Mangaung Metropolitan Municipality

Road Asset Management Plan

Version 1

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DOCUMENT CONTROL

Project Name:	**Road asset management Plan**
Project Number:	BCM45
Report for:	Mangaung Metropolitan Municipality

Preamble

This Plan is prepared as a live document to record the development of the road asset register and related information.

The intention is to keep it continually updated and to reflect the status of the road assets as the records and conditions of these assets are improved over time.

EXECUTIVE SUMMARY

The purpose of the document is to assist the Mangaung Metropolitan Municipality (MMM) to develop and implement a Road Asset Management Plan in order to maintain and upgrade its road assets in a reasonably optimal manner.

The data set that is used to start the project is obtained from the asset register of the 2018-2019 financial year of the MMM coupled with a detailed visual inspection of all roads carried out in 2019.

The Plan has been prepared using the results of the Municipal-wide road inventory update and inspections to obtain an initial indication of the budget and programme required to maintain the Metro's road networks.

It has been prepared with due consideration of:

(i) The extent, condition and usage of the road network.
(ii) Road User Requirements in terms of road roughness, condition and functional class of the roads.
(iii) Existing Practices in the Metro
(iv) Current contract prices
(v) Estimates of long term road needs
(vi) First draft Budget Prognoses which envisages long term consistent budgets.

ROAD INVENTORY

In summary, the Metro contains a total of 3800 km of roads of which 2200 km are unpaved.

Around 80% of the roads are Class 5 Access roads with the balance being Class 4 Collectors with a few Class 1, 2 and 3 roads.

The road inventory has been divided between 8 geographic to obtain an indication of the relative needs of each area, many which have only recently been incorporated into the Metro.

ROAD CONDITIONS

Road conditions are generally poor across most of the areas with **90%** of the bituminous road surfacings needing urgent attention to prevent moisture ingress and extend the life of the underlying pavements.

Rehabilitation backlogs are also substantial with less than **35%** of the pavements in a very poor condition.

ASSET VALUES

The current replacement cost (CRC) /asset value of roads in the Metro is some R6.8 billion. Based on the current road conditions as determined through recent inspections and related condition ratings for each component of the road (surfacing, pavement and formation) gives a depreciated replacement value (DRC) of some R2.9 billion which is less than half or the replacement cost.

ISSUES AND RISKS

The major issues and risks identified at this stage are:

- The total road maintenance need estimated from asset values is around R170 million per year while current expenditure is only a fraction of this.

- Many of the road surfacings are old and dry and rejuvenation and resealing projects to the value of R300million have been identified for the short term while the long term periodic maintenance need is only around R110million per year.
- If the long term maintenance need is made available as a maintenance budget all of the resurfacing projects can be attended to in 2 to 3 years to avoid the roads deteriorating to the point where road conditions become a danger to road users and the costs associated with reconstruction, instead of surface maintenance, will have to be borne.
- Rehabilitation and reconstruction projects totalling almost R1 Billion have been identified. This reflects the generally poor condition of the road pavements and the cost of this work could possibly be reduced through patching and resurfacing.
- There is a high risk of giving too much attention to the roads in very poor condition to the detriment of maintaining surfacings on roads in a fair condition and resulting in a poor allocation of resources.
- There are many kms of unpaved roads and the roads that require paving over the next 10 years need to be identified and attended to without compromising maintenance of existing paved roads.

ROAD ASSET MANAGEMENT SYSTEM

The Metro wide RRAMS system has been implemented to assist in managing the road network. This system will be improved using the information and systems supplied as part of this initiative.

POLICY

The Metro is in the process of developing a Road Asset Management Policy.

OBJECTIVES

The objectives of this Plan are

- to try and extend the lives of the paved roads in order to minimise the rehabilitation need
- to rehabilitate roads where required
- to ensure road standards are commensurate with the functional class of the road.

ROAD MAINTENANCE OPERATIONS

Current road maintenance operations are identifying problems and repairing them as appropriate but budgets need to be brought in line with the needs in order to sustain and improve the road network.

ROAD UPGRADING

Upgrading of gravel roads to paved is required that can proceed over time in a prioritised manner one the deterioration of paved roads has been addressed. Where available, MIG funding can be obtained to upgrade roads.

RESOURCING

The Metro has reasonable institutional resources but budgets for road maintenance fall far short of the long term need required to sustain the road network.

CONTINUOUS IMPROVEMENT

The outputs of the RAMS as well as the current maintenance practices can be continuously evaluated by the Metro to ensure value for money and cost-effectiveness.

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1. INTRODUCTION

This report documents the current status of the road networks within the Mangaung Metropolitan Municipality and sets out the annual road needs as well as a prioritised list of roads requiring maintenance.

1.1 Definitions and Abbreviations

AFS – Annual Financial Statements

CRC – Current Replacement Cost

DRC - Depreciated Replacement Cost

GIS – Geographic Information Systems

Component Type Codes are contained in the Table in Appendix A.

1.2 Current RAMS Status

(i) The existing GIS and inventory accurately depicts the local roads in the Mangaung Metropolitan Municipality.

(ii) The inventory has been confirmed and minor adjustments made to the extent of the road network as well as road widths and road types.

(iii) The roads in the Metro have been inspected in accordance with the new draft TMH9 guidelines.

(iv) The road inventory, GIS and inspection results has been uploaded into a PostGIS opensource database that will be made available to the Metro.

(v) The road assets have been unbundled into components as follows:

- Paved roads Flexible surfacing, pavement, formation
- Paved roads – Block pavement and formation
- Paved roads – concrete pavement and formation
- Unpaved roads formation

(vi) The roads have been classified into Distributors (Class3), Collectors (Class 4) and access streets (Class 5). Some Arterials (Class 2) also exist.

(vii) No traffic counts were available at the time of this report. It is recommended that traffic counts be done as an ongoing action to ensure that road-usage can be brought into account in prioritising actions on the road network.

2. ROAD INVENTORY

2.1 Mangaung Regions

While the Manguang Metro Municipality includes a number of smaller towns and areas the greater area has been subdivided into smaller areas to facilitate a better understanding of the distribution of roads throughout the Municipality. While the database includes details of smaller areas such as wards and sub-places(suburbs) the breakdown into these areas is not shown in this report.

A map of the regions used in this report is shown below:

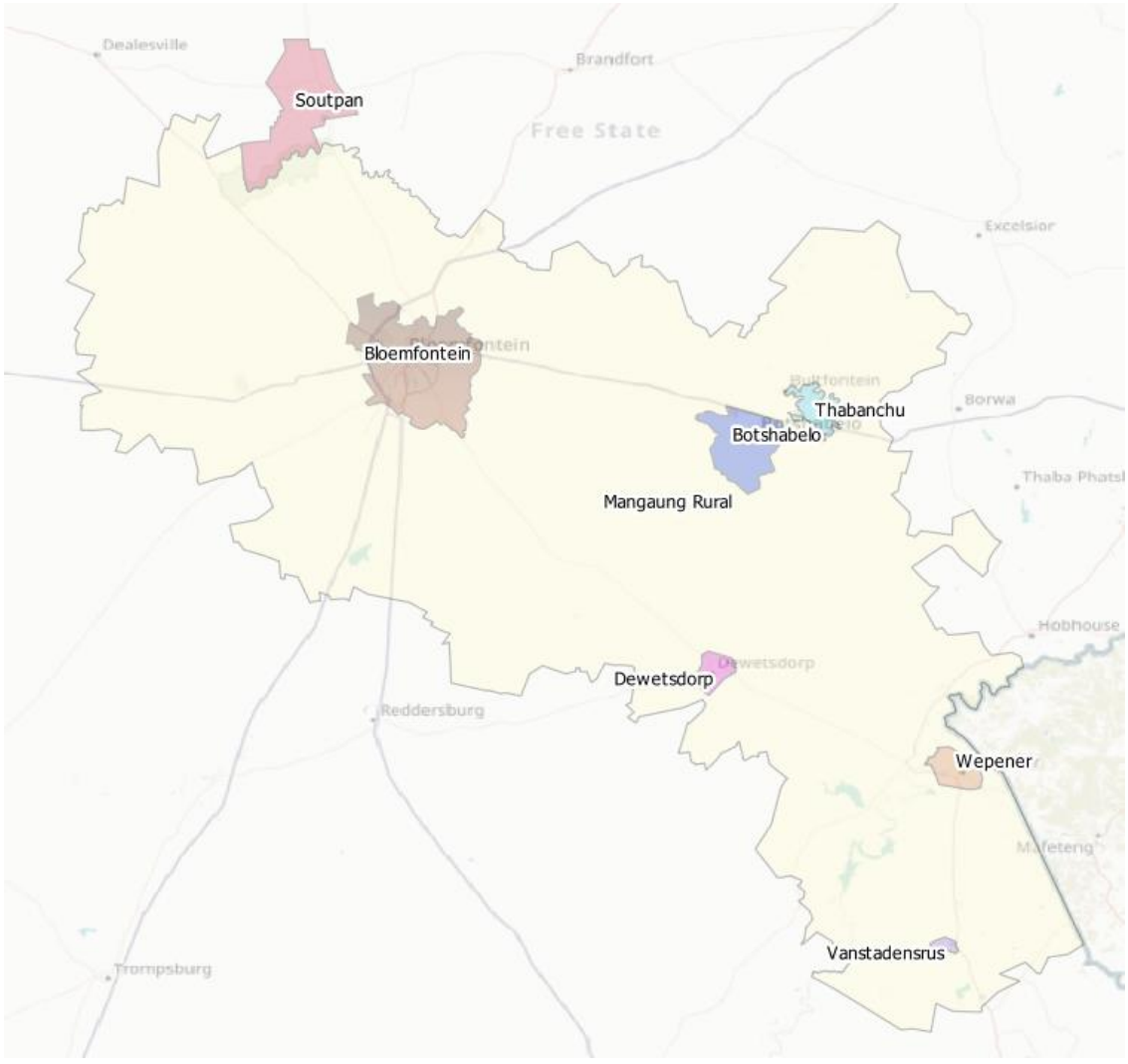


Figure 2-1: Mangaung Regions

2.2 Road Hierarchy

The roads have been classified in accordance with TMH26 and this is shown in map form in the Appendices.

The road classification is summarised in the tables and figures below:

Table 2-1: Road Class

Municipality	Road Class					Grand Total
	National	Arterial	Distributor	Collector	Access	
Bloemfontein	30.2	29.6	182.6	194.2	1402.9	**1839.5**
Botshabelo	0.0	0.0	15.5	105.4	535.7	**656.6**
Dewetsdorp	0.0	0.0	0.0	10.6	42.6	**53.2**
Mangaung Rural	0.0	1.1	3.9	22.3	738.0	**765.3**
Soutpan	0.0	0.0	0.0	0.0	19.1	**19.1**
Thabanchu	0.0	0.0	8.6	46.5	361.0	**416.1**
Vanstadensrus	0.0	0.0	0.0	4.0	16.1	**20.1**
Wepener	0.0	0.0	0.0	8.4	52.6	**61.0**
Grand Total	**30.2**	**30.7**	**210.6**	**391.5**	**3168.0**	**3831.0**

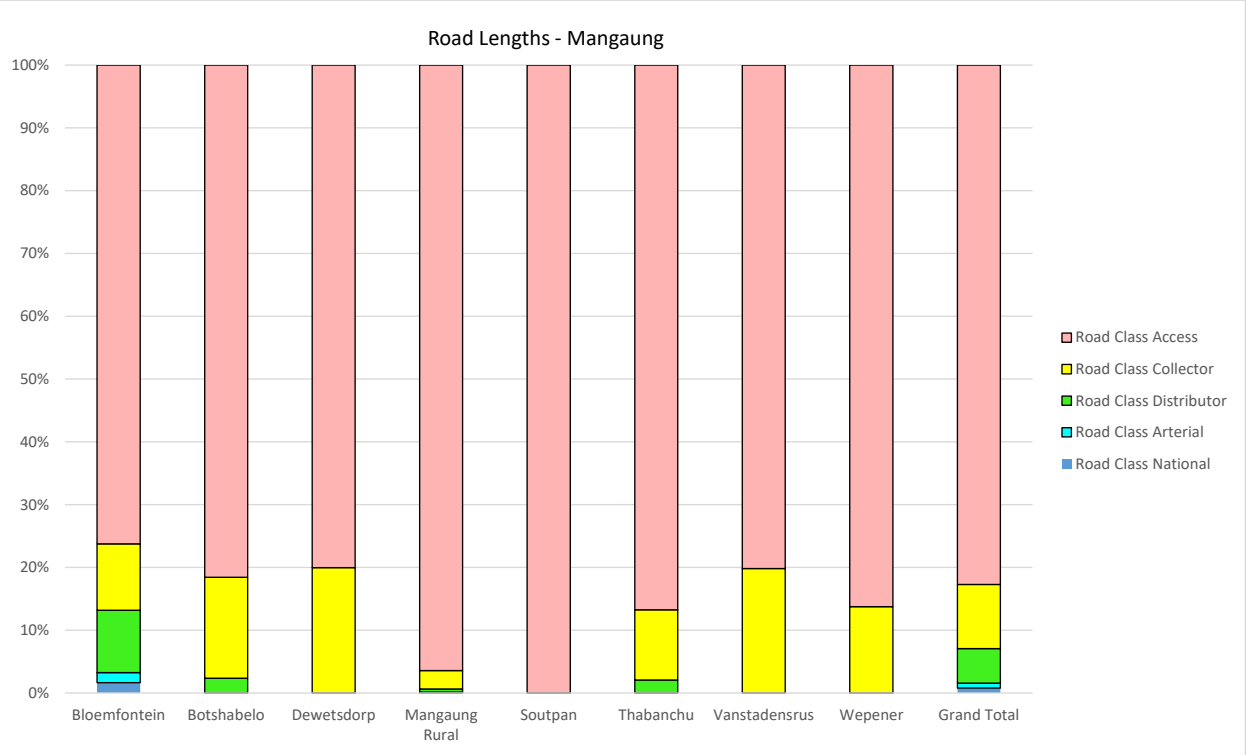


Figure 2-2: Percentage Road Class per Area

The table shows that there are 3831 km of road in Mangaung with roughly 85% of these roads are Class 5 roads (access roads) with approximately 10% being Class 4 (collectors).

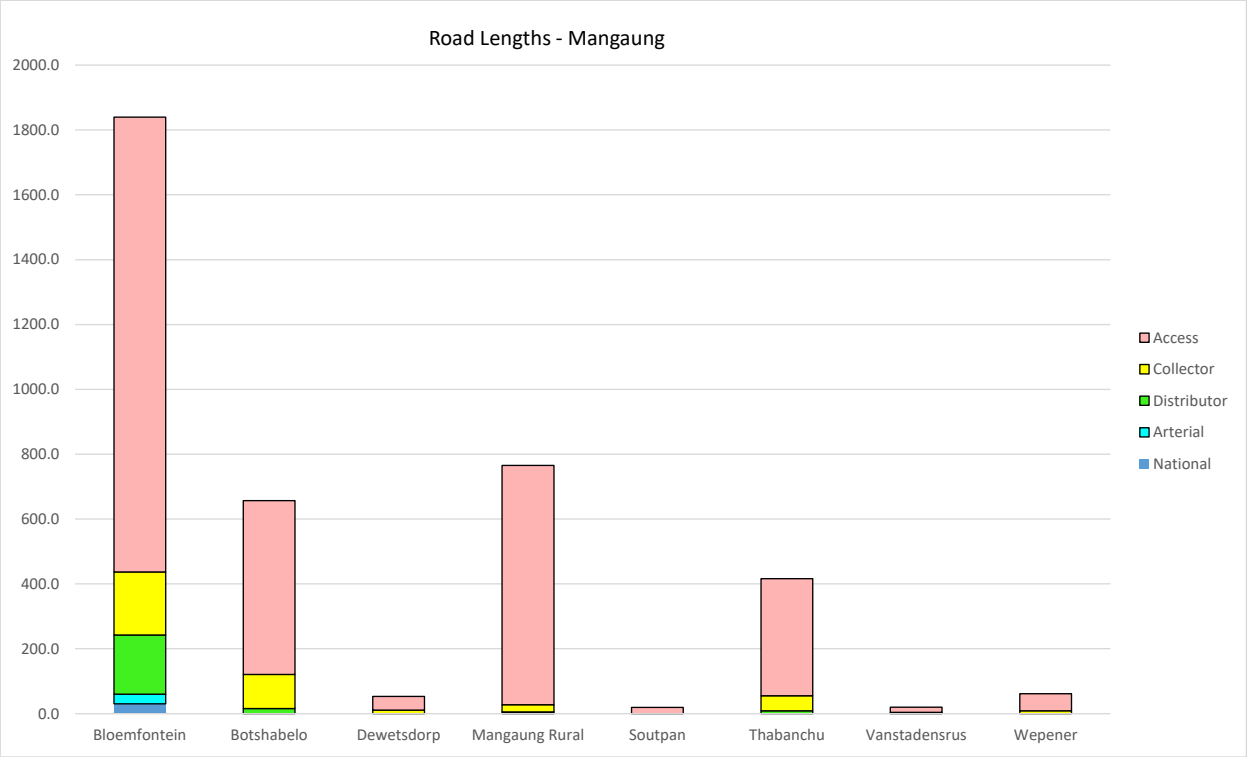


Figure 2-3: Lengths per Class and Area

The figure shows that relatively uneven distribution of roads across the various areas and gives an overall appreciation of where the majority of roads are located.

This road classification is shown in map form on the accompanying maps.

Table 2-2: Road Type - Mangaung

Municipality/Town	Road Type									Grand Total
	Dual c/way	Paved - Flexible	Paved - Block	Paved - Concrete	Gravel	Roundabout	Link or Slip Road	Earth	Walkway - Paved	
Bloemfontein	236.2	899.0	41.2	0.0	655.3	2.4	5.3	0.0	0.1	**1839.5**
Botshabelo	1.0	165.2	6.6	0.0	483.7	0.0	0.2	0.0	0.0	**656.6**
Dewetsdorp	0.0	11.7	10.9	0.0	30.6	0.0	0.0	0.0	0.0	**53.2**
Mangaung Rural	3.6	84.7	19.1	0.0	657.8	0.0	0.2	0.0	0.0	**765.3**
Soutpan	0.0	0.0	1.3	0.0	0.0	0.0	0.0	17.8	0.0	**19.1**
Thabanchu	3.9	56.4	13.0	0.0	342.8	0.0	0.0	0.0	0.0	**416.1**
Vanstadensrus	0.0	2.0	2.3	0.0	15.8	0.0	0.0	0.0	0.0	**20.1**
Wepener	0.0	7.4	12.4	0.5	40.7	0.0	0.0	0.0	0.0	**61.0**
Grand Total	**244.7**	**1 226.4**	**106.9**	**0.5**	**2 226.5**	**2.4**	**5.7**	**17.8**	**0.1**	**3831.0**

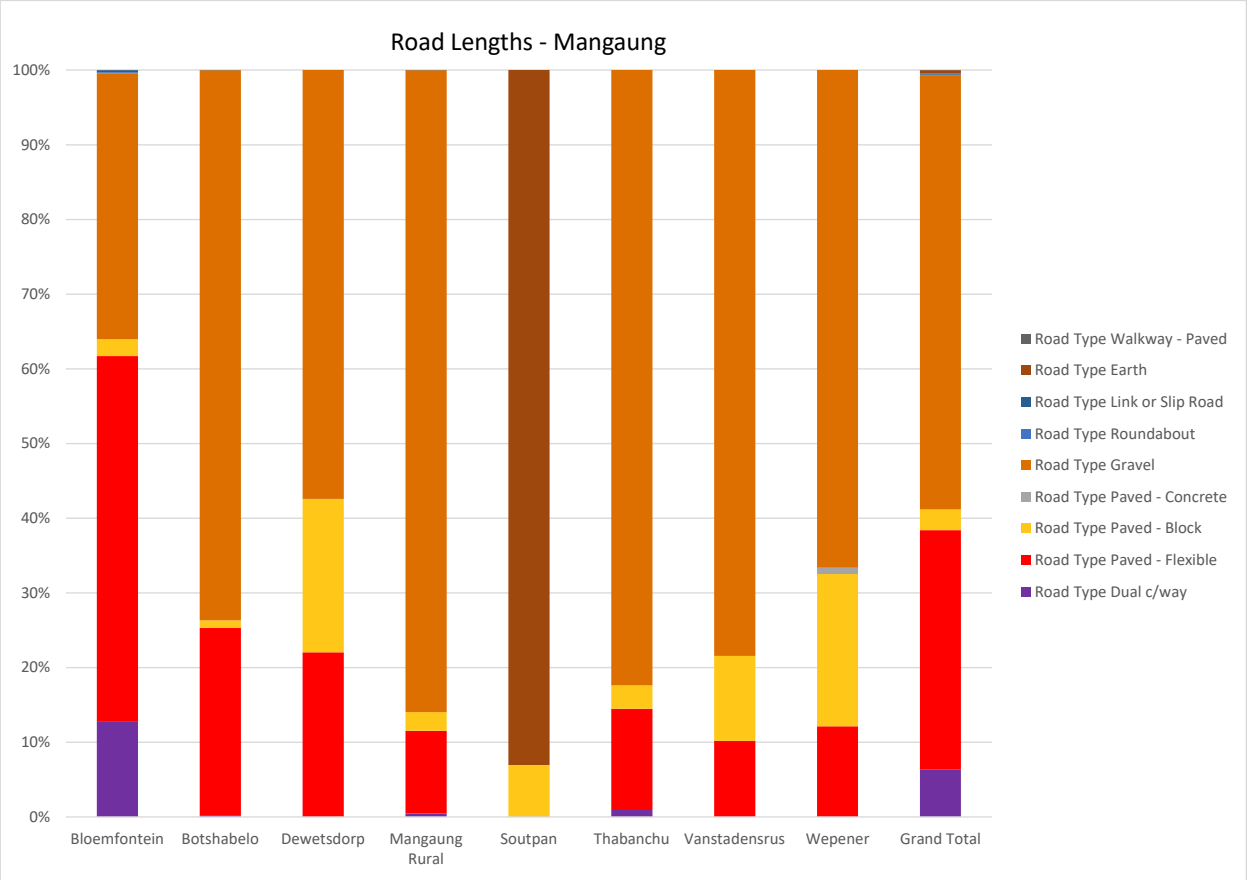


Figure 2-4: Percentage Road Type per Area

The data shows that roughly 60% (2265km) of all roads in Manguang are unpaved.

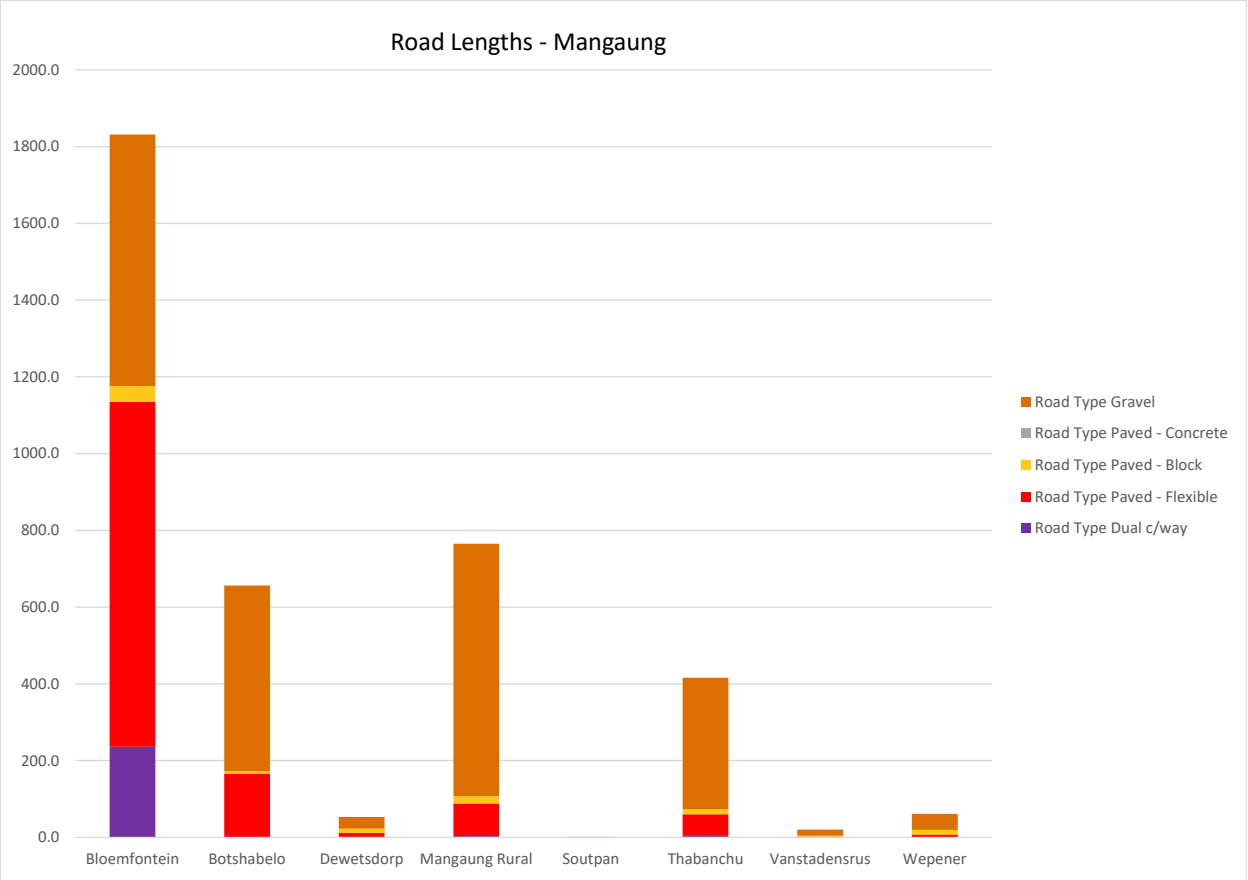


Figure 2-5" Length of Road Type per Area

A large proportion of the unpaved road lengths are in rural areas (Mangaung Rural) but a significant length of unpaved roads also exists in the Bloemfontein, Botshabelo and Thabanchu areas.

In addition to these roads, there are roughly 475km of roads in the municipal database that fall under the custodianship of others but which are included to present a comprehensive picture.

3. ROAD CONDITIONS

3.1 General Conditions

Road conditions are described broadly in terms of the visual condition index (VCI) of the road. This index represents a weighted average of the condition based on all defects on flexible pavements. Similar indices are calculated for the other road types and the overall situation is presented in the table and figures below:

Table 3-1: General road conditions per region

Municipality	Road General Condition (km)					
	1 - Very Good	2 - Good	3 - Fair	4 - Poor	5 - Very Poor	Total
Bloemfontein	133	386	378	327	547	**1 770**
Botshabelo	102	60	32	112	341	**646**
Dewetsdorp	3	6	3	7	24	**43**
Mangaung Rural	16	34	70	169	470	**758**
Soutpan	0	0	2	4	9	**15**
Thabanchu	35	25	94	88	161	**403**
Vanstadensrus	2	0	2	4	11	**18**
Wepener	4	2	3	5	34	**48**
Grand Total	**294**	**513**	**584**	**716**	**1 596**	**3 702**

This is shown graphically in the figure below to show proportions:

In general, around 60% (1596+716= 2312km) of the roads in Mangaung Metropolitan Municipality are in a poor or very poor condition with Wepener having the worst conditions and Bloemfontin the best.

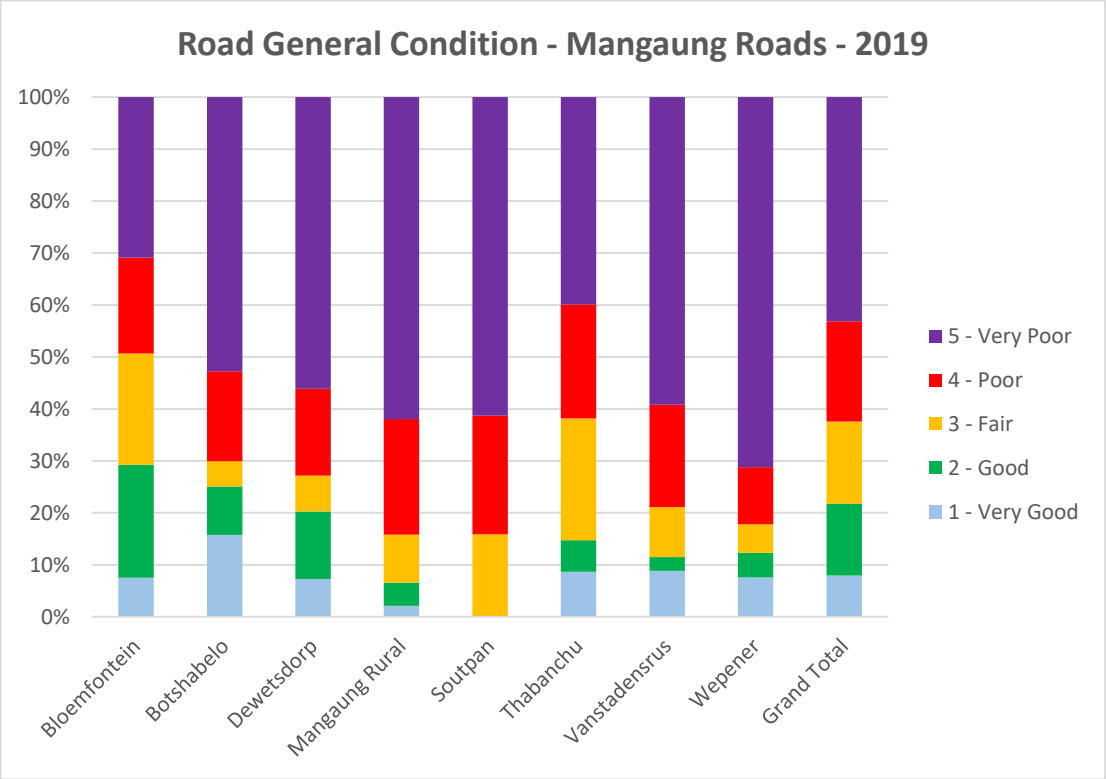


Figure 3-1: Road Condition Distribution per Area

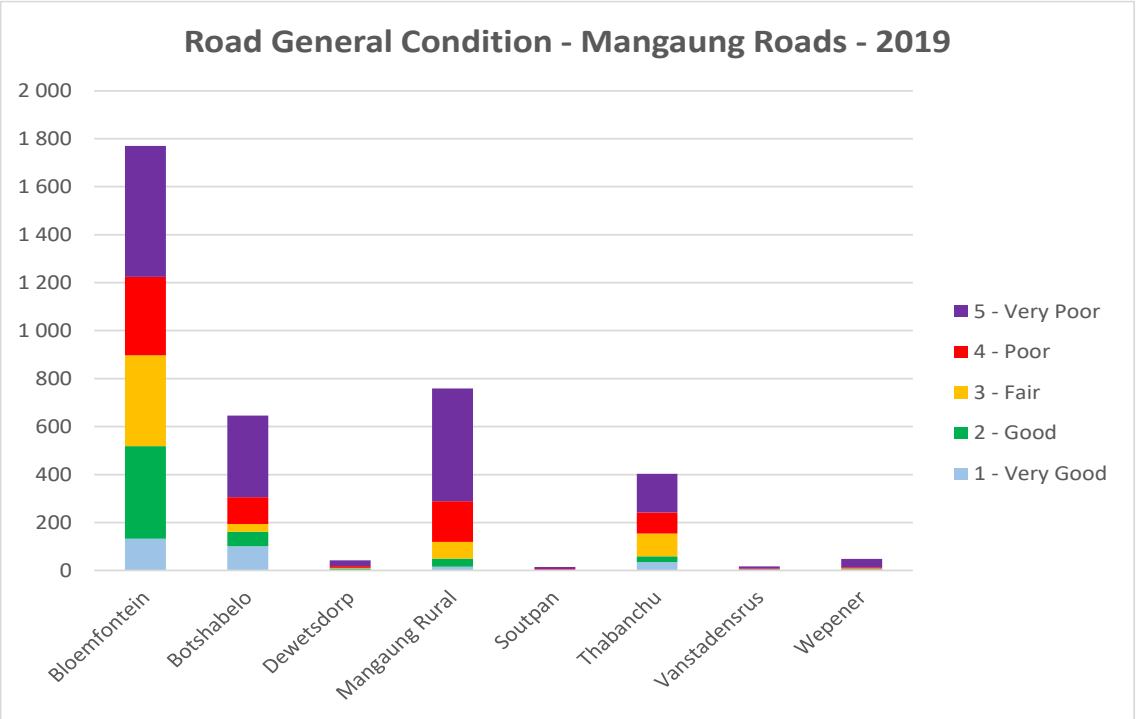


Figure 3-2: Road General Condition - Length per Area

3.2 Component Conditions

The distributions (per sqm) of Surfacing (SCI), Pavement (PCI) and Formation (FCI) Condition indices respectively are shown for the 7 towns in the tables and graphs below.

A very large proportion (90%) of all surfacings and in a poor condition, which occurs throughout the LM.

Table 3-2: Surfacing Condition (Flex)

Municipality	Surface Condition (sqm)					
	1 - Very Good	2 - Good	3 - Fair	4 - Poor	5 - Very Poor	Total
Bloemfontein	0	12 408	589 843	4 489 584	3 726 338	**8 818 174**
Botshabelo	12 982	26 755	185 820	949 144	6 499	**1 181 200**
Dewetsdorp	1 445	6 946	13 838	34 976	49 210	**106 415**
Mangaung Rural	14 550	11 213	89 773	243 405	239 479	**598 420**
Soutpan	0	0	0	0	0	**0**
Thabanchu	0	0	57 182	371 532	701	**429 415**
Vanstadensrus	0	0	949	12 169	0	**13 118**
Wepener	0	0	11 047	49 591	1 024	**61 663**
Grand Total	**28 977**	**57 323**	**948 452**	**6 150 401**	**4 023 252**	**11 208 405**

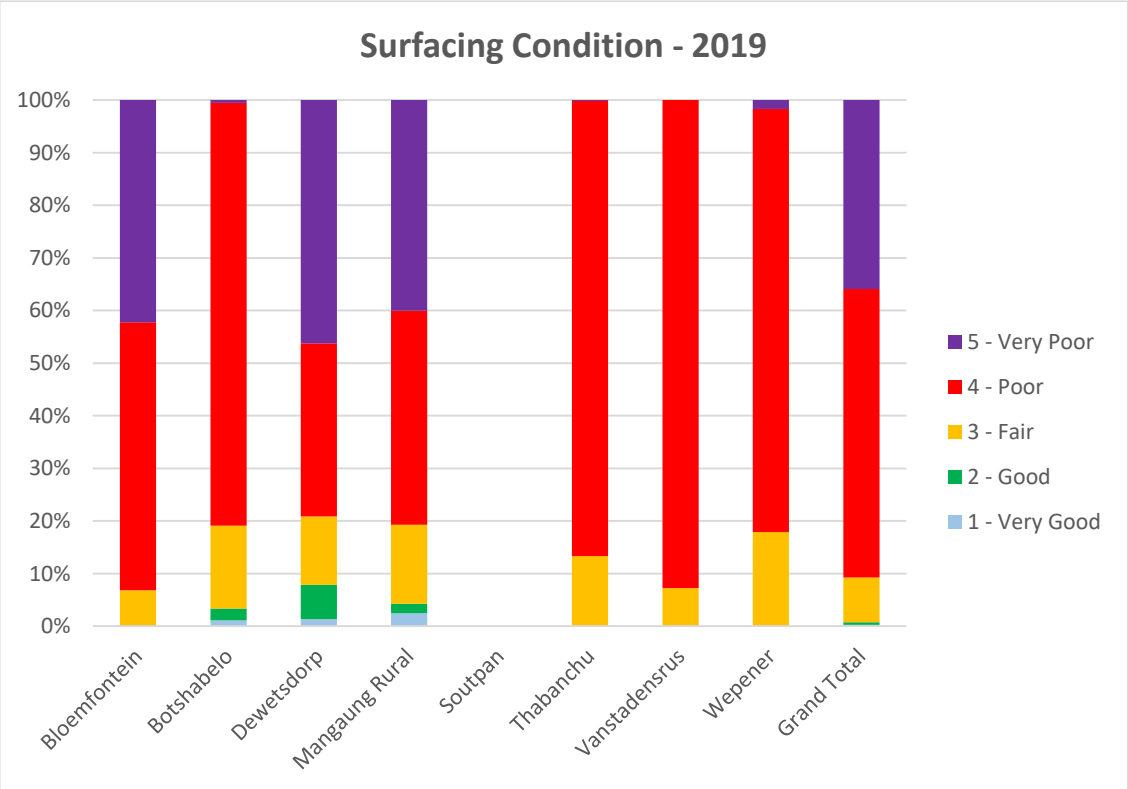


Figure 3-3: Surfacing Conditions (Flexible Pavements)

The pavement conditions are generally better than the surfacings with roughly 50% in a poor condition.

Table 3-3: Pavement Condition

Municipality	Pavement Condition (sqm)					
	1 - Very Good	2 - Good	3 - Fair	4 - Poor	5 - Very Poor	Total
Bloemfontein	10 699	264 653	3 451 687	1 680 932	3 580 525	**8 988 496**
Botshabelo	14 215	166 418	594 486	303 609	144 690	**1 223 417**
Dewetsdorp	9 609	44 259	59 260	25 067	29 525	**167 720**
Mangaung Rural	38 410	58 329	230 137	91 941	295 265	**714 082**
Soutpan	0	1 375	611	5 764	0	**7 750**
Thabanchu	10 269	86 594	313 551	96 047	5 672	**512 133**
Vanstadensrus	402	8 598	8 807	8 411	1 562	**27 779**
Wepener	7 124	36 374	45 502	50 464	2 598	**142 062**
Grand Total	**90 726**	**666 600**	**4 704 040**	**2 262 235**	**4 059 837**	**11 783 438**

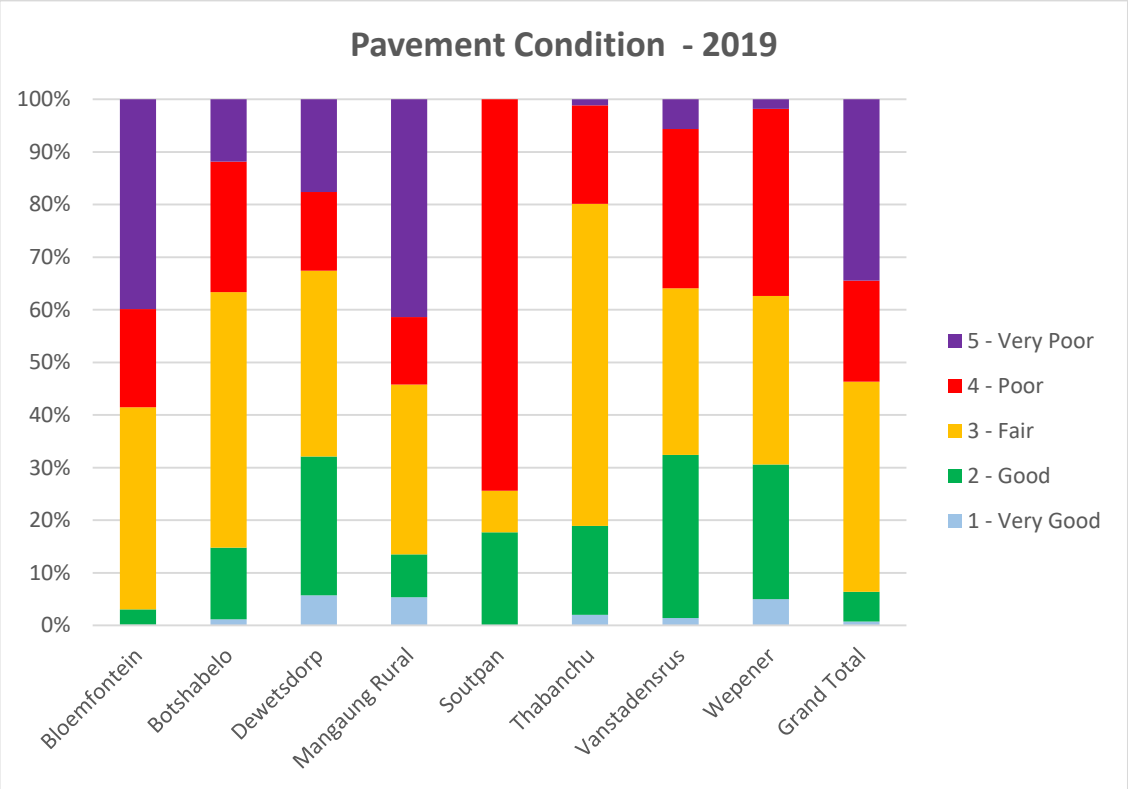


Figure 3-4: Pavement Condition Distribution

The formation conditions are generally also poor although this is primarily represented by the unpaved roads.

Table 3-4: Formation Condition

Municipality	Formation Condition (sqm)					
	1 - Very Good	2 - Good	3 - Fair	4 - Poor	5 - Very Poor	Total
Bloemfontein	766 708	845 676	5 460 051	3 292 480	2 605 264	**12 970 179**
Botshabelo	309 197	441 146	595 164	506 563	1 552 333	**3 404 403**
Dewetsdorp	63 154	50 918	38 898	48 966	130 931	**332 867**
Mangaung Rural	107 838	61 420	641 961	818 317	1 816 176	**3 445 712**
Soutpan	1 375	0	15 454	15 475	40 907	**73 211**
Thabanchu	255 589	112 401	580 820	426 966	776 935	**2 152 711**
Vanstadensrus	11 557	15 716	8 276	16 119	53 414	**105 083**
Wepener	49 518	52 657	46 290	29 722	164 577	**342 763**
Grand Total	**1 564 936**	**1 579 934**	**7 386 914**	**5 154 609**	**7 140 537**	**22 826 930**

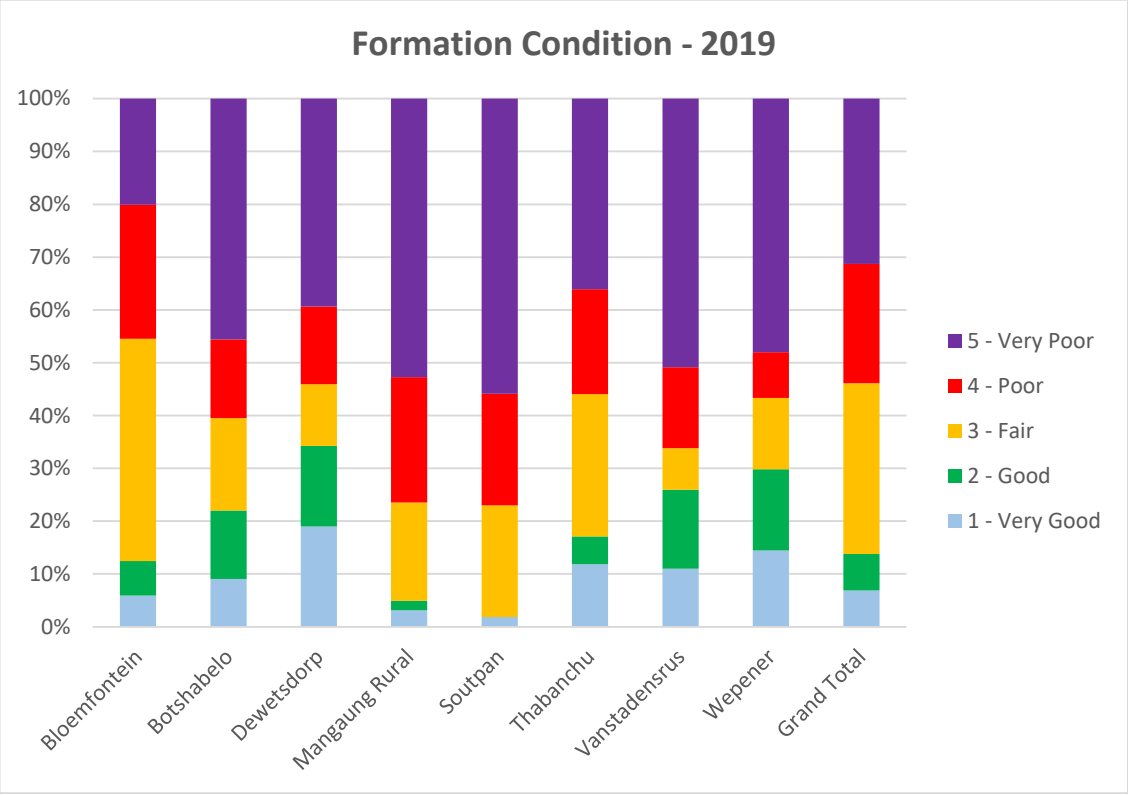


Figure 3-5: Formation Condition: All Roads

When the unpaved roads are excluded the situation is as shown below with only 20% of all paved roads having formations in a poor condition:

Table 3-5: Formation Condition - Excluding Unpaved

Municipality	Formation Condition (sqm)					
	1 - Very Good	2 - Good	3 - Fair	4 - Poor	5 - Very Poor	Total
Bloemfontein	766 708	845 676	4 930 937	2 395 530	52 439	**8 991 291**
Botshabelo	309 197	441 146	467 898	1 570	3 607	**1 223 417**
Dewetsdorp	63 154	50 918	37 442	13 850	2 637	**168 001**
Mangaung Rural	107 838	57 161	411 658	110 062	31 144	**717 863**
Soutpan	1 375	0	6 375	0	0	**7 750**
Thabanchu	255 589	112 401	143 666	701	0	**512 358**
Vanstadensrus	11 557	15 716	506	0	0	**27 779**
Wepener	49 518	52 657	38 347	0	2 168	**142 690**
Grand Total	**1 564 936**	**1 575 675**	**6 036 829**	**2 521 713**	**91 995**	**11 791 148**

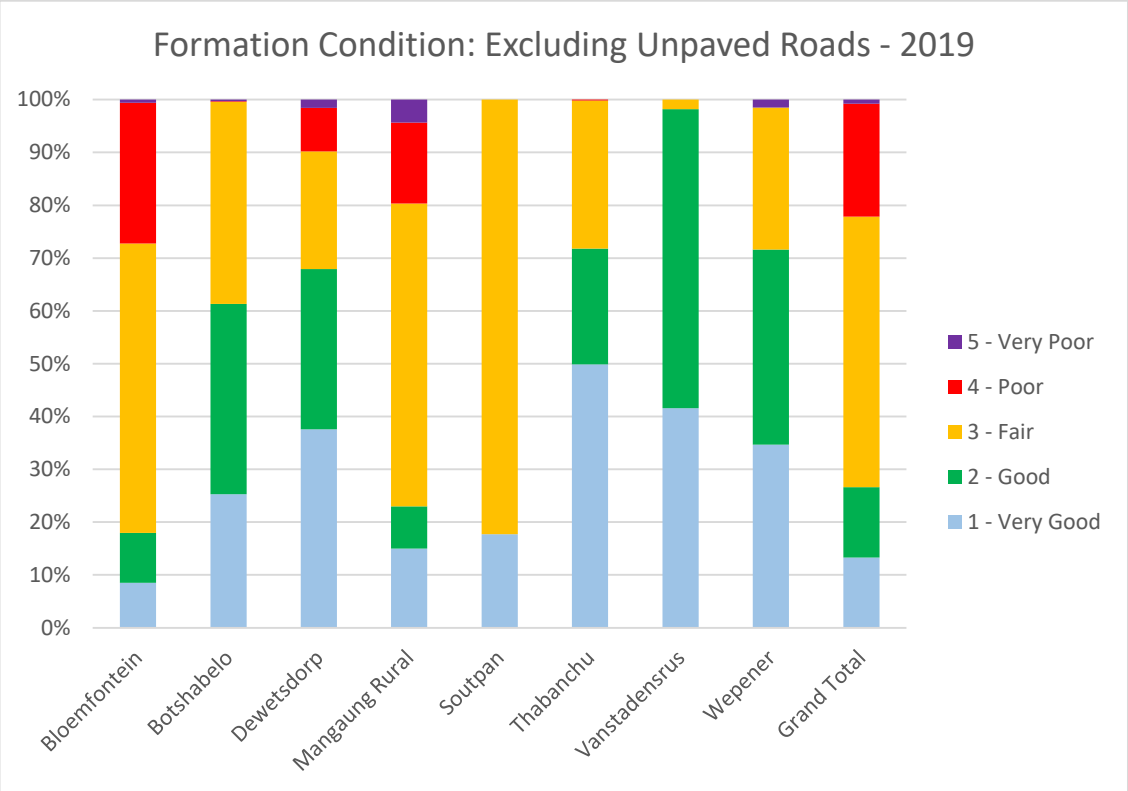


Figure 3-6: Formation Condition Distribution Excluding Unpaved Roads

3.3 Modes of Failure

The mode of failure of most of the flexible pavements involves surface ageing and cracking with associated moisture ingress, followed by deformation and potholing of the pavement.

As most of the distress appears to be associated with water ingress through old surfacings, this distress development can be arrested through surface rejuvenation and resealing.

4. ASSET VALUES

4.1 Unit Costs

The following table shows the unit cost used to calculate Current Replacement Cost (CRC) of the road network.

Row Labels	costcode_desc	Average of unit_rate	Average of current_allinrate
Road Formation		**R 122.64**	**R 181.31**
906	Formation for Earth Road - Low Standard 60kph	R 50.00	R 75.18
872	Formation for Gravel Road Incl wearing course - Low Standard 80kph	R 100.00	R 150.36
387	Formation for Paved Road - Low Standard	R 150.00	R 225.54
389	Formation for Paved Road - Medium standard	R 132.64	R 167.45
1500	Formation for paved and dual roads in flat terrain	R 200.00	R 252.50
1501	Formation for paved and dual roads in rolling terrain	R 250.00	R 315.62
Road Kerb		**R 584.21**	**R 878.44**
390	Kerbs - all Types	R 584.21	R 878.44
Road Pavement		**R 230.08**	**R 331.30**
660	Block Paving Full Interlock - Herringbone	R 217.58	R 308.64
671	Block Paving Full Interlock - Other Pattern	R 217.58	R 308.64
691	Block paving No interlock - Other pattern	R 217.58	R 308.64
699	Block paving partial interlock - Other pattern	R 180.64	R 256.24
700	Block Paving Full Interlock - Basket Weave	R 217.58	R 308.64
701	Block Paving Full Interlock - Stretcherbond	R 180.64	R 256.24
393	Granular Pavement - base & Subbase (< = 300mm), ES1	R 213.94	R 321.69
1502	Granular Pavement - base & Subbase (< = 450mm), ES3	R 300.00	R 378.74
1503	Granular Pavement - base & Subbase (< = 600mm), ES10	R 400.00	R 504.99
1505	Thin concrete pavement ca. 100mm thick	R 250.00	R 315.62
Road Sidewalk		**R 250.00**	**R 315.62**
1504	Paved Sidewalk	R 250.00	R 315.62
Road Surfacing		**R 86.10**	**R 128.02**
396	Singe Seal (aggregate size unknown)	R 50.00	R 75.18
395	Double seal (aggregate size unknown)	R 86.07	R 129.42
703	13mm & slurry (Thin Cape Seal)	R 86.99	R 123.40
394	Asphalt	R 105.63	R 158.83
Grand Total		**R 216.45**	**R 319.56**

4.2 Asset Current Replacement Costs

Based on the above rates the table below shows the CRC of the roads in the road network.

Table 4-1: Roads - Current Replacement Cost - 2012 Rates

	Road Current Replacement Cost (CRC R1000s)			
Municipality	**Formation**	**Pavement**	**Surfacing**	**Total**
Bloemfontein	R 1 798 192	R 2 204 902	R 791 972	**R 4 795 065**
Botshabelo	R 411 159	R 276 374	R 102 751	**R 790 285**
Dewetsdorp	R 41 687	R 36 091	R 7 900	**R 85 678**
Mangaung Rural	R 384 997	R 156 205	R 50 447	**R 591 649**
Soutpan	R 4 913	R 1 664	R 0	**R 6 577**
Thabanchu	R 242 962	R 116 671	R 36 187	**R 395 820**
Vanstadensrus	R 11 897	R 5 996	R 1 129	**R 19 023**
Wepener	R 41 658	R 31 206	R 5 454	**R 78 318**
Grand Total	**R 2 937 465**	**R 2 829 109**	**R 995 841**	**R 6 762 414**

Using straight line depreciation, based on the deduct-value condition indices, provides an indication of the depreciated replacement cost (DRC) of the road network:

Table 4-2: Depreciated Replacement Cost (2012 Rates)

	Road Depreciated Replacement Cost (DRC R1000s)			
Municipality	**Formation**	**Pavement**	**Surfacing**	**Total**
Bloemfontein	R 910 909	R 832 549	R 223 574	**R 1 967 032**
Botshabelo	R 190 655	R 154 049	R 48 725	**R 393 429**
Dewetsdorp	R 21 981	R 20 127	R 3 002	**R 45 110**
Mangaung Rural	R 133 609	R 66 127	R 19 001	**R 218 736**
Soutpan	R 1 804	R 923	R 0	**R 2 726**
Thabanchu	R 115 067	R 72 712	R 16 346	**R 204 126**
Vanstadensrus	R 5 102	R 3 481	R 480	**R 9 062**
Wepener	R 20 091	R 17 960	R 2 374	**R 40 426**
Grand Total	**R 1 399 217**	**R 1 167 928**	**R 313 503**	**R 2 880 647**

This results in the following Ratios of DRC/CRC that can be used to calculate remaining life.

Table 4-3: DRC/CRC Ratios

	Road DRC/ CRC Ratio			
Municipality	**Formation**	**Pavement**	**Surfacing**	**Asset**
Bloemfontein	0.51	0.38	0.28	**0.41**
Botshabelo	0.46	0.56	0.47	**0.50**
Dewetsdorp	0.53	0.56	0.38	**0.53**
Mangaung Rural	0.35	0.42	0.38	**0.37**
Soutpan	0.37	0.55		**0.41**
Thabanchu	0.47	0.62	0.45	**0.52**
Vanstadensrus	0.43	0.58	0.42	**0.48**
Wepener	0.48	0.58	0.44	**0.52**
Average	**0.48**	**0.41**	**0.31**	**0.43**

The surfacings generally have remaining lives of around 30% and need attention.

The pavement remaining lives are generally around 40% and if the surfacings are resurfaced or rejuvenated these will improve significantly. The paved road formations generally have adequate remaining lives but the unpaved roads generally need attention.

5. ROAD NEEDS

5.1 Maintenance Based on Asset Value

The total asset replacement cost of roads in the Municipality is some R 6.8 Billion. At an asset maintenance tempo of 2.5% per year the road maintenance budgets should be of the order of R170 million per year. This is broken down per area in the following table:

Annual Need as percentage of CRC	**2.50%**
Bloemfontein	**R 119 877**
Botshabelo	**R 19 757**
Dewetsdorp	**R 2 142**
Mangaung Rural	**R 14 791**
Soutpan	**R 164**
Thabanchu	**R 9 896**
Vanstadensrus	**R 476**
Wepener	**R 1 958**
Grand Total	**R 169 060**

5.2 Periodic Maintenance Need

Assuming that paved roads with bituminous surfacings needs to be resurfaced every 10 years gives a resurfacing need of around 1 120 000 sqm per year and at an average cost of R100 /sqm this amounts to some **R112m per year**. This can be compared to the 10 173 653 sqm (90%) of surfacing currently in a poor or very poor condition which will cost some 10 times the above "need" amount to repair.

Table 5-1: Resurfacing Need per Area

Municipality	**Total Surface Area**	**Resurfacing Need Per Annum (Rmillions)**
		R 10
Bloemfontein	**8 818 174**	R 88.2
Botshabelo	**1 181 200**	R 11.8
Dewetsdorp	**106 415**	R 1.1
Mangaung Rural	**598 420**	R 6.0
Soutpan	**0**	R 0.0
Thabanchu	**429 415**	R 4.3
Vanstadensrus	**13 118**	R 0.1
Wepener	**61 663**	R 0.6
Grand Total	**11 208 405**	**R 112.1**

The difference between the “Need Area” of 1 1 million sq m and the area of 10 million sq m in a poor and very poor condition (based on SCI) represents the backlog in respect of re-surfacing. This amounts to some 9 million sq metres or 80% of the total road surface area in the Metro. This backlog amount for resurfacing these streets is around R900 million which substantially exceeds the total annual maintenance “need” of R170 million based on asset value.

This is shown for each of the areas in the table below.

Table 5-2: Surfacing area in a poor condition per area versus "Need Area"

Municipality	Surface Condition (sqm)			Need Area	Poor Condition / Need Area
	4 - Poor	5 - Very Poor	Total	10%	
Bloemfontein	4 489 584	3 726 338	**8 215 922**	**881 817**	**9.3**
Botshabelo	949 144	6 499	**955 643**	**118 120**	**8.1**
Dewetsdorp	34 976	49 210	**84 185**	**10 642**	**7.9**
Mangaung Rural	243 405	239 479	**482 884**	**59 842**	**8.1**
Soutpan					
Thabanchu	371 532	701	**372 233**	**42 941**	**8.7**
Vanstadensrus	12 169	0	**12 169**	**1 312**	**9.3**
Wepener	49 591	1 024	**50 616**	**6 166**	**8.2**
Grand Total	**6 150 401**	**4 023 252**	**10 173 653**	**1 120 840**	**9.1**

Therefore, a carefully considered strategy needs to be developed to maintain the paved road network within budget constraints.

5.3 Rehabilitation Backlog

The paved roads in a very poor condition (4 059 837 sqm) can be regarded as a rehabilitation backlog need.

Assuming a unit rate of R300/sqm this gives a rehabilitation backlog of some R1.2 Bn. This is shown per area in the table below:

Table 5-3: Rehabilitation Backlog per Area

Municipality	Pavement Area in Very Poor Condition	Rehab Rate (R/sqm)	Amount (R Millions)
Bloemfontein	3 580 525	R 294	**R 1 052.7**
Botshabelo	144 690	R 295	**R 42.7**
Dewetsdorp	29 525	R 296	**R 8.7**
Mangaung Rural	295 265	R 297	**R 87.7**
Soutpan	0	R 298	**R 0.0**
Thabanchu	5 672	R 299	**R 1.7**
Vanstadensrus	1 562	R 300	**R 0.5**
Wepener	2 598	R 300	**R 0.8**
Grand Total	**4 059 837**	**R 300**	**R 1 218.0**

5.4 Gravel Road Upgrading Need

There are many kilometres of unpaved road in the Municipality. Some of these are rural roads while others are roads within townships. The set of unpaved roads that should be upgraded to paved roads over time needs to be identified from the 2200 km of unpaved roads in the Municipality and a programme developed to upgrade these roads where required.

The annual upgrading need if all the unpaved roads are attended to over 10 years amounts to some R891 million.

Table 5-4: Gravel Road Upgrading Need

Municipality	Gravel Road kms	Annual km upgraded assuming all over 10 years	Upgrade Rate (R Million/km)	Amount (R Millions)
Bloemfontein	655	65.5	R 4	**R 262**
Botshabelo	484	48.4	R 4	**R 193**
Dewetsdorp	31	3.1	R 4	**R 12**
Mangaung Rural	658	65.8	R 4	**R 263**
Soutpan	0	0.0	R 4	**R 0**
Thabanchu	343	34.3	R 4	**R 137**
Vanstadensrus	16	1.6	R 4	**R 6**
Wepener	41	4.1	R 4	**R 16**
Grand Total	**2 227**	**222.7**	**R 4**	**R 891**

5.5 Road Maintenance Strategy

Pavement resurfacing is always considered to be the highest priority for paved roads as this prevents moisture ingress into the pavement with associated moisture accelerated distress.

The estimated long-term annual need for the municipality based on current replacement cost is of the order of R170 million while the long term annual resurfacing need (10%) is of the order of R112 million.

However, 90% of the road surfacings are in a poor condition and these will need to be attended to over time as a priority to try and arrest further deterioration of the pavements with the associated much higher rehabilitation cost.

Therefore, it is suggested that rejuvenation of the roads be tackled as soon as possible to extend the lives of the surfacings. This can be followed with repairs and resurfacing of the poorer areas and finally major patching and rehabilitation where required.

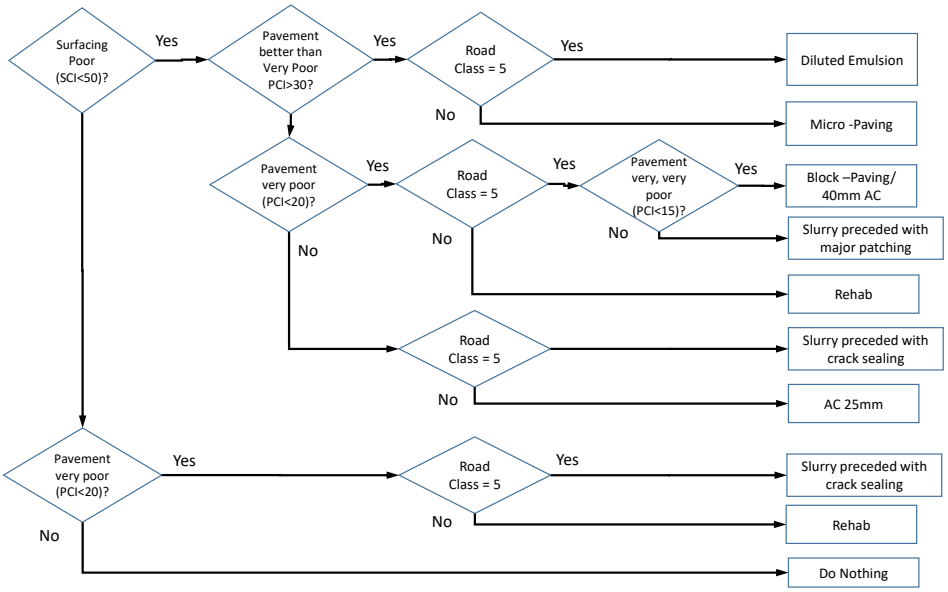
This is discussed in more detail below.

6. ROAD MANAGEMENT PLAN

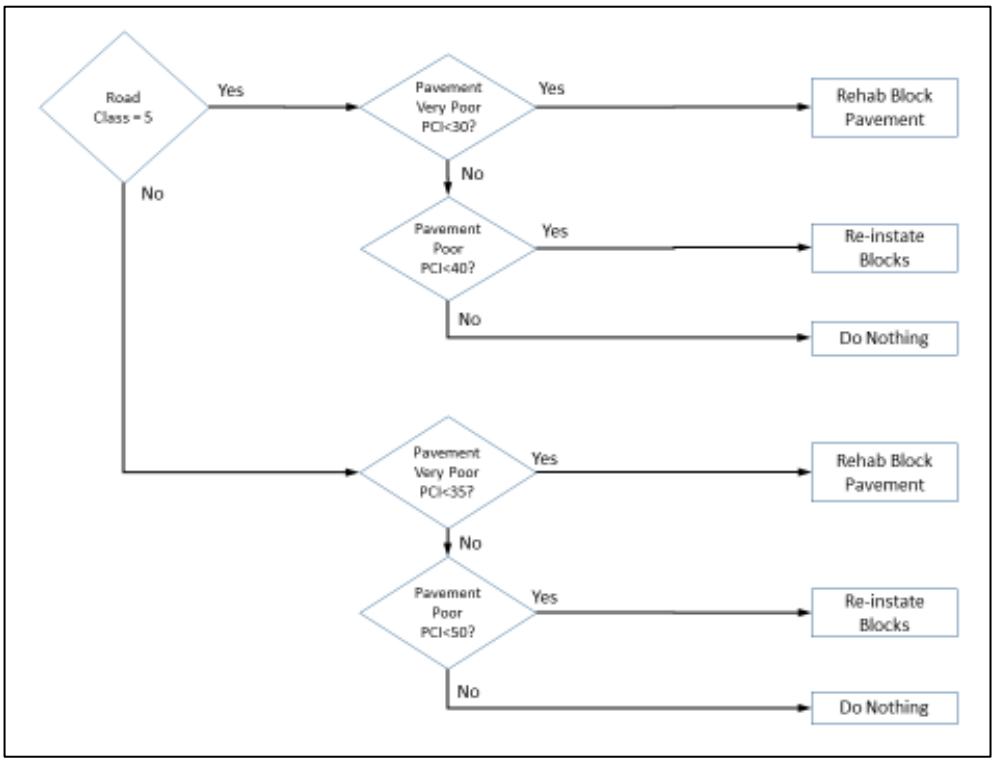
6.1 Existing Paved Roads

6.1.1 Treatment Algorithm

The following road maintenance algorithm has been prepared for the roads in the Mangaung Metropolitan Municipality.



And for block pavements:



The strategy shows that the primary determinant in selecting roads to be maintained is the condition of the surfacing. In this way, primarily the roads that are in need of urgent attention, as well as a few roads in a uniquely poor condition, will be included on the programme. The approach is also to treat all class 5 access roads with dry and old surfacings with a diluted emulsion at this stage in order to rejuvenate the surfacing and to monitor the results and assess the effectiveness of the treatment. It is expected that this approach will work well on these streets and the treatment could be repeated in 2 to 3 year's time, if required. When budgets are more consistent a reseal or micro-surfacing can be applied to these streets when required.

Class 4 collectors are expected to have greater traffic volumes and micro-paving is proposed as a low cost resurfacing treatment and also to improve the riding quality. Where necessary, pre-treatment and patching will need to be carried out.

Where the road's pavement is also in a very poor condition, and if it is an access road, it will be replaced with block paving or repaired and re-surfaced using a slurry. Then a more long lasting reseal can be applied at a later date, assuming budget consistency is a part of the future road maintenance planning scenario.

Block pavement rehabilitation involves total rehabilitation where conditions are very poor or block re-instatement where deformation is more isolated.

In addition to the treatment algorithm, a priority is assigned to each treatment based on the class of each road and a related minimum condition for that class as well as the degree to which the current condition falls below this minimum condition.

It is well known in practice that the highest priority of any pavement treatment programme should always be assigned to resurfacings in order to retard deterioration and to avoid a "worst-first" strategy. Proposed treatment lists have been prepared for each municipality reflecting this approach.

6.1.2 Treatments Rates

The unit rates used in the analysis are as follows:

Table 6-1: Treatment Unit Rates

id	code	description	All in rate R/sqm
1	DE1	Diluted emulsion	15
2	DE2	Diluted emulsion, minor patching and crack seal	20
3	DE3	Diluted emulsion and major patching	30
4	DE4	Diluted emulsion and medium slurry over 30%	35
5	SL1	Slurry Seal	30
6	SL2	Slurry seal preceded with DE and crack sealing	40
7	SL3	Slurry seal preceded with DE and patching	50
8	STC1	Cape Seal - 13mm	50
9	STC2	Cape Seal - 19mm	70
10	MP15	Micro Paving 15mm	70
11	STM	Single seal modified binder	50
12	AC25	Asphalt 25m	100
13	AC40	Asphalt 40mm	125
14	REH	Rehabilitation	300
15	REC	Reconstruction	400
16	BL	Replace with Block Paving	270
17	NONE	No Treatment	0
18	BLR	Block Reinstatement	70
19	REH-BL	Rehab Block Pavement	200

6.1.3 Results

The results of the application of this strategy are as follows:

	Proposed Treatment Type and Cost (R1000s)									
Municipality	Diluted Emulsion and Crack Seal	Micro-paving 15mm	Slurry preceded with DE and crack sealing	Slurry preceded with DE and patching	25mm Asphalt Overlay	Rehab-ilitation	New Block Pavement	Block Pavement Re-instatement	Block Pavement Rehab	Total
Bloemfontein	R 55.0	R 133.6	R 23.9	R 17.0	R 18.3	R 236.5	R 422.5	R 0.0	R 5.7	R 912.5
Botshabelo	R 5.5	R 32.8	R 1.4	R 0.9	R 1.9	R 2.7	R 7.5	R 0.0	R 0.0	R 52.7
Dewetsdorp	R 0.6	R 1.9	R 0.4	R 0.2	R 0.4	R 0.4	R 2.2	R 0.1	R 0.0	R 6.2
Mangaung Rural	R 3.3	R 5.8	R 1.6	R 1.1	R 1.4	R 11.3	R 30.9	R 1.9	R 4.4	R 61.7
Soutpan										
Thabanchu	R 3.3	R 13.1	R 0.1	R 0.0	R 0.1	R 0.0	R 0.2	R 0.1	R 0.0	R 16.9
Vanstadensrus	R 0.2	R 0.2	R 0.1	R 0.0	R 0.0	R 0.0	R 0.0	R 0.1	R 0.0	R 0.5
Wepener	R 0.5	R 1.8	R 0.0	R 0.0	R 0.0	R 0.6	R 0.0	R 0.4	R 0.6	R 3.8
Grand Total	R 68.3	R 189.2	R 27.4	R 19.3	R 22.1	R 251.5	R 463.3	R 2.7	R 10.7	R 1 054.4

The quantum identified for road surfacing rejuvenation, reseals and overlays is some **R325m** which is a round 1/3 of the backlog need but represents an approach to gradually rejuvenate the roads, which are still in reasonable condition, over time in order to extend the lives of surfacings and try to get the greatest benefit for each Rand of expenditure.

Should an annual amount of R150m be allocated to resurfacings then these needs can be attended to over 2 to 3 years. This will buy time to assess the resurfacing needs in more detail and to consider a wide range of resurfacing options to minimize overall costs while protecting the pavements.

This will also buy time to assess the roads requiring rehabilitation or that can be considered for conversion to block pavements in more detail. In addition, during this time pavement deterioration should be monitored to ascertain whether resurfacing could be used to extend the life of the road instead of rehabilitation or replacing the road with block pavement.

The block pavements in a poor condition also need to be assessed to identify the modes of failure and appropriate rehabilitation methodologies.

The list of roads and their proposed treatments and priorities are contained in Appendix B while a list of all roads and the proposed treatments are contained in Appendix C.

6.2 Unpaved Roads

The length of unpaved road in the municipality is considerable. These roads represent rural and semi-rural roads as well as urban streets.

The planned actions here can be:

- Identify roads that can be retained as well-maintained gravel roads for the foreseeable future as well as those that need to be paved.
- Prioritise the roads that need to be paved using the road class, traffic volumes and location to ensure a reasonably equitable distribution of upgrading expenditure across the municipality.
- Develop or procure a gravel road maintenance capacity and develop a maintenance programme for the unpaved roads.

- Procure a road upgrading programme and upgrade the present unpaved roads at a reasonable rate. For example, assuming that 500km of the 2200 km of unpaved roads need to be paved over a 10 year period means that 50 km of road needs to be upgraded per annum at a cost of roughly R200 million per annum and these funds will need to be sourced.

7. CONCLUSIONS

The road network involves some 3 800km of road of which 2 200 km are unpaved.

Up to 90% of the paved road surfacings are in a poor condition and rejuvenation of these old road surfacings is a high priority. Initial treatment with diluted emulsion is proposed to extend the life of the surfacing and, at the same time to form part of pre-treatment prior to resurfacing. The effectiveness of all these treatments should be monitored to assess the nature and scope of the follow-up treatment, patching and resurfacing.

The surfacings on the higher order roads can be improved using micro-paving or thicker asphalt where required. This must be preceded with crack sealing and patching as well as investigations to ensure that the pavement has sufficient structural capacity to carry the traffic loads when it has an asphalt surface.

Up to 35% of road pavements are in a very poor condition and these roads need to be assessed at a project level to determine the nature and extent of their rehabilitation requirements and to draw up a rehabilitation program of some R50million per year to try and attend to all the problems over a 10 year period. The roads in better condition should be patched and resurfaced with slurry to obtain a uniform texture and improve riding quality. Where the surface texture is already fairly uniform a single seal can be applied.

Where access roads are excessively deformed or potholed, the existing pavement can be ripped up and recompacted as a subbase and a new block pavement constructed.

There are many kilometres of unpaved road in the Municipality and those that need to be upgraded to paved roads need to be identified and attended to in a prioritised manner.

Appendix A:

Deduct Point Indices

Since the VCI gives a rough average condition, the latest draft TMH22 proposes that the deduct calculations be used to compute condition indices to avoid substantial defects of one type being ameliorate by others that are less severe. In addition, general indices do not provide a good indication of problems associated with individual components of a road which all have substantially different expected useful lives. Therefore, the deduct system of index calculation has been extended in this analysis in order to compute condition indices for each component of the road and to evaluate their maintenance needs and remaining useful lives.

Appendix B:

Draft Road Maintenance Programme

Appendix C:

Road List and Proposed Treatments