.75	602.38	201.31	593.65
			3	193.73	617.17	196.37	605.31
			4	181.38	655.17	193.59	612.15
			5	179.31	654.18	195.61	604.91
4+850	Libom bos bound	Centre line					
			1	431.72	273.05	566.61	203.71
			2	429.11	273.7	524.22	225.34
			3	424.03	277.22	507.21	235.3
			4	421.43	281.33	514.22	229.35
			5	424.66	277.25	534.55	222.8
4+850	Libom bos bound	Centre line					
			1	621.24	186.63	480.41	243.13
			2	528.76	222.12	461.5	255.98
			3	523.03	222.37	462.4	252.72
			4	515.19	226.63	459.5	257.77
			5	528.94	221.24	467.45	249.87
4+900	Libom bos bound	Centre line					
			1	424.91	274.25	435.74	272.2
			2	383.67	306.85	409.11	285.17
			3	374.48	310.67	405.73	282.4

			4	178.74	654.85	404.96	289.86	
			5	370.19	317.56	387.25	302.58	
4+950	Libom bos bound	Centre line						
			1	199.86	594.47	230.94	503.48	
			2	230.45	517.51	230.17	517.28	
			3	198.17	600.57	224.4	527.79	
			4	194.5	608.61	218.54	533.59	
			5	202.81	585.99	226.69	520.5	
5+000	Libom bos bound	Centre line	1	481.67	239.05	495.21	235.75	
			2	420.19	273.94	471.62	246.72	
			3	413.91	280.26	480.04	281.62	
			4	408.75	284.91	475.07	245.62	
			5	402.61	289.39	459.97	254.57	
5+050	Libom bos bound	Centre line	1	965.7	118.04	715.73	161.6	
			2	701.25	161.53	702.85	165	
			3	705.7	164.06	670.24	174	
			4	680.96	170.14	685.47	170.56	
			5	683.36	170.14	667.67	173.43	
5+048	Libom bos bound	Centre line	1	789.63	141.71	710.37	159.29	pothole
			2	657.44	172.54	690.44	166.07	
			3	631.57	180.97	679.85	170.6	
			4	621.85	182.33	667.85	171.76	
			5	620.13	183.89	681.04	168.67	
5+100	Libom bos bound	Centre line	1	216.72	552.1	209.91	553.75	
			2	204.54	570.87	197.85	605.18	

			3	202.8	561.87	204.59	660.76	
			4	194.87	611.22	15.122	784.77	
			5	170.32	696.56	10.169	2267.8	
						220.85	535.69	
						217.59	537.13	
						216.23	543.57	
						207.19	563.79	
						208.34	565.42	
						209.01	532.13	
5+150	Libom bos bound	Centre line	1	592.01	250.93	485.74	233.96	shoulder
			2	481.2	441.79	464.83	245.93	
			3	461.11	250.34	464.66	253.87	
			4	473.8	250.07	458.71	248.34	
			5	557.62	255.44	458.61	251.48	
5+500	Libom bos bound	Centre line	1	609.67	183.35	385.9	299.55	
			2	430.45	269.91	410.61	281.32	
			3	434.09	267.05	421.08	277.06	
			4	428.02	270.43	407.41	279.46	
			5	413.09	270.41	422.86	277.1	

**Axle Load Surveys**

**Road Name: Boane Libombos**

**Surveyor Inacio Zingai**

**Date: 27-Oct-12**

Test No.	No. of Axles				Medium	Buses	Axle Loads					
	6	5	3	2	2	2	1	2	3	4	5	6
1				√			1.84	1.66				
2						√	1.78	2.08				
3				√			4.66	6.1				
4						√	3.16	4.1				
5				√			3.02	3.74				
6				√			2.66	3.44				
7				√			1.7	1.64				
8	√						5.58	5.54				
9						√	2.84	4.08				
10				√			2.02	2.74				
11				√			3.42	7.36				
12				√			2.54	1.8				
13				√			1.72	1.94				
14						√	1.86	2				
15				√			2.26	6.4				
16				√			1.56	1.3				
17				√			1.96	1.56				
18				√			2.26	1.48				
19	√						7.16	3.84	3.56			
20				√			1.26	1.34				
21				√			2.94	2.52				
22				√			2.46	3.14				
23				√			2.26	1.54				
24				√			5.36	4.12	7.76	4.34	4.6	
25				√			1.68	1.62				
26				√			1.7	2.82				
27				√			3.14	2.88				
28						√	3.22	4.42				
29	√						5.06	3.98	3.8	1.76	1.88	
30				√								



Delineation of study sections





Deformation on wheel track probably due to poor drainage



Low lying area with poor surface drainage



Low lying area with poor drainage



Rut depth measurement





Deflection survey using PRIMA 100



Axle load survey using portable weighbridge



Disruption of sampling due to rain





Disruption of sampling due to rain



Sampling