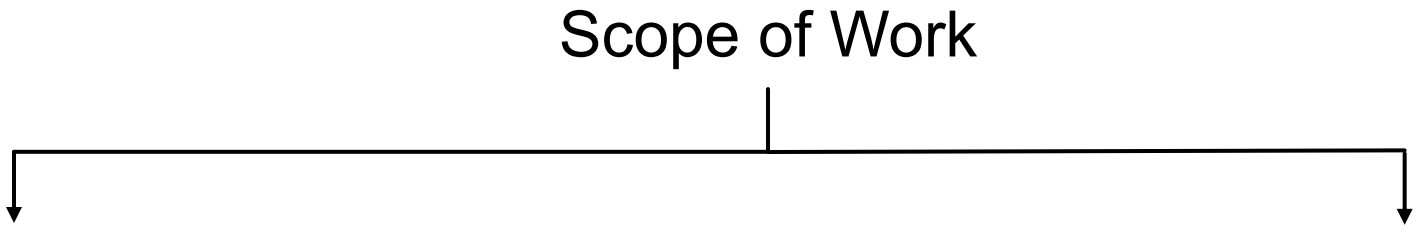
Materials Manual Updates

- **Guidelines to districts for reviewing a proposed scope of work to examine defective materials**



Delineation

- Evaluation of roadway cores to check one or more of the following failure types:
  - Density
  - Binder content
  - Gradation
  - High air voids
- Performed by contractor under supervision of VT
- Cannot include APA testing or binder extraction & recovery

Engineering Analysis

- Evaluation of roadway cores or loose mixtures to check one or more of the following failure types:
  - Low air voids
  - Binder grade
- Performed by an independent lab
- The lab results should be signed and sealed by PE
- Contractor cannot perform the test in-house

Flexible Pavement Committee

Asphalt Research Update

Mohab El-Hakim, Ph.D., P.E.

July 29, 2026

FDOT Research Avenues

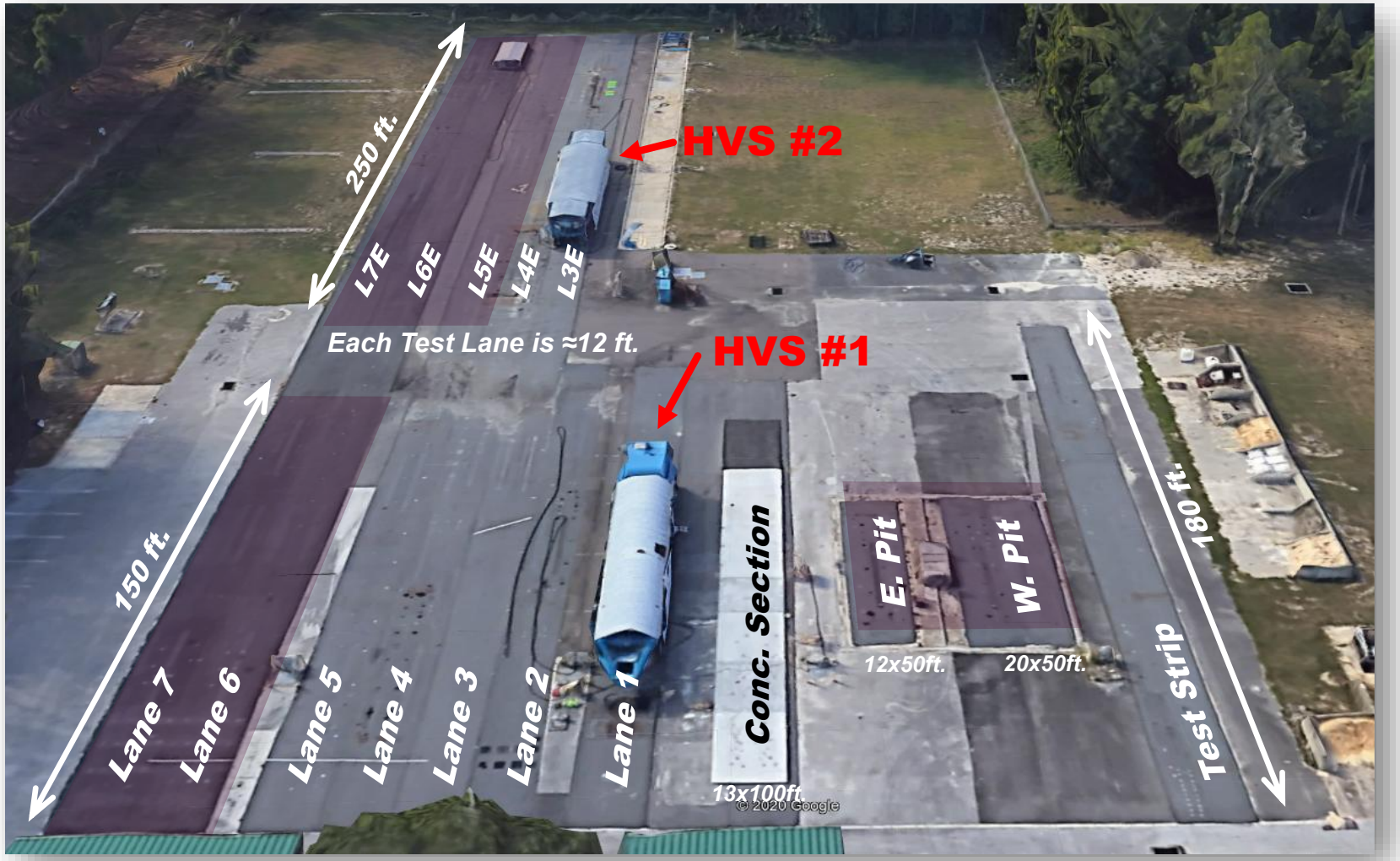
State Materials Office (SMO) Research Lab

Accelerated Pavement Testing (APT)

Field Trials (e.g. Test Road on US 301)

National Center for Asphalt Technology (NCAT) Test Track

FDOT Accelerated Pavement Testing

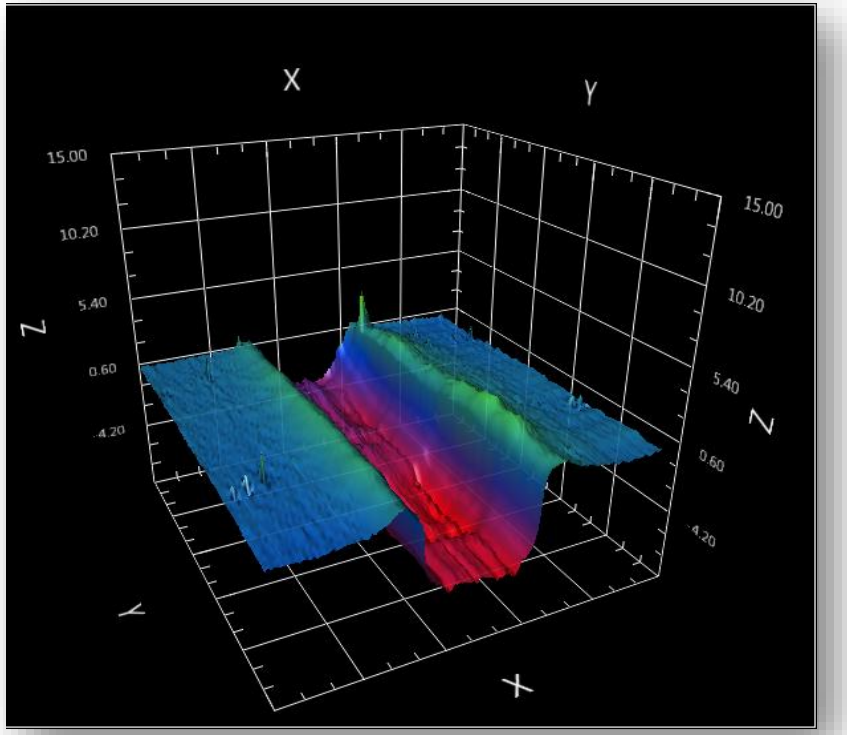


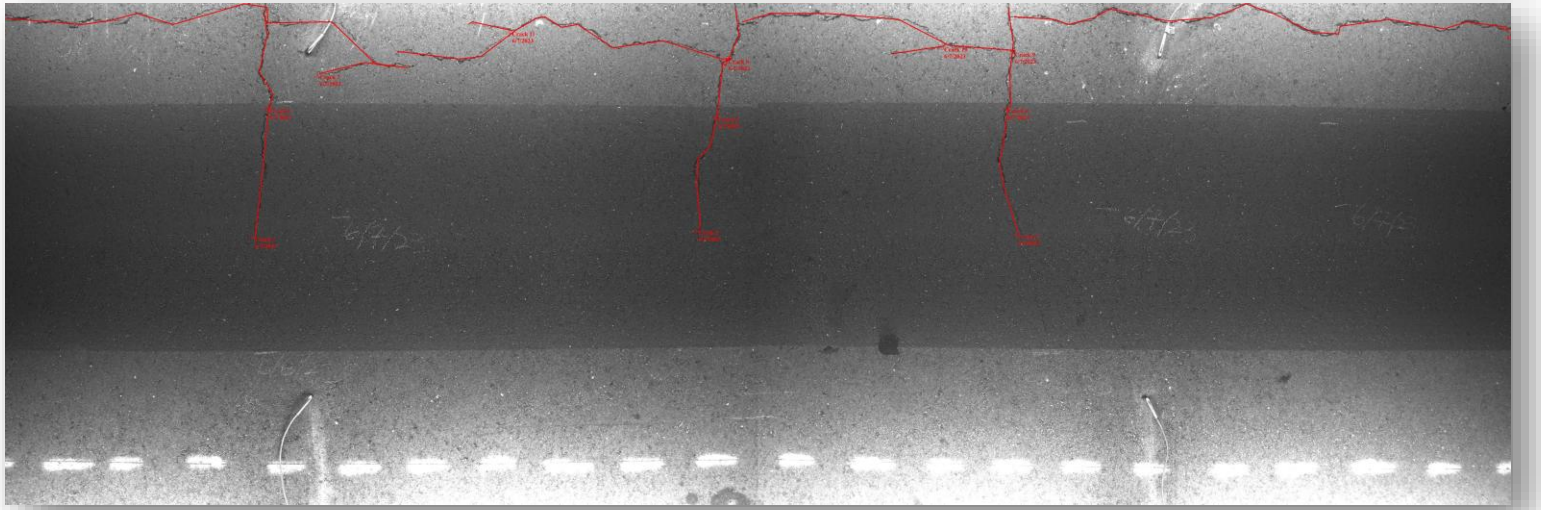
1.5 in. AC Top
1.5 in. AC Middle
1.5 in. AC Bottom
10.5 in. Limerock Base
12 in. Stabilized Subgrade

Typical Cross Section

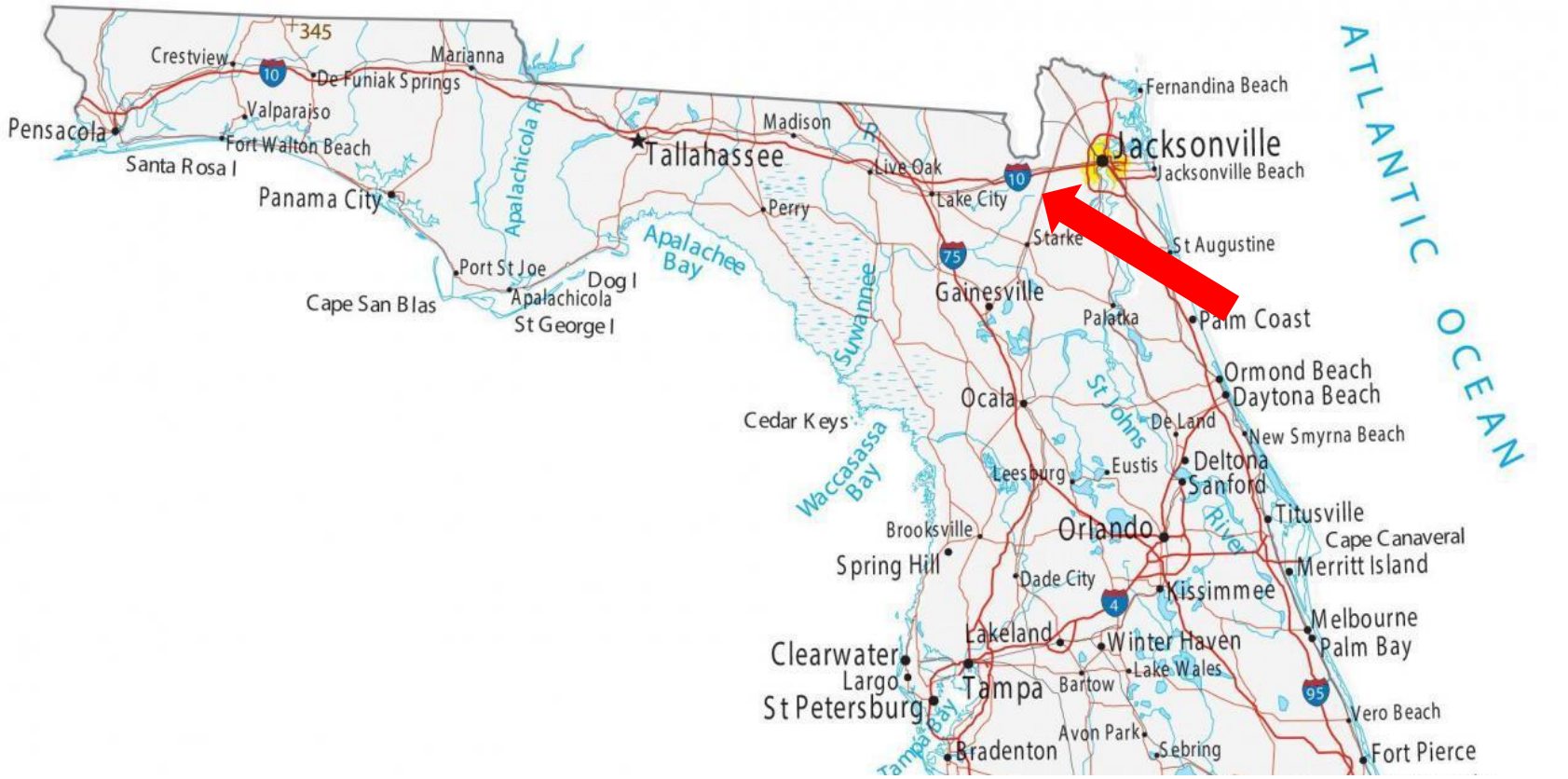
FDOT Accelerated Pavement Testing

FDOT Accelerated Pavement Testing





Asphalt Test Road (US 301)



- US 301 (SR 200) in Clay County.
- Approximately 2.5 miles long.
- 12 test sections, 1000 ft. long.

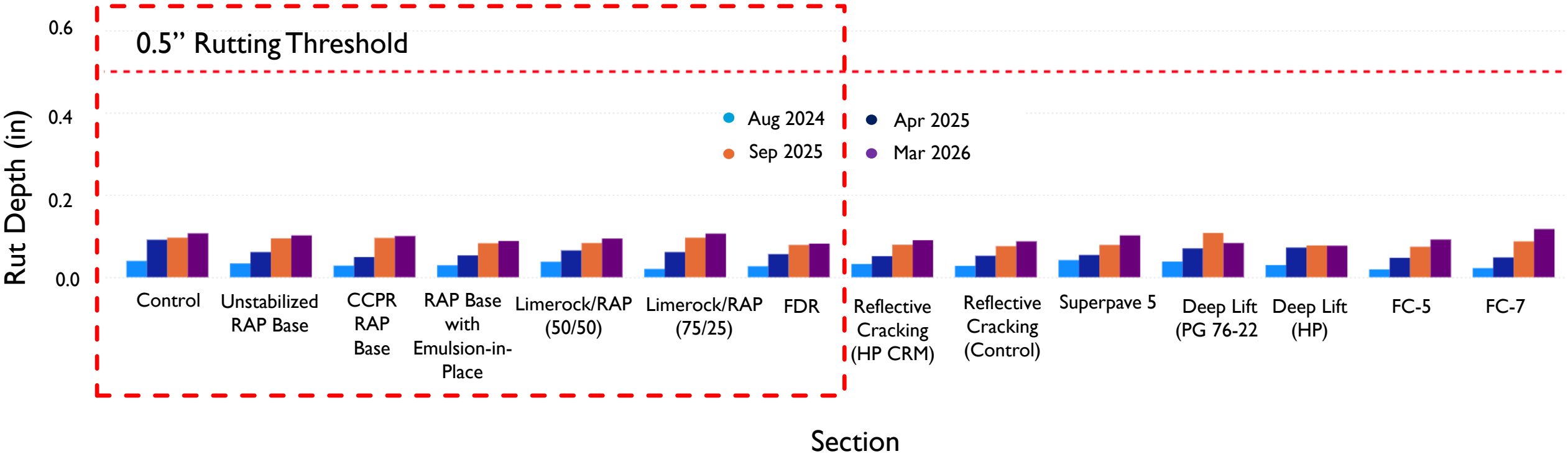
Asphalt Test Road (US 301)

- Southbound travel lanes:
  - Asphalt Test Road
- Northbound travel lanes:
  - Concrete Test Road
- Middle lanes:
  - Diversion Lanes

Asphalt Test Road (US 301)

- 12 Sections: 1,000 feet in length, both southbound travel lanes
- Construction began October 23rd, 2023
  - Opened to traffic end of September 2024
- Five Primary Studies
  - Base Study
  - Thick Lift Study
  - Reflective Cracking Mitigation Study
  - Alternative Mix Design Protocol Study
  - Open Graded Friction Course Study

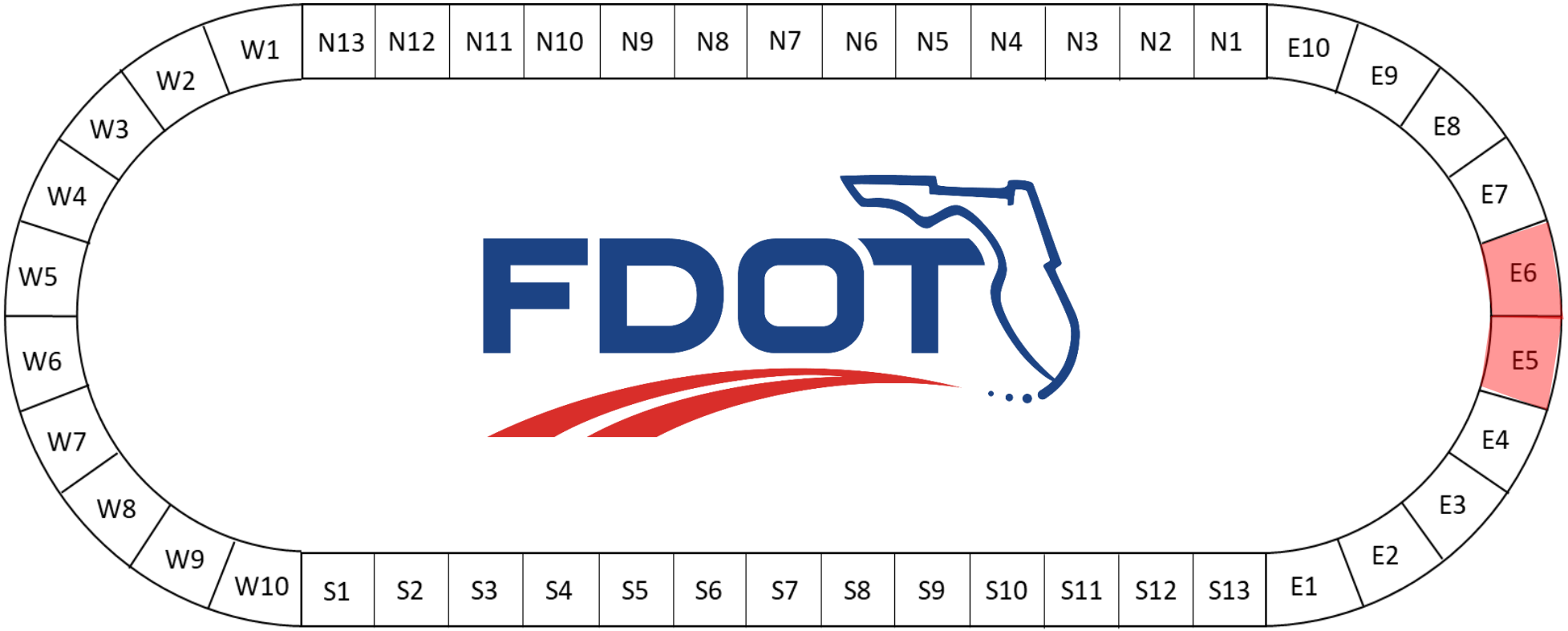
Asphalt Test Road (US 301)



NCAT Test Track

- Auburn, AL
- 5 trucks
- 46 test sections
- 5 million ESALs /year

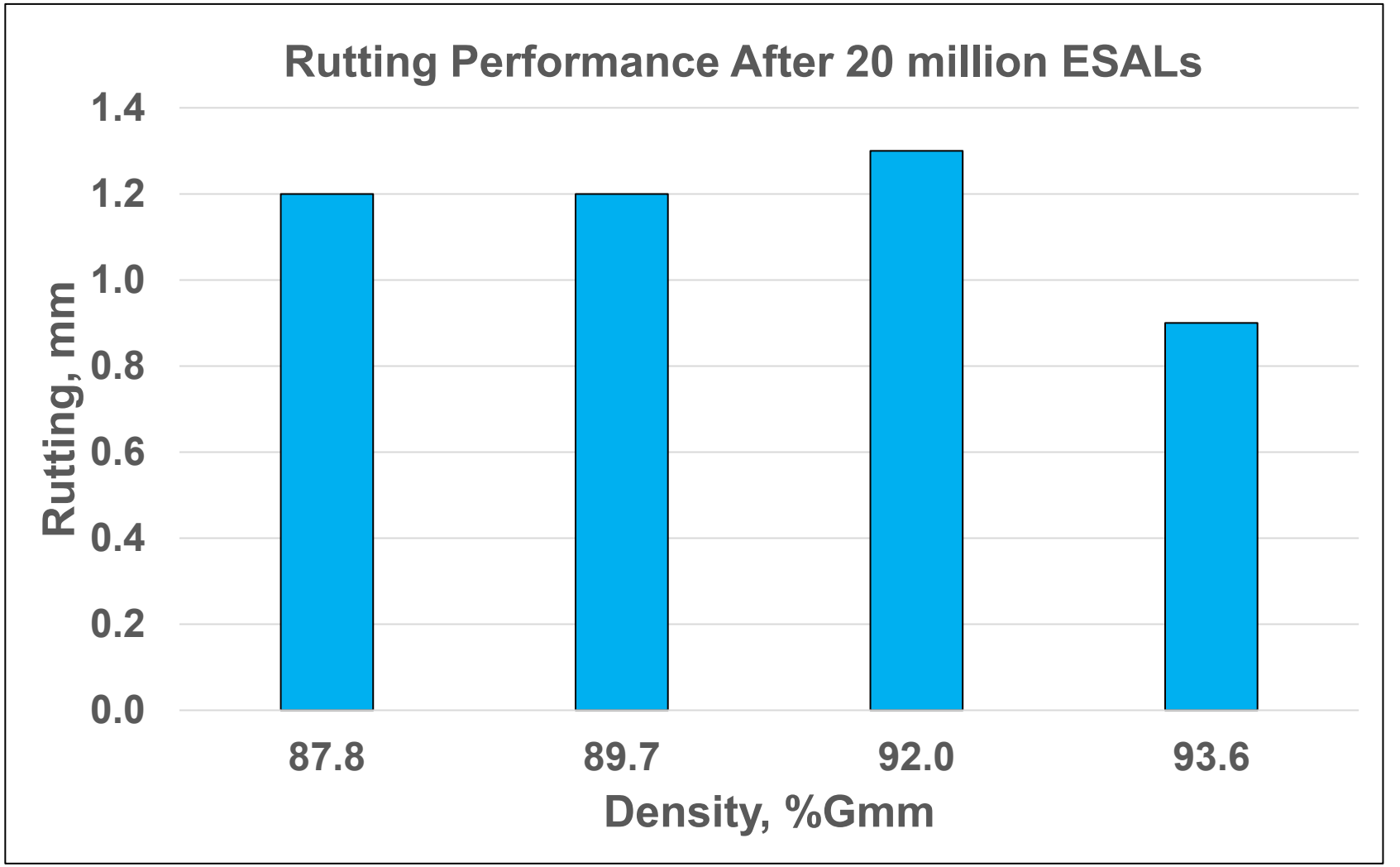
In-Place Density Study @ NCAT Test Track



In-Place Density Study @ NCAT Test Track

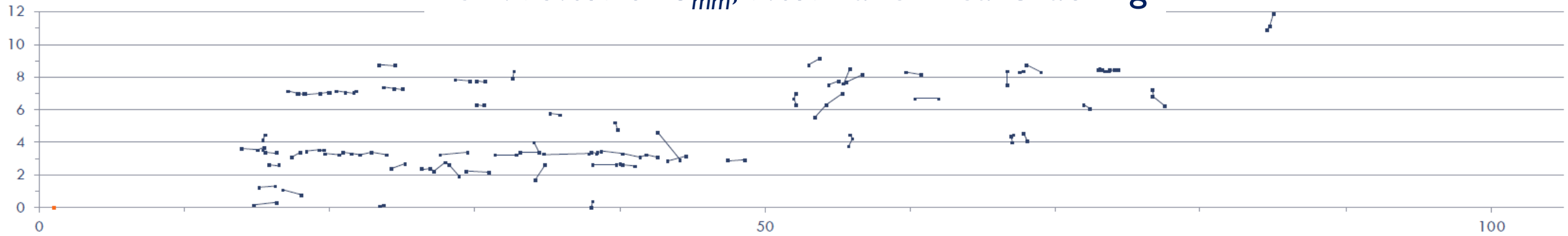
Section	In-Place Density, % of Gmm	
	As-Constructed	Dec. 2025 23+ MESALs
	Average	
E5A	93.6	96.3
E5B	92.0	94.6
E6B	89.7	92.0
E6A	87.8	93.2

In-Place Density Study @ NCAT Test Track

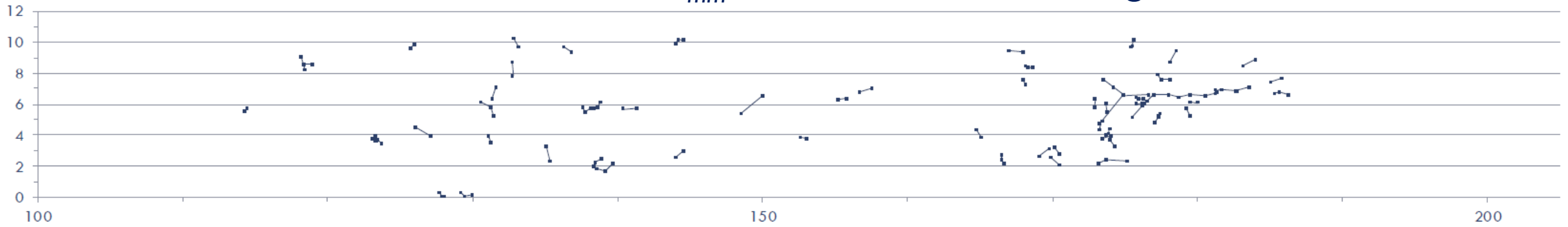


In-Place Density Study @ NCAT Test Track

E5A: 93.6% of G_{mm}, 7.6% Lane Area Cracking



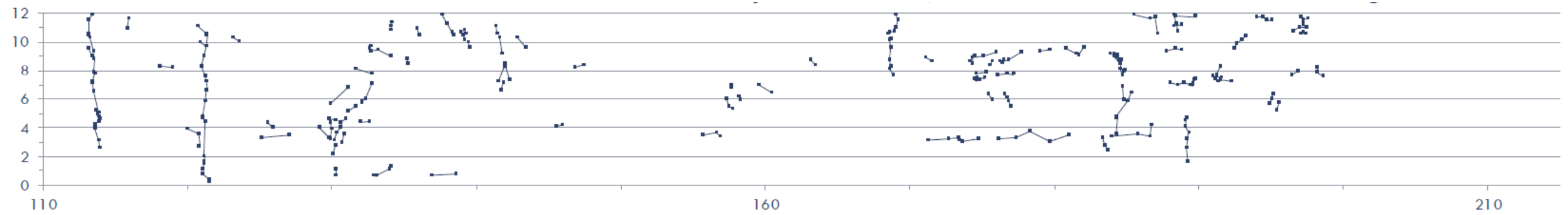
E5B: 92.0% of G_{mm}, 5.7% Lane Area Cracking



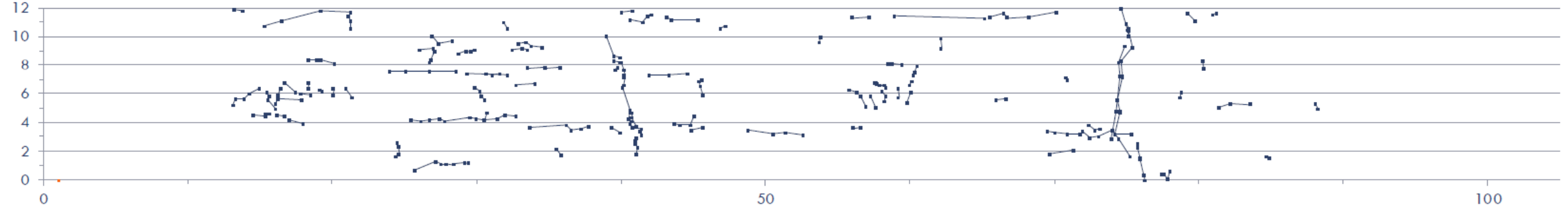
Crack Maps March 2026 (excluding reflective cracks)

In-Place Density Study @ NCAT Test Track

E6B: 89.7% of G_{mm}, 10.9% Lane Area Cracking

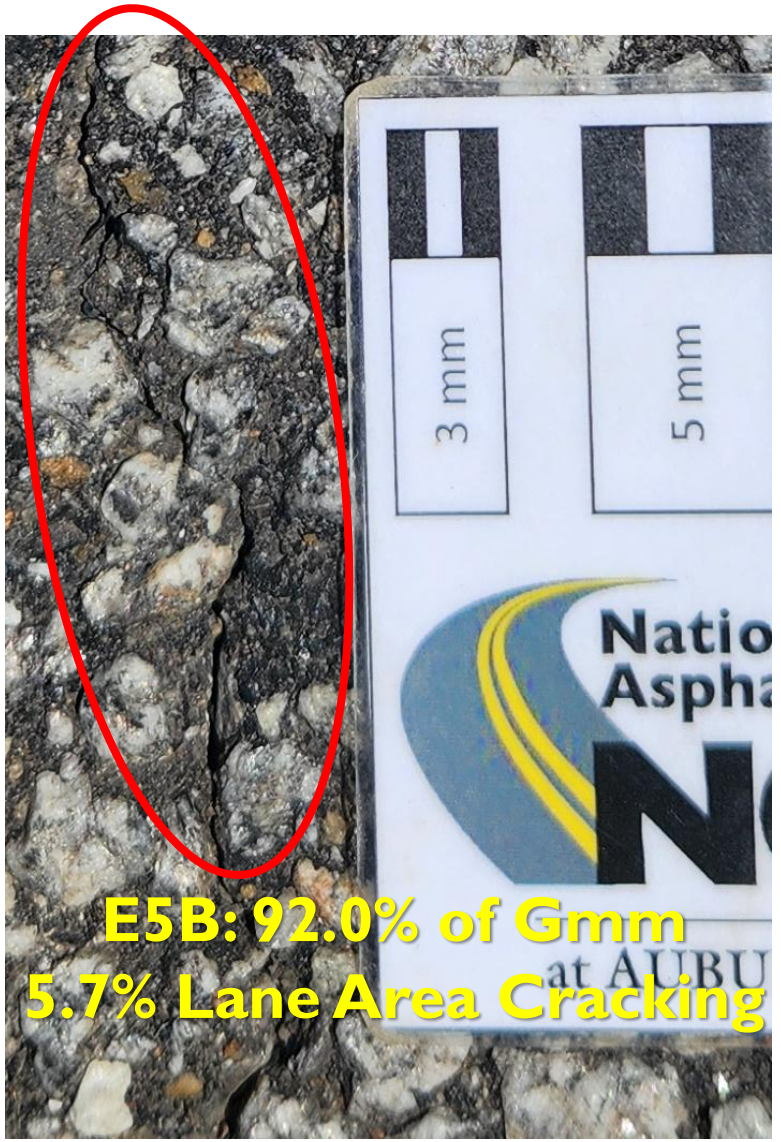


E6A: 87.8% of G_{mm}, 15.0% Lane Area Cracking

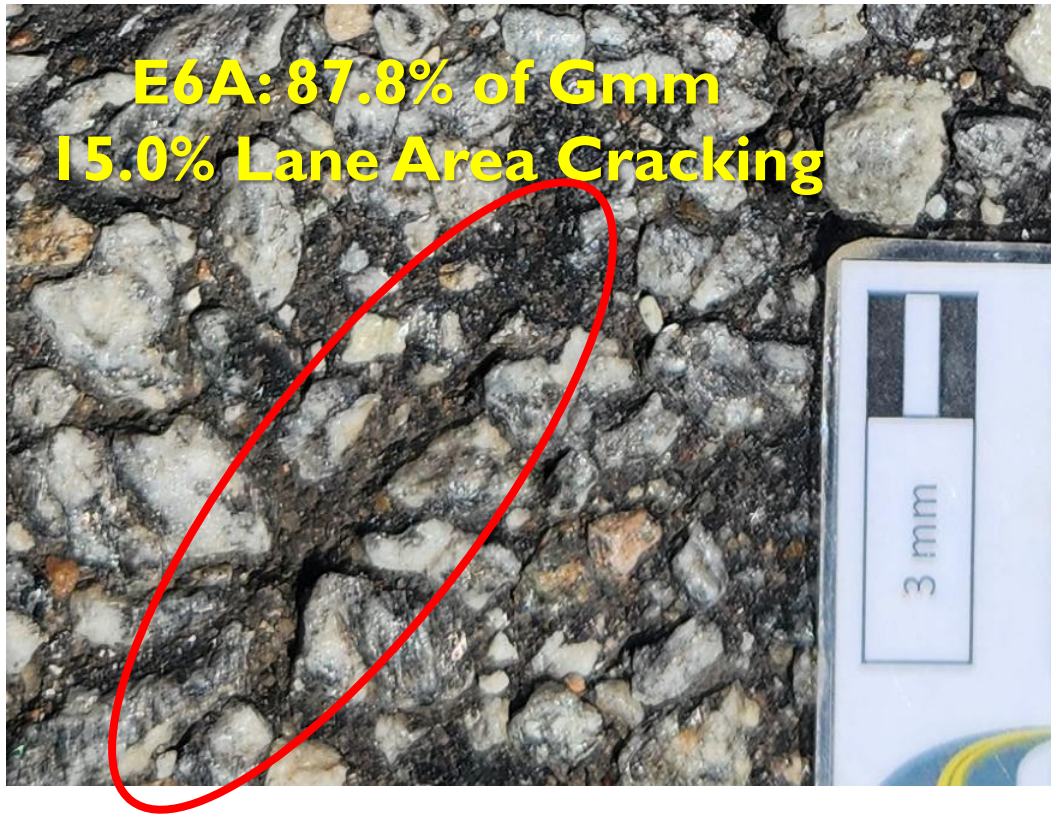


Crack Maps March 2026 (excluding reflective cracks)

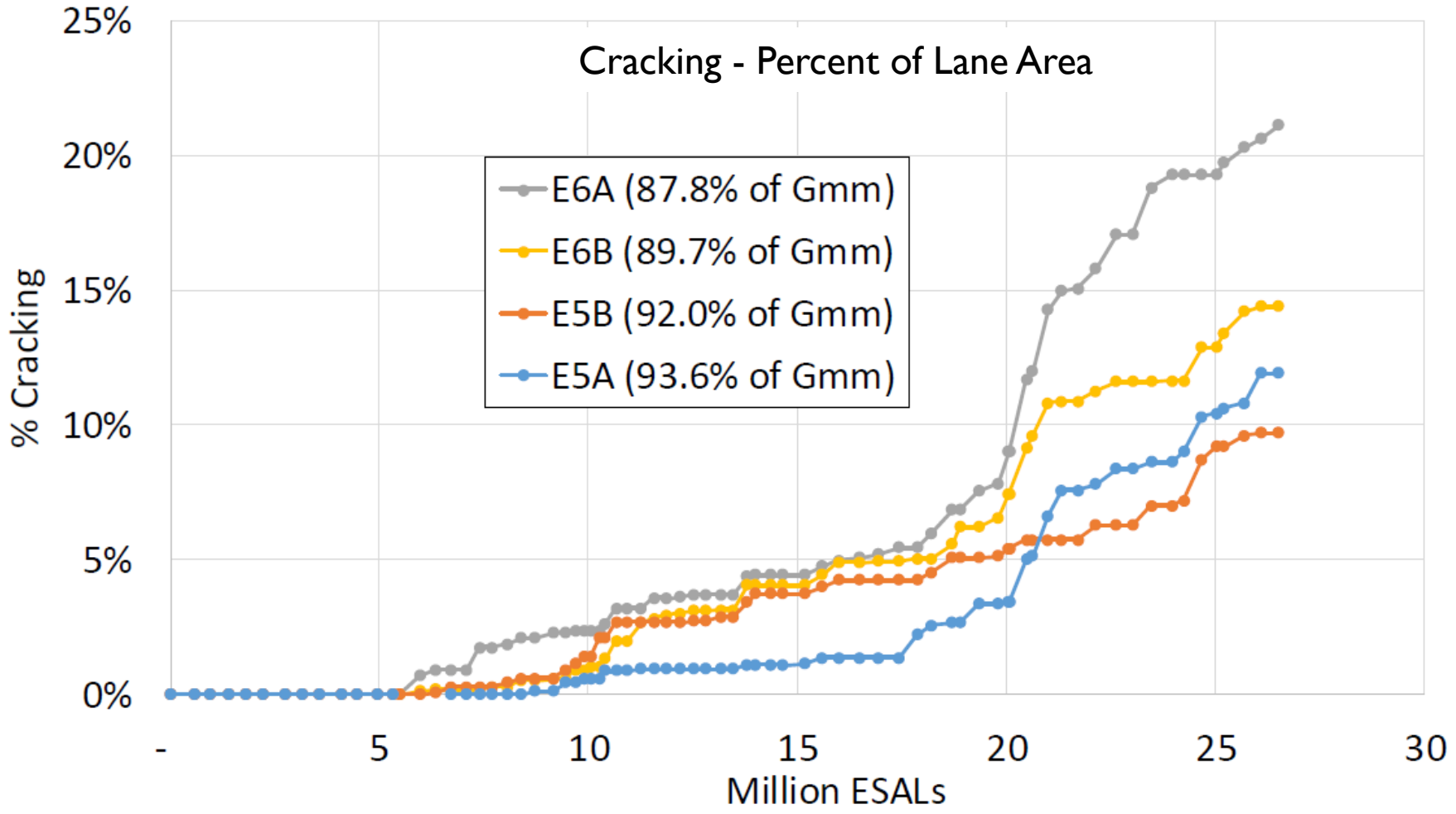
In-Place Density Study @ NCAT Test Track



In-Place Density Study @ NCAT Test Track



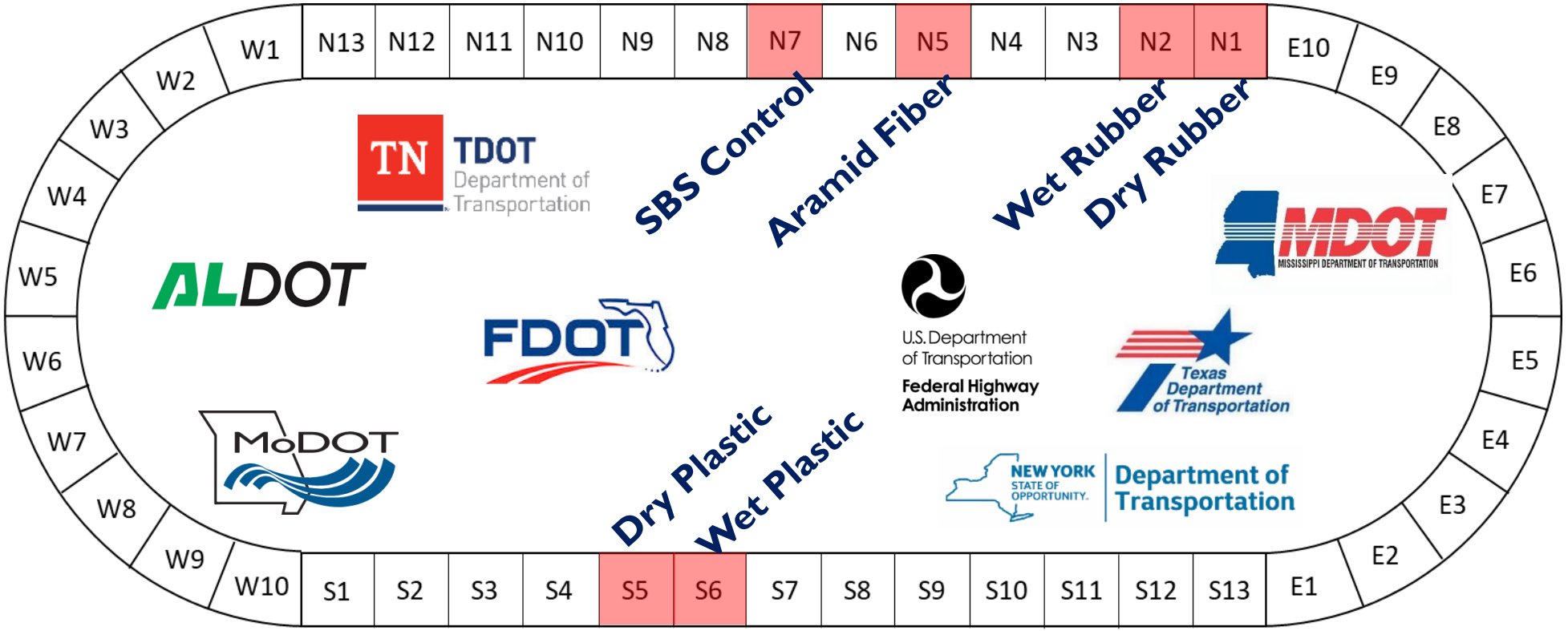
In-Place Density Study @ NCAT Test Track



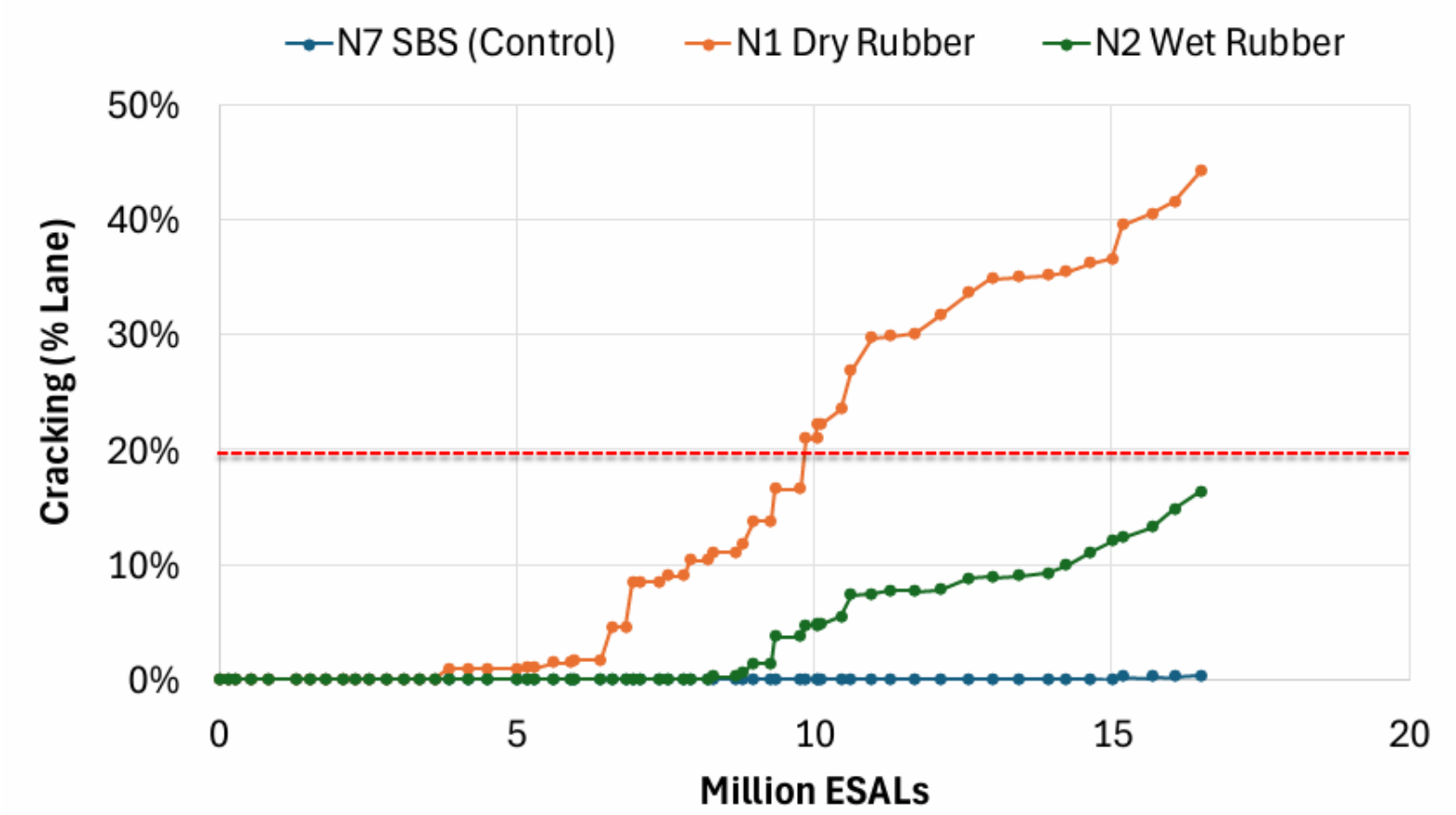
In-Place Density Study @ NCAT Test Track

- Low in-situ density has a negative impact on cracking resistance
- Binders from the sections with lower in-place densities have aged more as indicated by most recovered binder properties
- The binder in the upper ¾” has aged much more than the next ¾” for the well-compacted test sections.

Additive Group Study @ NCAT Test Track

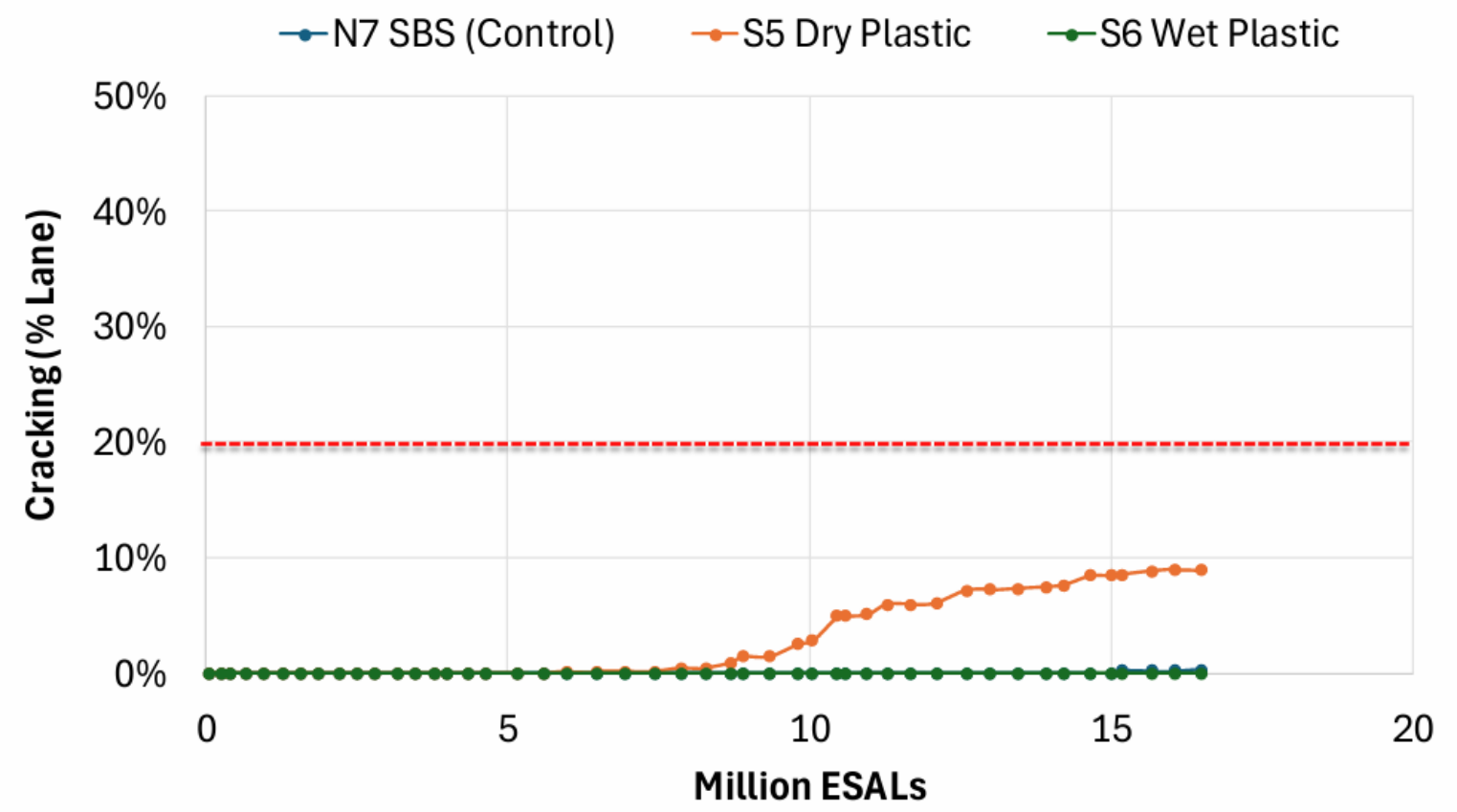


Additive Group Study @ NCAT Test Track



% Lane Cracking @ 16.5 MESALs

Additive Group Study @ NCAT Test Track



Note: N7 SBS Control started cracking shortly after 15 MESAL but Wet Plastic section didn't crack until this point.

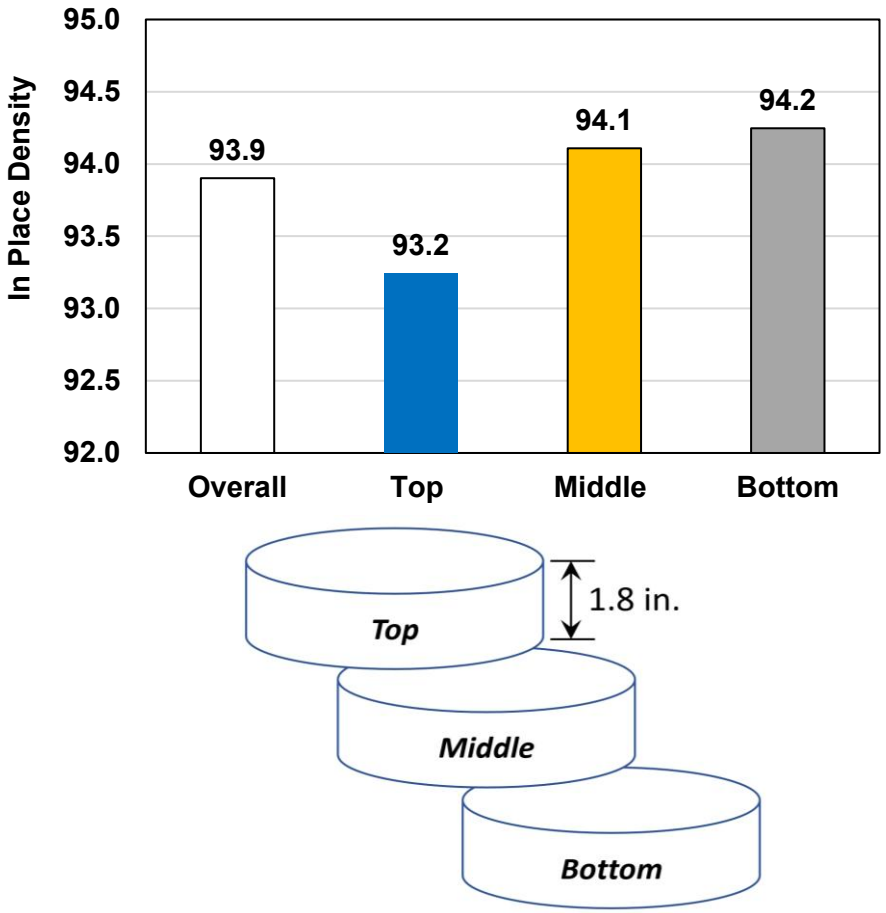
% Lane Cracking @ 16.5 MESALs

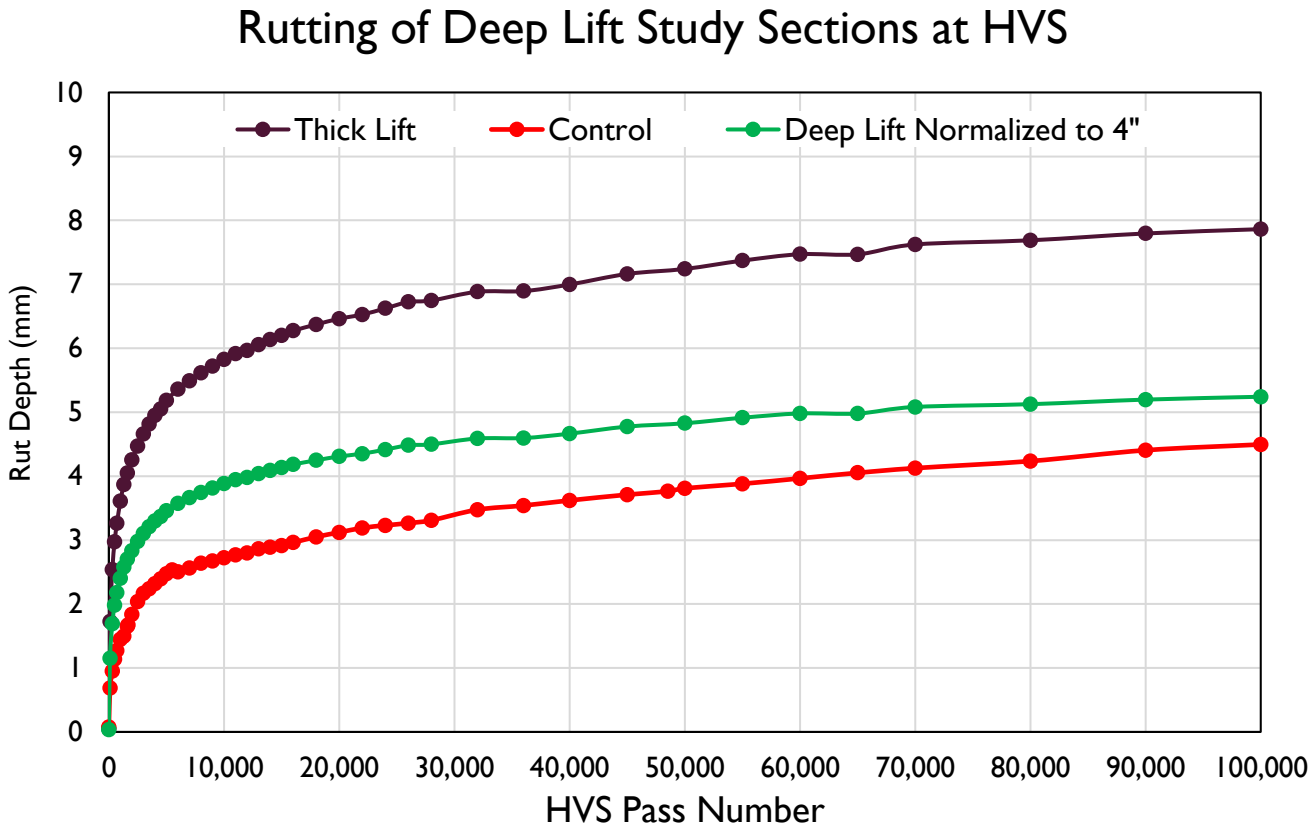
Single Lift Deep Mill/Fill @ HVS

- **Background**
  - Multi-layer paving involves additional paving processes, resulting in longer lane closures and increased traffic disruptions.
- **Objectives**
  - Evaluation of constructability of the thick lift mill/fill (≥ 4”)

Single Lift Deep Mill/Fill @ HVS

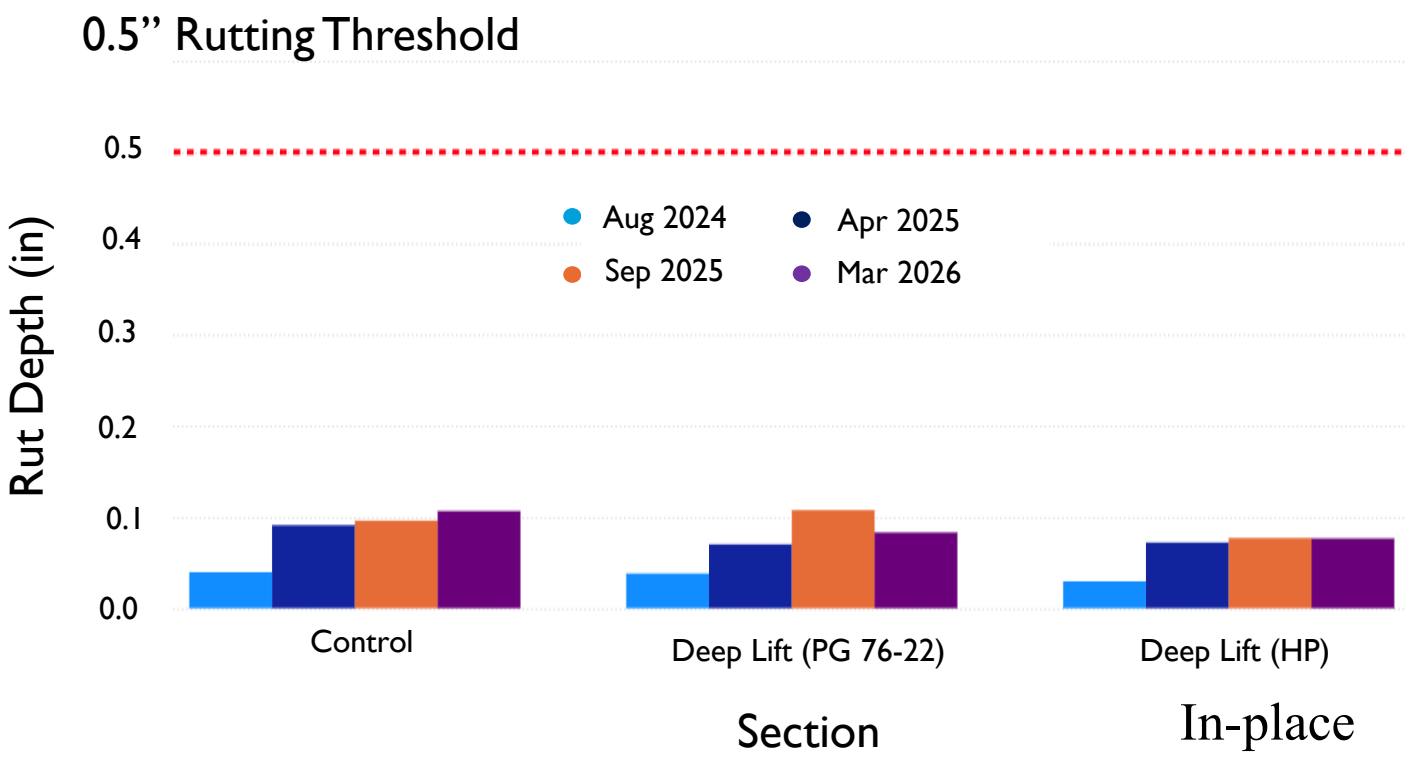
In-Place Density





Single Lift Deep Mill/Fill @ US 301 Test Road

In-Place Density



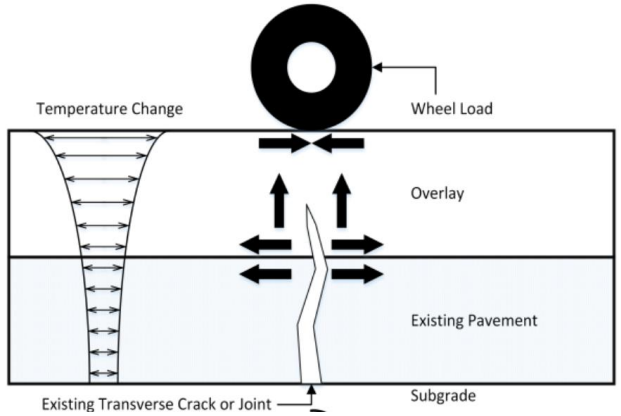
In-place density 95.9%

10A Deep Lift (76-22)	10B Deep Lift (HP)
0.75" FC-5	0.75" FC-5
1.5" Type SPM	1.5" Type SPH HP Binder
6.0" Type SPM	6.0" Type SPH HP Binder
Existing Base	Existing Base

In-place density 94.8%

Crack Relief Mixture @ HVS

- **Background**
  - Deeper pavement cracks require milling and filling at greater depths, which increases resurfacing costs and time
- **Objectives**
  - Evaluate the effectiveness of the crack relief asphalt mix in preventing bottom-up reflective cracking



Crack Relief Mixture @ HVS

1.50 in. Control
1.50 in. Control
2.5 in. Sawcut Existing Layer

Lane 1 – Section 1

1.50 in. HP Mix
1.00 in. HP CRM
2.5 in. Sawcut Existing Layer

Lane 2 – Section 1

2.00 in. Control
1.00 in. HP CRM
2.5 in. Sawcut Existing Layer

Lane 3 – Section 3

1.50 in. Control
1.00 in. HP CRM
2.5 in. Sawcut Existing Layer

Lane 3 – Section 1

1.50 in. Control
1.25 in. HP CRM
2.5 in. Sawcut Existing Layer

Lane 3 – Section 2

1.50 in. Control
1.00 in. PG 76-22 CRM
3.5 in. Sawcut Existing Layer

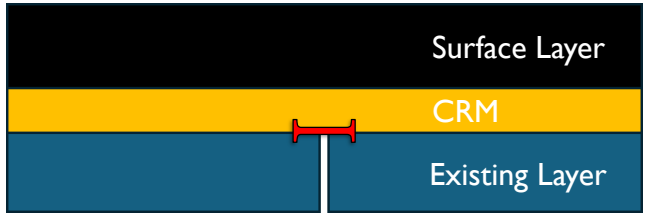
Lane 4 – Section 3

1.50 in. HP Mix + 20% RAP
1.00 in. HP CRM
2.5 in. Sawcut Existing Layer

Lane 4 – Section 1

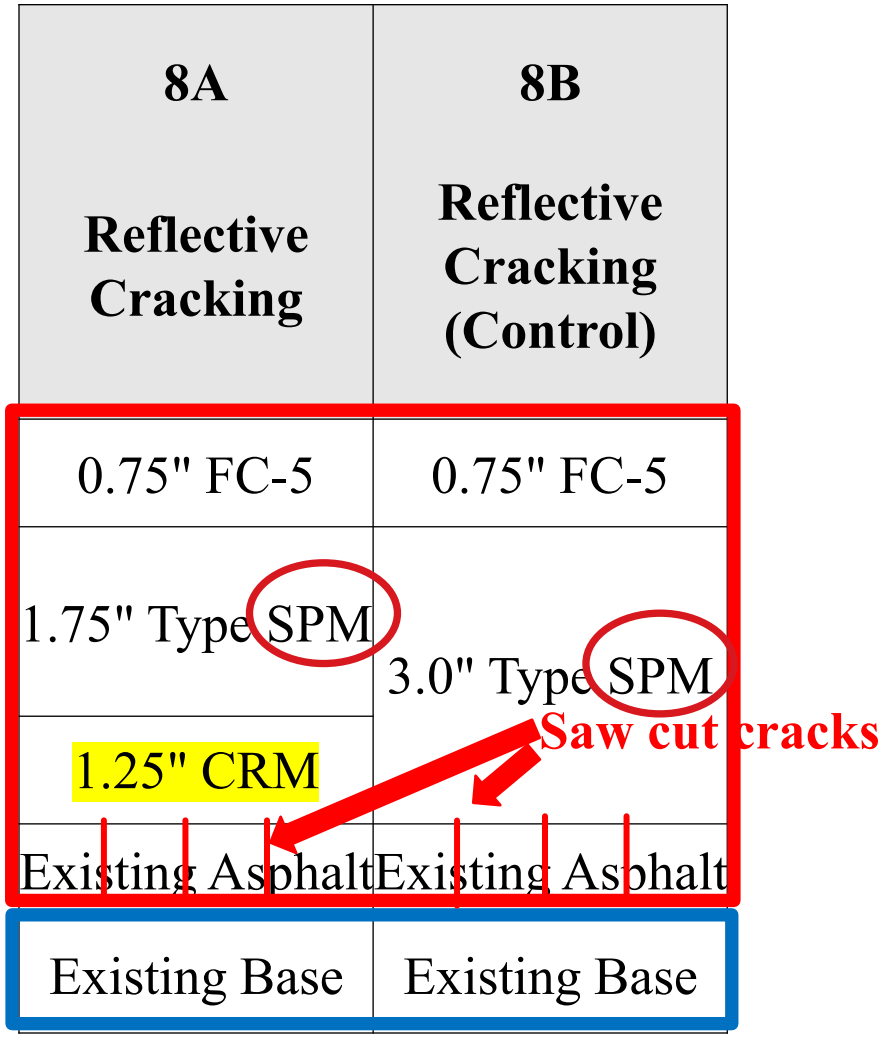
1.50 in. Control
1.25 in. PG 76-22 CRM
3.5 in. Sawcut Existing Layer

Lane 4 – Section 2



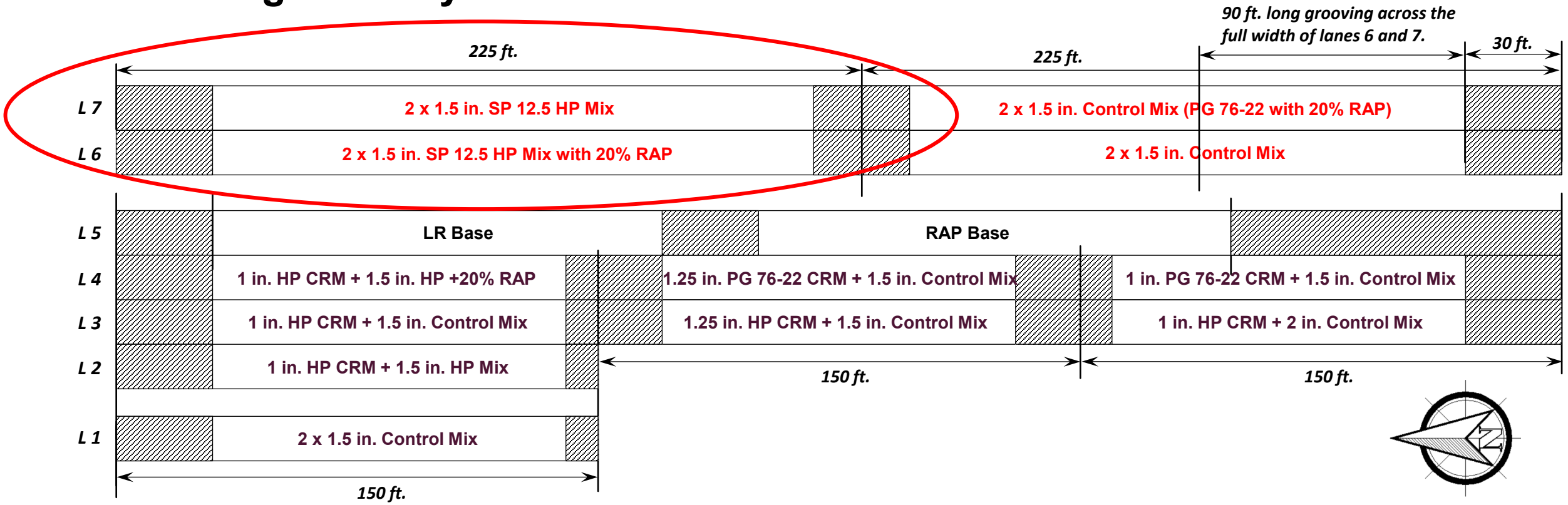
Crack Relief Mixture @ US 301

- No reflective cracking to-date



RAP in HP Mixtures @ HVS

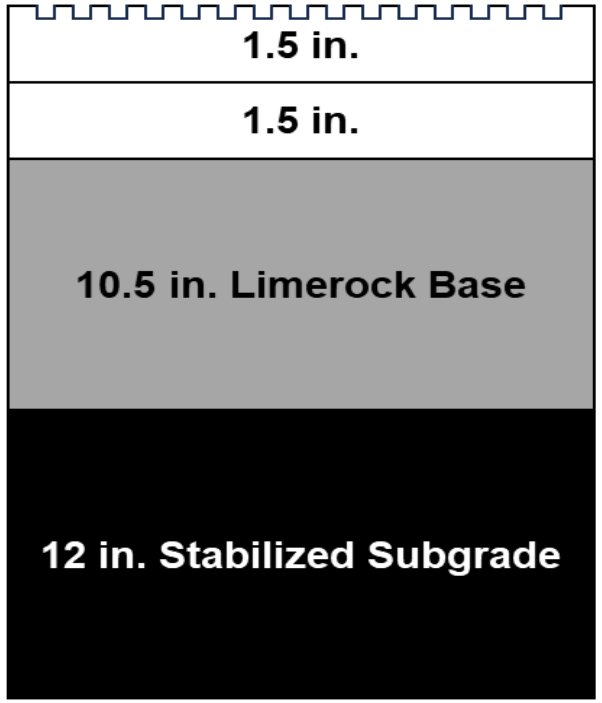
✓ Testing Plan Layout



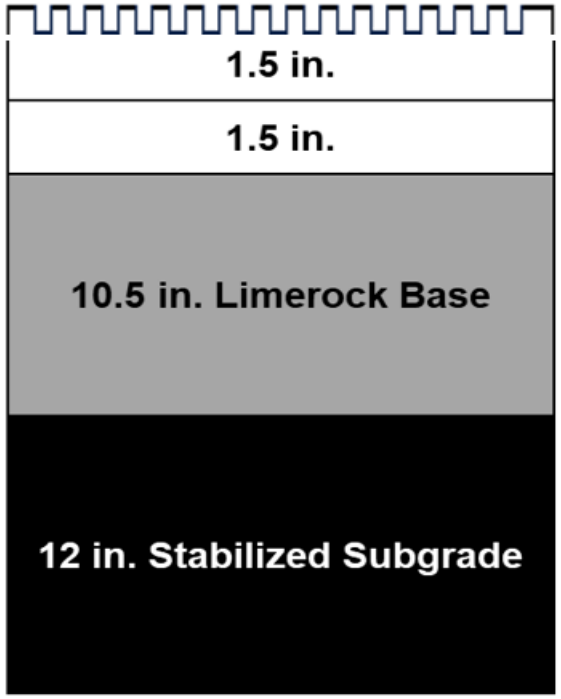
Longitudinal Grooving Study @ HVS

- **Grooving pattern #1:** ¾” (19 mm) spacing, 1/8” (3 mm) width, 1/8” (3 mm) depth
- **Grooving pattern #2:** ¾” (19 mm) spacing, 1/8” (3 mm), 1/4” (6 mm) depth

Grooving pattern #1



Grooving pattern #2

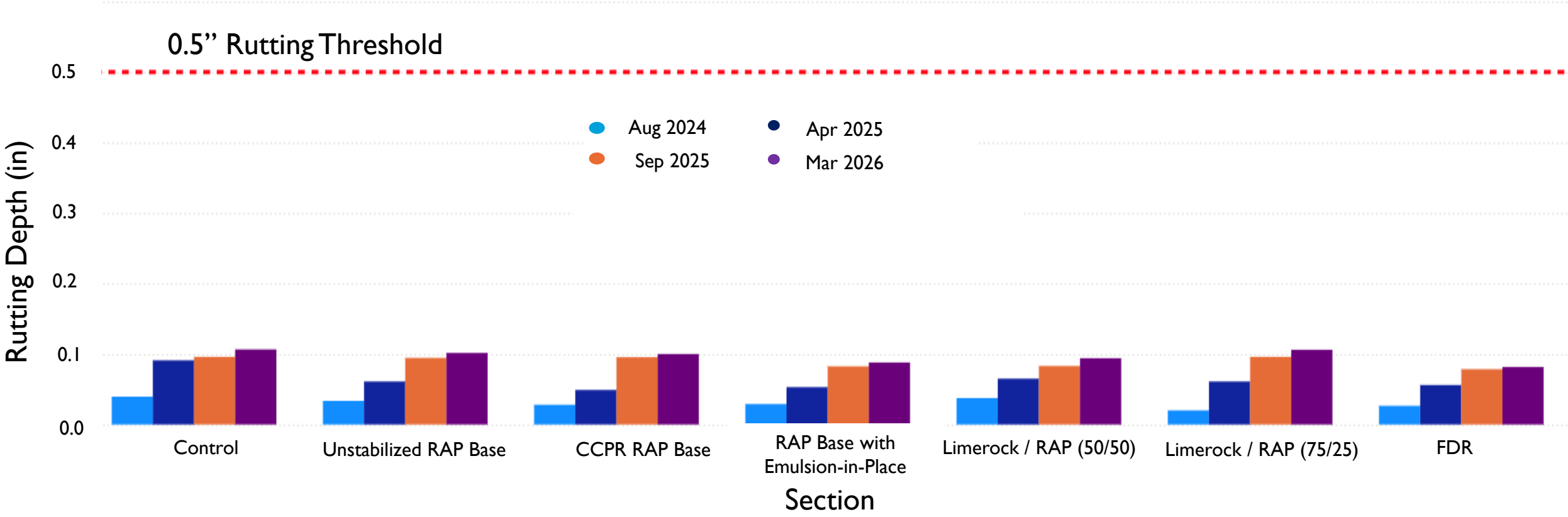


Longitudinal Grooving Study on SR 60 (East of Bartow)

RAP Base Study @ US 301

1 Control	2 Unstabilized RAP Base	3 CCPR RAP Base	4 Emulsion Stabilized RAP Base Mixed in Place	5 Limerock/ RAP Base (50/50)	6 Limerock/ RAP Base (75/25)	7 Full-Depth Reclamation
0.75" FC-5	0.75" FC-5	0.75" FC-5	0.75" FC-5	0.75" FC-5	0.75" FC-5	0.75" FC-5
2" Type SPM	2" Type SPM	2” Type SPM	2" Type SPM	2" Type SPM	2" Type SPM	2" Type SPM
4" Type SP	4" Type SP	4" Type SP	4" Type SP	4" Type SP	4" Type SP	4" Type SP
12" Limerock	12" Unstabilized 100% RAP Base	12" CCPR RAP Base	12" Emulsion Stabilized RAP Base	12" Limerock/ RAP Base (50/50)	12" Limerock/ RAP Base (75/25)	12" FDR (Mill 6.75")

RAP Base Study @ US 301

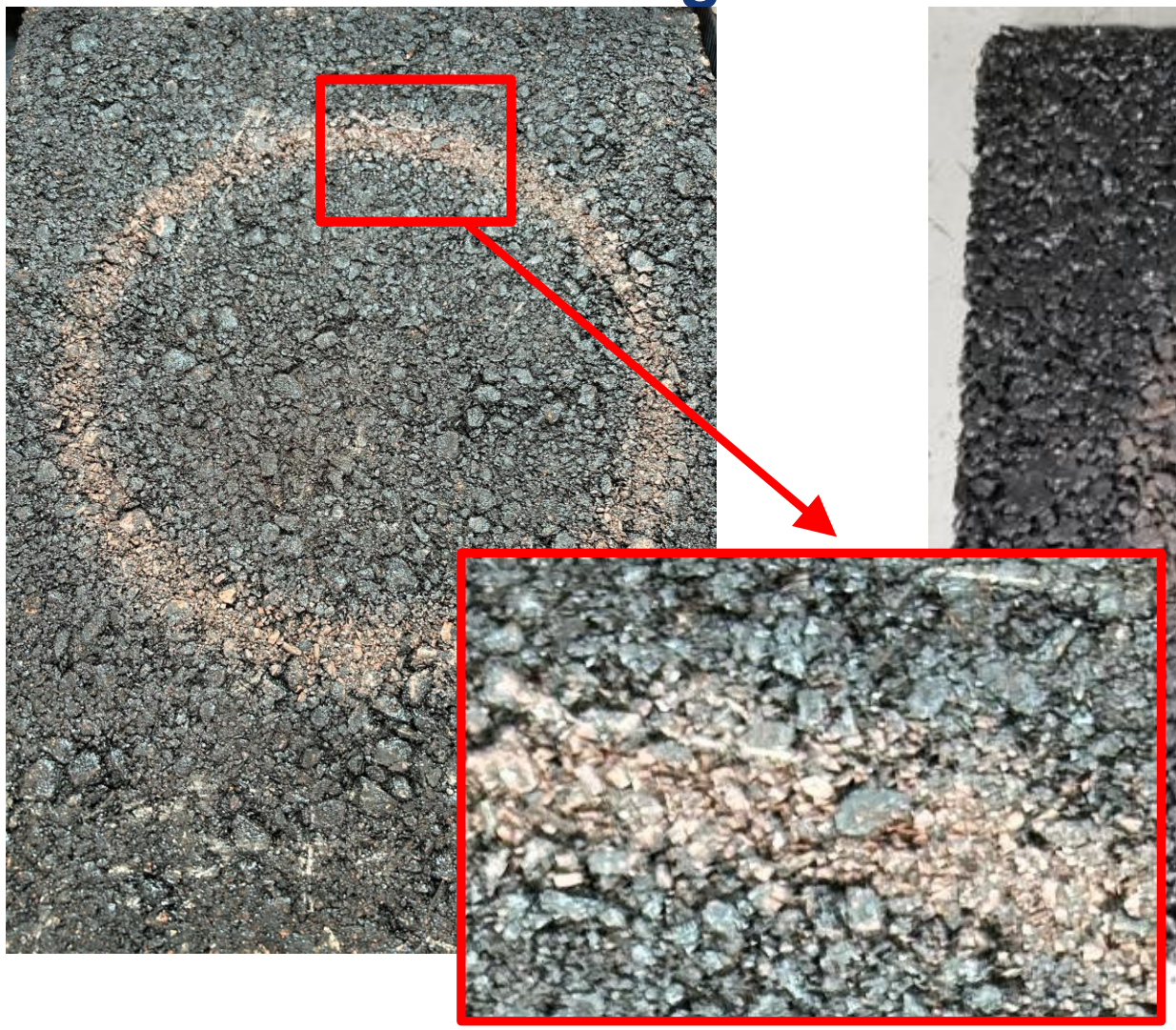


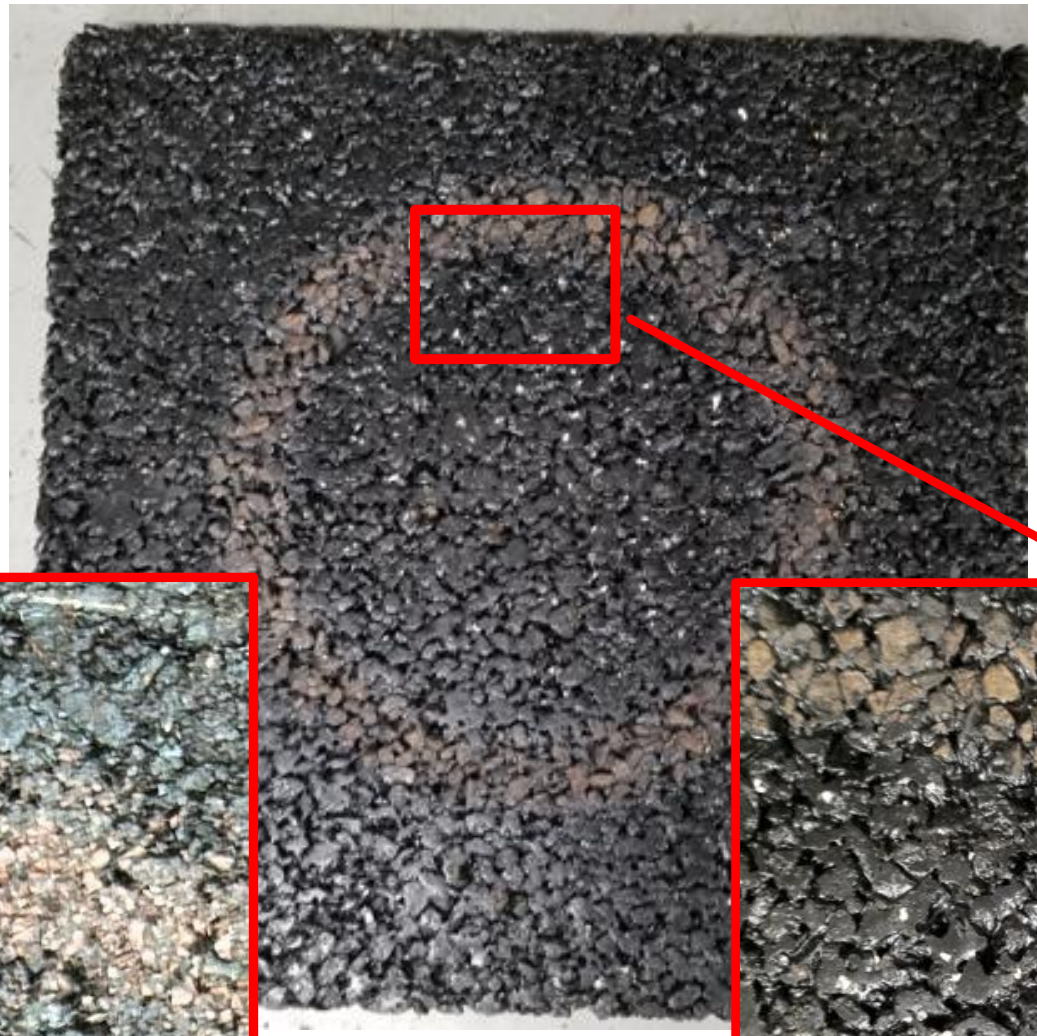
Adding RAP to FC-5 @ NCAT

- Project investigated adding 15% RAP to FC-5 mixtures (Granite and Limestone)
- Results showed ≈17% reduction in permeability
- Reduction in friction in Granite mixtures
- No significant impact on macrotexture using three-wheel polishing and increase in Mean Profile Depth
- Significant reduction of FC-5 + RAP durability after aging using NCAT Accelerated Weathering System (NAWS) for 1,000 hours

Pavement Wearing and Friction Determination

Pavement Wearing and Friction Determination

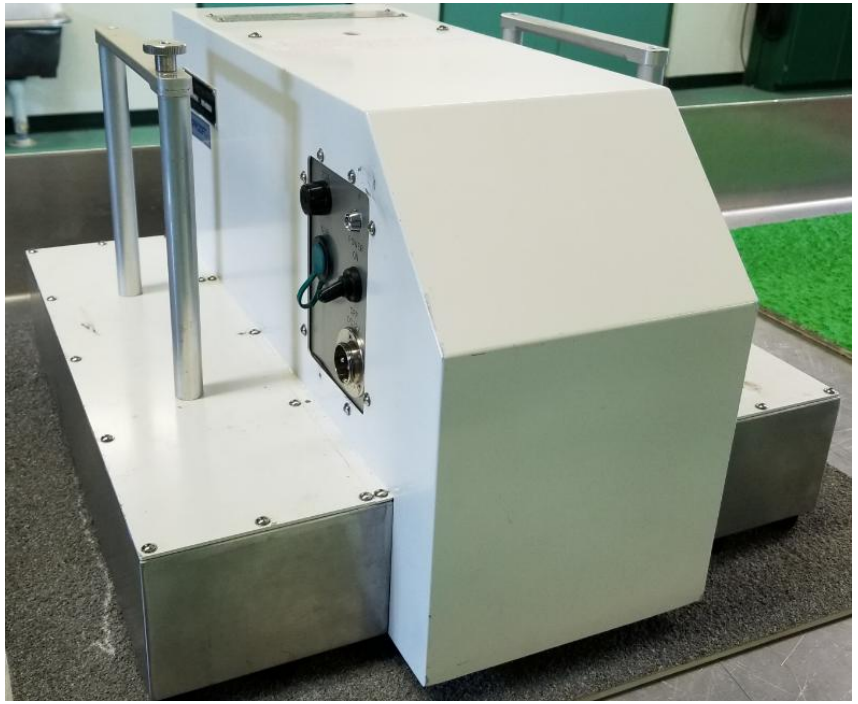


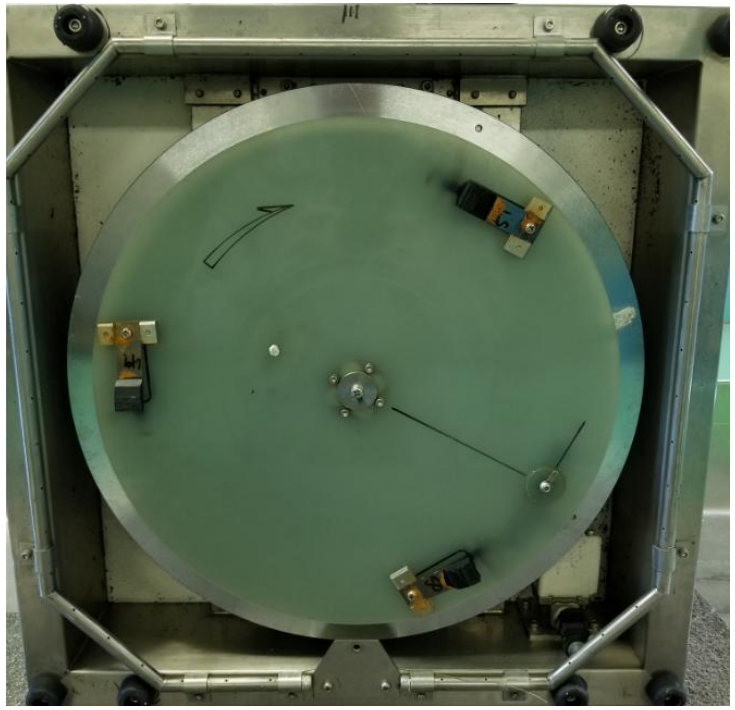


Low Friction Number (FN)

High Friction Number (FN)

Pavement Wearing and Friction Determination





Pavement Wearing and Friction Determination

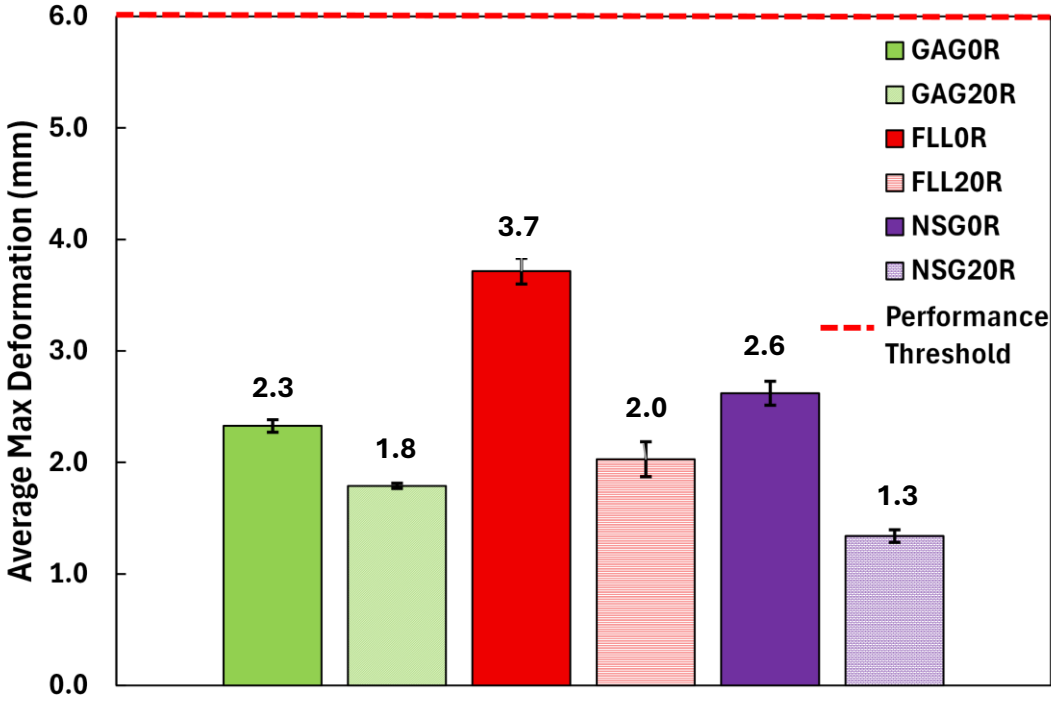
Three Wheel Polisher

Pavement Wearing and Friction Determination

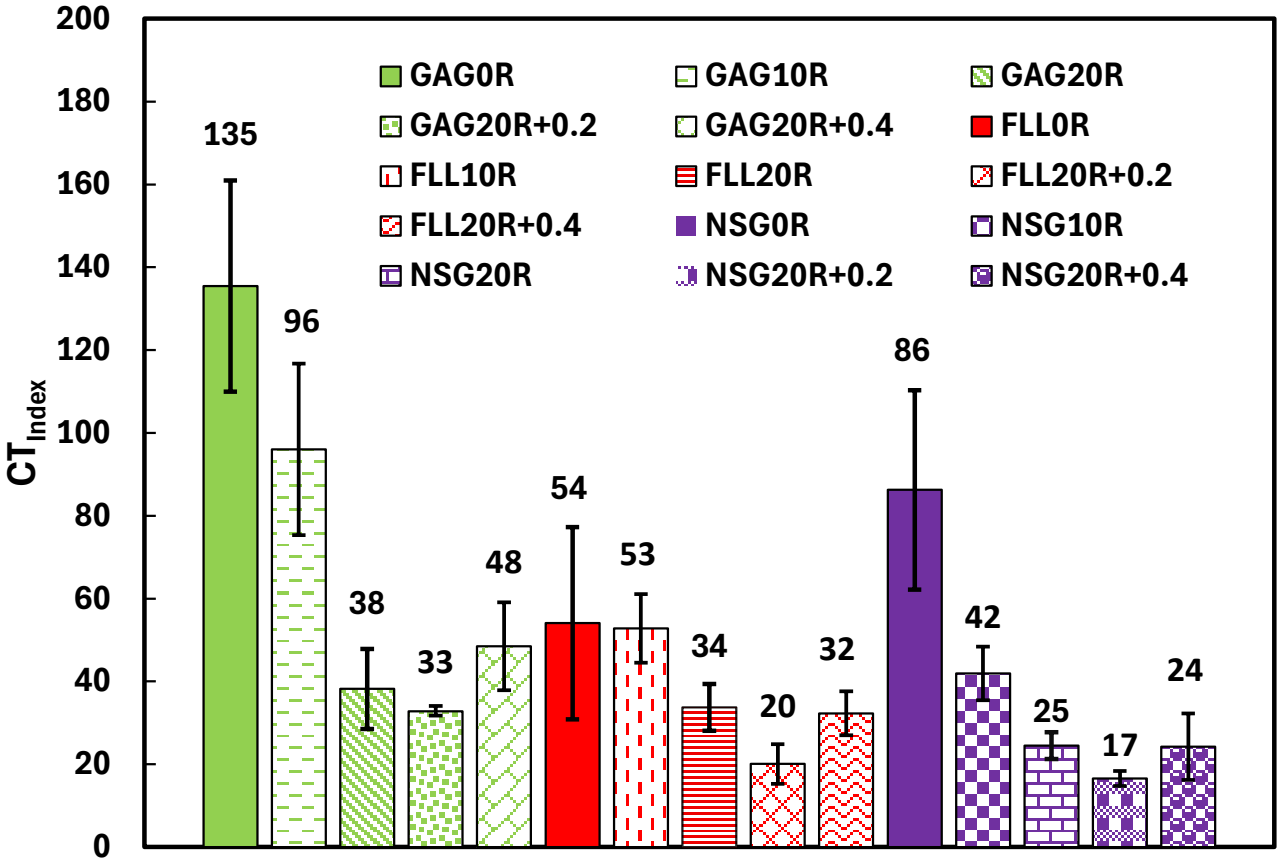
- **Allows expedited evaluation (4-6 weeks once materials received).**
- **Previous process required a roadway test section and the application of six million vehicle passes (2-3 years).**
- **Results so far:**
  - *Approved 20% RAP in limestone dense graded friction course.*
  - *Efficiently approved 4 new friction aggregate types with up to 20% RAP to overcome aggregate shortage in Florida.*

Adding RAP to High Polymer Asphalt Mixtures (by FSU)

- The project studied the impact of adding 20% RAP to HP mixtures on rutting and cracking resistance.



Lower rutting is favorable



Higher CT_{Index} is favorable

Thank you
Comments/Questions?

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mohab.el-hakim@dot.state.fl.us
Office: 352-955-6632

DEV340: Asphalt Crack Relief Mixtures

Developmental Specifications

SECTION 340

ASPHALT CONCRETE CRACK RELIEF MIXTURES

340-1 Description.

340-1.1 General: Construct an asphalt concrete crack relief pavement with the type of mixture specified in the Contract Documents. This Section specifies mixtures designated as asphalt concrete crack relief mixtures (CRM).

Obtain asphalt concrete crack relief mixtures from a plant that is currently on the Department's Asphalt Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105. Producers must meet the requirements of Section 320 for plant and equipment and the general construction requirements of Section 330.

340-1.2 Gradation Requirements of CRM: Use a mixture having a gradation at design within the ranges shown in Table 340-1.

Table 340-1
CRM Gradation Design Range

1/2 inch	3/8 inch	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
100	90-100	55-80	32-50	--	--	--	--	2-8

DEV340: Asphalt Crack Relief Mixtures

Developmental Specifications

- **No RAP Permitted**
- **No Blending between limestone and granite aggregates**

Table 340-2 CRM Design Requirements				
Air Voids	VMA	Dust to Binder Ratio	Dominant Aggregate Size Range Porosity (DASRP)	Asphalt Pavement Analyzer (APA) Rutting @ 4% Air Voids
2.0	17.0 – 20.0	0.6 – 1.4	≤ 50%	≤ 4.0 mm

https://www.fdot.gov/materials/asphalt