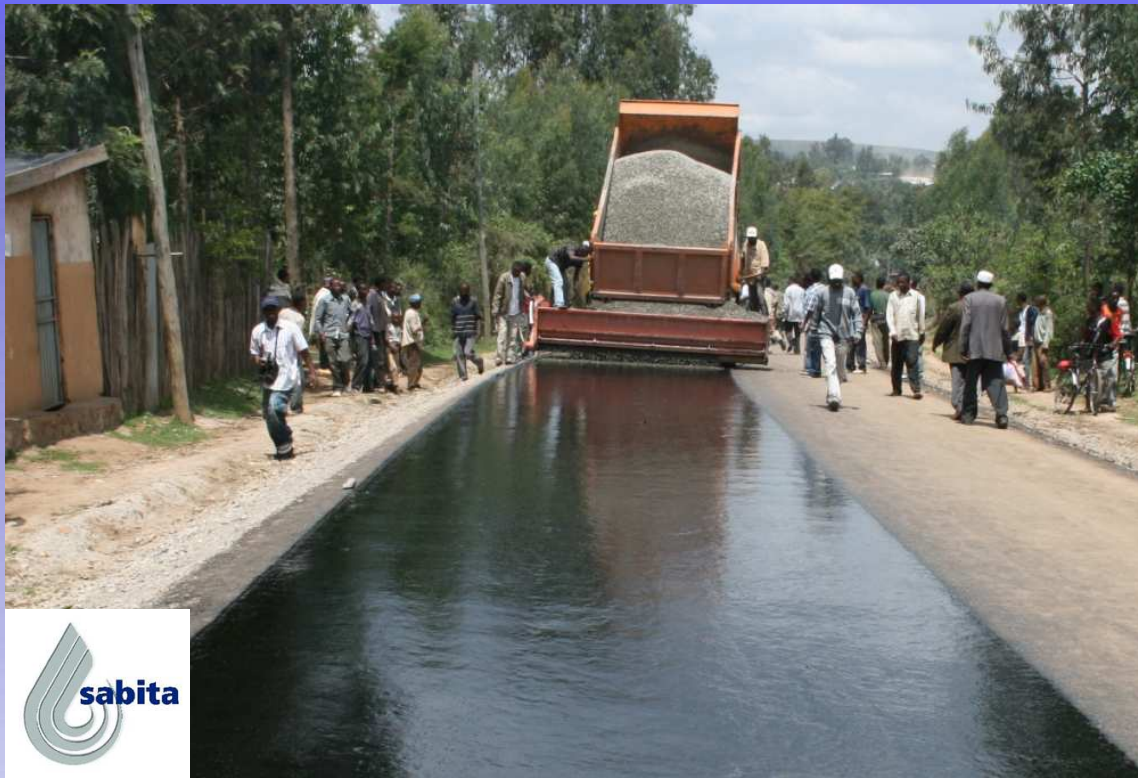


SABITA Manual 10

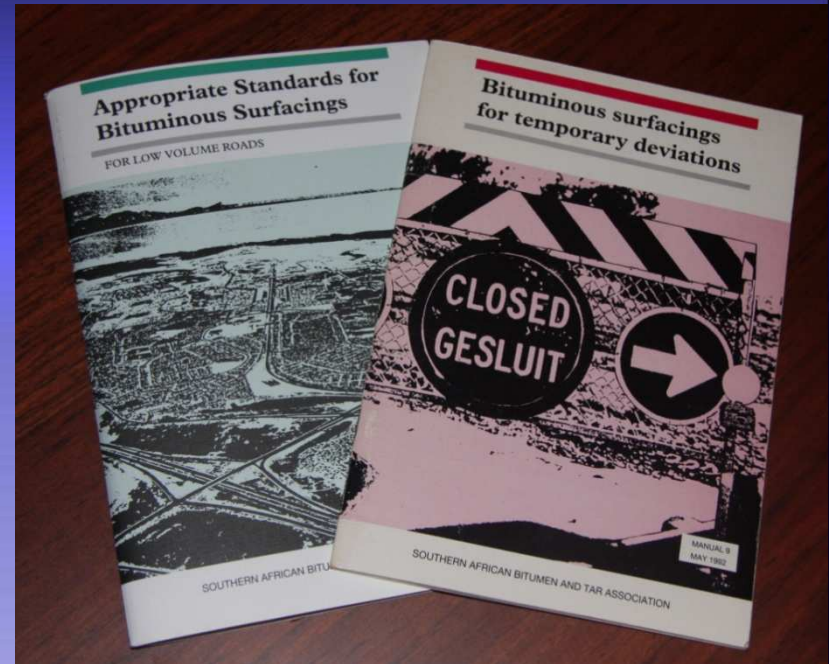
Bituminous Surfacing for Low Volume Roads and Temporary Deviations



Gerrie van Zyl
Phil Paige-Green
Les Sampson

Background

- Manual 9 and 10 published 1992
- Based on 3-year study (98 road sections)
- Some aspects
 - Still valid
 - Outdated



Updating Manual 9 and 10

- Revisit initial study documentation
- Reassess old sites
- Feedback from industry
- 40 New sites
- Update document
 - Risks
 - Surfacing selection
 - Costs
 - Warrants for upgrading

New Manual 10

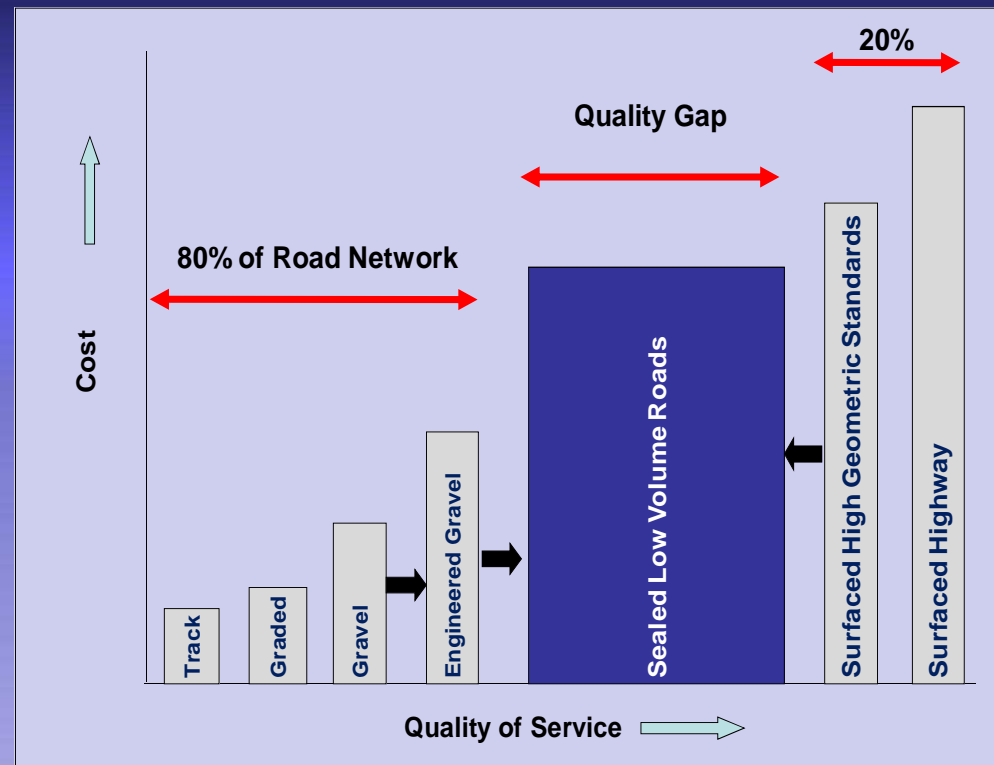
- **Introduction**
- **Surfacing of unsealed roads**
 - Main considerations
 - Levels and standards of upgrading
 - Principles of pavement performance
- **Selection of appropriate surfacings**
- **Definitions of surfacing types**
- **Prime coat need and selection**
- **New construction surfacings**
 - Temporary seals & deviations
 - Forestry roads and nature reserves
 - Footways and cycling lanes

New Manual 10

- **Appropriate standards**
 - Design
 - Materials
 - Construction
- **Surfacing Costs**
- **Maintenance planning and management**
 - Reseal selection
 - Seal maintenance
 - When to reseal
- **Warrants for upgrading**
 - Simple economic calculations
 - Available software
 - Multi-criteria analysis

Need for surfacing

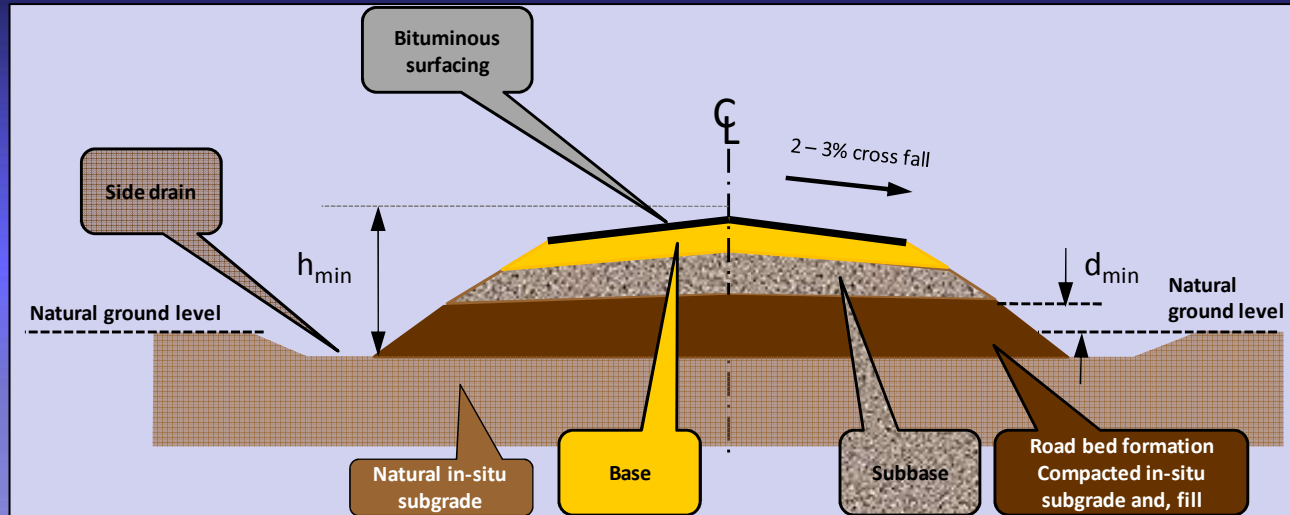
- Economic
- Social
- Environment
- Government strategies
- Quality of service delivery



Upgrading guidelines

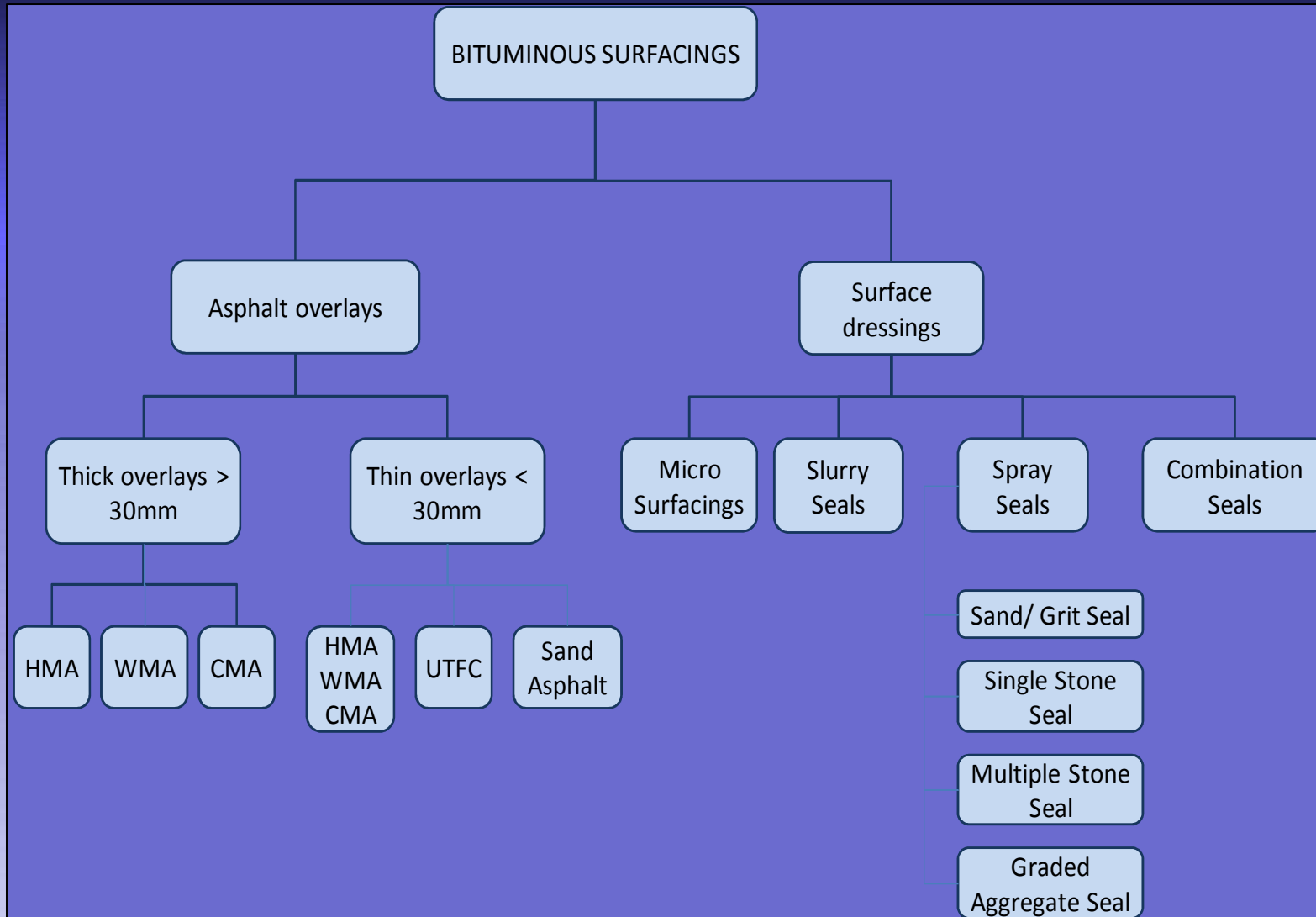


Upgrading guidelines

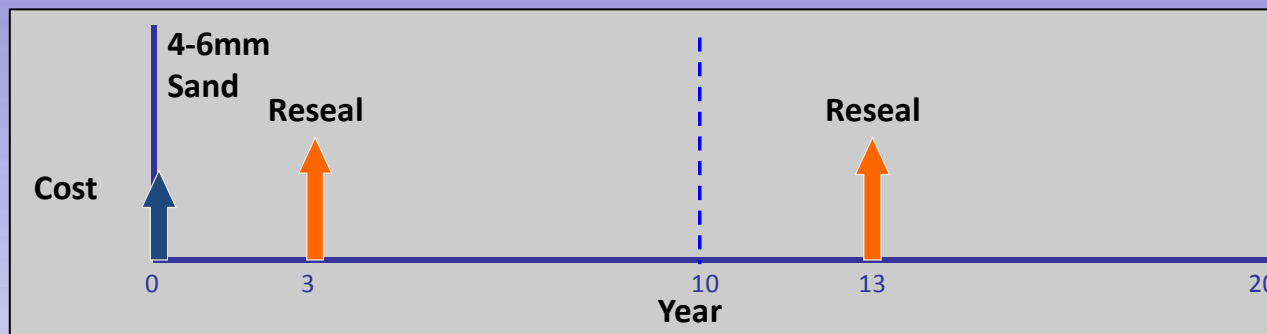
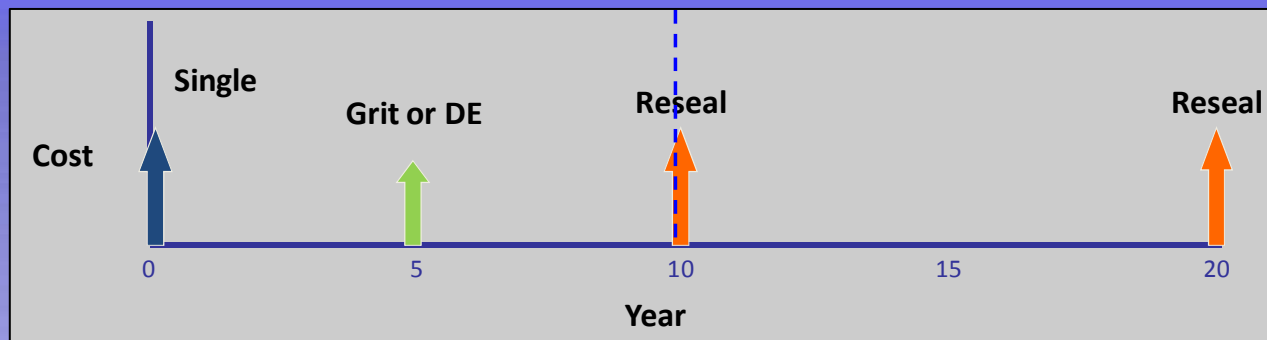
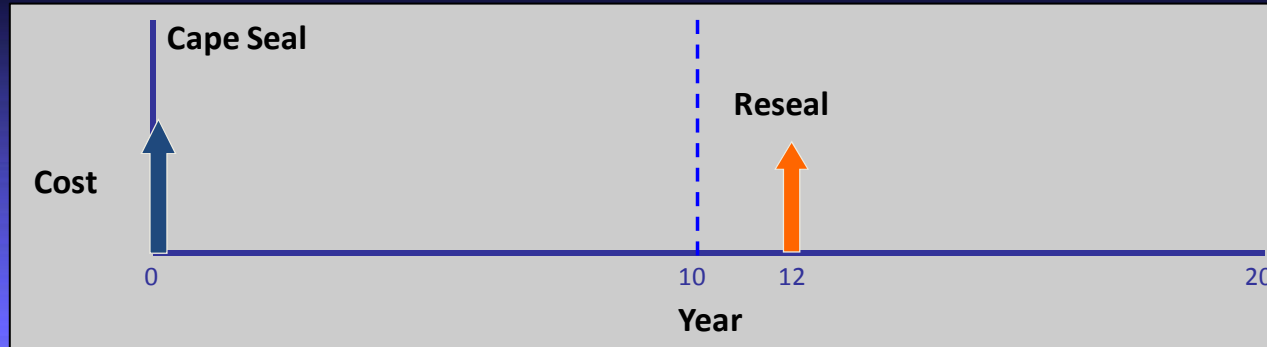


Traffic Class grouping	Approximate AADT with 10% Heavy vehicles (Both Directions)	h_{min}		
		Dry Climate (Weinert $N > 5$)	Moderate Climate Weinert $N (2-5)$	Wet Climate Weinert $N < 2$
ES 0.003 – ES 0.01	< 200	250mm	300mm	350mm
ES 0.03 – ES 0.1	200 – 400	350mm	400mm	450mm
ES 0.1 – ES 0.30	>400	450mm	500mm	550 mm

DEFINITIONS

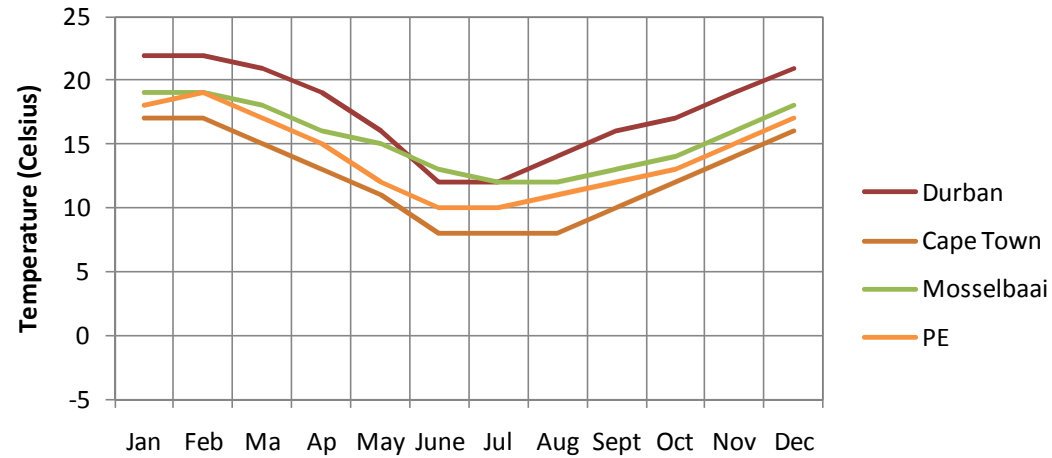


Surfacing strategies

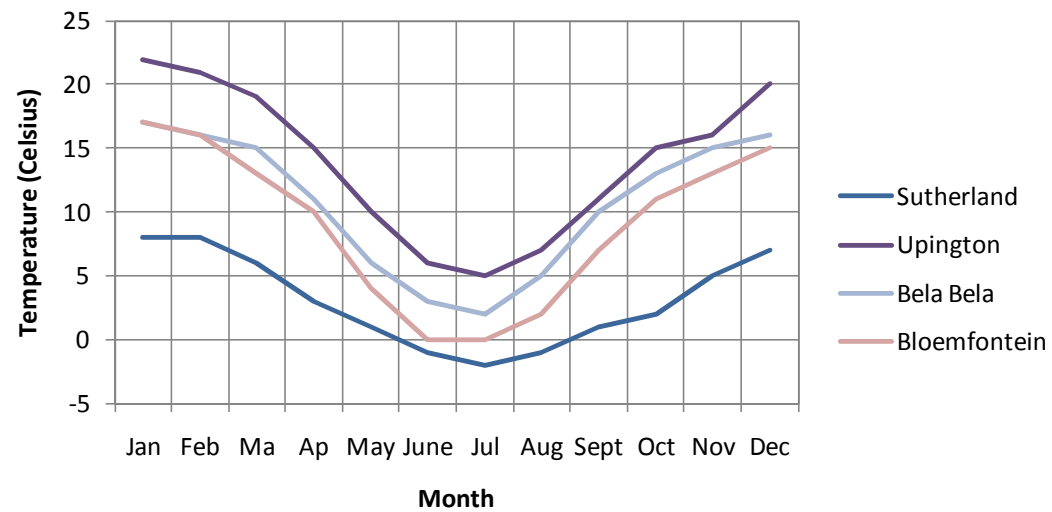


Climate risks

Average Minimum Temperature (Coastal)



Average Minimum Temperature (Inland)



Initial Surfacing Selection:

	Thin seal/ phased strategy				Double/ Comination seal strategy							Microsurfacing/Asphalt Strategy			
	Thin sand/ Grit	Thin Slurry	Thick graded sand	Single seal	Single plus sand seal	Double stone	Single Otta plus sand	Double Otta	13 Cape Seal	19 Cape Seal	SB Macadam	Thick Microsurfacing	Sand Asphalt	Thin Asphalt	Thick Asphalt
Suitability for labour Intensive construction	Yellow	Green	Yellow	Orange	Orange	Red	Yellow	Yellow	Orange	Orange	Green	Red	Red	Red	Red
Risk of poor maintenance capability	Red	Red	Yellow	Red	Orange	Orange	Green	Green	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green
High skid resistance required	Red	Orange	Red	Green	Yellow	Green	Red	Red	Yellow	Green	Orange	Orange	Red	Orange	Yellow
Early road marking required	Red	Green	Red	Green	Yellow	Green	Red	Red	Green	Green	Green	Green	Green	Green	Green
Suitability for turning actions	Red	Red	Orange	Red	Orange	Orange	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Green
Sensitivity to gradient	Yellow	Yellow	Orange	Yellow	Orange	Orange	Red	Red	Orange	Orange	Yellow	Yellow	Yellow	Yellow	Green
Sensitivity to Urban drainage	Red	Orange	Red	Red	Orange	Red	Red	Red	Orange	Yellow	Green	Yellow	Green	Green	Green
	Green Very Good		Yellow Good			Orange Reasonable			Red High Risk/ Not suitable						

Temporary deviations

Duration of temporary deviation (months)	Traffic Volume		
	500 vpd	2 500 vpd	10 000 vpd
1	Gravel (DP)	DP	DP
2	Gravel (DP)	S1	S1
3	DP	S1	S1
4 to 5	S1	S1	S2
6	S1	S1	S2
7	S1	S2	Asphalt
8 to 9	S1	S2	Asphalt
10 – 12	S1	Asphalt	Asphalt
13 - 24	S2	Asphalt	Asphalt

Notes:

- Gravel - Properly compacted wearing course (Refer TRH20)
- DP - Dust Palliative
- S1 - Both bituminous with sand or chemical products could work
Single seal with cover spray and preferably with sand blinding or Thick graded sand
- S2 - Multiple or combination seal type e.g.
Stone and Grit seals (9,5 or 13,2 mm plus grit)
Stone and slurry combination (9,5mm plus slurry)
Otta seals

Material standards

- **Binders - No reduction in standards recommended**
- **Aggregate (Appropriate for LVSR) e.g.**
 - ❑ 10% FACT (150 for < 200vpd) (180 for up to 500 vpd)
 - ❑ PSV (45 up to 500 vpd)
 - ❑ ALD – target values (COLTO) reduced
 - ❑ Grading of seal aggregate (Grade 3 COLTO acceptable)
 - ❑ Flakiness (Grade 3 COLTO acceptable)
 - ❑ Sand equivalent (Reduced - Dependant of seal type)

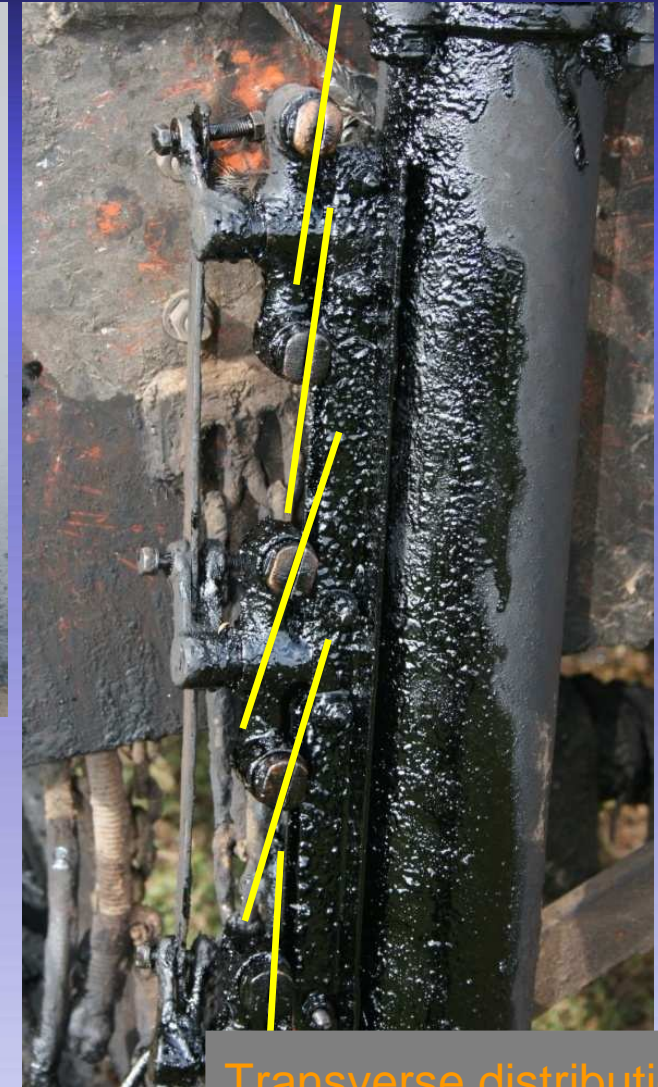
Construction

- **Main reasons for poor performance**
 - Poor base construction
 - Poor joint construction
 - Transverse distribution
 - Too low binder content
 - Quality control

Nozzle angles



Observed



Transverse distribution

Nozzle alignment



Observed

Poor Longitudinal Joints

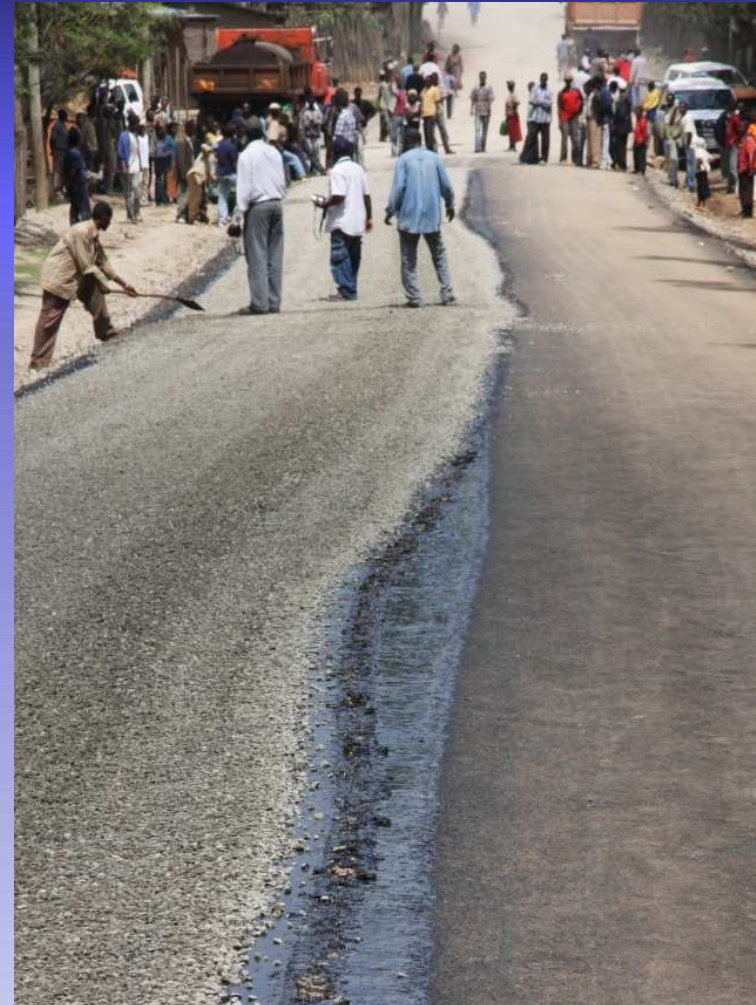


Main Cause ?
•Construction

Longitudinal joints

Longitudinal Joints

- **Damage caused**
 - ❑ Chip spreader wheel running on bitumen

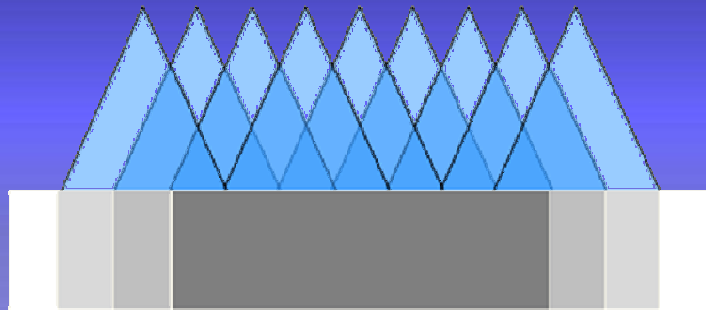


Stringline could help



Longitudinal joints

Longitudinal joint overlap



200 mm overlap in case of triple overlap

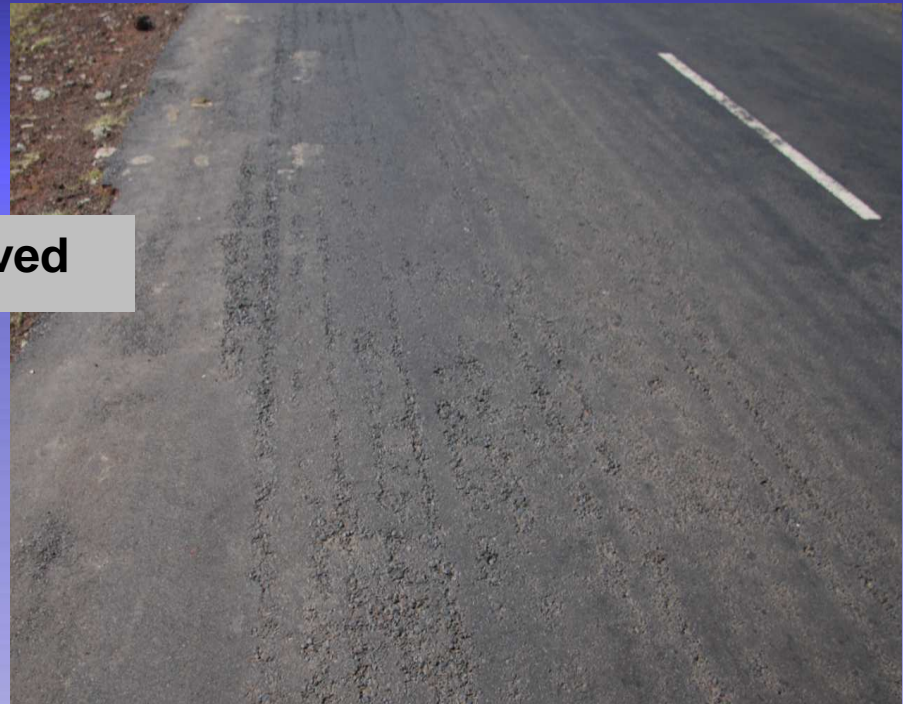
Uniform Triple overlap

Joint overspray 4/3

Poor transverse distribution



Observed

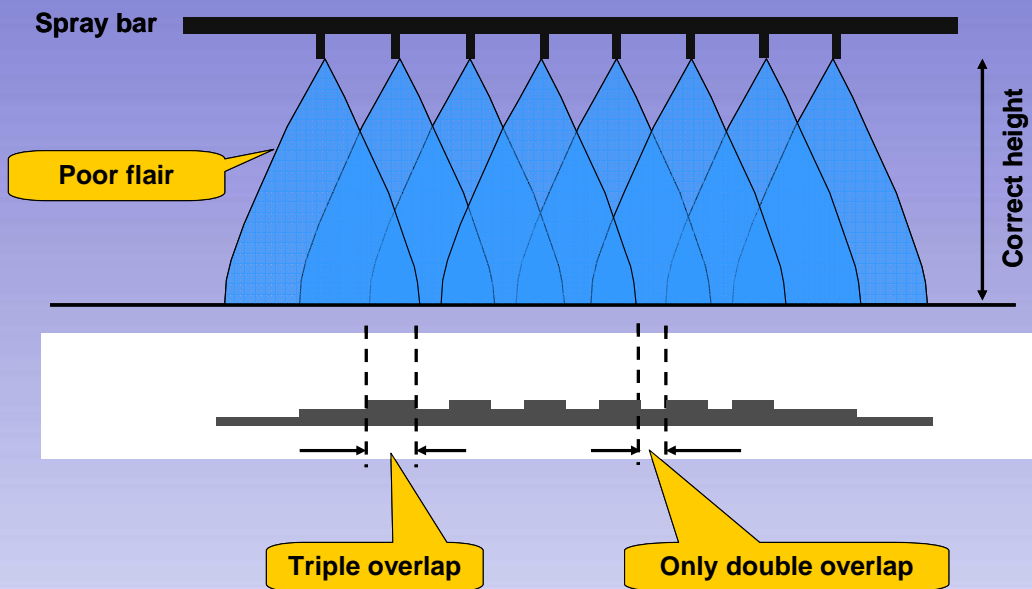
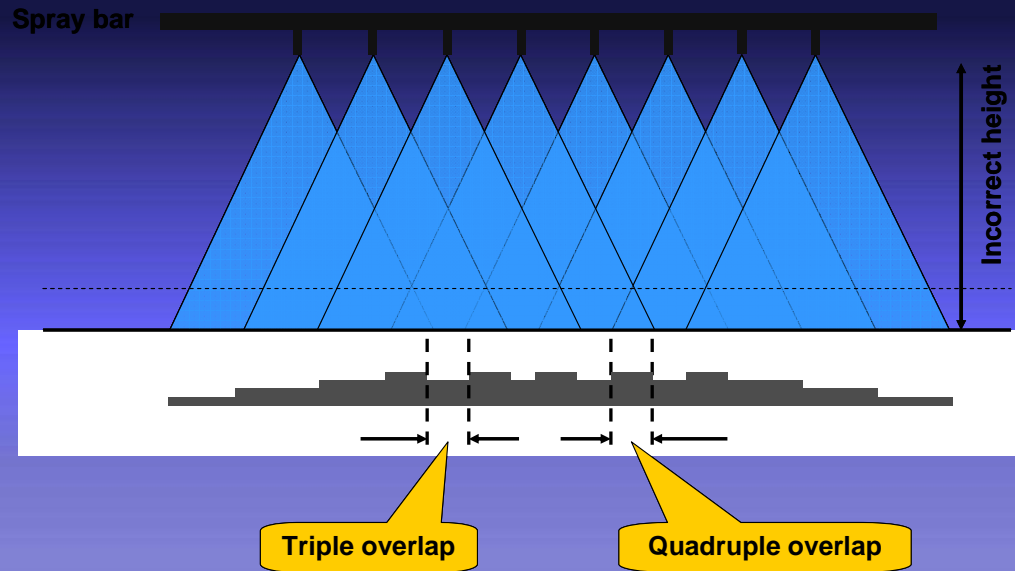


Too low binder application

Too high binder application

Transverse distribution

Tramlines



Transverse Joints

Observed



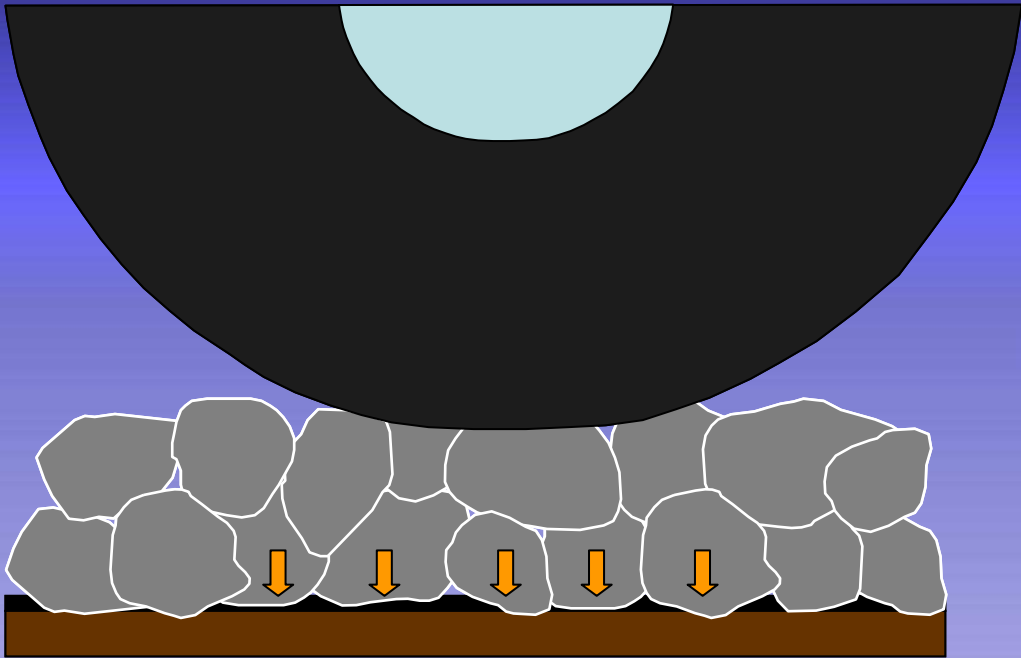
May 12, 2011



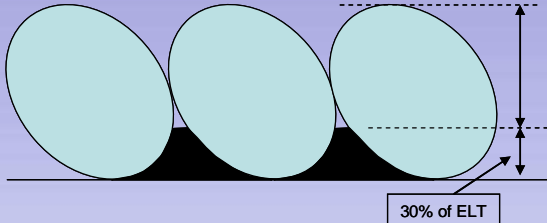
Recommended

Slide 24

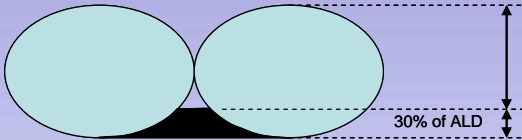
Over application of single sized aggregate



Flaky Aggregate "In Contact" – high spread rate



Flaky Aggregate on ALD "In Contact"

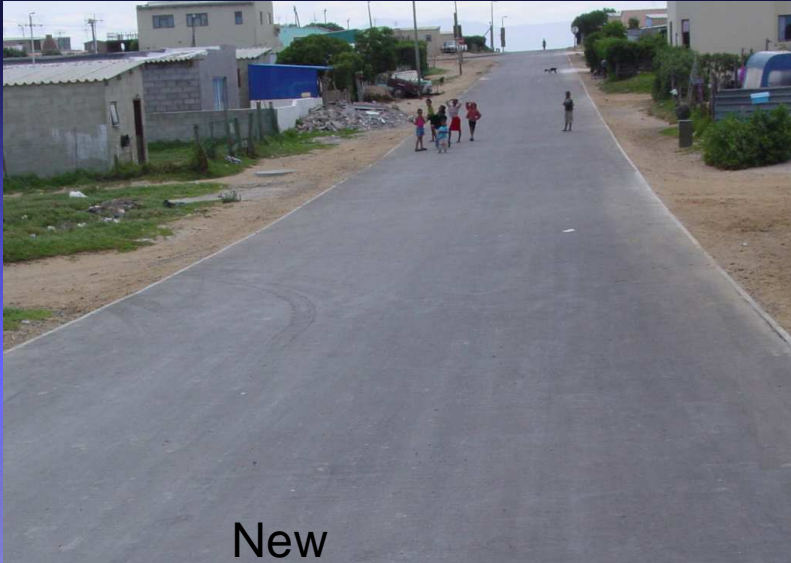


Impact

Impacts of wrong surfacing

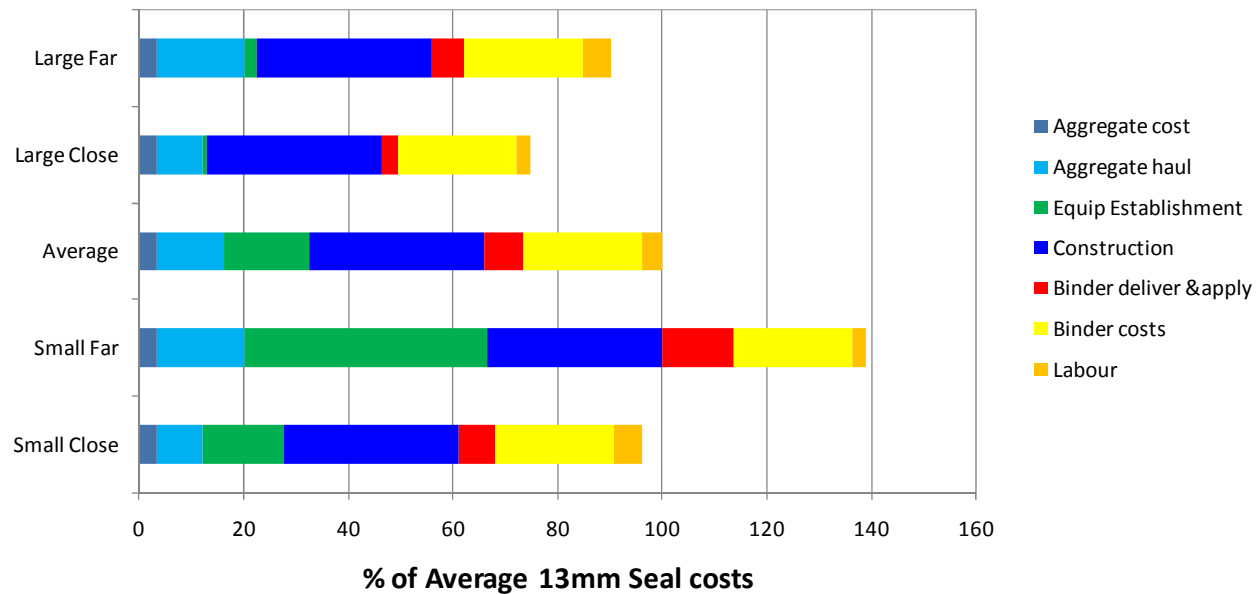


QA on Slurry bound



Cost of bituminous surfacings

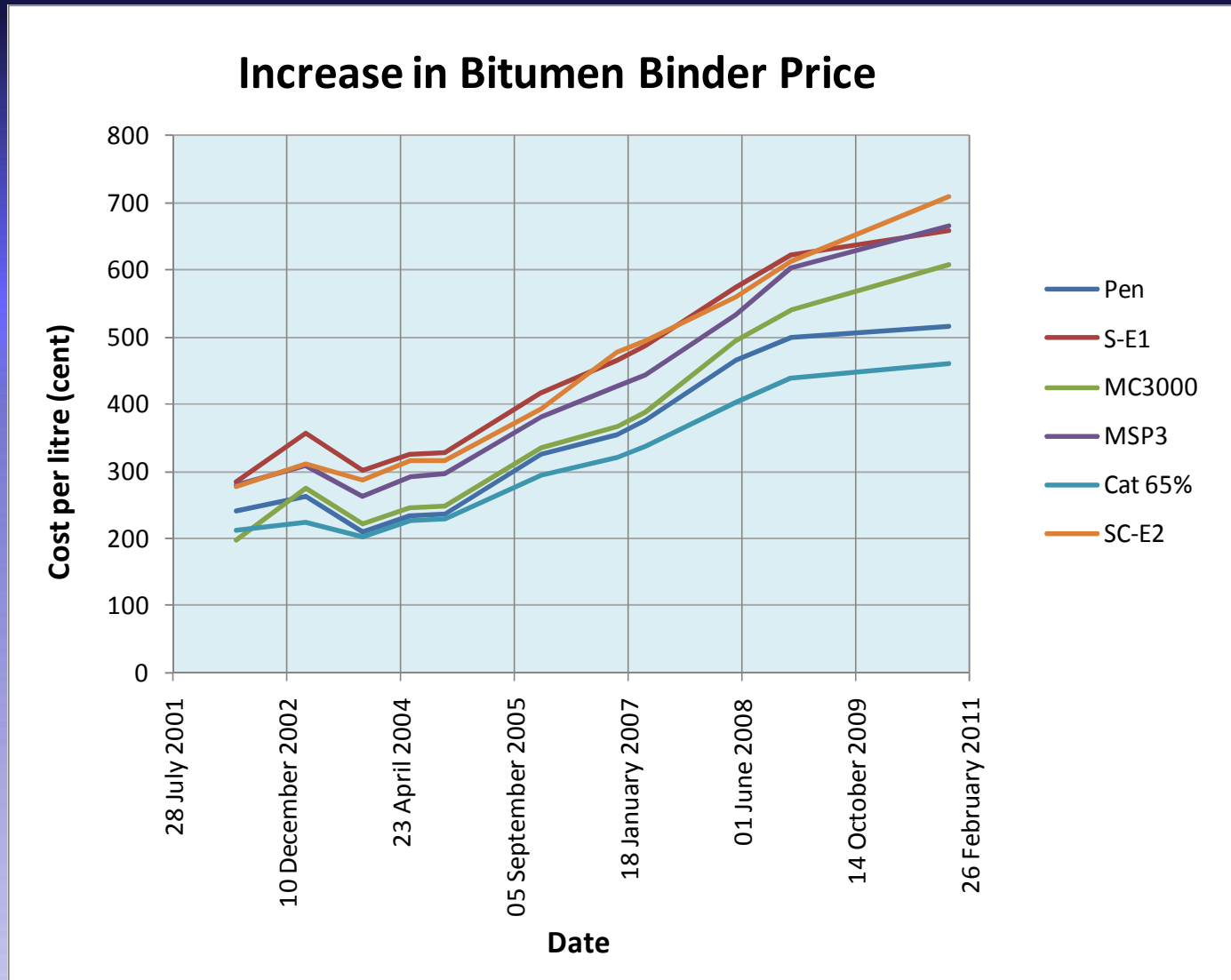
Proportional costs for 13mm Single seal (80/100 Pen Bitumen)



Relative costs (Simplified cost model)

Type of surfacing		Binder	Cost ratio
Single seals	13,2 mm (precoated)	Penetration grade bitumen	1
		Bitumen rubber	1.49
		Polymer-modified bitumen	1.25
	13,2 mm + fog spray	Emulsion 65%	1.11
	13,2 mm + fog + sand	Emulsion 65%	1.52
		Latex emulsion	1.61
	9,5 mm (pre-coated)	Penetration grade bitumen	0.92
		Polymer-modified bitumen	1.08
	9,5 mm + fog spray	Emulsion 65%	1.01
	9,5 mm + fog spray + sand	Emulsion 65%	1.24
		Latex emulsion	1.41
	6,7 mm (pre-coated)	Penetration grade bitumen	0.6
6,7 mm + fog spray	Emulsion 65%	0.87	
Sand seals	Sand seal (single)	MC 3000	0.69
		Emulsion 65%	0.73
	Sand seal (double)	MC 3000	1.4
Graded aggregate seals	10 mm graded coarse sand seal	MC 3000	1.16
	Single Otta and Sand seal	MC 3000	1.8
	Double Otta seal	MC 3000	2
Slurry/ Microsurfacing	Fine slurry (3 mm)		0.87
	Coarse slurry (6 mm)		1.32
	Rapid setting coarse slurry (10 mm)		2.1
Double seals	13,2 mm + 6,7 mm	Penetration grade bitumen	1.43
		Polymer-modified bitumen	1.82
	19,0 mm + 9,5 mm	Penetration grade bitumen	1.6
	19,0 mm + 6,7 mm	Split application Polymer-	

Binder cost increase (12-14% pa)

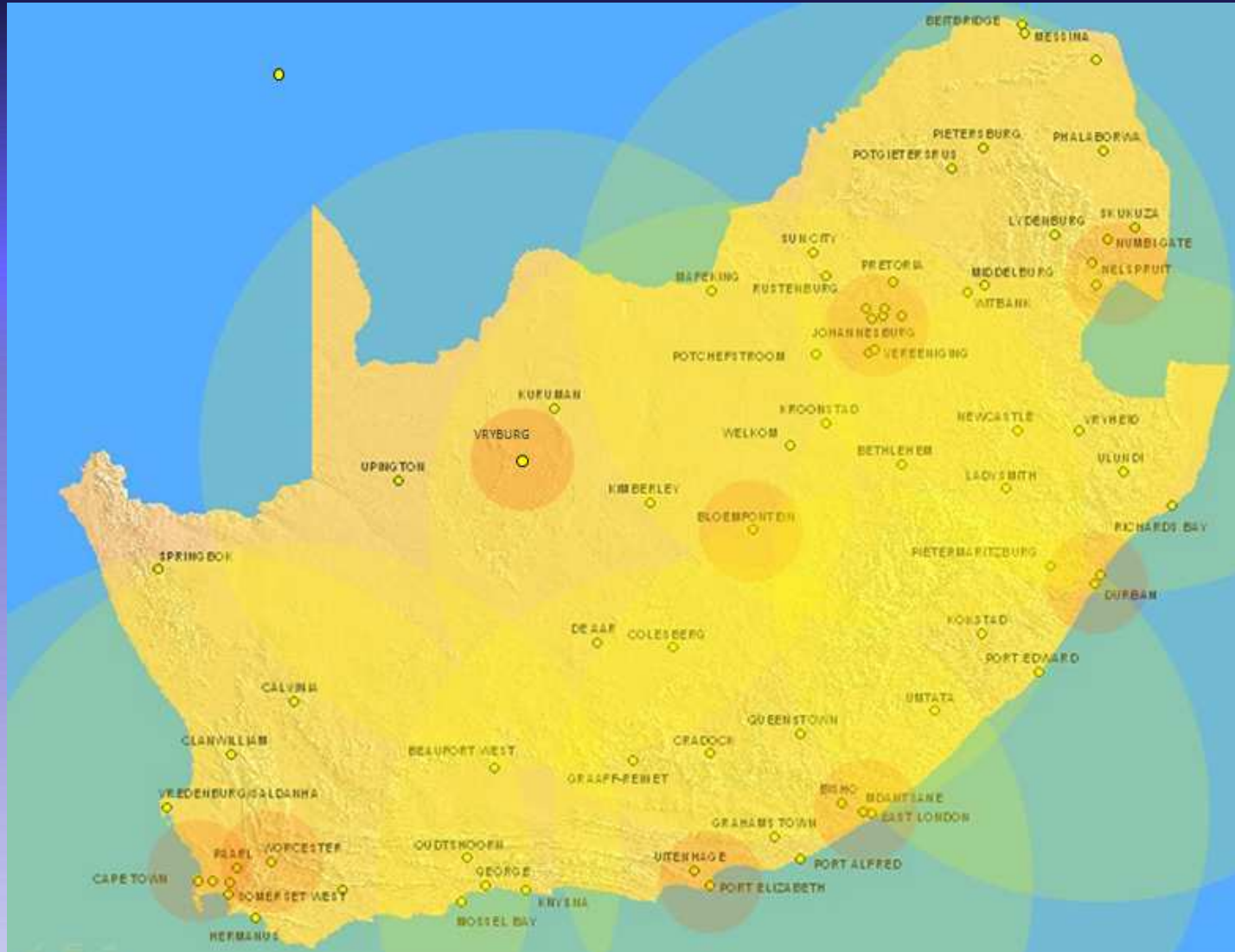


Detailed cost model

- Seal type
- Binder type for 2 layers
- Area to be surfaced at a time
- Distance from binder depot
- Haul distance of aggregate
- Expected surfacing production rate
- Distance of surfacing team establishment

Note: Taxes, traffic accomodation, risks etc not included

Main binder distribution depots



Warrants for upgrading

- **Simplified model for manual calculation**
- **Available software**
 - HDM4
 - RED (Roads Economic Decision Model)
 - Super Surf

Warrants for upgrading (Simple model)

Table 26 Comparison of IRI values and road condition

Comfortable Speed	IRI (photo)	Typical Condition
100 km/h	< 5 (3)	
80 – 100 km/h	7.5 – 5 (5.7)	
60 – 80 km/h	10 – 7.5 (8)	
45 – 60 km/h	12.5 – 10 (11)	
< 35 km/h	15 (15)	

Table 27 Cost to maintain at other roughness levels

IRI	Cost ratio
3	1.96
4	1.44
5	1.14
5.7	1.00
6	0.94
7	0.80
8	0.69
9	0.61
10	0.55
12	0.45
15	0.35

Vehicle Operating Costs for the current period in Rands per Vehicle/Kilometer

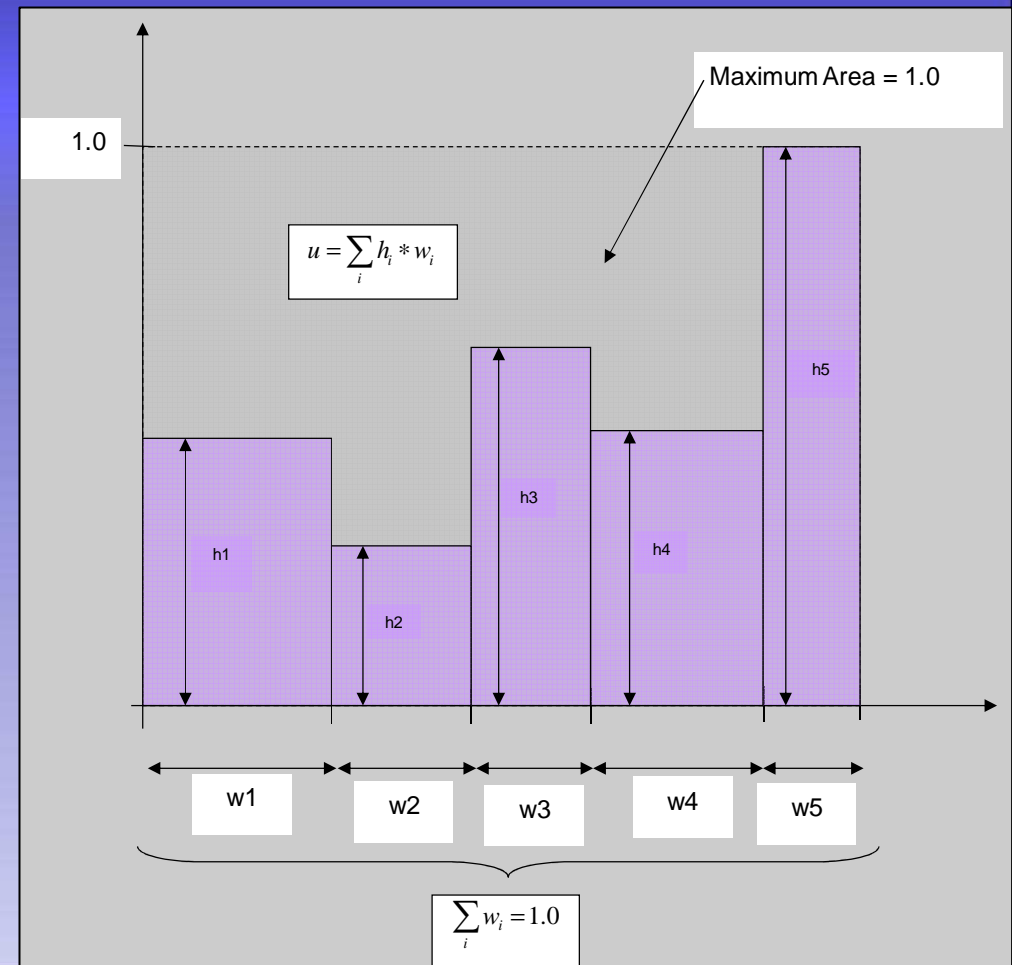
IRI m/km	View Unit Prices										
	Paved	Light	Gravel	Paved	Taxi	Gravel	Paved	Bus	Gravel	Paved	Heavy
0.5	2.45857565	2.49191888	2.52409661	2.56924990	2.58143052	6.21001745	6.29042696	7.65445705	7.72976047	9.10854783	9.10854783
0.6	2.46828512	2.50292284	2.53457977	2.58143052	2.59358737	6.28963358	6.37248637	7.72976047	7.80473914	9.10854783	9.10854783
0.7	2.47796939	2.51390242	2.54503760	2.59358737	2.60572100	6.36800549	6.4523095	7.80473914	7.87940348	9.10854783	9.10854783
0.8	2.48762900	2.52485819	2.55547068	2.60572100	2.61783194	6.44523095	6.52139547	7.87940348	7.95376333	9.10854783	9.10854783
0.9	2.49726448	2.53579068	2.56587953	2.61783194	2.62992072	6.52139547	6.61159248	7.95376333	8.02782805	9.10854783	9.10854783
1.0	2.50687634	2.54670039	2.57626468	2.62992072	2.64198782	6.59657443	6.68922430	8.02782805	8.10160653	9.10854783	9.10854783
1.1	2.51646508	2.55758782	2.58662662	2.64198782	2.65403374	6.67083463	6.76593975	8.10160653	8.17510720	9.10854783	9.10854783
1.2	2.52603118	2.56845345	2.59696583	2.65403374	2.66605893	6.74423560	6.84179837	8.17510720	8.24833811	9.10854783	9.10854783
1.3	2.53557508	2.57929773	2.60728277	2.66605893	2.67806385	6.81683072	6.91685354	8.24833811	8.32130690	9.10854783	9.10854783
1.4	2.54509724	2.59012111	2.61757791	2.67806385	2.69004893	6.88866802	6.99115327	8.32130690	8.39402089	9.10854783	9.10854783
1.5	2.55459809	2.60092401	2.62785166	2.69004893	2.70201458	6.95979091	7.06474099	8.39402089	8.46648704	9.10854783	9.10854783
1.6	2.56407804	2.61170686	2.63810445	2.70201458	2.71396122	7.03023881	7.13765612	8.46648704	8.53871200	9.10854783	9.10854783
1.7	2.57353750	2.62247006	2.64833669	2.71396122	2.72588924	7.10004761	7.20993454	8.53871200	8.61070213	9.10854783	9.10854783
1.8	2.58297684	2.63321399	2.65854877	2.72588924	2.73779901	7.16925015	7.28160909	8.61070213	8.68246353	9.10854783	9.10854783
1.9	2.59239646	2.64393904	2.66874107	2.73779901	2.74969094	7.23787650	7.35270986	8.68246353	8.75400203	9.10854783	9.10854783
2.0	2.60179673	2.65464558	2.67891398	2.74969094	2.76156543	7.30595440	7.42326456	8.75400203	8.82532327	9.10854783	9.10854783
2.1	2.61117807	2.66533403	2.68906792	2.76156543	2.77342305	7.37350954	7.49329890	8.82532327	8.89643274	9.10854783	9.10854783
2.2	2.62054100	2.67600491	2.69920344	2.77342305	2.78526465	7.44056611	7.56283706	8.89643274	8.96733600	9.10854783	9.10854783
2.3	2.62988634	2.68665905	2.70932141	2.78526465	2.79709177	7.50714752	7.63190245	8.96733600	9.03803886	9.10854783	9.10854783
2.4	2.63921549	2.69729784	2.71942335	2.79709177	2.80890707	7.57327753	7.70051885	9.03803886	9.10854783	9.10854783	9.10854783
2.5	2.64853089	2.70792372	2.72951194	2.80890707		7.63898187	7.76871197	9.10854783		9.10854783	9.10854783

Multi-Criteria analysis

- Principles to incorporate difficult quantifiable parameters e.g.

- Social

- Environmental



Way forward

- Draft for review (Week 16th May 2011)
- Feedback as soon as possible (Max mid June) gerriev@mycube.co.za
- Final adjustments
- Publishing

THE END

