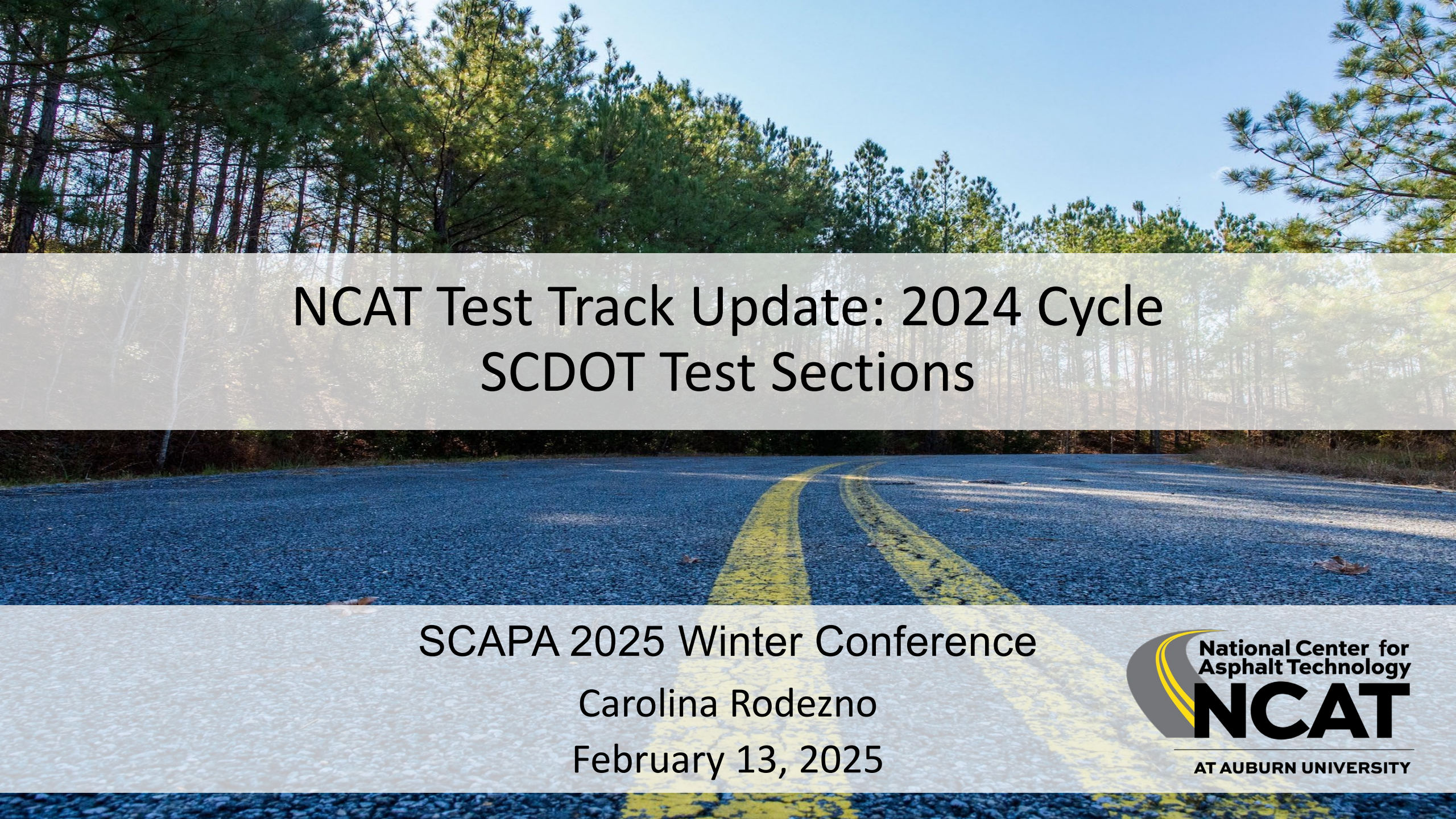

NCAT Test Track Update: 2024 Cycle
SCDOT Test Sections

SCAPA 2025 Winter Conference

Carolina Rodezno

February 13, 2025

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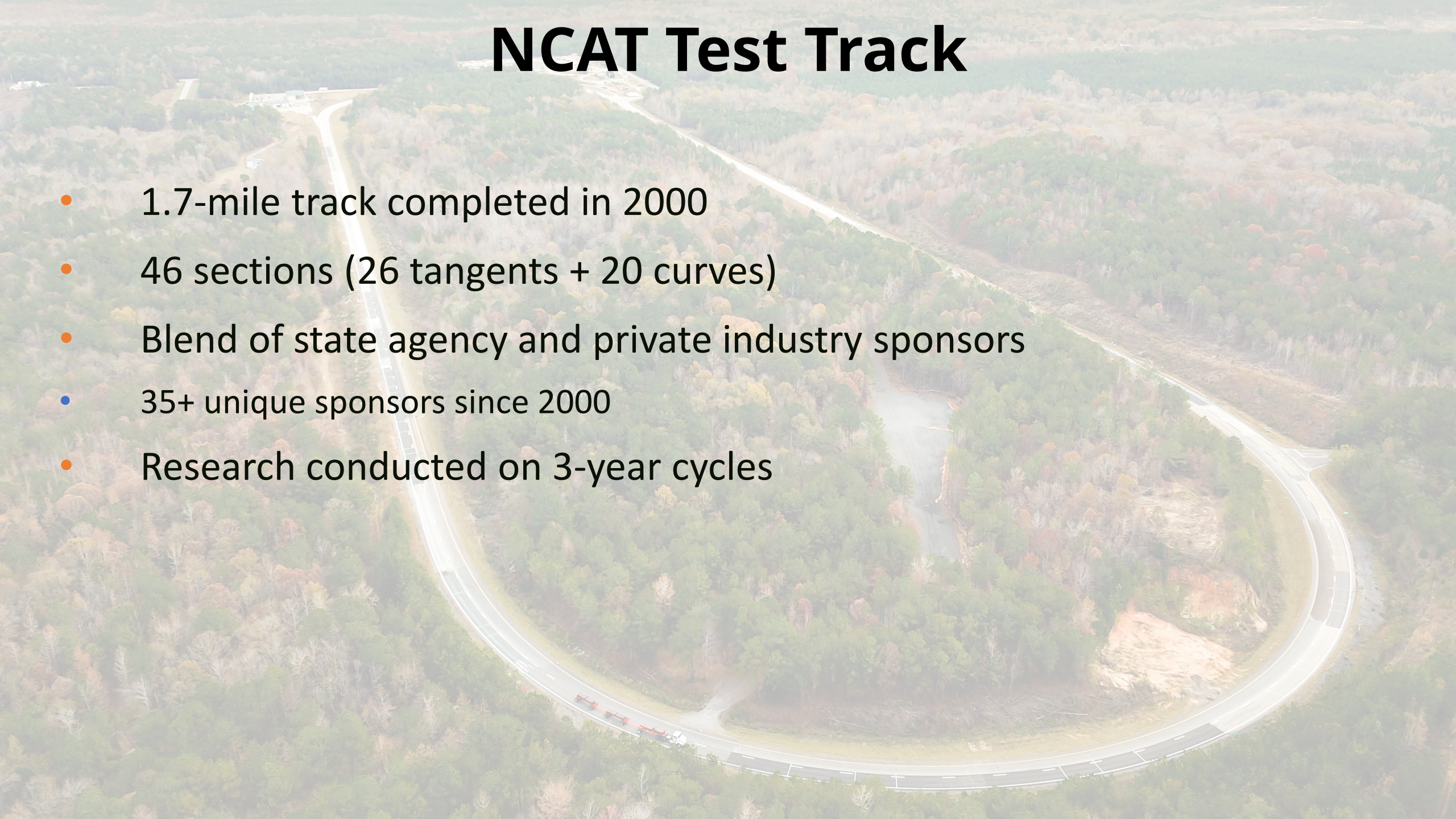
NCAT Test Track

- 1.7-mile track completed in 2000
- 46 sections (26 tangents + 20 curves)
- Blend of state agency and private industry sponsors
- 35+ unique sponsors since 2000
- Research conducted on 3-year cycles

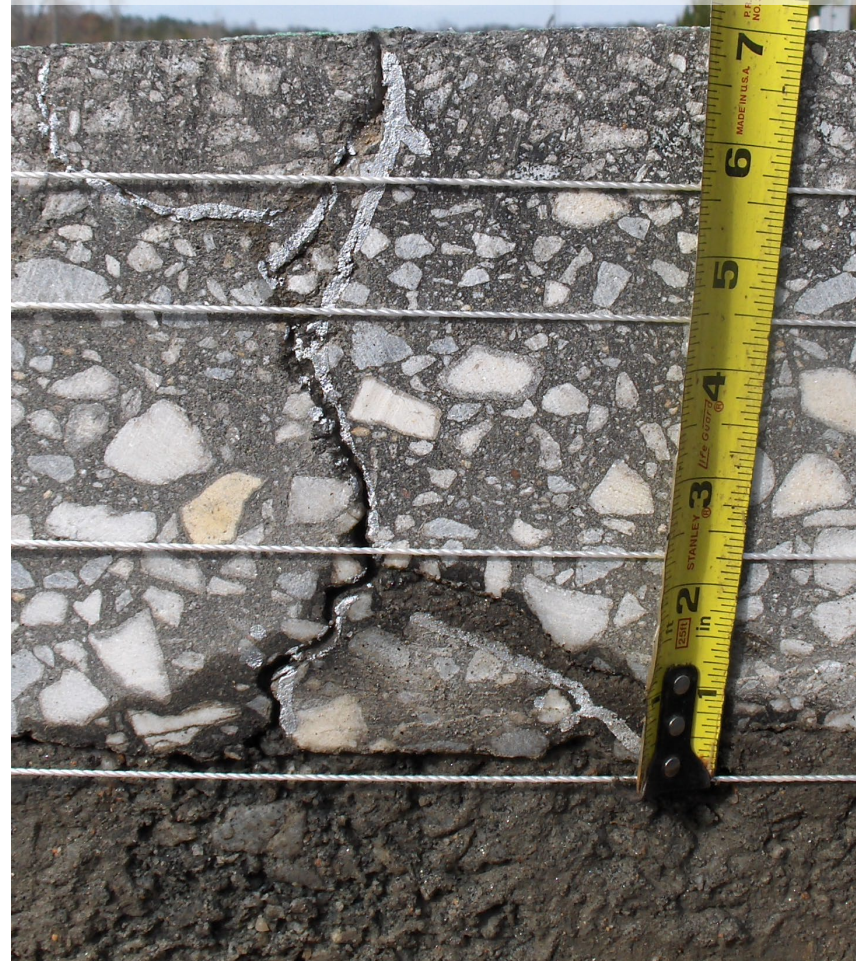


NCAT Test Track Research Cycle

Phase 1
Plan/Build Test Sections

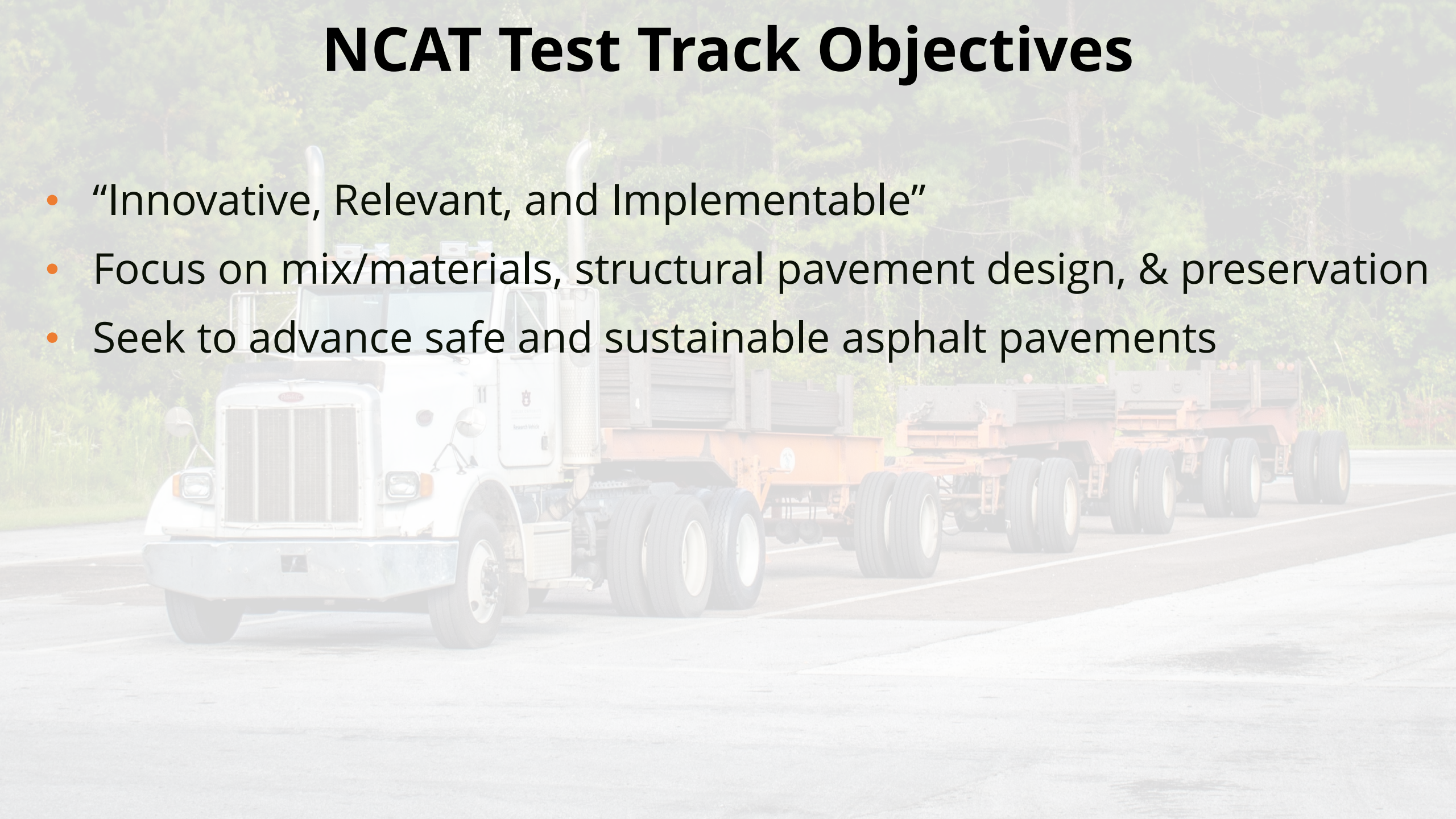
Phase 2
Traffic

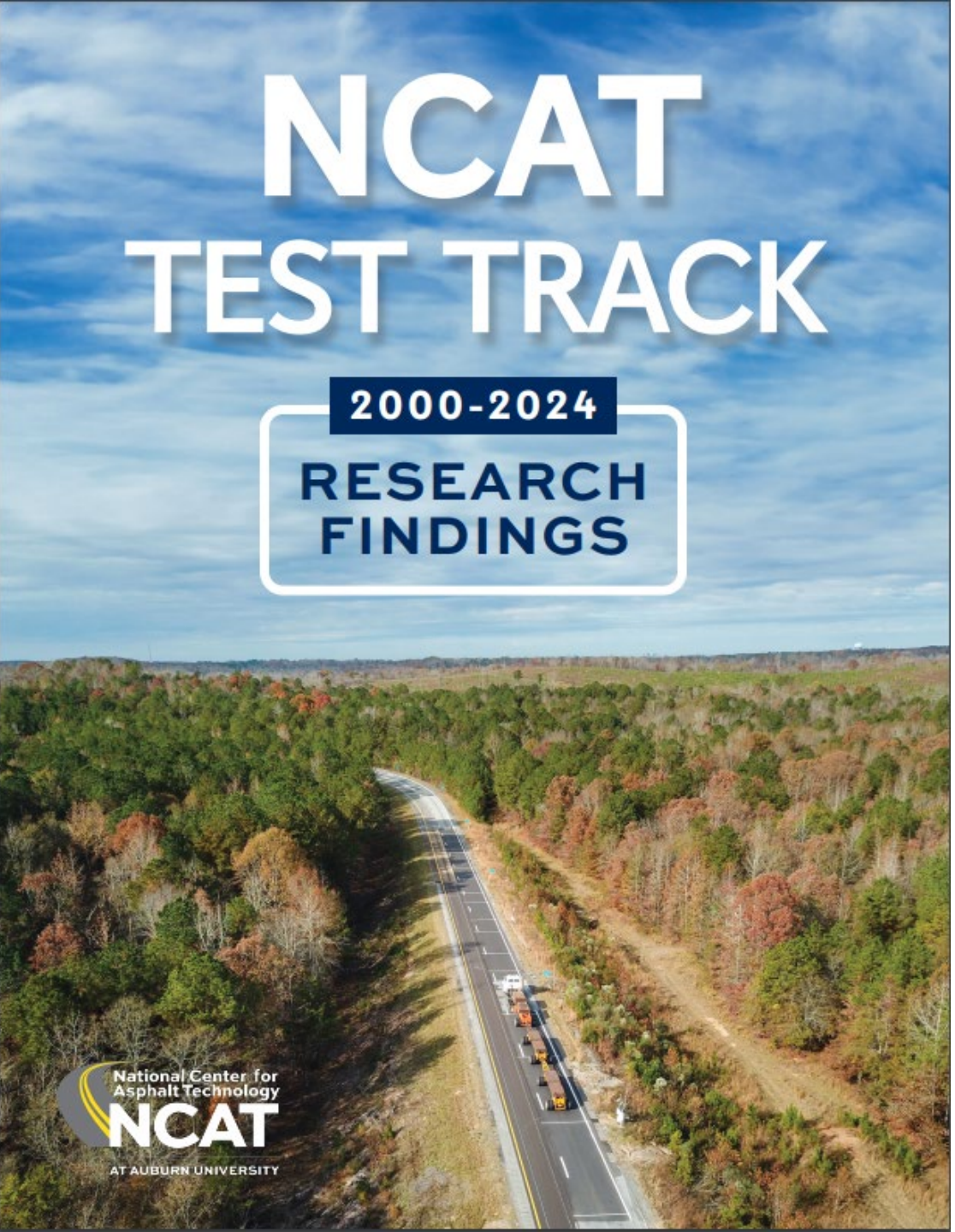
Phase 3
Forensic Analysis



NCAT Test Track Objectives

- “Innovative, Relevant, and Implementable”
- Focus on mix/materials, structural pavement design, & preservation
- Seek to advance safe and sustainable asphalt pavements





Scan QR Code to Download

SCDOT Track Partnership History

- Started with Test Track first research cycle in 2000
- Continues every cycle since then
- Sponsoring experiments on individual sections and multi-state experiments (e.g. group experiment, green group)
- Currently sponsoring 2 test sections + pavement preservation group

THANK YOU!

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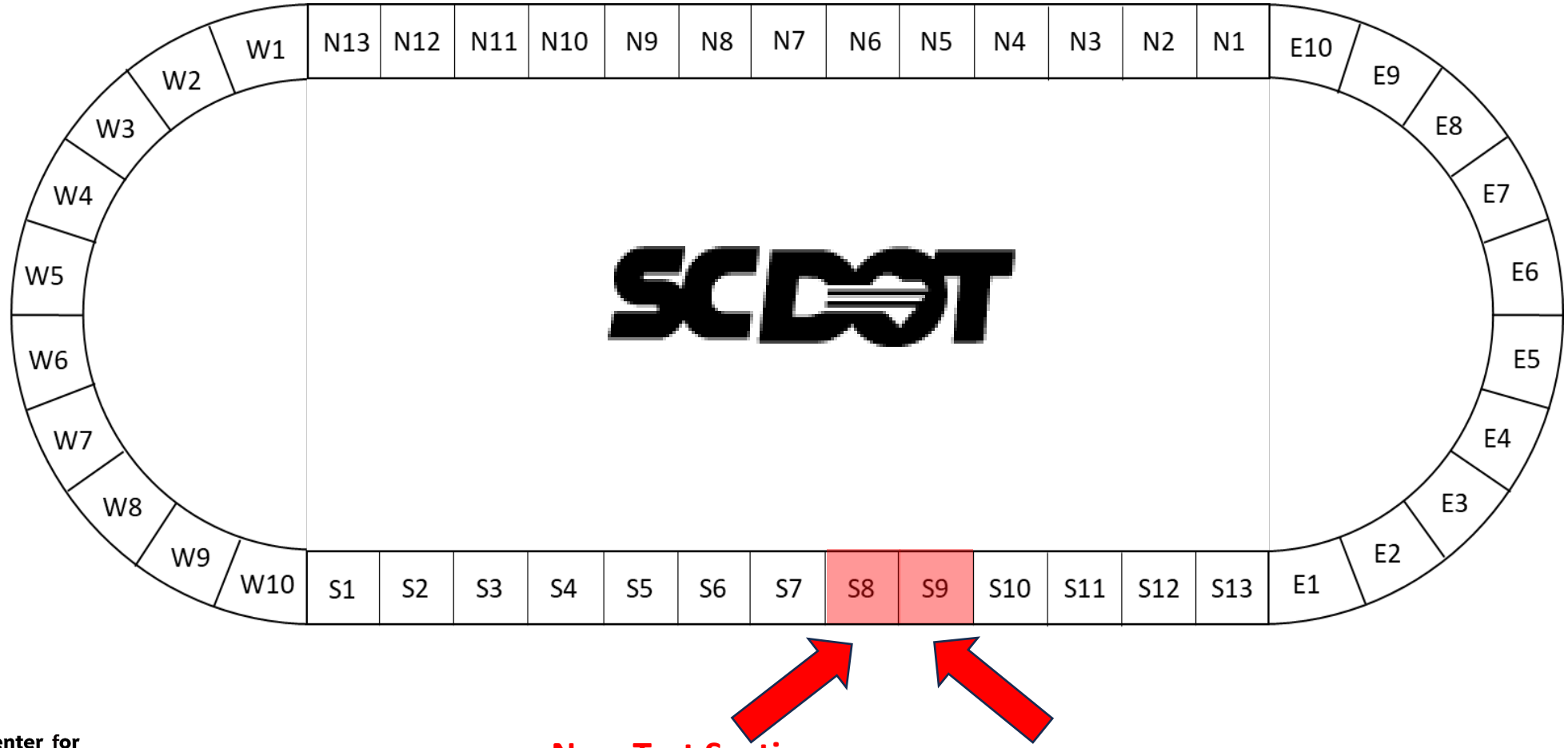
MnROAD

SCDOT Current Test Sections–S8 and S9



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Background – Thick Lift Paving-S9

- Flexible pavements usually built in a series of lifts
  - Tack between layers
  - Different materials
  - Long and time-consuming work zones
- Due to traffic demands, SCDOT working on rapid deep rehabilitations in single lifts (4 to 5”)
- Desire to pave even thicker in single lift
- Key concerns
  - Time to Cool & Compaction
  - Rutting susceptibility

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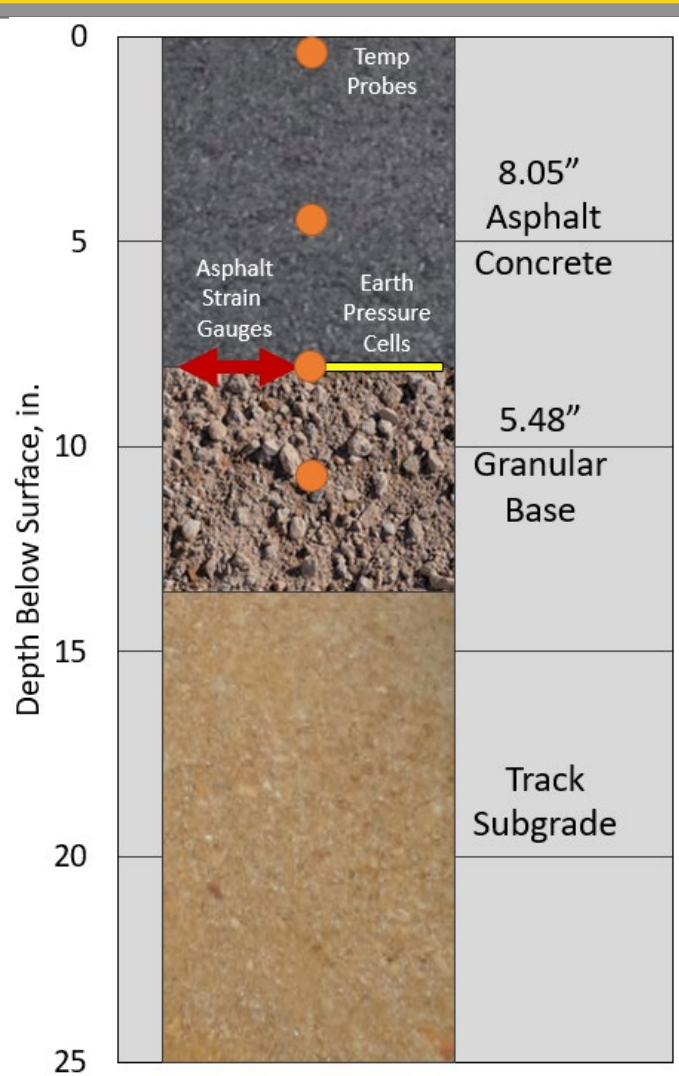
Experiment Objective Thick Lift Paving-S9

Further develop a rapid construction method to reduce lane closure lengths on major highways and primary routes

- Traffic Continuation –Third research cycle ongoing



Thick Lift Cross Section (S9)

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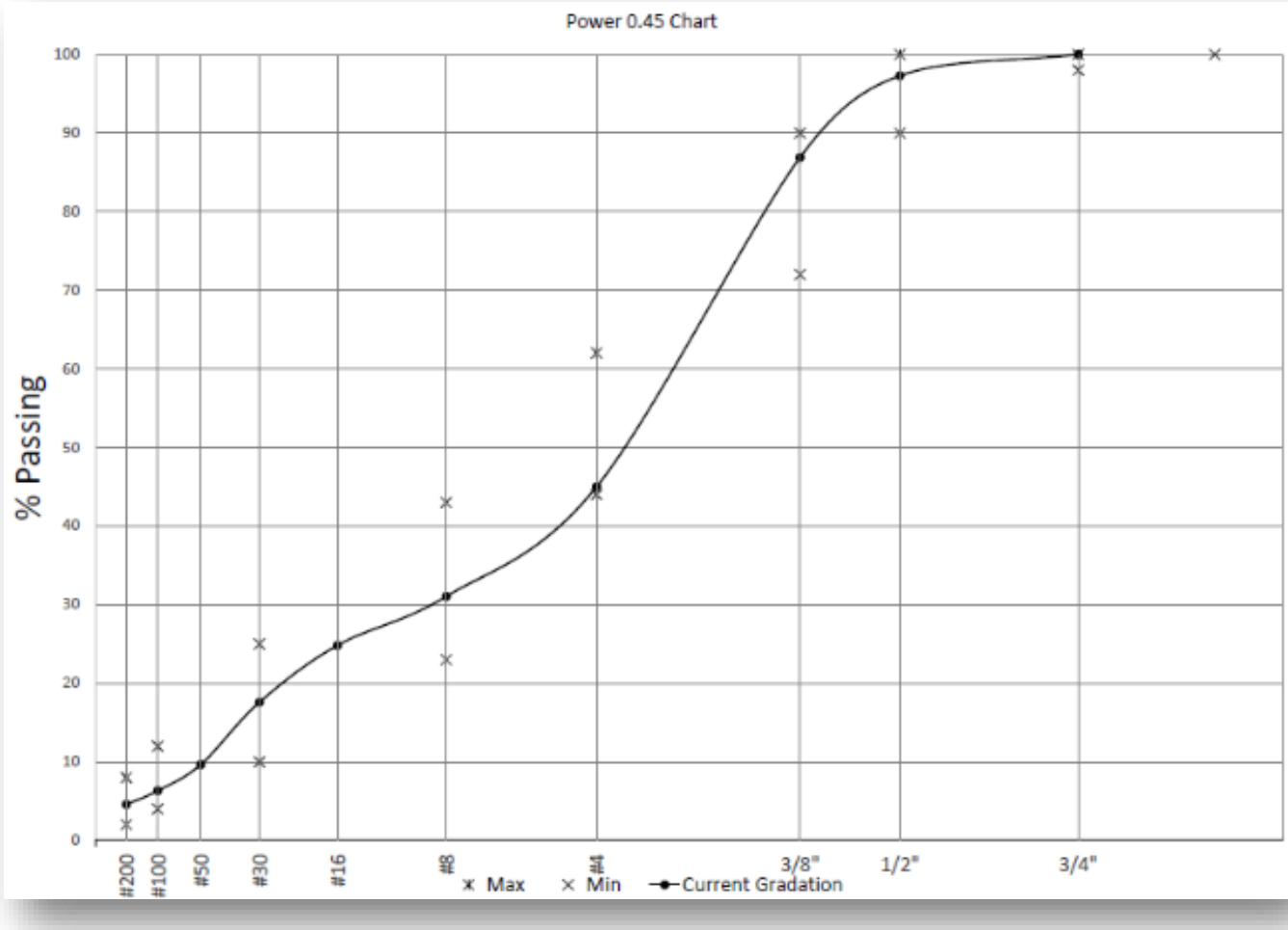
Thick Lift Asphalt Mix Design – S9

- "Type B Intermediate Special"
  - Rehabilitation Repairs, Interstates, High Volume Primary Routes
- 12.5 NMAS
- PG 64-22 with 25% RAP
- WMA (Evotherm M1 @ 0.5%)
  - Mixing @ 275-280F
  - Compaction @ 245-250F
- Design Air Voids = 2.5%
- N_{des} = 75
- Asphalt Content = 5.75%
  - 4.37% Virgin, 1.38% RAP



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Thick Lift Asphalt Mix Design – S9

- Section paved on August 24, 2018, beginning at 10:00 AM. On the day of construction, the high temperature was 85°F and the low temperature was 67°F
- Thermal sensors embedded showed section required ~ 6 hours to cool from 242°F to 175°F at mid-depth
- No issues to achieve compaction using the same equipment and similar rolling patterns as the other sections

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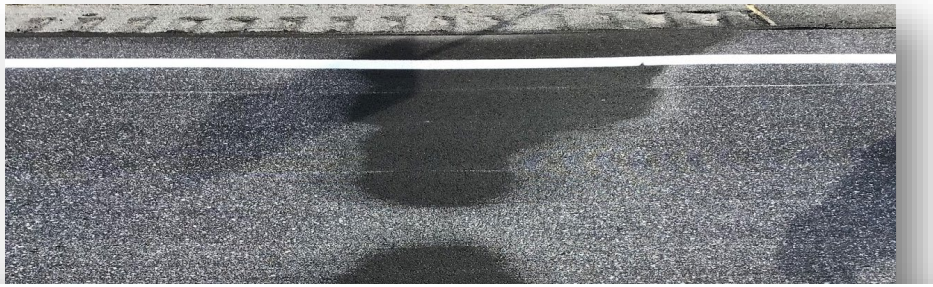
Thick Lift Post Construction Grinding – S9



Condition	L, IRI (in/mile)	R, IRI (in/mile)	Mean, IRI (in/mile)
After Paving	457.3	335.5	396.4
After Grinding	79.3	122.5	100.9

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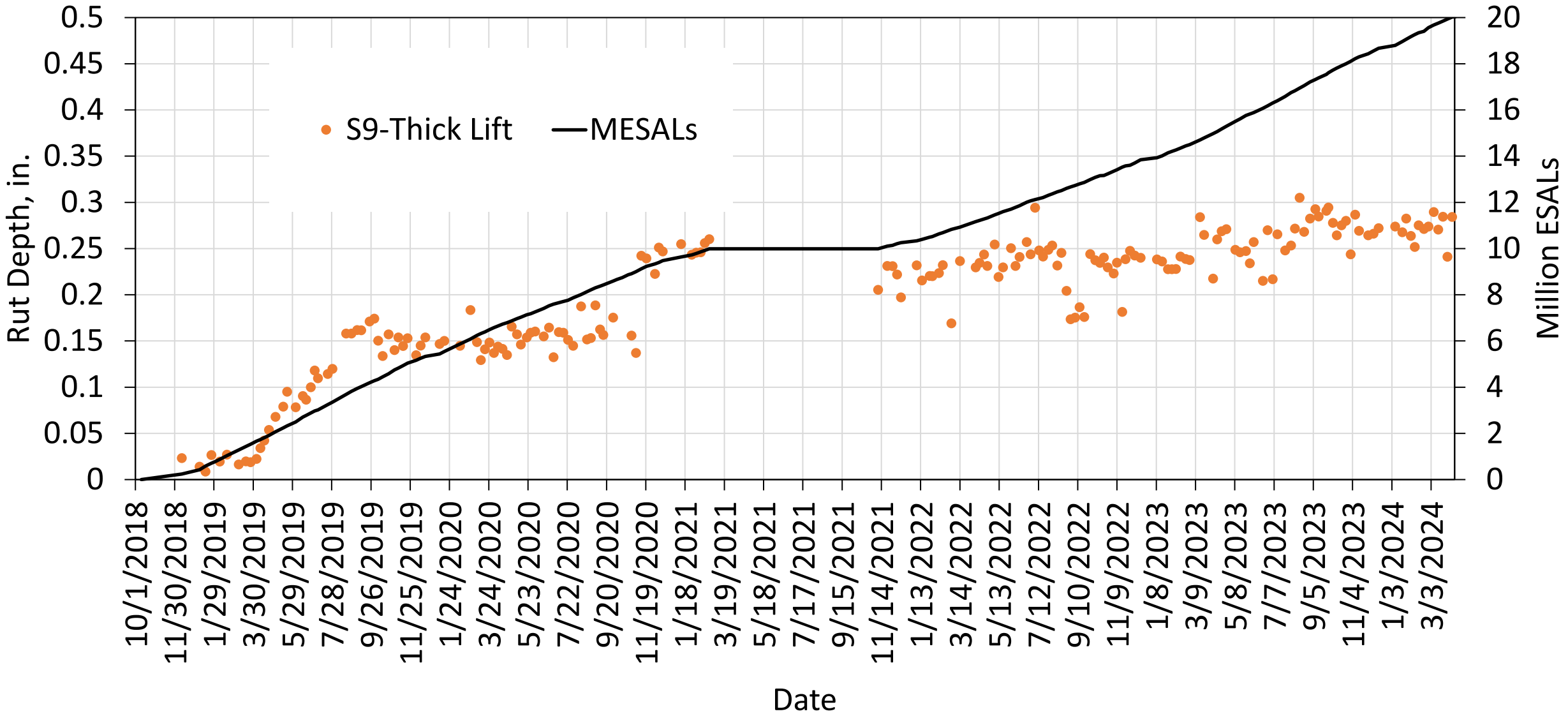
Rutting


S9-Thick Lift
MESALs
Rut Depth, in.
Million ESALs
Date
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
20
18
16
14
12
10
8
6
4
2
0
10/1/2018
11/30/2018
1/29/2019
3/30/2019
5/29/2019
7/28/2019
9/26/2019
11/25/2019
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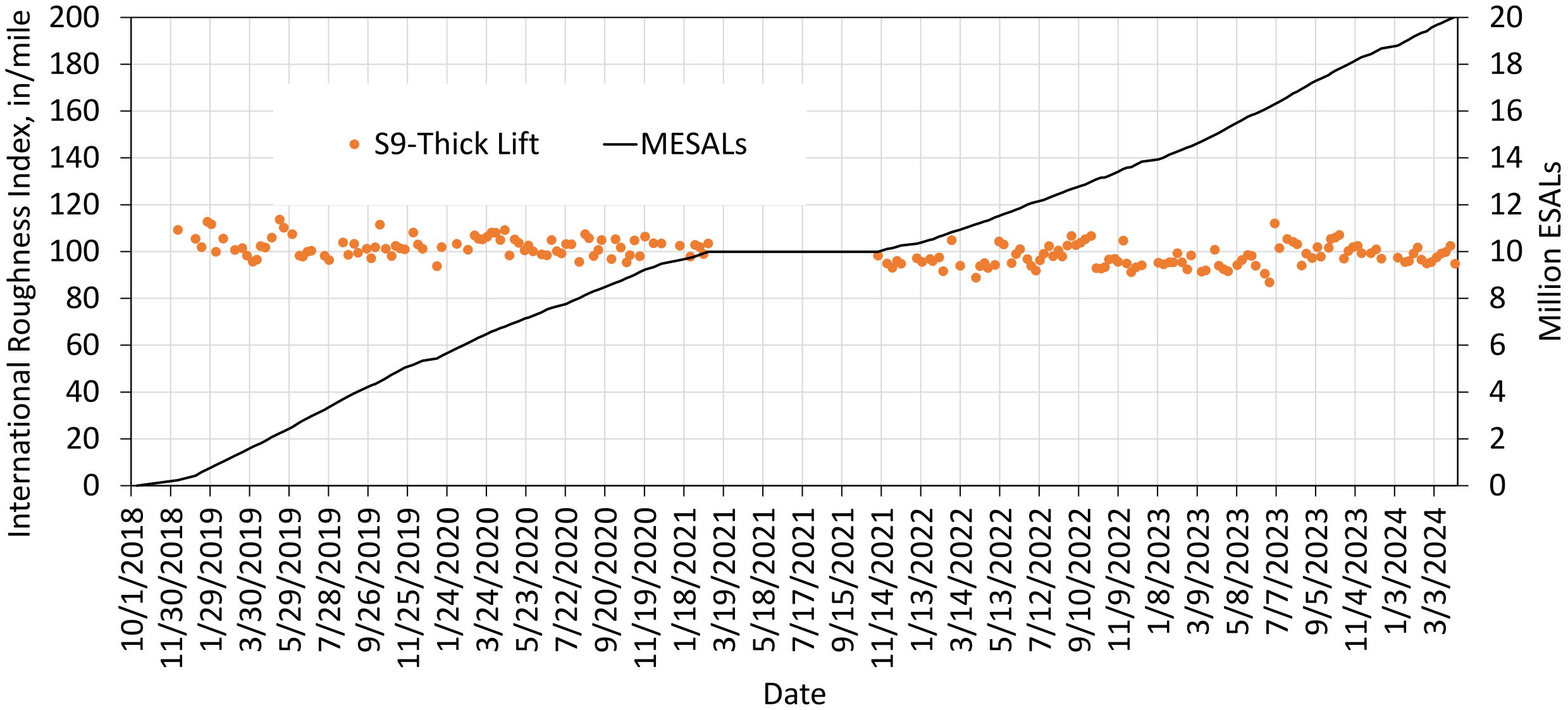
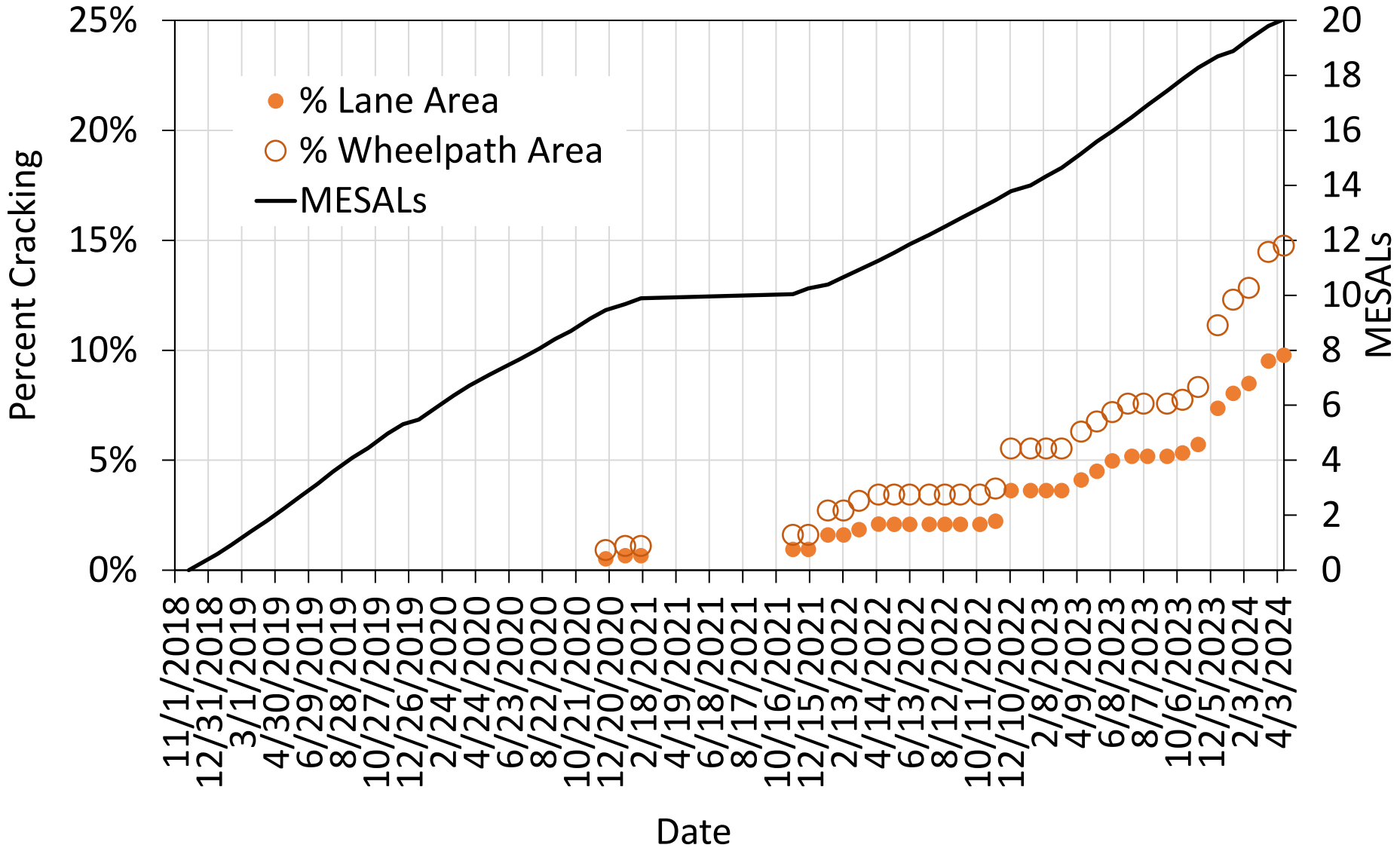
3/3/2024

Ride Quality



Cracking – Thick Lift (S9)



Recommendations – Thick Lift (S9)

- 8” thick lift is viable
  - Good compaction
  - Careful consideration of cooling time needed
  - Smoothness may be an issue
- Rutting is not a problem
  - 0.3” after 20 MESALs
- Top down cracking is growing in extent but not severity
- Ride quality improving
  - Down 15 in/mile since start of traffic
- No evidence of bottom-up cracking
- Section left in place for another 10 MESALs

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Section S8-Experiment Objective

Design, build, and evaluate the performance of an SMA mix with dry GTR added during production as a mix modifier to provide an alternative to current SCDOT SMA mixes with polymer binders and cellulose fibers

- A 6” thick lift built underneath the structure to simulate “typical” SCDOT mill and fill projects
- Thick lift used the same mix design as the lift used in section S9 (2018)

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S8 Mix Design-Surface Mix

- SCDOT 12.5 mm SMA (220 psy, 2” overlay), 35 gyrations
- Base mix design (without GTR) selected from mixes developed previously at NCAT for another study, PG 76-22 with 0.3% cellulose fiber
- For new Mix Design with dry rubber
  - Binder: PG 64-22 binder, 0.5% Evotherm P25
  - Aggregate: SC granite (25% -7s, 24%-67s, 6%-W screenings), 6% fly ash, 1% hydrated lime
  - GTR-Lehigh -MycroDyne 400-TRXP-10.5% (by weight of the virgin binder)

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S8 Mix Design-Surface Mix

- Original mix design used as a starting point had 6.4% AC content
- Modified design with GTR at 6.4% AC content caused air voids to drop from 3% to 1.9%
- Design adjusted to 6.0% AC, air voids at 2.9%
- SCDOT approved the design at 6% AC content

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S8 Mix Design-Surface Mix-Draindown

Temperature (°F)	Draindown (%)
310	0.09
335	0.16

No issues with draindown potential even at higher temperature than typical production temperatures for SMA

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S8 Mix Design-Surface Mix-Performance Test

Binder	Cellulose (%)	Rubber	AC (%)	HWTT-Rut Depth at 20,000 passes (mm)	Cantabro Mass Loss (%) - Avg.	OT-CPR
PG 76-22 (Original Design)	0.3	n/a	6.4	4.45	3.7	0.38
PG 64-22(Rubber Mix)	0.0	Lehigh	6.0	5.32	6.5	0.48

- IDEAL-CT tends to yield very high CT_{Index} values for SMA
- Cracking Evaluation- Overlay Test Crack Progression Rate (CPR) as a potential candidate/better to discriminate SMA performance
- Texas has a preliminary criteria for OT-CPR of ≤ 0.45

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S8-2 Thick Lift - Construction
August 19, 2024

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S8-1 SMA-GTR Section- Construction
August 20, 2024

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S8-1 SMA-GTR Section- Construction
August 20, 2024

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S8 Mix Design-Surface Mix

Sieve Size	SCDOT SMA 12.5 mm	SMA-GTR 12.5 mm Design	SMA-GTR 12.5 mm QC
19 mm (3/4”)	100	100	100
12.5 mm (1/2")	83-93	86	85
9.5 mm (3/8”)	60-80	66	65
4.75 mm (#4)	25-32	28	34
2.36 mm (#8)	18-24	18	21
0.60 mm (#30)	12-20	13	14
0.15 mm (#100)	9-15	10	10
0.075 mm (#200)	8-12	8.2	8.7
AC (%)	5.6-7.0	6.0	6.0
Va (%)	3.0-4.0	**2.9**	**2.7**
VMA (%)	16.5 min	16.5	16.3
VFA (%)	65-85	76	85

- Satisfactory QC Results
- As built thickness: 2.1”
- In-place density: 95.3%
- Production mix:
  - HWTT-6mm at 20,000 passes
  - IDEAL-CT-CT_{Index} 300.4

Current Cycle -Ongoing

- Sections S8 and S9 will continue to be monitored for the duration of the test track cycle
- Approximately 0.8 MESALs

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GTR Research on the Track (Ninth Cycle)-2024

New Rubber Sections

- South Carolina DOT –SMA mix (dry GTR)
- Arkansas DOT-Gap graded mix (pre-swelled GTR)
  - Overlay to mitigate reflective cracking from rubblized concrete
- Virginia DOT (Dry GTR)
  - Dense graded mixes with dry rubber and SBS

Long-term Performance Evaluation

- Oklahoma DOT- (Dry GTR)
  - Mitigation of reflective cracking
- Additive Group Experiment (Dry and wet GTR)

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The Additive Group Experiment

- Multiple section experiment
  - Rubber-modified asphalt sections (dry and wet)
  - Plastic-modified asphalt sections (dry and wet)
  - Fiber-modified asphalt section
  - Control mix section
- Sections built at NCAT Test Track and MnROAD

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The Additive Group Experiment - Objectives

- Comprehensively evaluate the performance impact of multiple mix additives at the same time
- Establish a process to evaluate future additives without having to build test sections
- Support the goal of providing sustainable pavement technologies that outperform current materials

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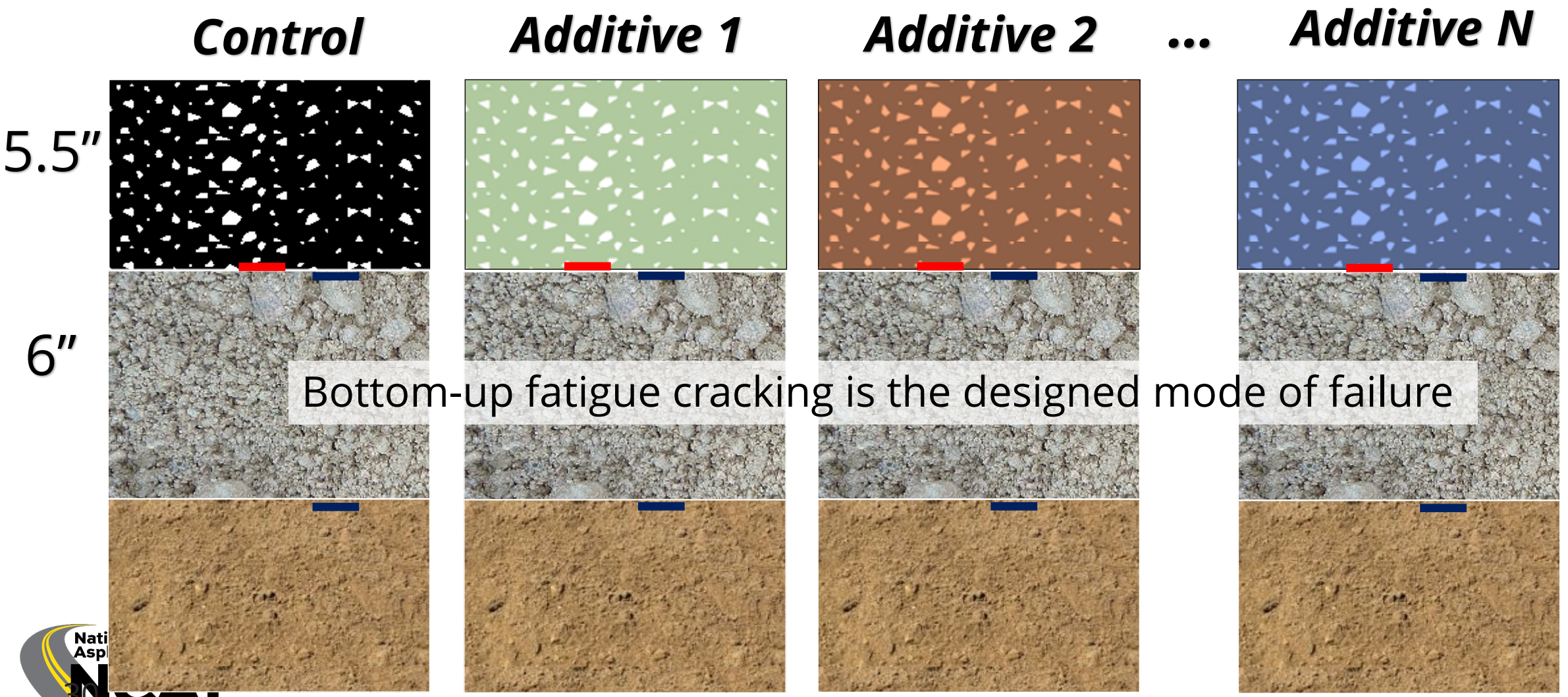
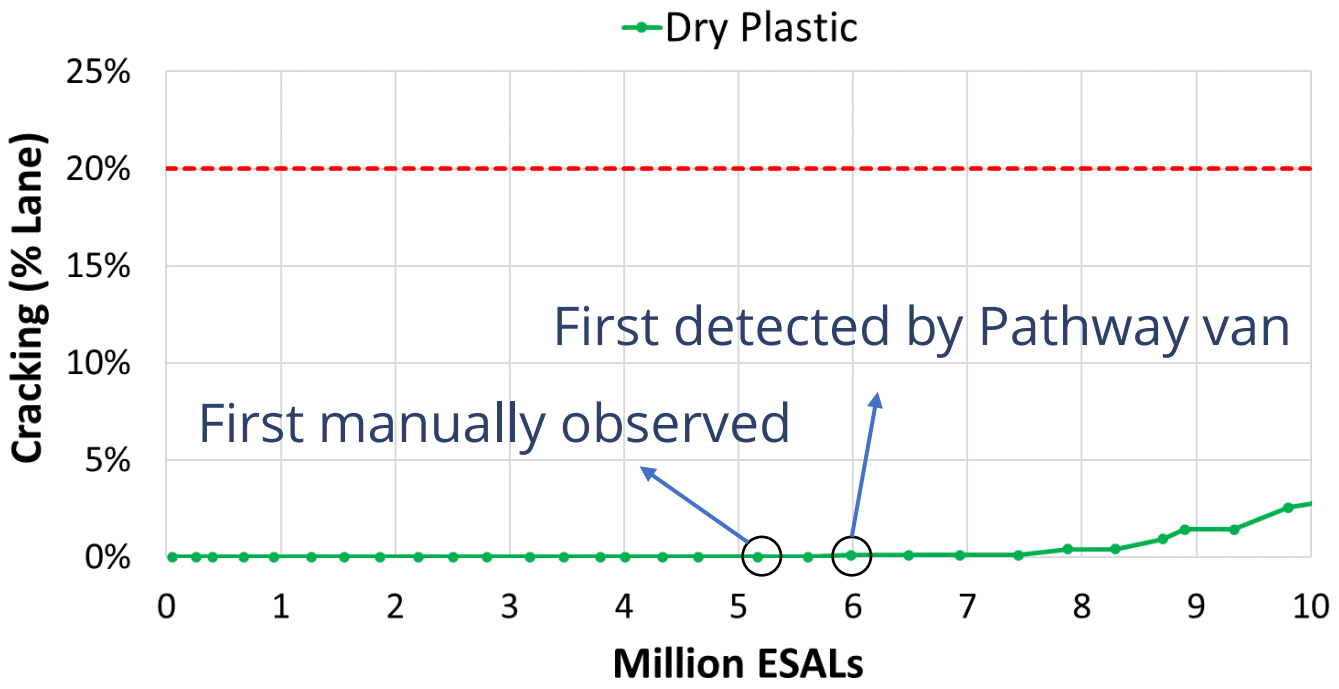
Additive Group Pavement Design



Pavement Performance-Fiber, Plastic Sections

- Cracking
  - Fiber section: no cracking
  - SBS control: no cracking
  - Wet plastic: no cracking
  - Dry plastic: 2.8%



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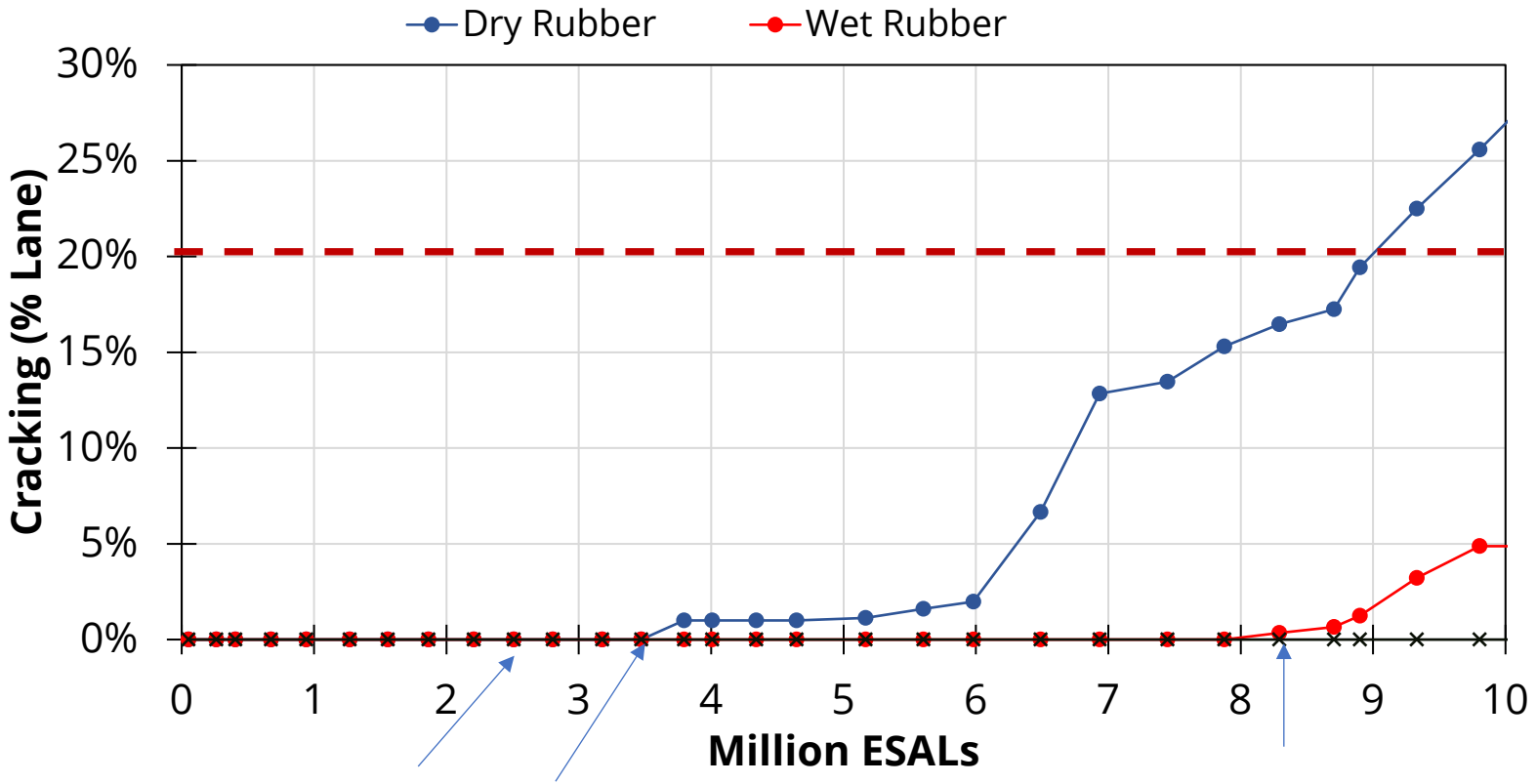
Pavement Performance-Rubber Sections

- Cracking
  - SBS control: no cracking
  - Wet rubber: 5%
  - Dry rubber: 26%



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Additive Group Experiment Status

- 8th Cycle report published on the NCAT website
  - Chapter 3
- 9th Cycle began trafficking in early November 2024
  - All AG sections remain in service

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Thank you!

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