

How Cool is Warm Mix Asphalt in South Africa

Krishna Naidoo

Road Pavement Forum

12-13 November 2018- CSIR Pretoria

warm mix
asphalt rsa

Road Materials Committee News

- ▶ **TMH5 Revision:** The partnership between RMC & SABITA, Conc. Institute & rest of industry is going well.
- ▶ Being chaired by RMC's Gretchen-Webber Cherry

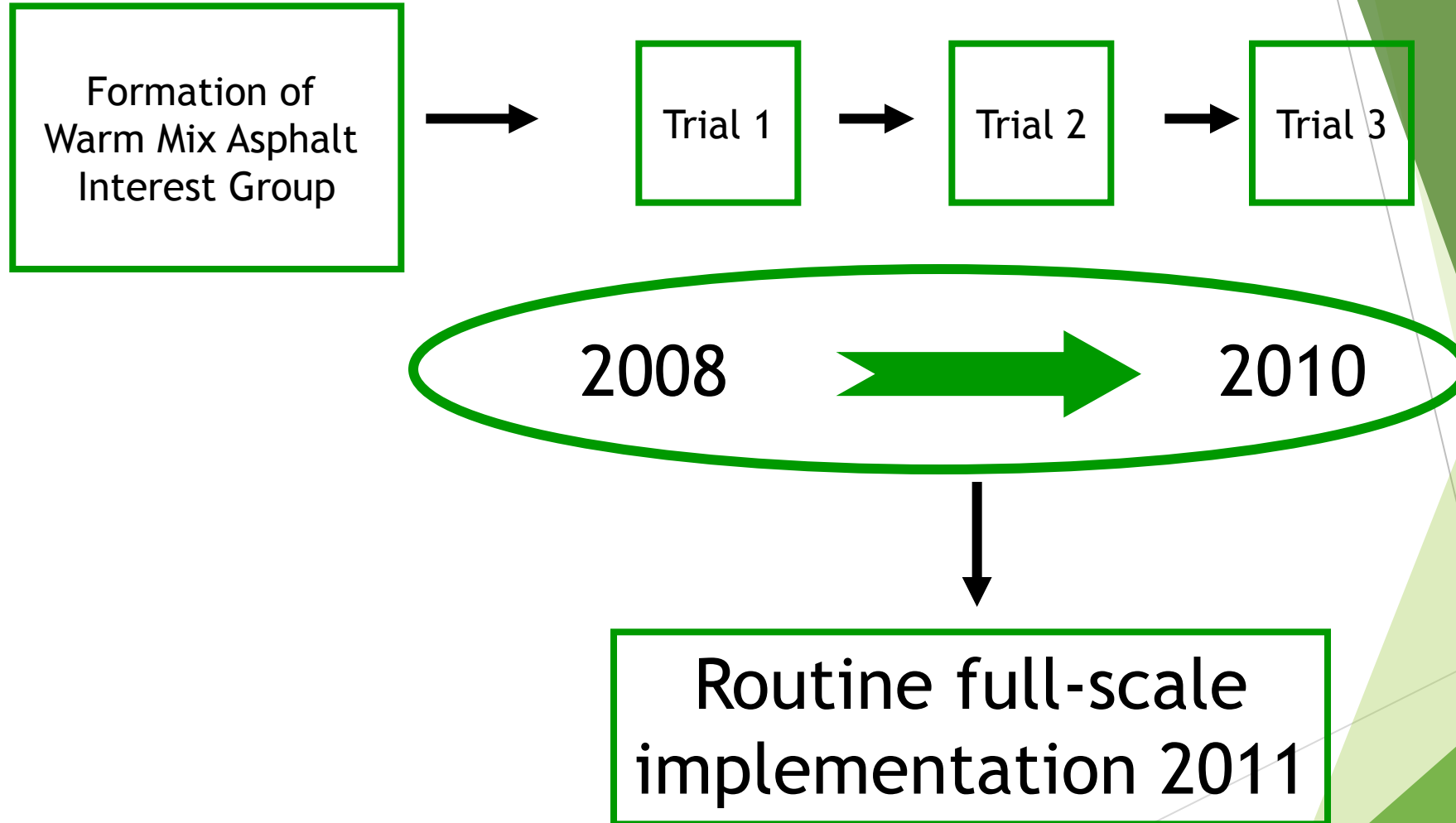
- ▶ **Formation of Southern African Road Profiler User Group (SARPUG)**
- ▶ Users wanting to join should e-mail:
- ▶ RMC - Krishna Naidoo NaidooKr@nra.co.za
- ▶ User Group Lead - Werner Lategan Lategan@nra.co.za

WMA: Re-defining Asphalt?

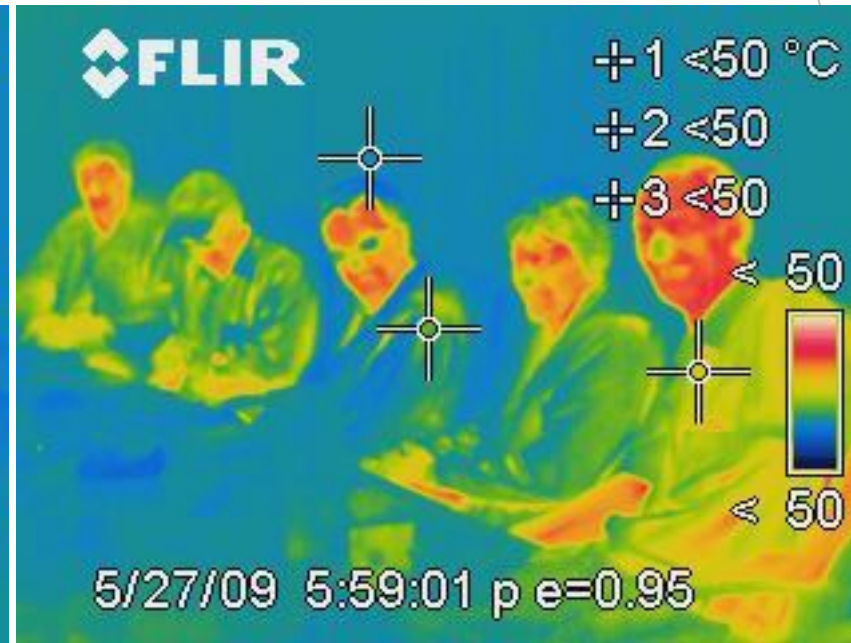
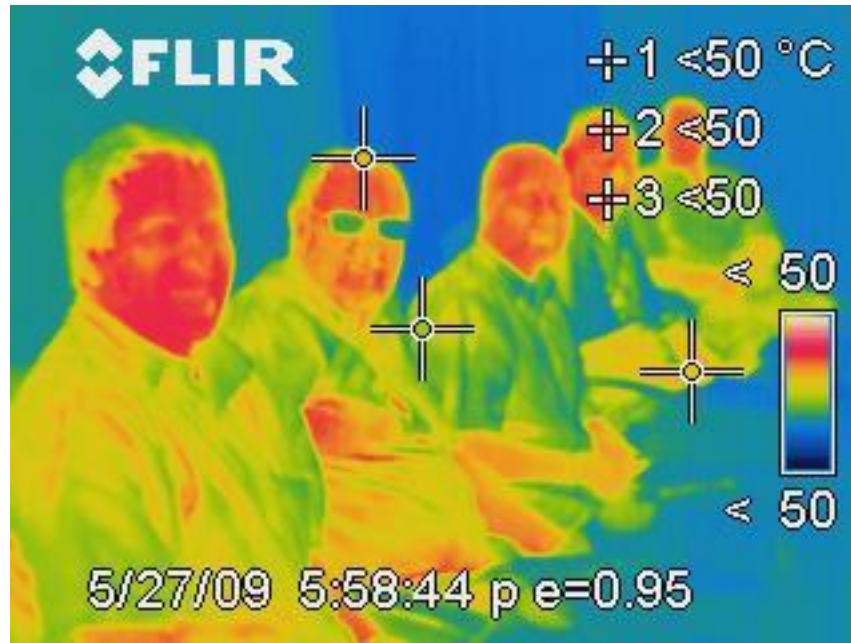
WMA is asphalt that is manufactured and paved at between **20°C and 30°C lower** than conventional hot mix asphalt (HMA), with all its properties and performance being equal to or better than HMA

warm mix
asphalt

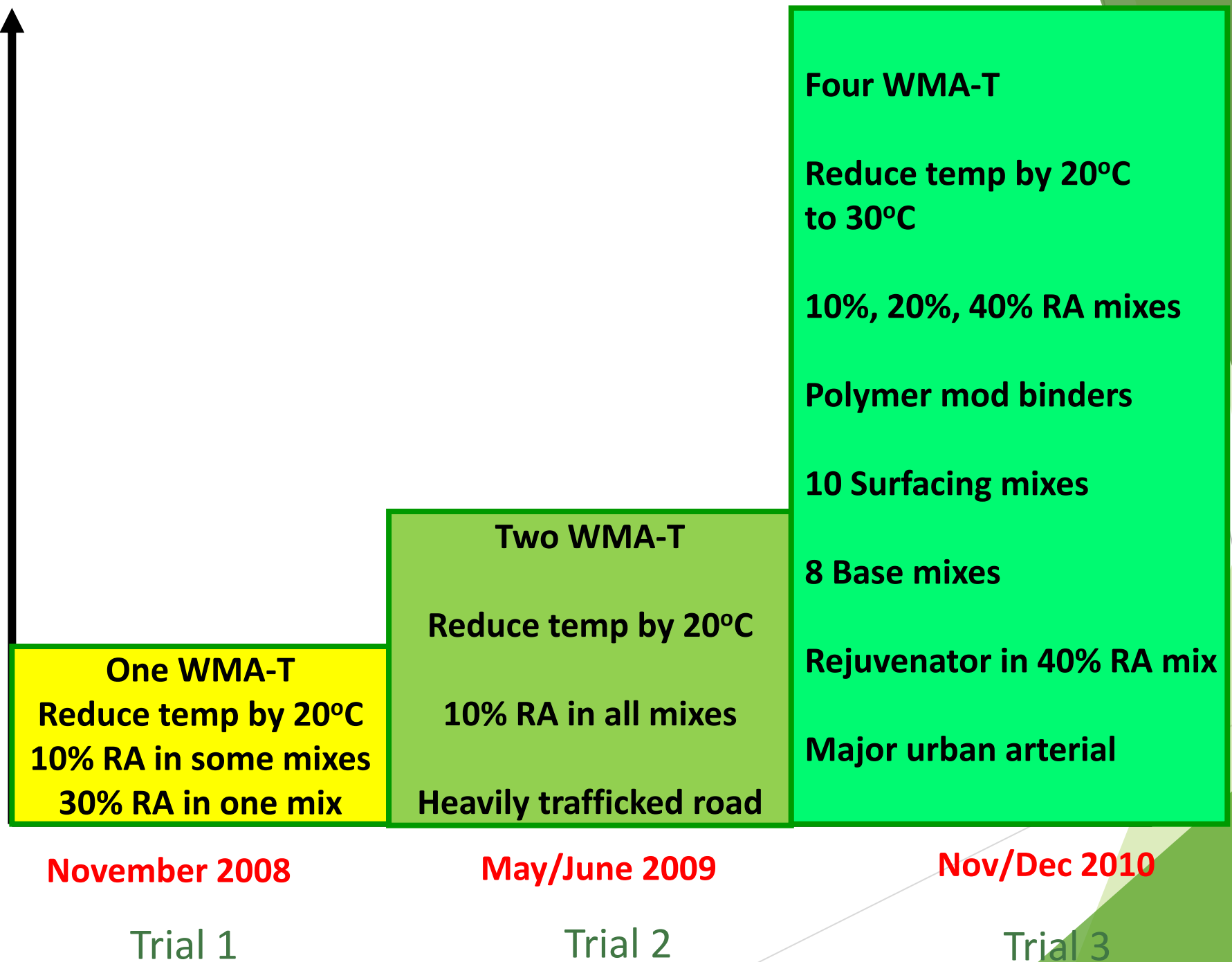
Fast-tracking the introduction of WMA in RSA



Tradition....**HMA hot .hot. hot**



Knowledge & Practical Experience



Publication of SA national WMA Guideline September 2012



excellence in bituminous products

Manual 32

Best practice guideline and specification
for warm mix asphalt

ISBN 978-1-8974968-55-1

September 2011

Contents of this CD

This document presents best practice guidelines for the production and construction of Warm Mix Asphalt (WMA) for roads and airports. WMA, which has significant environmental, occupational health and safety, economic and engineering benefits, is already being used extensively in the USA, some European countries and China, and its use seems set to expand significantly over the next five years.

The main purpose of these guidelines, which utilise knowledge and experience gained from extensive local trials as well as that gleaned from international experience, is to ensure that best practice is implemented in the application of WMA in South Africa.

Accompanying these best practice guidelines is a stand-alone interim specification, its purpose being to assist practitioners to implement the production and paving of WMA in South Africa.

The full range of Sabita manuals, guidelines and other publications is more fully described and may be ordered from the Sabita website:

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email: info@sabita.co.za



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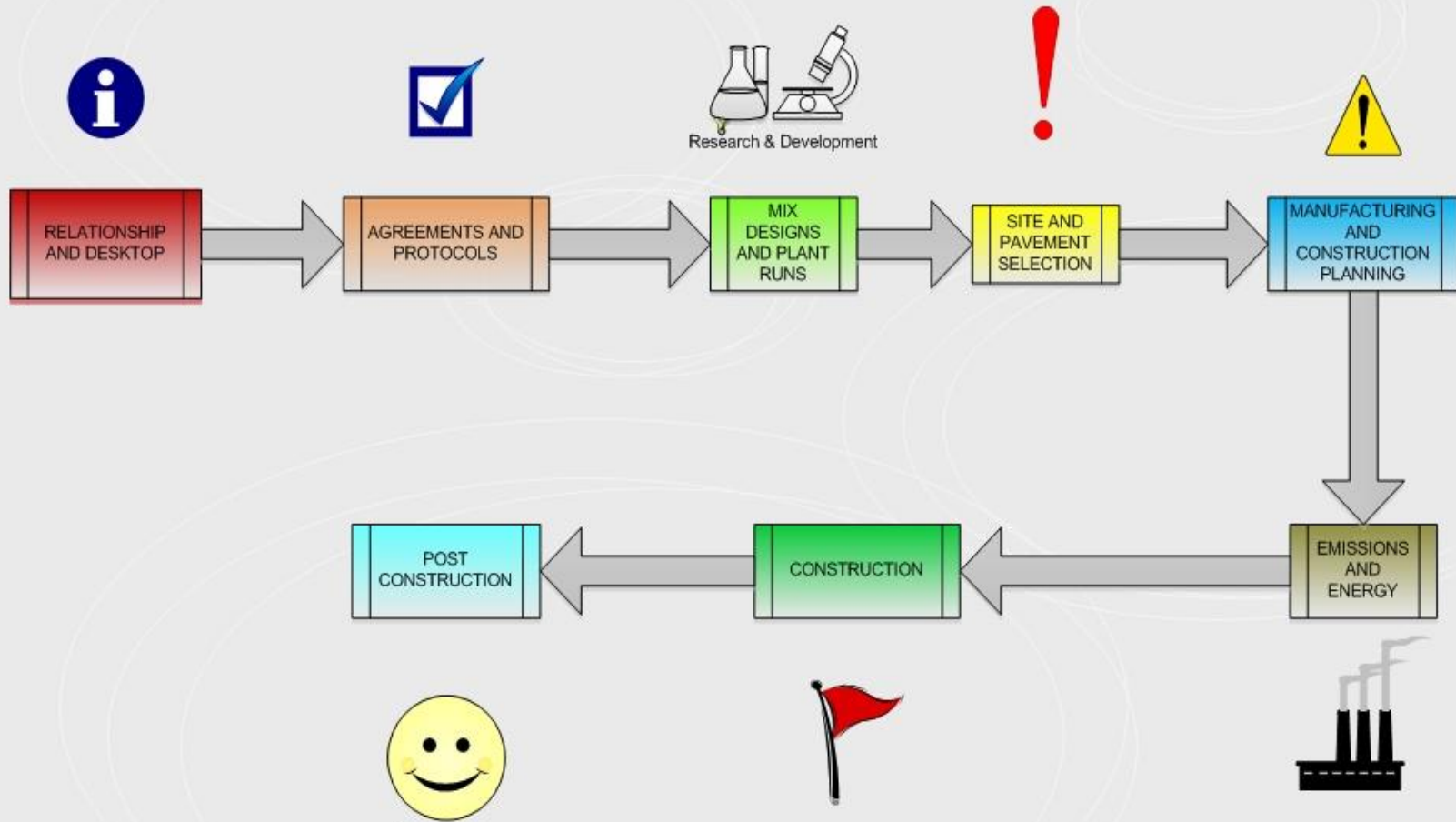
WMA BEST PRACTICE GUIDELINE & SPECIFICATION

FAQ	CHAPTER
What are the benefits of WMA in terms of the environment, working conditions and costs?	3
What technologies are used to reduce the asphalt temperature while still enabling a high level of compaction to be achieved?	4
How are WMA Technologies classified?	5
Are any additional or less stringent measures required regarding HSE when manufacturing and paving WMA?	6
How should the various components that are used to make up the WMA handled?	7
What quality assurance methods should be applied to the mix components?	8
What process is used to approve the mix? What changes are there to the mix design procedures normally used for HMA?	9
How is WMA manufactured; can both batch and continuous drum mixer type plants be used to produce WMA, what modifications are required? How is the plant adjusted to produce the lower temperature mixes?	10
What quality assurance measures should be implemented during the manufacture of WMA? Are aspects such as moisture susceptibility and rutting potential addressed?	11
Are any special measures required during the transportation and paving of WMA?	12
What quality assurance measures should be implemented at the paving site?	13
When new WMA Technologies become available what procedure is used to implement and approve them?	14

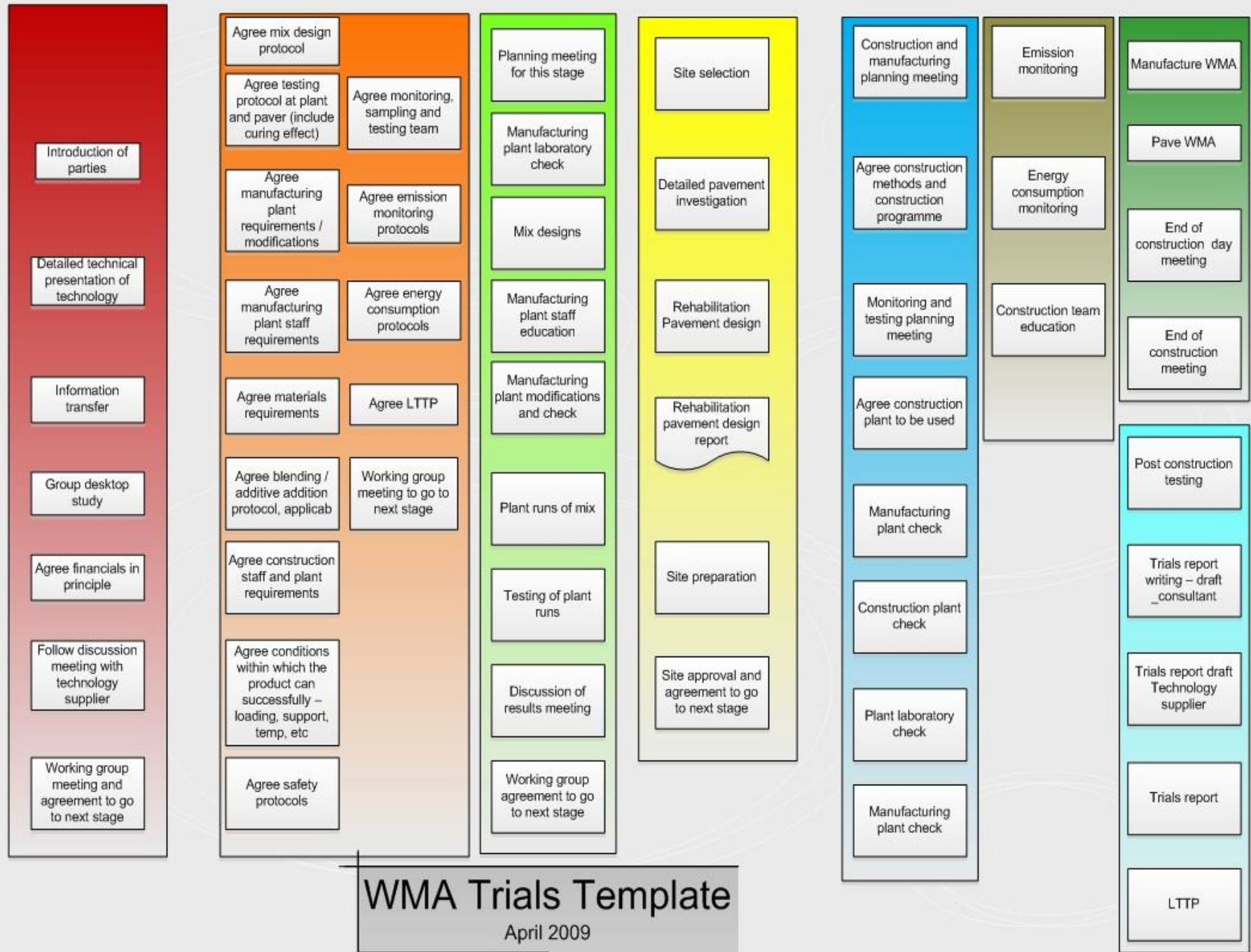


Consequential outcomes: Know Thy Self – Intense Interrogation of plant and paving operations

- ▶ Intelligent compaction or paying attention
- ▶ Moisture in the crusher dust or polluting forward
- ▶ Logistics management or paying attention
- ▶ Rolling pattern or being efficient
- ▶ High speed tampers or adjusting equipment
- ▶ Morning construction planning meetings or rush tackling
- ▶ Quality management of raw materials or blame the supplier
- ▶ Calibration of burners or blame the moisture
- ▶ Plant heat lose
- ▶ Mixing time



Warm mix asphalt trials
South Africa
Template Version April 2009



WMA - Catalyst for further new developments

- ▶ Very early question - What is workability?
- ▶ TRH 21 - 40% RA mixes - coupled with WMA is winning formulae
- ▶ EME Guideline - Piet Myburgh “ why are you not trialing EME” - WMA Trial Template
- ▶ TRH 21 - Recovered binder properties, Rejuvenation and handling RA
- ▶ TRH 8 - Can Marshall still Marshall

WMA - Catalyst & Stimulation for revision of other documents

Technical Recommendations for Highways TRH 21: 2016

Use of reclaimed asphalt in the production of asphalt

1/6/2017

FINAL 2nd DRAFT

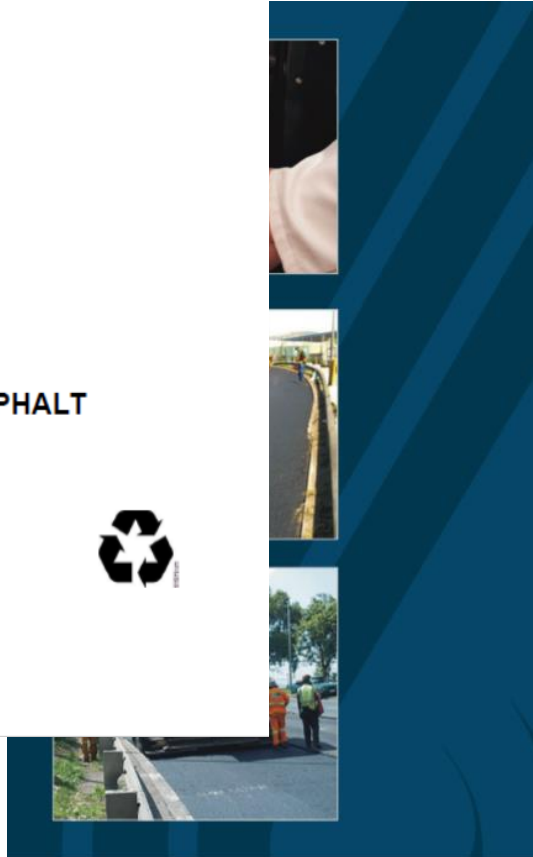
TECHNICAL RECOMMENDATIONS FOR HIGHWAYS

TRH 21: 2009

HOT MIX RECYCLED ASPHALT



July 2009



Design procedure for high modulus asphalt (EME)

Manual 33 July 2015



Design and Use of Asphalt in Road Pavements

Manual 35 / TRH 8



SA WMA Usage to since 2012

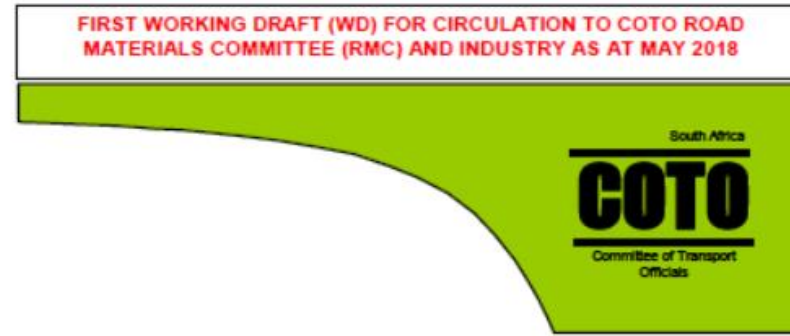
Over a millions tonnes
paved successfully

Used by all 3 level of client
bodies

Most of the larger
manufacturers are WMA
ready

warm mix
asphalt rsa

WMA Specification development



Standard Specifications for Road and Bridge Works

Working Draft (WD)
CHAPTER 9: ASPHALT LAYERS
May 2018

Confidential

This document is confidential and may only be distributed for purposes of obtaining comment and not intended for use.

WMA Making SANI PASSable since 2012

Client: KZNDOT

Manufacturer: National Asphalt

Haul from Shongweni to Sani Pass -

2am departure

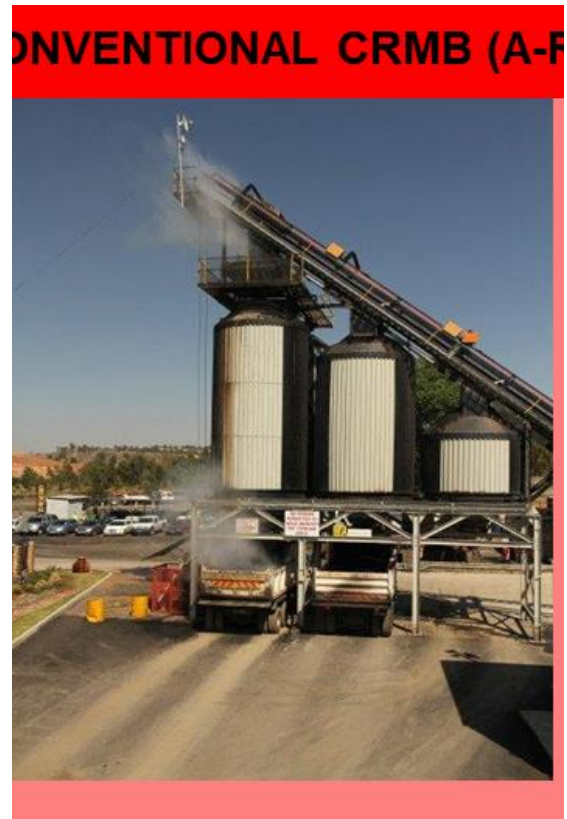
5 hr haul + 2 hr standing on site

Manufactured at @ 165 deg

Lost 10/15 deg in the truck

arm mix
phalt rsa

WMA: New Crumbed Rubber Technology: N5



- ▶ Client: Edwin Construction / SANRAL
- ▶ Manufacturer: Much Asphalt
- ▶ Haul distance : 370km
- ▶ Mix Type : NCRT Thin layer Porous Asphalt
- ▶ Compaction Temp: 90-140 deg

WMA Foam Frontier

- ▶ Foamed bitumen + Foam enhancer + 40% RA + Rejuvenator = Asphalt @ 105 deg
- ▶ Foam half life increased from 30 s to 1 minute
- ▶ Next step
- ▶ Same technology combination for EME (10/20 pen)

Long Term Field
Performance of
WMA

Warm mix
asphalt

WMA National Trail 2: Leceister Rd, Durban - +-10 years on.

- ▶ Paved June 2009
- ▶ Traffic is heavily laden container trucks, multi-links
- ▶ Speeds from standstill to about 60km/hr
- ▶ Lots of turning action

- ▶ **Visual assessment Nov 2018** - Looking good, quite good, yeah quite good.
- ▶ Longitudinal paving joints open in some places
- ▶ Some very slightly coarse surface texture in section where paver stopped
- ▶ Isolated fatty spot
- ▶ NO RUTTING
- ▶ NO CRACKING





WMA National Trail 2: Leceister Rd, Durban - +/-10 years on

NAPA / FHWA Partnership survey since 2009

- ▶ 39 % asphalt of produced in 2017 was WMA
- ▶ Equivalent of 147.4 million tonnes
- ▶ 777% increase since 2009

- ▶ Reference www.asphaltpavement.org/recycling

Long-Term Field Performance of Warm Mix Asphalt Technologies

- ▶ NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM: RESEARCH REPORT 843
- ▶ Published in 2017
- ▶ A total of 17 WMA technologies were used in the field projects, including asphalt foaming additives, plant foaming units, chemical additives, and organic additives.

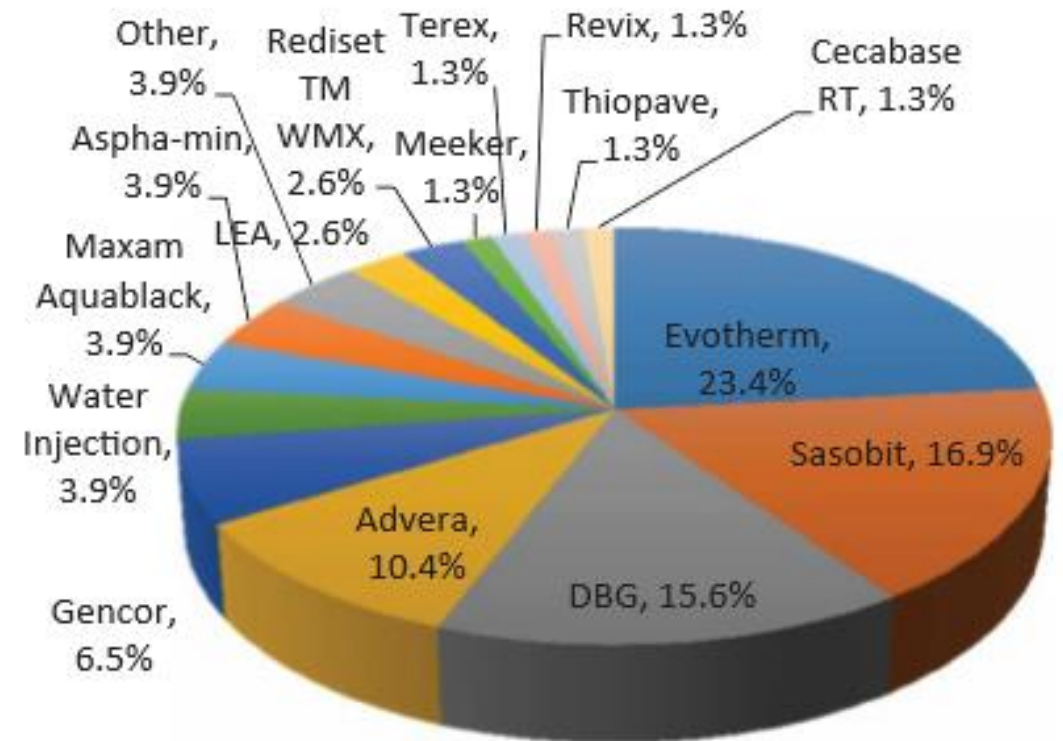


Figure 1.2. Distribution of WMA technologies based on individual technologies.

International status - NCHRP: RESEARCH REPORT 843



- ▶ This research report compares material properties and field performance of warm mix asphalt (WMA) and control hot mix asphalt (HMA) pavement sections constructed at 28 locations across the United States between 2005 and 2012 and evaluated in the period 2012 through 2015.
- ▶ Pavements containing various WMA technologies exhibited long-term field performance comparable with that of the companion HMA pavement in terms of transverse cracking, wheel-path longitudinal cracking, and rutting.
- ▶ No moisture-related distress was found in the field for either the HMA or the WMA pavements.

Asphalt Plants & WMA

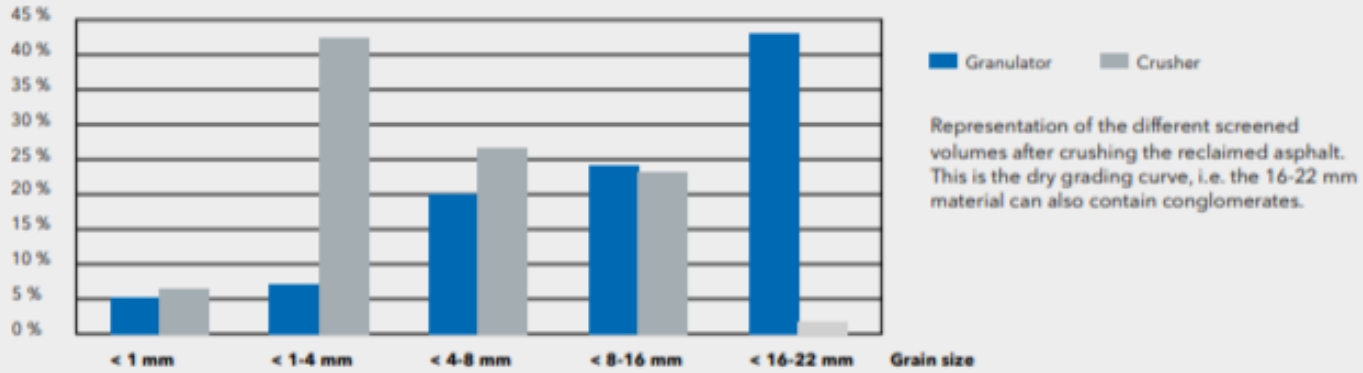


How have the asphalt plants responded



- ▶ Most major asphalt plant manufacturers have now incorporated WMA technology into their plants.
- ▶ Common to find proprietary foaming technologies
- ▶ Common to find WMA additive addition mechanical and software options
- ▶ As we have found, high RA & WMA systems appear a symbiotic relationship

Granulator vs. crusher for reclaimed asphalt processing



GRANULATOR DESIGN AND FUNCTION



// DESIGN OF THE GRANULATOR

- 1 Power unit
- 2 Primary granulator
- 3 Pre-grinding of large slabs with reciprocating tampers
- 4 Primary granulator - milling shaft, grain size: 0-70 mm
- 5 Magnetic separator
- 6 Screen, 2-level screen
- 7 Stockpile conveyor 1, grain size 0-8 mm
- 8 Stockpile conveyor 2, grain size: 8-22 mm (0-22 through conglomerates)
- 9 Secondary granulator, variable grain size adjustable: 0-22 mm
- 10 Return of oversize aggregate



// MILLING SHAFT WITH WEAR PROTECTION AND SPECIAL CHIPPER, EASY TO REPLACE

// CRUSHING STAGE 1/2

The granulator is loaded with reclaimed asphalt by a wheel loader - as a one-person operation. During the first crushing stage, the asphalt slabs are broken into smaller pieces and pressed down onto the milling shaft. During the upwards motion, the reciprocating tampers prevent bridge formation in the hopper. The milling shaft achieves an output of 0-70 mm in the second grinding stage.



// SECONDARY GRANULATOR SHAFTS WITH HARD CAST LUG SHELLS, EASY TO REPLACE

// CRUSHING STAGE 3





Before the broken material is conveyed to the screen, any contained iron parts are removed by a magnetic separator. After fractioning trough the screen, the oversize aggregate from crushing stage 3 is fed to the secondary granulator. The result of stage 3 is variable - analogue to the screen used - and is fed back to the screen through the oversize aggregate return (output free from oversize aggregate).

Processing of RA: Granulate for truer particle size of RA

SYSTEM MEETS PLANT.

OVERVIEW RECYCLING SYSTEMS AND PLANTS



	Plant	Mixing capacity	Middle ring dosing system	Dosing system into the mixer	Multivariable dosing system	Parallel drum	RPP	Parallel drum in counterflow with hot gas generator
	MBA 2000	160 t/h						
	MBA 3000	240 t/h	X					
	ECO 2000	160 t/h		X				
	ECO 3000	240 t/h	X	X				
	ECO 4000	320 t/h	X	X				
	TBA 2000	160 t/h		X	X			
	TBA 3000	240 t/h	X	X	X	X		
	TBA 4000	320 t/h	X	X	X	X		
	BA 3000	240 t/h		X	X	X	X	X
	BA 4000	320 t/h		X	X	X	X	X
	BA 5000	400 t/h		X	X	X	X	X

Plant RA Capabilities - System & Energy optimization

type BA 4000 with a mixing capacity of 320t/h. A parallel drum in counterflow with a hot gas generator for the gentle, indirect heating of granulated RAP ensures a high level of environmental friendliness and maximum RAP material rates. This unique innovation enables RAP material rates of 90 + X% to be achieved – higher than with any other recycling system on the market. Presented at Bauma 2016 and



// HOT GAS GENERATOR



// HOT GAS GENERATOR

- > Parallel drum in counterflow with hot gas generator
- > Highest possible feed rates of RAP material
- > Indirect heating of the material
- > Lowest emission rates
- > Significant positive overall energy balance of the plant

South Africa's Carbon Tax Bill

- ▶ December 2017, Second Draft Carbon Tax bill published for comment.
- ▶ Intended implementation date: July 2019
- ▶ Proposed tax is R120/ton of carbon dioxide equivalent for emissions above tax free threshold.

▶ **Polluter pays - we all pay**

Industry Response to Carbon Tax

- ▶ Mitigation measures in place - active monitoring and reducing emissions
- ▶ WMA will be default mix, should you want HMA, then you pay extra to off-set Carbon Tax implication.

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what should we change for more use
producers say

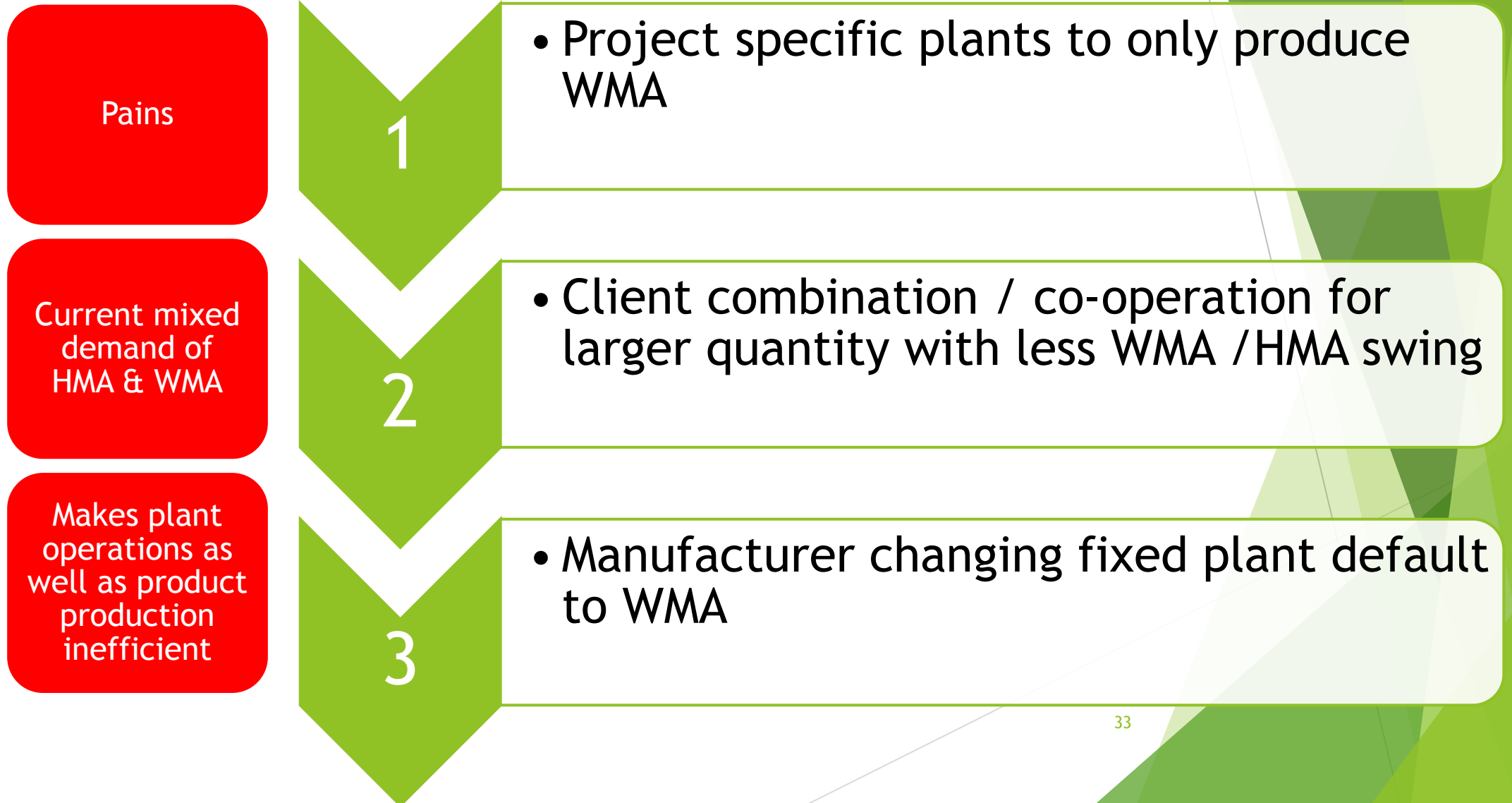
1

spec it and we
will produce it

2

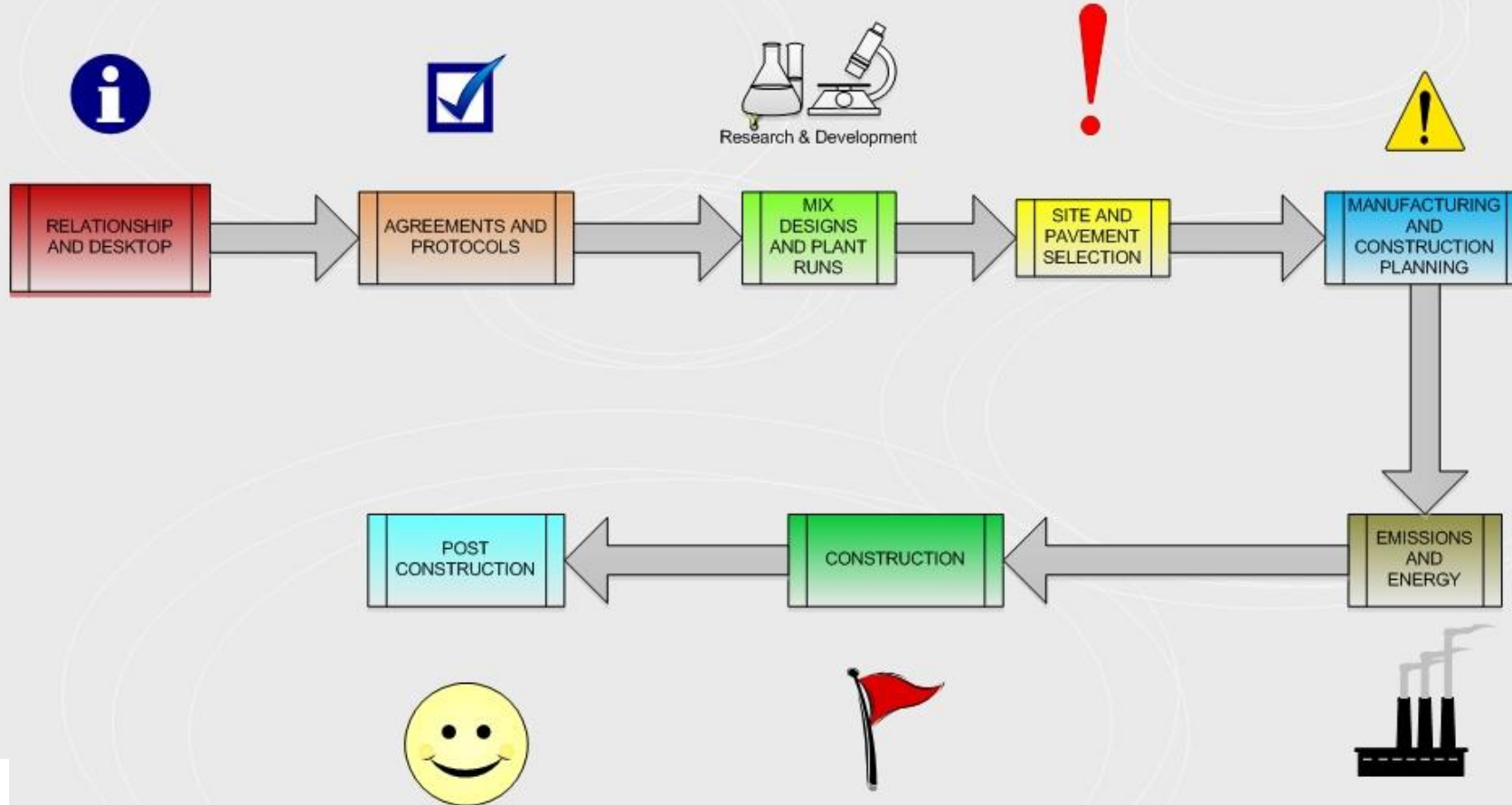
remove
compaction
temperature
limit

Overcoming transition pains



WMA Interest Group

- ▶ Interest Group needs to do more work.....



Warm mix asphalt trials
South Africa
Template Version April 2009

SA Intention - get us back on pace with international best practice

