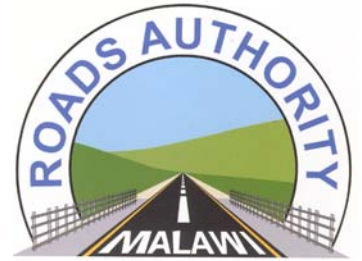


**African Community Access Programme
Project MAL/016**



**Performance Review of Design Standards
and Technical Specifications for Low Volume
Sealed Roads in Malawi**

Final Fieldwork Report

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LIST OF ABBREVIATIONS

AFCAP	African Community Access Programme
CBR	California Bearing Ratio
CML	Central Materials Laboratory
DCP	Dynamic Cone Penetrometer
IDD	In situ Dry Density
LVSR	Low Volume Sealed Road
MDD	Maximum Dry Density
MK	Malawi Kwacha
OMC	Optimum Moisture Content
OWT	Outer Wheel Track
RA	Roads Authority
SADC	Southern African Development Community
ToR	Terms of Reference
TRL	Transport Research Laboratory
USD	United States Dollar

EXECUTIVE SUMMARY

The project to undertake a *Performance Review of Design Standards and Technical Specifications for Low Volume Sealed Roads in Malawi* commenced on 26 October 2009 with the following main objectives:

- Undertake a review of performance of existing low volume sealed roads (LVSR), existing design standards and specifications used for the construction of low volume sealed roads in Malawi;
- Provide recommendations for the development of manuals and other official documentation needed to facilitate the use of appropriate standards by the Roads Authority, its consultants and contractors;
- Gain acceptance of the LVSR approach amongst decision makers using an evidence-based approach.

Phase 1 of the project – Mobilisation and Preliminaries – was completed on schedule, culminating in the preparation of an Inception Report.

Phase 2 of the project – Field Investigations and Laboratory Testing - is now complete. This phase was delayed due to the need to undertake some supplementary sampling and testing to improve the confidence of the new specifications and design methods being developed. This additional work was completed towards the end of December 2010 and, together with the previous sampling and testing carried out during the first half of 2010, marks the completion of Phase 2 of the project, some 12 months behind schedule.

A review of the results of the additional sampling and testing was carried out on 17 and 18 January 2011 and revealed that the results now all fall within the normally expected range for the various materials tested and properties investigated. A site visit was also made with the AFCAP project manager, the NRA project coordinator and the head of the CML to familiarize the former with the field details of two of the key sites investigated, Ntchisi and Dowa.

In accordance with the revised programme, the final phase of the project – the Analysis and Reporting – will commence in Mid-February with a draft Final Report scheduled for completion in mid-March 2011, a Final Report in mid-April 2011 and the holding of a stakeholder workshop within the first half of May, 2011.

1. INTRODUCTION

1.1 Background

Based on a proposal submitted to the Technical Director of the African Community Access Programme (AFCAP), Michael I. Pinard, independent Development Consultant, was appointed to undertake a *Performance Review of Design Standards and Technical Specifications for Low-volume Sealed roads in Malawi*.

1.2 Objectives

The main objectives of the project are to:

- (a) Undertake a review of performance of existing low volume sealed roads, existing design standards and specifications used for the construction of low volume sealed roads in Malawi;
- (b) Provide recommendations for the development of manuals and other official documentation needed to facilitate the use of appropriate standards by the Roads Authority, its consultants and contractors;
- (c) Gain acceptance of the LVSR approach amongst decision makers using an evidence-based approach.

The project commenced on 26th October 2009 and was expected to run for about seven months to the end of May 2010 – a period which covers both the dry and wet seasons in Malawi which it is necessary to capture in the investigation of the roads being reviewed.

1.3 Scope of Work

The scope of work necessary to satisfy the ToR include, but are not necessarily limited to, the following:

- (1) Undertake a desk study of historical project reports and technical monitoring reports (where available) concerning low volume sealed road construction in Malawi.
- (2) Undertake field visits to establish potential projects to be surveyed based on the recommendations of the Road Authority. Recommend a manageable list of projects to be surveyed.
- (3) Update technical monitoring on selected road sections including: details of subsequent maintenance interventions, traffic counts, visual inspections, measurements of rut depth and cracking, measurements of residual pavement strength, etc.
- (4) Determine any additional information required for the study sections and provide advice to the Roads Authority and Central Materials Laboratory for the collection of this information and agree a programme for carrying out the work.

-
- (5) Analyse the new information obtained on the study sections and relate it to the information obtained during the desk study, drawing conclusions on the appropriateness of the design standards used on the roads. Support these observations with sample analyses of typical low volume road pavements in Malawi using standard pavement design methods.
 - (6) Develop recommendations for national design standards and technical specifications for low volume sealed roads in Malawi. Prepare draft TORs for the development of a Design Manual, Technical Specifications and Standard Bidding Documents for LVSRs.
 - (7) Estimate the cost savings that can be achieved through adopting more appropriate design standards for low volume roads.
 - (8) Disseminate the study findings through seminars and meetings with key stakeholders in the government, development partners and the private sector.

1.4 Phase 1 of project

Phase 1 of the project – Mobilisation and Preliminaries – was completed on schedule and culminated in the submission of an Inception Report in November, 2009. During this phase a number of existing LVSRs were selected for detailed investigation and the field and laboratory testing programme was discussed agreed with the RA and the Central Materials Laboratory. The field investigations were initiated at one of the selected roads to confirm the procedures to be followed in carrying out the overall programme.

1.5 Phase 2 of Project

Phase 2 of the project – Fieldwork – has been now been satisfactorily completed. This phase of the project was delayed, ultimately by 12 months, due initially to the delayed start of the fieldwork caused by a shortage of fuel in Malawi in the last quarter of 2009 and, subsequently, the need to undertake supplementary fieldwork which was also delayed due to the protracted period required by the NRA to secure the additional funding.

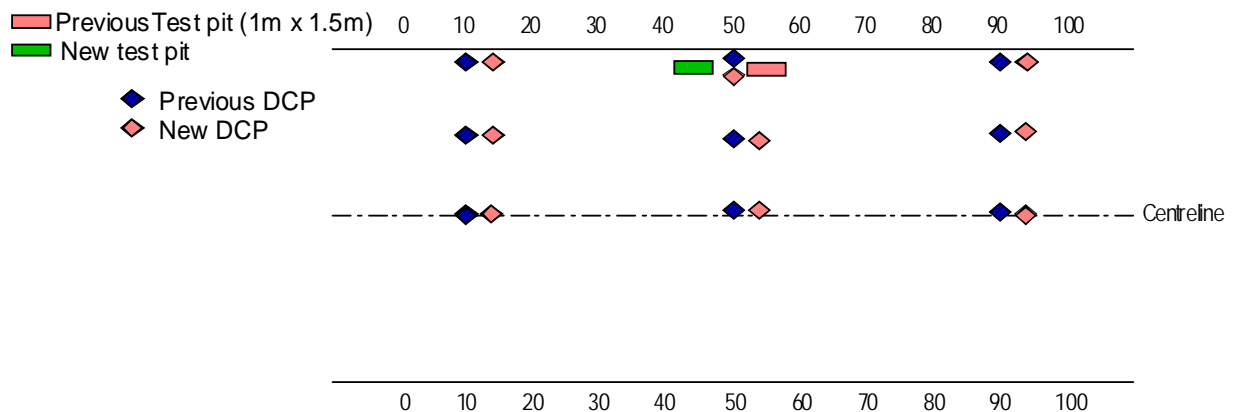
This Final Fieldwork Report:

- Summarises the scope of the supplementary fieldwork (Section 2);
- Presents the Work Programme to be followed in undertaking the remaining phases of the project (Section 3).
- Outlines the way forward for completing the remaining phases of the project (section 4).

2. SUPPLEMENTARY FIELD AND LABORATORY TESTING PROGRAMME

2.1 Summary of Additional Field Investigations

The layout of the test sections for the additional in situ testing and materials sampling for lab testing is shown in Figure 1 and the scope of the work is summarized in Table 1. These additional field investigations were carried out in the dry season from July – September, 2011, in contrast to the previous measurements that were carried out in the wet season from January to April, 2010. This will allow a good comparison to be made between wet and dry season in situ strength (DCP) and in situ moisture contents as a basis for ascertaining the sensitivity of these materials parameters to climatic conditions for the given drainage conditions. This information will facilitate the development of appropriate materials specifications and a simplified design method in relation to climatic and drainage conditions for varying traffic loading.



Notes:

- (1) 3 moisture contents to be taken in test pit in each pavement layer
- (2) Sufficient sample to be taken from test pit to allow 6 No. CBRs to be determined (3 No. soaked, 3 No. at OMC and 3 No. at 0.75 OMC).

Figure 1 - Layout of test area for in situ investigations and sampling

Table 1 – Summary of in situ measurements at each sample location

Location	DCPs		Test Pits	In situ Moisture Content		
	Paved	Unpaved*		Base	Subbase	Subgrade
New Sections						
Dowa Boma	9	6	1	3		3
Ntchisi Boma	9	6	1	3		3
Nchisi Std Constr	9	0	1	3		3
Rumphi Boma	9	3	1	3		3
Cape Maclear	9	6	1	3		3
Lilongwe ABC	9	0	1	3		3
Total	54	21	6	18		18

* Applies to situations where there is an unpaved section abutting the paved section (e.g. Nchisi Boma road)

2.2 Summary of Additional Laboratory Testing

The scope of laboratory testing programme is summarized below.

Laboratory Testing Programme - All Sections

Layer	MOD	CBR (Soaked)	CBR (OMC)	CBR (0.75 OMC)	Atterbergs	Shrinkage	Grading
Base	2 + 5	2	2	2	2	2	2
Subbase/Subgrade	2 + 5	2	2	2	2	2	2
Total	4 + 10	4	4	4	4	4	4

Summary of Laboratory Tests

Location	Laboratory Test						
	MOD	CBR (Soaked)	CBR (OMC)	CBR (0.75 OMC)	Atterbergs	Shrinkage	Grading
Dowa Boma	4 + 10	2	2	2	2	2	2
Ntchisi Boma	4 + 10	2	2	2	2	2	2
Ntchisi Std Constr	4 + 10	2	2	2	2	2	2
Rumphi Boma	4 + 10	2	2	2	2	2	2
Cape Maclear	4 + 10	2	2	2	2	2	2
Lilongwe ABC	4 + 10	2	2	2	2	2	2
Total	24 + 60	12	12	12	12	12	12

At each road section (6 No. in all), three cross-section profiles at Chainage 0, 50 and 100, are required to enable the values of h and d to be determined as shown in Figure 2. This will entail a level survey to determine the elevation of points 1,2,3 and 4 above a given datum, as well as measurements of lengths h and d . This information is required to enable the drainage environment for each site to be quantified – a key factor that affects moisture contents in the pavement layers and the ultimate performance of the road.

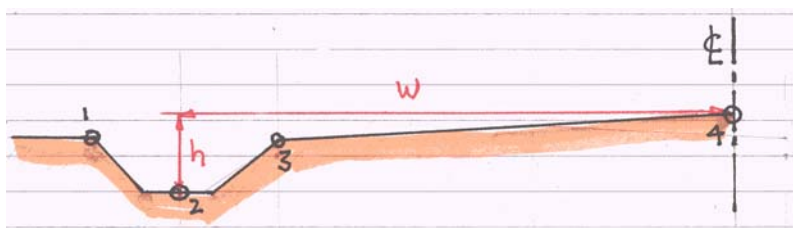


Figure 2 – Idealised cross-section showing parameters (d , h) to be determined

(b) Date of construction and traffic flow

The date of construction of each road section as well as historical records of classified traffic flows are required for estimating the traffic that the road has carried since its construction. Such traffic should be broken down by vehicle type in the manner adopted by NRA in recording their traffic counts. If no such records are available, then at least three ad hoc 16 hour counts should be carried out on different days of the week that reflect traffic patterns (e.g market days).

(c) Rainfall

Some indication of average annual rainfall is required from the station closest to the road site. This is to allow the site to be placed in its appropriate climatic zone (represented by the Weinert 'N' value) for pavement design purposes.

3. REVIEW OF RESULTS OF ADDITIONAL FIELD INVESTIGATIONS AND LABORATORY TESTING

3.1 General

A preliminary review and analysis of the results of the additional field measurements and laboratory testing was carried out to ensure that the outputs were sufficiently reliable for subsequent detailed analysis in Phase 3 of the programme. This activity was undertaken with the team at the Central Materials Laboratory that was responsible for executing the field and laboratory testing programmes over the period 20 and 21 January, 2011.

3.2 Field Testing Results

3.2.1 General

All the additional field investigations were carried out as per the agreed schedule and results were available for the following measurements:

Dry season

- (a1) - in situ moisture content (from test pit in outer wheel path)
- in situ dry density (IDD) (in test pit)
- DCP's (cross-section profile)

3.2.2 Review of results

From the review of the results of the field investigations, it was apparent that they all fell within the normally expected range for such parameters. Thus, they provide a sound basis for more detailed analysis in the next phase of the project.

3.3 Laboratory Testing Results

3.3.1 General

All the laboratory testing was carried out as per the agreed schedule and results were available for the following:

- (a) Laboratory testing (on material extracted from the pavement layers)
 - classification
 - shrinkage
 - grading
 - MDD/OMC (with CBR at each moisture content point)
 - CBR (soaked, OMC and 0.75 OMC)

3.3.2 Review of results

From the review of the results of the it was also apparent that they all fell within the normally expected range for such parameters. Thus, they provide a sound basis for more detailed analysis in the next phase of the project.

4. WORK PROGRAMME AND PROGRESS

4.1 General

The general scoping of the project for execution of the full scope of work is shown in Figure 4.1 whilst the original Work Programme is shown in Table 4.1.

Figure 4.1 – General scoping of project

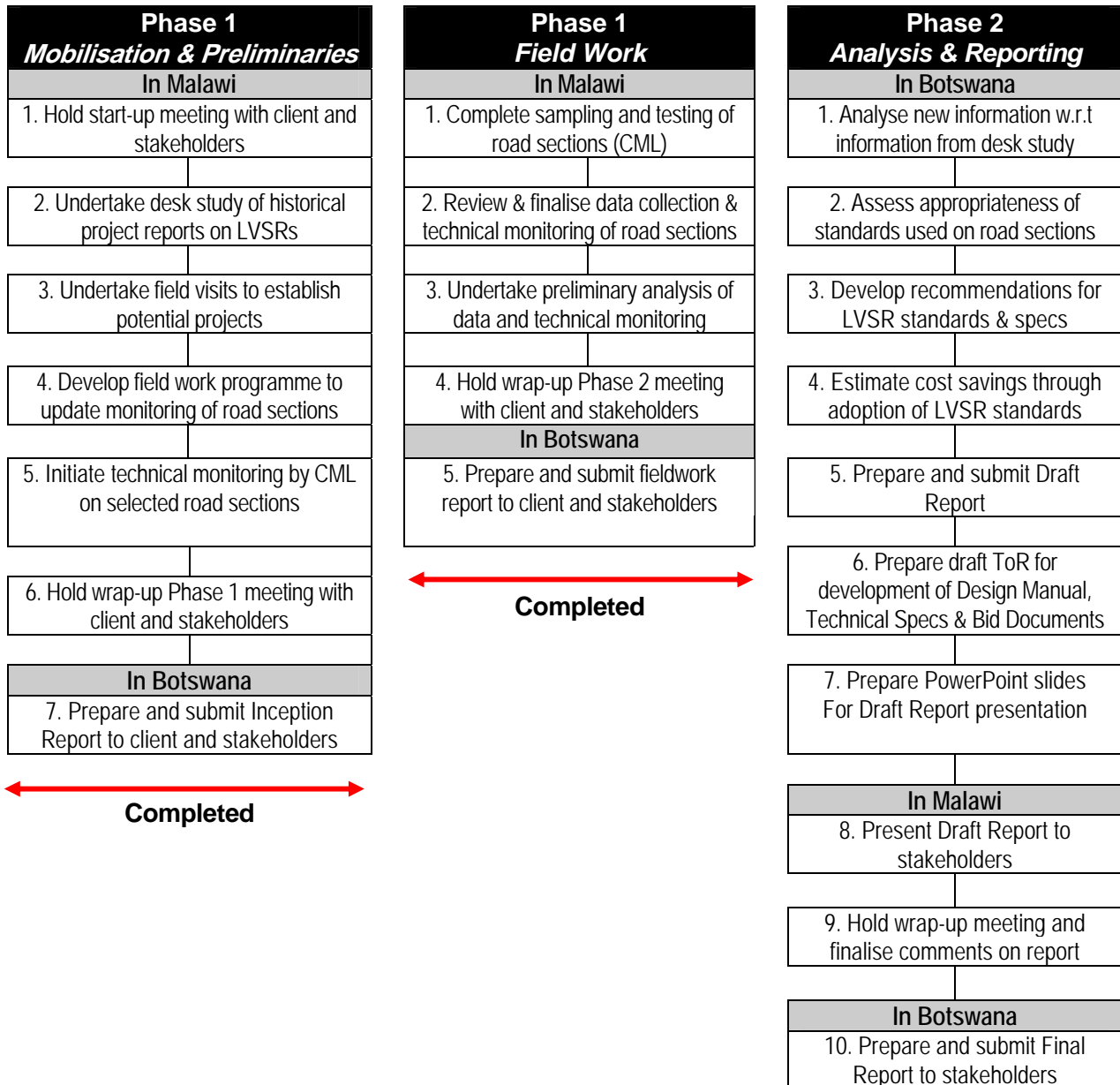


Figure 4.1 – General scoping of project

4.2 Progress

4.2.1 Phase 1

Phase 1 of the project – Mobilisation and Preliminaries - was completed on schedule and culminated in the submission of an Inception Report in November 2009.

4.2.2 Phase 2

Phase 2 of the project – Fieldwork – has been now been satisfactorily completed. As indicated in Section 2, this phase of the project was delayed, ultimately by 12 months, due initially to the delayed start of the fieldwork caused by a shortage of fuel in Malawi in the last quarter of 2009 and, subsequently, the need to undertake supplementary fieldwork which was also delayed due to the protracted period required by the NRA to secure the additional funding.

4.2.3 Phase 3

Phase 3 of the project – Analysis and Reporting – will commence in Mid-February with a draft Final Report scheduled for completion in mid-March 2011, a Final Report in mid-April 2011 and the holding of a stakeholder workshop within the first half of May, 2011.

4.3 Programme

The programme for completing the final Phase 3 of the project is shown in Table 4.2.

Table 4.2 – Phase 3 Programme

ACTIVITY	Week No.											
	1	2	3	4	5	6	7	8	9	10	11	12
Phase 3: Analysis and Reporting	Phase 3: Mid-Feb – Mid-May 2011											
1. Analyse results of field investigations and laboratory testing												
2. Assess appropriateness of standards used on road sections												
3. Develop recommendations for LVSR standards & specs												
4. Estimate cost savings through adoption of LVSR standards												
5. Prepare draft ToR for preparation of Design Manual, Standard Specs & Bid Documents												
6. Prepare and submit Draft Report								◆				
7. Client's comments on Draft Report												
8. Prepare and submit Final Report t										◆		
9. Hold stakeholder workshop												
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5. WAY FORWARD AND SUMMARY

5.1 Remaining Phases

The remaining, final Phase 3 of the project entails the analysing the results of the field and laboratory testing work, preparation of a project report and presentation at a workshop of the main findings, conclusions and recommendations of the project to stakeholders.

5.2 Way Forward

The way forward to completion of the project has been discussed and agreed in outline with the NRA's Project Coordinator. Following submission of the Final Report, a one or possibly 2-day stakeholder workshop will be held, including a site visit to the Ntchisi Doma site.

The main objectives of the workshop will be to disseminate the study findings and recommendations, including an estimate of the cost savings that can be achieved through adopting more appropriate design standards for low volume roads.

The workshop will separately target technical stakeholders (including NRA staff, other Government roads sector personnel, Road Fund, consultants and contractors, etc.) and key senior level decision-makers (including Minister responsible for roads, Permanent Secretary in the roads ministry, Ministry of Finance, donor organizations, etc.).

5.3 Summary

Phase 2 of the project has been completed, culminating in the preparation of this Final Fieldwork Report. The third and final phase of the project will commence in mid-February 2011 and will culminate with the holding of a stakeholder workshop during the first half of May 2011 to disseminate the study findings and recommendations.