



Multiple Stress Creep Recovery (MSCR): Binder Selection and Lessons Learned

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Andy Cascione
Flint Hills Resources, LP

Past Asphalt Binder Specification

- Grading System Based on Climate

PG 58 - 28

Performance
Grade

Average 7-day
max pavement
design temp

Minimum
pavement
design
temperature

MSCR Asphalt Binder Specification

- Grading System Based on Climate and Traffic

PG 58H - 28

Performance
Grade

Average 7-day
max pavement
design temp

**Traffic
Level**

Minimum
pavement
design
temperature

MSCR Asphalt Binder Specification

Letter Designation	Traffic Level
S	Standard
H	Heavy
V	Very Heavy
E	Extreme

Specification Differences

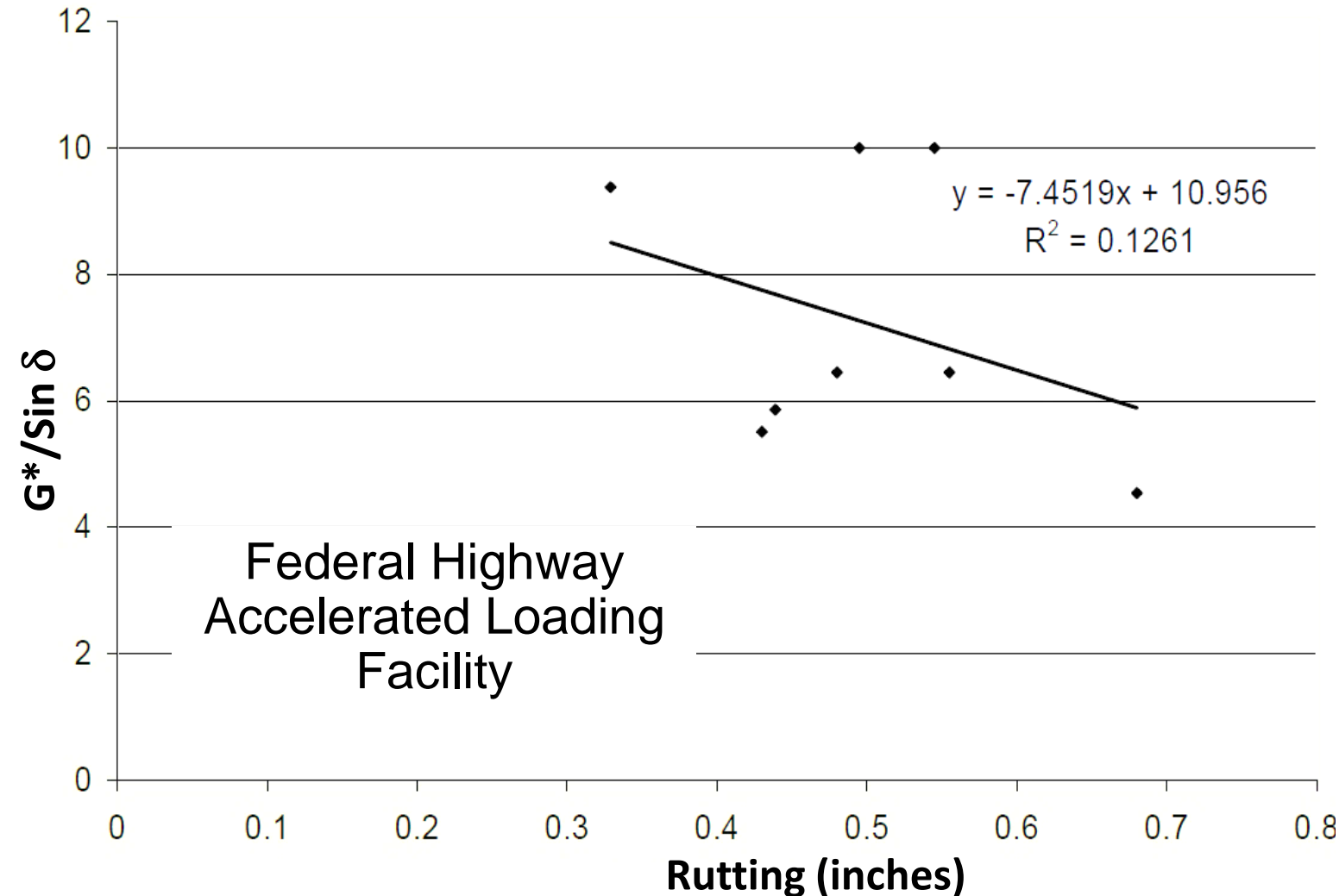
- Past Asphalt Binder Specification
 - The greater the temperature spread, the greater the modification level

- MSCR Asphalt Binder Specification
 - Temperature spread doesn't change
 - Rather, the greater the traffic level “letter”, the greater the modification level

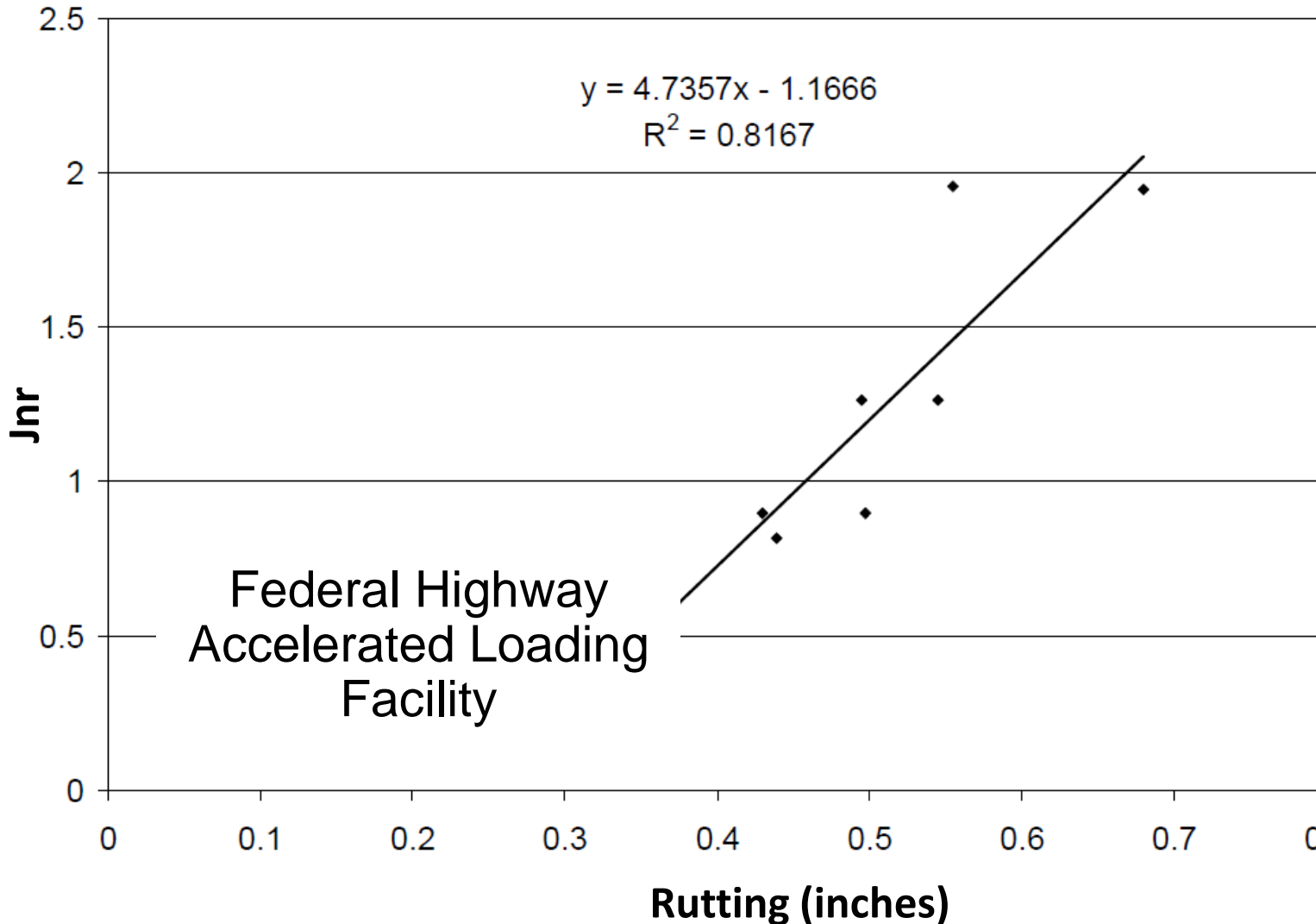


Why Change to the MSCR Specification?

G*/Sinδ - Poor Rutting Correlation



Jnr - Improved Rutting Correlation

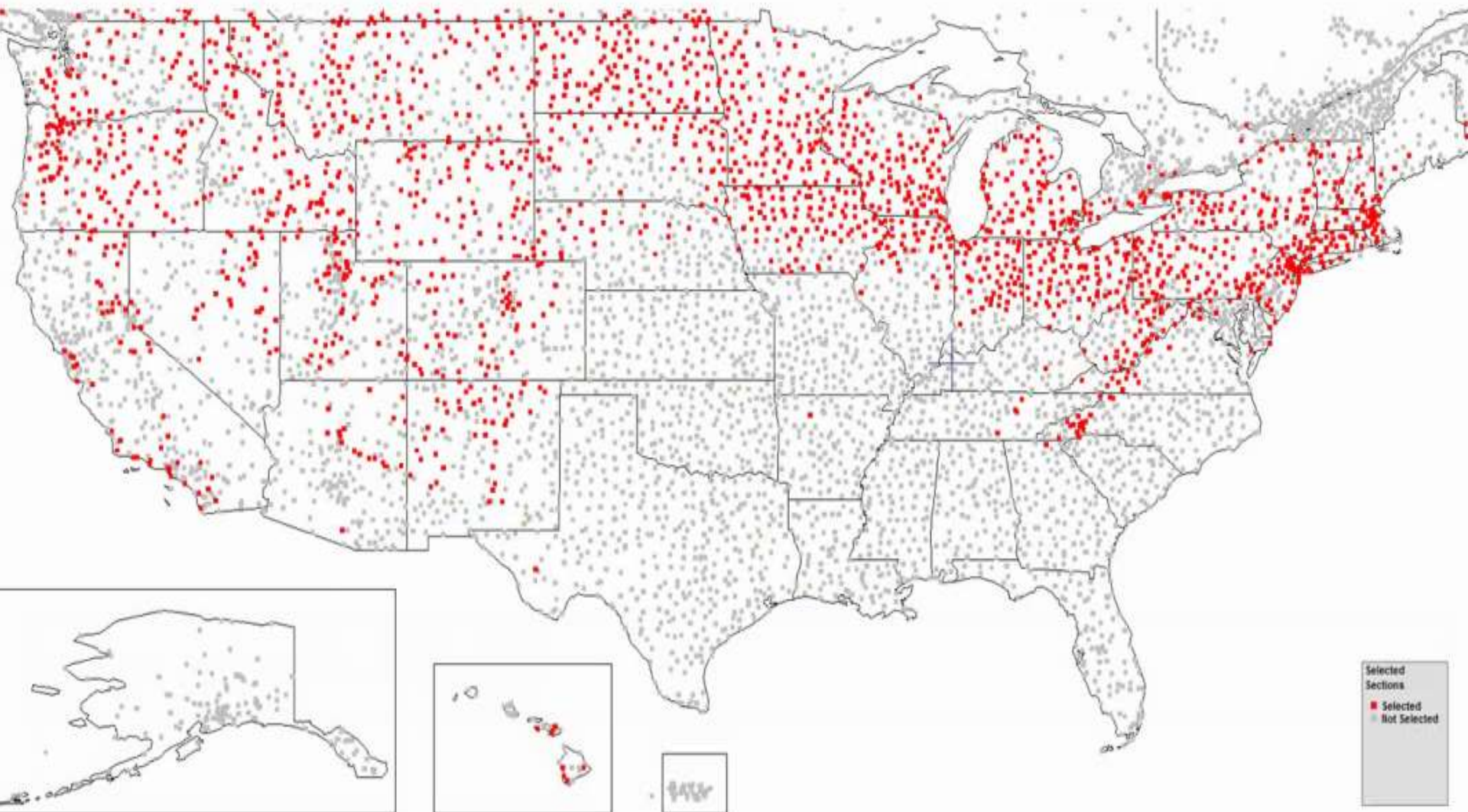




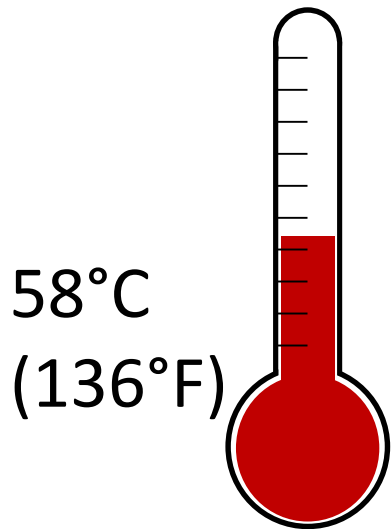
Development of the MSCR Test

- Still use the DSR
- Test at actual pavement temperature
- No temperature bumping
- Change the specification value rather than the test temperature

58°C (98% Confidence)

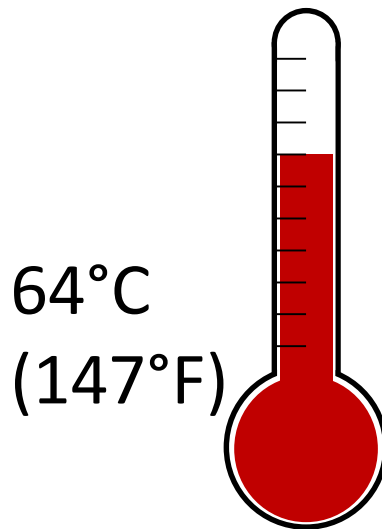


Past Temperature Grade Bumps



PG 58-28

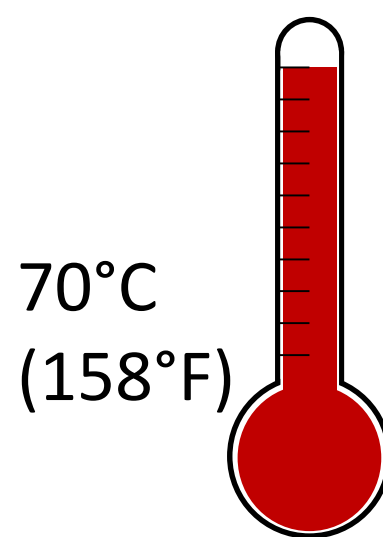
■ Standard traffic



PG 64-28

1 Bump

■ Slow or heavy traffic



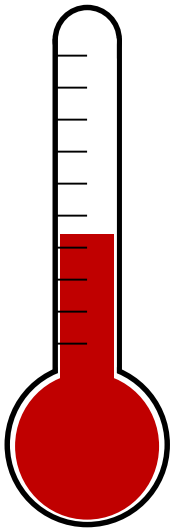
PG 70-28

2 Bumps

■ Stationary or high volume traffic

MSCR Traffic Bumping

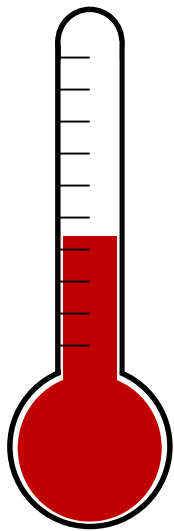
58°C



PG 58S-28

■ Standard traffic

58°C

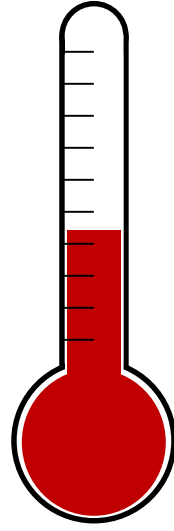


PG 58H-28

1 Bump

■ Heavy traffic

58°C

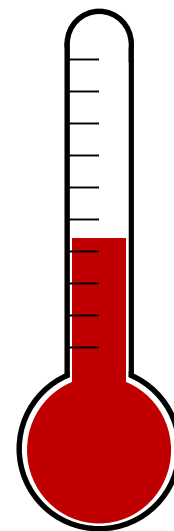


PG 58V-28

2 Bumps

■ Very heavy traffic

58°C

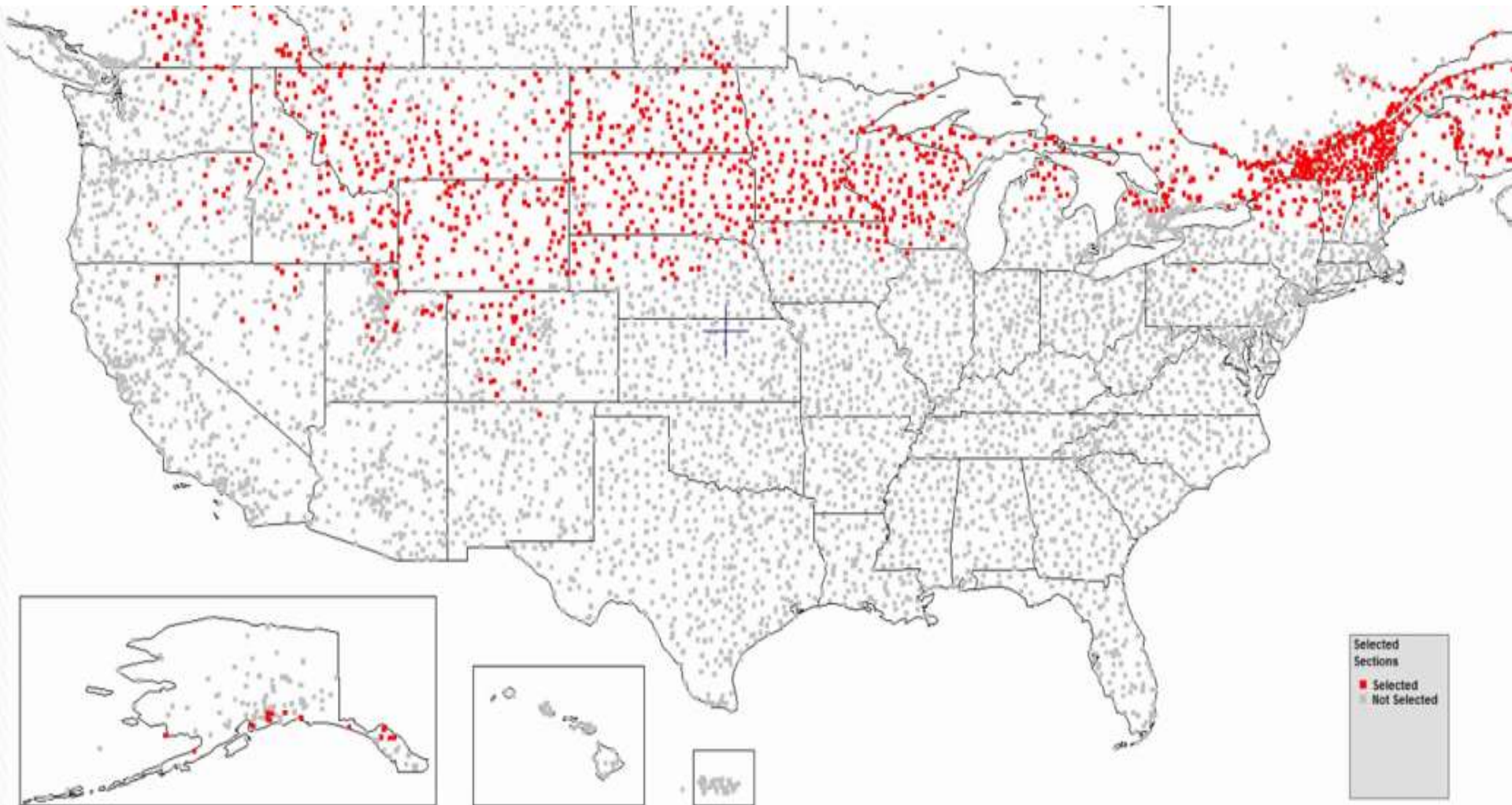


PG 58E-28

3 Bumps

■ Extreme traffic

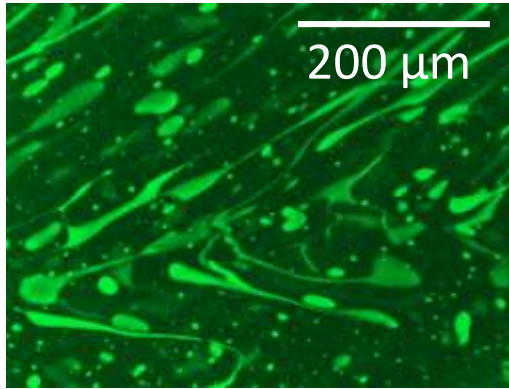
-34°C (98% Confidence)



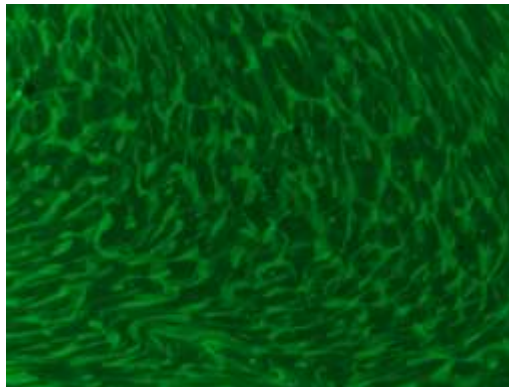
Combined States MSCR Specifications

Letter	Traffic Level	Jnr Value	% Recovery
58S – 28	< 3 M ESAL's	< 4.5 kPa ⁻¹	
58H – 28	> 3 M ESAL's	< 2.0 kPa ⁻¹	≥ 30%
58V – 28	> 10 M ESAL's	< 1.0 kPa ⁻¹	≥ 55%
58E – 28	> 30 M ESAL's	< 0.5 kPa ⁻¹	≥ 75%

Benefit of % Recovery PMAC under Fluorescence Microscope



Unreacted	
% R = 21.0	Jnr = 0.68 Pa ⁻¹



Partially Reacted	
%R = 46.4	Jnr = 0.39 Pa ⁻¹



Fully Reacted	
%R = 58.3	Jnr = 0.31 Pa ⁻¹

Binder Grade Comparisons

This MSCR Grade...

PG 58S – 28

PG 58H – 28

PG 58V – 28

PG 58E – 28

PG 58S – 34

PG 58H – 34

PG 58V – 34

PG 58E – 34

Is close (not equal) to a...

PG 58 – 28

PG 64 – 28

PG 64/70 – 28

PG 70/76 – 28

PG 58 – 34

PG 58 – 34

PG 58/64 – 34

PG 64/70 – 34

Lessons learned with MSCR

- Temperature bumping + traffic bumping
 - Results in over designing an asphalt binder

PG 64V-34 → PG 70 – 34

Lesson's learned with MSCR

- Challenges with JnrDiff
 - The JnrDiff specification was designed to limit stress sensitivity
 - Parameter has high variability (no spec tolerance)
 - AMRL does not certify labs on this parameter
 - Never properly evaluated for -34 binders
 - In fall 2016, the Binder ETG created a task group to investigate
 - Other CSBG DOT's have waived JnrDiff

Summary

- MSCR eliminates bumping the high temperature
- New parameters relate better to pavement rutting
- Selecting the right asphalt binder is only one part of producing long lasting roads
 - Aggregate selection, mix design, hot mix production, and application technique will remain as integral parts for project success



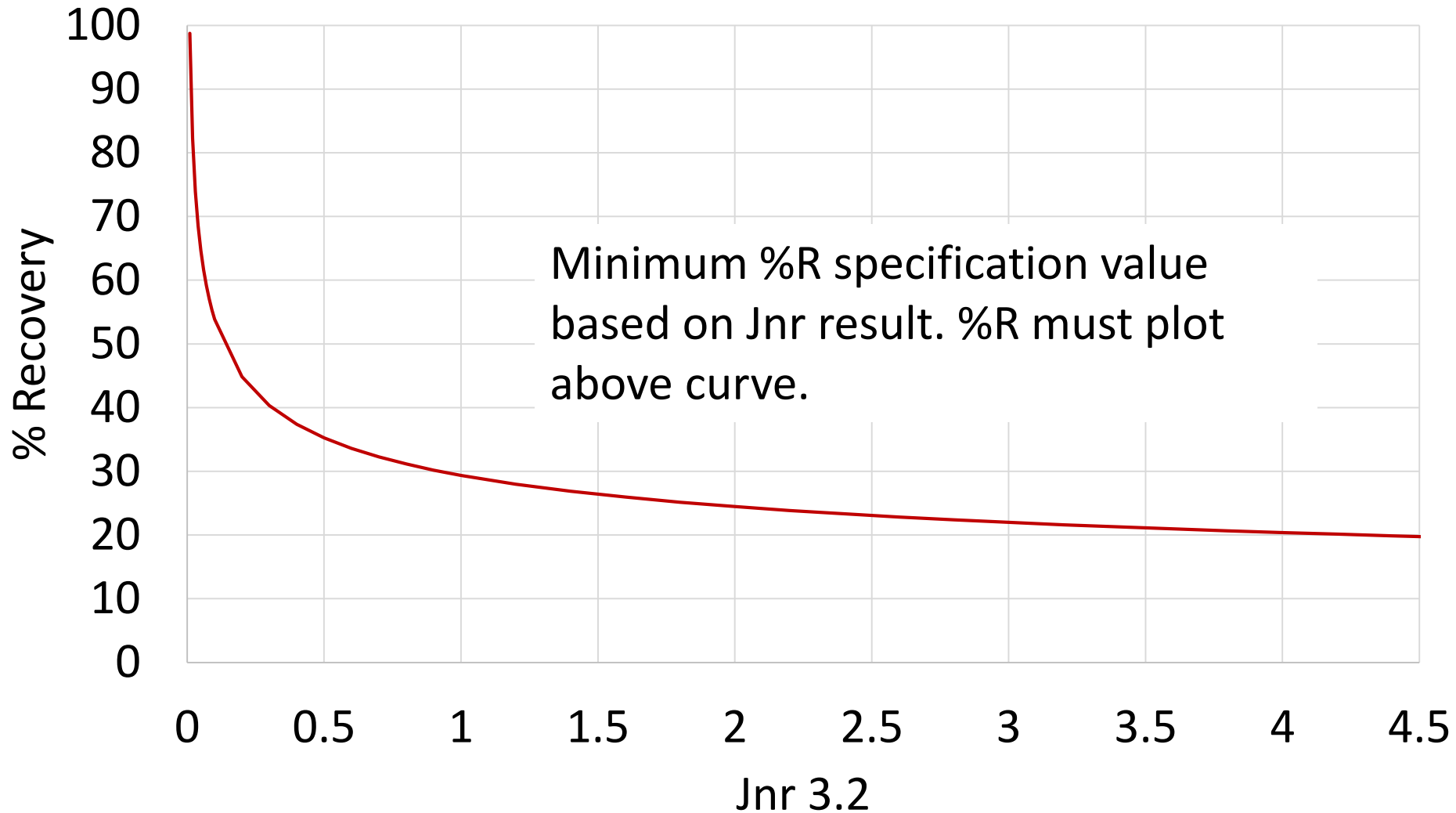
Thank You

Questions ?

Lessons learned with MSCR

- Accounting for RAP
 - Lower the low temperature PG since that's where the failures are on RAP mixes
 - Some States lower the high temperature too
 - Iowa is trying 52°C for RAP mixes
 - All other CSGB States are sticking with 58°C

AASHTO M332 – Jnr vs %R Curve



AASHTO M332 – CSBG Modified

