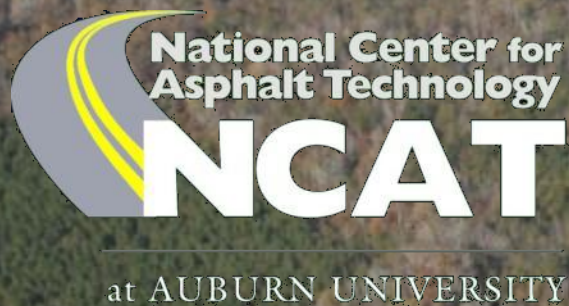


NCAT Pavement Test Track



- Findings from the 4th Research Cycle

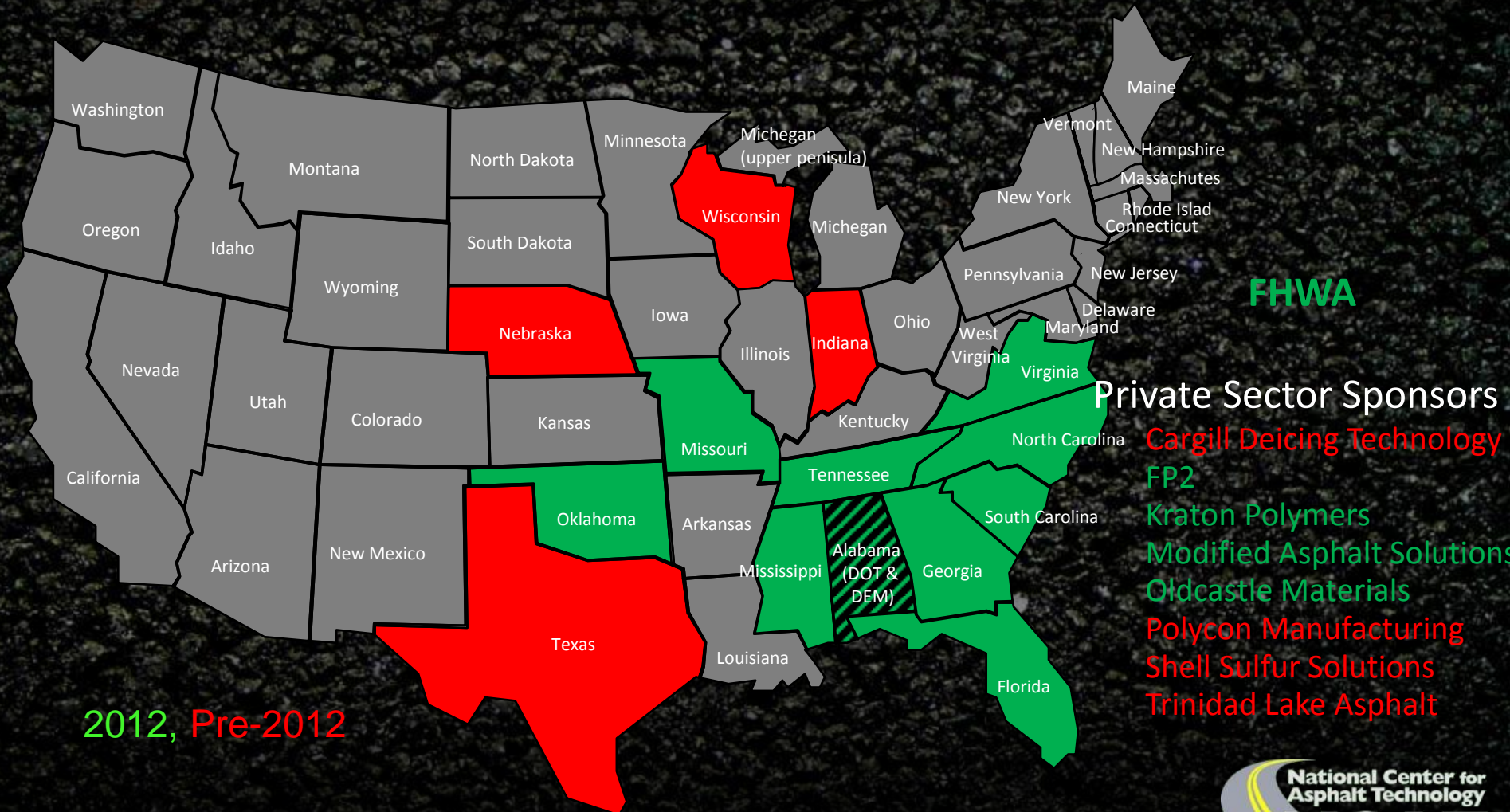
Accelerated Pavement Damage



Pavement Performance Data

- Weekly
 - Rutting
 - Roughness
 - Raveling
 - Cracking
 - Response
- Monthly
 - Density
 - Friction
- Quarterly
 - Permeability
 - Noise
 - Reflectivity

NCAT Pavement Test Track



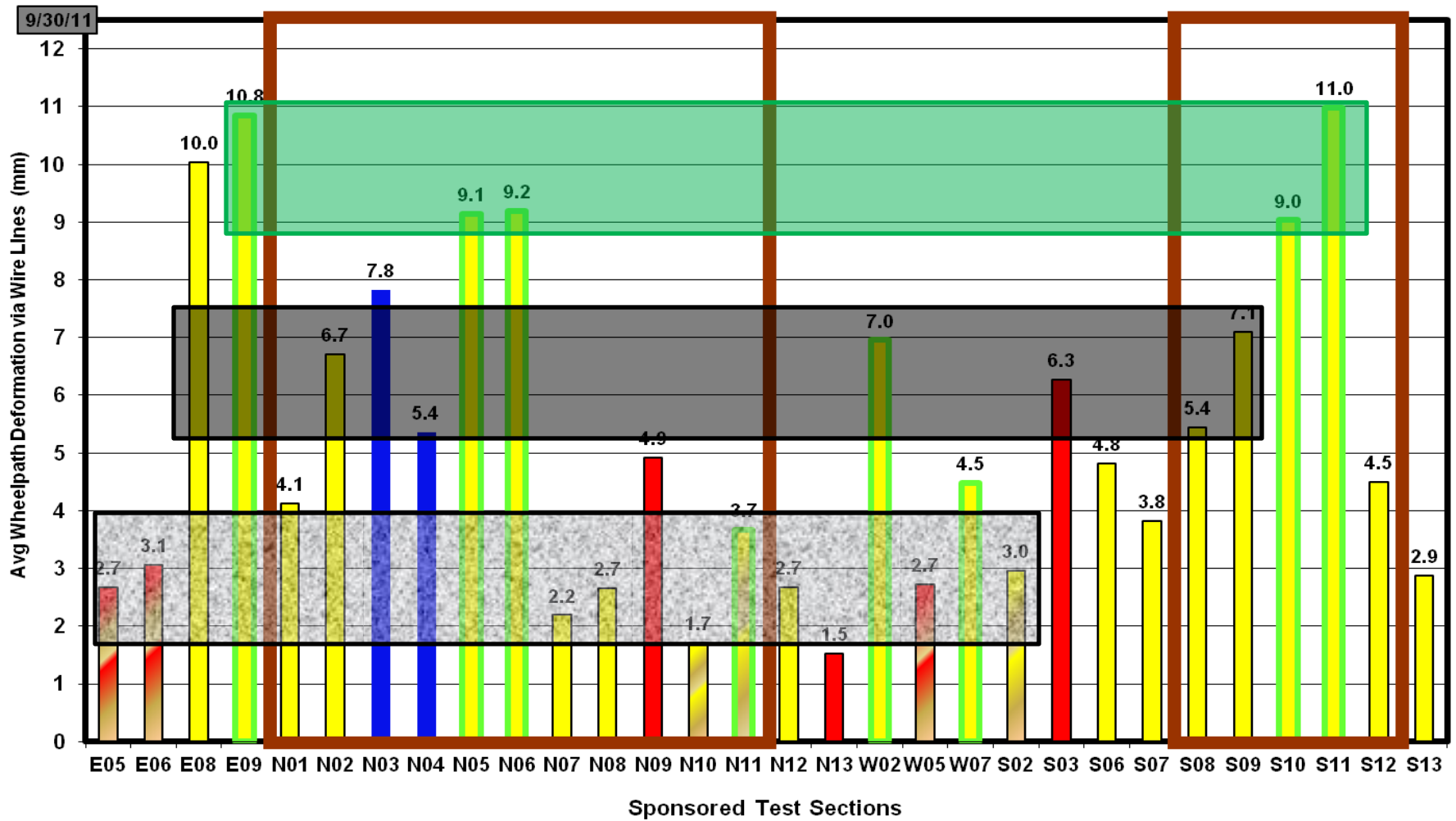
2012, Pre-2012

2009 Track (4th Research Cycle)

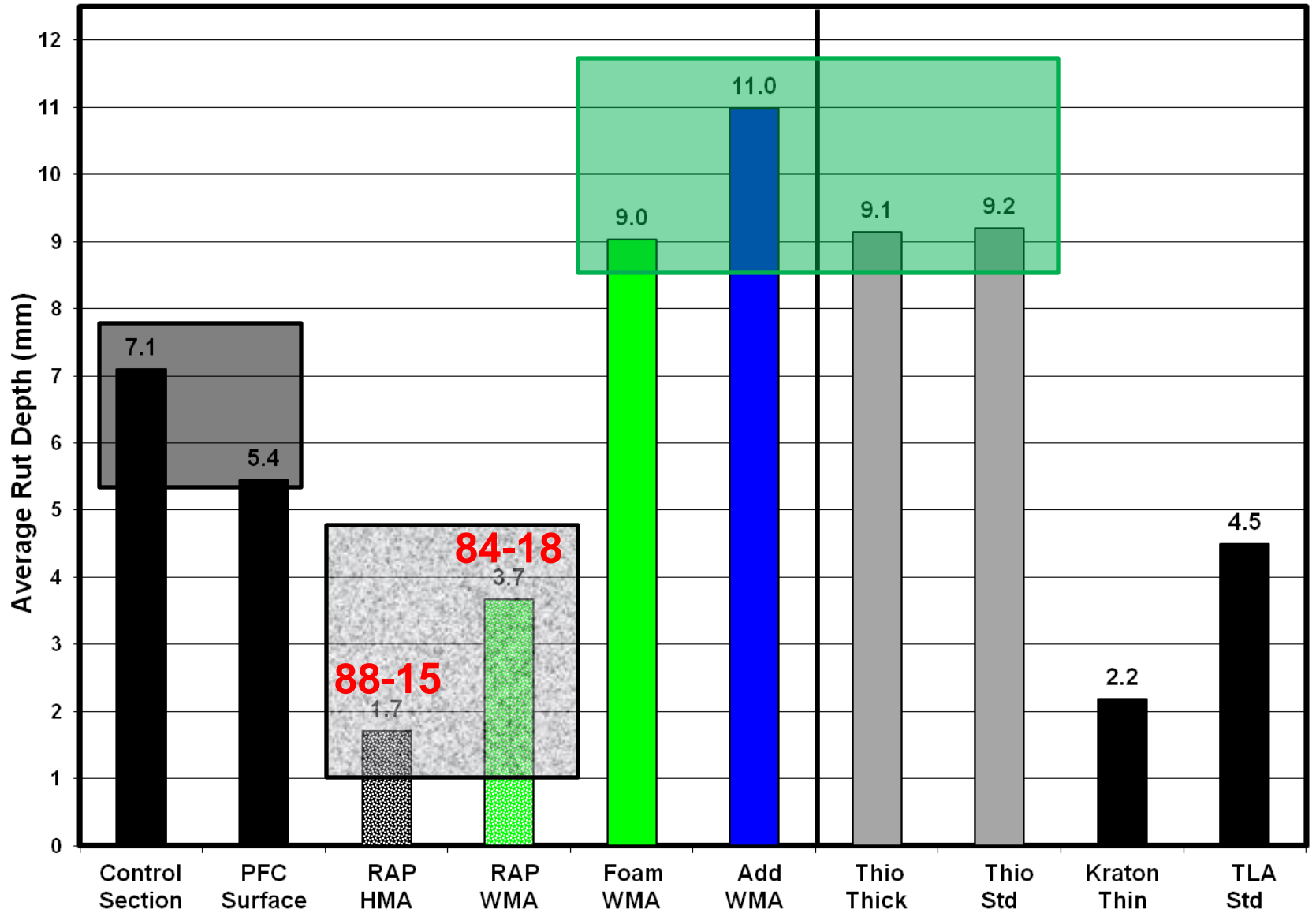
- High recycled content mixes
- Warm mix asphalt
- Optimized structural design
- Alternative binder materials
- Enhanced pavement interlayers
- Pavement preservation

Wire Line Rutting Performance All

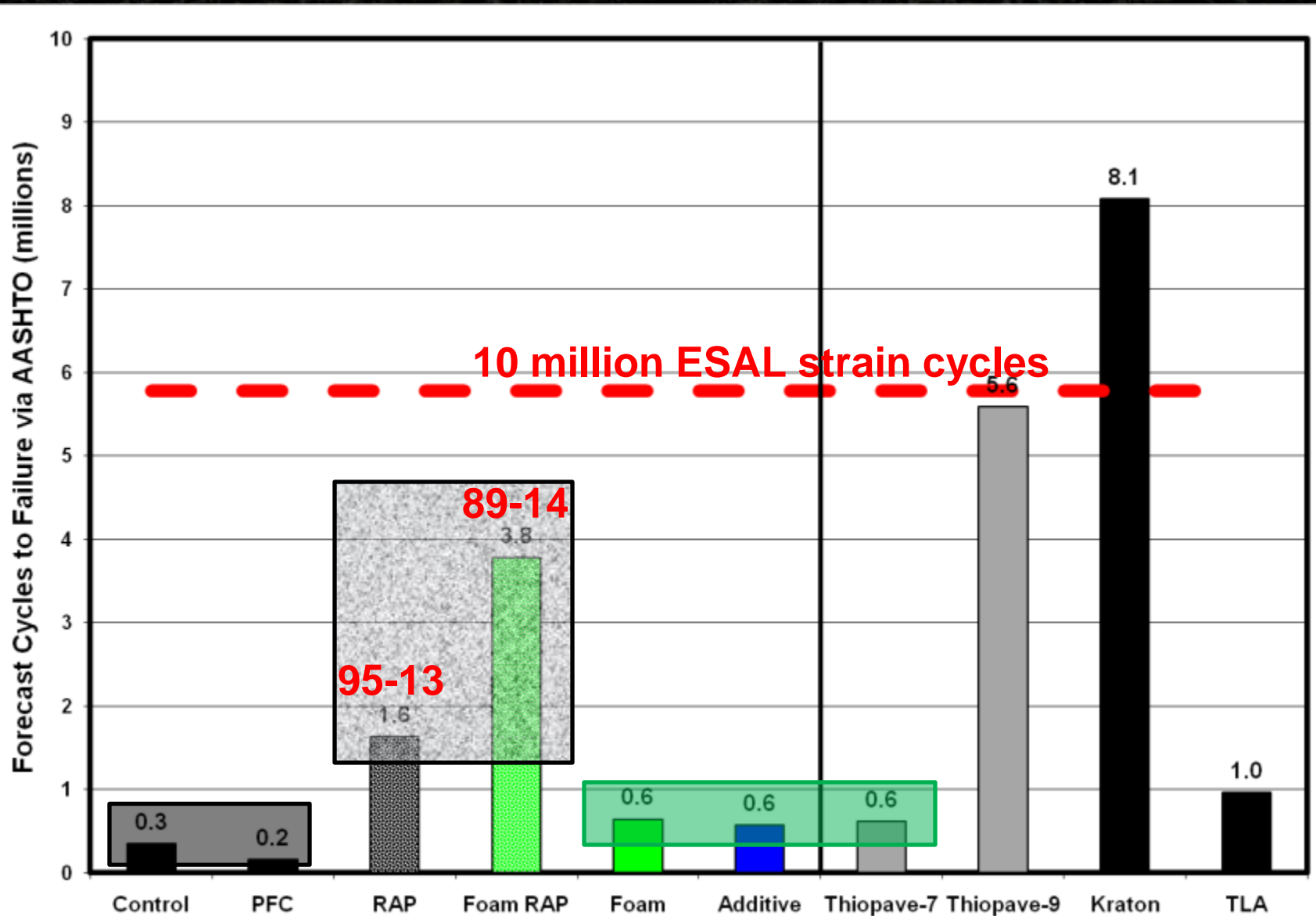
Cycle of Construction by Color (Blue=2003, Red=2006, Yellow=2009); High RAP with Texture;
 WMA with Green Outline; Thinner Structural Sections in Brown Boxes
 (All Others on Perpetual Foundations); Trucking Percent Complete via Height of Gray Box on Y-axis



"GE+" Rutting Performance



“GE+” Fatigue Life Expectations



100% RAP Mix with Foamed Binder



Optimized Structural Design

- Stiff subgrade & dense crushed granite base
 - 9 inch perpetual versus 24 inch '93 AASHTO design
- Soft subgrade with shallow lime modification
 - 10 inch failure versus 14 inch proven perpetual
- Highly polymer modified mix (HiPM)
 - 5¾ inch perpetual (?) via high fatigue tolerance
 - 10 inch on soft subgrade mill/inlay perpetual (???)
- Pre-ME AASHTO layer coefficient $0.44 \Rightarrow 0.54$
 - ≥ 0.15 for Open Graded Surface Courses

Optimized Structural Design



Optimized Structural Design

Purpose of Each Layer	N5 Control	S5 Higher RAP	S6 RAP+RAS	S13 Recyc Tires
Durable, Rut Resistant Surface	20% RAP 67-22 DGA	25% RAP 67-22 SMA	5% RAS 67-22 SMA	VIRGIN ARB12 SMA
Stiff, Strain Reducing Middle	35% RAP 67-22 DGA	50% RAP 67-22 DGA	50% AGED 67-22 DGA	35% RAP ARB12 DGA
Fatigue Resistant Base Layer	35% RAP 67-22 DGA	35% RAP 88-22 DGA	25% RAP 76-22+ DGA	VIRGIN ARB20 AZ

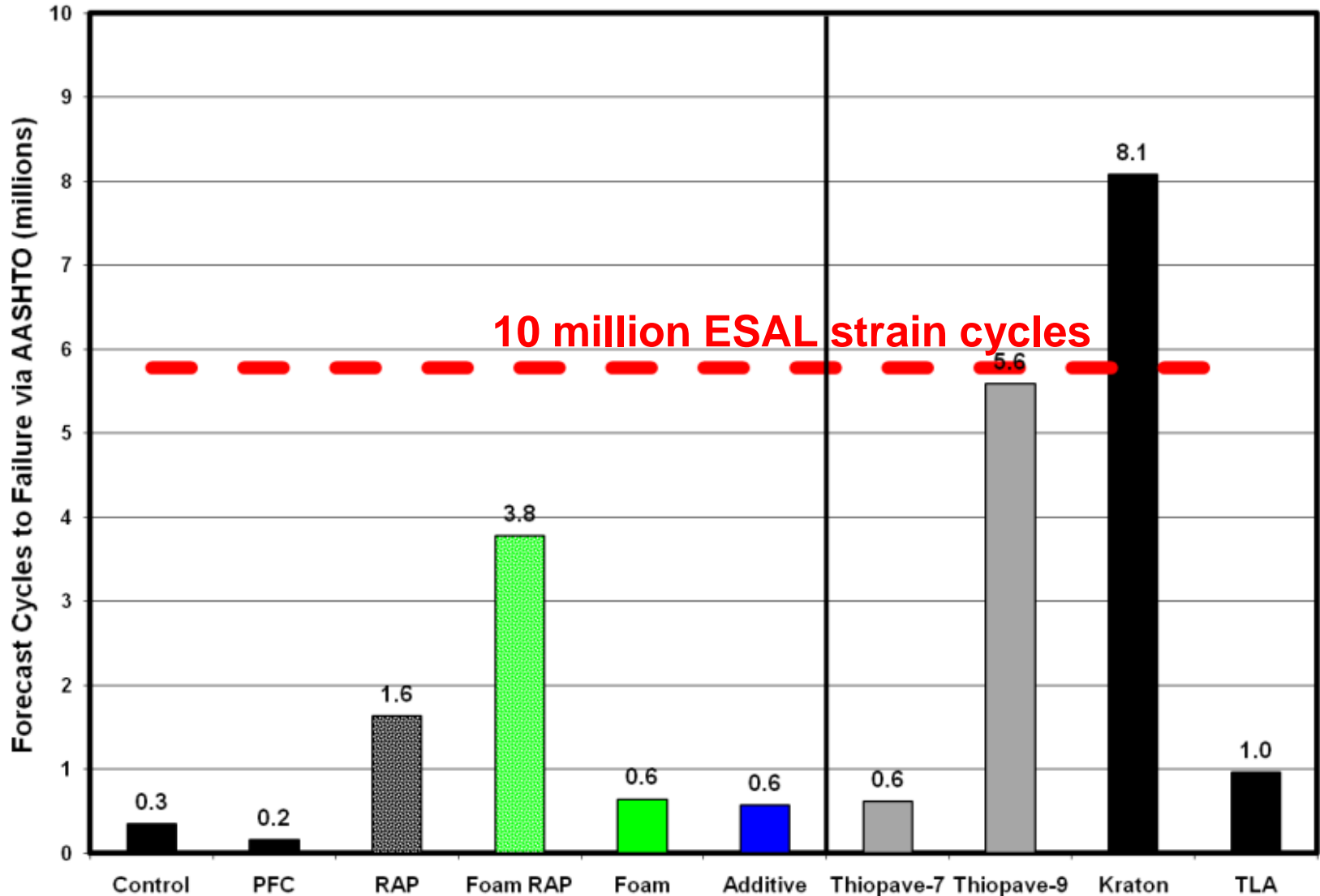
Green = Evotherm Q1 Additive, Blue = Astec Green Foamer

Alternative Binder Materials

Purpose of Each Layer	N5 Control	S5 Higher RAP	S6 RAP+RAS	S13 Recyc Tires
Durable, Rut Resistant Surface	20% RAP 67-22 DGA	25% RAP 67-22 SMA	5% RAS 67-22 SMA	VIRGIN ARB12 SMA
Stiff, Strain Reducing Middle	35% RAP 67-22 DGA	50% RAP 67-22 DGA	50% AGED 67-22 DGA	35% RAP ARB12 DGA
Fatigue Resistant Base Layer	35% RAP 67-22 DGA	35% RAP 88-22 DGA	25% RAP 76-22+ DGA	VIRGIN ARB20 AZ

Green = Evotherm Q1 Additive, Blue = Astec Green Foamer

Alternative Binder Materials



Enhanced Pavement Interlayers



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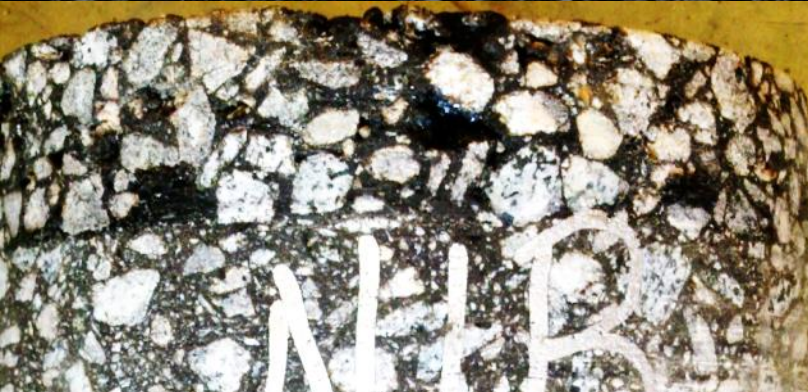
Enhanced Pavement Interlayers



Enhanced Pavement Interlayers



← N1A eTac 0.10/0.06



← N1B UltraFuse 0.15/0.15



← N2 Trackless 0.05/0.03

Enhanced Pavement Interlayers



Pavement Preservation

- 4.75 mm NMAS low volume road mix
- 70% limestone screenings, 30% natural sand
- 6.1% polymer modified binder
- High cost per ton, low cost per square yard
- Placed in '03, looks great after 32 million ESALs
- Need to reduce cost & maintain performance

Pavement Preservation



Pavement Preservation

- Polymer modified binder (control)
- Neat asphalt binder
- Neat asphalt binder on 100% RAP base
- 50% fine fractionated RAP
- 5% post consumer RAS
- Highly modified asphalt (HiMA) binder

- Ultra thin bonded wearing surface

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65°F
Cloudy

Feels Like: 65°F
Humidity: 72%
Wind: SSE at 14 mph

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Weather at 30,000 feet



Performance data for each section will soon be available for viewing by positioning your mouse over the section in question and left-clicking. Based on feedback from our research sponsors, the performance reports have been revised to include crack maps. The 2012 performance reports will be a fully integrated and active part of the web presentation.

- Click [here](#) for a recent rutting bar graph with ESAL update!
- Click the layout below for information specific to each section



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1,725,738 ESALs on the Track as of 2300 hours on March 9, 2013 (17% of the 10,000,000 ESAL goal). [Rut depths](#) recently averaged 4 mm. while roughness



at AUBURN UNIVERSITY

Performance Report

Quadrant: 5
Section: 10

3/19/2013

Surface Mix and Materials

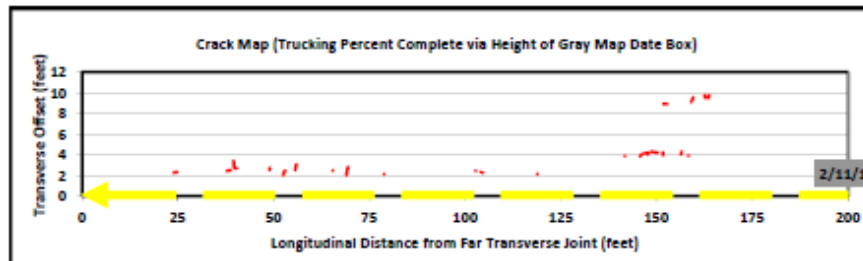
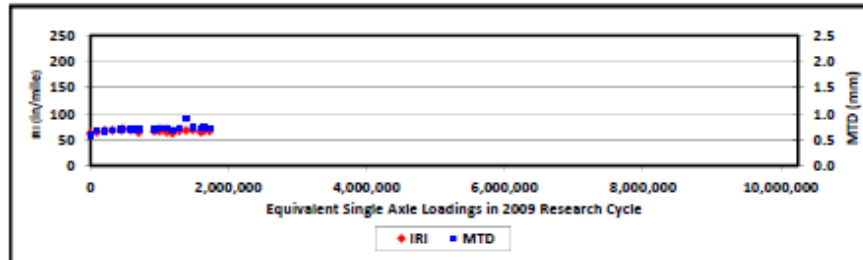
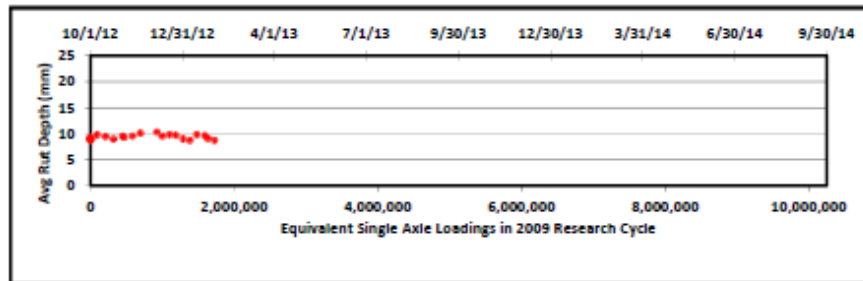
Year of Completion: 2009
Mix Design Methodology: Suprpave
Specified Binder: PG76-22
Surface Mix Stockpiles: Granite/Sand/Limestone

Structural Buildup Information

Study HMA (in): 7
Total HMA (in): 7
Base Material: Granite
Subgrade: Stiff

Research Objective: GE Foamed WMA & M-E Design + PG

Preliminary Field Performance Data



Construction Report

3/9/2010

Quadrant: 8
Section: 10
Sublot: 1

Laboratory Diary

General Description of Mix and Materials

Design Method: WMA
Compactive Effort: 80 gyrations
Binder Performance Grade: 75-22
Modifier Type: Foam
Aggregate Type: Gm/Sand/Lms
Design Gradation Type: Fine

Avg. Lab Properties of Plant Produced Mix

Sieve Size	Design	QC
25 mm (1"):	100	100
19 mm (3/4"):	100	100
12.5 mm (1/2"):	100	100
9.5 mm (3/8"):	100	100
4.75 mm (#4):	78	81
2.36 mm (#8):	60	60
1.18 mm (#16):	46	47
0.60 mm (#30):	31	32
0.30 mm (#60):	16	17
0.15 mm (#100):	10	10
0.075 mm (#200):	5.8	6.7
Binder Content (Pb):	5.8	6.1
Eff. Binder Content (Pbe):	5.1	5.5
Dust-to-Binder Ratio:	1.1	1.2
Rice Gravity (Gmm):	2.483	2.471
Avg. Bulk Gravity (Gmb):	2.384	2.390
Avg Air Voids (Va):	4.0	3.3
Agg. Bulk Gravity (Gsb):	2.667	2.671
Avg VMA:	15.8	16.0
Avg. VFA:	75	80

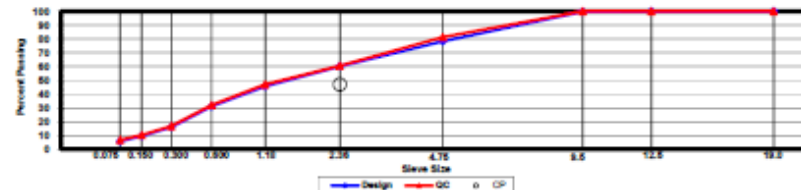
Construction Diary

Relevant Conditions for Construction

Completion Date: July 16, 2009
24 Hour High Temperature (F): 92
24 Hour Low Temperature (F): 74
24 Hour Rainfall (in): 0.00
Planned Subot Lift Thickness (in): 1.3
Paving Machine: Roadtec

Plant Configuration and Placement Details

Component	% Setting
Asphalt Content (Plant Setting)	6.5
89 Columbus Granite	36.0
8910 Opelika Limestone Screenings	23.0
M10 Columbus Granite	13.0
Shorter Coarse Sand	28.0
As-Built Sublot Lift Thickness (in):	1.3
Total Thickness of All 2009 Sublots (in):	7.0
Approx. Underlying HMA Thickness (in):	0.0
Type of Tack Coat Utilized:	NTSS-1HM
Target Tack Application Rate (gal/sy):	0.04
Approx. Avg. Temperature at Plant (F):	275
Avg. Measured Mat Compaction:	92.3%



General Notes:

- 1) Mixes are referenced by quadrant (E=East, N=North, W=West, and S=South), section # (sequential) and sublot (top=1);
- 2) The total HMA thickness of all structural study sections (N1-N11 and S8-S12) ranges from 5-3/4 to 14 inches by design;
- 3) All non-structural sections are supported by a uniform perpetual foundation in order to study surface mix performance;
- 4) SMA and OGFC refer to stone matrix asphalt and open-graded friction course, respectively; and
- 5) All liquid asphalt purchased for use in Track reconstruction contained LOF 6500 antistripping additive at a rate of 0.5 percent

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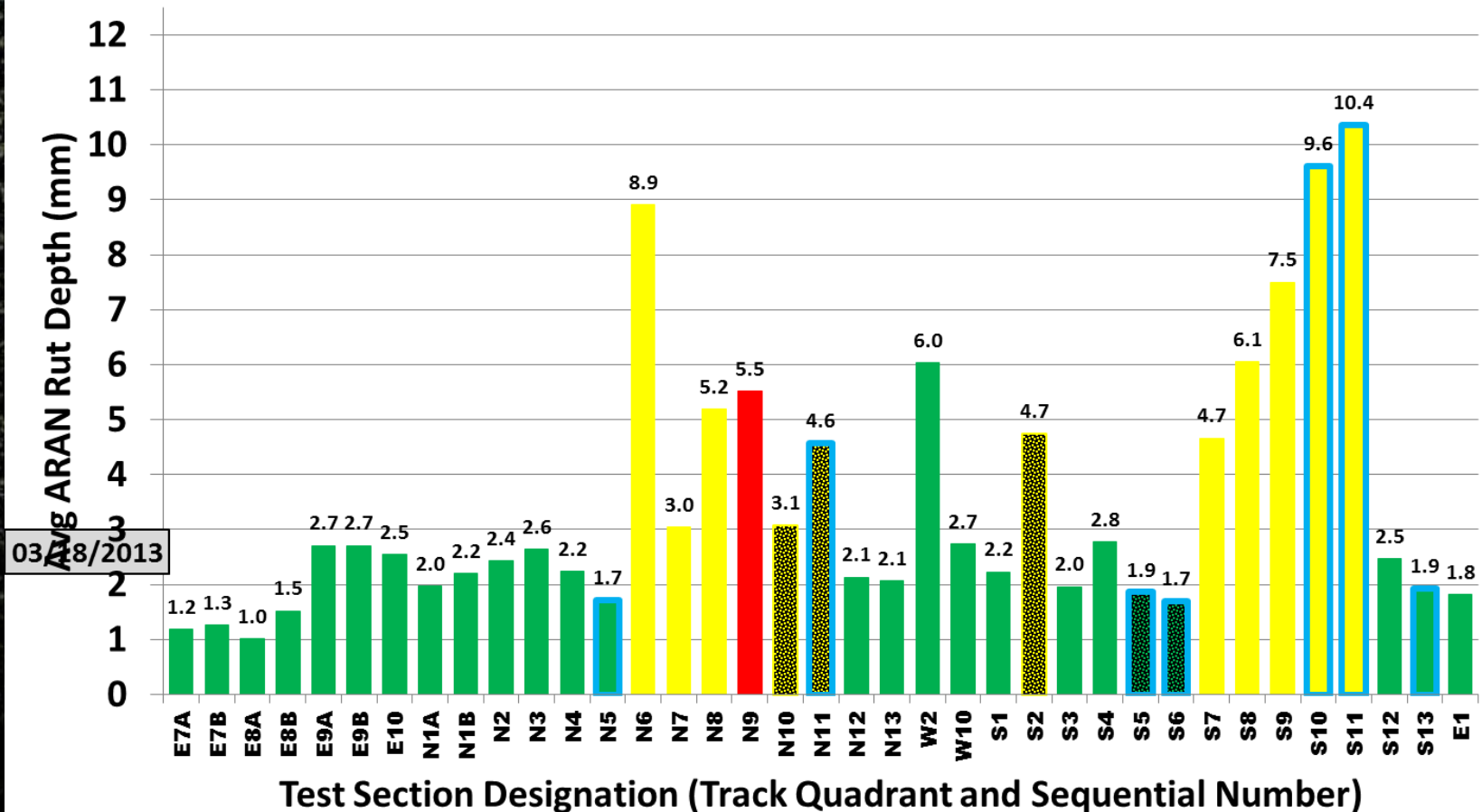


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Track Rut Depths

N1 - N11, S5 - S6, and S8-S13 are thinner structural sections;
 All other sections have deep perpetual foundations;
 Research cycle shown by color (red=2006, yellow=2009, green=2012);
 Blue outline for WMA and hatching for high recycled contents



Questions ?



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