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

Four Research Projects - First Monitoring Report

Final

Hunduma Chali
Alemgena A. Araya (PhD)

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Cover Photo: Images taken during the monitoring

Quality assurance and review table			
Version	Author(s)	Reviewer(s)	Date
Second/Final	Hunduma Chali Alemgena A. Araya	Nkululeko Leta; Jon Hongve Les Sampson	July 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
GPS	Global positioning system
LTPP	Long Term Pavement Performance
LHS	Left Hand Side
ReCAP	Research for Community Access Partnership
RHS	Right Hand Side
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Project Background

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 maximise 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 nonstandard materials for Low Volume Sealed Road (LVSR) pavements. As part of this process the constructed trial sections require periodic monitoring and evaluation.

1.2 Report Structure

The main objective of this report is to present the first monitoring and evaluation of the demonstration/research trials with particular reference given to the monitoring activities undertaken, the status and conditions of the trial section together with outcomes to date.

The report consist of general site description and location of the four trail section projects, pavement structure types and section descriptions. More over the report consist of outcomes and analysis of pavement evaluation works performed during the monitoring period and brief discussion of about the works performed and their indications.

The four demonstration/research projects described in this first monitoring report 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 Hawsawa-Abala-Irebti road

2 Assosa-Kurmuk Laterite Base Trials

2.1 Site Description

The trial base is located at the far western region of Ethiopia within the Benishangul Gumuth Regional Government of Ethiopia. It is located at 49Km along the Assosa – Kumruk Road which begin from the capital of regional government Assosa Town. The trial section also located within a small town administration called Kibur Hamsa i.e. 2Km after passing the centre of the town.

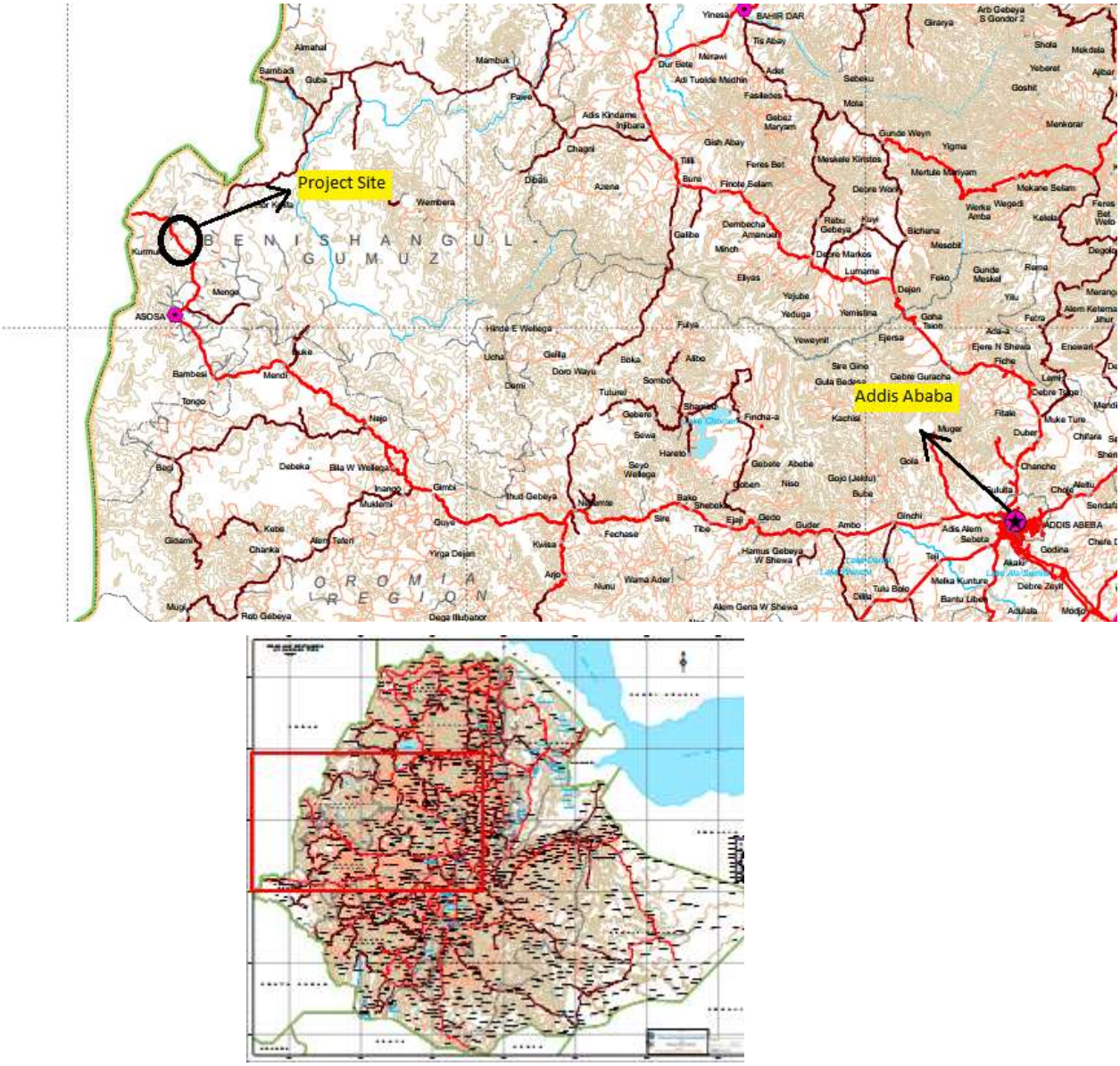


Figure 2-1: Site Location

Table 2-1: Sections

Section	Chainage	Length	Description
1	49+140 – 49+225	85	Unsealed Shoulder on Cut Section
2	49+225 – 49+290	65	Unsealed Shoulder on Fill Section

3	49+290 – 49+393	103	Sealed Shoulder on Fill Section
4	49+393 – 49+496	103	Sealed Shoulder on Cut Section
5	49+496 – 49+602	106	Unsealed Shoulder on Cut Section
6	49+602 – 49+712	110	Sealed Shoulder on Fill Section
7	49+712 – 49+970	258	Unsealed Shoulder on Fill Section

2.2 Pavement Description

The existing pavement was constructed with a laterite sub-base of thickness 150mm, the base material used is laterite of 200mm thickness. The surfacing aggregate size is 9.5mm second layer aggregate placed on a first layer of 19mm aggregate

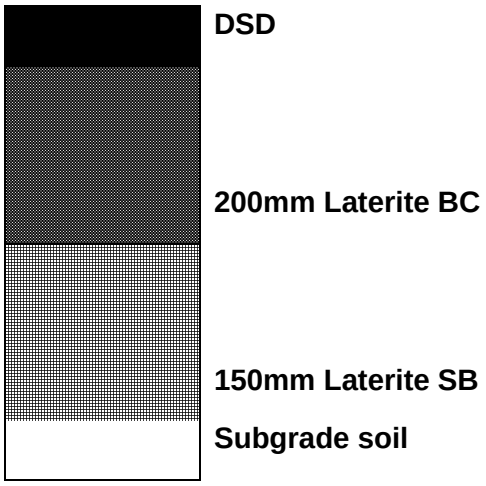


Table 2-2: Pavement Structure

2.3 Mobilization and Setting up Measurement Sections

The team was mobilized to setup two new LTPP sections and two control sections as part of the first monitoring programme which also include visual condition survey, DCP measurement, Traffic count and Rut depth measurements. However marked points were already encountered and previous measurements has been taken from these points. Accordingly in consultation with ERA Research Directorate the service provider repainted the faded marks and improved them in accordance with the clients' requirements.

At the beginning it was difficult to locate the trial section as the stations given on the report is project stations instead of Kilometre posts along the road which shows distance from the capital Addis Ababa and the marking has been faded out remarkably that it was difficult to see from moving vehicle. Moreover the start points were marked in reverse direction that is starting from the Kumruk side hence it took a considerable time until we figure out the whole situation.

At the time of monitoring it was almost the beginning of rainy season and was occasionally raining. Especially at the time of DCP measurement schedule the rain begin to intensify and certain DCP measurements has been taken after the rain passed. This may not influence the DCP measurements significantly since it takes time for the pavement moisture to increase during the wet season.

2.4 Monitoring Period

The report incorporates pavement evaluation works performed by the service provider for the first monitoring programme on April 2017. The weather condition in this month is the end of the dry season and there were flashes of rain signalling the beginning of the rainy season. As per table 4 of the terms of reference the first monitoring programme for Assosa – Kumruk laterite base trial incorporates:-

- Marking of LTPP sections
- Classified traffic counts
- Visual Condition survey
- Roughness measurement
- Rut depth measurement
- DCP tests and
- Drainage Assessment (part of visual condition survey)

Accordingly the report consists of the outcomes and analysis of all the above listed activities as part of the reporting structure of the first monitoring cycle report.

2.5 Traffic Survey

Traffic count was carried out around the project area of the trial section for seven days which includes 12 hours for seven days and 24 hours for 2 days (one on working days and the other on weekends). The 12 hours reading are factored to convert to 24 hours reading based up on the reading taken at the night hours. The average daily traffic count is summarized and presented in table 2-3.

Table 2-3: Traffic Volume Summary

Vehicle Type	Daily Volume (vpd)
Motorcycles	21
Bajaj	139
Cars	0
4×4 Station Wagons (Land Rover)	16
Small Bus <27 Passengers	44
Large Bus >27 Passengers	0
Small Truck <3.5 Tonnes	5
Medium Truck 3.5 to 7.0 tonnes	1
Heavy Truck 7.5 - 12Tonne	1
Truck Trailer > 12 tonne	0
Tractors and Aggric Vehicles	3
Daily Total	**230**

The road do not carry considerable heavy vehicles, more than half of the traffic count are bajaj (Tuk-Tuk) transporting local people around the test section to the centre of the town Kibure Hamsa.

2.6 Rutting

Rut depth measurement has been performed on 75 marked panels and for each panel four reading has been taken on outer and inner wheel paths for both left and right lanes. Out of which the 52 panels were on trial sections which were already established during previous evaluation works. And the other 22 panels were marked for the two control LTPP section with 11 panels each.

Figure 2-2: Rut depth measurement using 2m standard straight edge and measuring wedge.

The rut depth measurement was taken using standard 2m straight edge with a measuring wedge us shown in picture above.

Table 2-4: Average Rut Depth (mm)

Section	Left Lane		Right Lane	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel Path
Unsealed Shoulder on Cut Section (UC1)	6	5	5	7
Sealed Shoulder on Cut Section (UF1)	5	5	8	6
Sealed Shoulder on Fill Section (SF1)	4	3	4	8
Sealed Shoulder on Cut Section (SC1)	2	8	6	2
Unsealed Shoulder on Cut Section (UC2)	5	5	5	8
Sealed Shoulder on Fill Section (SF2)	6	8	2	8

Unsealed Shoulder on Fill Section (UF2)	4	7	4	11
Control Section - Unsealed Cut (CS1 – UC)	5	8	5	13
Control Section - Unsealed Fill (CS2 – UF)	2	1	3	1

The average rut depth measurement for all roads is considerably lower than 20mm which shows the pavement structures are sound and defects are due to surfacing.

The result also shows that there is no considerable difference in sealed and unsealed shoulders on fill sections however there is small difference for cut sections that unsealed shoulders shows marginal increment in rut depth than that of filled sections for both the trial section as well as the control sections.

At this stage in terms of the rut depth measurement results shows the trial section shows the same performance with that of the control section. And it also shows that road formation have a marginal effect on the rut depth. As a result fill sections show little rutting than that of cut sections. More over sealed shoulders have a better effect on cut sections rather that fill sections.

2.7 DCP and Base Moisture Measurements

2.7.1 DCP Measurements

DCP measurements performed on all the trial section near the previously tested points and on the two LTPP sections established on the new control sections. The DCP test performed on the Outer Wheel Path Left (OWL), Inner Wheel Path Left (IWL), Centreline (CL), Inner Wheel Path Right (IWR), and Outer Wheel Path Right (OWR). The outcome has been summarized and present as follows.

Table 2-5: DN values at cross-section UC - 1

Depth (mm)	DN values (mm/blow)					
	Specifications (e.g. TLC 0.1)	OWL	IWL	CL	IWR	OWR
0 – 150	≤4	2.31	4.41	5.17	4.55	3.49
150 – 300	≤9	5	5.26	5.77	5.56	5
300 – 450	≤19	9.38	6.52	10	10.71	9.38
450 – 600	≤50	11.52	8.12	6.67	8.33	11.54
600 – 800	≤50	10.81	8	6.56	8.33	6.56

Table 2-6: DN values at cross-section UF 1

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	6.3	5.8	4.8	5.1	5.4
150 - 300	≤ 9	13.6	8.8	7.3	9.4	13.6
300 - 450	≤ 19	9.7	9.4	13.6	27.3	10.7
450 - 600	≤ 50	11.1	8.3	9.4	8.3	8.8
600 - 800	≤ 50	8.3	9.1	10.3	7.1	10.0

Table 2-7: DN values at cross-section SF1

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	6.4	8.6	6.3	8.8	6.3
150 - 300	≤ 9	6.0	14.3	11.1	10.7	16.7
300 - 450	≤ 19	8.8	15.0	17.6	11.1	30.0
450 - 600	≤ 50	7.9	11.5	10.3	9.4	13.6
600 - 800	≤ 50	10.0	10.0	20.0	11.4	18.2

Table 2-8: DN values at cross-section SC1

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	6.3	5.6	7.9	5.8	7.1
150 - 300	≤ 9	7.1	11.1	8.8	7.5	9.4
300 - 450	≤ 19	8.8	13.6	10.0	12.0	13.6
450 - 600	≤ 50	7.5	13.0	17.6	20.0	14.3
600 - 800	≤ 50	23.5	13.8	13.8	12.1	21.1

Table 2-9: DN values at cross-section UC2

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	4.5	5.6	3.9	5.0	5.8
150 - 300	≤ 9	5.9	6.7	4.7	5.0	9.7
300 - 450	≤ 19	7.9	5.7	14.3	5.2	15.0
450 - 600	≤ 50	11.1	11.1	7.7	11.5	12.5
600 - 800	≤ 50	9.8	10.3	8.5	18.2	11.8

Table 2-10: DN values at cross-section SF2

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	7.9	8.8	10.0	11.5	10.7
150 - 300	≤ 9	11.5	8.3	10.7	9.4	10.0
300 - 450	≤ 19	7.1	9.7	11.5	16.7	11.1
450 - 600	≤ 50	10.0	9.4	12.5	21.4	12.0
600 - 800	≤ 50	12.5	10.8	16.0	10.0	11.8

Table 2-11: DN values at cross-section UF2

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	7.1	5.0	5.8	6.8	7.9
150 - 300	≤ 9	7.1	6.5	6.8	10.7	9.4
300 - 450	≤ 19	10.0	10.0	8.8	10.0	11.5
450 - 600	≤ 50	15.0	15.0	10.0	11.5	15.0
600 - 800	≤ 50	13.3	10.0	9.1	8.3	12.5

Table 2-12: DN values at cross-section CS1-UC1

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	3.0	4.2	3.5	3.0	4.3
150 - 300	≤ 9	5.6	5.4	4.3	6.5	10.0
300 - 450	≤ 19	8.8	7.1	7.5	7.9	11.5
450 - 600	≤ 50	9.4	6.3	5.2	7.1	13.6
600 - 800	≤ 50	14.3	8.0	6.3	7.4	11.1

Table 2-13: DN values at cross-section CS1-UC2

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	7.1	3.7	3.6	3.5	4.4
150 - 300	≤ 9	10.0	10.0	9.4	9.4	11.5
300 - 450	≤ 19	18.8	10.7	6.3	16.7	18.8
450 - 600	≤ 50	18.8	7.5	8.3	15.0	18.8
600 - 800	≤ 50	14.3	9.5	11.1	16.7	18.2

Table 2-14: DN values at cross-section CS2-UF1

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	2.6	2.1	2.4	2.1	2.9
150 - 300	≤ 9	8.3	4.7	6.8	12.5	7.1
300 - 450	≤ 19	7.9	10.7	15.0	30.0	7.9
450 - 600	≤ 50	7.1	18.8	18.8	10.0	6.5
600 - 800	≤ 50	9.1	20.0	16.7	12.5	16.7

Table 2-15: DN values at cross-section CS2-UF2

Depth (MM)	DN Values (mm/blow)					
	Specifications	OWL	IWL	CL	IWR	OWR
0 -150	≤ 4	4.8	3.9	2.6	6.3	2.1
150 - 300	≤ 9	7.9	3.9	4.8	6.3	6.5
300 - 450	≤ 19	9.4	7.5	5.6	6.8	18.8
450 - 600	≤ 50	10.7	5.8	6.3	5.4	12.5
600 - 800	≤ 50	14.3	12.5	9.5	7.7	11.8

The DCP reading on some of the sections regardless of their shoulder condition and road formations shows deviation from the required specification on the upper 300mm. This may be connected with infiltration of water via the pavement and the unpaved shoulders due the raining prior to the measurements.

2.7.2 Base Moisture Content

Samples has been taken from the base material to measure field moisture content in the outer wheels on both directions and on the centre of the road, adequate reinstating work has been

done on the test points after the DCP tests and base moisture measurements. The field moisture content measured for the laterite base trial section for both in cut and fill sections shown in table 2.16 are generally below the optimum moisture content (OMC) reported during construction which is in the range of 11.2 – 16.3% with an average OMC 14.8%.

Figure 2-3: Reinstating works after DCP test

Table 2-16: Measured Moisture content along the site

SECTION	Field Moisture Content [%]		
	Outer Left Wheel-path	Center line	Outer Right Wheel-path
Unsealed Shoulder on Cut Section(UC1)	7.2	6.4	7.7
Unsealed Shoulder on Fill Section (UF1)	5.6	6.4	7.7
Sealed Shoulder on Fill Section(SF1)	4.6	3.9	5.2
Sealed Shoulder on Cut Section(SC1)	8.4	7.1	9.8
Unsealed Shoulder on Cut Section(UC2)	3.7	4.8	5.3
Sealed Shoulder on Fill Section(SF2)	9.4	6.7	8.1
Unsealed Shoulder on Fill Section(UF2)	10.6	8.5	8.9
Control Section - Unsealed Cut Start (CS1-UC1)	7.2	9.1	8.6
Control Section - Unsealed Cut End (CS1-UC2)	3.5	7.4	5.8
Control Section - Unsealed Fill Start (CS2-UF1)	9.2	10.2	8.9
Control Section - Unsealed Fill End (CS2-UF2)	7.6	5.1	5.7

2.8 Roughness Measurements

Roughness measurement was first intended to be performed using ARRB walking profile meter from ERA, however during preparation we understood that the devise is defective and we instead forced to use Merlin roughness measuring instrument which were available at the research centre of ERA. The outcome of the calibration procedure and the roughness measurements are presented in the tables 2-17 and 2-18 respectively.

Table 2-17: Calibration results of the MERLIN

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

Table 2-18 Roughness Measurements

SECTION		**Right Lane**			**Left Lane**			**Average IRI**
	Length	**Initial Reading (D_i)**	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+0.0471*D_f**	**Initial Reading (D_i)**	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+0.0471*D_f**	
Unsealed Shoulder on Cut Section(UC1)		72	66	3.72	-	-	-	**3.72**
Unsealed Shoulder on Fill Section (UF1)		62	57	3.29	73	67	3.77	**3.72**
Sealed Shoulder on Fill Section(SF1)		92	85	4.59	75	69	3.85	**4.22**
Sealed Shoulder on Cut Section(SC1)		66	61	3.46	56	52	3.03	**3.25**
Unsealed Shoulder on Cut Section(UC2)		68	63	3.55	80	74	4.07	**3.81**
Sealed Shoulder on Fill Section(SF2)		62	57	3.29	75	69	3.85	**3.57**
Unsealed Shoulder on Fill Section(UF2)		72	66	3.72	73	67	3.77	**3.75**
Control Section - Unsealed Cut		63	58	3.33	51	47	2.81	**3.07**
Control Section - Unsealed Fill		49	45	2.72	50	46	2.77	**2.75**

The result shows the road sections do not show considerable difference in roughness and all have a good ridding quality with an IRI in the range of 2.5 to 4.

2.9 Visual Condition Assessment

Visual condition data was collected using the formats and procedures advised by AFCAP guideline and the service provider has established a suitable condition indication procedures using the South Africa methods TRH 22. The analysis is based on an aggregate formula as described in TRH 22: Pavement Management Systems.

The formula for calculating the VCI (Visual Condition Index) is

$$\text{VCI} = \left(a * VCI_P + b * VCI_p^2\right)^2$$

Where:

$$VCI_p = 100\left\{1 - C\left[\sum_{n=0}^{n} F_n\right]\right\}$$

a = 0.04

b = 0.0006 and

VCI_{max} = 100

VCI_{min} = 0

VCI_p = preliminary VCI

F_n = $D_n*(E_n\text{^}Y_n)*W_n*S_n$

n = Visual assessment item number that specified on the condition assessment sheet

D_n = Degree rating of defect n
Range: 0 to 4 for functional defects and
:0 to 5 for other defects

E_n = Extent rating of defect n
Range: Default 3 for functional defects
:0 to 5 for other defects

W_n = Weight for defect n as in the following table

Yn = Extent weight factor of the value shown in the following table

S_n = Small scale factor to be set to 1 for functional degree rating >1, or for other defects degree rating >2, or else the Sn is according to the next table

C = $1/\sum_{n=0}^{n} F_{nmax}$

$F_{n(max)}$ = Fn with degree and extent rating set at maximum

Table 2-19: Weight set for VCI formula (TRH 22)

Item #	Defect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)
1	SURFACING FAILURES	6.5	1.0	1.2
2	SURFACING PATCHING	6.5	1.0	1.2
3	SURFACING CRACKS	5	1.0	1.1
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9
5	AGGREGATE LOSS	4	1.0	1.1
6	BLEEDING / FLUSHING	3	0.5	1.0

7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0
9	TRANSVERSE CRACKS	4.5	1.0	1.0
10	LONGITUDINAL CRACKS	4.5	1.0	1.0
11	CROCODILE CRACKS	10	1.0	1.3
12	PUMPING	10	1.0	1.3
13	RUTTING	8	0.5	1.0
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0
15	PATCHING	8	0.8	1.1
16	FAILURES / POTHOLES	15	1.0	1.3
17	ROUGHNESS	5.5	0.8	1.0
18	SKID RESISTANCE	3	0.5	1.0
19	SURFACE DRAINAGE	3	0.5	1.0
20	SHOULDERS (unpaved)	3.5	1.0	1.0
21	EDGE DEFECTS	3.5	0.8	1.0

Based on the outcome of the VCI the condition of the sections is calorized as per the following table:

Table 2-20: Condition Categories

Description of category	Condition index range
Very good	85 ≤ VCI ≤ 100
Good	70 ≤ VCI < 85
Fair	50 ≤ VCI < 70
Poor	30 ≤ VCI < 50
Very poor	0 ≤ VCI < 30

Table 2-21: Condition Index for each Section

SECTION	VCI	Pictures
Unsealed Shoulder on Cut Section(UC1)	95	
Unsealed Shoulder on Fill Section (UF1)	95	
Sealed Shoulder on Fill Section(SF1)	98	
Sealed Shoulder on Cut Section(SC1)	98	
Unsealed Shoulder on Cut Section(UC2)	99	
Sealed Shoulder on Fill Section(SF2)	98	

Unsealed Shoulder on Fill Section(UF2)	92	
Control Section - Unsealed Cut(CS1-UC)	98	
Control Section - Unsealed Fill (CS2-UF)	98	

Based up on the visual assessment all the section fall under the very good condition.

3 Otta Seal Surfacing at Combel

3.1 Site Description

The demonstration project is located in the village of Combel situated to the South of Addis Ababa, 37km from Tulubolo along the Tulubolo - Kela road. The road links Addis – Jimma and Addis – Butajira – Sodo road. And Combel village located at the South People Nations and Nationality Regional Government. The trial section begins at 37+400 Km after a 75m transition section.

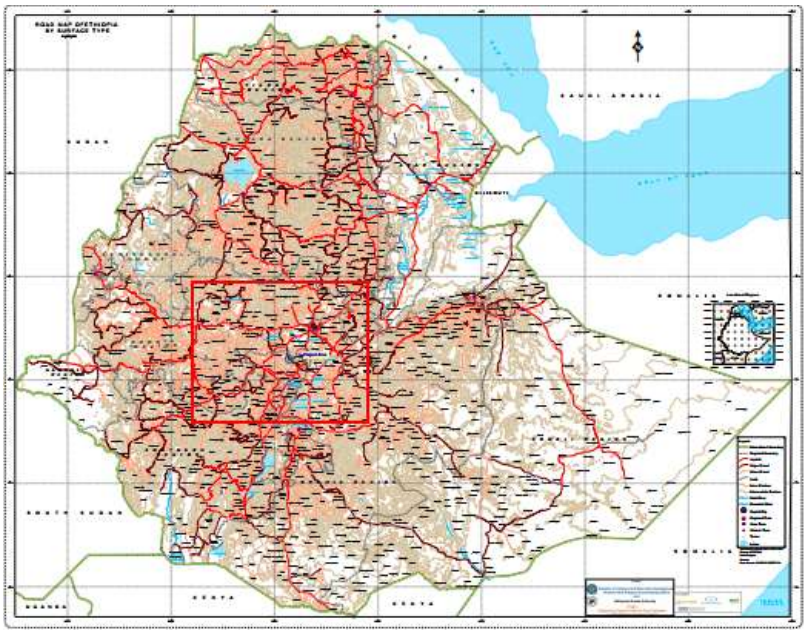


Figure 3-1: Site Location

This demonstration project in Combel comprises nine sections of various lengths using the following different types of aggregate:

- Crushed hard basalt aggregate,
- Natural screened weathered basalt,
- Volcanic screened Cinder aggregate
- The above aggregates combined with a crusher dust seal.

The nine sections are in-between the 75m and 30m transition zones at the beginning and at end respectively.

Table 3-1: Sections

Section	Chainages	Length (m)	Description of the Double Seal
1	37+400–37+500	100	Crusher dust seal on crusher dust seal
2	37+500–37+650	150	Otta seal crushed basalt on Otta seal cinder aggregate
3	37+650–37+700	50	Otta cinder aggregate on Otta cinder aggregate
4	37+700–38+000	300	Otta seal weathered basalt on Otta seal weathered basalt
5	38+000–38+260	260	Crusher dust seal on Otta seal crushed basalt
6	38+260–38+390	130	Otta seal crushed basalt on Otta seal crushed basalt
7	38+390–39+100	710	Crushed dust seal on Otta seal crushed basalt
8	39+100–39+250	150	Otta Cinder aggregate on Otta seal crushed basalt
9	39+250–39+300	50	Crusher dust seal on Otta seal crushed basalt

3.2 Pavement Description

Description of existing pavement and cross-section or designed pavement – drawing may be best.

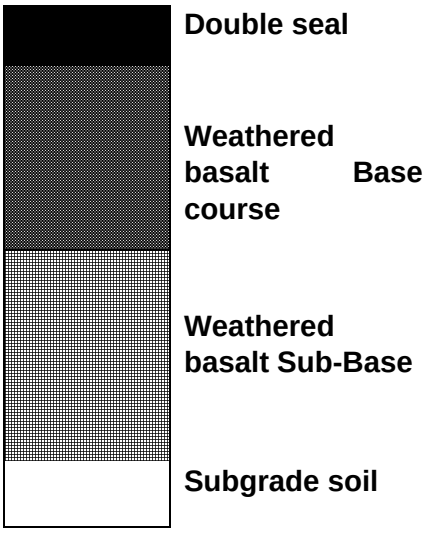


Table 3-2: Pavement Structure

3.3 Monitoring Period

The report incorporates pavement evaluation works performed by the service provider for the first monitoring programme on April 2017.

During the evaluation there were a few scattered showers, but for the majority of time sunny and dry. As per table 4 of the terms of reference the first monitoring programme for Combel village Otta seal demonstration section incorporates:-

- Classified traffic counts
- Visual Condition survey
- Roughness measurement and
- Drainage Assessment (part of visual condition survey)

Accordingly the report consists of the outcomes and analysis of all the above listed activities as part of the reporting structure of the first cycle monitoring report.

3.4 Traffic Survey

Traffic count was carried out at Combel village located at the centre of the project for seven days which include 12 hours for seven days and 24 hours for 2 days (one on working days and the other on weekends). The 12 hours counts are factored to convert to 24 hours counts based up on the counts taken at the night hours. The average daily traffic count is summarized and presented as follows.

Table 3-3: Traffic Volume Summary

Vehicle Type	Daily Volume (vpd)
Motorcycles	56
Bajaj	0
Cars	1
4×4 Station Wagons (Land Rover)	12
Small Bus <27 Passengers	25
Large Bus >27 Passengers	0
Small Truck <3.5 Tonnes	25
Medium Truck 3.5 to 7.0 tonnes	1

Heavy Truck 7.5 - 12Tonne	1
Truck Trailer > 12 tonne	0
Tractors and Aggric Vehicles	0
ADT	**121**

3.5 Roughness Measurements

Roughness measurement was first intended to be performed using ERA's ARRB Walking Profiler. However during testing and calibration the devise prove to be defective and it was necessary to use MERLIN roughness measuring instrument which was available at the research centre of ERA.

The outcome of the calibration procedure for the MERLIN and the results are presented in the following tables 3-4 and 3-5 respectively.

Table 3-4: Calibration result of the MERLIN

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

Table 3-5: Roughness values

SECTION		**Left Lane**			**Right Lane**			**Average**
	Length (m)	**Initial Reading (D_i)**	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+0.0471*D_f**	**Initial Reading (D_i)**	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+0.0471*D_f**	
1. crusher Dust seal ON crusher Dust seal	100	98	90	4.85	84	78	4.25	4.85
2. otta seal crushed basalt ON otta seal cinder Agg.	150	105	97	5.16	81	75	4.11	4.85
3. otta cinder Agg. ON otta cinder Agg.	50	116	107	5.64	113	104	5.51	5.57
4. otta seal weathered basalt ON otta seal weathered basalt	300	91	84	4.55	164	151	7.72	6.14
5. crusher Dust seal ON otta seal crushed basalt	260	126	116	6.07	138	127	6.59	6.33
6. otta seal crushed basalt ON otta seal crushed basalt	130	105	97	5.16	161	149	7.59	6.38
7. crusher Dust seal ON otta seal crushed basalt	710	100	92	4.94	91	84	4.55	4.75
8. otta cinder Agg. ON otta seal crushed basalt	150	112	103	5.46	77	71	3.94	4.70
9. crusher Dust seal otta seal On crushed basalt	50	78	72	3.98	69	64	3.59	3.79

The result shows only section 9 i.e. the section with crusher dust seal on otta seal crushed basalt having good roughness less than IRI 4. The other sections have roughness values in the range of IRI 4 to 8, which would be typical for older and damaged pavements.

From the visual assessment it is deemed that poor construction, with rough joints and oversize aggregates is contributing to the relatively high roughness values on many of the sections.

3.6 Visual Condition Assessment

Visual condition data was collected using the formats and procedures advised by the draft AFCAP regional protocol. A procedure for establishment of the Visual Condition Index based on the South African TRH22 Pavement Management Systems, is proposed:

The formula for calculating the VCI (Visual Condition Index) is

$$\text{VCI} = \left(a * VCI_P + b * VCI_p^2\right)^2$$

Where:

$$VCI_p = 100\left\{1 - C\left[\sum_{n=0}^{n} F_n\right]\right\}$$

a	=	0.04
b	=	0.0006 and
VCI_{max}	=	100
VCI_{min}	=	0
VCI_p	=	preliminary VCI
F_n	=	D_n*(E_n^Y_n)*W_n*S_n
n	=	Visual assessment item number that specified on the condition assessment sheet
D_n	=	Degree rating of defect n Range: 0 to 4 for functional defects and :0 to 5 for other defects
E_n	=	Extent rating of defect n Range: Default 3 for functional defects :0 to 5 for other defects
W_n	=	Weight for defect n as in the following table
Yn	=	Extent weight factor of the value shown in the following table
S_n	=	Small scale factor to be set to 1 for functional degree rating >1, or for other defects degree rating >2, or else the Sn is according to the next table
C	=	$1/\sum_{n=0}^{n} F_{nmax}$
$F_{n(max)}$	=	Fn with degree and extent rating set at maximum

Table 3-6: Weight set for VCI formula

Item #	Defect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)
1	SURFACING FAILURES	6.5	1.0	1.2
2	SURFACING PATCHING	6.5	1.0	1.2
3	SURFACING CRACKS	5	1.0	1.1
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9
5	AGGREGATE LOSS	4	1.0	1.1
6	BLEEDING / FLUSHING	3	0.5	1.0
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0
9	TRANSVERSE CRACKS	4.5	1.0	1.0
10	LONGITUDINAL CRACKS	4.5	1.0	1.0
11	CROCODILE CRACKS	10	1.0	1.3
12	PUMPING	10	1.0	1.3
13	RUTTING	8	0.5	1.0
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0
15	PATCHING	8	0.8	1.1
16	FAILURES / POTHOLES	15	1.0	1.3
17	ROUGHNESS	5.5	0.8	1.0
18	SKID RESISTANCE	3	0.5	1.0
19	SURFACE DRAINAGE	3	0.5	1.0
20	SHOULDERS (unpaved)	3.5	1.0	1.0
21	EDGE DEFECTS	3.5	0.8	1.0

Based on the outcome of the VCI the condition of the sections is calorized as per the following table:

Table 3-7: Condition Categories

Description of category	Condition index range
Very good	$85 \leq VCI \leq 100$
Good	$70 \leq VCI < 85$
Fair	$50 \leq VCI < 70$
Poor	$30 \leq VCI < 50$
Very poor	$0 \leq VCI < 30$

Based on the Visual Condition Survey using the above the visual condition index and the category have been summarized and presented on the following table.

Table 3-8: Condition Index for each Section

Section	Description	Condition Index	Category
1	Crusher dust seal on crusher dust seal	89.8	Very Good
			
2	Otta seal crushed basalt on Otta seal cinder aggregate	70.9	Good
			

3	Otta cinder aggregate on Otta cinder aggregate	90.7	Very Good
			
4	Otta seal weathered basalt on Otta seal weathered basalt	76.3	Good
			
5	Crusher dust seal on Otta seal crushed basalt	74.7	Good

			
6	Otta seal crushed basalt on Otta seal crushed basalt	85.6	Very good
			
7	Crushed dust seal on Otta seal crushed basalt	76.8	Good

			
8	Otta Cinder aggregate on Otta seal crushed basalt	77.8	Good
			
9	Crusher dust seal on Otta seal crushed basalt	81.2	Very Good

From the above, all the trial sections are deemed to be in good to very good condition. This is due to there being very little structural failures in the road pavements. The majority of the failures on the sections are surface failures in the form of materials loss and surface cracks.

Most of the sections have defects arising from poor construction. Improper application of material and migration of materials by traffic during the curing process of the Otta seal left the surfacing with a rough appearance. However, currently no signs of active material loss are visible and if closely observed the pavement have better performance than what is expected from first appearance.

Map cracks (none structural cracks) are observed on the majority of the test sections due to large quantity fine materials present on the surfacing materials. Apart from this, most of the cracking is not due to structural problems.

The roughness measurements show that the road is older and defective. However the results are exaggerated due to the above reasons.

4 Otta Seals in the Village of Gerado

4.1 Site Description

Combolcha town is situated about 376Km North of Addis Ababa and is one of major town located at the Amhara Regional Government, after 25Km to the North-West exists another big town Dessie. The demonstration site located in Gerado village, which is 8Km along the Combolcha – Mekaneselam which starts at a left side junctions at 20Km on the Combolcha – Dessie road. The site location is shown on the map in figure 4-1.

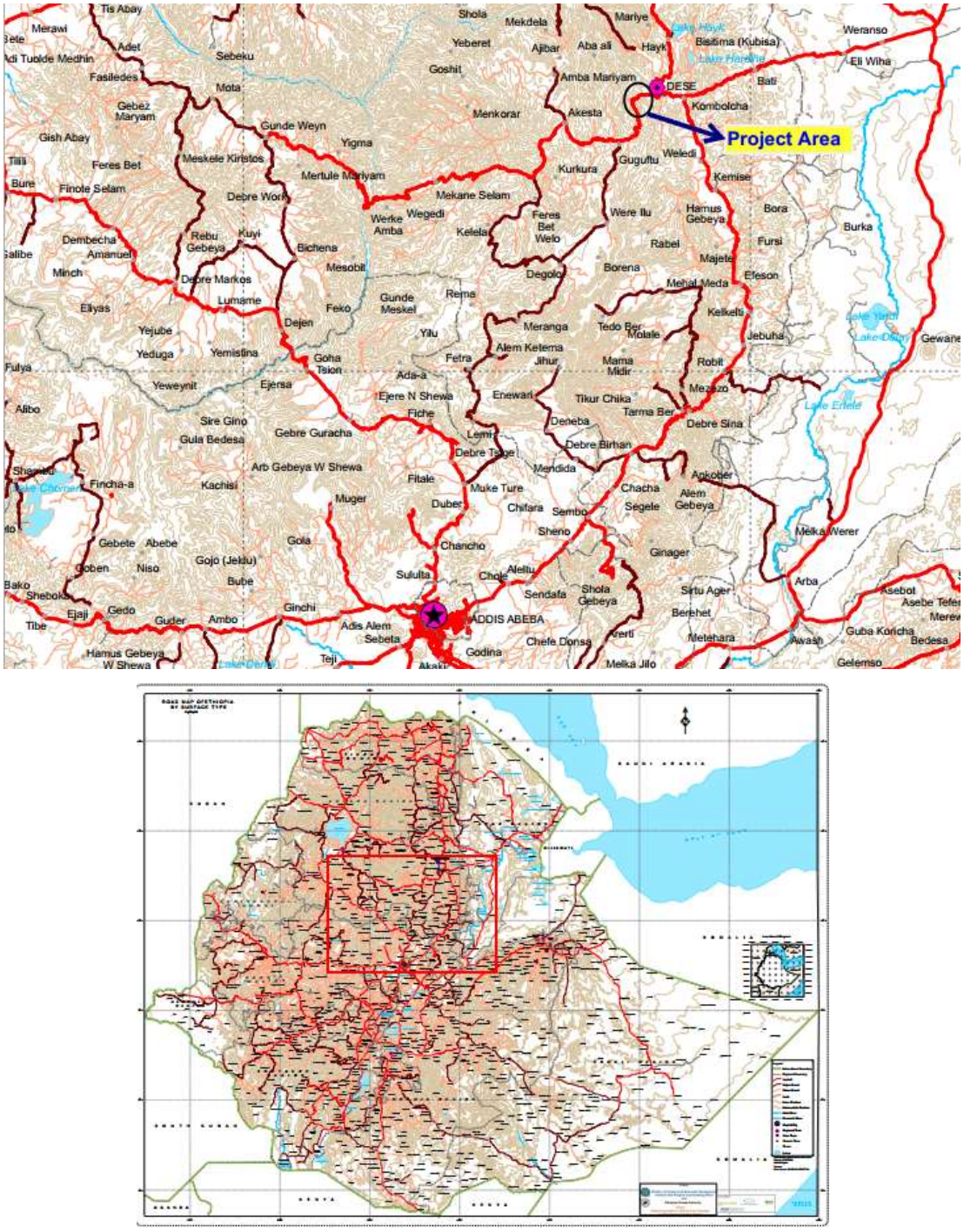


Figure 4-1: Site Location

Table 4-1: Sections

Section	Chainages	Length (m)	Surfacing First Seal	Surfacing Second (Upper) Seal	Prime on Base Layer
1	0+100-0+800	700	Double Otta Seal using hard aggregate	Double Otta Seal using hard aggregate	Prime
2	1+800-1+100	300	Single Otta Seal (Hard agg.) with crusher sand cover seal	Single Otta Seal (Hard agg.) with crusher sand cover seal	Prime
3	1+100-1+500	400	Single Otta Seal (Hard agg.) with crusher sand cover seal)	Double Otta Seal using hard aggregate	Prime
4	1+500-2+000	500	Single Otta Seal (Hard agg.) with crusher sand cover seal)	Double Otta Seal using hard aggregate	No Prime
5	2+000-2+200	200	Single Otta Seal (Hard agg.) with crusher sand cover seal)	Single Otta Seal (Hard agg.) with crusher sand cover seal)	No Prime
6	2+200-2+900	700	Double Otta Seal using hard aggregate	Double Otta Seal using hard aggregate	No Prime

4.2 Pavement Description

The existing pavement of the road was constructed in 2011 as part of a new gravel road that comprised 275mm of sub-base course, and 150mm of wearing course material according to the construction records. However, field tests carried out one year later showed 330mm of Upper Gravel Wearing Course on top of 300mm of Lower Gravel Wearing Course.

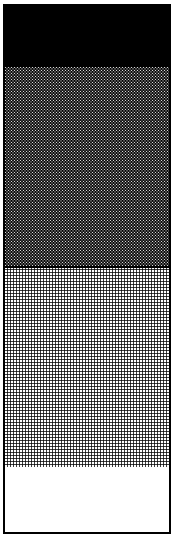


Table 4-2: Pavement Structure

4.3 Monitoring Period

The report incorporates field monitoring and evaluation works performed by the service provider for the first monitoring programme on April 2017. The weather condition in this month is the end of the dry season, during the monitoring there were a few scattered showers, but for the majority of time sunny and dry.

As per table 4 of the terms of reference the first monitoring programme for Gerado Village Otta seal demonstration trial section incorporates:-

- Marking of LTPP sections
- Classified traffic counts
- Visual Condition survey
- Roughness measurement
- Rut depth measurement
- DCP tests and
- Drainage Assessment (part of visual condition survey) and
- Deflection Measurement

In accordance to the methods set in the inception following the recommendation given by ERA and international consultant at the first kick-off meeting the service provider established two LTPP sections. DCP, Deflection and Rut depth measurements have been carried out on these LTPP section while visual condition survey, drainage assessment and roughness measurements were conducted throughout the trial section.

Accordingly the report consists of the outcomes and analysis of all the above listed activities as part of the reporting structure of the first monitoring report.

4.4 Traffic Survey

Traffic count was carried out around the project area of the trial section for seven days which includes 12 hours for seven days and 24 hours for 2 days (one on working days and the other on weekends). The 12 hours reading are factored to convert to 24 hours reading based up on the reading taken at the night hours. The average daily traffic count is summarized and presented as follows.

Table 4-3: Traffic Volume Summary

Vehicle Type	Daily Volume (vpd)
Motorcycles	18
Animal Carts and Bajaj's	63
Cars	5
4×4 Station Wagons (Land Rover)	168
Small Bus <27 Passengers	1581
Large Bus >27 Passengers	68
Small Truck <3.5 Tonnes	176
Medium Truck 3.5 to 7.0 tonnes	179

Heavy Truck 7.5 - 12Tonne	76
Truck Trailer > 12 tonne	41
Tractors and Aggric Vehicles	0
ADT	**2375**

During counting a lot of animal driven carts has been encountered and has been recorded together with Bajaj's (Tricycle passenger motors). Some small buses has been giving services in between Gerado village and Dessie town and returned back from the middle of the town therefore their traffic only affected half the trial section towards Dessie. However almost all the heavy vehicles pass by the village to other destination and have equal effect on the trial section.

4.5 Marking of LTPP Sections

Two LTPP section has been established on the project trial section in consultation with ERA road research directorate and the AFCAP international consultant on site. Taking in to consideration that the location of the LTPP sections selected should be representative of the whole section as much as possible and safer to conduct routine monitoring and evaluation.

Accordingly the team selected two LTPP sections to be established on the second and third sections. The start of the first LTPP section begins at the start of the second section and the second LTPP section begins at 100m from the start of the third section with respect to the six sections shown in table 4-1.

The LTPP sections are marked in accordance with the guidelines set and temples provided by the AFCAP and ERA. Rut depth measurement, Deflection measurement and DCP measurements have been performed on these LTPP section while other condition assessments such as the visual condition and drainage condition assessments programmed for the first monitoring cycle have been performed on the whole section.

Figure 4-2: Marking of the LTPP sections

4.6 Rutting and Surface Deflection

4.6.1 Rutting

Rutting measurements has been taken on the two LTPP sections established on the second and third trial sections and the results have been summarized and presented as follows.

Table 4-4: Maximum Rut Depth for LTPP 1 (Section 2)

LTTP Panel	Left Lane		Right Lane	
	Outer Wheel Path	Inner Wheel Path	Outer Wheel Path	Inner Wheel Path
1	12	8	16	6
2	19	5	13	16
3	17	7	7	5
4	5	7	6	8
5	9	7	0	7
6	11	0	8	8
7	0	8	10	4
8	10	10	0	19
9	25	7	0	10
10	12	6	6	8
11	13	8	8	10
Average (mm)	**13**	**7**	**7**	**10**

Table 4-5 : Maximum Rut Depth for LTPP 2 (Section 3)

LTTP Panel	Left Lane		Right Lane	
	Outer Wheel Path	Inner Wheel Path	Outer Wheel Path	Inner Wheel Path
1	6	13	0	6
2	0	0	0	12
3	0	0	0	8
4	8	0	0	18
5	5	0	6	0
6	0	0	0	9
7	8	11	0	15
8	10	0	17	0
9	12	9	22	9
10	4	3	20	7
11	7	7	19	8
Average (mm)	**6**	**4**	**8**	**9**

The average rut depth on both LTPP sections shows low rutting severity and are less than 15 however some panels on both section show medium severity level of rutting in between 15 and 25mm. The 25mm rut depth on the outer left lane of panel 9 of LTPP section 1 is the highest.

4.6.2 Surface Deflection /Non-destructive Test (NDT) Measurement

In accordance with the field survey guide both transient and rebound deflection measurements was planned to be collected. However the Benkelman Beam instrument provided by ERA was not suitable to perform the transient deflection measurement thus only rebound deflection measurements could be carried out. Accordingly the rebound test results are summarized and presented for each LTPP sections in table 4-6 and table 4-7.

Table 4-6: Deflection and Stiffness for LTPP 1 (Section 2)

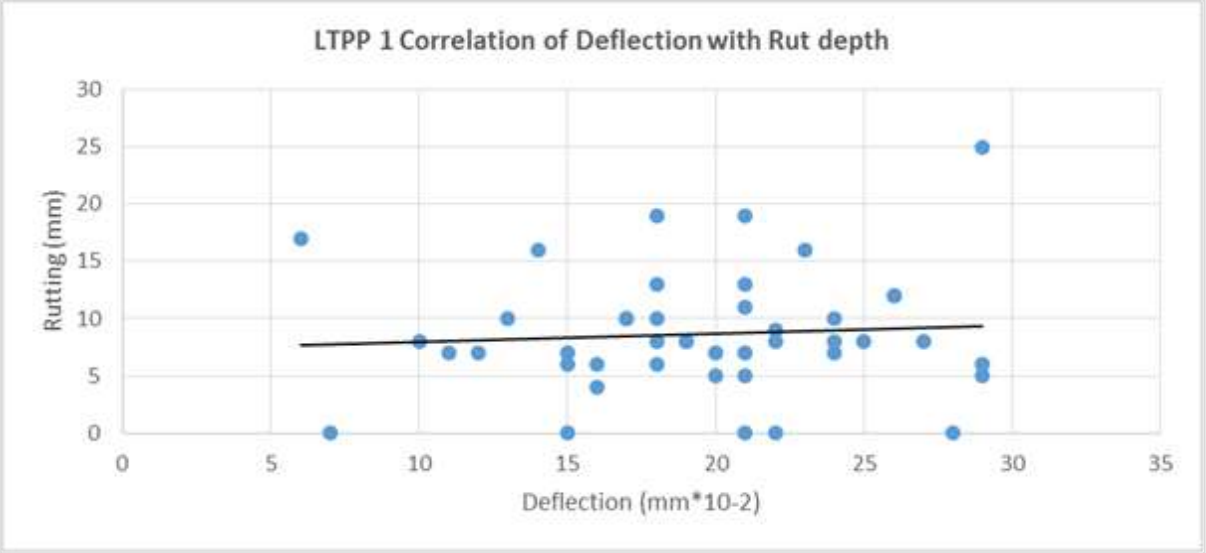
Panel #	D_0 ($\times 10^{-2}$mm)			
	LHS		RHS	
	Outer Wheel Path	Inner Wheel Path	Outer Wheel Path	Inner Wheel Path
1	26	22	14	16
2	21	21	18	23
3	6	24	15	20
4	29	21	15	25
5	22	20	7	11
6	21	15	24	19
7	21	19	13	16
8	18	24	22	18
9	29	12	28	17
10	26	18	29	18
11	21	10	27	17

Table 4-7: Deflection and Stiffness for LTPP 2 (On Section 4)

Panel #	D_0 ($\times 10^{-2}$mm)			
	LHS		RHS	
	Outer Wheel Path	Inner Wheel Path	Outer Wheel Path	Inner Wheel Path
1	19	20	20	16
2	29	15	23	23
3	28	17	30	20
4	30	24	22	25
5	13	13	18	11
6	15	14	18	19
7	19	11	21	16
8	13	18	21	18
9	24	22	23	17
10	23	22	25	18
11	19	21	19	17

The maximum deflection recorded for the two LTPP sections is 0.3 mm, which indicates that the pavement is able to carry up to 10 MESA. Therefore, the deflection measurement shows that the pavement structures is sound.

Figure 4-1 shows the relation of deflection with rut depth for both LTPP, although the correlation of deflection to rut depth shows generally scattered, LTPP2 shows better trend the rut depth to deflection measurement.



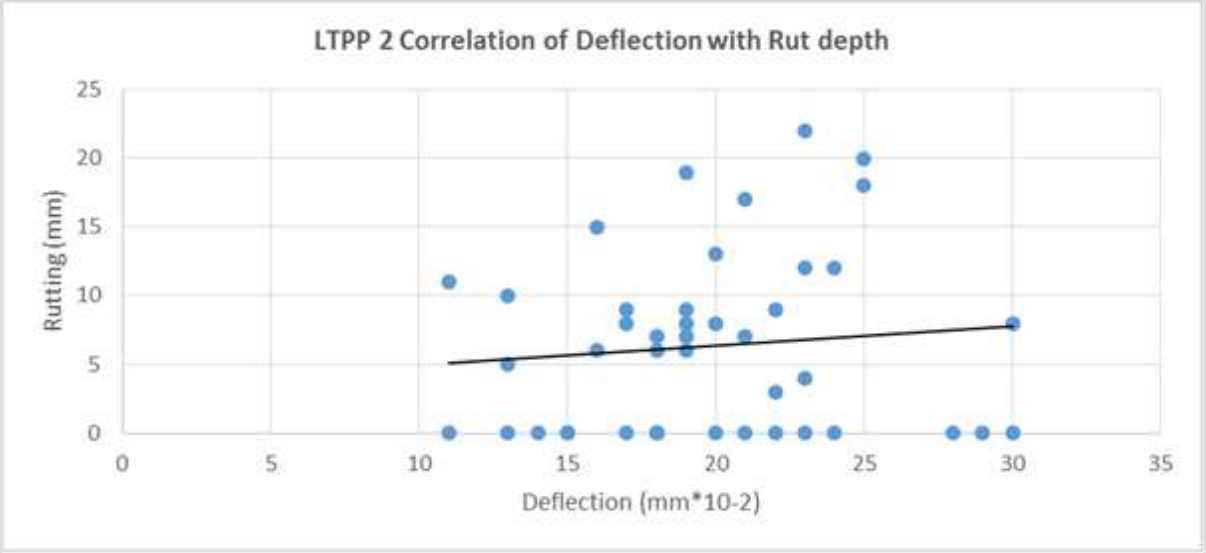


Figure 4-3: Deflection versus Rut Depth

4.7 DCP and Base Moisture

4.7.1 DCP Measurements

Even if the base course is rocky, the service provider performed DCP tests on the two LTPP section. For each LTPP section, 5 DCP tests were carried out across the road as follows: Outer Wheel Path Left (OWL), Inner Wheel Path Left (IWL), Centreline (CL), Inner Wheel Path Right (IWR), Outer Wheel Path Right (OWR), and Test Pit Right (TPR) or Left (TPL).

Table 4-8: DN values at cross-section

Depth (mm)	DN values (mm/blow) / LTPP 1 start					
	Specifications (e.g. TLC o.1)	OWL	IWL	CL	IWR	OWR
0 – 150	≤4	4	3	3	2	3
150 – 300	≤9	6	5	2	3	3
300 – 450	≤19	3	5	3	6	3
450 – 600	≤50	5	5	4	1	4
600 – 800	≤50	8	5	4	3	-

Depth (mm)	DN values (mm/blow) / LTPP 1 End					
	Specifications	OWL	IWL	CL	IWR	OWR
0 – 150	≤4	2	2	3	2	2
150 – 300	≤9	3	2	3	3	2
300 – 450	≤19	3	3	2	3	2
450 – 600	≤50	2	3	3	2	5
600 – 800	≤50	2	3	-	3	3

Depth (mm)	DN values (mm/blow) /LTPP 2 Start					
	Specifications	OWL	IWL	CL	IWR	OWR
0 – 150	≤4	2	3	2	2	1
150 – 300	≤9	3	3	3	4	-
300 – 450	≤19	3	2	3	2	-
450 – 600	≤50	3	-	1	-	-
600 – 800	≤50	-	-	-	-	-

Depth (mm)	DN values (mm/blow) / LTPP 2 End					
	Specifications	OWL	IWL	CL	IWR	OWR
0 – 150	≤4	2	3	2	1	2
150 – 300	≤9	2	3	1	2	3
300 – 450	≤19	3	4	2	-	3
450 – 600	≤50	3	4	2	-	1
600 – 800	≤50	1	2	2	-	0

Although the DN values are "dry season" values, they seem to indicate a TLC higher than 0.1. This agrees with the above assessment based deflection measurements.

4.7.2 Moisture Content

On the LTPP section base-course moisture contents were measured at the same point where DCP tests carried out. Each test points has been reinstated carefully to minimize the defects introduced on the site. The results have been summarized and presented in table below.

Table 4-9 : Moisture content along the site

SECTION	Moisture Content %				
	Outer wheel at LHS	Inner wheel at LHS	Center	Inner wheel at RHS	Outer wheel at RHS
LTPP 1, Start	10.7	7.9	8.9	9.9	10.9
LTPP 1, End	11.9	12.9	13.9	14.9	8.2
LTPP 2, Start	9.2	9.4	8	9.4	6.7
LTPP 2,End	4.6	4.1	3.5	3.2	3.6

4.8 Roughness Measurements

Roughness measurement was first intended to be performed using ERA's ARRB Walking Profiler. However during preparation we understood that the devise is defective and we

instead forced to use Merlin roughness measuring instrument which were available at the research centre of ERA. The outcome of the calibration procedure and the results are presented in the following tables.

Figure 4-4: roughness measurement using MERLIN for Gerado Otta seal trial section

Table 4-10: Calibration Result of the MERLIN

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

Table 4-11: Roughness Result

SECTION	Right Lane			Left Lane			Average IRI
	Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+0.0471 *D_f	Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+0.0471 *D_f	
1	107	99	5.25	95	88	4.72	4.98
2	118	109	5.72	87	80	4.38	5.05
3	100	92	4.94	81	75	4.11	4.53
4	108	100	5.29	93	86	4.64	4.96
5	65	60	3.42	73	67	3.77	3.59
6	128	118	6.16	92	85	4.59	5.38

The roughness result shows in the range of 4.5 to 5.5 IRI that is a roughness of older and defective paved road. However defects during construction causing uneven surfacing also contributed to the higher roughness value.

4.9 Visual Condition Assessment

Visual condition data was collected using the formats and procedures advised by AFCAP and ERA, the service provider has established a suitable condition indication procedures using the South Africa methods.

The analysis is based on an aggregate formula as described in TRH 22: "Pavement Management Systems.

The formula for calculating the VCI (Visual Condition Index) is

$$\text{VCI} = \left(a * VCI_P + b * VCI_p^2\right)^2$$

Where:

$$VCI_p = 100\left\{1 - C\left[\sum_{n=0}^{n} F_n\right]\right\}$$

a = 0.04

b = 0.0006

VCI_{max} = 100

VCI_{min} = 0

VCI_p = preliminary VCI

F_n = D_n*(E_n^Y_n)*W_n*S_n

n = Visual assessment item number that specified on the condition assessment sheet

D_n = Degree rating of defect n
Range: 0 to 4 for functional defects and
:0 to 5 for other defects

E_n = Extent rating of defect n
Range: Default 3 for functional defects
:0 to 5 for other defects

W_n = Weight for defect n as in the following table

Yn = Extent weight factor of the value shown in the following table

S_n = Small scale factor to be set to 1 for functional degree rating >1, or for other defects degree rating >2, or else the Sn is according to the next table

C = $1/\sum_{n=0}^{n} F_{nmax}$

$F_{n(max)}$ = Fn with degree and extent rating set at maximum

Table 4-12: Weight set for VCI formula

Item #	Defect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)
1	SURFACING FAILURES	6.5	1.0	1.2
2	SURFACING PATCHING	6.5	1.0	1.2
3	SURFACING CRACKS	5	1.0	1.1
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9
5	AGGREGATE LOSS	4	1.0	1.1
6	BLEEDING / FLUSHING	3	0.5	1.0
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0

8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0
9	TRANSVERSE CRACKS	4.5	1.0	1.0
10	LONGITUDINAL CRACKS	4.5	1.0	1.0
11	CROCODILE CRACKS	10	1.0	1.3
12	PUMPING	10	1.0	1.3
13	RUTTING	8	0.5	1.0
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0
15	PATCHING	8	0.8	1.1
16	FAILURES / POTHOLES	15	1.0	1.3
17	ROUGHNESS	5.5	0.8	1.0
18	SKID RESISTANCE	3	0.5	1.0
19	SURFACE DRAINAGE	3	0.5	1.0
20	SHOULDERS (unpaved)	3.5	1.0	1.0
21	EDGE DEFECTS	3.5	0.8	1.0

Based on the outcome of the VCI the condition of the sections is calorized as per the following table:

Table 4-13: Condition Categories

Description of category	Condition index range
Very good	85 ≤ VCI ≤ 100
Good	70 ≤ VCI < 85
Fair	50 ≤ VCI < 70
Poor	30 ≤ VCI < 50
Very poor	0 ≤ VCI < 30

Table 4-14: Condition Index for each section

Section #	LHS VCI	RHS VCI	Average VCI	Category	Pictures
1	72	74	73	Good	
2	76	66	71	Good	

3	70	85	78	Good	
4	80	74	77	Good	
5	77	84	81	Very Good	
6	83	80	82	Very Good	

All the trial section falls under Good to Very Good category due to minor structural failures present on the trial sections.

5 Revised AC Mix Design – Hawsewa – Abala – Erebti road

5.1 Site Description

The trial sections located on Hawusewa – Abala – Erebti road which is found on both Tigray and Afar Regional Governments. The road starts at a left side Junction 10Km from Mekele town on the road to Addis Ababa around a place called Ashengoda near Wind Turbine Electric Power Station. The road connects Tigray to the port of Djibouti and services mainly heavy trucks. The two LTPP section exists between Hawusewa and Abala villages and the other three exists between Abala and Erebti towns.

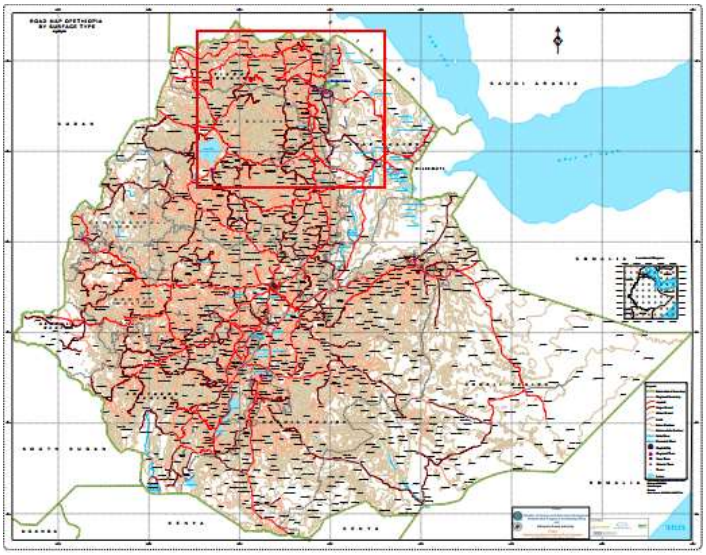


Figure 5-1: Site Location

The LTPP sections, shown in table 5-1, are established base on terrain characteristics, temperature and method of Design.

Table 5-1: LTPP Sections

Section	Chainage	Description
1	9+200 – 9+380	Top of Escarpment (2343m-2347m above sea level)
2	25+100 – 25+300	On Escarpment grade (1826m – 1843m above sea level)
3	38+700 – 39+000	Bottom of Escarpment (1414m – 1422m above sea level)
4	59+740 – 59+940	On Second Escarpment grade (1340m – 1357m above sea level)
5	92+062 – 92+190	On second flat section hot area about 850m above sea level

5.2 Pavement Description

The project road was constructed using 50mm AC, 200mm Crushed stone base and 350mm Selected Natural Sub-Base. Apart from section 3 and 4 of table 5-1 the AC was designed using marshal mix design method, however the two sections (3 and 4) are designed using refusal compaction method and built as a trial section.

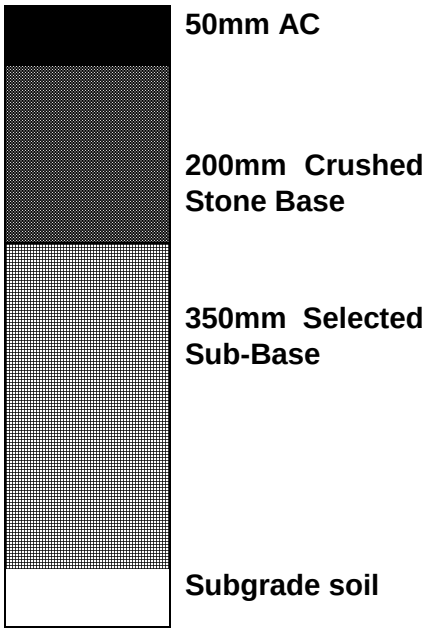


Table 5-2: Pavement Structure

5.3 Monitoring Period

The report incorporates pavement evaluation works conducted by the service provider for the first monitoring programme on April 2017.

During the evaluation there were no rain the majority of time was sunny and dry. As per table 4 of the terms of reference the first monitoring programme for Hawusewa – Abala – Erebti AC mix design trial incorporates:-

- Marking of LTPP sections
- Classified traffic counts
- Axle Load Survey
- Visual Condition survey
- Rut depth measurement
- Drainage Assessment (part of visual condition survey)

Accordingly the report consists of the outcomes and analysis of all the above listed activities as part of the reporting structure of the first cycle monitoring report.

5.4 Traffic Survey

5.4.1 Classified Traffic Counts

Traffic count was carried out around the project area of the trial section for seven days which includes 12 hours count for seven days and 24 hours count for 2 days (one on working days and the other on weekends). The 12 hours reading are factored to convert to 24 hours reading based up on the reading taken at the night hours. The average daily traffic count is summarized and presented in table 5-3.

Table 5-3: Traffic Volume Summary

Vehicle Type	Daily Volume (vpd)
Motorcycles	0
Bajaj	0
Cars	16
4×4 Station Wagons (Land Rover)	84
Small Bus <27 Passengers	89
Large Bus >27 Passengers	4
Small Truck <3.5 Tonnes	29
Medium Truck 3.5 to 7.0 tonnes	6
Heavy Truck 7.5 - 12Tonne	238
Truck Trailer > 12 tonne	167
Tractors and Agaric Vehicles	8
ADT	**641**

5.4.2 Axle Load Survey

Axle load Survey has been carried out on the project area and majority of the vehicle were dump trucks transporting mainly sand form Abala Region to Mekele Area. Due to this sections 1, 2 and 3 influenced by all the vehicles categories however the other two section mainly influenced by the loading of Truck Trailer Categories.

Table 5-4: Number of Vehicles surveyed by each category

Vehicle Types	Axle Configuration	Number of Vehicles	Category
Small Bus - SB	1.2	2	Small Bus
Small Truck - ST	1.2	16	Small Truck
Medium Truck - MT	1.2	7	Medium Truck
Water Truck - WT	1.22	1	Heavy Truck
Dump Truck - DT	1.22	135	

Fuel Truck - FT	1.22	2	
	1.22+2.2	3	Truck Trailer
	1.22+2.22	19	
Trailer Truck - TT	1.22+2.22	97	
Articulated Truck - AT	1.2-22	9	
	1.22-222	20	
	1.22-2222	3	
Total Number of Vehicles Surveyed		**314**	

Table 5-5: Traffic ESA

Vehicle Type	Equivalency Factor	ESA/Day
Large Bus >27 Passengers	2[1]	4
Small Truck <3.5 Tonnes	0.18	2.61
Medium Truck 3.5 to 7.0 tonnes	1.72	5.16
Heavy Truck 7.5 - 12Tonne	39.47	4,697
Truck Trailer > 12 tonne	48	4,008
Total ESA/day	**8,717**	

5.5 Rutting

Rut depth measurement for each 5 LTPP sections marked during the monitoring and evaluation period are categorized and summarized in table 5-6 below.

Table 5-6: Maximum Rut Depth

LTPP 1	1 - Top of Escarpment (2343m-2347m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	3	0	0	3
2	4	0	0	0
3	3	0	0	0
4	0	0	0	0
5	2	0	0	0
6	3	0	0	5
7	4	0	0	0
8	5	0	0	0
9	3	0	0	0
10	5	0	0	0
90th Percentile	5	0	0	4
Maximum Rut depth (mm)	5	0	0	5
Average Rut depth (mm)	4	0	0	1

[1] The value is according to ERA 2013 since we do not encountered any Large Bus during the Axle Load Survey. Since large busses strictly supervised by Road Transport Authority the loading condition do not fluctuate throughout the country hence we can adapt the results from upcoming surveys for future reviews.

LTPP 2	2 - On Escarpment (1826m – 1843m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	5	0	0	9
2	3	0	0	3
3	3	0	0	7
4	5	0	0	3
5	3	3	0	0
6	4	0	0	4
7	0	0	0	0
8	12	0	0	0
9	0	0	0	0
10	0	0	0	0
11	3	0	0	6
12	11	0	0	3
13	7	0	0	3
90th Percentile	11	0	0	7
Maximum Rut depth (mm)	12	3	0	9
Average Rut depth (mm)	5	1	0	3

LTPP 3	3 - Bottom of Escarpment (1414m – 1422m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	2	0	0	0
6	3	0	0	2
7	0	0	0	2
8	0	0	0	2
9	0	0	0	0
10	0	0	0	2
11	0	0	0	2
12	0	0	0	0
13	0	0	0	0
90th Percentile	2	0	0	2
Maximum Rut depth (mm)	3	0	0	2
Average Rut depth (mm)	1	0	0	1

LTPP 4	4 - On Second Escarpment (1340m – 1357m above sea level)					
PANEL	LEFT LANE		RIGHT LANE		RIGHT Climbing Lane	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path	Inner Wheel path	Outer Wheel path
1	34	16	0	0	0	9
2	11	14	0	0	4	5
3	9	12	0	0	0	0
4	17	12	0	0	7	4
5	5	0	0	0	6	12
6	21	14	3	0	3	11
7	14	5	0	0	3	0
8	19	10	3	0	3	8
9	9	4	0	0	8	4
10	14	8	0	0	3	5
11	38	16	0	0	0	5
12	11	8	0	0	0	8
13	11	12	0	0	4	9
90th Percentile	32	16	3	0	7	11
Maximum Rut depth (mm)	38	16	3	0	8	12
Average Rut depth (mm)	17	11	1	0	4	7

LTPP 5	5 - On second flat section hot area about 850m above sea level			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	15	10	3	4
2	14	3	0	6
3	12	10	0	3
4	14	4	3	4
5	24	13	6	4
6	27	24	6	6
7	24	22	10	7
8	10	0	5	14
9	11	3	0	10
10	16	9	3	4
11	17	10	0	12
12	14	10	4	9
13	12	0	0	3
14	13	5	0	4
15	15	6	0	4
16	14	10	0	3
17	7	4	0	3
90th Percentile	24	17	6	11
Maximum Rut depth (mm)	27	24	10	14

Average Rut depth (mm)	16	9	3	6

The measurements indicate the escarpments on the hot section of the road exhibit higher rutting and both the LTTP sections exists on the trial section designed by refusal compaction method it will be better to establish another LTPP section on Escarpments designed by Marshal method around the hotter area for more comparison.

The Hawusewa – Abala – Erebti road is the fevered route due to its much shorter distance to transport goods from and to Djibouti port to the northern part of the country. However, usually the heavy vehicles leave empty to the Djibouti import export border or leave to other side of the country mostly to Addis Ababa to carry other goods to the border. Moreover sand carrying dump trucks left Mekele City empty and transport the sand from the Afar region to Mekele most of the time highly loading the vehicle above the legally permitted amount i.e. 8 tonnes for front axle and 10 tonnes for rear axle. Accordingly the table clearly indicates that the left hand side (LHS) lane heavily loaded than the right hand side (RHS) lane due to the above reasons.

The tables show clear differences in rutting on the different lanes, with the LHS lane probably being the heaviest loaded lane. Total traffic loading per lane should be estimated at the later monitoring and evaluation cycles. After having the actual traffic counts and axle load surveys of these specific sections for some three to four cycles, it could give more realistic total traffic loading per lane (ESAL) instead of adopting general traffic growth trends and equivalent load factors to estimate the total loading since construction at the moment.

5.6 Visual Condition Assessment

Visual condition data was collected using the formats and procedures advised by the client and the contractor has established a suitable condition indication procedures using the South Africa methods.

The analysis is based on an aggregate formula as described in TRH 22: “Pavement Management Systems.

The formula used for calculating the VCI (Visual Condition Index) is

$$\mathrm{VCI} = \left(a * VCI_P + b * VCI_p^2\right)^2$$

Where:

$$VCI_p = 100\left\{1 - C\left[\sum_{n=0}^{n} F_n\right]\right\}$$

a = 0.04

b = 0.0006 and

VCI_{max} = 100

VCI_{min} = 0

VCI_p = preliminary VCI

F_n = $D_n*(E_n\text{^}Y_n)*W_n*S_n$

n = Visual assessment item number that specified on the condition assessment sheet

D_n = Degree rating of defect n
Range: 0 to 4 for functional defects and
:0 to 5 for other defects

E_n = Extent rating of defect n
Range: Default 3 for functional defects
:0 to 5 for other defects

W_n = Weight for defect n as in the following table

Yn = Extent weight factor of the value shown in the following table

S_n = Small scale factor to be set to 1 for functional degree rating >1, or for other defects degree rating >2, or else the Sn is according to the next table

C = $1/\sum_{n=0}^{n} F_{nmax}$

$F_{n(max)}$ = Fn with degree and extent rating set at maximum

Table 5-7: Weight set for VCI formula

Item #	Defect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)
1	SURFACING FAILURES	6.5	1.0	1.2
2	SURFACING PATCHING	6.5	1.0	1.2
3	SURFACING CRACKS	5	1.0	1.1
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9
5	AGGREGATE LOSS	4	1.0	1.1
6	BLEEDING / FLUSHING	3	0.5	1.0
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0
9	TRANSVERSE CRACKS	4.5	1.0	1.0
10	LONGITUDINAL CRACKS	4.5	1.0	1.0
11	CROCODILE CRACKS	10	1.0	1.3
12	PUMPING	10	1.0	1.3
13	RUTTING	8	0.5	1.0
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0
15	PATCHING	8	0.8	1.1
16	FAILURES / POTHOLES	15	1.0	1.3
17	ROUGHNESS	5.5	0.8	1.0
18	SKID RESISTANCE	3	0.5	1.0
19	SURFACE DRAINAGE	3	0.5	1.0
20	SHOULDERS (unpaved)	3.5	1.0	1.0
21	EDGE DEFECTS	3.5	0.8	1.0

Based on the outcome of the VCI the condition of the sections is calorized as per the following table:

Table 5-8: Condition Categories

Description of category	Condition index range
Very good	85 ≤ VCI ≤ 100
Good	70 ≤ VCI < 85
Fair	50 ≤ VCI < 70
Poor	30 ≤ VCI < 50
Very poor	0 ≤ VCI < 30

Based on the visual condition Survey using the above the visual condition index and the category has been summarized and presented on table 5-9.

Table 5-9: Condition Index for each section

Section	Condition Index	Category
9+200 – 9+380, Top of Escarpment (2343m-2347m above sea level)	97	Very Good
25+100 – 25+300, On Escarpment (1826m – 1843m above sea level)	97	Very Good
		
38+700 – 39+000, Bottom of Escarpment (1414m – 1422m above sea level)	97	Very Good
		

59+740 – 59+940, On Second Escarpment (1340m – 1357m above sea level)	81	Good
		
92+062 – 92+190, On second flat section hot area about 850m above sea level	81	Good
		

The results at section 4 and 5 is poorer from the rest due to rutting and shoving occurred especially on the left lane of the road due to slow moving heavy loading on the escarpments coming from the port Djibouti.

APPENDIX I: Assosa - Kurmuk Laterite Base Measurements

Appendix IA: Traffic Count Summary

TRAFFIC COUNT SUMMARY FORM for Assosa - Kumruk Road														
Date	**Day**		**Motorcycles**	**Bajaj**	**Passenger Cars**	**4×4 Station Wagons (Land Rover)**	**Small Bus >27 Passengers**	**Larg Bus >27 Passengers**	**Small Truck <3.5 Tonnes**	**Medium Truck 3.5 to 7.0 tonnes**	**Heavy Truck 7.5 - 12Tonne**	**Truck Trailer > 12 tonne**	**Tractors and Aggric Vehicles**	**Daily Factored Totals**
17-04-2017	Monday		20	299	5	9	108	10	2	2	0	0	3	493
18-04-2017	Tuesday	Day	18	133	0	15	33	0	6	0	0	0	3	240
		Ngt.	5	12	0	4	4	0	2	2	0	0	3	
19-04-2017	Wednesday		9	91	3	25	31	0	5	5	4	0	0	184
20-04-2017	Thursday		14	112	2	20	30	0	0	1	0	0	2	203
21-04-2017	Friday		23	103	1	8	20	0	5	6	0	0	0	181
22-04-2017	Saturday	Day	16	80	0	6	14	0	9	2	2	1	1	150
		Ngt.	7	9	0	0	2	0	0	0	0	0	1	
23-04-2017	Sunday		13	74	8	7	36	0	3	2	2	0	3	162
ADT			21	139	0	16	44	0	5	1	1	0	3	230

Appendix IB: Rut Depth Measurement Assosa – Kumruk Road

Rut Depth Measurement Assosa - Kumruk Road				
SECTION	**Unsealed Shoulder on Cut Section(UC1)**			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
UC1-1	10	0	0	9
UC1-2	0	10	0	11
UC1-3	11	0	10	6
UC1-4	0	11	12	0
UC1-5	0	6	0	11
UC1-6	10	0	5	0
90th Percentile	11	11	11	11
Maximum Rut depth (mm)	11	11	12	11
Average Rut depth (mm)	6	5	5	7

SECTION	**Sealed Shoulder on Cut Section(SC1)**			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
SC1-1	6	0	0	7
SC1-2	0	10	9	0
SC1-3	6	10	11	0
SC1-4	0	14	7	0
SC1-5	0	10	6	0
SC1-6	0	0	0	0
SC1-7	0	8	0	7
SC1-8	0	7	12	0
90th Percentile	6	12	12	7
Maximum Rut depth (mm)	6	14	12	7
Average Rut depth (mm)	2	8	6	2

SECTION	Sealed Shoulder on Fill Section(SF1)			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
SF1-1	6	0	0	8
SF1-2	0	0	5	7
SF1-3	6	0	0	8
SF1-4	0	5	9	12
SF1-5	0	0	5	11
SF1-6	0	5	0	9
SF1-7	0	8	8	7
SF1-8	10	9	0	0
SF1-9	8	0	9	5
90^{th} Percentile	9	9	9	12
Maximum Rut depth (mm)	10	9	9	12
Average Rut depth (mm)	4	3	4	8

SECTION	Unsealed Shoulder on Fill Section (UF1)			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
UF1-1	6	10	7	0
UF1-2	6	10	10	10
UF1-3	0	0	6	11
UF1-4	7	0	8	0
90^{th} Percentile	7	10	10	11
Maximum Rut depth (mm)	7	10	10	11
Average Rut depth (mm)	5	5	8	6

SECTION	Unsealed Shoulder on Cut Section(UC2)			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
UC2-1	7	5	6	8
UC2-2	0	0	4	5
UC2-3	5	7	0	6
UC2-4	7	11	10	5
UC2-5	0	7	7	6
UC2-6	7	0	0	17
90^{th} Percentile	7	9	9	13
Maximum Rut depth (mm)	7	11	10	17
Average Rut depth (mm)	5	5	5	8

SECTION	Sealed Shoulder on Fill Section(SF2)			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
SF2-1	5	5	0	5
SF2-2	12	0	0	15
SF2-3	0	14	0	0
SF2-4	0	9	0	10
SF2-5	6	7	9	7
SF2-6	10	8	0	10
90^{th} Percentile	11	12	5	13
Maximum Deflection	12	14	9	15
Average Rut depth	6	8	2	8

SECTION	Unsealed Shoulder on Fill Section(UF2)			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
UF2-1	4	0	0	19
UF2-2	0	5	0	8
UF2-3	6	0	9	12
UF2-4	0	0	10	12
UF2-5	0	0	8	13
UF2-6	7	16	9	11
UF2-7	7	15	15	8
UF2-8	12	20	0	15
UF2-9	13	22	0	13
UF2-10	0	0	0	15
UF2-11	0	6	0	7
UF2-12	7	0	0	5
UF2-13	0	0	0	6
UF2-14	0	10	0	0
90^{th} Percentile	11	19	10	15
Maximum Rut depth (mm)	13	22	15	19
Average Rut depth (mm)	4	7	4	11

SECTION	Control Section - Unsealed Cut			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
00+025	4	0	0	19
00+040	0	5	0	8
00+055	6	0	9	12
00+070	0	0	10	12
00+085	0	0	8	13
00+100	7	16	9	11
00+115	7	15	15	8
00+130	12	20	0	15
00+145	13	22	0	13
00+160	0	0	0	15
00+175	0	6	0	7
90th Percentile	12	20	10	15
Maximum Rut depth (mm)	13	22	15	19
Average Rut depth (mm)	5	8	5	13

SECTION	Control Section - Unsealed Fill			
SUB SECTION	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
00+025	0	0	0	0
00+040	0	0	6	0
00+055	0	0	0	0
00+070	3	0	4	0
00+085	0	2	2	0
00+100	0	0	3	0
00+115	4	0	0	2
00+130	0	3	3	0
00+145	2	3	2	0
00+160	0	0	0	0
00+175	4	0	3	0
90th Percentile	4	3	4	0
Maximum Rut depth (mm)	4	3	6	2
Average Rut depth (mm)	2	1	3	1

Appendix IC: Roughness Measurement Assosa – Kumruk Road

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

SECTION	Right Lane			Left Lane			Average
	Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+ 0.0471*D_f	Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+ 0.0471*D_f	
Unsealed Shoulder on Cut Section(UC1)	72	66	3.72	0	0	0.59	3.72
Unsealed Shoulder on Fill Section (UF1)	62	57	3.29	73	67	3.77	3.72
Sealed Shoulder on Fill Section(SF1)	92	85	4.59	75	69	3.85	4.22
Sealed Shoulder on Cut Section(SC1)	66	61	3.46	56	52	3.03	3.25
Unsealed Shoulder on Cut Section(UC2)	68	63	3.55	80	74	4.07	3.81
Sealed Shoulder on Fill Section(SF2)	62	57	3.29	75	69	3.85	3.57
Unsealed Shoulder on Fill Section(UF2)	72	66	3.72	73	67	3.77	3.75
Control Section - Unsealed Cut	63	58	3.33	51	47	2.81	3.07
Control Section - Unsealed Fill	49	45	2.72	50	46	2.77	2.75

Appendix ID: DCP and Base Moisture Measurement Assosa – Kumruk Road

Unsealed Shoulder on Fill Section (UF1)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications (e.g. TCL 0.1)	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
0 -150	≤ 4	6.3	5.8	4.8	5.1	5.4
150 - 300	≤ 9	13.6	8.8	7.3	9.4	13.6
300 - 450	≤ 19	9.7	9.4	13.6	27.3	10.7
450 - 600	≤ 50	11.1	8.3	9.4	8.3	8.8
600 - 800	≤ 50	8.3	9.1	10.3	7.1	10.0

Sealed Shoulder on Fill Section (SF1)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
0 -150	≤ 4	6.4	8.6	6.3	8.8	6.3
150 - 300	≤ 9	6.0	14.3	11.1	10.7	16.7
300 - 450	≤ 19	8.8	15.0	17.6	11.1	30.0
450 - 600	≤ 50	7.9	11.5	10.3	9.4	13.6
600 - 800	≤ 50	10.0	10.0	20.0	11.4	18.2

Sealed Shoulder on Cut Section (SC1)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
1 -150	≤ 4	6.3	5.6	7.9	5.8	7.1
151 - 300	≤ 9	7.1	11.1	8.8	7.5	9.4
301 - 450	≤ 19	8.8	13.6	10.0	12.0	13.6
451 - 600	≤ 50	7.5	13.0	17.6	20.0	14.3
601 - 800	≤ 50	23.5	13.8	13.8	12.1	21.1

Unsealed Shoulder on Cut Section (UC2)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
2 -150	≤ 4	4.5	5.6	3.9	5.0	5.8
152 - 300	≤ 9	5.9	6.7	4.7	5.0	9.7
302 - 450	≤ 19	7.9	5.7	14.3	5.2	15.0
452 - 600	≤ 50	11.1	11.1	7.7	11.5	12.5
602 - 800	≤ 50	9.8	10.3	8.5	18.2	11.8

Sealed Shoulder on Fill Section (SF2)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
1 -150	≤ 4	7.9	8.8	10.0	11.5	10.7
151 - 300	≤ 9	11.5	8.3	10.7	9.4	10.0
301 - 450	≤ 19	7.1	9.7	11.5	16.7	11.1
451 - 600	≤ 50	10.0	9.4	12.5	21.4	12.0
601 - 800	≤ 50	12.5	10.8	16.0	10.0	11.8

Unsealed Shoulder on Fill Section (UF2)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
2 -150	≤ 4	7.1	5.0	5.8	6.8	7.9
152 - 300	≤ 9	7.1	6.5	6.8	10.7	9.4
302 - 450	≤ 19	10.0	10.0	8.8	10.0	11.5
452 - 600	≤ 50	15.0	15.0	10.0	11.5	15.0
602 - 800	≤ 50	13.3	10.0	9.1	8.3	12.5

Control Section - Unsealed Cut (CS1-UC1)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
3 -150	≤ 4	3.0	4.2	3.5	3.0	4.3

153 - 300	≤ 9	5.6	5.4	4.3	6.5	10.0
303 - 450	≤ 19	8.8	7.1	7.5	7.9	11.5
453 - 600	≤ 50	9.4	6.3	5.2	7.1	13.6
603 - 800	≤ 50	14.3	8.0	6.3	7.4	11.1

Control Section - Unsealed Cut (CS1-UC2)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
2 -150	≤ 4	7.1	3.7	3.6	3.5	4.4
152 - 300	≤ 9	10.0	10.0	9.4	9.4	11.5
302 - 450	≤ 19	18.8	10.7	6.3	16.7	18.8
452 - 600	≤ 50	18.8	7.5	8.3	15.0	18.8
602 - 800	≤ 50	14.3	9.5	11.1	16.7	18.2

Control Section - Unsealed Fill (CS2-UF1)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
3 -150	≤ 4	2.6	2.1	2.4	2.1	2.9
153 - 300	≤ 9	8.3	4.7	6.8	12.5	7.1
303 - 450	≤ 19	7.9	10.7	15.0	30.0	7.9
453 - 600	≤ 50	7.1	18.8	18.8	10.0	6.5
603 - 800	≤ 50	9.1	20.0	16.7	12.5	16.7

Control Section - Unsealed Fill (CS2-UF2)						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
4 -150	≤ 4	4.8	3.9	2.6	6.3	2.1
154 - 300	≤ 9	7.9	3.9	4.8	6.3	6.5
304 - 450	≤ 19	9.4	7.5	5.6	6.8	18.8
454 - 600	≤ 50	10.7	5.8	6.3	5.4	12.5
604 - 800	≤ 50	14.3	12.5	9.5	7.7	11.8

Appendix IE: Visual Condition Index Assosa – Kumruk Road

Condition Index Summary

SECTION	Average CI (Condition Index)
Unsealed Shoulder on Cut Section(UC1)	95
Unsealed Shoulder on Fill Section (UF1)	95
Sealed Shoulder on Fill Section(SF1)	98
Sealed Shoulder on Cut Section(SC1)	98
Unsealed Shoulder on Cut Section(UC2)	99
Sealed Shoulder on Fill Section(SF2)	98
Unsealed Shoulder on Fill Section(UF2)	92
Control Section - Unsealed Cut(CS1-UC)	98
Control Section - Unsealed Fill (CS2-UF)	98

UF1 R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	1	1.5	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	1	1.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n =$	38		$\sum F_{nmax} =$	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\} =$	99.55806167
$C = 1/\sum_{n=0}^{n} F_{nmax} =$	0.00
$VCI = (a * VCI_P + b * VCI_p^2)^2$	**99**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

	UF1 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= D_n*(E_n^Yn)*W_n*S_n	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	3	96	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n$=	131		$\sum F_{nmax}$=	8598.484726
	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	98.47647575								
	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
	VCI = $\left(a * VCI_P + b * VCI_p^2\right)^2$	**95**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	SC1 R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= D_n*(E_n^Yn)*W_n*S_n	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	0	0	0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	0	0	0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	0	0	0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	0	0	0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	42.2		$\sum F_{nmax}$=	8598.484726
→	Priminary VCI = VCI_P $= 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.50921585								
→	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
→	$VCI = (a * VCI_P + b * VCI_p^2)^2$	**98**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	SC1 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	0	0	0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	0	0	0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	0	0	0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	0	0	0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	52.7		$\sum F_{nmax}$=	8598.484726
→	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.38710131								
→	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
→	$VCI = (a * VCI_P + b * VCI_p^2)^2$	**98**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	UF2 R									
Item #	**Deffect Type**	**Weight (W_n)**	**Small degree (S_n)**	**Extent Weight (Y_n)**	**Degree Rating of Defect (D_n)**	**Extent Rating of Defect (E_n)**	**F_n= D_n*(E_n^Yn)*W_n*S_n**	**MaximumDegree Rating of Defect $(D_n)_{max}$**	**Maximum Extent Rating of Defect $(E_n)_{max}$**	**F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n**
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	0	0	0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	0	0	0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	1	1.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	3	144	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	1	1	15	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	208.7		$\sum F_{nmax}$=	8598.484726
	Priminary VCI = VCI_P $= 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	97.57282816								
	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
	VCI = $\left(a * VCI_P + b * VCI_p^2\right)^2$	**92**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	UF2 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	0	0	0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	0	0	0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	5	23.49237886	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	1	1.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	5	240	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	0	0	0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n =$	306.6923789		$\sum F_{nmax} =$	8598.484726
	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	96.43318109								
	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
	VCI = $\left(a * VCI_P + b * VCI_p^2\right)^2$	**89**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

SF1 R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	0	0	0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	0	0	0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	0	0	0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	0	0	0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n$=	44.78504942		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.47915184
$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00
$VCI = (a * VCI_P + b * VCI_p^2)^2$	**98**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

	SF1 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	1	5	20	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0	1	1	2	5	5	200
15	PATCHING	8	0.8	1.1	1	1	6.4	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	1	1	15	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n =$	67.9		$\sum F_{nmax} =$	8598.484726
	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\} =$	99.21032598								
	$C = 1/\sum_{n=0}^{n} F_{nmax} =$	0.00								
	$VCI = \left(a * VCI_P + b * VCI_p^2\right)^2$	**97**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

UC2 R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= D_n*(E_n^Yn)*W_n*S_n	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n
1	SURFACING FAILURES	6.5	1.0	1.2			0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n$=	18		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.79066079
$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00
$VCI = (a * VCI_P + b * VCI_p^2)^2$	**99**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

	UC2 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= D_n*(E_n^Yn)*W_n*S_n	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n
1	SURFACING FAILURES	6.5	1.0	1.2			0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n$=	18		$\sum F_{nmax}$=	8598.484726
→	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.79066079								
→	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
→	$VCI = (a * VCI_P + b * VCI_P^2)^2$	**99**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	SF2 R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= D_n*(E_n^Yn)*W_n*S_n	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n
1	SURFACING FAILURES	6.5	1.0	1.2			0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	1	4	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n$=	22		$\sum F_{nmax}$=	8598.484726
	Primary VCI = VCI_P $= 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.74414097								
	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
	VCI $= (a * VCI_P + b * VCI_P^2)^2$	**99**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	SF2 L									
Item #	**Deffect Type**	**Weight (W_n)**	**Small degree (S_n)**	**Extent Weight (Y_n)**	**Degree Rating of Defect (D_n)**	**Extent Rating of Defect (E_n)**	**F_n= D_n*(E_n^Yn)*W_n*S_n**	**MaximumDegree Rating of Defect $(D_n)_{max}$**	**Maximum Extent Rating of Defect $(E_n)_{max}$**	**F_{nmax}= D_{nmax}*(E_{nmax}^Yn)*W_n*S_n**
1	SURFACING FAILURES	6.5	1.0	1.2			0	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	1	4	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	2	64	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	0	3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n$=	86		$\sum F_{nmax}$=	8598.484726
	Priminary VCI = VCI_P $= 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	98.99982377								
	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.00								
	VCI $= \left(a * VCI_P + b * VCI_p^2\right)^2$	**97**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

CS1

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.65
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	1	1.5	5	5	127.70
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.92
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.49
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.89
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.33
12	PUMPING	10	1.0	1.3			0	5	5	810.33
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.85
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.49
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n =$	54.2		$\sum F_{nmax} =$	8598.48

Primiary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	99.369656
$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.0001163
$VCI = (a * VCI_P + b * VCI_p^2)^2$	**98**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

	CS2									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	0	0	0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	0	0	0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	0	0	0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	1	4	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	1	1.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	0	0	0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n =$	58.2		$\sum F_{nmax} =$	8598.484726
	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\} =$	99.32313655								
	$C = 1/\sum_{n=0}^{n} F_{nmax} =$	0.00								
	$\text{VCI} = \left(a * VCI_P + b * VCI_p^2\right)^2$	**98**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

APPENDIX II: Combel Otta Seal Road Measurements

Appendix IIA: Traffic Count Summary

TRAFFIC COUNT SUMMARY FORM for Combel Otta Seal														
Date	**Day**		**Motorcycles**	**Bajaj**	**Passenger Cars**	**4×4 Station Wagons (Land Rover)**	**Small Bus >27 Passengers**	**Larg Bus >27 Passengers**	**Small Truck <3.5 Tonnes**	**Medium Truck 3.5 to 7.0 tonnes**	**Heavy Truck 7.5 - 12Tonne**	**Truck Trailer > 12 tonne**	**Tractors and Aggric Vehicles**	**Daily Factored Totals**
22-05-2017	Monday		44	0	1	3	21	0	13	0	1	0	0	108
23-05-2017	Tuesday	Day	39	0	5	21	28	2	24	2	4	0	0	159
		Ngt.	15	0	1	2	3	0	10	3	0	0	0	
24-05-2017	Wednesday		39	0	0	8	14	0	11	0	1	2	0	95
25-05-2017	Thursday		38	0	0	8	15	0	14	1	0	0	0	100
26-05-2017	Friday		67	0	2	11	22	0	32	0	0	0	0	177
27-05-2017	Saturday	Day	27	0	0	8	19	0	4	0	0	0	0	76
		Ngt.	3	0	0	1	7	0	4	0	0	2	1	
28-05-2017	Sunday		41	0	0	15	26	0	17	0	2	0	0	132
ADT			56	0	1	12	25	0	25	1	1	0	0	121

Appendix IIB: Roughness Measurement Combel Otta Seal Road

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

SECTION	length (m)	Right Lane			Left Lane			Average
		Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+ 0.0471*D_f	Initial Reading (D_i)	Final Reading (D_f) = SF*D_i	RI = 0.593+ 0.0471*D_f	
1. crusher Dust seal ON crusher Dust seal	100	98	90	4.85	84	78	4.25	4.85
2. otta seal crushed basalt ON otta seal cinder Agg.	150	105	97	5.16	81	75	4.11	4.85
3. otta cinder Agg. ON otta cinder Agg.	50	116	107	5.64	113	104	5.51	5.57
4. otta seal weathered basalt ON otta seal weathered basalt	300	91	84	4.55	164	151	7.72	6.14
5. crusher Dust seal ON otta seal crushed basalt	260	126	116	6.07	138	127	6.59	6.33
6. otta seal crushed basalt ON otta seal crushed basalt	130	105	97	5.16	161	149	7.59	6.38
7. crusher Dust seal ON otta seal crushed basalt	710	100	92	4.94	91	84	4.55	4.75
8. otta cinder Agg. ON otta seal crushed basalt	150	112	103	5.46	77	71	3.94	4.70
9. crusher Dust seal otta seal On crushed basalt	50	78	72	3.98	69	64	3.59	3.79

Appendix IIC: Visual Condition Index Combel Otta Seal Road

Section: 1. Crusher dust seal on crusher dust seal
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	2	3	97.16701329	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	4	110.2750421	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	1	1.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	285.5271048		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 96.6793

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **89.781**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 2. Otta seal crushed basalt on otta seal cinder aggregate
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	4	5	358.729712	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	3	1	30	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	4	5	187.9390309	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	4	48	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0	1	1	4.5	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3	3	1	60	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	3	96	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	881.5537923		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 89.7476

$VCI = \left(a * VCI_P + b * VCI_p^2\right)^2$ = **70.942**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 3. Otta cinder agg. On otta cinder agg.
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	2	89.59847169	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	2	51.4451262	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	258.4286473		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 96.9945

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **90.717**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 4. Otta seal weathered basalt on otta seal weathered basalt
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	4	5	358.729712	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	5	140.9542732	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	5	60	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	2	64	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	0	3	0	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	702.0690346		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 91.835

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **76.276**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 5. Crusher dust seal on otta seal crushed basalt
Lane: both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	4	5	358.729712	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	2	4	91.8958684	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	5	140.9542732	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	2	3	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	2	64	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	754.964903		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 91.2198

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **74.674**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 6. Otta seal cursched basalt on otta seal crushed basalt
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	2	14.93307861	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	3	4	137.8438026	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	3	80.36086853	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	2	3	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	2	64	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	3	3	27	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n$=	409.6377497		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 95.2359

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **85.588**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 7. Crusher dust seal on otta seal crushed basalt
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	4	5	358.729712	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	2	3	97.16701329	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	5	140.9542732	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	2	3	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	3	3	27	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	685.4360479		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 92.0284

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **76.784**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 8. Otta cinder aggregate on otta seal crushed basalt
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	2	4	137.2288227	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	4	5	187.9390309	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	650.9151376		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 92.4299

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **77.848**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

Section: 9. Crusher dust seal on otta seal crushed basalt
Lane: Both

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	2	1	20	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	4	5	187.9390309	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	3	3	27	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n$=	543.5863149		$\sum F_{nmax}$=	8598.484726

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 93.6781

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **81.225**

a= 0.04000
b= 0.00060
VCI_{max}= 100
VCI_{min}= 0

APPENDIX III: Gerado Otta Seal Road Measurements

Appendix IIIA: Traffic Count Summary

TRAFFIC COUNT SUMMARY FORM for Gerado Otta Seal Road														
Date	**Day**		**Motorcycles**	**Bajaj**	**Passenger Cars**	**4×4 Station Wagons (Land Rover)**	**Small Bus >27 Passengers**	**Larg Bus >27 Passengers**	**Small Truck <3.5 Tonnes**	**Medium Truck 3.5 to 7.0 tonnes**	**Heavy Truck 7.5 - 12Tonne**	**Truck Trailer > 12 tonne**	**Tractors and Aggric Vehicles**	**Daily Factored Totals**
03-04-2017	Monday		4	119	9	136	849	62	56	35	54	48	0	1841
04-04-2017	Tuesday	Day	8	60	2	146	507	37	36	25	58	22	0	1229
		Ngt.	6	3	0	42	90	3	68	82	24	10	0	
05-04-2017	Wednesday		20	14	12	117	563	40	72	27	55	25	0	1356
06-04-2017	Thursday		11	59	4	156	761	71	73	42	49	21	0	1749
07-04-2017	Friday		14	58	1	117	5589	43	52	25	55	23	0	7233
08-04-2017	Saturday	Day	5	56	5	121	506	54	55	17	34	21	0	1422
		Ngt.	3	2	0	52	133	46	126	128	33	25	0	
09-04-2017	Sunday		12	58	3	95	545	55	66	53	43	19	0	1804
ADT			18	63	5	168	1581	68	176	179	76	41	0	2376

Appendix IIIB: Rut Depth Measurement Gerado Otta Seal Road

SECTION	LTPP 1			
Panel	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	12	8	16	6
2	19	5	13	16
3	17	7	7	5
4	5	7	6	8
5	9	7	0	7
6	11	0	8	8
7	0	8	10	4
8	10	10	0	19
9	25	7	0	10
10	12	6	6	8
11	13	8	8	10
90^{th} Percentile	19	8	13	16
Maximum Rut depth (mm)	25	10	16	19
Average Rut depth (mm)	13	7	7	10

SECTION	LTPP 2			
Panel	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	6	13	0	6
2	0	0	0	12
3	0	0	0	8
4	8	0	0	18
5	5	0	6	0
6	0	0	0	9
7	8	11	0	15
8	10	0	17	0
9	12	9	22	9
10	4	3	20	7
11	7	7	19	8
90th Percentile	10	11	20	15
Maximum Rut depth (mm)	12	13	22	18
Average Rut depth (mm)	6	4	8	9

Appendix IIIC: Roughness Measurement Gerado Otta Seal Road

Calibration	
Thickness of Calibration Block (T) =	6
Corresponding Displacement (S) =	65
Scaling Factor (SF) = (10*T)/S =	0.923

SECTION	**Right Lane**			**Left Lane**			**Average**
	Initial Reading (D_i)	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+ 0.0471*D_f**	**Initial Reading (D_i)**	**Final Reading (D_f) = SF*D_i**	**RI = 0.593+ 0.0471*D_f**	
Section 1	107	99	5.25	95	88	4.72	4.98
Section 2	118	109	5.72	87	80	4.38	5.05
Section 3	100	92	4.94	81	75	4.11	4.53
Section 4	108	100	5.29	93	86	4.64	4.96
Section 5	65	60	3.42	73	67	3.77	3.59
Section 6	128	118	6.16	92	85	4.59	5.38

Appendix IIID: DCP and Base Moisture Measurement Gerado Otta Seal Road

LTPP 1 Start						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications (e.g. TCL 0.1)	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
0 -150	≤ 4	4	3	3	2	3
150 - 300	≤ 9	6	5	2	3	3
300 - 450	≤ 19	3	5	3	6	3
450 - 600	≤ 50	5	5	4	1	4
600 - 800	≤ 50	8	5	4	3	-

LTPP 1 End						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
0 -150	≤ 4	2	2	3	2	2
150 - 300	≤ 9	3	2	3	3	2
300 - 450	≤ 19	3	3	2	3	2
450 - 600	≤ 50	2	3	3	2	5
600 - 800	≤ 50	2	3	-	3	3

LTPP 2 Start						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
1 -150	≤ 4	2	3	2	2	1
151 - 300	≤ 9	3	3	3	4	-
301 - 450	≤ 19	3	2	3	2	-
451 - 600	≤ 50	3	-	1	-	-
601 - 800	≤ 50	-	-	-	-	-

LTPP 2 End						
Depth (MM)	**DN Values (mm/blow)**					
	Specifications	**OWL**	**IWL**	**CL**	**IWR**	**OWR**
2 -150	≤ 4	2	3	2	1	2
152 - 300	≤ 9	2	3	1	2	3
302 - 450	≤ 19	3	4	2	-	3
452 - 600	≤ 50	3	4	2	-	1
602 - 800	≤ 50	1	2	2	-	0

SECTION	**Moisture Content %**				
	Outer wheel at LHS	**Inner wheel at LHS**	**Center**	**Inner wheel at RHS**	**Outer wheel at RHS**
LTPP 1 Start, Toward Combolcha	10.7	7.9	8.9	9.9	10.9
LTPP 1 End, Toward Mekaneselam	11.9	12.9	13.9	14.9	8.2
LTPP 2 Start, Toward Combolcha	9.2	9.4	8	9.4	6.7
LTPP 2 End, Toward Mekaneselam	4.6	4.1	3.5	3.2	3.6

Appendix IIIE: Visual Condition Index Gerado Otta Seal Road

Section 1 - R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	1	1	5	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	5	140.9542732	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	4	3	72	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3	1	1	10	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	5	160	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	4	3	42	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n$=	792.3866066		$\sum F_{nmax}$=	8598.484726

Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	90.7846
$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561
$VCI=(a*[\![VCI]\!]_P+b*[\![VCI]\!]_p$	**74**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

Section 1 - L

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	4	5	187.9390309	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	3	4	72	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	5	240	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n =$	845.5713643		$\sum F_{nmax} =$	8598.484726

Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$ 90.166

$C=1/\sum_{-}(n=0)\text{^}n$ 0.000116299561

$VCI=(a*[\![VCI]\!]_P+b*[\![VCI]\!]_{p'}$ **72**

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0

	Section 2 - R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	4	5	358.729712	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	2	1	20	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	4	3	72	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3	2	1	40	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	5	160	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1	2	1	32	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	4	2	295.4746592	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	0	3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	0	3	0	4	3	42
						$\sum F_n =$	1040.089421		$\sum F_{nmax} =$	8598.484726
→	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	87.9038								
→	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
→	$VCI=(a*[\![VCI]\!]_P+b*[\![VCI]\!]_{p'}$	**66**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	Section 2 - L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	3	13.39347809	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	3	36	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3	2	5	324.1313193	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n =$	714.0571308		$\sum F_{nmax} =$	8598.484726
→	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	91.6955								
→	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
→	$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**76**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	Section 3 - R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1			0	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	3	3	54	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n =$	426.9323334		$\sum F_{nmax} =$	8598.484726
→	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	95.0348								
→	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
→	$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**85**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	Section 3 - L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	4	205.8432341	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	1	3	16.74184761	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	3	80.36086853	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	5	60	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3	3	3	250.2700507	5	5	810.3282983
12	PUMPING	10	1.0	1.3	2	3	166.8467004	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	3	3	27	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n =$	918.7430967		$\sum F_{nmax} =$	8598.484726
→	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	89.3151								
→	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
→	$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**70**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	Section 4 - R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	5	269.047284	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	5	140.9542732	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	3	144	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	2	1	60	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n =$	780.5819525		$\sum F_{nmax} =$	8598.484726
→	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	90.9219								
→	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
→	$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**74**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

Section 4 - L

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	4	205.8432341	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	4	110.2750421	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	3	144	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	1	3	4.5	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n$=	593.3986715		$\sum F_{nmax}$=	8598.484726

Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	93.0988
$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561
$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**80**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

Section 5 - R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	2	3	97.16701329	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	2	1	20	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	2	3	53.57391235	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	3	3	54	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0	2	1	18	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	1	32	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0	1	1	2	5	5	200
15	PATCHING	8	0.8	1.1	2	1	32	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	2	1	60	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	452.8259751		$\sum F_{nmax}$=	8598.484726

Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	94.7337
$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561
$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**84**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

Section 5 - L

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	2	5	179.364856	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	2	3	66.96739044	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	4	110.2750421	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	5	60	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0	3	3	81	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	3	96	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n =$	681.2876839		$\sum F_{nmax} =$	8598.484726

Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	92.0767
$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561
$VCI=(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**77**
a=	0.04000
b=	0.00060
VCI_{max}=	100
VCI_{min}=	0

	Section 6 - R									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	3	3	145.7505199	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	1	2	14.93307861	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	3	80.36086853	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	3	36	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	4	128	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1	1	1	6.4	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	1	1	15	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	2	3	33	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	1	3	4.5	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	2	3	21	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	575.0248624		$\sum F_{nmax}$=	8598.484726
	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	93.3125								
	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
	$VCI=(a*[\![VCI]\!]_P+b*[\![VCI]\!]_{p'}$	**80**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

	Section 6 - L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	5	44.841214	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2	1	3	24.29175332	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	2	5	51.08039535	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	3	3	80.36086853	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	2	5	60	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	2	4	128	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1	1	3	21.42956494	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0	2	3	18	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0	1	3	10.5	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	3	3	31.5	4	3	42
						$\sum F_n =$	501.2037961		$\sum F_{nmax} =$	8598.484726
	Priminary VCI = VCI_P $=100\{1-C[\sum_{-}(n=0)\text{^}n$	94.171								
	$C=1/\sum_{-}(n=0)\text{^}n$	0.000116299561								
	VCI= $(a*[\![VCI]\!]_{-}P+b*[\![VCI]\!]_{-}p'$	**83**								
	a=	0.04000								
	b=	0.00060								
	VCI_{max}=	100								
	VCI_{min}=	0								

APPENDIX IV: Hawsewa – Abala – Erebti Road Revised AC Mix Design Measurements

Appendix IVA: Traffic Count Summary

TRAFFIC COUNT SUMMARY FORM for Hawsewa – Abala – Erebti Road														
Date	**Day**		**Motorcycles**	**Bajaj**	**Passenger Cars**	**4×4 Station Wagons (Land Rover)**	**Small Bus >27 Passengers**	**Larg Bus >27 Passengers**	**Small Truck <3.5 Tonnes**	**Medium Truck 3.5 to 7.0 tonnes**	**Heavy Truck 7.5 - 12Tonne**	**Truck Trailer > 12 tonne**	**Tractors and Aggric Vehicles**	**Daily Factored Totals**
17-04-2017	Monday		0	0	7	84	22	1	12	12	96	94	3	422
18-04-2017	Tuesday	Day	0	0	5	53	102	2	35	6	100	111	0	526
		Ngt.	0	0	2	8	13	0	7	1	26	55	0	
19-04-2017	Wednesday		0	0	9	65	91	4	42	2	84	117	0	528
20-04-2017	Thursday		0	0	15	24	114	0	26	5	123	134	0	570
21-04-2017	Friday		0	0	13	70	101	4	20	3	101	92	0	509
22-04-2017	Saturday	Day	0	0	7	74	104	2	21	2	4	121	0	463
		Ngt.	0	0	2	25	21	0	7	0	25	48	0	
23-04-2017	Sunday		0	0	27	114	17	1	15	0	142	148	0	1465
ADT			0	0	16	84	89	4	29	6	238	167	8	641

Appendix IVB: Axle Load Measurement Hawsewa – Abala - Erebti Road

Axle load Summary Hawsawa - Abala - Erebti Road

Row Labels	Average of Total ESA	Average of Total Load
SB	**0.08**	**7**
1.2	0.08	7
ST	**0.18**	**7**
1.2	0.18	7
MT	**1.72**	**13**
1.2	1.72	13
WT	**18.92**	**35**
1.22	18.92	35
AT	**38.48**	**63**
1.2-22	16.59	40
1.22-222	39.23	67
1.22-2222	99.10	99
FT	**39.26**	**64**
1.22	13.40	25
1.22+2.22	41.50	69
1.22+2.2	42.29	56
DT	**40.01**	**38**
1.22	40.01	38
TT	**52.58**	**74**
1.22+2.22	52.58	74
Grand Total	**40.47**	**51**

Vehicle Types	Axle Configuration	Number of Vehicles	Category
Small Bus	1.2	2	Small Bus
Small Truck	1.2	16	Small Truck
Midium Truck	1.2	7	Midium Truck
Water Truck	1.22	1	Heavy Truck
Dumb Truck	1.22	135	
Fuil Track	1.22	2	
	1.22+2.2	3	Truck Trailer
	1.22+2.22	19	
Trailor Truck	1.22+2.22	97	
Arthiculated Truck	1.2-22	9	
	1.22-222	20	
	1.22-2222	3	
Total Number of Vehicles Surveyed		**314**	

Axle Load Measurment Hawsawa - Abala - Erebti Road

Vehicle	Axle Configuration	Axle 1	Axle 2	Axle 3	Axle 4	Axle 5	Axle 6	Axle 7	Total Load	ESA Axle 1	ESA Axle 2	ESA Axle 3	ESA Axle 4	ESA Axle 5	ESA Axle 6	ESA Axle 7	Total ESA
DT	1.22	82	158	159	0	0	0	0	39.9	1.02	19.56	20.12	0.00	0.00	0.00	0.00	40.70
TT	1.22+2.22	91	162	164	144	155	175	0	89.1	1.63	21.89	23.13	12.88	17.94	30.98	0.00	108.46
DT	1.22	76	152	159	0	0	0	0	38.7	0.73	16.43	20.12	0.00	0.00	0.00	0.00	37.28
TT	1.22+2.22	77	138	122	108	120	134	0	69.9	0.77	10.64	6.11	3.53	5.67	9.32	0.00	36.04
DT	1.22	77	171	165	0	0	0	0	41.3	0.77	27.92	23.77	0.00	0.00	0.00	0.00	52.46
TT	1.22+2.22	65	136	132	102	129	109	0	67.3	0.36	9.96	8.71	2.73	7.85	3.68	0.00	33.29
TT	1.22+2.22	76	133	131	94	120	119	0	67.3	0.73	9.01	8.42	1.89	5.67	5.46	0.00	31.18
DT	1.22	82	163	166	0	0	0	0	41.1	1.02	22.50	24.43	0.00	0.00	0.00	0.00	47.95
TT	1.22+2.22	84	184	176	125	165	129	0	86.3	1.14	38.82	31.78	6.82	23.77	7.85	0.00	110.19
DT	1.22	76	175	172	0	0	0	0	42.3	0.73	30.98	28.66	0.00	0.00	0.00	0.00	60.36
DT	1.22	67	146	151	0	0	0	0	36.4	0.41	13.71	15.95	0.00	0.00	0.00	0.00	30.07
DT	1.22	73	173	169	0	0	0	0	41.5	0.61	29.42	26.48	0.00	0.00	0.00	0.00	56.50
DT	1.22	80	166	178	0	0	0	0	42.4	0.91	24.43	33.44	0.00	0.00	0.00	0.00	58.78
MT	1.2	38	74	0	0	0	0	0	11.2	0.03	0.64	0.00	0.00	0.00	0.00	0.00	0.68
ST	1.2	19	25	0	0	0	0	0	4.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
DT	1.22	76	183	183	0	0	0	0	44.2	0.73	37.88	37.88	0.00	0.00	0.00	0.00	76.49
MT	1.2	50	74	0	0	0	0	0	12.4	0.11	0.64	0.00	0.00	0.00	0.00	0.00	0.75
DT	1.22	77	174	166	0	0	0	0	41.7	0.77	30.19	24.43	0.00	0.00	0.00	0.00	55.39
TT	1.22+2.22	74	154	146	122	122	94	0	71.2	0.64	17.43	13.71	6.11	6.11	1.89	0.00	45.89
DT	1.22	84	164	159	0	0	0	0	40.7	1.14	23.13	20.12	0.00	0.00	0.00	0.00	44.39
DT	1.22	82	168	165	0	0	0	0	41.5	1.02	25.78	23.77	0.00	0.00	0.00	0.00	50.57
DT	1.22	81	148	154	0	0	0	0	38.3	0.97	14.57	17.43	0.00	0.00	0.00	0.00	32.97
DT	1.22	82	186	159	0	0	0	0	42.7	1.02	40.76	20.12	0.00	0.00	0.00	0.00	61.90
TT	1.22+2.22	75	130	110	125	127	111	0	67.8	0.68	8.13	3.83	6.82	7.32	3.99	0.00	30.78

TT	1.22+2.22	81	186	178	146	144	145	0	88	0.97	40.76	33.44	13.71	12.88	13.29	0.00	115.05
FT	1.22+2.22	55	49	46	32	36	31	0	24.9	0.17	0.10	0.08	0.01	0.03	0.01	0.00	0.40
ST	1.2	29	38	0	0	0	0	0	6.7	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.04
AT	1.22-2222	86	159	152	150	149	154	143	99.3	1.27	20.12	16.43	15.48	15.02	17.43	12.49	98.24
DT	1.22	76	158	158	0	0	0	0	39.2	0.73	19.56	19.56	0.00	0.00	0.00	0.00	39.84
SB	1.2	29	38	0	0	0	0	0	6.7	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.04
ST	1.2	18	19	0	0	0	0	0	3.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TT	1.22+2.22	73	139	142	111	121	114	0	70	0.61	10.99	12.10	3.99	5.89	4.50	0.00	38.08
FT	1.22+2.22	72	114	115	97	115	114	0	62.7	0.57	4.50	4.68	2.18	4.68	4.50	0.00	21.12
DT	1.22	54	57	52	0	0	0	0	16.3	0.16	0.20	0.13	0.00	0.00	0.00	0.00	0.49
DT	1.22	38	45	45	0	0	0	0	12.8	0.03	0.07	0.07	0.00	0.00	0.00	0.00	0.17
FT	1.22+2.2	62	97	109	92	91	0	0	45.1	0.29	2.18	3.68	1.72	1.63	0.00	0.00	9.50
TT	1.22+2.22	64	126	133	88	122	116	0	64.9	0.34	7.06	9.01	1.40	6.11	4.87	0.00	28.79
DT	1.22	73	118	130	0	0	0	0	32.1	0.61	5.26	8.13	0.00	0.00	0.00	0.00	14.00
MT	1.2	46	109	0	0	0	0	0	15.5	0.08	3.68	0.00	0.00	0.00	0.00	0.00	3.76
ST	1.2	16	18	0	0	0	0	0	3.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FT	1.22+2.2	71	115	109	87	199	0	0	58.1	0.53	4.68	3.68	1.33	55.24	0.00	0.00	65.47
DT	1.22	87	145	142	0	0	0	0	37.4	1.33	13.29	12.10	0.00	0.00	0.00	0.00	26.72
DT	1.22	77	136	138	0	0	0	0	35.1	0.77	9.96	10.64	0.00	0.00	0.00	0.00	21.37
TT	1.22+2.22	87	148	144	132	151	147	0	80.9	1.33	14.57	12.88	8.71	15.95	14.14	0.00	67.59
TT	1.22+2.22	79	164	148	141	146	45	0	72.3	0.86	23.13	14.57	11.72	13.71	0.07	0.00	64.06
TT	1.22+2.22	73	139	144	126	159	154	0	79.5	0.61	10.99	12.88	7.06	20.12	17.43	0.00	69.09
TT	1.22+2.22	67	127	141	135	150	164	0	78.4	0.41	7.32	11.72	9.64	15.48	23.13	0.00	67.70
TT	1.22+2.22	74	134	130	104	109	128	0	67.9	0.64	9.32	8.13	2.98	3.68	7.58	0.00	32.34
DT	1.22	72	136	164	0	0	0	0	37.2	0.57	9.96	23.13	0.00	0.00	0.00	0.00	33.66
DT	1.22	73	138	159	0	0	0	0	37	0.61	10.64	20.12	0.00	0.00	0.00	0.00	31.37
DT	1.22	62	141	142	0	0	0	0	34.5	0.29	11.72	12.10	0.00	0.00	0.00	0.00	24.11
DT	1.22	67	154	149	0	0	0	0	37	0.41	17.43	15.02	0.00	0.00	0.00	0.00	32.86
DT	1.22	69	154	141	0	0	0	0	36.4	0.47	17.43	11.72	0.00	0.00	0.00	0.00	29.62

TT	1.22+2.22	79	175	158	146	162	151	0	87.1	0.86	30.98	19.56	13.71	21.89	15.95	0.00	102.95
AT	1.2-22	69	136	96	106	0	0	0	40.7	0.47	9.96	2.08	3.25	0.00	0.00	0.00	15.75
ST	1.2	24	34	0	0	0	0	0	5.8	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
TT	1.22+2.22	76	139	137	118	130	118	0	71.8	0.73	10.99	10.30	5.26	8.13	5.26	0.00	40.66
AT	1.22-222	50	66	57	39	69	88	0	36.9	0.11	0.38	0.20	0.04	0.47	1.40	0.00	2.61
DT	1.22	80	163	156	0	0	0	0	39.9	0.91	22.50	18.47	0.00	0.00	0.00	0.00	41.89
DT	1.22	77	150	151	0	0	0	0	37.8	0.77	15.48	15.95	0.00	0.00	0.00	0.00	32.20
DT	1.22	89	166	162	0	0	0	0	41.7	1.48	24.43	21.89	0.00	0.00	0.00	0.00	47.79
TT	1.22+2.22	75	146	144	114	127	139	0	74.5	0.68	13.71	12.88	4.50	7.32	10.99	0.00	50.09
AT	1.22-222	68	139	139	133	127	132	0	73.8	0.44	10.99	10.99	9.01	7.32	8.71	0.00	47.46
FT	1.22	51	37	43	0	0	0	0	13.1	0.12	0.03	0.06	0.00	0.00	0.00	0.00	0.21
DT	1.22	78	187	190	0	0	0	0	45.5	0.82	41.75	44.85	0.00	0.00	0.00	0.00	87.42
DT	1.22	77	171	174	0	0	0	0	42.2	0.77	27.92	30.19	0.00	0.00	0.00	0.00	58.88
DT	1.22	49	78	69	0	0	0	0	19.6	0.10	0.82	0.47	0.00	0.00	0.00	0.00	1.39
DT	1.22	77	156	156	0	0	0	0	38.9	0.77	18.47	18.47	0.00	0.00	0.00	0.00	37.71
DT	1.22	81	146	146	0	0	0	0	37.3	0.97	13.71	13.71	0.00	0.00	0.00	0.00	28.38
DT	1.22	78	176	174	0	0	0	0	42.8	0.82	31.78	30.19	0.00	0.00	0.00	0.00	62.79
DT	1.22	39	48	49	0	0	0	0	13.6	0.04	0.09	0.10	0.00	0.00	0.00	0.00	0.23
TT	1.22+2.22	89	130	126	116	147	143	0	75.1	1.48	8.13	7.06	4.87	14.14	12.49	0.00	48.16
DT	1.22	72	145	146	0	0	0	0	36.3	0.57	13.29	13.71	0.00	0.00	0.00	0.00	27.57
MT	1.2	45	53	0	0	0	0	0	9.8	0.07	0.14	0.00	0.00	0.00	0.00	0.00	0.21
DT	1.22	41	49	70	0	0	0	0	16	0.05	0.10	0.50	0.00	0.00	0.00	0.00	0.65
DT	1.22	50	126	126	0	0	0	0	30.2	0.11	7.06	7.06	0.00	0.00	0.00	0.00	14.24
DT	1.22	77	177	171	0	0	0	0	42.5	0.77	32.60	27.92	0.00	0.00	0.00	0.00	61.29
FT	1.22+2.22	63	136	132	105	145	132	0	71.3	0.31	9.96	8.71	3.11	13.29	8.71	0.00	44.09
FT	1.22+2.22	77	158	141	127	156	146	0	80.5	0.77	19.56	11.72	7.32	18.47	13.71	0.00	71.55
DT	1.22	81	141	142	0	0	0	0	36.4	0.97	11.72	12.10	0.00	0.00	0.00	0.00	24.78
TT	1.22+2.22	73	143	140	128	137	131	0	75.2	0.61	12.49	11.35	7.58	10.30	8.42	0.00	50.74
DT	1.22	83	161	167	0	0	0	0	41.1	1.08	21.29	25.10	0.00	0.00	0.00	0.00	47.46

DT	1.22	81	160	159	0	0	0	0	40	0.97	20.70	20.12	0.00	0.00	0.00	0.00	41.79
AT	1.22-222	73	161	152	124	128	134	0	77.2	0.61	21.29	16.43	6.57	7.58	9.32	0.00	61.80
DT	1.22	76	142	145	0	0	0	0	36.3	0.73	12.10	13.29	0.00	0.00	0.00	0.00	26.11
TT	1.22+2.22	67	131	145	82	136	119	0	68	0.41	8.42	13.29	1.02	9.96	5.46	0.00	38.56
DT	1.22	77	152	139	0	0	0	0	36.8	0.77	16.43	10.99	0.00	0.00	0.00	0.00	28.19
ST	1.2	22	31	0	0	0	0	0	5.3	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
TT	1.22+2.22	76	144	140	106	139	130	0	73.5	0.73	12.88	11.35	3.25	10.99	8.13	0.00	47.32
TT	1.22+2.22	84	143	141	98	115	117	0	69.8	1.14	12.49	11.72	2.28	4.68	5.06	0.00	37.37
TT	1.22+2.22	77	143	137	125	127	116	0	72.5	0.77	12.49	10.30	6.82	7.32	4.87	0.00	42.56
TT	1.22+2.22	77	139	131	104	118	122	0	69.1	0.77	10.99	8.42	2.98	5.26	6.11	0.00	34.52
TT	1.22+2.22	74	134	132	105	128	117	0	69	0.64	9.32	8.71	3.11	7.58	5.06	0.00	34.43
FT	1.22+2.22	76	143	146	104	117	125	0	71.1	0.73	12.49	13.71	2.98	5.06	6.82	0.00	41.78
TT	1.22+2.22	72	135	140	107	128	130	0	71.2	0.57	9.64	11.35	3.39	7.58	8.13	0.00	40.65
ST	1.2	31	51	0	0	0	0	0	8.2	0.01	0.12	0.00	0.00	0.00	0.00	0.00	0.13
AT	1.2-22	56	41	51	60	0	0	0	20.8	0.18	0.05	0.12	0.25	0.00	0.00	0.00	0.60
TT	1.22+2.22	73	135	145	137	144	131	0	76.5	0.61	9.64	13.29	10.30	12.88	8.42	0.00	55.13
TT	1.22+2.22	75	132	139	106	143	148	0	74.3	0.68	8.71	10.99	3.25	12.49	14.57	0.00	50.69
DT	1.22	82	143	146	0	0	0	0	37.1	1.02	12.49	13.71	0.00	0.00	0.00	0.00	27.22
TT	1.22+2.22	71	112	114	76	113	116	0	60.2	0.53	4.16	4.50	0.73	4.33	4.87	0.00	19.12
DT	1.22	87	135	130	0	0	0	0	35.2	1.33	9.64	8.13	0.00	0.00	0.00	0.00	19.10
DT	1.22	68	148	141	0	0	0	0	35.7	0.44	14.57	11.72	0.00	0.00	0.00	0.00	26.73
ST	1.2	27	60	0	0	0	0	0	8.7	0.01	0.25	0.00	0.00	0.00	0.00	0.00	0.26
DT	1.22	78	152	147	0	0	0	0	37.7	0.82	16.43	14.14	0.00	0.00	0.00	0.00	31.38
ST	1.2	31	74	0	0	0	0	0	10.5	0.01	0.64	0.00	0.00	0.00	0.00	0.00	0.66
SB	1.2	29	50	0	0	0	0	0	7.9	0.01	0.11	0.00	0.00	0.00	0.00	0.00	0.12
TT	1.22+2.22	82	146	146	116	124	113	0	72.7	1.02	13.71	13.71	4.87	6.57	4.33	0.00	44.21
AT	1.22-2222	85	133	147	128	144	166	164	96.7	1.20	9.01	14.14	7.58	12.88	24.43	23.13	92.37
AT	1.2-22	63	92	86	103	0	0	0	34.4	0.31	1.72	1.27	2.85	0.00	0.00	0.00	6.15
DT	1.22	74	168	174	0	0	0	0	41.6	0.64	25.78	30.19	0.00	0.00	0.00	0.00	56.61

ST	1.2	30	62	0	0	0	0	0	9.2	0.01	0.29	0.00	0.00	0.00	0.00	0.30
TT	1.22+2.22	80	150	145	114	129	115	0	73.3	0.91	15.48	13.29	4.50	7.85	4.68	0.00	46.73
AT	1.22-222	65	140	136	142	172	169	0	82.4	0.36	11.35	9.96	12.10	28.66	26.48	0.00	88.91
TT	1.22+2.22	82	151	142	114	133	113	0	73.5	1.02	15.95	12.10	4.50	9.01	4.33	0.00	46.91
TT	1.22+2.22	81	144	142	128	113	108	0	71.6	0.97	12.88	12.10	7.58	4.33	3.53	0.00	41.39
TT	1.22+2.22	74	151	138	107	138	130	0	73.8	0.64	15.95	10.64	3.39	10.64	8.13	0.00	49.39
TT	1.22+2.22	78	147	144	93	126	108	0	69.6	0.82	14.14	12.88	1.80	7.06	3.53	0.00	40.23
DT	1.22	68	177	168	0	0	0	0	41.3	0.44	32.60	25.78	0.00	0.00	0.00	0.00	58.82
DT	1.22	66	187	170	0	0	0	0	42.3	0.38	41.75	27.19	0.00	0.00	0.00	0.00	69.33
FT	1.22+2.22	76	137	139	102	133	120	0	70.7	0.73	10.30	10.99	2.73	9.01	5.67	0.00	39.42
DT	1.22	79	179	181	0	0	0	0	43.9	0.86	34.30	36.05	0.00	0.00	0.00	0.00	71.21
DT	1.22	77	194	180	0	0	0	0	45.1	0.77	49.26	35.17	0.00	0.00	0.00	0.00	85.20
TT	1.22+2.22	59	141	147	117	140	132	0	73.6	0.23	11.72	14.14	5.06	11.35	8.71	0.00	51.21
TT	1.22+2.22	83	142	147	96	140	122	0	73	1.08	12.10	14.14	2.08	11.35	6.11	0.00	46.85
TT	1.22+2.22	72	134	154	115	141	121	0	73.7	0.57	9.32	17.43	4.68	11.72	5.89	0.00	49.61
DT	1.22	68	84	82	0	0	0	0	23.4	0.44	1.14	1.02	0.00	0.00	0.00	0.00	2.60
DT	1.22	62	145	167	0	0	0	0	37.4	0.29	13.29	25.10	0.00	0.00	0.00	0.00	38.68
TT	1.22+2.22	80	139	140	113	104	108	0	68.4	0.91	10.99	11.35	4.33	2.98	3.53	0.00	34.09
DT	1.22	91	183	187	0	0	0	0	46.1	1.63	37.88	41.75	0.00	0.00	0.00	0.00	81.27
DT	1.22	84	177	169	0	0	0	0	43	1.14	32.60	26.48	0.00	0.00	0.00	0.00	60.22
DT	1.22	79	152	139	0	0	0	0	37	0.86	16.43	10.99	0.00	0.00	0.00	0.00	28.29
FT	1.22+2.22	66	137	132	108	136	124	0	70.3	0.38	10.30	8.71	3.53	9.96	6.57	0.00	39.45
FT	1.22+2.22	80	116	132	114	119	124	0	68.5	0.91	4.87	8.71	4.50	5.46	6.57	0.00	31.03
AT	1.22-222	73	133	128	123	121	124	0	70.2	0.61	9.01	7.58	6.34	5.89	6.57	0.00	36.00
DT	1.22	73	136	135	0	0	0	0	34.4	0.61	9.96	9.64	0.00	0.00	0.00	0.00	20.20
AT	1.22-222	67	129	133	106	108	132	0	67.5	0.41	7.85	9.01	3.25	3.53	8.71	0.00	32.76
DT	1.22	86	178	187	0	0	0	0	45.1	1.27	33.44	41.75	0.00	0.00	0.00	0.00	76.46
WT	1.22	79	131	135	0	0	0	0	34.5	0.86	8.42	9.64	0.00	0.00	0.00	0.00	18.92
ST	1.2	24	83	0	0	0	0	0	10.7	0.00	1.08	0.00	0.00	0.00	0.00	0.00	1.08

AT	1.22-222	77	114	122	113	116	131	0	67.3	0.77	4.50	6.11	4.33	4.87	8.42	0.00	29.00
DT	1.22	58	56	48	0	0	0	0	16.2	0.22	0.18	0.09	0.00	0.00	0.00	0.00	0.49
TT	1.22+2.22	75	148	146	105	131	119	0	72.4	0.68	14.57	13.71	3.11	8.42	5.46	0.00	45.95
DT	1.22	71	146	148	0	0	0	0	36.5	0.53	13.71	14.57	0.00	0.00	0.00	0.00	28.82
DT	1.22	80	176	158	0	0	0	0	41.4	0.91	31.78	19.56	0.00	0.00	0.00	0.00	52.26
DT	1.22	83	156	172	0	0	0	0	41.1	1.08	18.47	28.66	0.00	0.00	0.00	0.00	48.21
DT	1.22	78	179	173	0	0	0	0	43	0.82	34.30	29.42	0.00	0.00	0.00	0.00	64.53
TT	1.22+2.22	85	149	167	121	171	162	0	85.5	1.20	15.02	25.10	5.89	27.92	21.89	0.00	97.01
TT	1.22+2.22	78	145	141	120	120	116	0	72	0.82	13.29	11.72	5.67	5.67	4.87	0.00	42.04
AT	1.22-222	78	132	129	161	168	178	0	84.6	0.82	8.71	7.85	21.29	25.78	33.44	0.00	97.89
DT	1.22	73	157	150	0	0	0	0	38	0.61	19.01	15.48	0.00	0.00	0.00	0.00	35.10
DT	1.22	79	183	182	0	0	0	0	44.4	0.86	37.88	36.96	0.00	0.00	0.00	0.00	75.70
TT	1.22+2.22	76	139	137	110	123	128	0	71.3	0.73	10.99	10.30	3.83	6.34	7.58	0.00	39.77
DT	1.22	73	169	162	0	0	0	0	40.4	0.61	26.48	21.89	0.00	0.00	0.00	0.00	48.97
AT	1.22-222	67	122	126	132	112	128	0	68.7	0.41	6.11	7.06	8.71	4.16	7.58	0.00	34.04
TT	1.22+2.22	70	138	137	108	123	121	0	69.7	0.50	10.64	10.30	3.53	6.34	5.89	0.00	37.19
DT	1.22	89	157	165	0	0	0	0	41.1	1.48	19.01	23.77	0.00	0.00	0.00	0.00	44.26
DT	1.22	86	154	158	0	0	0	0	39.8	1.27	17.43	19.56	0.00	0.00	0.00	0.00	38.25
TT	1.22+2.22	72	138	130	120	133	112	0	70.5	0.57	10.64	8.13	5.67	9.01	4.16	0.00	38.18
TT	1.22+2.22	65	136	136	96	134	111	0	67.8	0.36	9.96	9.96	2.08	9.32	3.99	0.00	35.67
DT	1.22	82	151	156	0	0	0	0	38.9	1.02	15.95	18.47	0.00	0.00	0.00	0.00	35.44
TT	1.22+2.22	70	192	188	121	149	136	0	85.6	0.50	47.02	42.77	5.89	15.02	9.96	0.00	121.16
TT	1.22+2.22	76	172	166	144	156	150	0	86.4	0.73	28.66	24.43	12.88	18.47	15.48	0.00	100.65
TT	1.22+2.22	75	142	147	113	136	108	0	72.1	0.68	12.10	14.14	4.33	9.96	3.53	0.00	44.74
DT	1.22	80	156	149	0	0	0	0	38.5	0.91	18.47	15.02	0.00	0.00	0.00	0.00	34.41
TT	1.22+2.22	75	142	152	113	136	108	0	72.6	0.68	12.10	16.43	4.33	9.96	3.53	0.00	47.03
TT	1.22+2.22	82	147	144	111	121	112	0	71.7	1.02	14.14	12.88	3.99	5.89	4.16	0.00	42.08
AT	1.2-22	74	126	132	119	0	0	0	45.1	0.64	7.06	8.71	5.46	0.00	0.00	0.00	21.88
TT	1.22+2.22	85	131	130	130	147	111	0	73.4	1.20	8.42	8.13	8.13	14.14	3.99	0.00	44.01

TT	1.22+2.22	74	150	142	109	122	118	0	71.5	0.64	15.48	12.10	3.68	6.11	5.26	0.00	43.27
AT	1.2-22	72	132	144	135	0	0	0	48.3	0.57	8.71	12.88	9.64	0.00	0.00	0.00	31.80
ST	1.2	21	52	0	0	0	0	0	7.3	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
FT	1.22+2.2	77	150	149	143	130	0	0	64.9	0.77	15.48	15.02	12.49	8.13	0.00	0.00	51.89
TT	1.22+2.22	77	149	134	111	128	126	0	72.5	0.77	15.02	9.32	3.99	7.58	7.06	0.00	43.75
AT	1.22-222	75	145	138	113	91	103	0	66.5	0.68	13.29	10.64	4.33	1.63	2.85	0.00	33.43
ST	1.2	21	41	0	0	0	0	0	6.2	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
AT	1.22-222	80	139	126	82	69	79	0	57.5	0.91	10.99	7.06	1.02	0.47	0.86	0.00	21.32
AT	1.22-222	78	127	125	87	74	76	0	56.7	0.82	7.32	6.82	1.33	0.64	0.73	0.00	17.66
AT	1.2-22	71	112	105	103	0	0	0	39.1	0.53	4.16	3.11	2.85	0.00	0.00	0.00	10.65
AT	1.22-222	69	120	118	100	87	112	0	60.6	0.47	5.67	5.26	2.50	1.33	4.16	0.00	19.39
AT	1.22-222	72	101	106	102	94	104	0	57.9	0.57	2.61	3.25	2.73	1.89	2.98	0.00	14.02
DT	1.22	78	183	175	0	0	0	0	43.6	0.82	37.88	30.98	0.00	0.00	0.00	0.00	69.68
AT	1.22-222	65	83	79	92	105	103	0	52.7	0.36	1.08	0.86	1.72	3.11	2.85	0.00	9.98
FT	1.22+2.22	69	142	141	102	119	110	0	68.3	0.47	12.10	11.72	2.73	5.46	3.83	0.00	36.31
FT	1.22+2.22	69	141	142	102	107	112	0	67.3	0.47	11.72	12.10	2.73	3.39	4.16	0.00	34.56
FT	1.22+2.22	74	138	137	99	119	132	0	69.9	0.64	10.64	10.30	2.39	5.46	8.71	0.00	38.13
FT	1.22+2.22	73	158	154	107	133	125	0	75	0.61	19.56	17.43	3.39	9.01	6.82	0.00	56.80
FT	1.22+2.22	72	140	126	88	128	134	0	68.8	0.57	11.35	7.06	1.40	7.58	9.32	0.00	37.29
TT	1.22+2.22	67	174	166	105	151	141	0	80.4	0.41	30.19	24.43	3.11	15.95	11.72	0.00	85.81
FT	1.22+2.22	66	144	143	100	132	126	0	71.1	0.38	12.88	12.49	2.50	8.71	7.06	0.00	44.02
TT	1.22+2.22	66	143	135	108	123	106	0	68.1	0.38	12.49	9.64	3.53	6.34	3.25	0.00	35.62
ST	1.2	17	23	0	0	0	0	0	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DT	1.22	79	164	168	0	0	0	0	41.1	0.86	23.13	25.78	0.00	0.00	0.00	0.00	49.78
TT	1.22+2.22	81	135	136	109	124	110	0	69.5	0.97	9.64	9.96	3.68	6.57	3.83	0.00	34.65
DT	1.22	57	49	54	0	0	0	0	16	0.20	0.10	0.16	0.00	0.00	0.00	0.00	0.46
TT	1.22+2.22	72	152	138	128	124	118	0	73.2	0.57	16.43	10.64	7.58	6.57	5.26	0.00	47.05
DT	1.22	73	149	137	0	0	0	0	35.9	0.61	15.02	10.30	0.00	0.00	0.00	0.00	25.92
DT	1.22	71	185	178	0	0	0	0	43.4	0.53	39.78	33.44	0.00	0.00	0.00	0.00	73.76

DT	1.22	73	152	150	0	0	0	0	37.5	0.61	16.43	15.48	0.00	0.00	0.00	0.00	32.52
DT	1.22	70	135	137	0	0	0	0	34.2	0.50	9.64	10.30	0.00	0.00	0.00	0.00	20.43
DT	1.22	82	142	145	0	0	0	0	36.9	1.02	12.10	13.29	0.00	0.00	0.00	0.00	26.41
DT	1.22	72	139	134	0	0	0	0	34.5	0.57	10.99	9.32	0.00	0.00	0.00	0.00	20.88
DT	1.22	74	153	153	0	0	0	0	38	0.64	16.92	16.92	0.00	0.00	0.00	0.00	34.49
DT	1.22	70	145	140	0	0	0	0	35.5	0.50	13.29	11.35	0.00	0.00	0.00	0.00	25.14
DT	1.22	76	170	172	0	0	0	0	41.8	0.73	27.19	28.66	0.00	0.00	0.00	0.00	56.58
DT	1.22	69	121	129	0	0	0	0	31.9	0.47	5.89	7.85	0.00	0.00	0.00	0.00	14.21
TT	1.22+2.22	82	156	143	112	120	114	0	72.7	1.02	18.47	12.49	4.16	5.67	4.50	0.00	46.31
DT	1.22	77	130	132	0	0	0	0	33.9	0.77	8.13	8.71	0.00	0.00	0.00	0.00	17.61
AT	1.2-22	62	130	122	128	0	0	0	44.2	0.29	8.13	6.11	7.58	0.00	0.00	0.00	22.11
TT	1.22+2.22	75	138	135	127	128	144	0	74.7	0.68	10.64	9.64	7.32	7.58	12.88	0.00	48.74
TT	1.22+2.22	77	142	139	106	132	134	0	73	0.77	12.10	10.99	3.25	8.71	9.32	0.00	45.13
TT	1.22+2.22	81	139	135	103	138	139	0	73.5	0.97	10.99	9.64	2.85	10.64	10.99	0.00	46.07
DT	1.22	83	151	143	0	0	0	0	37.7	1.08	15.95	12.49	0.00	0.00	0.00	0.00	29.52
DT	1.22	78	143	142	0	0	0	0	36.3	0.82	12.49	12.10	0.00	0.00	0.00	0.00	25.40
DT	1.22	76	147	146	0	0	0	0	36.9	0.73	14.14	13.71	0.00	0.00	0.00	0.00	28.57
DT	1.22	77	140	137	0	0	0	0	35.4	0.77	11.35	10.30	0.00	0.00	0.00	0.00	22.41
DT	1.22	83	147	146	0	0	0	0	37.6	1.08	14.14	13.71	0.00	0.00	0.00	0.00	28.92
AT	1.22-222	67	139	143	120	122	130	0	72.1	0.41	10.99	12.49	5.67	6.11	8.13	0.00	43.80
TT	1.22+2.22	81	144	145	119	142	139	0	77	0.97	12.88	13.29	5.46	12.10	10.99	0.00	55.69
DT	1.22	81	141	138	0	0	0	0	36	0.97	11.72	10.64	0.00	0.00	0.00	0.00	23.32
AT	1.22-222	79	101	165	132	138	147	0	76.2	0.86	2.61	23.77	8.71	10.64	14.14	0.00	60.73
AT	1.22-2222	78	142	141	166	154	152	165	99.8	0.82	12.10	11.72	24.43	17.43	16.43	23.77	106.69
DT	1.22	67	135	138	0	0	0	0	34	0.41	9.64	10.64	0.00	0.00	0.00	0.00	20.69
TT	1.22+2.22	77	142	137	103	128	136	0	72.3	0.77	12.10	10.30	2.85	7.58	9.96	0.00	43.56
FT	1.22+2.22	76	143	136	130	138	134	0	75.7	0.73	12.49	9.96	8.13	10.64	9.32	0.00	51.26
FT	1.22+2.22	69	131	132	96	127	133	0	68.8	0.47	8.42	8.71	2.08	7.32	9.01	0.00	36.00
TT	1.22+2.22	80	142	138	103	138	134	0	73.5	0.91	12.10	10.64	2.85	10.64	9.32	0.00	46.46

TT	1.22+2.22	78	142	148	108	130	134	0	74	0.82	12.10	14.57	3.53	8.13	9.32	0.00	48.47
TT	1.22+2.22	81	144	144	126	151	149	0	79.5	0.97	12.88	12.88	7.06	15.95	15.02	0.00	64.77
TT	1.22+2.22	69	175	178	136	160	141	0	85.9	0.47	30.98	33.44	9.96	20.70	11.72	0.00	107.27
TT	1.22+2.22	73	145	138	114	128	138	0	73.6	0.61	13.29	10.64	4.50	7.58	10.64	0.00	47.26
AT	1.2-22	64	135	118	124	0	0	0	44.1	0.34	9.64	5.26	6.57	0.00	0.00	0.00	21.80
FT	1.22+2.22	66	136	134	148	145	150	0	77.9	0.38	9.96	9.32	14.57	13.29	15.48	0.00	63.01
FT	1.22	78	143	145	0	0	0	0	36.6	0.82	12.49	13.29	0.00	0.00	0.00	0.00	26.59
DT	1.22	37	184	182	0	0	0	0	40.3	0.03	38.82	36.96	0.00	0.00	0.00	0.00	75.81
DT	1.22	79	179	182	0	0	0	0	44	0.86	34.30	36.96	0.00	0.00	0.00	0.00	72.12
DT	1.22	81	173	162	0	0	0	0	41.6	0.97	29.42	21.89	0.00	0.00	0.00	0.00	52.27
TT	1.22+2.22	81	154	165	134	144	165	0	84.3	0.97	17.43	23.77	9.32	12.88	23.77	0.00	88.14
DT	1.22	66	175	171	0	0	0	0	41.2	0.38	30.98	27.92	0.00	0.00	0.00	0.00	59.28
TT	1.22+2.22	82	167	157	141	120	131	0	79.8	1.02	25.10	19.01	11.72	5.67	8.42	0.00	70.93
DT	1.22	76	162	182	0	0	0	0	42	0.73	21.89	36.96	0.00	0.00	0.00	0.00	59.57
DT	1.22	80	180	183	0	0	0	0	44.3	0.91	35.17	37.88	0.00	0.00	0.00	0.00	73.96
MT	1.2	42	103	0	0	0	0	0	14.5	0.05	2.85	0.00	0.00	0.00	0.00	0.00	2.90
TT	1.22+2.22	80	152	159	116	137	121	0	76.5	0.91	16.43	20.12	4.87	10.30	5.89	0.00	58.52
DT	1.22	78	188	180	0	0	0	0	44.6	0.82	42.77	35.17	0.00	0.00	0.00	0.00	78.75
DT	1.22	86	172	182	0	0	0	0	44	1.27	28.66	36.96	0.00	0.00	0.00	0.00	66.88
TT	1.22+2.22	73	148	143	93	132	124	0	71.3	0.61	14.57	12.49	1.80	8.71	6.57	0.00	44.75
TT	1.22+2.22	75	134	134	109	95	102	0	64.9	0.68	9.32	9.32	3.68	1.98	2.73	0.00	27.71
DT	1.22	79	155	144	0	0	0	0	37.8	0.86	17.94	12.88	0.00	0.00	0.00	0.00	31.69
DT	1.22	72	154	149	0	0	0	0	37.5	0.57	17.43	15.02	0.00	0.00	0.00	0.00	33.02
DT	1.22	88	158	148	0	0	0	0	39.4	1.40	19.56	14.57	0.00	0.00	0.00	0.00	35.54
TT	1.22+2.22	73	152	143	121	131	115	0	73.5	0.61	16.43	12.49	5.89	8.42	4.68	0.00	48.51
DT	1.22	74	164	151	0	0	0	0	38.9	0.64	23.13	15.95	0.00	0.00	0.00	0.00	39.73
DT	1.22	84	163	168	0	0	0	0	41.5	1.14	22.50	25.78	0.00	0.00	0.00	0.00	49.42
DT	1.22	77	156	151	0	0	0	0	38.4	0.77	18.47	15.95	0.00	0.00	0.00	0.00	35.19
TT	1.22+2.22	80	128	127	115	135	166	0	75.1	0.91	7.58	7.32	4.68	9.64	24.43	0.00	54.56

TT	1.22+2.22	78	164	166	140	146	149	0	84.3	0.82	23.13	24.43	11.35	13.71	15.02	0.00	88.45
AT	1.2-22	66	131	114	118	0	0	0	42.9	0.38	8.42	4.50	5.26	0.00	0.00	0.00	18.56
TT	1.22+2.22	74	140	148	116	137	140	0	75.5	0.64	11.35	14.57	4.87	10.30	11.35	0.00	53.08
ST	1.2	25	33	0	0	0	0	0	5.8	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
MT	1.2	41	92	0	0	0	0	0	13.3	0.05	1.72	0.00	0.00	0.00	0.00	0.00	1.76
TT	1.22+2.22	82	149	152	121	147	160	0	81.1	1.02	15.02	16.43	5.89	14.14	20.70	0.00	73.20
DT	1.22	85	183	185	0	0	0	0	45.3	1.20	37.88	39.78	0.00	0.00	0.00	0.00	78.86
MT	1.2	47	94	0	0	0	0	0	14.1	0.08	1.89	0.00	0.00	0.00	0.00	0.00	1.97
TT	1.22+2.22	81	129	131	98	124	120	0	68.3	0.97	7.85	8.42	2.28	6.57	5.67	0.00	31.76
TT	1.22+2.22	79	161	147	102	124	123	0	73.6	0.86	21.29	14.14	2.73	6.57	6.34	0.00	51.93
TT	1.22+2.22	72	151	149	112	142	143	0	76.9	0.57	15.95	15.02	4.16	12.10	12.49	0.00	60.28
DT	1.22	79	154	151	0	0	0	0	38.4	0.86	17.43	15.95	0.00	0.00	0.00	0.00	34.24
DT	1.22	82	152	153	0	0	0	0	38.7	1.02	16.43	16.92	0.00	0.00	0.00	0.00	34.38
DT	1.22	77	158	160	0	0	0	0	39.5	0.77	19.56	20.70	0.00	0.00	0.00	0.00	41.03
DT	1.22	89	141	136	0	0	0	0	36.6	1.48	11.72	9.96	0.00	0.00	0.00	0.00	23.16
TT	1.22+2.22	78	139	139	114	137	135	0	74.2	0.82	10.99	10.99	4.50	10.30	9.64	0.00	47.23
DT	1.22	70	145	149	0	0	0	0	36.4	0.50	13.29	15.02	0.00	0.00	0.00	0.00	28.81
DT	1.22	83	141	142	0	0	0	0	36.6	1.08	11.72	12.10	0.00	0.00	0.00	0.00	24.90
DT	1.22	68	143	135	0	0	0	0	34.6	0.44	12.49	9.64	0.00	0.00	0.00	0.00	22.56
ST	1.2	26	49	0	0	0	0	0	7.5	0.01	0.10	0.00	0.00	0.00	0.00	0.00	0.11
DT	1.22	86	130	137	0	0	0	0	35.3	1.27	8.13	10.30	0.00	0.00	0.00	0.00	19.69
DT	1.22	83	173	171	0	0	0	0	42.7	1.08	29.42	27.92	0.00	0.00	0.00	0.00	58.41
DT	1.22	74	154	149	0	0	0	0	37.7	0.64	17.43	15.02	0.00	0.00	0.00	0.00	33.09
TT	1.22+2.22	82	137	139	102	128	134	0	72.2	1.02	10.30	10.99	2.73	7.58	9.32	0.00	41.94
DT	1.22	74	158	164	0	0	0	0	39.6	0.64	19.56	23.13	0.00	0.00	0.00	0.00	43.33
TT	1.22+2.22	68	142	151	118	153	154	0	78.6	0.44	12.10	15.95	5.26	16.92	17.43	0.00	68.10
DT	1.22	84	152	157	0	0	0	0	39.3	1.14	16.43	19.01	0.00	0.00	0.00	0.00	36.58
DT	1.22	82	139	147	0	0	0	0	36.8	1.02	10.99	14.14	0.00	0.00	0.00	0.00	26.15
TT	1.22+2.22	74	189	168	115	141	142	0	82.9	0.64	43.80	25.78	4.68	11.72	12.10	0.00	98.72

TT	1.22+2.22	63	44	47	50	40	42	0	28.6	0.31	0.06	0.08	0.11	0.04	0.05	0.00	0.66
TT	1.22+2.22	73	140	136	100	128	125	0	70.2	0.61	11.35	9.96	2.50	7.58	6.82	0.00	38.81
TT	1.22+2.22	79	150	145	120	132	134	0	76	0.86	15.48	13.29	5.67	8.71	9.32	0.00	53.34
TT	1.22+2.22	79	155	157	111	142	144	0	78.8	0.86	17.94	19.01	3.99	12.10	12.88	0.00	66.79
TT	1.22+2.22	77	153	151	107	134	129	0	75.1	0.77	16.92	15.95	3.39	9.32	7.85	0.00	54.20
FT	1.22+2.22	79	138	143	108	144	139	0	75.1	0.86	10.64	12.49	3.53	12.88	10.99	0.00	51.39
DT	1.22	88	172	166	0	0	0	0	42.6	1.40	28.66	24.43	0.00	0.00	0.00	0.00	54.49
DT	1.22	86	191	186	0	0	0	0	46.3	1.27	45.92	40.76	0.00	0.00	0.00	0.00	87.95
FT	1.22+2.22	79	145	141	134	130	128	0	75.7	0.86	13.29	11.72	9.32	8.13	7.58	0.00	50.91
DT	1.22	87	157	144	0	0	0	0	38.8	1.33	19.01	12.88	0.00	0.00	0.00	0.00	33.23
DT	1.22	81	146	149	0	0	0	0	37.6	0.97	13.71	15.02	0.00	0.00	0.00	0.00	29.70
AT	1.22-222	66	132	136	125	125	152	0	73.6	0.38	8.71	9.96	6.82	6.82	16.43	0.00	49.12
DT	1.22	85	162	168	0	0	0	0	41.5	1.20	21.89	25.78	0.00	0.00	0.00	0.00	48.87
TT	1.22+2.22	75	141	142	125	136	130	0	74.9	0.68	11.72	12.10	6.82	9.96	8.13	0.00	49.41
TT	1.22+2.22	77	132	128	98	115	108	0	65.8	0.77	8.71	7.58	2.28	4.68	3.53	0.00	27.56
DT	1.22	49	156	153	0	0	0	0	35.8	0.10	18.47	16.92	0.00	0.00	0.00	0.00	35.49
TT	1.22+2.22	79	159	152	128	144	148	0	81	0.86	20.12	16.43	7.58	12.88	14.57	0.00	72.46
TT	1.22+2.22	68	132	118	96	111	114	0	63.9	0.44	8.71	5.26	2.08	3.99	4.50	0.00	24.98
DT	1.22	84	153	142	0	0	0	0	37.9	1.14	16.92	12.10	0.00	0.00	0.00	0.00	30.16
DT	1.22	81	151	153	0	0	0	0	38.5	0.97	15.95	16.92	0.00	0.00	0.00	0.00	33.84
DT	1.22	77	130	132	0	0	0	0	33.9	0.77	8.13	8.71	0.00	0.00	0.00	0.00	17.61
DT	1.22	78	129	130	0	0	0	0	33.7	0.82	7.85	8.13	0.00	0.00	0.00	0.00	16.80
DT	1.22	87	190	191	0	0	0	0	46.8	1.33	44.85	45.92	0.00	0.00	0.00	0.00	92.11
DT	1.22	73	178	173	0	0	0	0	42.4	0.61	33.44	29.42	0.00	0.00	0.00	0.00	63.46
DT	1.22	79	153	150	0	0	0	0	38.2	0.86	16.92	15.48	0.00	0.00	0.00	0.00	33.27
TT	1.22+2.22	75	149	145	130	140	130	0	76.9	0.68	15.02	13.29	8.13	11.35	8.13	0.00	56.61
AT	1.22-222	71	139	134	110	131	128	0	71.3	0.53	10.99	9.32	3.83	8.42	7.58	0.00	40.68
AT	1.22-222	69	142	136	118	130	130	0	72.5	0.47	12.10	9.96	5.26	8.13	8.13	0.00	44.05
DT	1.22	87	135	127	0	0	0	0	34.9	1.33	9.64	7.32	0.00	0.00	0.00	0.00	18.29

Appendix IVC: Rut Depth Measurement Hawsewa – Abala – Erebti Road

Hawsewa - Abala - Erebti Road Rut Depth Measurement

LTPP 1	1 - Top of Escarpment (2343m-2347m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	3	0	0	3
2	4	0	0	0
3	3	0	0	0
4	0	0	0	0
5	2	0	0	0
6	3	0	0	5
7	4	0	0	0
8	5	0	0	0
9	3	0	0	0
10	5	0	0	0
90th Percentile	5	0	0	4
Maximum Rut depth (mm)	5	0	0	5
Average Rut depth (mm)	4	0	0	1

LTPP 2	2 - On Escarpment (1826m – 1843m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	5	0	0	9
2	3	0	0	3
3	3	0	0	7
4	5	0	0	3
5	3	3	0	0
6	4	0	0	4
7	0	0	0	0
8	12	0	0	0
9	0	0	0	0
10	0	0	0	0
11	3	0	0	6
12	11	0	0	3
13	7	0	0	3
90th Percentile	11	0	0	7
Maximum Rut depth (mm)	12	3	0	9
Average Rut depth (mm)	5	1	0	3

LTPP 3	3 - Bottom of Escarpment (1414m – 1422m above sea level)			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	2	0	0	0
6	3	0	0	2
7	0	0	0	2
8	0	0	0	2
9	0	0	0	0
10	0	0	0	2
11	0	0	0	2
12	0	0	0	0
13	0	0	0	0
90th Percentile	2	0	0	2
Maximum Rut depth (mm)	3	0	0	2
Average Rut depth (mm)	1	0	0	1

LTPP 4	4 - On Second Escarpment (1340m – 1357m above sea level)					
PANEL	LEFT LANE		RIGHT LANE		RIGHT Climbing Lane	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path	Inner Wheel path	Outer Wheel path
1	34	16	0	0	0	9
2	11	14	0	0	4	5
3	9	12	0	0	0	0
4	17	12	0	0	7	4
5	5	0	0	0	6	12
6	21	14	3	0	3	11
7	14	5	0	0	3	0
8	19	10	3	0	3	8
9	9	4	0	0	8	4
10	14	8	0	0	3	5
11	38	16	0	0	0	5
12	11	8	0	0	0	8
13	11	12	0	0	4	9
90th Percentile	32	16	3	0	7	11
Maximum Rut depth (mm)	38	16	3	0	8	12
Average Rut depth (mm)	17	11	1	0	4	7

LTPP 5	5 - On second flat section hot area about 850m above sea level			
PANEL	LEFT LANE		RIGHT LANE	
	Outer Wheel path	Inner Wheel path	Inner Wheel path	Outer Wheel path
1	15	10	3	4
2	14	3	0	6
3	12	10	0	3
4	14	4	3	4
5	24	13	6	4
6	27	24	6	6
7	24	22	10	7
8	10	0	5	14
9	11	3	0	10
10	16	9	3	4
11	17	10	0	12
12	14	10	4	9
13	12	0	0	3
14	13	5	0	4
15	15	6	0	4
16	14	10	0	3
17	7	4	0	3
90^{th} Percentile	24	17	6	11
Maximum Rut depth (mm)	27	24	10	14
Average Rut depth (mm)	16	9	3	6

Appendix IVD: Visual Condition Index Hawsewa – Abala – Erebti Road

Condition Index Summary

SECTION	Condition Index	Category
Section-1: 9+200 – 9+380, Top of Escarpment (2343m-2347m a.s.l.)	97	Very Good
Section-2: 25+100 – 25+300, On Escarpment (1826m – 1843m a.s.l.)	97	Very Good
Section-3: 38+700 – 39+000, Bottom of Escarpment (1414m – 1422m a.s.l.)	97	Very Good
Section-4: 59+740 – 59+940, On Second Escarpment (1340m – 1357m a.s.l.)	81	Good
Section-5: 92+062 – 92+190, On second flat section hot area about 850m a.s.l.)	81	Good

Section 1 R

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	5	44.841214	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	5	23.49237886	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0		3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	86.33359286		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 98.9959

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **96.8**

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0

	Section 1 L									
Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	F_n= $D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	F_{nmax}= $D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	5	44.841214	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1	1	1	5	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	5	23.49237886	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0			0	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0	1	1	4.5	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0		3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	95.83359286		$\sum F_{nmax}$=	8598.484726

→	Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$=	98.8855
→	$C = 1/\sum_{n=0}^{n} F_{nmax}$=	0.000116299561
→	$VCI = (a * VCI_P + b * VCI_p^2)^2$	**96.5**
	a=	0.04000
	b=	0.00060
	VCI_{max}=	100
	VCI_{min}=	0

Section 2 - Both lane

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	3	24.29175332	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	5	23.49237886	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0		3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	79.6691816		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 99.0735

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **97.1**

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0

Section 3 - Both lane

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	2	14.93307861	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	5	23.49237886	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3			0	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0			0	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0		3	0	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0		3	0	4	3	42
						$\sum F_n$=	70.3105069		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 99.1823

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

VCI = $\left(a * VCI_P + b * VCI_p^2\right)^2$ = **97.4**

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0

Section 4 - Both lane

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Rating of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Rating of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	1	6.5	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9			0	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	1	4	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3	2	4	363.771976	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	3	3	144	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3			0	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	1	3	8.4	4	3	42
						$\sum F_n$=	565.371976		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 93.4247

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

$VCI = (a * VCI_P + b * VCI_p^2)^2$ = **81**

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0

Section 5 – Both lane

Item #	Deffect Type	Weight (W_n)	Small degree (S_n)	Extent Weight (Y_n)	Degree Ratting of Defect (D_n)	Extent Rating of Defect (E_n)	$F_n = D_n*(E_n\text{^}Yn)*W_n*S_n$	MaximumDegree Ratting of Defect $(D_n)_{max}$	Maximum Extent Rating of Defect $(E_n)_{max}$	$F_{nmax} = D_{nmax}*(E_{nmax}\text{^}Yn)*W_n*S_n$
1	SURFACING FAILURES	6.5	1.0	1.2	1	2	14.93307861	5	5	448.41214
2	SURFACING PATCHING	6.5	1.0	1.2			0	5	5	448.41214
3	SURFACING CRACKS	5	1.0	1.1			0	5	5	293.6547358
4	BINDER CONDITION (DRY / BRITTLE)	3	0.5	0.9	1	5	6.385049419	5	5	127.7009884
5	AGGREGATE LOSS	4	1.0	1.1	1	1	4	5	5	234.9237886
6	BLEEDING / FLUSHING	3	0.5	1.0	1	5	7.5	5	5	150
7	SURFACING DEFORMATION / SHOVING	15	1.0	1.3	1	5	121.5492448	5	5	1215.492448
8N	BOCK/STABILISATION CRACKS (NARROW SPACING)	8	1.0	1.2			0	5	5	551.8918646
8M	BLOCK/STABILISATION CRACKS (MEDIUM SPACING)	6	1.0	1.0			0	5	5	300
8L	BLOCK/STABILISATION CRACKS (LARGE SPACING)	5	1.0	1.0			0	5	5	250
9	TRANSVERSE CRACKS	4.5	1.0	1.0			0	5	5	225
10	LONGITUDINAL CRACKS	4.5	1.0	1.0			0	5	5	225
11	CROCODILE CRACKS	10	1.0	1.3			0	5	5	810.3282983
12	PUMPING	10	1.0	1.3			0	5	5	810.3282983
13	RUTTING	8	0.5	1.0	4	5	320	5	5	400
14	UNDULATIONS / SETTLEMENT	4	0.5	1.0			0	5	5	200
15	PATCHING	8	0.8	1.1			0	5	5	469.8475772
16	FAILURES / POTHOLES	15	1.0	1.3	1	1	15	5	5	1215.492448
17	ROUGHNESS	5.5	0.8	1.0	1	3	13.2	4	3	66
18	SKID RESISTANCE	3	0.5	1.0	2	3	18	4	3	36
19	SURFACE DRAINAGE	3	0.5	1.0		3	0	4	3	36
20	SHOULDERS (unpaved)	3.5	1.0	1.0		3	0	4	3	42
21	EDGE DEFECTS	3.5	0.8	1.0	2	3	21	4	3	42
						$\sum F_n$=	541.5673728		$\sum F_{nmax}$=	8598.484726

Priminary VCI = $VCI_P = 100\{1 - C[\sum_{n=0}^{n} F_n]\}$= 93.7016

$C = 1/\sum_{n=0}^{n} F_{nmax}$= 0.000116299561

VCI = $\left(a * VCI_P + b * VCI_P^2\right)^2$ = **81** (81)

a= 0.04000

b= 0.00060

VCI_{max}= 100

VCI_{min}= 0