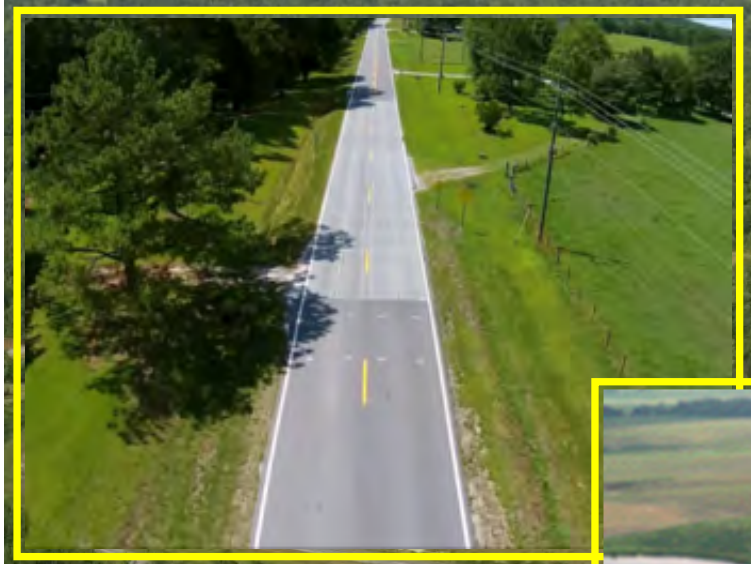
NCAT Pavement Test Track



Implementation of Track Findings


ADEM
Alabama Department of Environmental Management
Alabama Department Of Transportation
Kansas Department of Transportation
CDOT
COLORADO
Department of Transportation
COLLABORATIVE AGGREGATES LLC
ARDOT
ARKANSAS DEPARTMENT OF TRANSPORTATION
DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA
FP2
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
Illinois Department of Transportation
GDOT
Georgia Department of Transportation
KENTUCKY TRANSPORTATION CABINET
SHA
State Highway Administration
MDOT
Michigan Department of Transportation
MDOT
MISSISSIPPI DEPARTMENT OF TRANSPORTATION
MINNESOTA DEPARTMENT OF TRANSPORTATION
MoDOT
NEW YORK STATE OF OPPORTUNITY.
Department of Transportation
DOT
Oklahoma Department of Transportation
SCDOT
South Carolina Department of Transportation
TN
TDOT
Department of Transportation
VDOT
Virginia Department of Transportation
WISCONSIN DEPARTMENT OF TRANSPORTATION
MnROAD
Texas Department of Transportation
Cargill
STATE OF WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION
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Implementation Content

- Materials
- Mixes
- Structures
- Construction
- Preservation

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Materials

- Expanded use of local/underutilized stockpiles
- Use of (fractionated) RAP & processed PC-RAS
- “Healthy” binder content for mix durability (BMD)
- Economical use of polymer modified binders
- GTR for sustainable binder modification
- Aramid fibers to improve mix durability (PFC)
- Highly polymer modified asphalt (HiMA).

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Targeted Use of High Polymer Mixes

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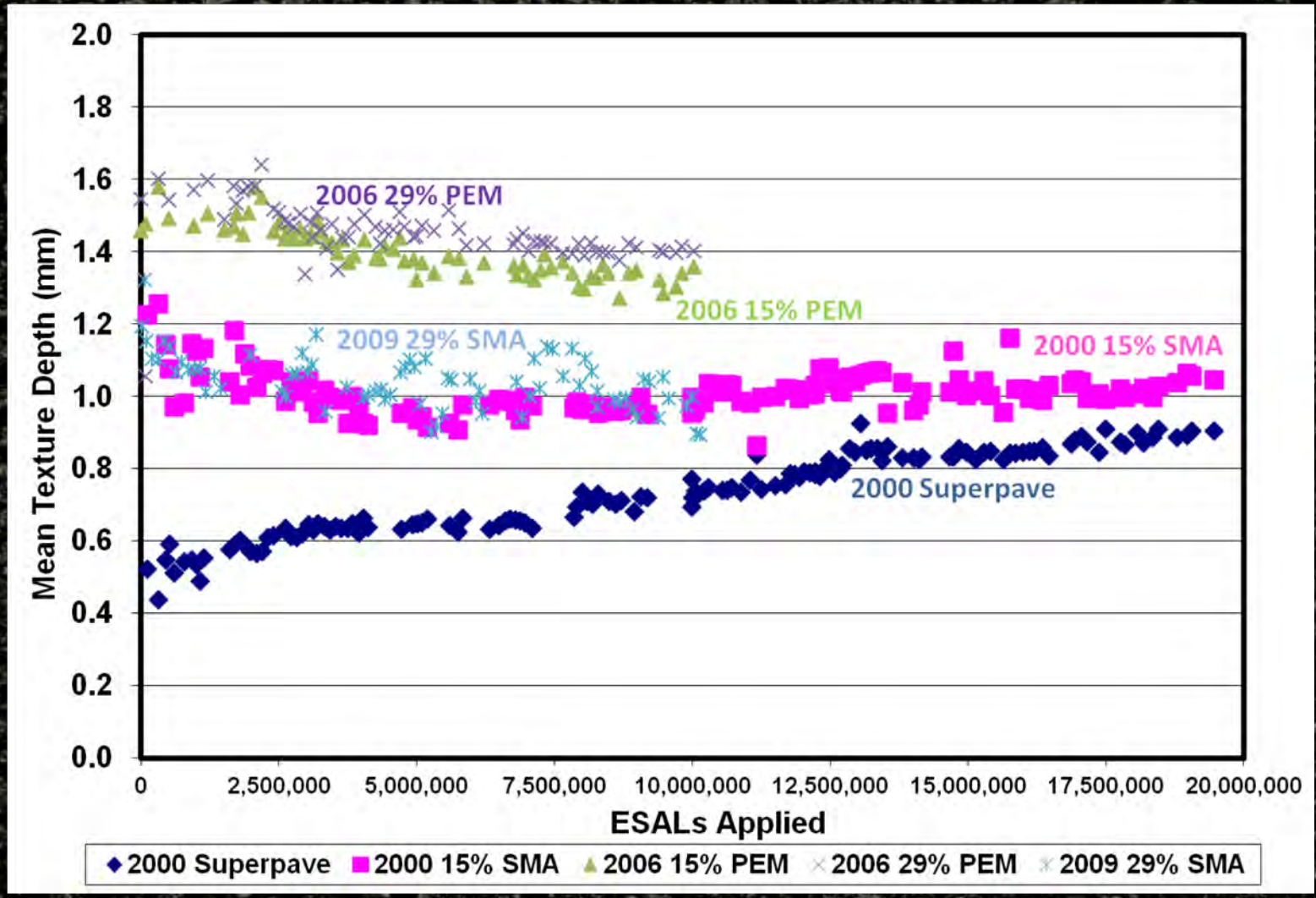
Local Aggregates



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Mixes

- Transition to Superpave/gyratory mix designs
- Reduction in design laboratory compaction
- Choosing between SMA and DGA mix options
- Aged binder ratio (ABR) mix design philosophy
- "Healthier" binder content in balanced mix design
- Cracking test needed for design approval & QC (!)
- Benefits of smaller NMAS and/or finer mixes.

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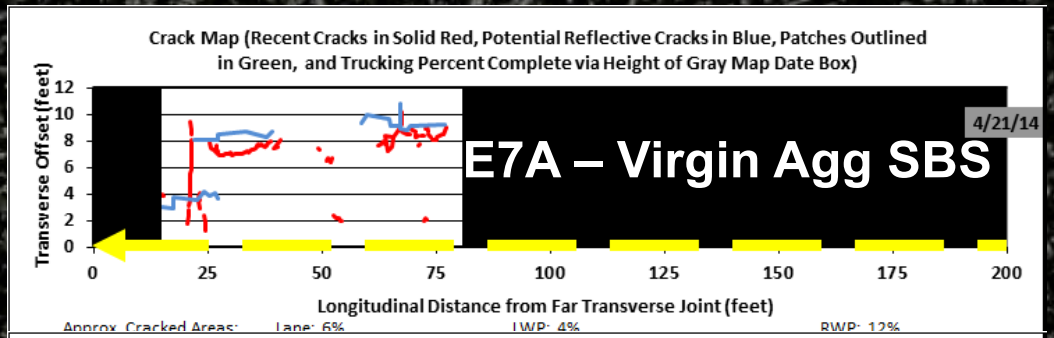
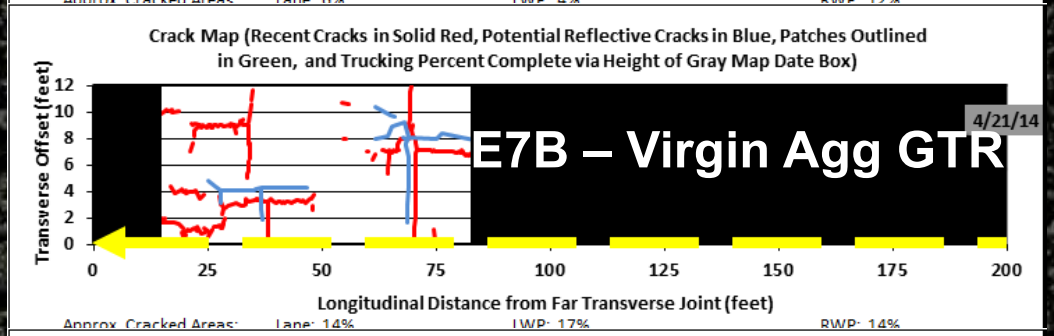
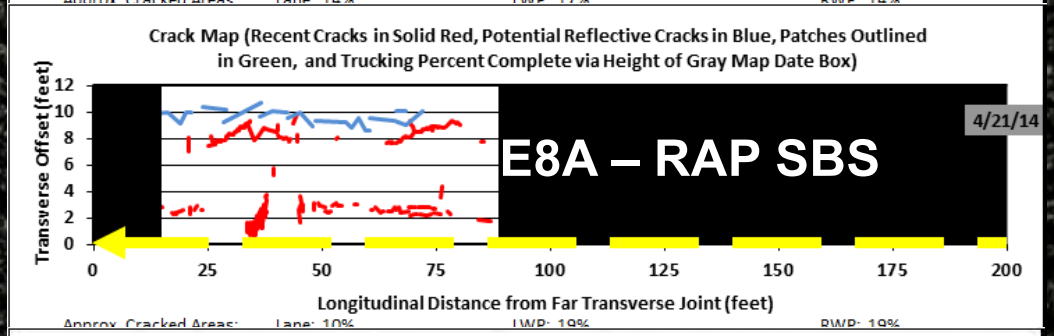
Reflective Cracking

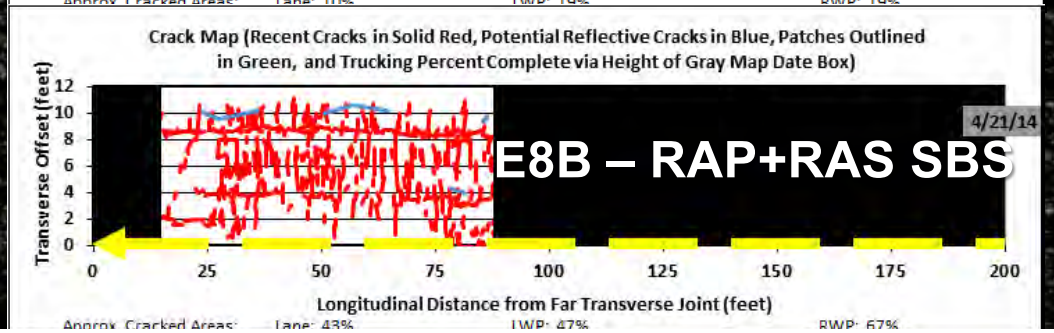




RAP BR = 29%



Aged BR = 41%
RAP BR = 20%
RAS BR = 21%



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Fine versus Coarse Gradations

MnR

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Smaller NMAS “Thinlay” Mix

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Smaller NMAS "Thinlay" Mix

4.6 mm in APA

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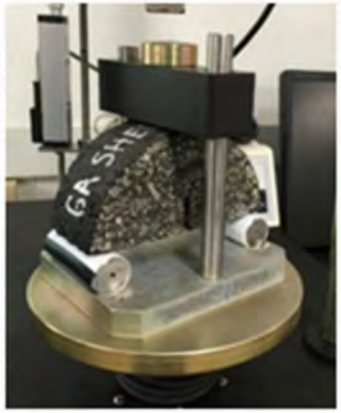
Need for a Production Cracking Test !

BBF



SCB-LA

I-FIT

OT-TX

OT-NCAT

SVECD

DCT

Energy Ratio

Nflex Factor

Cantabro

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Structures

- "M-E" versus "E" pavement buildup design
- Need for local calibration & strain thresholds
- Consideration for alternative materials/layers
- Layer coefficient increase from 0.44 to 0.54
- Reduces to 0.15 for OGFSC/PFC surfaces, but…
- Fog sealing prolongs OGFC/PFC surface life
- 0.36 ≤ 100% RAP CCPR base mix ≤ 0.39.

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RAP_{11}+RAS_3 $Thinlays_{20}$ on Cold Recycle

Foam

Emulsion

CCPR

CIR

No Rutting

No Cracking

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Construction

- WMA and higher aged binder ratio (ABR) mixes
- Less distinction between HMA and WMA
- Smaller NMAS and/or finer aggregate blends
- Longitudinal joint quality/performance
- Prevention of premature/reflective distresses
- Tack coat is critical to pavement performance (!).

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Strategic Use of RAP, RAS, GTR, & WMA

Purpose of Each Layer	N5 Control	S5 Higher RAP	S6 RAP+RAS	S13 Recyc Tires
Durable, Rut Resistant Surface	20% RAP_{20} 67-22/82-16 DG	25% RAP_{11} 67-22/76-22 SMA	5% RAS_{21} 67-22/88-16 SMA	VIRGIN $82\text{-}22_{12}$ SMA
Stiff, Strain Reducing Middle	35% RAP_{39} 67-22/88-10 DG	50% RAP_{41} 67-22/82-16 DG	50% $AGED_{26\text{-}24}$ 67-22/94-10 DG	35% RAP_{37} $82\text{-}22_{12}$ DG
Fatigue Resistant Base Layer	35% RAP_{39} 67-22/88-10 DG	35% RAP_{34} 94-28/94-10 DG	25% RAP_{24} +76-22/88-16 DG	VIRGIN $88\text{-}22_{20}$ AZ

Green = Evotherm Q1 Additive, Blue = Astec Green Foamer

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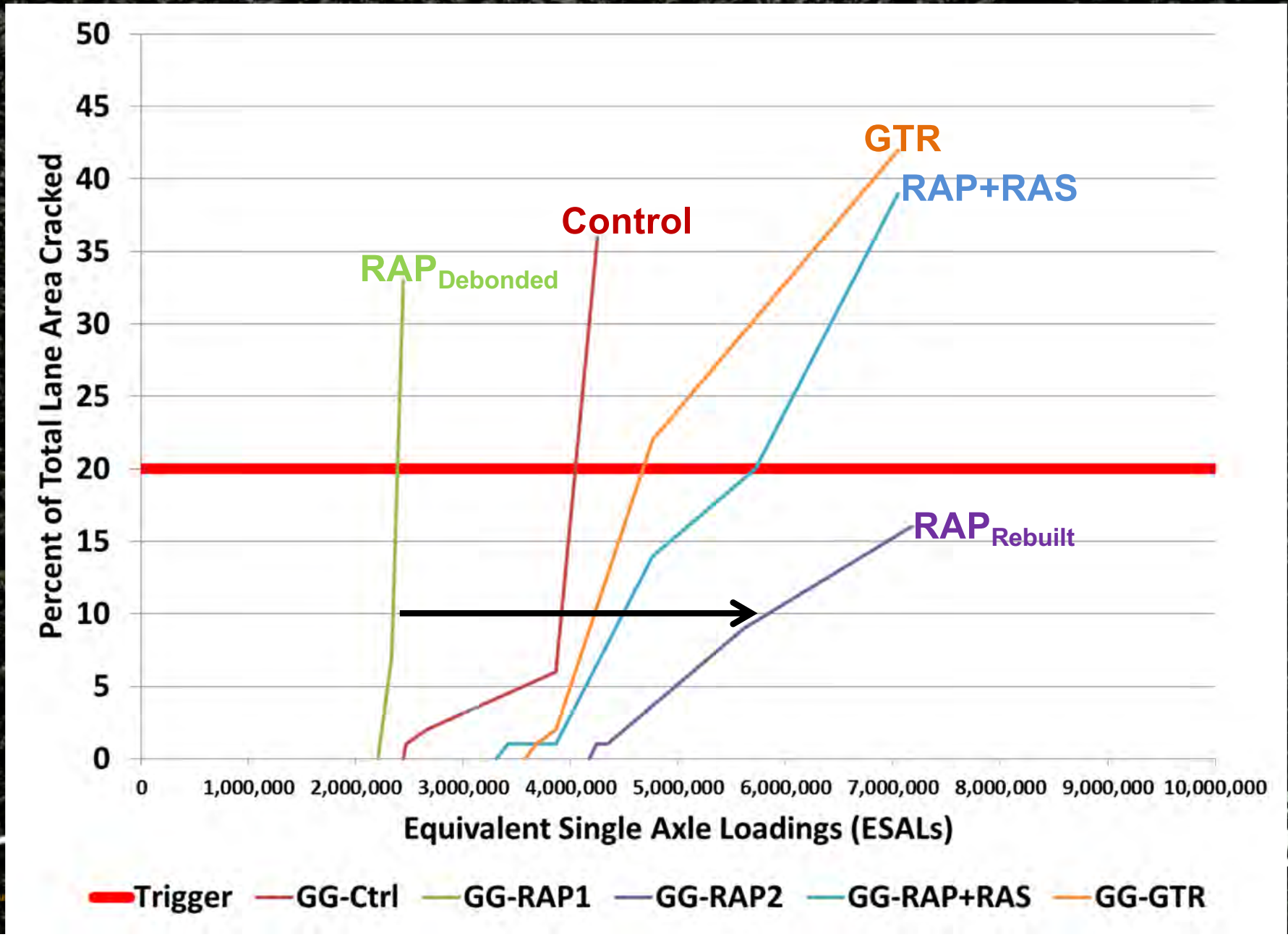
Effect of Increased Tack Rate



Preservation

- Crack sealing improves cracking performance
- Scrub seals exhibit both crack & chip seal benefit
- Treatments reduce subgrade moisture, but…
- Robust treatments provide more life extension
- Objective selection of preservation alternatives.

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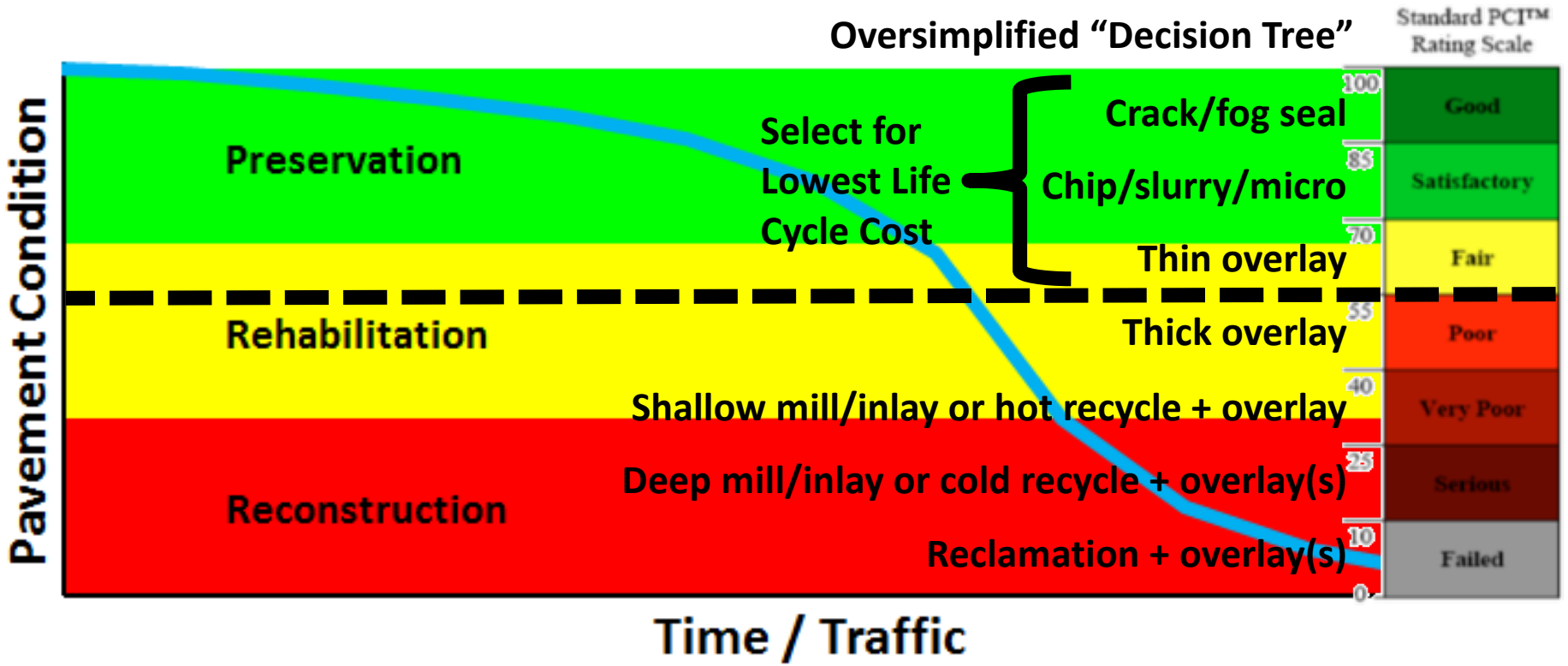
Preservation Selection Process



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SHRP2 – R26

Treatment	PCI	Cracking (L=Low, M=Medium, H=High)															Deformation (L=Low, M=Medium, H=High)												Raveling / Weather			Ride	Friction	Noise
		Fatigue[b] / Long WP[c] / Slippage			Block			Transverse Thermal[c]			Joint Reflection			Long / Edge[d]			Wear / Stable[e] Rutting			Corrug / Shove			Bumps / Sags			Patches								
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H			
Crack Filling	75-90																																	
Crack Sealing	80-95																																	
Single Chip Seal	70-85																																	
Double Chip Seal	70-85																																	
Slurry Sealing	70-85																																	
Single Micro Surface	70-85																																	
Ultra-Thin Bonded HMA Overlay	65-85																																	
½" to ¾" HMA Overlay	65-85																																	
⅜" to 1½" HMA Overlay	60-80																																	
Mill & HMA Overlay	60-75																																	
Hot In-Place & HMA Overlay[a]	70-85																																	
Cold In-Place & HMA Overlay[a]	60-75																																	

[a] Surface recycle with a thin HMA overlay

[b] Fatigue (alligator) cracking: L=<1/4" width or <10% area; M=1/4 to 1/2" or 10-20% area; H=1/2" or 20-30% area

[c] Longitudinal wheelpath and transverse cracking: L=<1/4" width; M=1/4 to 1/2"; H=1/2" width

[d] Edge cracking: L=no material loss; M=0-10% material loss; H=>10% material loss

[e] Stable rutting is related to densification, not plastic deformation

[f] Green=highly or generally recommended in SHRP 2 Report S2-R26-RR-2; Red=not recommended by the preservation industry due to > 1/4" width of unsealed cracks

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FAA

Surface Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Fog Seal	3 - 5	1 - 3	1 – 2
Chip Seal	7 - 10	3 - 5	1 – 3
Slurry Seal	7 – 10	3 - 5	1 – 3
Microsurfacing	8 – 12	5 - 7	2 – 4
Ultrathin Bonded Wearing Course	10+	5 - 10+	2 - 10
Thin HMA	10 - 12	5 - 7	2 – 4

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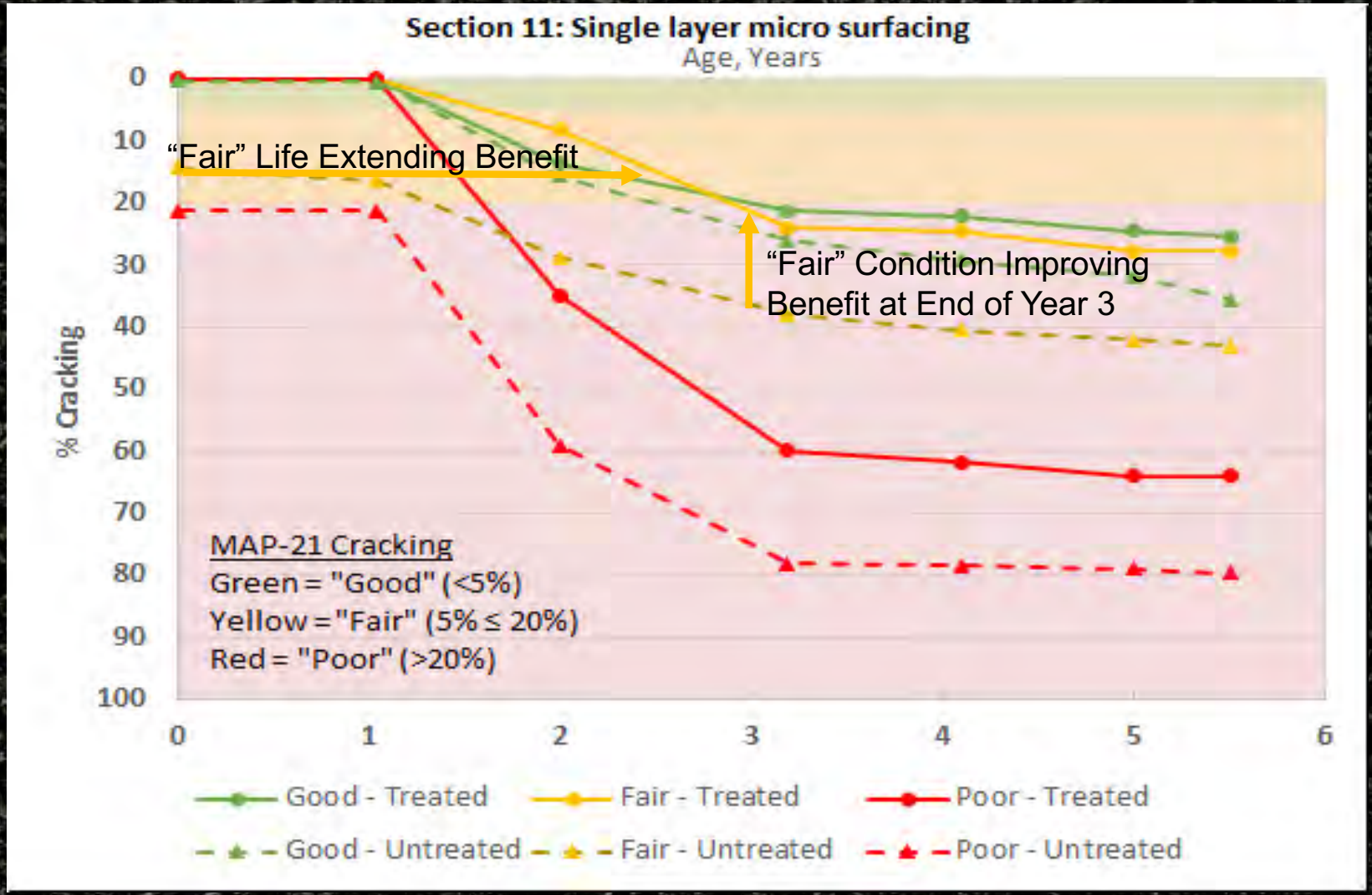
Benefits = *f*(Pretreatment Condition)



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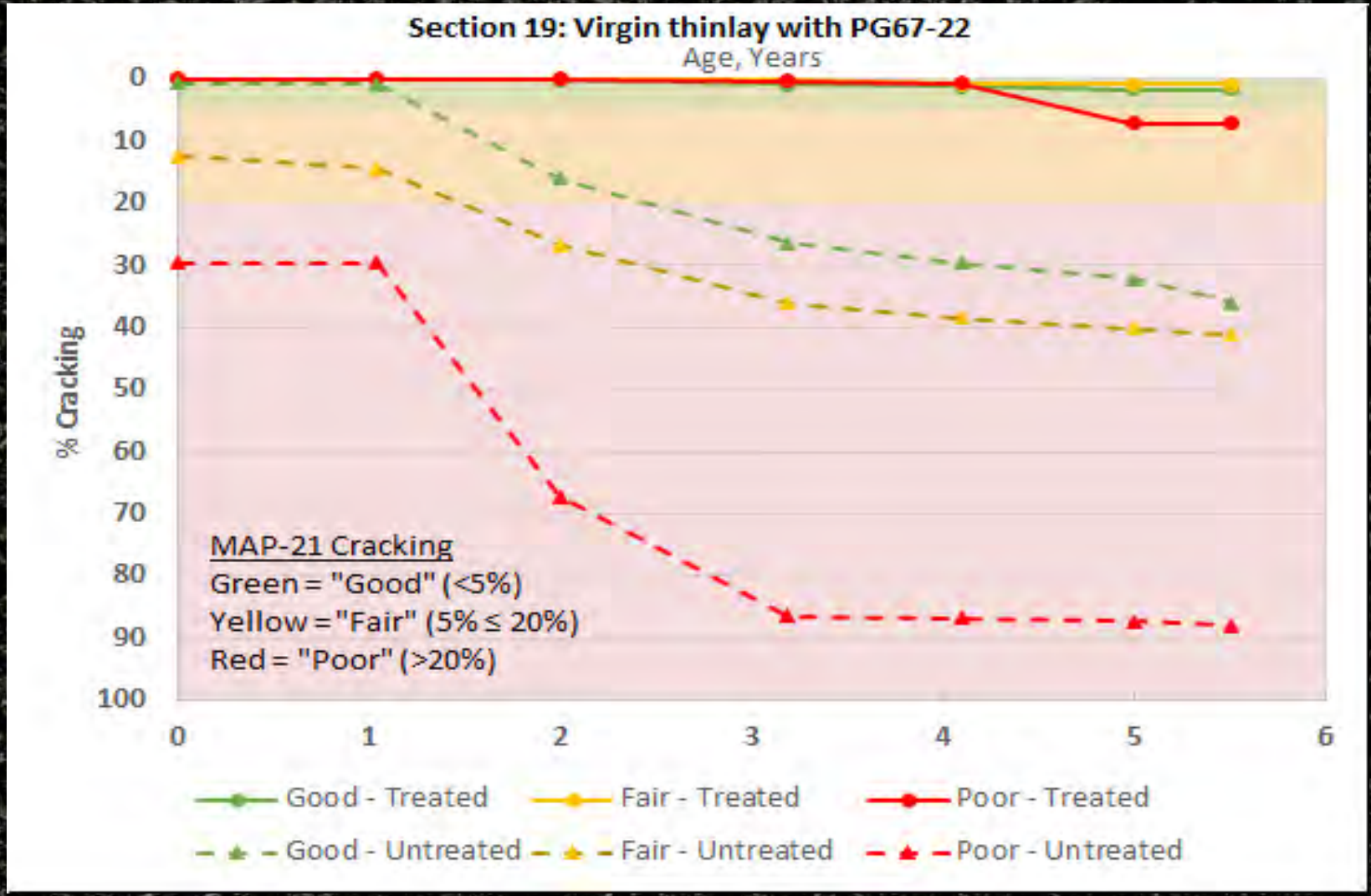
Benefits = *f*(Pretreatment Condition)



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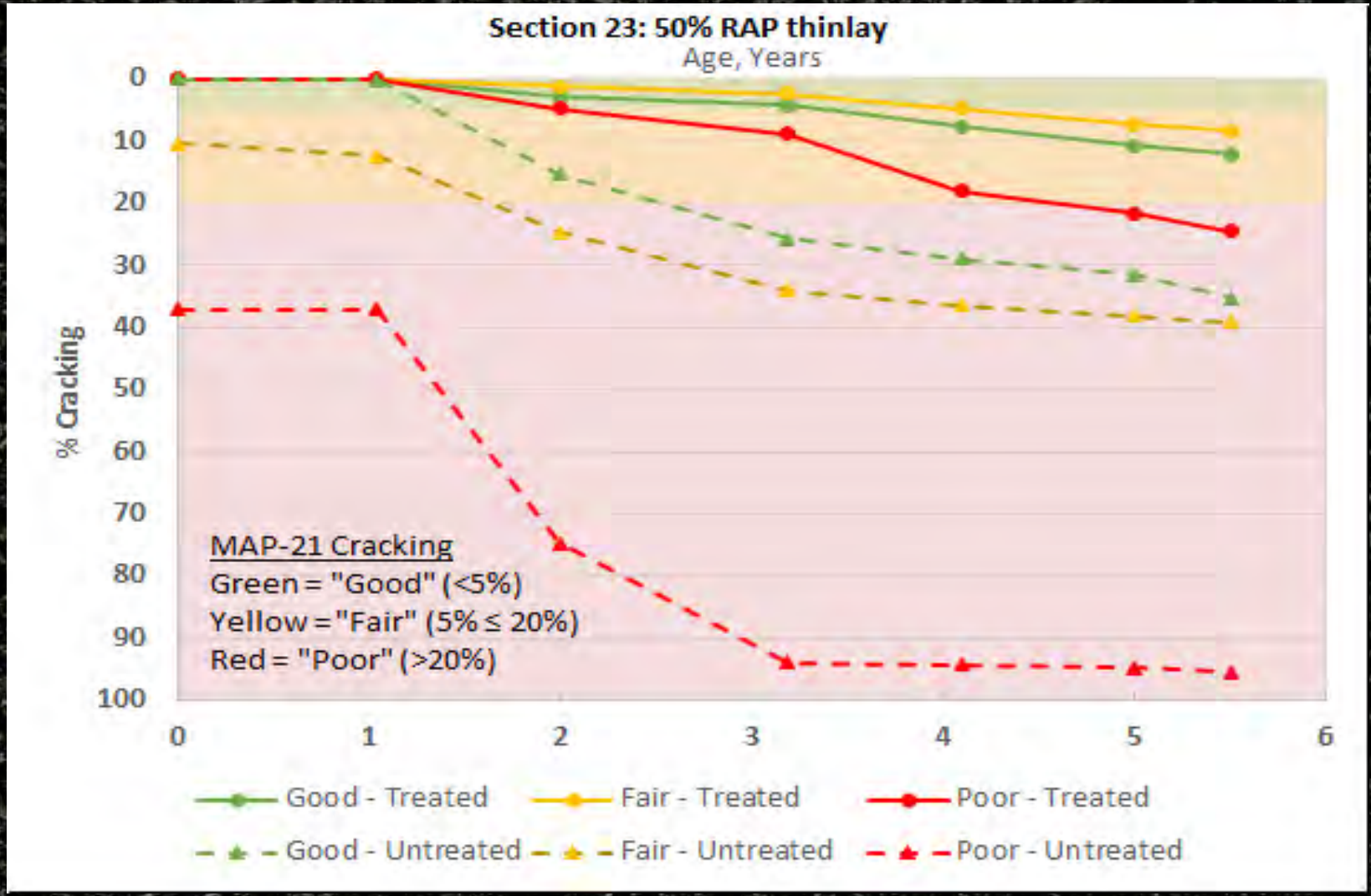
Benefits = *f*(Pretreatment Condition)



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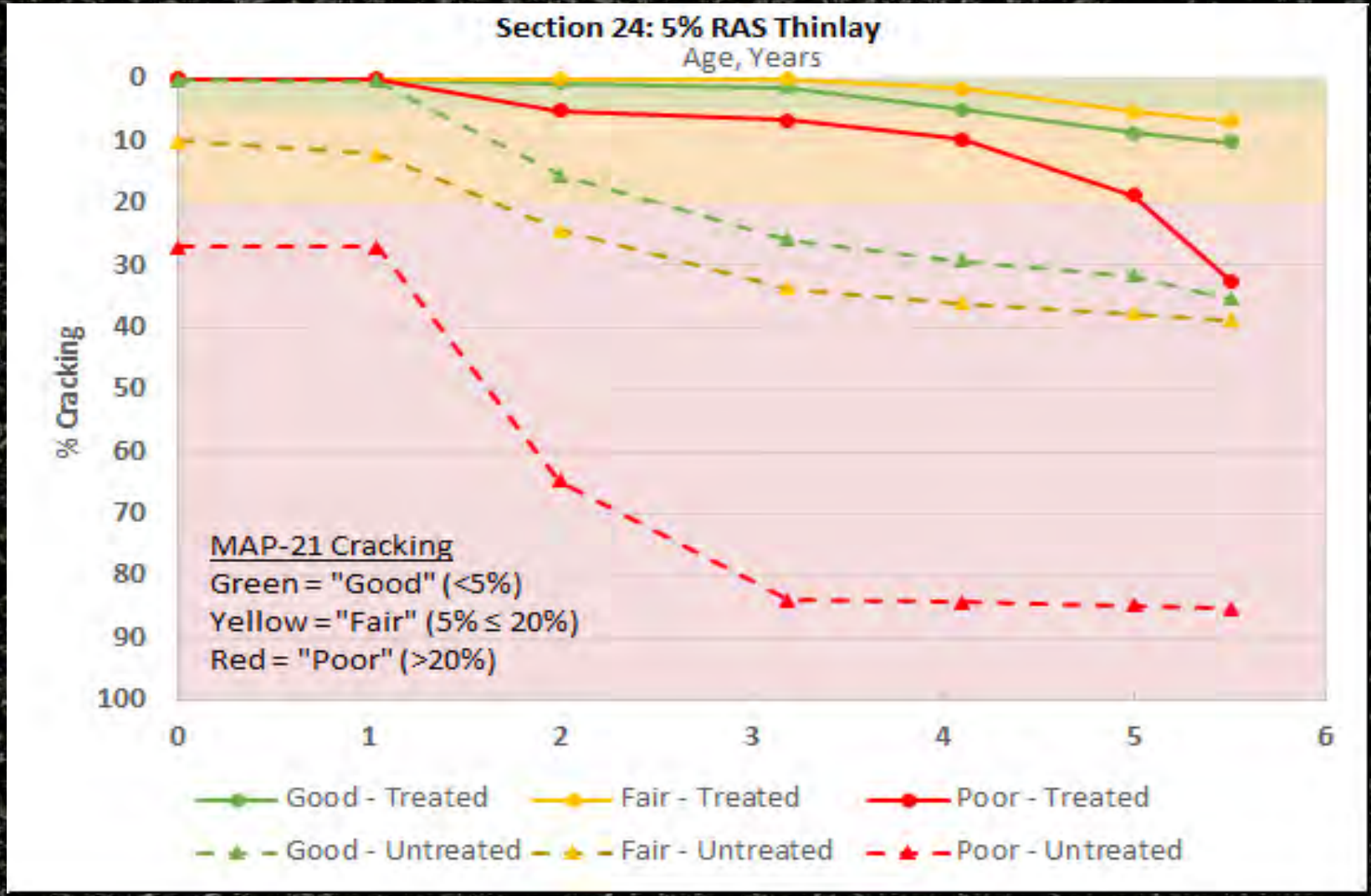
Benefits = *f*(Pretreatment Condition)



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Lee Road 159 Low Traffic Preservation

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US-280 High Traffic Preservation

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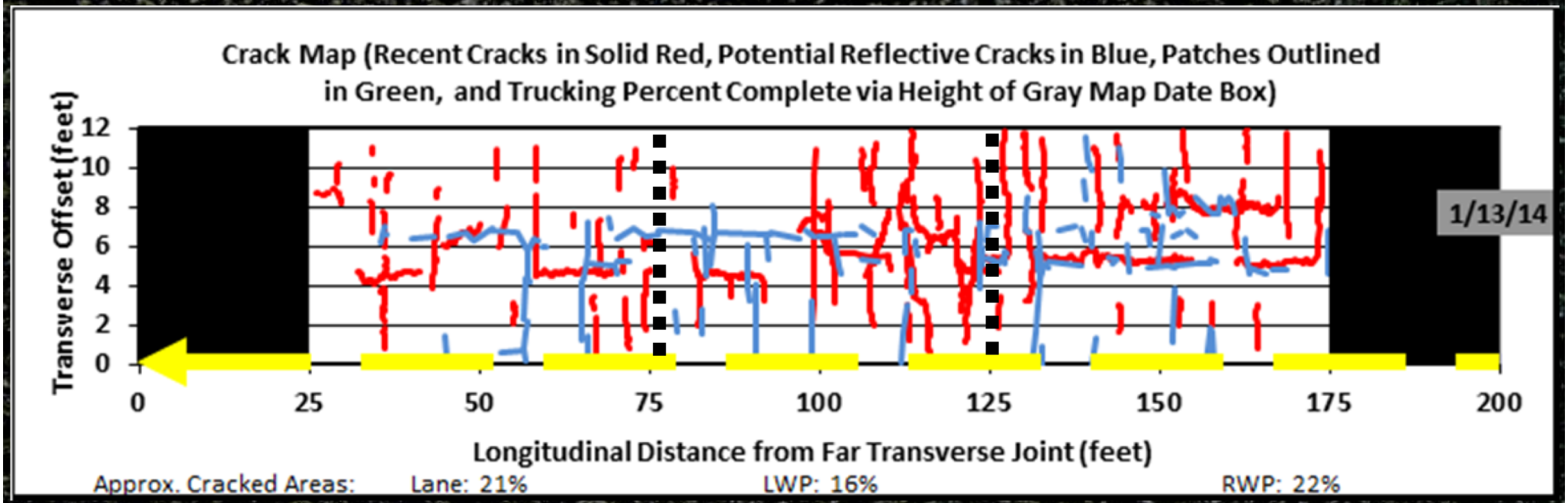
Perpetual Pavement Top-Down Cracking



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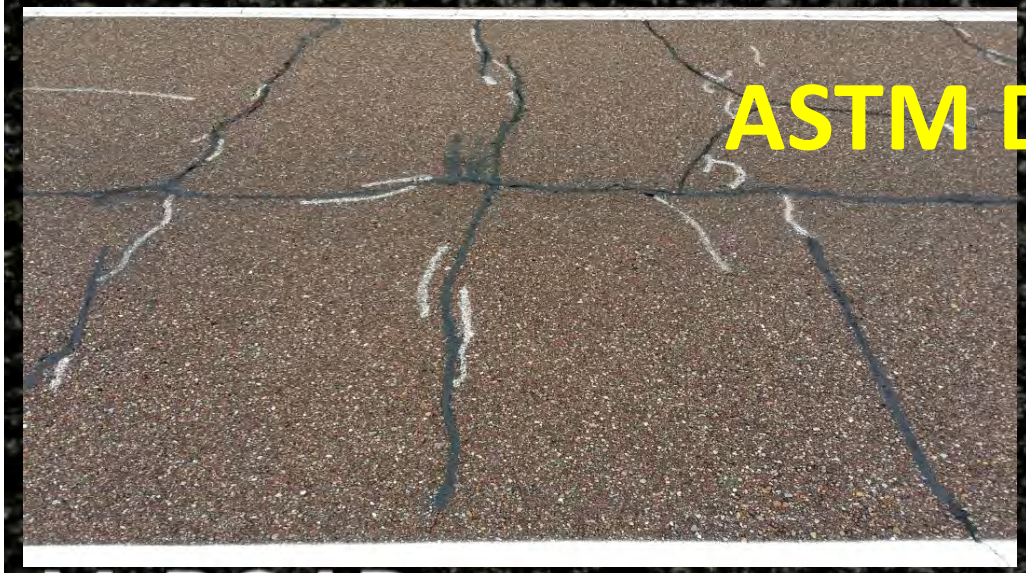
Perpetual Pavement Top-Down Cracking

← Untreated control

ASTM D 6690

↑ Blow and band



← Route and fill

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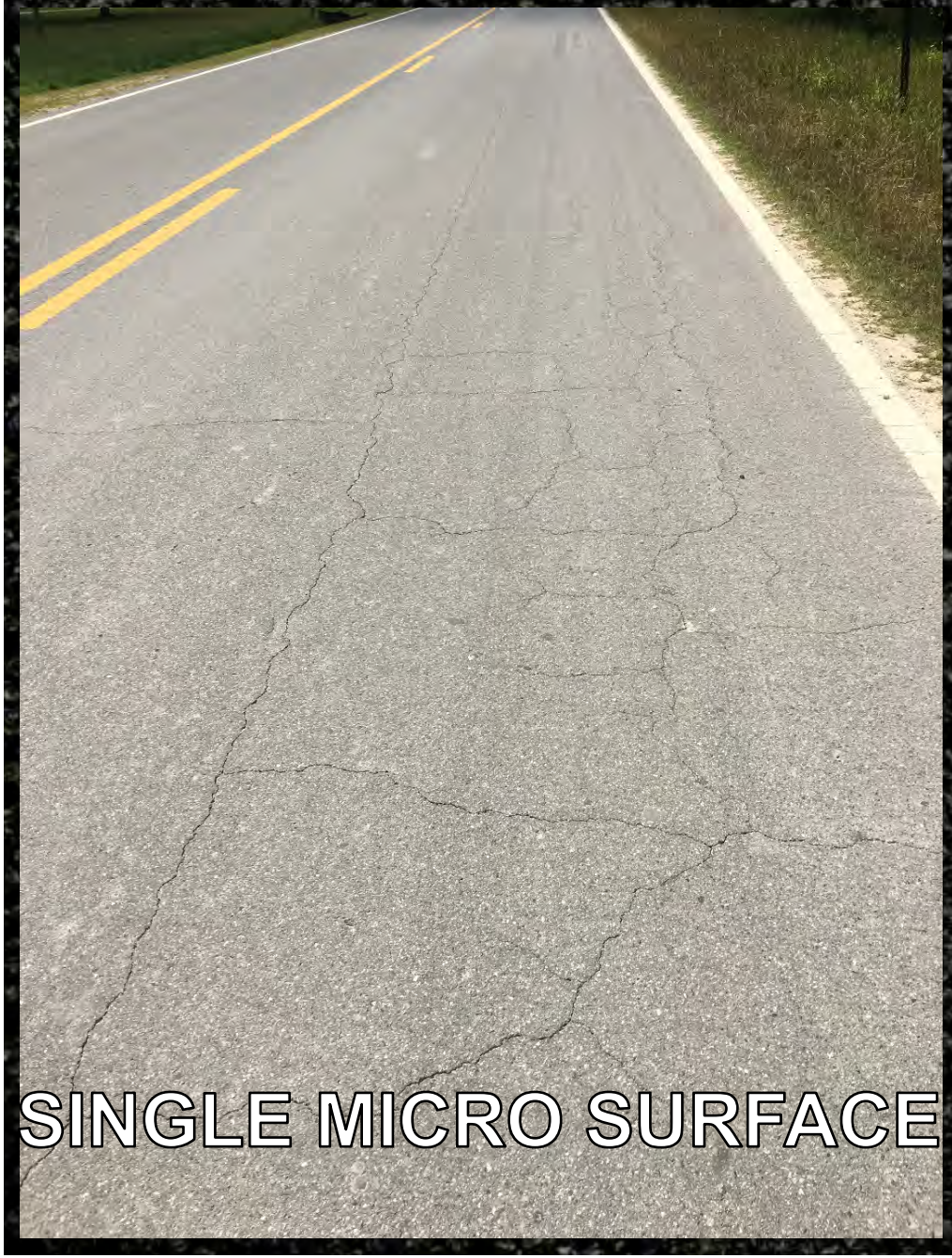
Crack Sealing in Thinner Pavements



SINGLE MICRO SURFACE

SINGLE MICRO SURFACE
+ CRACK SEALING

Current Track Research Focus

- Balanced mix design (design and construction)
- Design w/ lime modification, cement stabilization
- Effect of high-to-low density on performance
- Interlayers to reduce reflective cracking
- Single pass full depth rapid reconstruction
- Soybean-based biopolymer asphalt modification
- Thinlays and ultra thinlays for preservation
- Validation of laboratory cracking tests (aging).

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Reflective Crack Prevention

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Full Depth Rapid Rebuild

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Central Plant Cold Recycling

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In-Place Cold Recycling

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Cold Climate Sections

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MnROAD Cold Recycling/FDR

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Northern OGFC on Low Volume Loop

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2018 TEST TRACK CONFERENCE

MARCH 23-25, 2021

AUBURN, AL

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