# NCAT Pavement Test Track

# USA Today on 3/16/2011

- ND has third smallest population in US
  - Half the growth rate of the US average
- Lowest unemployment rate
  - Under 5 percent since 1987
- Greatest advance in per capita income
- $1B state budget surplus
  - $1B annual agricultural subsidies
  - Oil boom in western North Dakota

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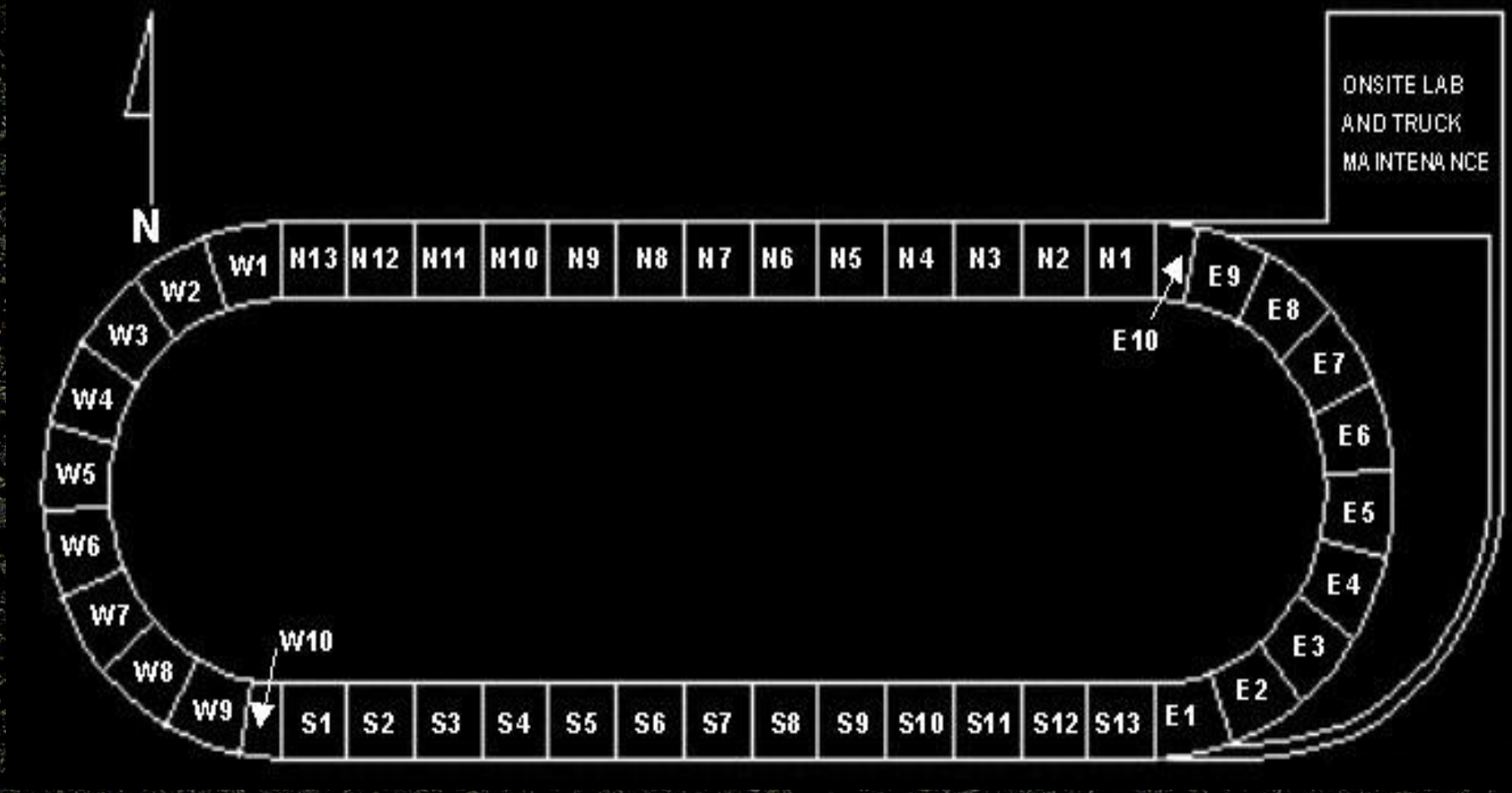
# Current NCAT Research Areas

- High recycled content mixes
- Warm mix asphalt
- Pavement preservation
- Optimized structural design
- Alternative binder materials
- Drainable, quiet pavements
- Automated QC technologies

# Accelerated Performance Testing

# Test Track Layout

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# Thinner Structural Test Sections


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# Track Research Program

- Optimize pavement thickness design
- Identify ideal mixes, materials, methods, etc.

- Build-traffic$_2$-forensics in 3-year research cycles

# Changes to Design Gradations

- 2000 – All mixes on coarse side of MDL
  - High design gyrations led to very dry mixes
  - Low durability resulted from poor compaction
- 2003 - Complete overhaul of methodology
  - Surface mixes required on fine side of MDL
  - Base and binder lifts optional coarse or fine

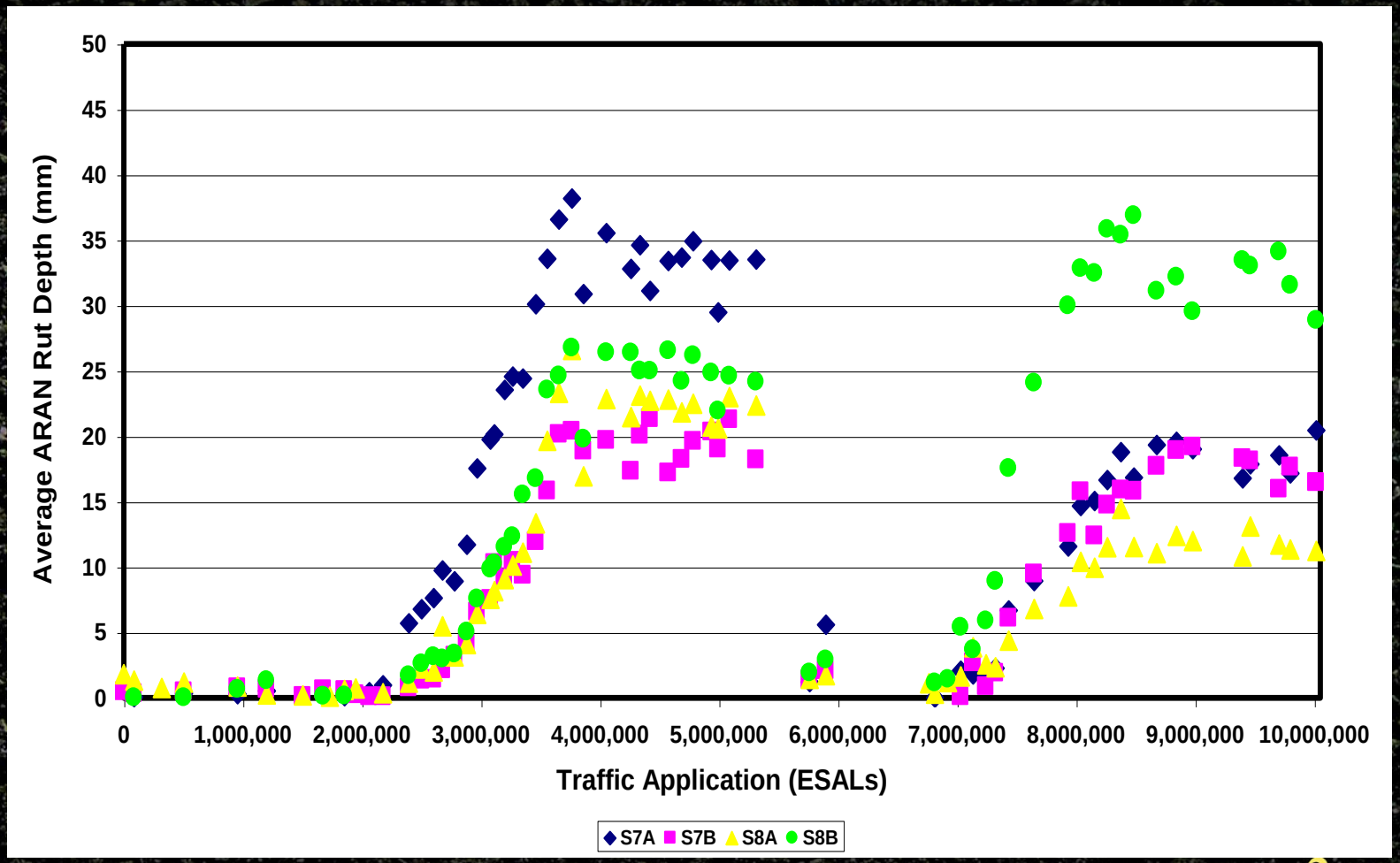
# Changes to Mix Materials

- Optimized use of polymer binders
- Absorptive gravels in dense, SMA, OGFC
- Off network proof test for polishing
- Threshold properties for SMA aggregates
- High friction surface treatments
- Deicing aggregates in surface treatments

# Changes to Design Gyrations

- 1998 - 139 gyration designs
- 2000 – 100 gyration designs
- 2003 – 80 gyration designs
- 2006 – 60 gyration designs
  - Via locking point (2 gyrations)

# Low QC Air Voids Neat AC, Ndes=60



# Pavement Preservation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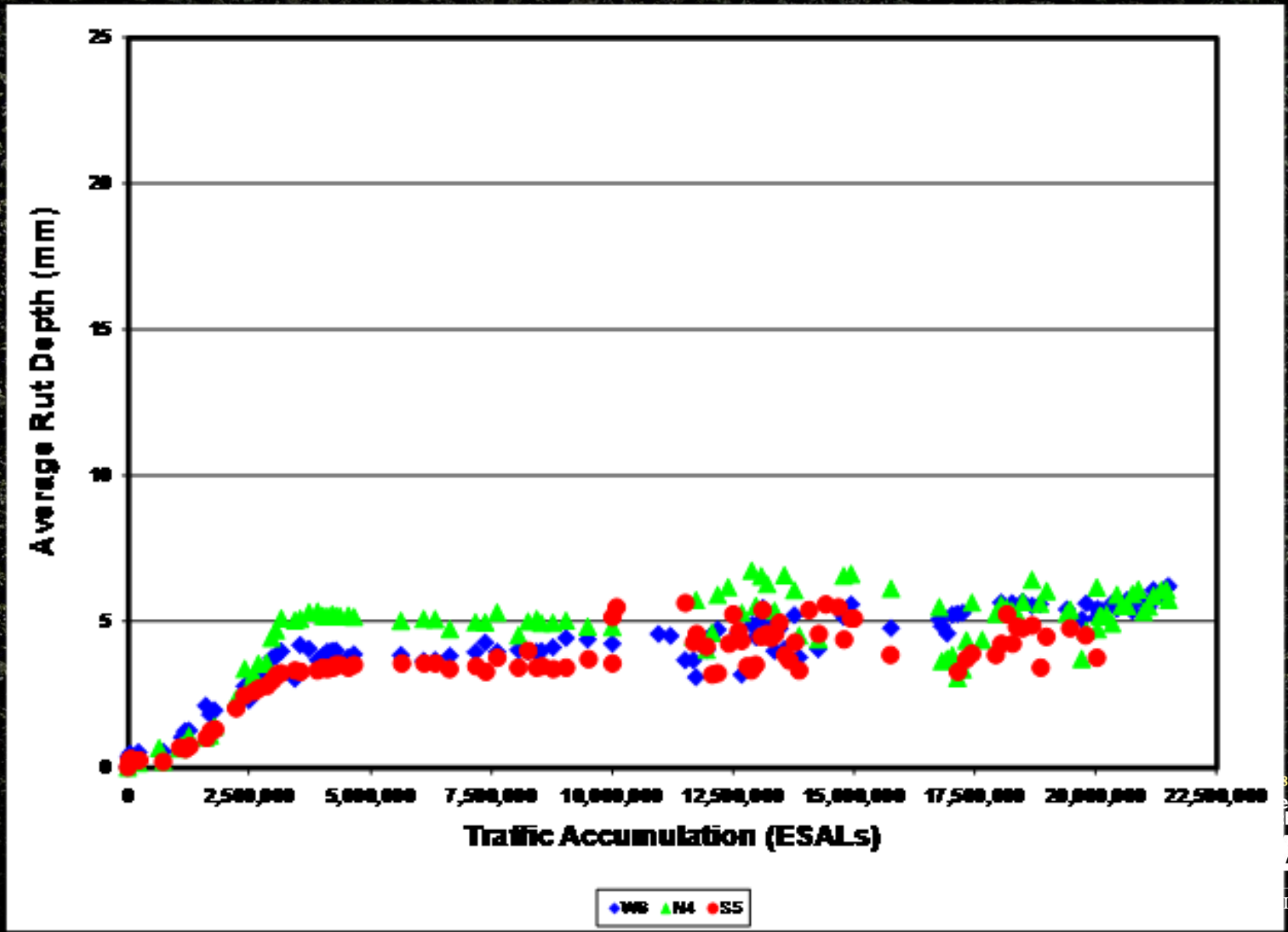
# Comparable Performance



# Thin Lift Laboratory Experiment

- Two screenings stockpiles identified (LMS & GRV)
- Blended 70/30 to match proven gradation in W6
- APA tests with binder contents at 6.0, 6.5, 7.0, & 7.5
- Control mixes are W6-like with both PG76 & PG67

# Thin Lift Laboratory Experiment

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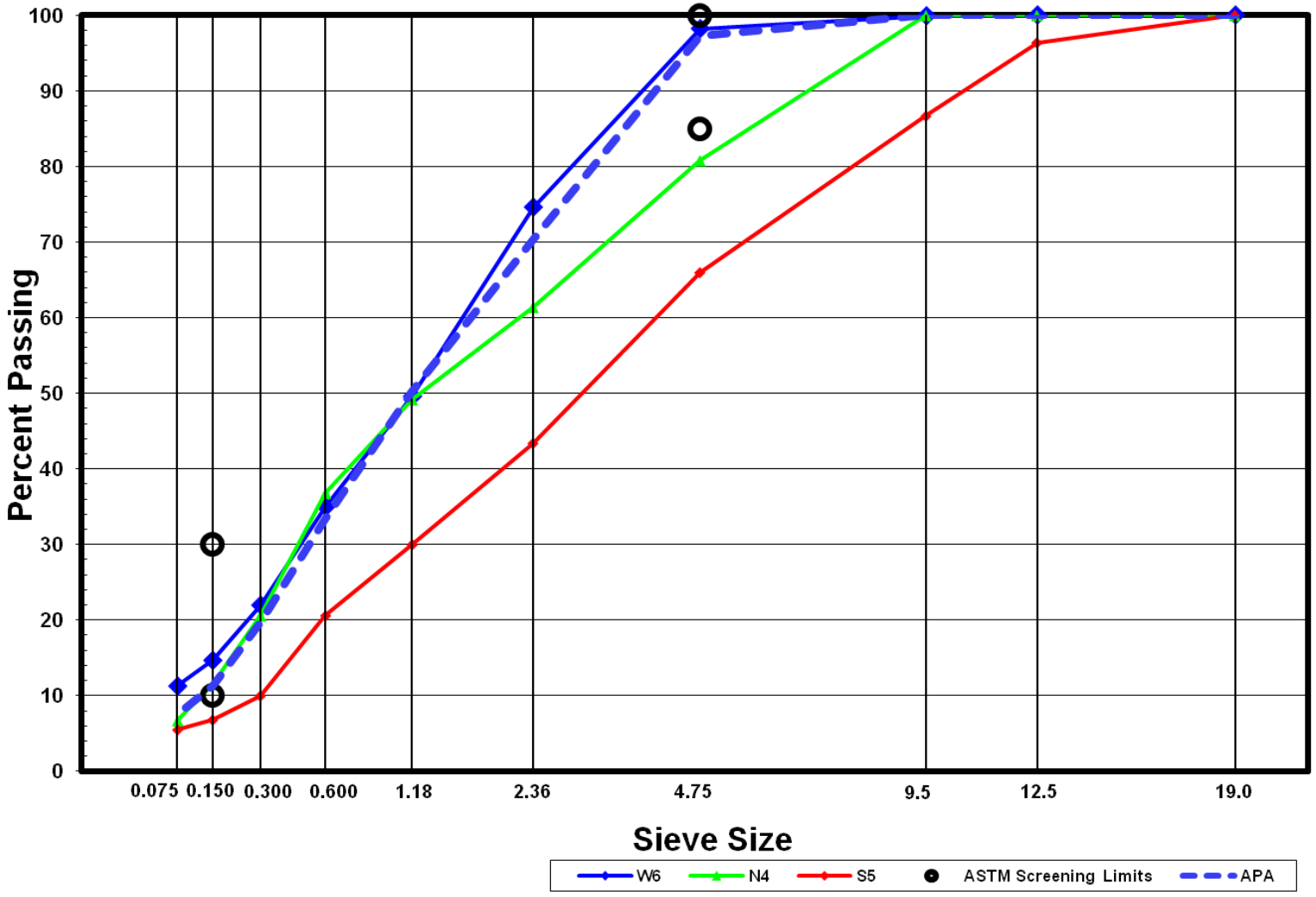
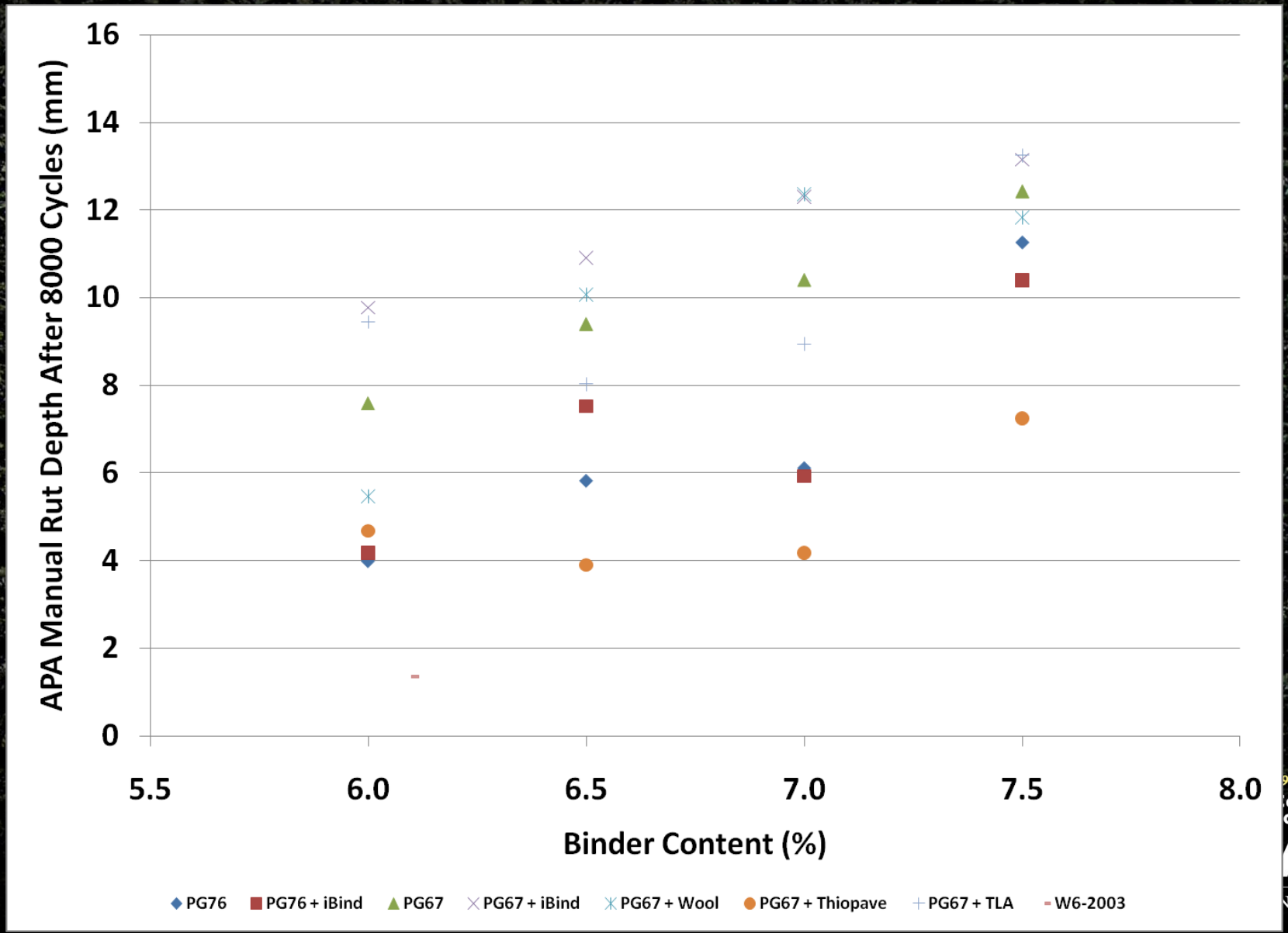
- Blended 70/30 to match proven gradation in W6
- APA tests with binder contents at 6.0, 6.5, 7.0, & 7.5
- Control mixes are W6-like with both PG76 & PG67
- Treatment mixes to target PG76-like performance:
  - Wool fibers
  - Thiopave sulfur pellets
  - Trinidad Lake Asphalt (TLA) pellets
  - iBind (in both PG67 and PG76)

# Gradation Comparison



# APA Rut Depths



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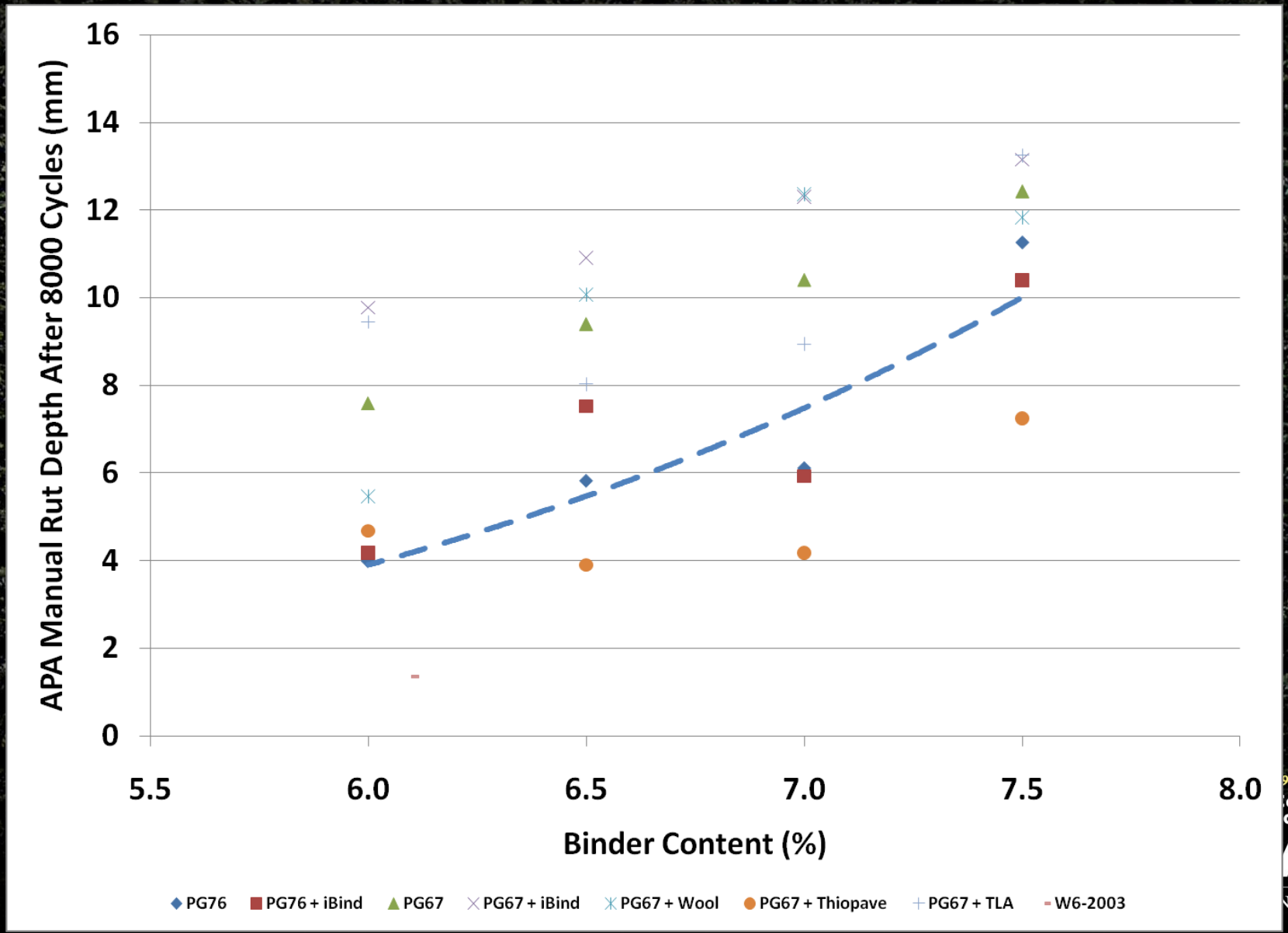
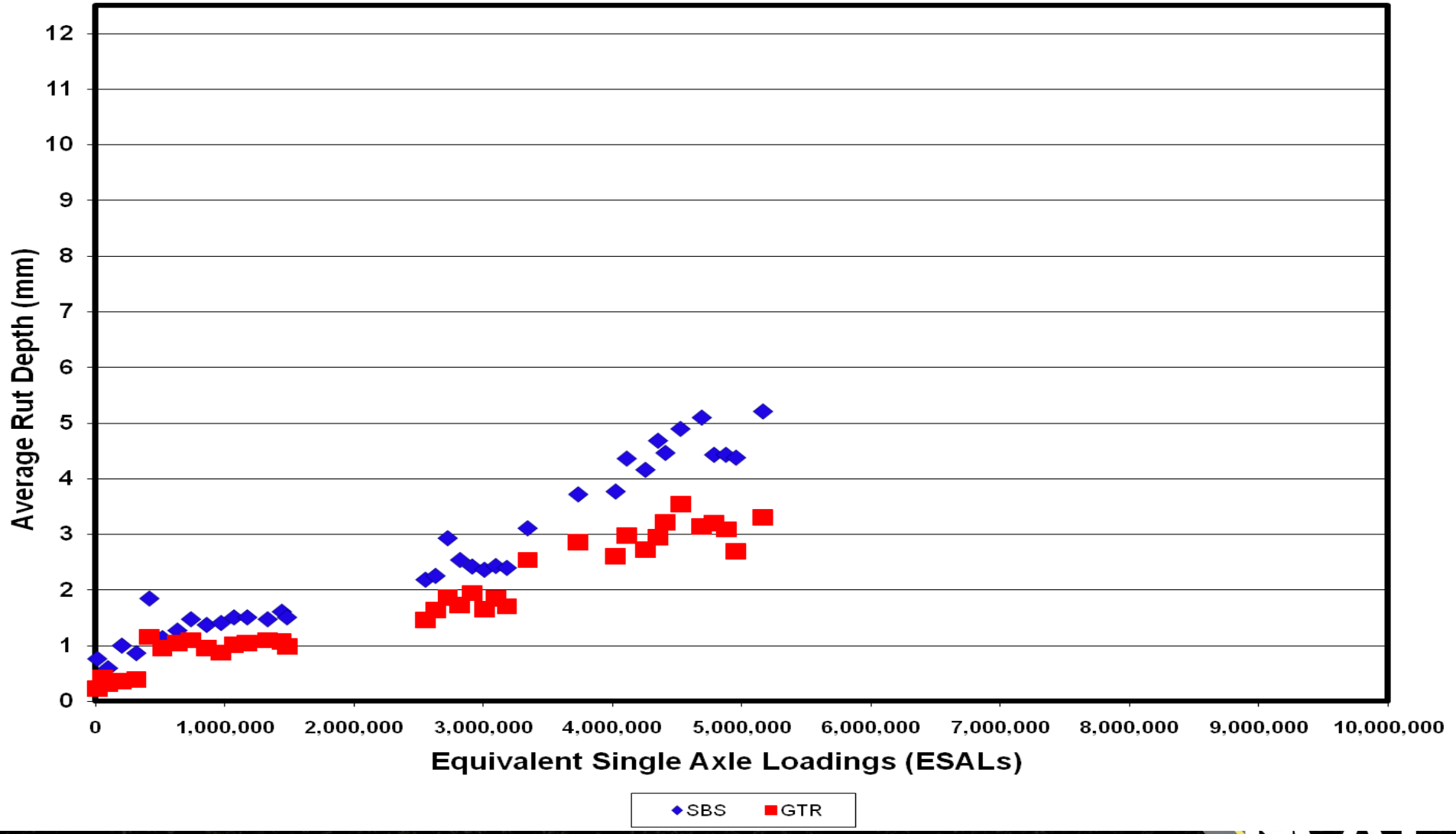


# GTR-Modified PG76-22



# Perpetual Pavement on Soft Clay

- 14” pavement looks good after 17 million ESALs
- 10” pavement recently rehabilitated for 2nd time
  - In need of 1st rehabilitation after 10 million ESALs
  - 5” mill/inlay failed again after 3 ½ million ESALs
  - 2 ½ million ESALs on 5-3/4” high polymer inlay

# Thin Perpetual Pavements

- 24 inch perpetual (original) Track foundation
  - Designed with ‘93 Guide for MANY cycles
- Two 9 inch thick structural sections in 2003
  - ‘93 Guide predicted failure near 10M ESALs
  - 27M ESALs to date (perpetual expectation)
- 15 inches of wasted (excess) thickness?

- 10 inches not enough on N8 soft subgrade

# PG67 in 2006 High RAP Surfaces

- 7 section high RAP study (including control)
- 45% RAP with PG52, PG67, PG76, PG76s
- Cracking, raveling in PG76s section
- Minor cracking, raveling in PG76 section
- Similar performance in PG52 and PG67

# Benefits of RAP

- Cost
- Quality
- Convenience
- Performance

# RAP Economics

- Aggregate: $15/ton
- Asphalt: $500/ton
- Mix Design AC Content: 5%

$15 x .95 = $14.25

$500 x .05 = $25.00

Total Mix = $39.25

# RAP Economics

- Aggregate: $15/ton
- Asphalt: $500/ton
- RAP: $5/ton (5% AC in RAP)
- Mix Design
  - AC Content: 5%
  - RAP content 20% (19% rock, 1% AC)

$15 x .76 = $11.40
$500 x .04 = $20.00
$5 x .20 = $ 1.00
Total Mix = $32.40

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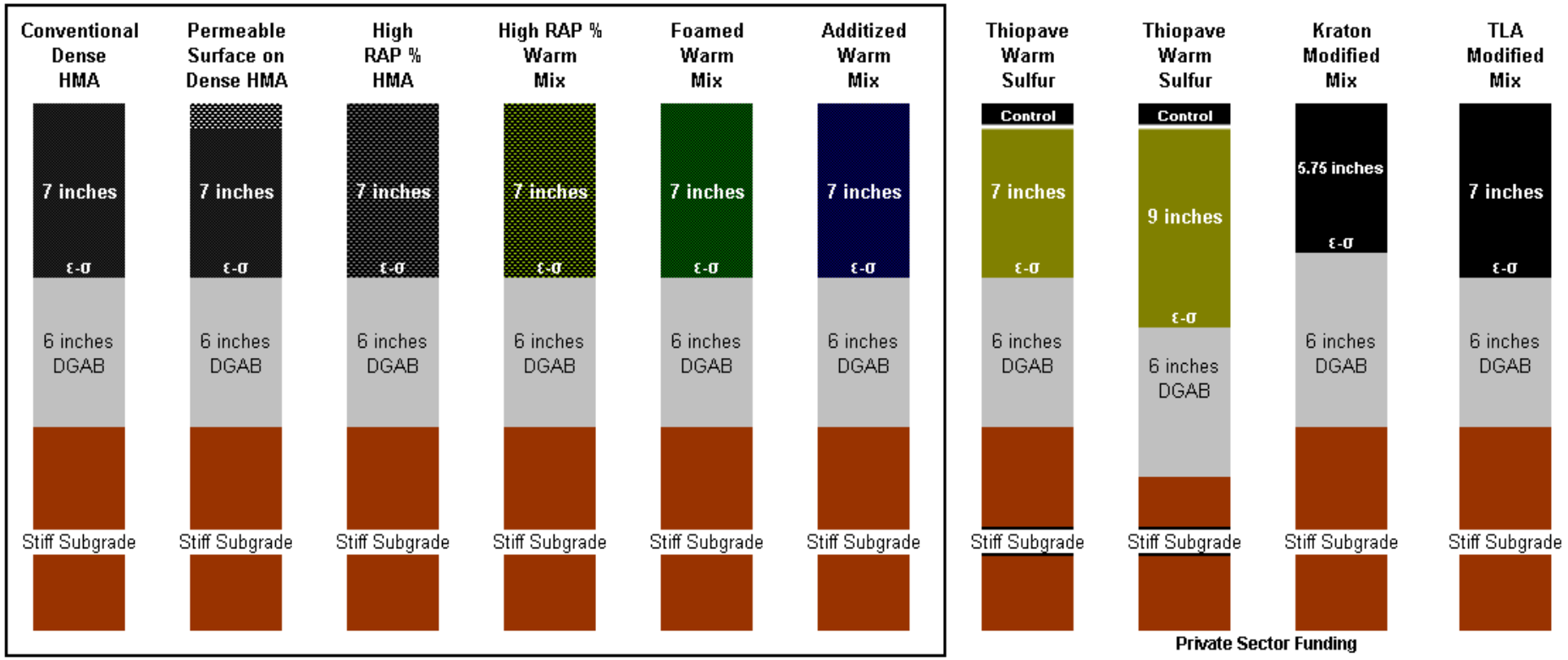
# RAP Economics

- Virgin Mix: $39.25/ton
- Recycled Mix: $32.40/ton

@20% RAP, Savings = 17%

# Fractionation

# 2009 Group Experiment (+)



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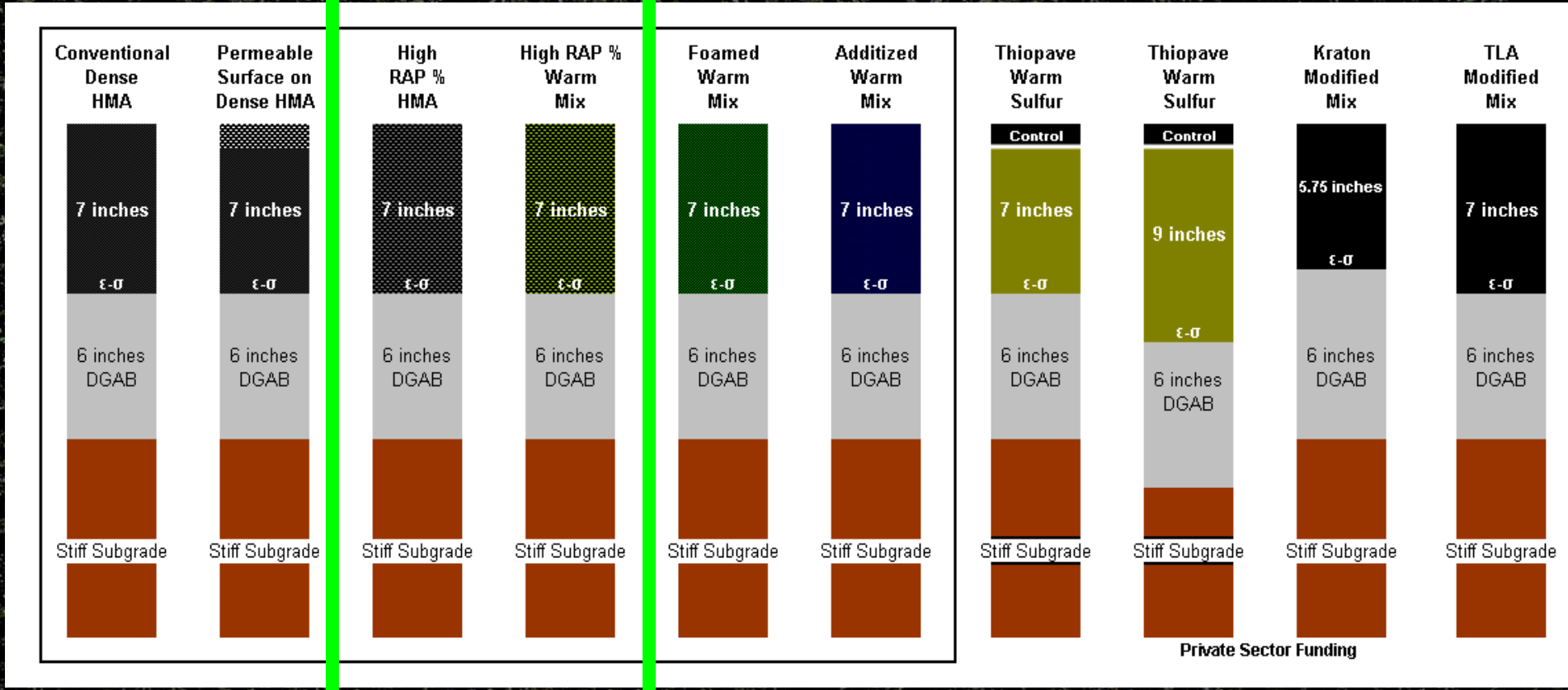
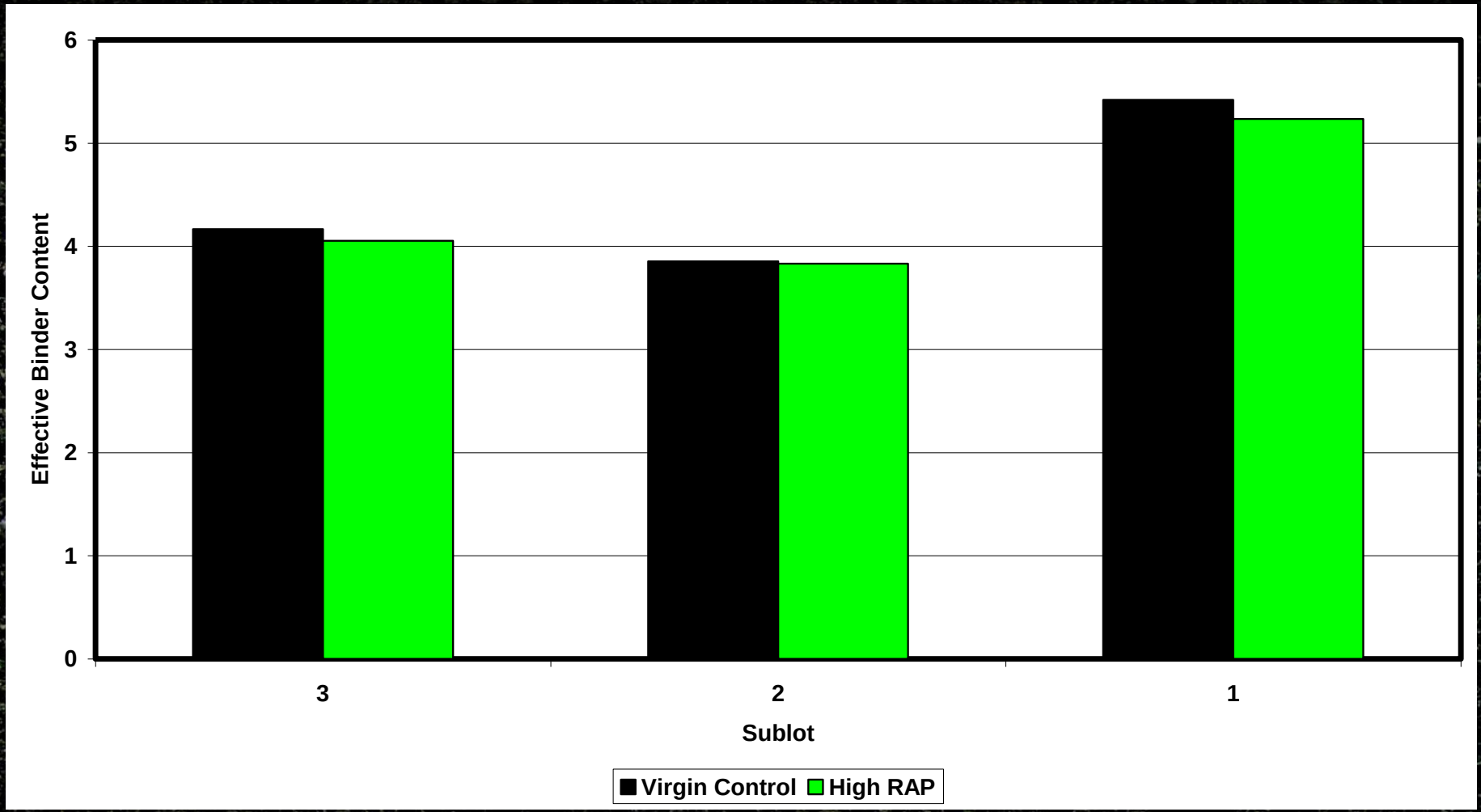
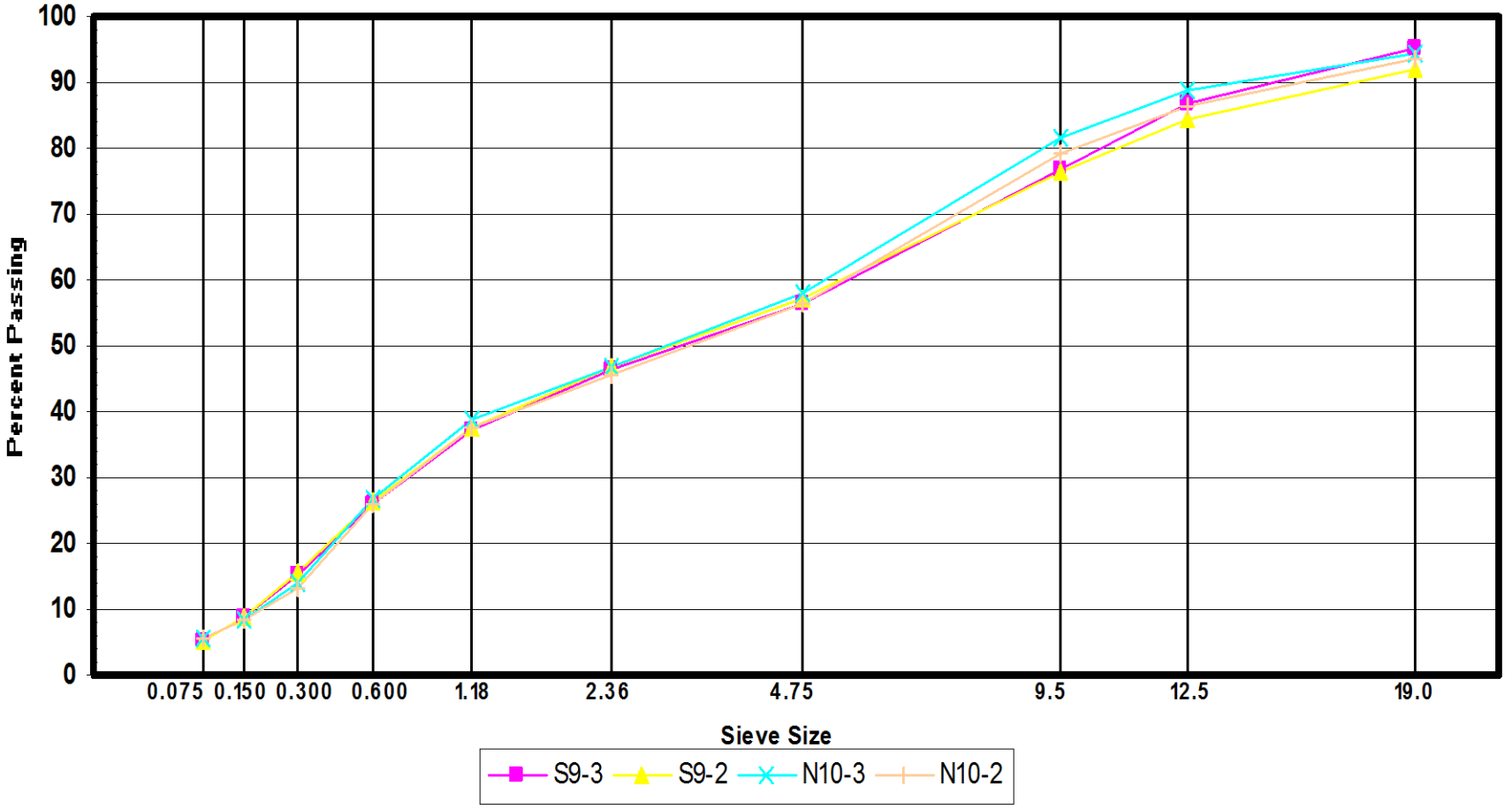


# Effective Asphalt Contents



# Gradations of 50% RAP Base/Binder



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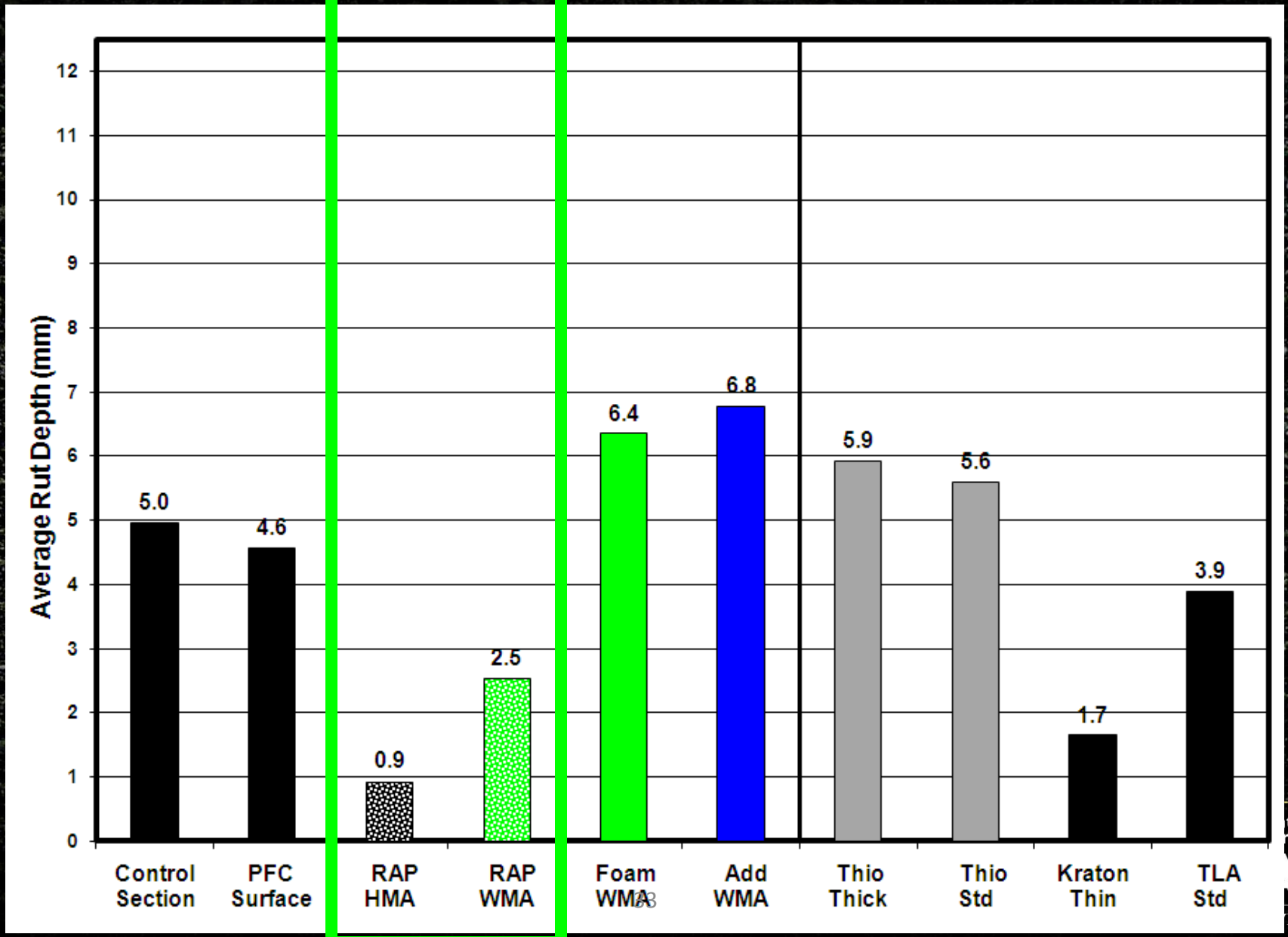

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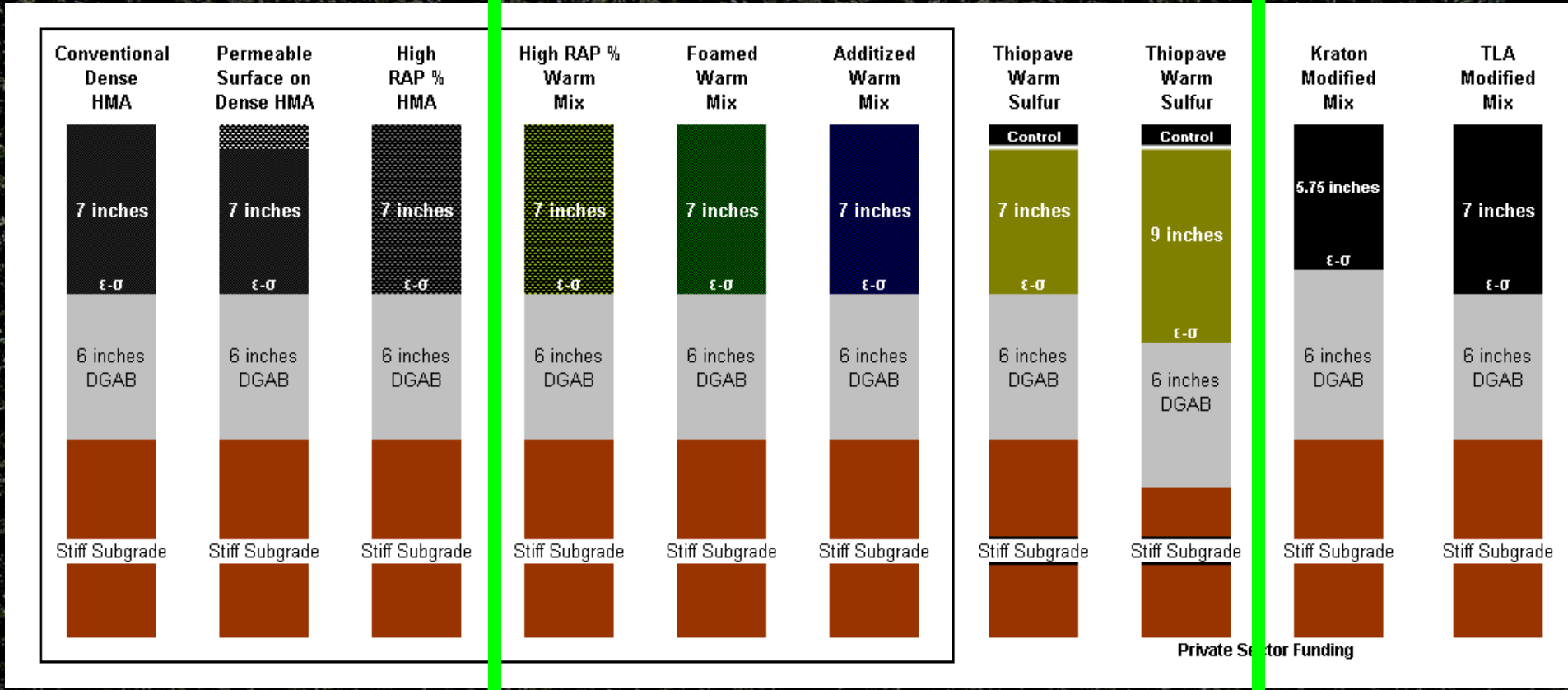
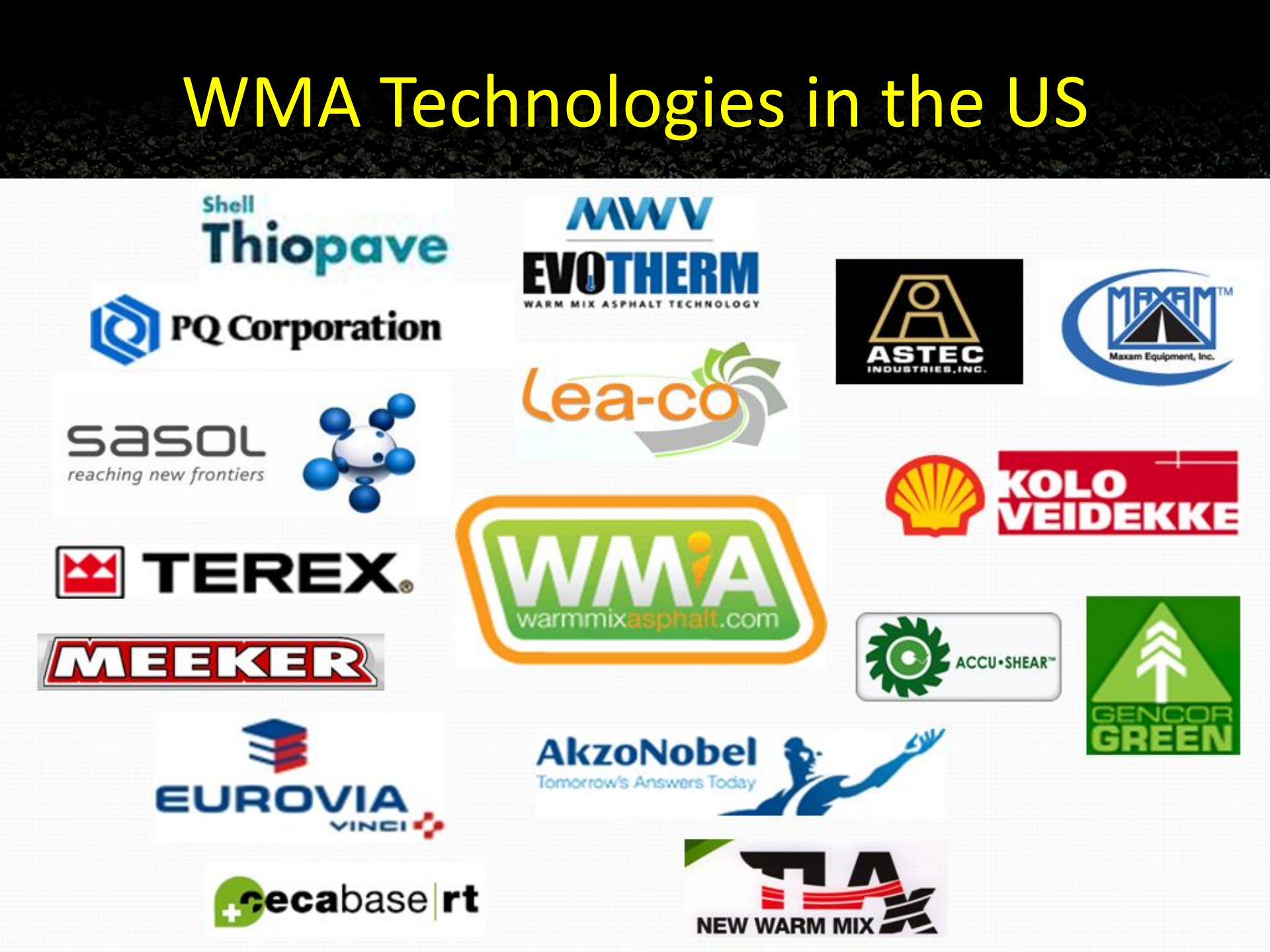


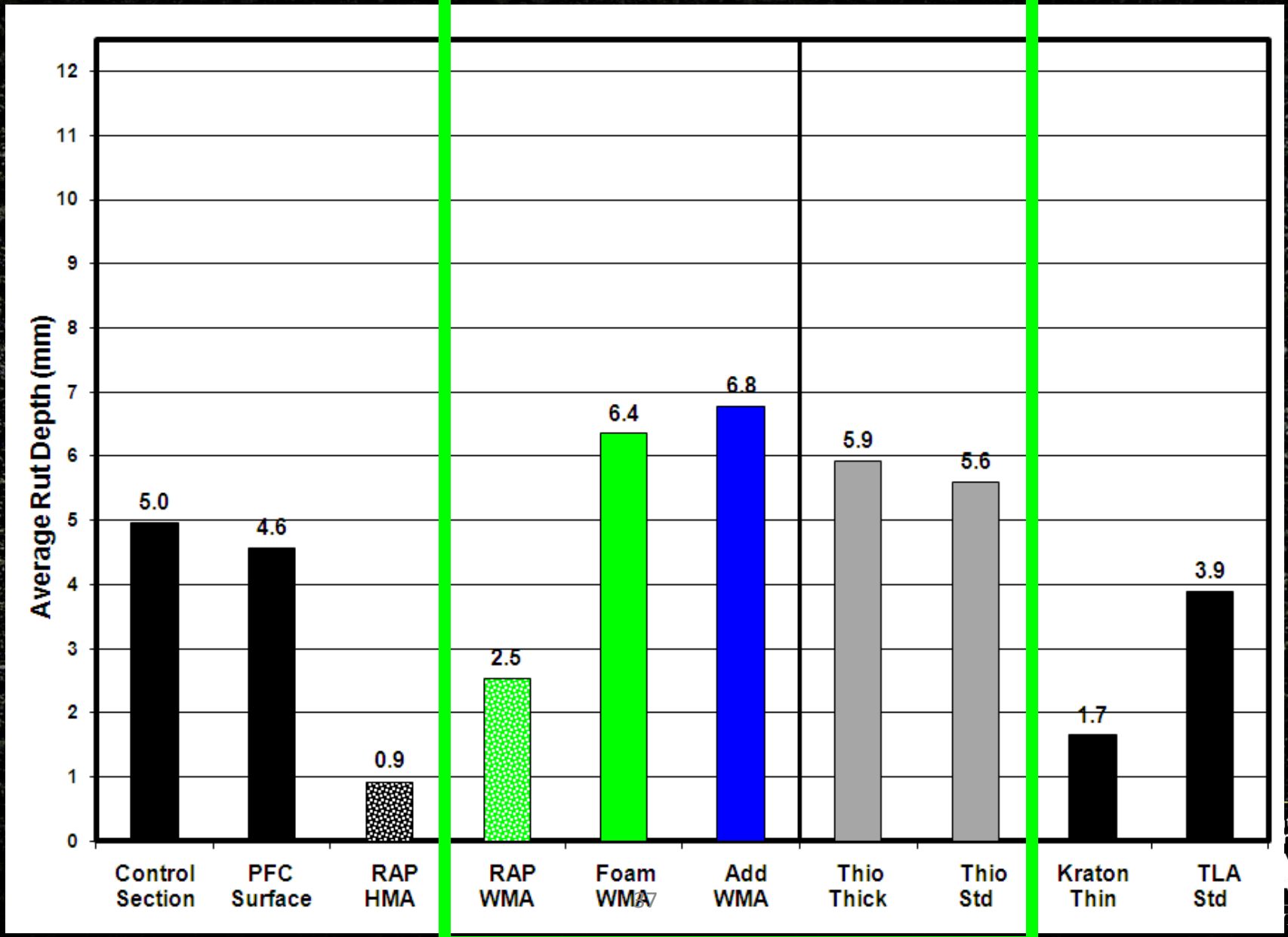
# WMA Technologies in the US



# Benefits of WMA

- Lower energy cost
- Less binder hardening in plant
- Lower binder absorption into aggregate
- Reduced emissions (plant and roadway)
- Longer hauling distance
- Better compaction on roadway
- No field performance issues identified

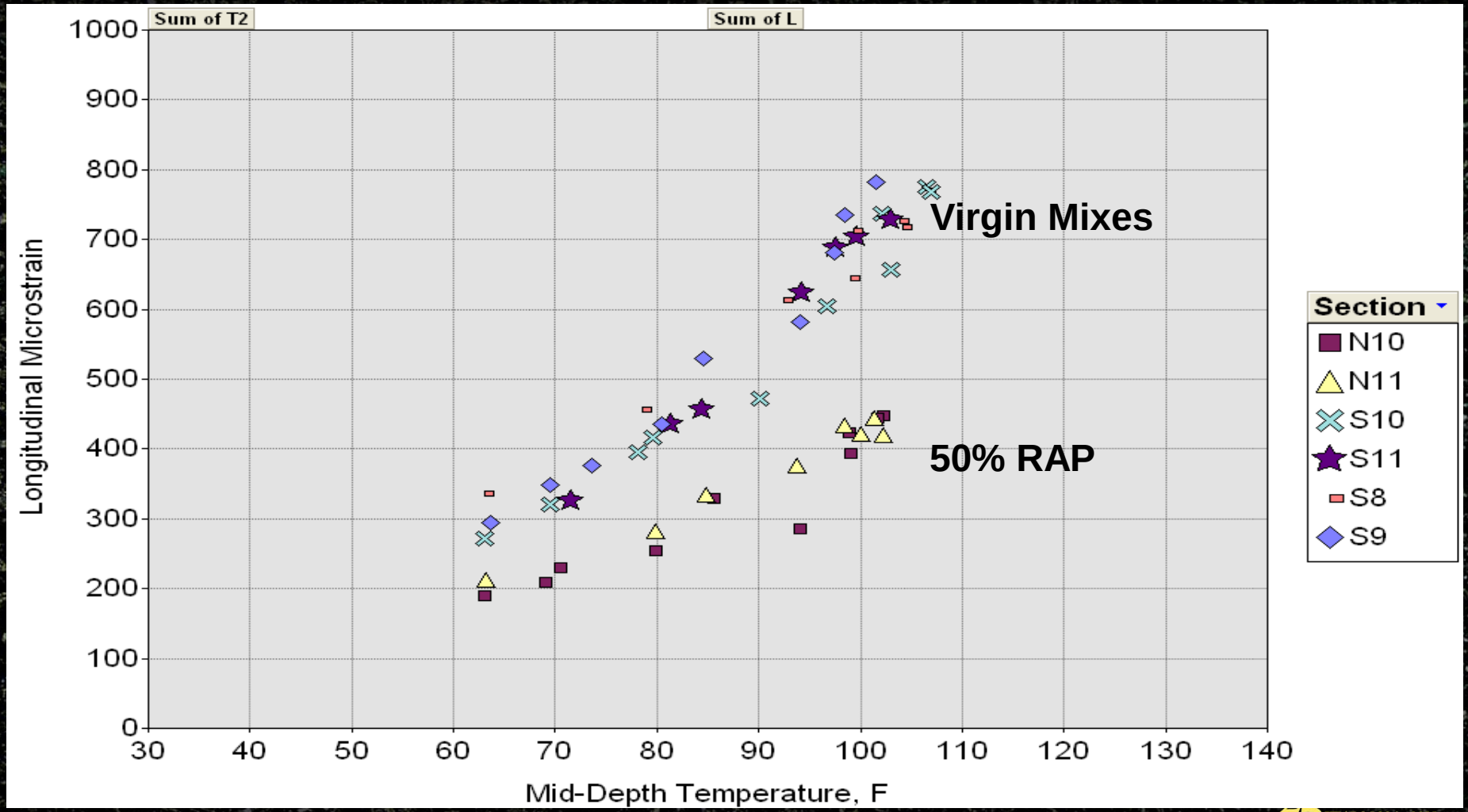
# 2009 Group Experiment (+)



# “Volumetrics Plus” for WMA in 9-43

- Mixing/compaction °F via additive provider
- Lab foamers recommended (technology neutral)
- Compactability (N92comp-30F / N92comp ≤ 1.25)
- T283 (≥ 80 percent) and coating test for moisture
- FN with criteria as function of traffic
- Mix °F above PG grade of recycled materials

# GE Strain Response



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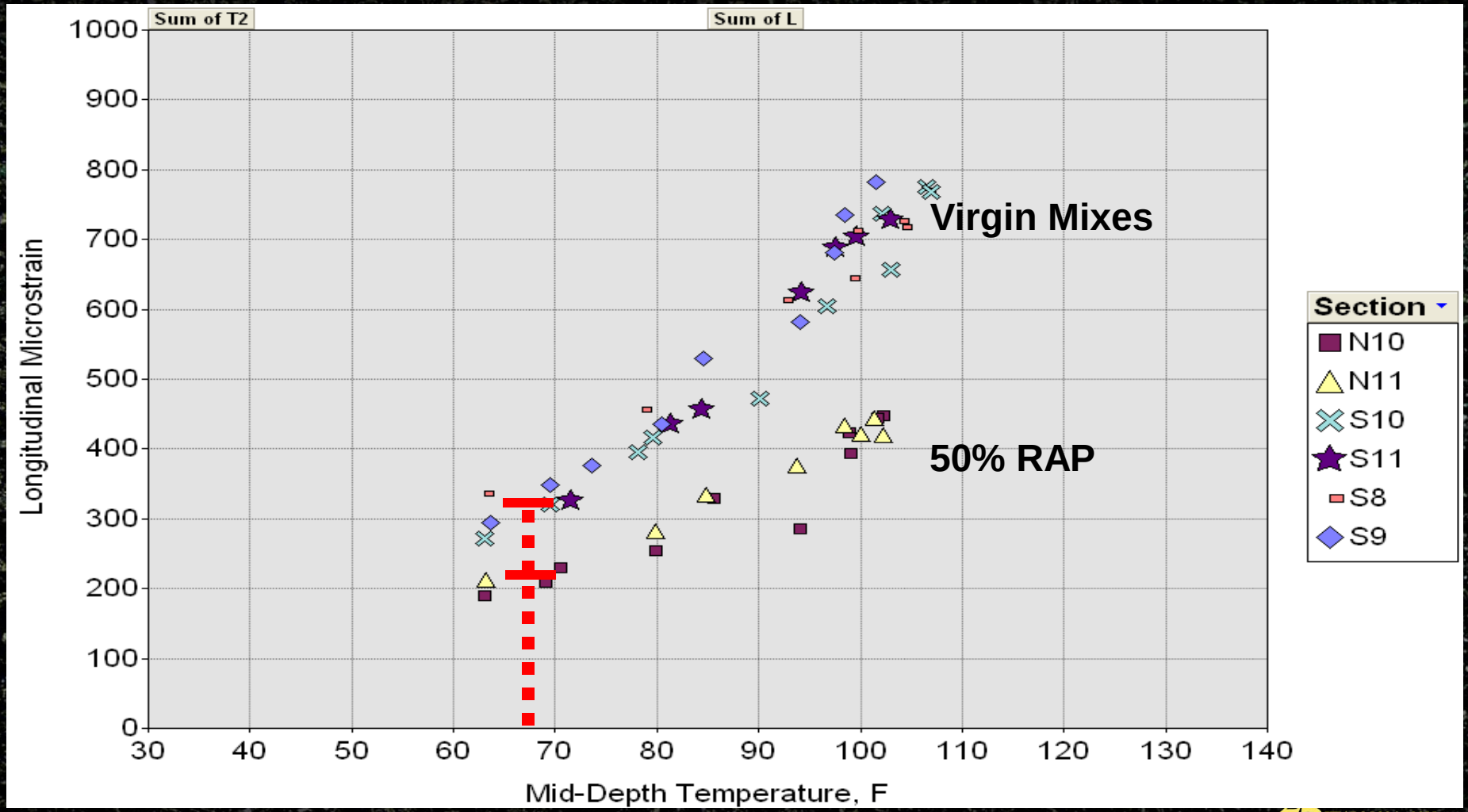

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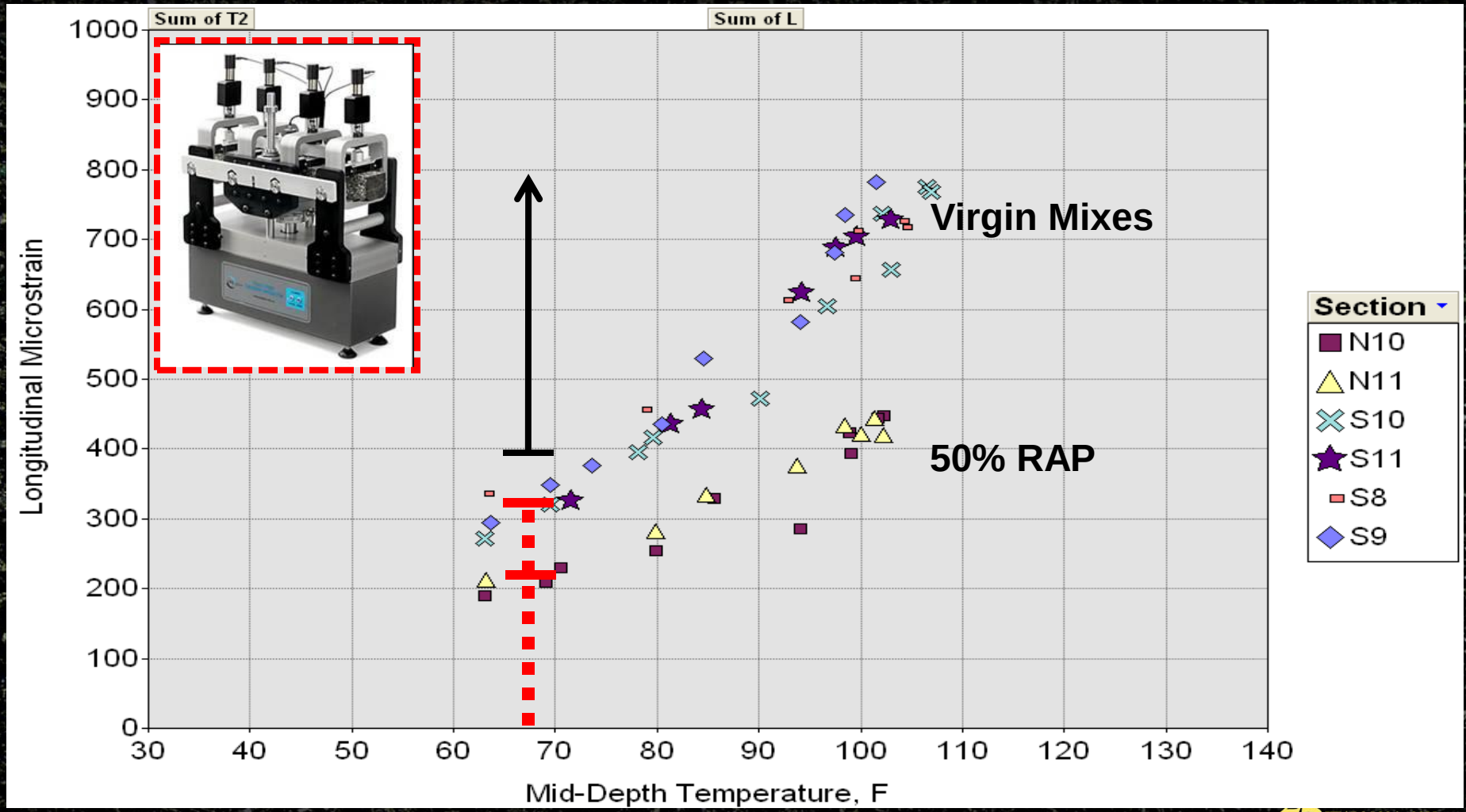
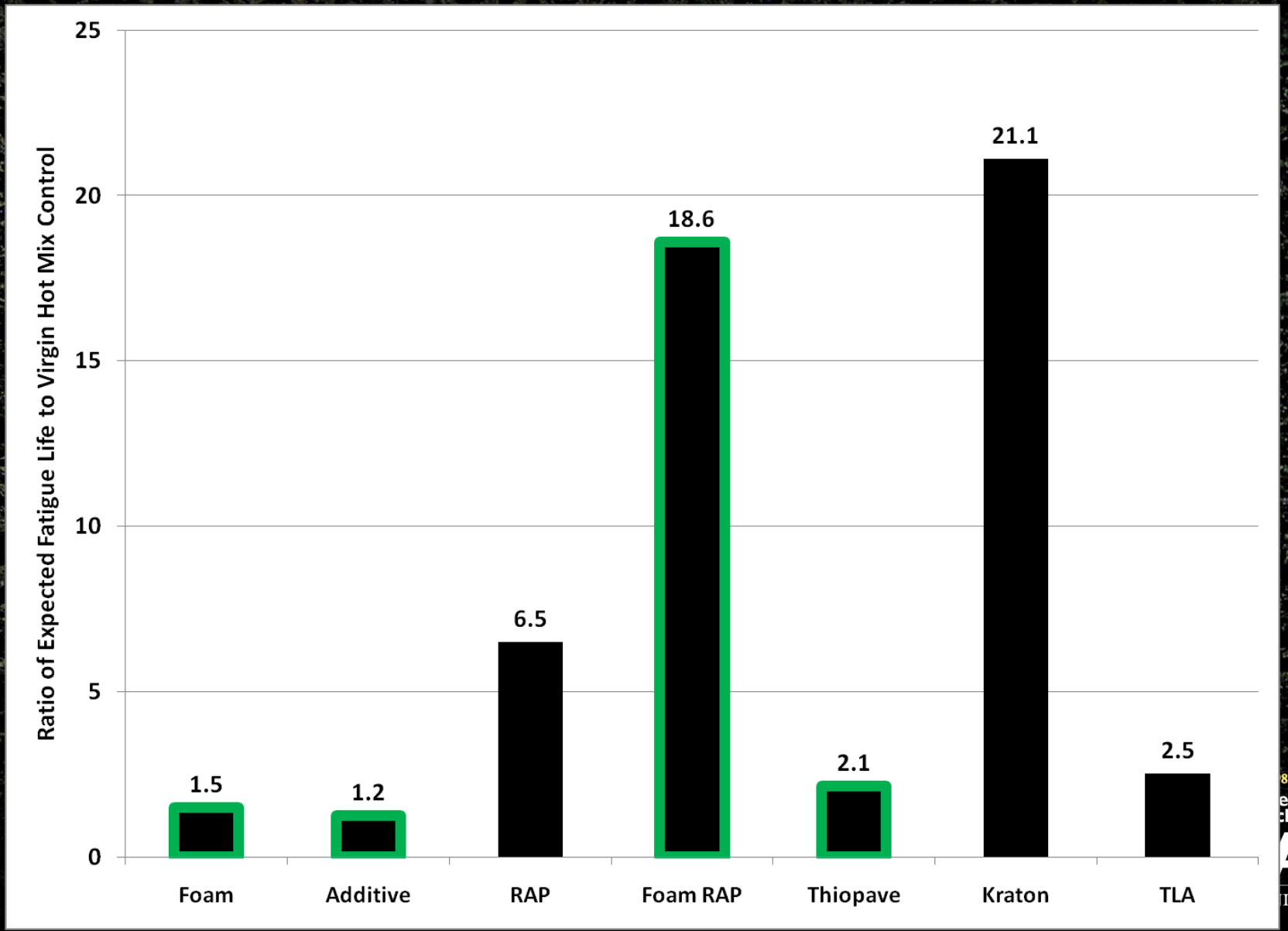


# Performance Expectations



# Benefits of RAP+WMA

- Minimizes blended binder aging (stiffness)
- Superheating eliminates baghouse condensation
- Ensures virgin aggregates are properly dried
- Allows plant production rate to increase
- Optimizes economic and environmental benefit
- RAP improves TSRs in WMA (some states require)

# Indirect RAP Characterization

- Dynamic Modulus

- Bending Beam Rheometer

- Dynamic Shear Rheometer Torsion Bar

- Indirect Tension Relaxation Modulus

# www.pavetrack.com

NCAT Pavement Test Track

Performance

PAVE

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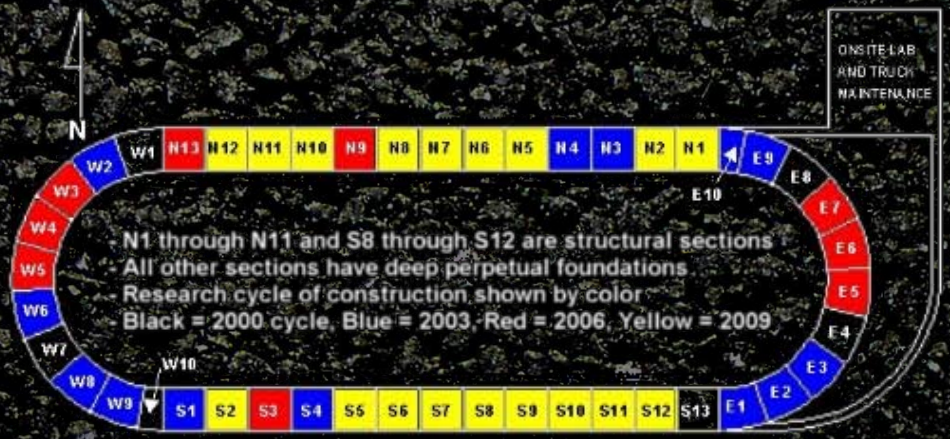
Performance data for each section can be viewed by positioning your mouse over the section in question and left-clicking. Based on feedback from our research sponsors, the performance reports have been revised to include crack maps. The 2009 performance reports are now a fully integrated and active part of the web presentation.




HOTLINKS to download PAVE reports, review upcoming NCAT training courses, query historical weather data, view current color radar or preview local forecast.

1,439,922 ESALs as of 2300 hours on December 5.

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# Web Performance Reports

3/22/2011

Quadrant: E
Section: 7

**Surface Mix and Materials**

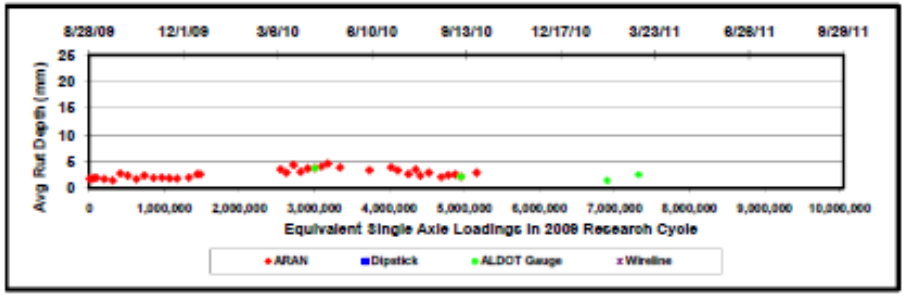
| | |
|---|---|
| Year of Completion: | 2006 |
| HMA Design Methodology: | Superpave |
| Specified Binder: | PG76-22s |
| Surface Mix Stockpile Materials: | Gm/Lms/Gnd (45% RAP) |

**Structural Buildup Information**

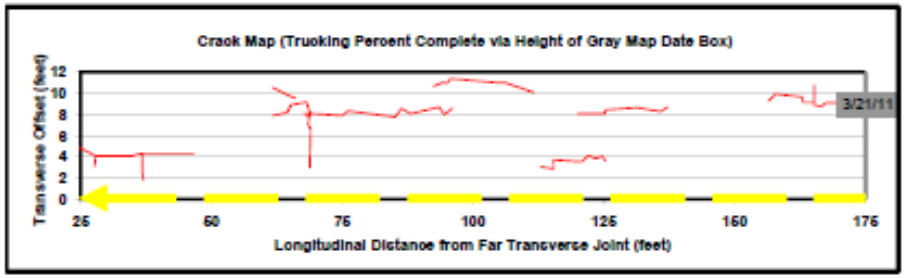
| | |
|---|---|
| Study HMA (in): | 2 |
| Total HMA (in): | 24 |
| Base Material: | Granite |
| Subgrade: | Stiff |

Research Objective: RAP Mix Construction/Performance w/ Sasobit

**Preliminary Field Performance Data**





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# Questions ?