AfCAP
Africa Community Access Partnership

UKaid
from the British people

Inception Report for

Monitoring and Evaluation of Low Volume Roads Trial Sections in Ethiopia – ETH2051D

Final

Alemgena A. Araya (PhD)
Hunduma Chali

ETH2051D

March 2017

ETHIOPIAN ROADS AUTHORITY

ALERT
ALERT Solutions - Bridging the Gap for Excellence

HITCON ENGINEERING PLC

The views in this document are those of the authors and they do not necessarily reflect the views of the Research for Community Access Partnership (ReCAP), or Cardno Emerging Markets (UK) Ltd for whom the document was prepared

Cover Photo: Otto, 2012

Quality assurance and review table			
Version	Author(s)	Reviewer(s)	Date
Second/Final	Alemgena A. Araya; Hunduma Chali	Nkululeko Leta; Jon Hongve Les Sampson	April 2017

ReCAP Project Management Unit
Cardno Emerging Market (UK) Ltd
Oxford House, Oxford Road
Thame
OX9 2AH
United Kingdom

AFRICA COMMUNITY ACCESS PARTNERSHIP (AfCAP)

Safe and sustainable transport for rural communities

AfCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa. The AfCAP partnership supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. AfCAP is brought together with the Asia Community Access Partnership (AsCAP) under the Research for Community Access Partnership (ReCAP), managed by Cardno Emerging Markets (UK) Ltd.

ACRONYMS, UNITS AND CURRENCIES

$	United States Dollar (US$ 1.00 ≈ provide conversion to local currencies)
ADB	Asian Development Bank
AFCAP	Africa Community Access Partnership
ASCAP	Asia Community Access Partnership
DCP	Dynamic cone penetrometer
ERA	Ethiopian Roads Authority
FWD	Falling weight deflectometer
GPS	Global positioning system
LTPP	Long term pavement performance programme
ORN	Overseas road note
ReCAP	Research for Community Access Partnership
TRL	Transport research laboratories
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

Contents

List of Tables

1 INTRODUCTION

The Africa Community Access Partnership (AFCAP) is a research programme funded by the UK Government's Department for International Development (DFID). AFCAP is promoting safe and sustainable rural access in Africa. AFCAP supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximize the use of local resources. The first phase of AFCAP commenced in June 2008 and ended in July 2014. The second phase, which will also run for 6 years, commenced on the 1st August 2014. The management of AFCAP 2 is contracted by DFID to Cardno UK. The aim of the new AFCAP initiative, under the overall Research in Community Access Partnership (ReCAP) umbrella, is to build on the programme of high quality research established under AFCAP phase 1 and take this forward to a sustainable future in which the results of the research are adopted in practice and influence future policy.

A significant portfolio of research activities has now been established in the AFCAP participating countries. AFCAP provides technical assistance for these activities and promotes the uptake of the research findings through revised, country specific design standards and specifications.

The Government of the Federal Democratic Republic of Ethiopia (FDRE) through the Roads Research Centre (RRC) of the Ethiopian Roads Authority (ERA) has constructed research sections with the aim of obtaining data that will assist in the rapid expansion of the sealed low-volume roads network. AFCAP has been asked by the ERA through the RRC to support research on utilization of non-standard materials for Low Volume Sealed Road (LVSR) pavements. As part of this process the constructed trial sections require periodic monitoring and evaluation.

As part of this programme, ALERT Engineering Plc. in JV with HITCON Engineering Plc entered a subcontractor agreement with the client Cardno Emerging Markets (UK) Ltd, and under the management of Roads Research Centre (RRC) of the Ethiopian Roads Authority to carry out a two year monitoring and evaluation of the trial sections twice a year.

2 CONTRACT DATA AND MANAGEMENT

Table 2-1: Contract Data

ITEM NUMBER	DESCRIPTION
1. Agreement Number	SC15280
2. Lead Project Name (Head Contract Title)	Research for Community Access Partnership (ReCAP)
3. Cardno Lead Project Reference Number	**EMUK10636A**
4. Project Title	Monitoring and Evaluation of Low Volume Roads Trial Sections in Ethiopia
5. Client	Cardno Emerging Markets (UK) Ltd
6. Donor	Department for International Development (DFID)
7. Contractor/Service provider	ALERT Engineering Plc. in JV with HITCON Engineering Plc.
8. Contractor's Contact Details	Contact Name: Dr Alemgena Alene Position: Managing Director, ALERT Engineering Plc. Contact Tel: +251 11 384 9009/+251 91 198 2909 Contact Email: alemgena@yahoo.com
9. Project Partner(s)	Roads Research Center (RRC), Ethiopian Roads Authority (ERA)
10. Location	Ethiopia
11. Partner Country(ies)	Ethiopia
12. Agreement Start Date	15 February 2017

13. Agreement Finish Date	15 March 2019
14. Term refer also Clause1 Schedule 1	24 months
15. Cardno Manager	George Mukkath
16. Project Director or equivalent	Gerome Rich
17. Team Leader or equivalent	Jasper Cook
18. Team Leader's Delegate	Nkululeko Leta
19. Project Specific Funding Source / Reference No.	ETH2051D

3 SERVICE PROVIDER'S MOBILIZATION OF PERSONNEL AND EQUIPMENT

3.1 Staff Mobilization

The following key personnel/experts will be mobilized for the project as per the contract requirement. The service provider couldn't mobilize the technician/Supervisor immediately as he is engaged on other commitment because of delays occurred on the contract document preparation and substitution is requested technician/supervisor with equivalent CV to fill the place and get approval.

Table 3-1: Key staff mobilization status

ITEM NO.	KEY STAFF	POSITION	REPLACEMENT REQUEST	MOBILIZATION STATUS	COMMENTS/REMARKS
1	Hunduma Chali	Overseeing Engineer	NA	Mobilized	Originally Named on the contract document
2	Tewodros Mulugeta	Technician/ Supervisor	Yes	Tsega Sisay	Replacement approved
3	Dr Alemgena Alene	Project Director	NA	Mobilized	Originally Named on the contract document

3.2 Deployment of Equipment

In Addition to the equipment required on site, the service provider will deploy sufficient vehicles for the field activity and will strive to avail enough resources on site to finish the work in time and in the required quality. Moreover, these are some of the equipment that will be deployed on site for the work.

Table 3-2: List of materials and Equipment to be mobilized for the programme

NO.	EQUIPMENT/TOOLS	PURPOSE	NUMBER
1	Traffic Warning Signs	Site safety	2 Sets per site
2	Reflective Traffic Cones	Site safety	12 cones per site
3	Reflective Tape	Site safety	250m per site/monitoring
4	Shovel	Cleaning	1 per site
5	Brushes/Brooms	Cleaning	1 per site
6	Water	Cleaning	60 liters/site/monitoring
7	Straight - edge (2m Preferably	Rutting Measurement	1 per site

	Flexible)		
8	Roughometer II	Roughness Measurement	1 (from ERA)
9	Benkelman Beam	Stiffness/Deflection	1 (from ERA)
10	Portable Weighing Pads	Axle Load Measurement	2 (from ERA)
11	DCP with adequate number of cones	Pavement Strength	2
12	Thermometer and Glycerin	Temperature measurement	1
13	Sand Replacement Apparatus - (Full Kit)	For Carrying out density measurement	1 per site
14	Crack Width Gauge	Crack width	1 per site
15	5Kg electronic weighing scale	Weighing of moisture samples/density measurement	1 per site
16	100m tape measure	Length Measurement	1 per site
17	10m tape measure	Length Measurement	2 per site
18	Large Sample Bags	Collecting and Transporting samples	3 per site per monitoring
19	Air - Tight sample bags	Collecting and Transporting moisture samples	20 per site per monitoring
20	Tools for excavation of trial pits	Trial Pit excavation	1 set per site
21	Vibratory Plate Compactor or Manual Tamper	Reinstatement of trial pits	1 per site

3.3 Equipment required from ERA

The Service provider shall seek provision of the under listed measuring equipment from ERA for the planned dates indicated in Table below.

Table 3-3: List of Equipment provided by ERA

NO.	EQUIPMENT TYPE	PURPOSE	Planned date for equipment mobilization
1	Mobile Weighbridge	Axle Load measurement	01 April 2017
2	Roughometer	Roughness Measurement	01 April 2017
3	Benkelman Beam	Deflection testing	01 April 2017

4 ANTICIPATED DIFFICULTIES

We anticipate the following challenges and we are making preparation to mitigate and minimize their effects on the project time and quality.

- Acquiring of the equipment from ERA
- Preparation of the equipment for the project
- Test pit sample adequacy and reinstatement.

5 SERVICE PROVIDER'S CONTACT

Table 5-1: Service provider's contact

SERVICE PROVIDERS ADDRESSES	
ALERT Engineering PLC Nifas Silk Lafto Sub-City, Wereda: 03, H.No.: 3063 Tel: +251113849009, Fax: +251113849092 P.o.box: 31890 Addis Ababa, Ethiopia	**HITCON Engineering PLC.**
AUTHORIZED OFFICER	
Alemgena A.Araya (PhD), Managing Director of ALERT Engineering PLC Tel: +251911982909, Email: alemgena@yahoo.com Addis Ababa, Ethiopia	

6 KICK-OFF MEETING

First Kick-off meeting was held on Friday 11 November 2016 at RRC, ERA and later 2nd kick-off meeting was held on Wednesday, March 01, 2017 at ERA head office conference hall No. 2. Second kickoff meeting was needed as the contract signing and commencement was delayed for significant period during contract negotiation. The participants at the later kickoff meeting were:

Table 6-1: List of Kick-off meeting participants

Alemayehu Ayele	ERA-RRC Director/ Chairperson/
Nkululeko Leta	AFCAP Regional Technical Manager
Deribachew Mezgebu	ERA RRC - Project Coordinator
Dr. Alemgena A. Araya	MD of ALERT Engineering Plc. and Project Director
Wubishet Dessalegn	GM of HITCON Engineering Plc.
Hunduma Chali	Overseeing Engineer

The meeting besides being opening has also helped to clarify some issues of the project process. The minutes of meeting is shown in Appendix A.

7 OBJECTIVES AND SCOPE OF THE SERVICES

7.1 Objective

The objective of the Monitoring & Evaluation Programme is to provide performance based evidence which will contribute to the establishment of appropriate standards for Low Volume Sealed Roads in Ethiopia.

The roads shall be monitored and evaluated in terms of:

- Pavement materials and performance
- Surfacing performance

The evaluation procedures will be in accordance with the guidelines followed by the AFCAP/Cardno for the whole programme and as per TOR and methodology stated in the technical proposal.

7.2 Scope

The scope of works shall include, but not necessarily be limited to, the following tasks:

- Review of design documents and construction records including materials testing and quality control records.
- Marking of LTPP section.
- Providing a safe working environment during monitoring surveys.
- Conducting classified traffic counts as per the existing ERA manuals.
- Conducting axle load surveys, if necessary in normal and peak traffic periods.
- Conducting a visual inspection to identify cause, extent and nature of defects such as cracking, and potholing.
- Conducting deflection measurements using a Benkelman Beam and computing the elastic moduli at 50m intervals on the outer wheel paths and centerline of the roads.
- Carrying out roughness measurements to classify the pavement condition in accordance with the International Roughness Index (IRI).
- Carrying out rut depth measurement at every 50m or shorter along the road. Additional measurements shall be taken at spots with visible rut development and the exact location and extent of the problematic section recorded.
- Carrying out density measurements where required.
- Establishing a methodology and determine the Performance Serviceability
- Carrying out DCP tests to a depth of 800mm at locations as shall be directed by the RRC; the number of tests for each site are shown in Tables 4, 5 and 6 below.
- Determination of Relative Moisture Content fluctuations from dry to wet season in the outer wheel path at 2 locations per road, in the base layer, sub base/improved subgrade and native soil and recording the actual thickness of each pavement layer. On completion of the trenching and collection of samples, the pavement shall be reinstated to its original condition. Two test locations will be determined in conjunction with the AFCAP research Consultant as illustrated in Figure 1 below.
- Determination of base layer moisture content at locations as shall be directed by the RRC.
- Obtain yearly climatic data (rainfall and evaporation) from meteorological stations nearest to each trial site.
- Assessing the drainage system highlighting areas that may affect the pavement performance. The depth of the side drain invert LHS/RHS below the crown shall be measured and recorded.
- Compiling a comprehensive report on the completion of each Monitoring and Evaluation (M&E) exercise and a Final Report summarizing and discussing the findings from the M&E Programme at the end of the assignment in 2017.
- Participation in dissemination workshops to be organized by the RRC at the end of each monitoring round.

8 PROJECT DESCRIPTION

8.1 General

As part of the first phase of AFCAP commenced in June 2008 and ended in July 2014, following initial discussions and an appraisal of potential projects with ERA, a provisional site selection report was prepared (Otto, 2010), which identified possible locations for research. The final composition of the research programme and the location of project sites were decided by ERA in consultation with TRL staff, who also assisted in the design and construction of the trials that were managed by ERA.

The programme included four projects that were designed to demonstrate approaches developed and used in neighboring and other African countries and which could benefit rural road provision in Ethiopia. They included research in the use of local materials and initiated possible alternative mix designs for asphaltic concrete roads.

The four demonstration/research projects established as part of the first phase of the programme are:

- Laterite base trial on the Assosa-Kurmuk road
- Otta sealing in the village of Combel
- Otta sealing in the village of Gerado
- Alternative AC mix design on the Hawusewa - Abala road

The sections consist of a range of surfacing options including Double Bituminous Surface Treatment, Otta Seal, Sand Seal and Asphalt Concrete surfacing. The base course materials consist of natural gravels except for Hawusewa – Abala where the base is made of crushed stone.

The constructed trial sections require periodic monitoring and evaluation for a longer period. ERA-RRC is expected to continue the monitoring programme after the second phase AfCAP, which is 6 years duration, commenced on the 1st August 2014. The following monitoring and evaluation programme established on the above four projects.

Table 8-1: Project Description

ROAD/SITE NAME	LENGTH (M)	COMMENTS
Assosa - Kurmuk	1600	Monitor 2 whole sections approx. 800m each and set up 2 LTPP sections of 200m each
Tulubolo - Kela	2100	Monitor whole section
Combolcha - Mekaneselam	3000	Set up and monitor 2 LTPP sections of 200m each
Hawusewa - Abala	900	Set up and monitor 4 LTPP sections of 200m each and 1 LTPP section 130m

8.2 Control Sections

ERA has provided the Control sections, but these sections have to be confirmed and justified on the site through discussion with the AfCAP international consultant. The control sections on Combolcha – Mekaneselam has been reduced form 4 LTPP sections to 2 but the locations shall be set up along with ERA and international consultant soon and will be confirmed on the site. The control sections for Combolcha – Mekaneselam road will be based on type of pavement structure and for the other two sites the provisional Control sections are shown in table 8-2 and table 8-3 below which will be verified and fixed with ERA in the field:

Table 8-2: Selected Section on Hawusewa – Abala – Irebti Road

SECTION	START CHAINAGE (KM)	END CHAINAGE (KM)	START COORDINATES	END COORDINATES
Top of Escarpment	9+200	9+380	N13°24.335, E39°37.435, 2343m	N13°24.239 E39°37.420 2347m
On Escarpment	25+100	25+300	N13°21.428 E39°43.577 1843m	N13°21.349 E39°43.652 1826m
Bottom of Escarpment	38+700	39+000	N13°18.866 E39°47.129 1422m	N13°18.871 E39°47.295 1414m
On second Escarpment to be established	59+740	59+940	N14°69.765 E59°74.928 (NC) 1340m	N14°69.863 E59°76.653 (NC) 1357m
On second flat section in hot area	92+062	92+190		

Table 8-3: Control Sections for Assosa – Kumruk Road

CHAINAGES	LENGTH (M)	SHOULDERS	LOCATION
57+500 – 57+900	400	Unsealed	Cut
57+900 – 58+400	500	Unsealed	Fill
Total 900			

8.3 Timing of Monitoring and Evaluation (M&E) Activities

Following the time schedule setup in the terms of reference and the discussions in the kick-off meetings the following monitoring and evaluation time and type of measurements is adopted. As the first M&E has been shifted from Oct-2016 to Apr-2017, tests that shall be carried in the 2nd M&E are moved to Oct-2017. Trail pits and laboratory testing are scheduled for the 2nd and 3rd M&E, here it is to be noted that the 2nd and 3rd M&E was dry and wet season respectively, with the re-scheduled arrangement the 2nd and 3rd M&E will still represent the wet and dry season respectively.

Moreover, the number of test pits and laboratory sampling are considered to be one pit per each LTPP section and monitoring section if any such as the Assosa – Kurmuk. The test pits will be located in outer wheel-track of LTPP sections alternatively in the right and left outer lanes.

Table 8-4: Monitoring program for Assosa – Kurmuk

Pavement Monitoring and Evaluation Tasks	**Qty per Survey**	**Year 1 (first 12 months)**		**Year 2 (second 12 months)**	
		Apr-17	**Oct-17**	**Mar-18**	**Oct-18**
Marking of Sections	2 LTPP	√			√
Classified Traffic Counts	7 days	√	√	√	√
Axle Load Survey	4 days	---	√	√	√
Visual Condition Survey	1600 m	√	√	√	√
Roughness Measurement		√	---	√	---
Rut Depth Measurement	84 location	√	√	√	√
Elastic Modulus/Deflection/FWD	84 location	---	√	√	---
DCP Tests	54 location	√	√	√	√
Base Layer Moisture Content		---	√	√	√
Trial Pits and Laboratory Testing	4 pits (2 LTPP & 2 monitoring)	---	√	√	---
Drainage Assessment	3.2 linear km	√	√	√	√
Reporting	1 Report	√	√	√	√

Table 8-5: Monitoring program for Combolcha – Mekaneselam

Pavement Monitoring and Evaluation Tasks	**Qty per Survey**	**Year 1 (first 12 months)**		**Year 2 (second 12 months)**	
		Apr-17	**Oct-17**	**Mar-18**	**Oct-18**
Marking of Sections	2 LTPP	√			√
Classified Traffic Counts	7 days	√	√	√	√
Axle Load Survey	4 days	---	√	√	√
Visual Condition Survey	1000 m	√	√	√	√
Roughness Measurement		√	---	√	---
Rut Depth Measurement	100 location	√	√	√	√
Elastic Modulus/Deflection/FWD	84 location	√	√	---	---
DCP Tests	20 location	√	√	√	√

Base Layer Moisture Content		---	√	√	---
Trial Pits and Laboratory Testing	2 pits (2 LTPP)	---	√	√	---
Drainage Assessment	2.0 linear km	√	√	√	√
Reporting	1 Report	√	√	√	√

Table 8-6: Monitoring program for Tulubolo – Kela

Pavement Monitoring and Evaluation Tasks	Qty per Survey	Year 1 (first 12 months)		Year 2 (second 12 months)	
		Apr-17	Oct-17	Mar-18	Oct-18
Marking of Sections	No LTPP	---	---	---	---
Classified Traffic Counts	7 days	√	√	√	√
Axle Load Survey	4 days	---	√	√	√
Visual Condition Survey	2100 m	√	√	√	√
Roughness Measurement		√	---	√	---
Rut Depth Measurement	---	---	---	---	---
Elastic Modulus/Deflection/FWD	---	---	---	---	---
DCP Tests	---	---	---	---	---
Base Layer Moisture Content	---	---	---	---	---
Trial Pits and Laboratory Testing	---	---	---	---	---
Drainage Assessment	4.2 linear km	√	√	√	√
Reporting	1 Report	√	√	√	√

Table 8-7: Monitoring program for Hawusewa – Abala

Pavement Monitoring and Evaluation Tasks	Qty per Survey	Year 1 (first 12 months)		Year 2 (second 12 months)	
		Apr-17	Oct-17	Mar-18	Oct-18
Marking of Sections	5 LTPP	√			√
Classified Traffic Counts	7 days	√	√	√	√
Axle Load Survey	4 days	√	√	√	√
Visual Condition Survey	930 m	√	√	√	√
Roughness Measurement		---	√	---	√
Rut Depth Measurement	100 location	√	√	√	√
Elastic Modulus/Deflection/FWD	100 location	---	√	√	---
DCP Tests	50 location	√	√	√	√
Base Layer Moisture Content		---	√	√	---
Trial Pits and Laboratory Testing	5 pits (5 LTPP)	---	√	√	---
Drainage Assessment	1.86 linear km	√	√	√	√
Reporting	1 Report	√	√	√	√

8.4 First Monitoring and Evaluation (1st M&E) Activities

Following the time schedule setup in the terms of reference and the discussions in the kickoff meetings the following monitoring and evaluation time and type of measurements is adopted for the first monitoring and evaluation period (1st M&E).

Table 8-8: First Monitoring program for all the four sites

Pavement Monitoring and Evaluation Tasks	Activity per site	Tulubolo-Kella	Combolcha-Mekanebirhan	Hawsewa-Abala	Assosa-kumruk
Marking of Sections		---	2LTPP	5LTPP	2LTPP
Classified Traffic Counts	7 days	√	√	√	√
Axle Load Survey	4 days	---	---	√	---
Visual Condition Survey		2100m	2100m	930m	---
Roughness Measurement		4200m	4200m	1860m	√
Rut Depth Measurement		---	80 location	200 location	80 location
Elastic Modulus/Deflection/FWD		---	80 location	---	---
DCP Tests		---	20 location	---	20 location
Base Layer Moisture Content		---	√	---	√
Trial Pits and Laboratory Testing		---	---	---	---
Drainage Assessment		4200	4200	1860	√
Reporting	1 Report	√	√	√	√

8.5 Reports and Deliverables

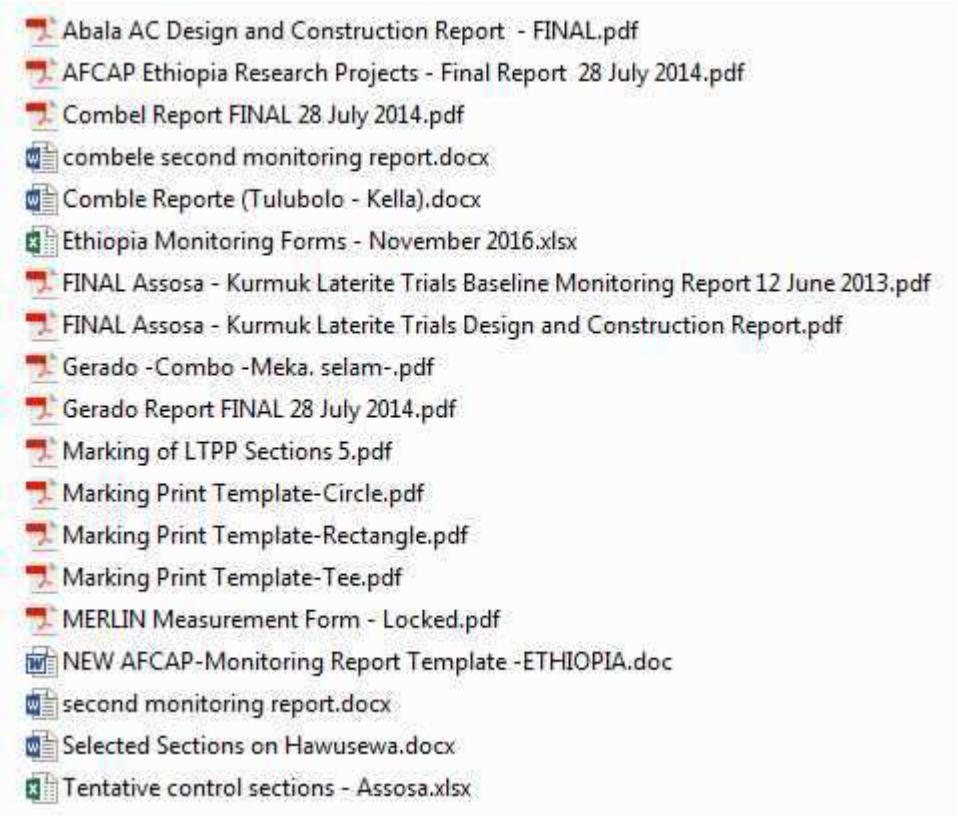
A comprehensive monitoring and evaluation report for each road will be submitted to the RRC and a copy submitted to the AFCAP Regional Technical Manager within one month of the completion of each monitoring survey. The report will contain all the raw data, summary tables and a discussion of the findings with recommendations for remedial measures.

The main milestone deliverables (Electronic version and hard copies for RRC) are:

- Inception report – 30 March 2017
- 1st M&E report – 30 June 2017
- 2nd M&E report – 20 Dec. 2017
- 3rd M&E report – 30 June 2018
- Final M&E report – 20 Dec. 2018

9 INITIAL FINDINGS

The service provider has received the following documents:-



These documents has been reviewed in order to:

- Get familiar with the projects.
- Identify the purpose and objectives of the project.
- Identify the design as well as construction history of the test section and noticing the effects during evaluation of the sections.
- Identify in advance the possible distortions that may arise from the design, construction methodology and material characteristics so that attention will be given to them during evaluation process.

ERA has confirmed to the service provider that the equipment listed on Table 3-3 are all available and will be provided at any required time.

10 METHODOLOGY

10.1 Safety

The crew will be equipped and will take standard safety procedures as per ERA maintenance specification and TRL (ORN 2) standards. The equipment and clothing listed in table 10-1 will be availed by the service provider.

The crew will be trained for two days on how to implement the safety procedures during the whole phase of the work. The overseeing engineer will make sure that the crew is following these procedures.

Table 10-1: Safety Items

NO.	ITEM	QUANTITY
1	Reflective Vests	One for Each Crew
2	Gloves	One for each Crew
3	'Men Working' Signs	2 Pcs.

4	'Road narrows' signs	2 Pcs.
5	'Keep left/right' arrows	4 Pcs.
6	Barriers	2 Pcs.
7	Cones	12 Pcs.
8	'Road clear' signs	2 Pcs
9	Reflective tape	250m per site/monitoring

10.2 Review of design documents and construction records including materials testing and quality control records.

The service provider has reviewed the documents received from ERA and the international consultant and the facts are elaborated in the following sub-sections

10.2.1 Assosa – Kurmuk Laterite Base Trials

The Assosa - Kurmuk site is located 49km along the 96km Assosa – Kurmuk road. This road links the capital of Benshangul Gumuz region to the Sudanese border town of Kurmuk. The road was previously a gravel road, and now being upgraded to a Double Surface Dressing (DBST). The road is expected to function as a major trade link between Ethiopia and Sudan as reflected in the design traffic. The trial section was constructed in the middle of the standard road construction so that the performance can be easily compared.

Table 10-2: Assosa – Kurmuk trial section description

Description

Location	49Km along the 96Km Assosa – Kurmuk Road
Width	Carriage way – 7m Unsealed laterite shoulders – 1.5m
Objectives	▪ To demonstrate that laterite can be used as base course ▪ To research the relative effects of sealed shoulders (in fill and cut) on pavement moisture ▪ To research the benefit of assessing the strength of base course materials at their insitu moisture content.

Design

DESIGN CHART REQUIREMENT (S5, LV5)		**ROAD SECTION DESIGN VALUES**		**APPLIED ON TRIAL SECTION**	
Layer	**Thickness (mm), strength (soaked CBR %)**	**Material type**	**Thickness (mm), Strength (soaked CBR %)**	**Material type**	**Thickness (mm), Strength (soaked CBR %)**
Base Layer	175, 80	Crushed stone	200, 80	Laterite at 100 % MDD	200, 70
Sub-base Layer	150, 30	Laterite	150, 45	Laterite at 95% MDD	150, 45

Layout of the sections

CHAINAGES	LENGTH (M)	SHOULDERS	LOCATION
49+140 - 49+225	85	Unsealed	Cut
49+225 - 49+330	105	Sealed	Cut

49+330 - 49+460	130	Sealed	Fill
49+460 - 49+580	120	Sealed	Cut
49+580 - 49+700	120	Unsealed	Cut
49+700 - 49+970	270	Unsealed	Fill
Total		830	

Summary of Laterite properties used during construction

PROPERTIES	AVERAGE USED BY CONTRACTOR IN COMPACTION APPROVAL	MEASURED IN APRIL 2011	MEASURED IN OCTOBER 2011	LAID ON THE SECTION
MDD (g/cc)	1.86	1.88		1.83 - 1.85
OMC (%)	14.8	16.3	11.2 – 12.9	15.9 - 16.8
CBR @ 65 blows (%)		61-71	70-74	60.1 - 69.8
Liquid Limit		44	37	40 – 47
Plastic Limit		34	22	29 – 36
Plasticity Index		10	15	11-12
PM, Envelope (LVR Manual)		300, B	340, B	360, B
% passing 75um sieve (wet analysis)		11.85	14.63-17.52	9.43 – 17.37

Field Compaction Densities

MDD AT 65 BLOWS = 1.86 G/CC		REQUIRED DENSITY RATIO = 98%		
Chainage	Date of Testing	Field Density (g/cc)	Relative Density (%)	Remarks
49+140	23/04/2012	1.84	99	
49+140	07/05/2012	1.93	104	Retest
49+240	23/04/2012	1.86	100	
49+240	07/05/2012	1.89	102	Retest
49+340	23/04/2012	1.83	98	
49+480	27/04/2012	1.85	99	
49+510	07/05/2012	1.83	98	Retest
49+540	23/04/2012	1.84	99	
49+640	23/04/2012	1.83	98	
49+740	20/04/2012	1.84	99	
49+840	07/05/2012	1.83	98	Retest

10.2.2 Otta Seal Demonstration project: Combel Village, Tulubolo-Kela Road

The Tulubolo – Kela trial section is located in the village of Combel situated to the South of Addis Ababa, 37km from Tulubolo along the Tulubolo – Kela road. The length of the trial is 1900m containing different combinations of materials. The project provided an opportunity to demonstrate

the suitability of an Otta seal for rural road construction in Ethiopia and provide a contractor with experience in using this technology.

Further benefit of the trial road was the opportunity to demonstrate the construction of a weathered basalt gravel base with the same material also being used as surfacing aggregate for the construction of sections of the Otta seal surfacing.

Table 10-3: Tulubolo – Kela trial section description

Description

OBJECTIVES	➢ Demonstrate an Otta seal using aggregate that is within the prescribed grading and strength requirements ➢ Demonstrate the use of locally available natural gravel (decomposed weathered basalt and volcanic cinder aggregate) that might perform satisfactorily although outside the specified aggregate requirements. ➢ Demonstrate that waste fines from crushing (crusher dust) could be used as a sand seal.
LOCATION	37 Km from Tulubolo, along the Tulubolo – Kela Road
GEOMETRY	▪ Road Length – 1900 m ▪ Width – between 5 and 7 meters ▪ Topography 1000 m flat 900m uphill gradient between 3% and 5%
TYPES OF AGGREGATES	▪ Crushed Stone Aggregate from Awash Crusher plant, located 130km from the site ▪ Crusher Sand (Crusher Dust) from the same plant in 1) ▪ Cinder gravels obtained from 60km from the site ▪ Decomposed Basalt obtained from 7km from the site

Design

Pavement Design Parameters

COMMERCIAL VEHICLES (ADT)	TWO-WAY ADT	ESTIMATED ESA/VEHICLE	ESA/DAY
Large Bus	24	1.0	24.0
Medium Trucks	8	2.5	20.0
Heavy Trucks	4	5.0	20.0
Sum			64.0
ESAs/Day in one direction			32.0
Design MESA (15 yrs., 5% growth)			0.04
Design Class			LV 2
Laboratory Results			**Others**
Subgrade CBR (4-day soaked, Mod AASHTO)	15	S5	PI = 22
Existing Gravel Wearing Course CBR (%)	44	G45	PI = 23
Proposed Base Material CBR (%)	45*; 65**	G45	PI = 20

Proposed Base Material	MDD = 2.26g/cm3	OMC = 8%	
*soaked at OMC **at OMC			
Field Tests			
Existing Layer	**CBR (%)**	**Thickness (mm)**	**Class**
Gravel Wearing Course CBR	120	170	G80
Design Chart Requirement (S5, LV2)	**Thickness (mm)**	**Strength Class**	**Others**
Base Layer	125	G65	PI<15, PM<400, Grading "B"
Sub-base Layer	125	G30	

Base Compaction

CHAINAGE	TEST LOCATION	CONSTRUCTION RELATIVE COMPACTION (% OF MDD)
39.125	CL	99
38.950	LHS	100
38.775	RHS	95
38.6	CL	100
38.425	LHS	95
38.25	RHS	100
38.075	CL	99
37.9	LHS	96
37.725	RHS	97
37.55	CL	99
37.375	LHS	98

Type of Binder and Spraying

BINDER	MC 800 (By Cutting back MC3000 with 15% MC30)
APPLICATION RATE OF BINDERS	1.1 – 3.9 l/m^3
APPLICATION RATE OF AGGREGATES	For all four types – About 25 l/m^2

10.2.3 Otta seals in the village of Gerado

The demonstration site is located in Gerado village, which is 8km along the Combolcha – Mekaneselam road and 20km from the turnoff on the Combolcha – Dessie Road. Aggregate for the Otta Seal Construction was obtained from Mitikolo Quarry Plant, 30km from site. Bitumen for the works was heated at a site 30km from the construction site at the heating plant opposite Wollo University Campus. The aim was to demonstrate the benefits of using Otta seal technology for surfacing rural roads.

Table 10-4: Combolcha – Mekaneselam trial section description

Description

OBJECTIVES	➢ Demonstrate an Otta seal technique ➢ Demonstrate the use of locally available natural weathered basalt as surfacing aggregate ➢ Research the suitability of a local cinder gravel as surfacing aggregate

	➢ Demonstrate the use of fines from crushed rock (crusher dust) as a sand seal.
LOCATION	At Gerado village 8 Km from Combolcha (376 Km from Addis Ababa) along Combolcha – Mekaneselam road.
GEOMETRY	Length ▪ 2900m with transition zone of 100m Gradient ▪ Zero - 600m (5%) ▪ 600m - 1500m (3%) ▪ 1500m - 2700m (0-2%) ▪ 2700m – 2900m (7%)

Design

Design Traffic in MESA (15 years, 5% growth estimation)	ESA per day = 0.41 Traffic Class= LV-4

LABORATORY RESULTS	**PROPERTY/ VALUES**	**CLASS/VALUE**	**OTHERS**
Subgrade CBR (4-day soaked, Mod AASHTO)	11	S4	PI = 20
Existing Gravel Wearing Course CBR (4-day soaked, Mod AASHTO)	82	CBR 80%	PI = 12
Proposed Base Material	MDD = 1.86g/cm3	OMC = 13%	
Field Tests			
LAYER	**DCP CBR (%) – 10TH LOWER PERCENTILE**	**THICKNESS (MM)**	**CLASS**
Existing Gravel Wearing Course	110	330	**G80**
Lower Gravel Wearing Course	104	300	**G80**
Subgrade	34		
DESIGN CHART REQUIREMENT (S4, LV4)	**THICKNESS (MM)**	**STRENGTH CLASS**	**OTHERS**
Base Layer	175	G65	PI<9, PM<200, Grading "B"
Sub-base Layer	200	G30	

Construction

CHAINAGE	TEST LOCATION	RELATIVE COMPACTION (% OF MDD)
8+060	CL	100
8+180	LHS	102
8+360	LHS	99
8+560	RHS	98
8+760	CL	102
8+960	LHS	102
9+200	RHS	100

Priming the base layer

Of the 2900m demonstration length, 1500m from 8+000 to 9+500 was primed at a rate of 1.0 l/m2 using MC30. The second half of the demonstration from 9+500 to 10+900 was not primed. This section was designed to demonstrate that an Otta seal can be constructed on an un-primed base with the low viscosity cut-back bitumen (MC800) acting as both binder and prime.

Problems were experienced with the binder distributor and half width of the road section from 8+000 to 9+000 on the left hand side was primed with labour-based technology using a hand lance to spray the binder. The binder distributor was used on the remaining primed section.

Layout of the demonstration project

The demonstration project comprises 100m transition section at the beginning and four sections of 700m length each as shown in Appendix A.

The first layer of the whole demonstration section comprised an Otta Seal using a medium graded aggregate of nominal maximum size 16mm.

Two sections of 700m length each were constructed on a primed base and the other two were constructed on an un-primed base. The plan for the second seal was that the outer two sections at each end of the trial will receive another Otta Seal layer whereas the inner two sections will receive a cover seal of crusher sand. The second seals was applied after the volatiles have evaporated and the surfacing is firm, which took 2 to 3 months from the completion of construction of the first seal.

10.3 Marking of LTPP Sections

10.3.1 General

LTPP Section will be marked and painted with epoxy paints on Assosa – Kumruk, Combolcha – Mekane Selam, and Hawusewa – Abala test locations. However for Tulu bolo – Kela test section, due to the inevitable upgrading and due to it containing numerous short section; the road marking permanent LTPP section found to be irrational for now; and this will be confirmed after discussion with in the parties.

The service provider use the templates[1] provided by the ERA and the international consultant to mark this LTPP sections. The templates acquired includes pictorial representation of LTPP marking sections (Not to scale) and marking print template of each symbols (to scale). Accordingly, the crew will mark the LTPP sections on the confirmed selected sections of each test sections. Moreover, the crew will maintain the LTPP section marking during every evaluation period to preserve the markings. The outline of LTPP Section in Appendix J.

10.3.2 Setting out

We will establish accurate setting out of the road marking line to facilitate easier application and to ensure the smoothness of the lines. For the shapes, pattern molds in accordance with shape templates made of cardboard will be adopted to assure workmanship and efficiency of the site works.

10.3.3 Materials and Equipment

Below is the list of equipment and materials required during the marking procedure:

Table 10-5: Materials and Equipment for marking

NO.	ITEM	QUANTITY
1	Epoxy Paint	As Required
2	Rolling Brushes	Four
3	Molded Cardboards	3 Pcs for each symbol.
4	String for setting out	As Required
5	Hand GPS	1 Pcs.

[1] See Appendix I

10.4 Conducting classified traffic Count.

The service provider will perform Manual traffic counts 24-hour per day for 7 days as per the clients' requirement.

In Ethiopia the major factors that influence the traffic tally are:

- Harvest Periods of major cash crops like Coffee, Teff and Corn.
- Seasonal condition, usually form June – end of August it is long rainy season and major schools will be at recess and most of the time mobility will be restricted at this period.
- Major holidays: New Year, Easter, Ed-Alfetir, Meskel, and Timket holidays have major effect on mobility.

Accordingly, the service provider will make sure that the count will avoid as much as possible the above factors

We will utilize mechanical counters (clickers) used with clipboards for to aid the technicians and we will assign adequate technicians for the work to avoid any negligent that might arise from tiredness.

The service provider also collect as much information needed that might influence the traffic tally like harvest seasons,

The service provider also will revise the filling formats according to the traffic characteristics the area and will take random axle load measurement for each traffic types to gather accurate data as much as possible.

The traffic-tallying format is presented in the Appendix B of the document.

10.5 Conducting axle load surveys

Axle Load Monitoring

Purpose

The service provider will carry out Axle load measurements using the Ethiopian Roads Authority's static mobile weighbridges for the work as per the contract.

The service provider will assign enough personnel to assist ERA's technician throughout the work. The service provider also will provide safety equipment and will make sure that safety procedures are followed strictly as per section 10.1.

The Axle load monitoring will be carried out for 24 hours for 7 days and both loaded and unload trucks will be weighted at the client's requirement to implement the same procedures throughout the programme. The service provider will also avoid abnormal days specified on section 10.4. The axle load filling form provided by the client is shown in the Appendix C of the document.

The service provider will follow applicable procedure while carrying out the survey and will select appropriate locations considering that:

- The surveying is carried out on Flatter gradient.
- Suitability of the location to carry out surveying on both direction and for implementing safety procedures
- Location where no alternative routes are present to prevent vehicles bypassing the survey.

10.6 Weather Data

The service provider will collect the rainfall, temperature and wind velocity data from the national recording stations around the test sections. If adequate data could not be found the service provider

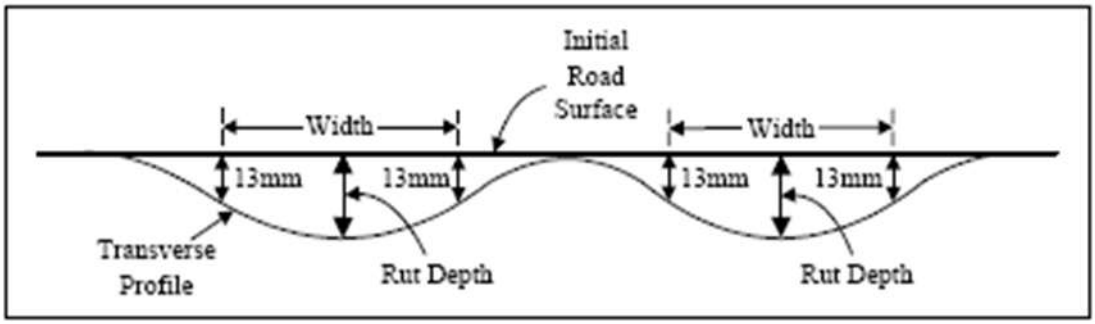
will recommend to the project parties possible means of collecting the data since they are crucial in assessing the possible causes of deterioration and the susceptibility to the trial pavement material to the surrounding weather condition.

10.7 Transverse and Longitudinal Profile of the section

10.7.1 Transverse Profiling

The service provider will use a two-meter straight edge and wedge can be used for profile measurements to be taken every 100 mm from the center of the lane to both the road edge and the road centreline as per ASTM E 1703/E 1703M – 95 (2005) on the LTPP sections.

Moreover, the rut width will be measured with a measuring tape, while the rut depth, which is the maximum measured perpendicular distance between the bottom surface of the straight edge and the contact area, can be measured with a calibrated wedge.



In connection with this rut depth, measurement will be performed on marked points on the LTPP section and will be recorded on the prepared form.

The form used for recording transverse profiling and rut depth measurement is attached on Appendix D and E of the document respectively.

10.7.2 Assessment of roughness (riding quality):

The service provider was planning to use ERA's ARRB walking profilometer to measure the roughness on the LTPP sections, however it has been noted later at the first trial test in the walking profilometer is not properly functioning, details will be presented in the 1st M&E report for Tulubolo - Kella. Therefore the roughness measurement will be carried out with MERLIN profiler. The service provider will consider the presence of cracks, texture, patching, potholes and surface contaminants as well as seasonal conditions while analyzing the test data.

IRI values will be presented to the client for every panel width as per the reporting system of the machine.

10.8 Structural Capacity

10.8.1 Deflection Measurement

General

The strength of a road pavement is inversely related to its maximum vertical deflection under a known dynamic/static load. The maximum deflection under a moving wheel load is an indicator of the elastic properties of the pavement and therefore a good indicator of its overall load spreading ability. Although it is not a direct measure of strength it has been shown to correlate well with long-term performance of pavements under traffic.

Since there is only one FWD equipment in the country owned by ERA its proper functionality and availability for the project is a challenge. Moreover "CLARIFICATION NO.4" of this Tender has made it clear that ERA will avail Benkelman Beam (BB) for deflection measurement, therefore the Service provider will use BB instead of FWD. The Service provider will avail a loaded truck for the measurement.

Deflection measurement will be carried out on the panels of the LTPP sections as stated on the project marked LTPP out line provided by the client. The marked points used for deflection measurement is stated on the annex of the document. The deflection measurement will be carried out four times during the two-year duration of the project

Timing of deflection surveys – it is normally recommended that the tests shall be carried out towards the end of the rainy season, when the road is at its weakest, and the deflection is at its greatest. For this the test carried in October will represent this condition and the test in March can give a good comparison towards the effect of seasonal variation on pavement strength.

Table 10-6: Equipment and Material for Deflection Measurement

Equipment

No.	Item	Quantity
1	Benkelman Beam	1 Pcs.
2	A two-axle load vehicle the back axle with dual tyred wheels.	1 Pcs.
3	Pavement Temperature measuring device	1 Pcs.
4	Glycerin for temperature testing	As Required

Procedures

The axle of the truck will be loaded to 8175 Kg. The axle load measurement will be taken routinely and the measurements will be recorded and if the values shows any deviation the readings shall be adjusted linearly to the values of the 8175Kg. Moreover, the wheels will adjusted to be:

- 11 x 20 or 10 x 20 tyre dimensions
- Road contact length: 200 mm
- Spacing between the walls of the tyres in the dual wheel combination: 75 – 90 mm
- Tyre pressure 590 kN/m^2 (85 psi)
- And the service provider will follow the following procedures:
- The tyre pressure should be checked before the first test and then at intervals not exceeding three hours.
- The truck will initially be positioned with the test wheel between 100 and 150mm to the rear of the test spot, i.e. position A.
- The probe of the beam will be inserted between the dual tyres of the test wheel with the toe located on the test spot.
- The locking device will be released and the rear of the beam adjusted so that the plunger is in contact with the dial gauge.
- The dial gauge will be set to read between 9 and 11mm and the initial reading will be recorded.

- The truck will move forward at creep speed so that the test wheel passes over the test spot and continues advancing to position at least 15 meters.
- The maximum dial gauge reading occurring during the wheel passes over the test spot will be recorded.
- The final reading will be recorded after the truck advance forward.

Temperature

A number of factors that should be taken into account can affect deflection readings, one of them is temperature, and temperature reading should be used before the deflection reading interpreted. The stiffness of asphalt surfacing will change with temperature and therefore the magnitude of deflection can also change. The temperature of the bituminous surfacing is recorded when the deflection measurement is taken, thus allowing the value of deflection to be corrected to a standard temperature. It is recommended that 30/35 ^{o}C, measured at a depth of 40mm in the surfacing, is a suitable standard temperature. Fortunately, it is often found that little or no correction is required when the road surfacing is old and age hardened, or relatively thin. The Service provider will record the road temperature every 15 min or whenever it is expected that the temperature will vary above 2.5 ^{o}C in one hour.

The form to be used to capture the deflection measurement is attached in Appendix F of the document.

10.8.2 In situ strength/balance (Dynamic Cone Penetrometer)

General

The DCP is an instrument that is used for the rapid measurement of the in situ strength of existing pavements constructed with unbound materials. Measurements will be made down to a depth of approximately 800 mm

DCP tests are particularly useful for identifying the cause of road deterioration when it is associated with one of the unbound pavement layers, e.g. shear failure of the road-base or sub-base. A comparison between DCP test results from subsections that are just beginning to fail and those that are sound will quickly identify the pavement layer that causes the problem.

DCP tests will be carried out on the three projects except for Tulubolo-kela (1-TK) where the road base and subbase are highly stony however if the client found to necessary we will conduct the test on layers beneath the subbase after we removed the above stony layers.

On the other three test section DCP tests will be carried out on 12 points for each LTPP sections established on them.

Table 10-7: Equipment and Material for DCP Measurement

Equipment and Material

NO.	EQUIPMENT/MATERIAL	AMOUNT
1	Dynamic Cone Penetrometer, with complete sets	1 pcs.
2	Coring Machine	1 Pcs.
3	A bar and tamping tool	As required
4	Cold Mix Asphalt	As required

Procedure

- During equipment assembly it is important that all the screwed joints be kept tight during testing. The joints should be secured with wrenches before beginning each test. The threaded portions will occasionally repaired with a tap and die set.
- During testing the instrument is held in a perpendicular position. The weight of the drop hammer seats the cone before the test begins.
- The top asphalt will be removed by coring. An area large enough to accommodate the base of the instrument is removed and the base course materials excavated to the subbase or subgrade. Before recording the zero reading of DCP, the drop hammer should be released once, to seat the cone in any disturbed material that may be present after excavation.
- Three people will be assigned complete the test. One person stands on the stool and holds the apparatus by the handle while the second person lifts the drop weight. The third observes the readings and records them on the appropriate form.
- The steel rule attached to the guide foot is placed through the slot in the hand guard. The foot is placed on the surface to be tested and the cone tip passed through the guide hole.
- The entire apparatus is then held by the handle perpendicular to the surface. The technician observes the reading on the rule at the top of the hand guard and records this as the Zero Reading of DCP.
- The drop weight is then raised to its maximum height and released but care will be taken not to strike the weight against the handle.
- The readings are taken with each 5 blows of the weight as per the form provided by the client
- Penetration depth less than 1 mm and exceeding 20 blows is considered as refusal.
- The test depth will be taken to 800 mm below the contact with the road base.
- Upon reaching the desired depth or refusal, the instrument is withdrawn.

Generally DCP tests are recommended for fine grain soil layers, when used on base course material, the DCP consistently produces high and sometimes misleading results. The accuracy of the DCP test result generally depends on the type, coarseness and compaction degree of the granular particles that affects the penetration resistance. Therefore the DCP test results from these materials shall be viewed with some caution.

The format to be used to capture the results is shown in Appendix F

10.9 Sampling and testing

10.9.1 General

Only by observing the materials and layers in a road directly, exact conditions of construction can be determined. The excavation of pits through pavement with testing and sampling of the materials comprising each layer is therefore an essential part of most structural pavement evaluations.

It is imperative therefore that the optimum locations are tested and that the maximum information is obtained from each test pit. The service provider will implement a standard sampling procedures and make sure that the testing are conducted to the required quality.

And all the layers will be tested, sampled and profiled.

10.9.2 Location

The location of the test pits will be on the place marked for this purpose on the LTPP sections. The test will be carried out at two points for each LTPP sections one on the left and the other on the right lanes.

10.9.3 Size of the test pit

The Service provider will make sure the areal extent of the test pit should be as small as possible so as to cause minimal disturbance of the pavement surface but large enough to Permit a sample of sufficient size to be collected and allow enough space to carry out in situ testing and excavation at depth.

The test pits will be excavated to a depth at which the in situ material can be inspected and sampled and where the road is built on a high fill up to the top 300 mm of the fill material will be excavated.

10.9.4 In situ measurements and procedures

- The surfacing will be carefully removed causing minimal disturbance of the upper base course.
- Immediately on exposure of the base to the atmosphere, an in situ density determination will be carried out on the base course using sand replacement method. Then at least one-Kilogram samples will be obtained for moisture content determination and dry densities will be calculated. Once the density of the base has been determined, the material will be loosened and sampled with sufficient material being collected for the laboratory testing envisaged.
- The test pit should then be carefully trimmed and cleaned until the next layer is exposed. If the materials in the two layers differ significantly, it is easy to prepare a suitable surface on the next layer for density testing.
- Each pavement layer should then be tested and sampled in turn until the subgrade is reached and this should be excavated until it is clear that the in situ material has been reached.
- Test pits should be carefully reinstated with similar quality materials to those removed and the hole sealed with cold-mix asphalt.

During sampling of test pits a summary of all samples collected with their depth and description will be made. This can be included on the soil profile description form. The samples removed from the test pits should be carefully bagged and labelled prior to submitting to the laboratory for appropriate testing.

10.9.5 Description and logging of THE SOIL profile

The seal removed from the trial pit will be closely inspected and descriptions of the bituminous surfacing (type, binder condition, adhesion to the base and to chippings, prime penetration, etc.) recorded.

Once the pit has been tested and sampled, one “wall” of it will be scraped with a spade and the pavement profile described and measured. The description will follow the process widely employed in southern Africa is based on a revision of the Jennings, Brink and Williams (1973) method by Brink and Bruin (1990) and six primary parameters are described as summarised below and will be filled on the stand form on Appendix G

Moisture condition

Assessment of the moisture condition is a precursor to the estimation of consistency which is largely dependent on the moisture content at the time of inspection. The following descriptors are used for the moisture evaluation.

Dry, *slightly moist*, *moist*, *very moist*, *wet*.

Slightly moist materials are near the optimum moisture condition while very moist soils require drying to attain optimum moisture content. Wet soils generally come from below the water table.

Colour

A repeatable description of the predominant colours of the soil assists with the correlation of different layers/strata on a site. The description will be limited to two colours, e.g., reddish brown or blue-green.

10.10 Visual Condition Survey

10.10.1 General

Introduction

The service provider will carry out the assessment of the trial section as per the document 'Guideline for the Monitoring of Experimental and LTPP Sections in Mozambique' that is based on TRH9; COTO, 2013 of south African manual; provided by AFCAP to implement a uniform methodology and evaluation procedures for all the projects under AFCAP programme.

The Crew will carry out visual condition survey for every 20-meter interval and will present the report on a standard format issued by AFCAP. In addition, the defects will be presents in sketch mapping and pictorial formats.

Visual condition will be carried out on the whole sections. For the LTPP sections, the segments will be the panels with in the sections and will have a width of 15 m for the internal panels and 25 m for the outer panels and for the rest of the sections the segments will recorded every 20 meters.

The typical form used to capture visual condition survey of flexible pavement is shown in appendix J.

APPENDIX A: MINUTES OF KICK-OFF MEETING

NOTES OF THE KICK-OFF MEETING

Date: 11th November 2016

Time: 11:00 – 13:00

Venue: ERA – RRD Office, Addis Ababa

Present:

Alemayehu Ayele (AA),	ERA-RRC Director/ Chair Person/
Andrew Otto (AO),	AFCAP Research Consultant
Deribachew Mezgebu (DM),	Client Project Coordinator
Alemgena A. Araya (AAA),	Service Provider Project Director

Subject: ETH2051C-Monitoring and Evaluation of Low Volume Roads Trial Sections in Ethiopia

The chair person (AA) opened the meeting and welcomed the participants. He introduce each participant and brief about the meeting as part of the first kick-off meeting for the service, he noted that the client and AFCAP Consultant have some points to discuss which shall be forwarded by the AFCAP Consultant.

The AFCAP Research Consultant (AO) introduced the background and objectives of the trial sections. He also noted that currently AFCAP is conducting or planning to carry out monitoring and evaluation in four countries namely Kenya, Tanzania, Mozambique and Ethiopia, and other counties to come soon which is handled by TRL as part of "the back analysis project".

AO explain that the objective of these parallel monitoring and evaluation in various countries is aimed at developing a database and sharing among them through data sharing protocol. Thus, AFCAP is trying to have uniform protocol among these counties with an appreciation of their particular objective/interest and the equipment and techniques they have for the monitoring.

Then he briefly summarizes the four project sites and test requirements in the ToR and some amendments namely:

Assossa - Kumruk: with trial section consisting of laterite base and laterite subbase (~800m); and first thing to do is to select a control section (~800m) from the normal crushed base course road.

Tulubolo – Kela: monitoring whole (2100m) section with various paving material sections but no LTPP. There are no LTPPs for two reasons: firstly, there are so many short sections and it would not be feasible to create LTPPs for all those sections; and secondly, the whole road from Tulubolo to Kela will soon be upgraded meaning the villages at Combel may require the same standard throughout the village thus removing the trial.

Combolcha – Mekaneselam: the 4 LTPPs each 200m sections have been amended to 2 LTPP sections but monitoring shall be carried out to the whole (~3000m) section; the client is also requesting the service provider to patch one existing pothole during their reinstatement of trial pits.

Hawsewa – Abala: the 4 LTPP each 200 m sections have been amended to 5 LTPPs. The first four are each 200 m and the fifth section (1 LTPP) of 130 m is an

addition that was constructed later. No baseline measurement has been taken on these sections as yet. That is because the RRC did not have a coring machine with a barrel or 150 mm. During this week, two coring machines have been acquired which will be provided to the service provider whenever monitoring is to take place.

The service provider (AAA) request for clarification to confirm that the basic amendments on the M&E activities are; changes on the No. of LTPPs for Combolcha – Mekaneselam from 4 to 2 sections each 200 m and adding one patching on existing pothole, and change on the No. LTPPs for Hawsewa – Abala from 4 to 5 sections the first 4 of each 200 m and the fifth one of 130 m; and get confirmation from AO and agreed.

AO also reminded that flexibility is important in order to gain as much knowledge as possible form the trials, he also noted that construction reports for the first 4 projects is already available but baseline monitoring reports exist for only 3 projects. There is no baseline report for Hawusewa – Abala since no baseline monitoring was done. All these reports plus many other documents (e.g. marking templates, guidelines, data collection forms, reporting templates) will be given to the Service Provider once they have signed their contract with Cardno.

AA notify that ERA-RRC will assist in obtaining construction records for all the monitoring sections on Hawusewa - Abala either from the North Region Contract Administration Directorate or Adigirat Road Network Management Directorate of ERA.

The chair person emphasised that all the data collected shall be delivered to ERA-RRC including raw data, ownership and use of these data shall be through written approval of ERA.

There then followed a discussion on availability of Key experts, the schedule of commencement date, mobilization, inception report, 1st M&E, equipment and it was agreed on the following points:

AAA *confirms availability of all key experts* offered in the tender for the project

Considering the delay on commencement from early October which now mid of November due to the procurement process: it was generally agreed that the milestone schedule for the first six months will be shifted parallel to the schedule on the ToR, while milestones from 2nd M&E will be kept as it is.

Commencement date is assumed to be *the date where contract is signed by both parties and delivered (electronically)* to the service provider.

The service provider will *mobilize his staff for the service within 5 working days* of the commencement date.

Inception report shall be *submitted after 15 working days* from the commencement date.

1st M&E shall *start after 25 working days* from commencement date, it is important to start the 1st M&E after the inception report in order to reach on an agreement in the techniques and methods of the M&E. It has been discussed that the 1st M&E will be shifted from the planned October to December/January in which the main wet season to end in October, this may require to consider the seasonal adjustment from climatic data in which the service provider is expected to collect.

AA request the service provider to confirm that except those which are mentioned in the ToR and Clarification No.4, all other equipment such as Truck for axle load measurement is to be provided by the service provider; AAA confirms the same

AAA request whether it is possible to revise the payment schedule (such as increase the percentage at the inception and 1st M&E) as the 1st M&E a major milestone in establishing all the Monitoring and Evaluation activities. AA and AO respond that for such cases the service provider can forward his request to the Technical Service Manager of ReCAP.

AO notify that as he will not be in Ethiopia for the next about 2 months (until early January 2017), baseline data, construction data, methodology (including report format, data collection format etc.) shall be provided to the service provider through the client project coordinator (DM) immediately after signing the contract.

At the end AA concludes the meeting with summarizing note that this research project is very important and it is expected a good quality output of international standard. As this project is important for the client, the client ERA-RRC will support the service provider in any aspect and give due follow up by assigning a counterpart research engineer to join the service provider in all field activities in addition to the client project coordinator.

****

MINUTES OF MEETING NO.1

Date: 1st of March 2017

Time: 9:30– 11:00 A.M.

Venue: ERA – Conference Room No.2, Addis Ababa

Presents:

Alemayehu Ayele,	ERA-RRC Director/ Chairperson/
Nkululeko Leta	AFCAP Regional Technical Manager
Deribachew Mezgebu	ERA RRC - Project Coordinator
Dr. Alemgena A. Araya	MD of ALERT Engineering Plc. and Project Director
Wubishet Dessalegn	GM of HITCON Engineering Plc.
Hunduma Chali	Overseeing Engineer

Re: ETH2051C-Monitoring and Evaluation of Low Volume Roads Trial Sections in Ethiopia

Subject: Notes of the Start-up Meeting

The chairperson opened the meeting and welcomed the participants and the meeting started with introduction of the participants. Then followed the presentation of the consultants by Dr. Alemgena to highlight the overall approach and methodology for carrying out the require service in line with the time frame set out in the contract.

The PowerPoint presentation described the overall work plan and modality for carrying out the field and office works by stating the major scopes, the formats to be used, the project site locations, the work method, the required staffing and equipment etc. It also highlighted on how to obtain these required equipment as well as the major changes of the contract that resulted from the delay of the date of commencement of the services.

Following the presentation discussion on some of the core issues was made and Mr Leta proposed to provide the recently updated field investigation formats for the consultants' use.

Regarding the consultants' proposal to use RRC's laboratory for testing of material samples, it was stated that RRC's laboratory is busy due to high work volume that will occupy the lab. Hence, the consultants were advised to better use other reliable commercial laboratories. It was however suggested that some selected tests could be made in RRC's Lab for confirming/checking results as necessary.

The consultants requested for the timely arrangement of the required equipment such as roughometer, mobile weighbridges, Benkelman Beam and Asphalt cutter to go in line with the work plan. The RRC mentioned that they already communicated the office of Road Asset Directorate for the arrangement of the equipment and will remind them. It was also requested by the consultants for possibility of using walking profiler which is available in ERA for measuring roughness as it would be more reliable for short stretch and scope of work of similar nature. The RRC suggested and promised to provide same as available.

The RRC suggested assigning two researchers by providing the necessary resources such as vehicles and so on. It was confirmed by the consultants and stated that the service shall be executed in partnership and close collaborations of all parties and accordingly committed to involve the researchers in the field and office work.

The consultants proposed for the possible replacement of the initially proposed technical supervisor (Tewdros Mulugeta) that made them difficult to avail him due to the delay of the service commencement date. The consultants' proposal was accepted and asked to propose competitive expert with equal or better qualifications.

The consultants accepted the request of the RRC and promised to prepare and submit hard copies of the deliverables to the RRC for their records. It is also confirmed that all communications with the consultants is to be made through the consultants' contact person, Dr. Alemgena.

The consultants were advised to follow the AFCAP reporting and Presentation formats and templates for consistency purposes.

As a final remark it was mentioned that the expectation of the service is high and it's expected that the consultants to work in close collaboration and partnership with all parties. The consultants also confirmed their understanding of the expectation and will try to exert their best endeavour to fulfil the requirements of the contract by using the experienced personnel and dedication.

The meeting adjourned at around 11:00A.M.

****

APPENDIX B: TRAFFIC TALLYING FORM

Traffic Tallying Form							Project:								
Area/Town:			Road:				Count made by:					Date:			
Location/Chainage of Count Section							Day:					Sheet	of		
VEHICLE CLASS \ HOUR	**6 - 7**	**7 - 8**	**8 - 9**	**9 - 10**	**10 - 11**	**11 - 12**	**12 - 13**	**13 - 14**	**14 - 15**	**15 - 16**	**16 - 17**	**17 - 18**	**COUNT**	**FACTOR**	**TOTAL**
Passenger Cars															
Light Goods Vehicle (Pick Ups, Small Bus, Vans, Small Trucks)															
Medium Bus															
Coach (eg. Salem Bus)															
Medium Truck (2 Axle)															
Heavy Truck (2 Axle)															
Heavy Truck (3 Axle)															

Heavy Truck (4 Axle)															
Articulated Trucks															
Tractor and Agric Vehicles															
HOUR TOTAL															

APPENDIX C: AXLE LOAD SURVEY FORM

AXLE LOAD SURVEY FORM																	
Project:																	
Road Name:						Remarks:											
Station:																	
Date:																	
Survey Number:						Surveyors:											
						Axle Number										**Totals**	
No.	Vehicle Type	O/D	Axle Configuration	Goods	Axle Number	1		2		3		4		5		Total	
		O:			Wheel (L/R)	L	R	L	R	L	R	L	R	L	R	L	R
					Wheel Load (kg)												
		D:			Axle Load (kg)												
					ESA												
	Vehicle Type	O/D	Axle Configuration	Goods	Axle Number	1		2		3		4		5		Total	
		O:			Wheel (L/R)	L	R	L	R	L	R	L	R	L	R	L	R
					Wheel Load (kg)												
		D:			Axle Load (kg)												
					ESA												
	Vehicle Type	O/D	Axle Configuration	Goods	Axle Number	1		2		3		4		5		Total	
		O:			Wheel (L/R)	L	R	L	R	L	R	L	R	L	R	L	R
					Wheel Load (kg)												
		D:			Axle Load (kg)												
					ESA												
	Vehicle Type	O/D	Axle Configuration	Goods	Axle Number	1		2		3		4		5		Total	
		O:			Wheel (L/R)	L	R	L	R	L	R	L	R	L	R	L	R
					Wheel Load (kg)												
		D:			Axle Load (kg)												
					ESA												
	Vehicle Type	O/D	Axle Configuration	Goods	Axle Number	1		2		3		4		5		Total	
		O:			Wheel (L/R)	L	R	L	R	L	R	L	R	L	R	L	R
					Wheel Load (kg)												
		D:			Axle Load (kg)												
					ESA												

APPENDIX D: PROFILING ASSESSMENT FORM

	LTPP Profile Assessment Form																				
	Section:					**Panels:**						**Date:**						**Evaluator:**			
TRANSVERSE PROFILING	**Panel**	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
	Panel	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
	Panel	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
	Panel	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
	Panel	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
	Panel	Lane Centre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	RE
	Max Rut:																					
	Width:		2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	CL
LONGITUDINAL	Position (m)		0	20	40	60	80	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
	Outer																					
	Inner																					
	Lane Centre																					

APPENDIX E: RUT DEPTH MEASUREMENT FORM

Project		**Survey no/Sheet**	
Province		**Surveyor**	
Road Name		**Date**	
Section		**Direction of counting on each**	

Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						
Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						
Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						
Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						
Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						
Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**

Reading (mm)						

Chainage						
Lane	**LEFT**			**RIGHT**		
Location	**Outer Path**	**Inner Path**	**Width**	**Inner Path**	**Outer Path**	**Width**
Reading (mm)						

Average rut depth:
Maximum rut depth:
90th percentile rut depth:
Average pond width:
Average pond depth:

APPENDIX F: BENKELMAN BEAM DEFLECTION FORM

Project:	**Chainage from/to:**
Direction:	**Lane (L/R):**
Tested by:	**Date:**

Chainage	Deflection Reading, X 10^{-2}							
	Inside wheel track				Outside wheel track			
	Initial Reading	Max Reading	Final Reading	Deflect. mm^{-2}	Initial Reading	Max Reading	Final Reading	Deflect. mm^{-2}

APPENDIX G: DCP MEASUREMENT FORM

Project Title		**Survey Number**			
Province		**Road Name**			
Section		**Chainages**			
Length		**Date**		**Zero Error (mm)**	
Test Position		**Cone**		**Surveyor**	

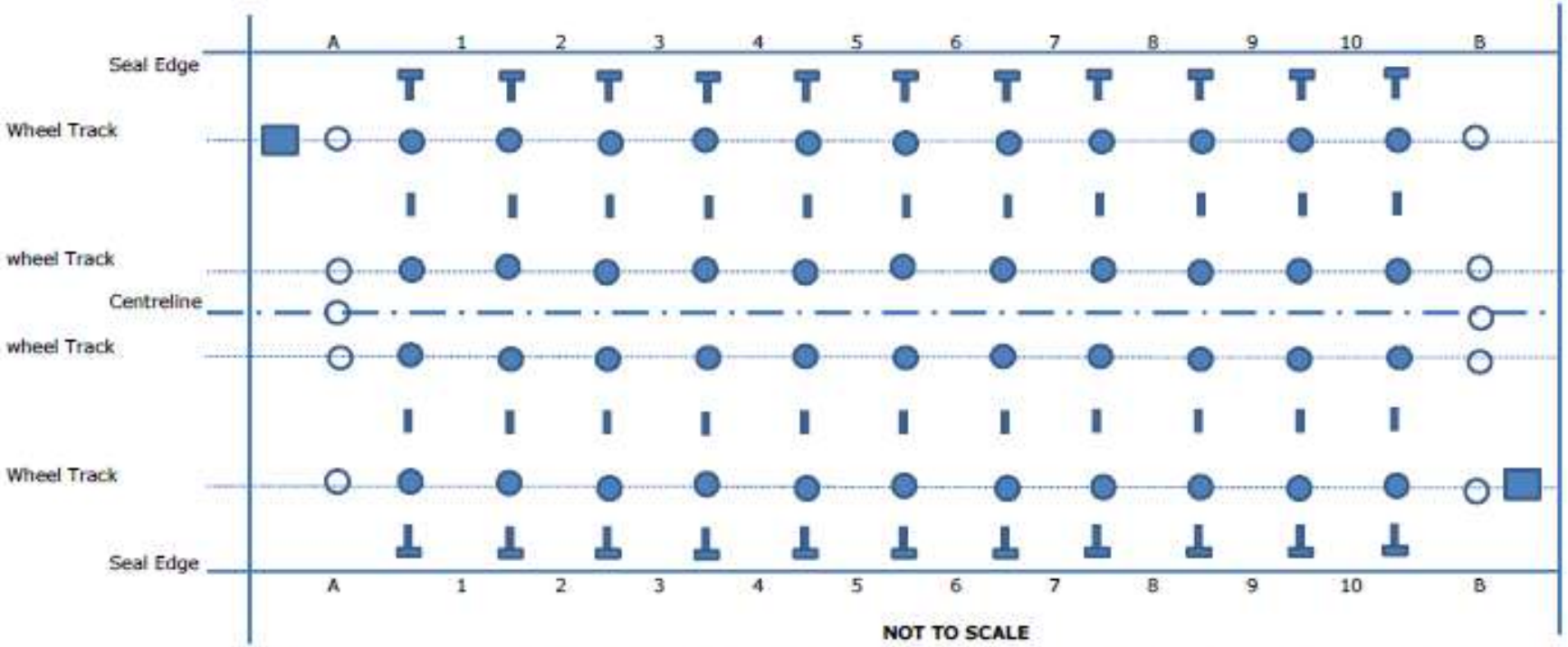
Blows	Reading (mm)	Penetration Depth (mm)	Blows	Reading (mm)	Penetration Depth (mm)
0					
5			205		
10			210		
15			215		
20			220		
25			225		
30			230		
35			235		
40			240		
45			245		
50			250		
55			255		
60			260		
65			265		
70			270		
75			275		
80			280		
85			285		
90			290		
95			295		
100			300		
105			305		
110			310		
115			315		
120			320		
125			325		
130			330		
135			335		

140			**340**		
145			**345**		
150			**350**		
155			**355**		
160			**360**		
165			**365**		
170			**370**		
175			**375**		
180			**380**		
185			**385**		
190			**390**		
195			**395**		
200			**400**		
Notes: Rutting, Pumping, Longitudinal Cracks, Crocodile Cracks, Block Cracks, Other					

APPENDIX H: LTPP TEST PIT FORM

LTPP Test Pit Form									
LTPP Section		**Panel**		**Position**		**Date**		**Profiled by**	
Surface/layer bond									
Depth (mm)	**Moisture**	**Colour**	**Consistency**	**Structure**	**Soil Type**	**Origin**	**Disturbed Sample**	**Undisturbed Sample**	**Comments**
to									
to									
to									
to									
to									
to									
Checklist	**Cracks**		**Description**						
	Rutting		**Heaving**		**Interference Bond**		**Moisture at Interference**		**Layer Definition**
	Carbonation								

APPENDIX I: LTPP MARKING LAYOUT



Notes

a) Wheel tracks can have deflection test points marked but DO NOT MARK a continuous straight line along the wheel track
b) A and B are 25 m wide, 1 to 10 are 15 m wide
c) Total section length is 200 m
d) The outer edges of grids A and B must be marked fully across the road width
e) Grids A and B are mainly for trial pits, DCP tests, sampling for lab testing, layer thicknesses, layer moistures

Deflection beam or FWD measurement point, on existing wheelpaths or if no wheel tracks visible then it should be estimated

Straight edge placement guidelines for measuring rut depths

Straight edge placement guidelines for measuring rut depths

Deflection/FWD, DCP, and Base Moisture Content test locations

Deflection/FWD, DCP, and Trial-Pit locations

APPENDIX J: VISUAL CONDITION ASSESSMENT FORM

VISUAL ASSESSMENT: FLEXIBLE PAVEMENTS							
Road Authority:		Route Class:					
Region/Suburb:		Traffic:	VL	L	M	H	VH
Road No/Street Name:		Gradient:	Flat		Med		Steep
		Terrain:	Flat		Rolling		Mount
Segment (From – To):							
Segment Dimensions:	Length (m):			Width (m):			

ENGINEERING ASSESSMENT					
SURFACING	Texture:	Coarse	Medium	Fine	Varying
Current Surfacing:	Voids:	Many	Few	None	Varying

			DEGREE						EXTENT				
			Slight		Warning		Severe		Isolated				Extensive
			0	1	2	3	4	5	1	2	3	4	5
Surface Failures													
Surface Patching													
Surface Cracks													
Binder Condition													
Aggregate Loss (A / N)													
Bleeding/Flushing													
Deformation/Shoving													
STRUCTURAL													
CRACKS (%)	Narrow	Wide											
Block													
Longitudinal													
Transverse													

Crocodile													
Parabolic													
Pumping													
Rutting													
Undulation/Settlement													
Failures													
	No	Dia											
Potholes													
	Small	Med	Large										
Patching													

FUNCTIONAL ASSESSMENT

	DEGREE						EXTENT				
	Slight		Warning		Severe		Isolated				Extensive
	0	1	2	3	4	5	1	2	3	4	5
Ride Quality: (Potholes/ patching/undulation/corr.)											
Skid Resistance: (bleeding / polishing)											
Surface Drainage											

Side Drainage	Overgrown		Blocked		Non-existent
Overall Pavement Condition	V Good	Good	Moderate	Poor	V Poor
Notes:					
Assessor:	Date:				