

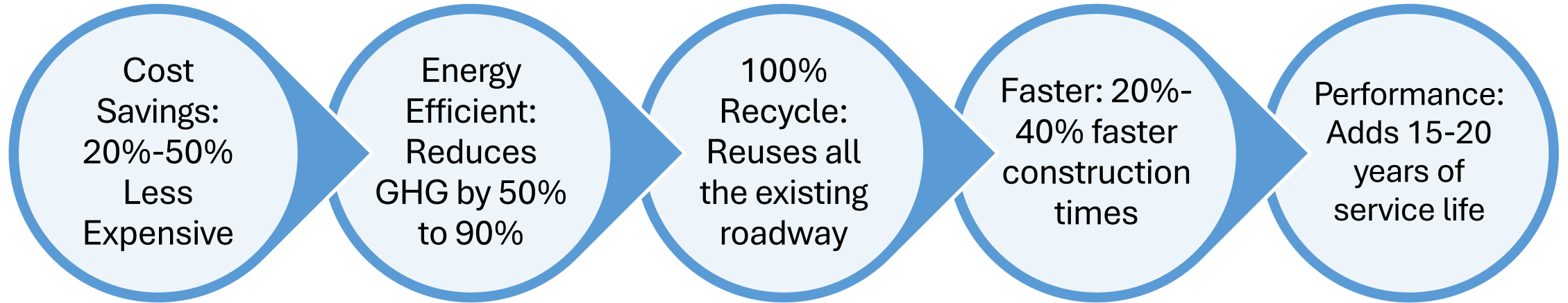
WORKSHOP ON BITUMEN EMULSION TECHNOLOGY

**10TH JUNE 2026
VIENNA, AUSTRIA**

Five-Year Field Performance of Cold Recycling in a Cold Climate

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Ingevity

Benefits of Cold Recycling

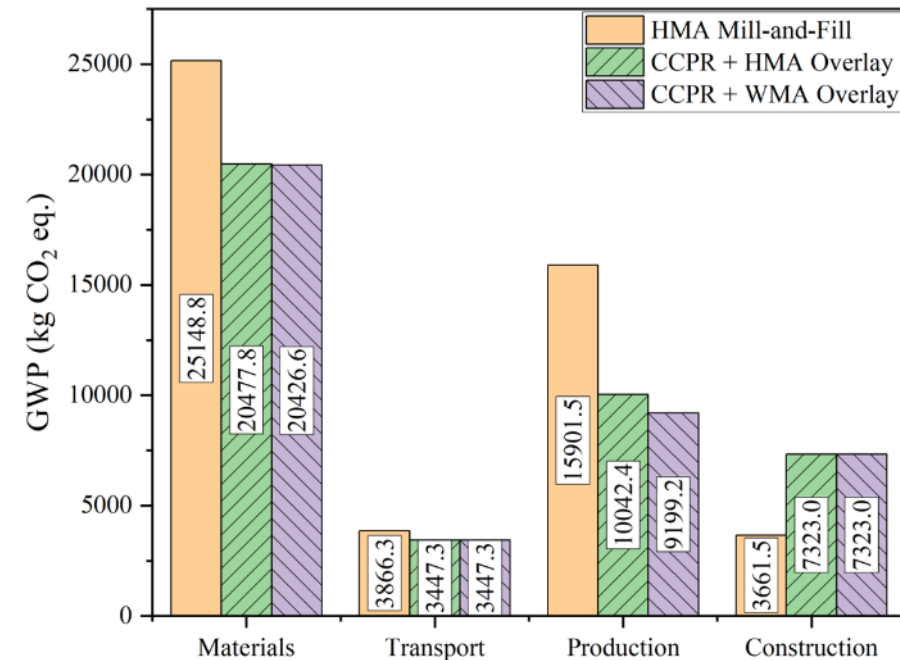
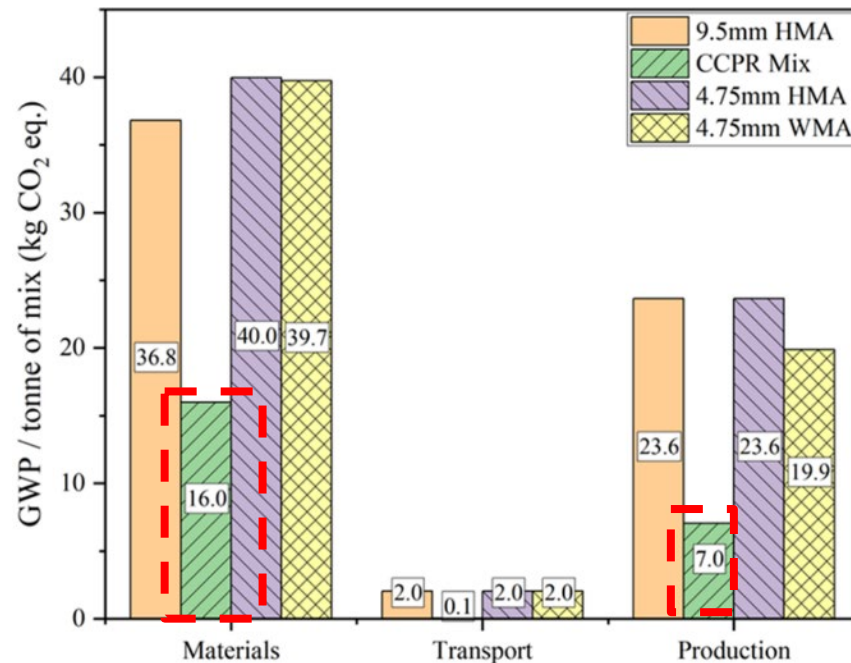


Life Cycle Analysis – Typical Mill/Fill vs Emulsion CCPR with WMA

Cradle-to-laid Analysis: raw material acquisition, transportation, production/construction

Functional unit: 1 lane-km, 3 MESALs over 15 years,

[HMA (7.6 cm)] vs [CCPR (7.6 cm) + HMA/WMA Overlay (2.54cm)]



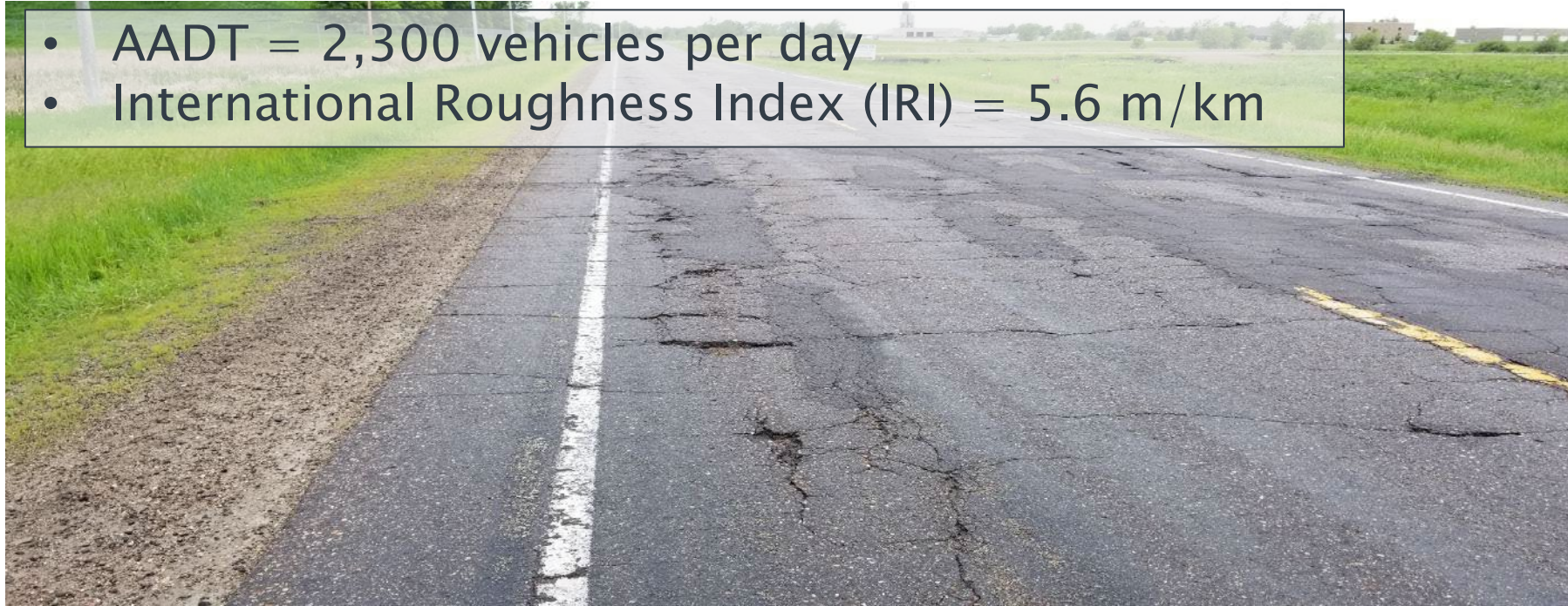
Findings:

- CCPR mix has relatively low GWP (15% savings in GWP vs HMA mill-and-fill)
- Approximately 900 kg CO2 eq. savings in GWP for WMA vs HMA Overlay
- A 84.5% savings in fuel consumption is derived from CCPR production

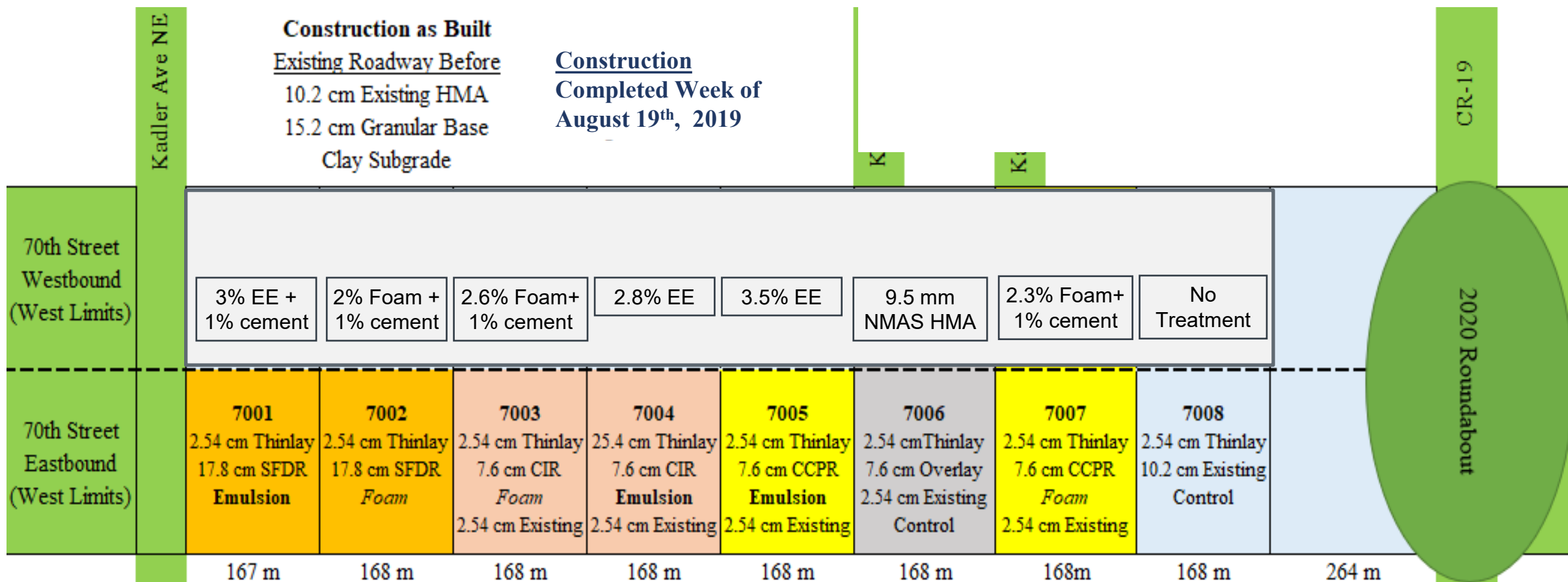
MnROAD 70th Steet Location and Condition



- AADT = 2,300 vehicles per day
- International Roughness Index (IRI) = 5.6 m/km



Test Section Layout and Treatment Types



Cold Central Plant Recycling (CCPR)



Cold In-Place Recycling (CIR)



Full Depth Reclamation (FDR)

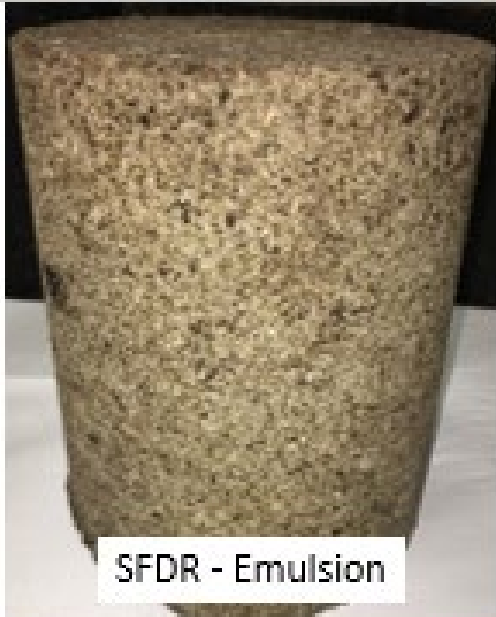


HMA Thinlay

4.75 mm NMAS, 20% RAP, 6.4% PG 58-28



Laboratory Compacted Samples



SFDR - Emulsion



CIR - Emulsion



CCPR - Emulsion



SFDR - Foam



CIR - Foam



CCPR - Foam

Data Collection and Monitoring

- MnROAD has been monitoring these test sections on 70th street since 2019 on a regular basis throughout the last five years.

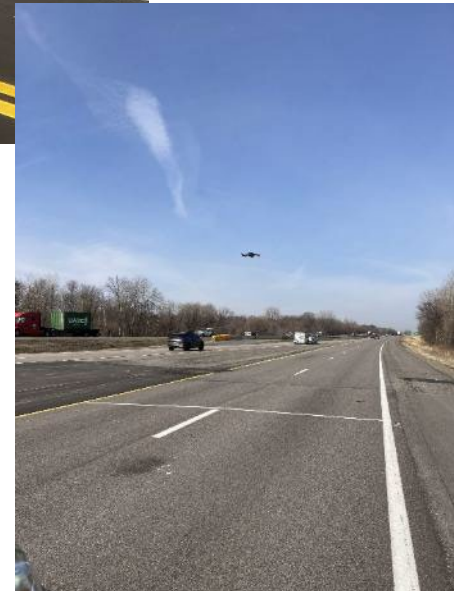
Data Collection using Pathway Services High Speed Profiler

- Ride Quality measured as International Roughness Index (IRI)
- Rutting

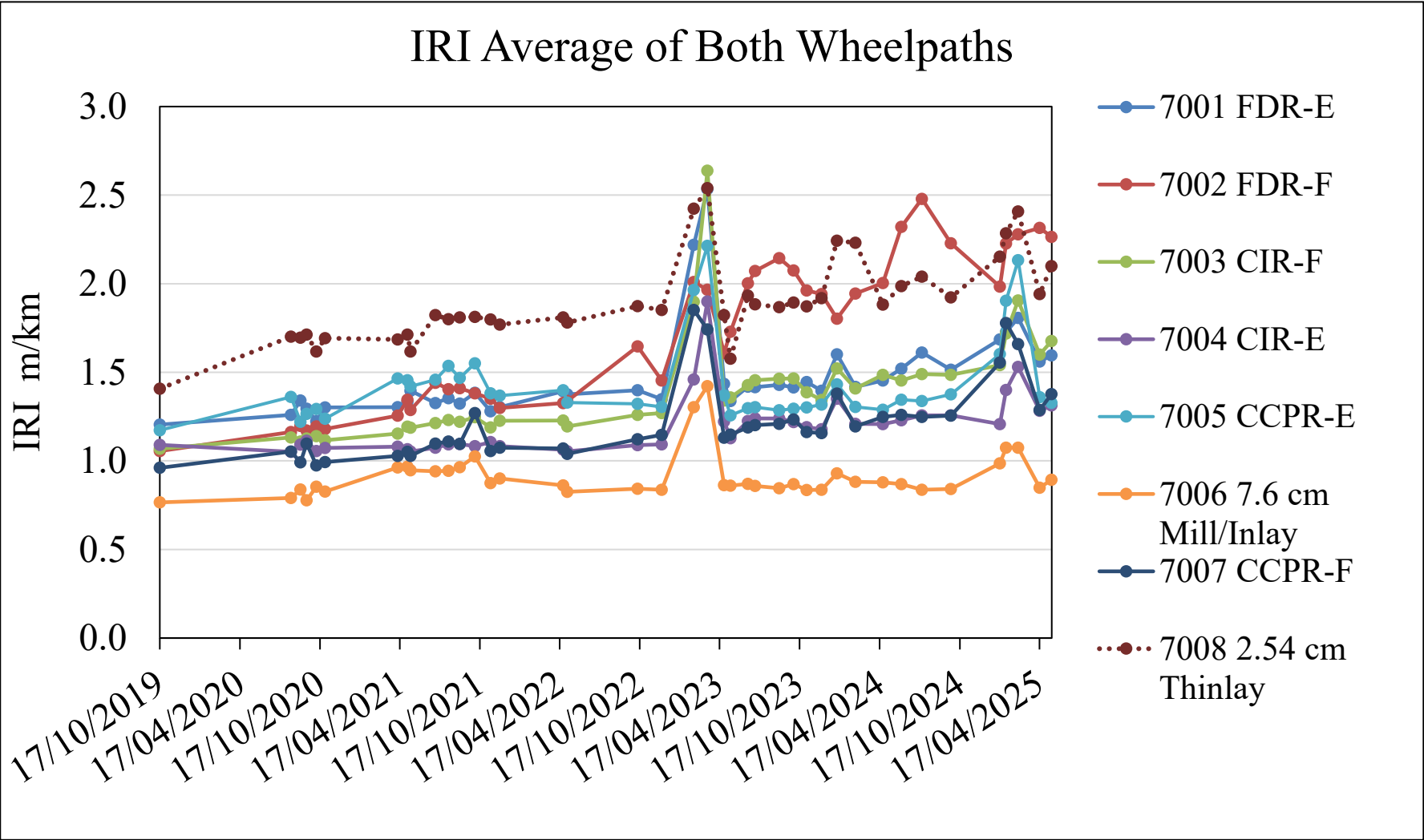
Data Collection using visual distress surveys

- Cracking

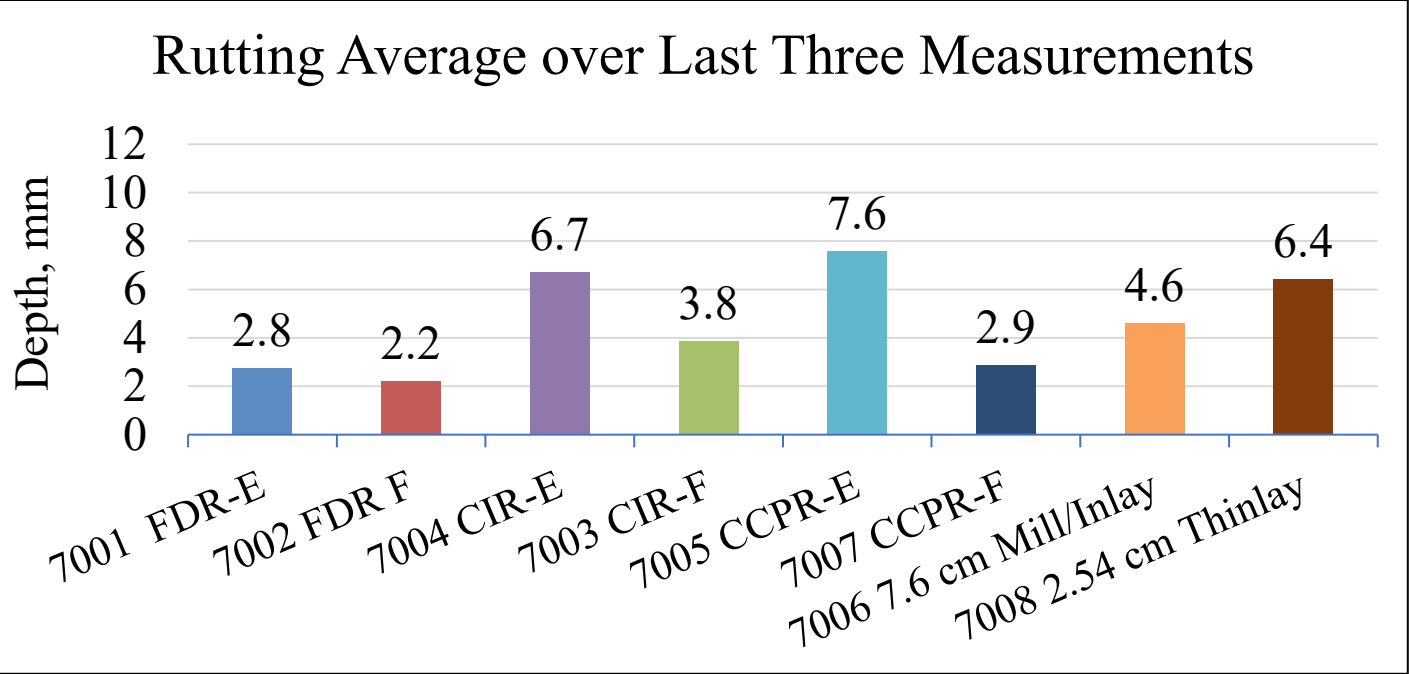
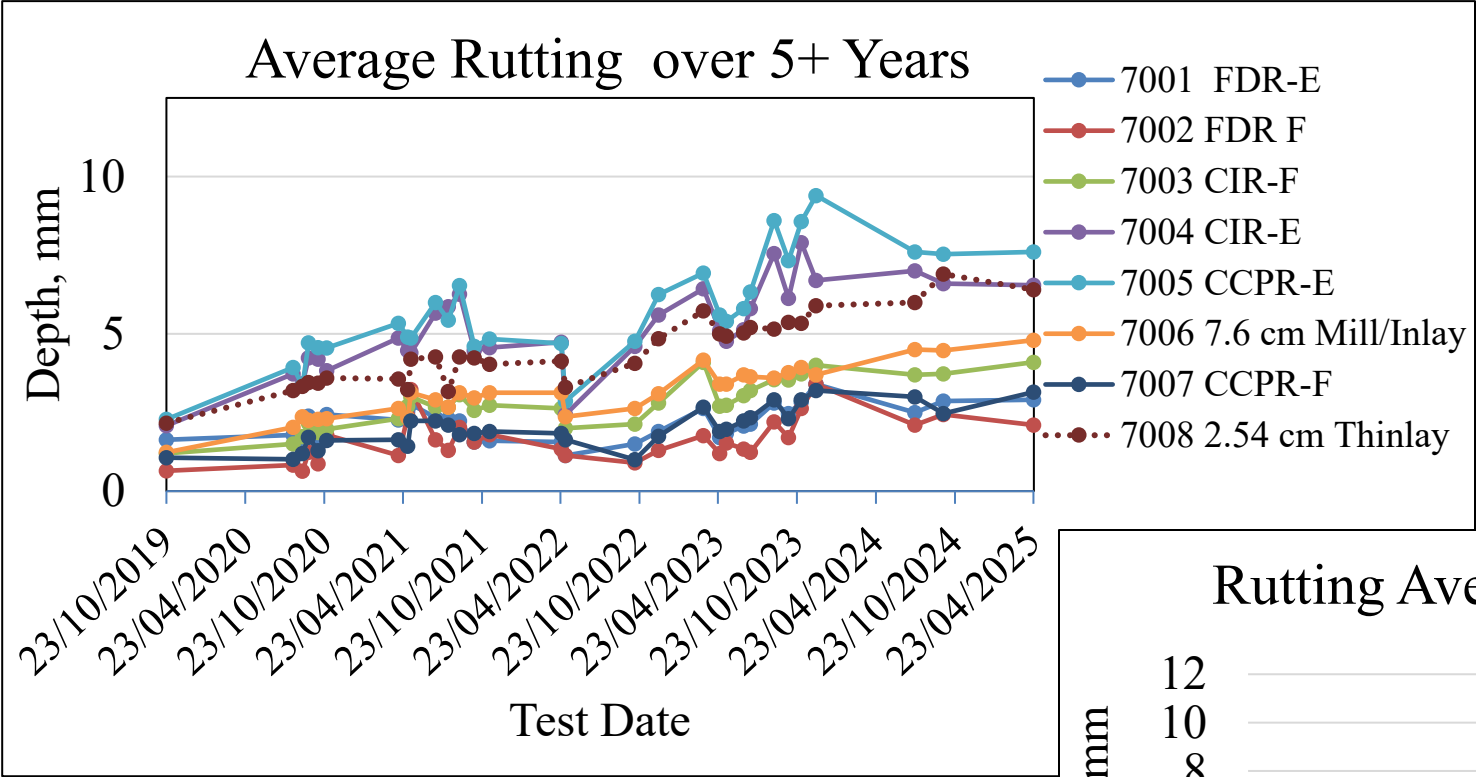
Video drone footage uploaded annually to YouTube by MnDOT Land Management



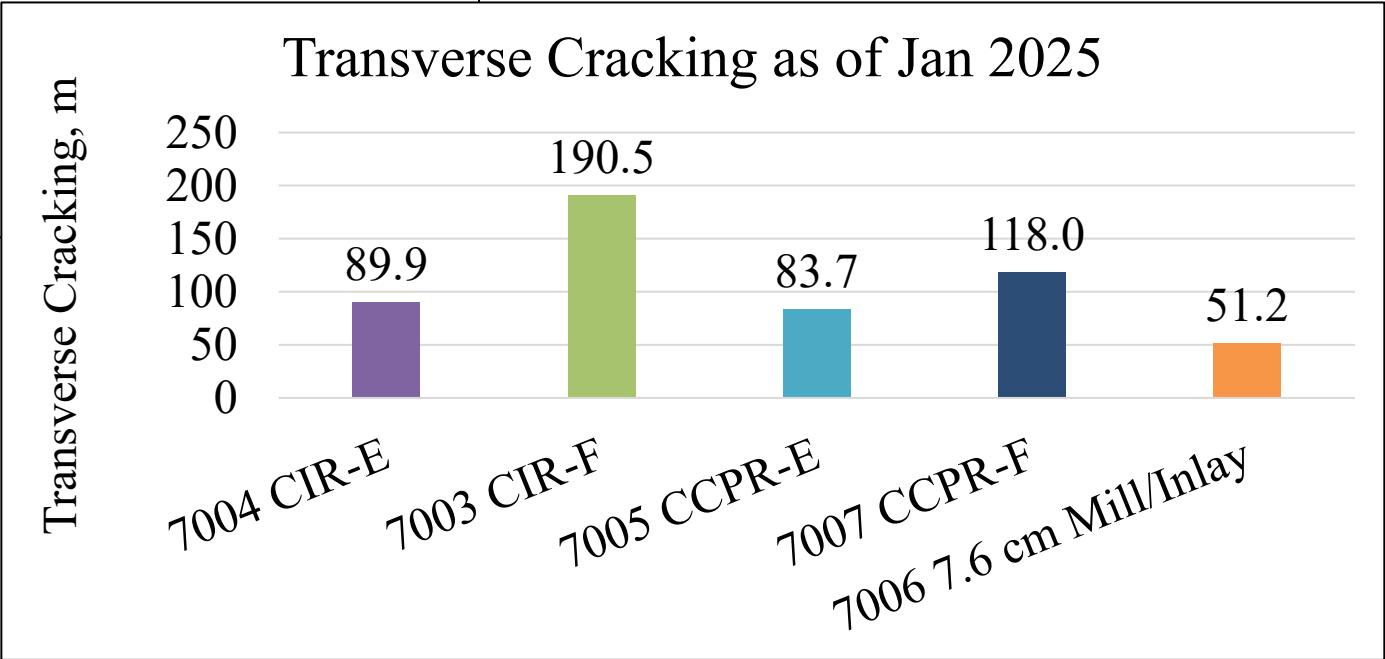
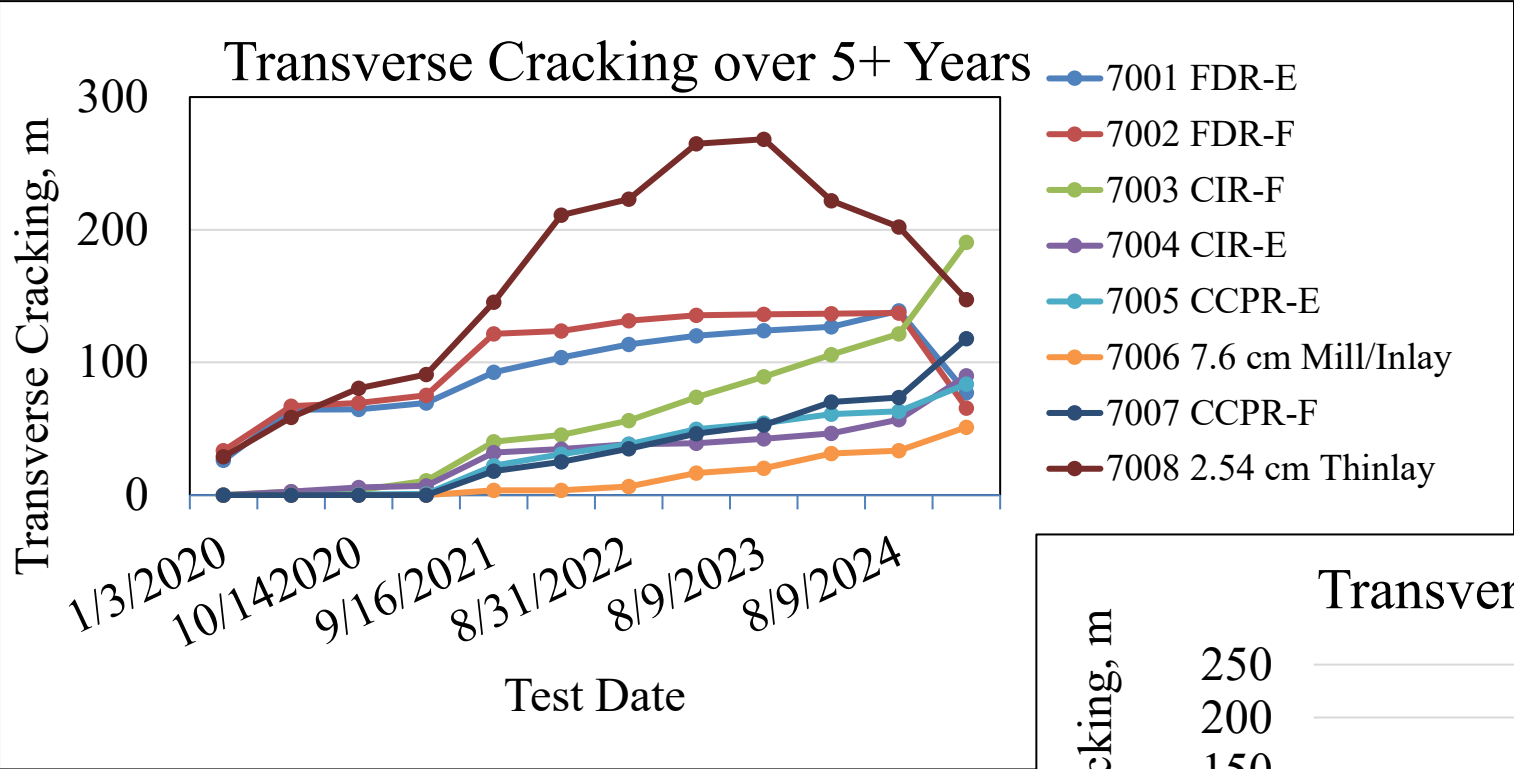
Results – Ride Quality



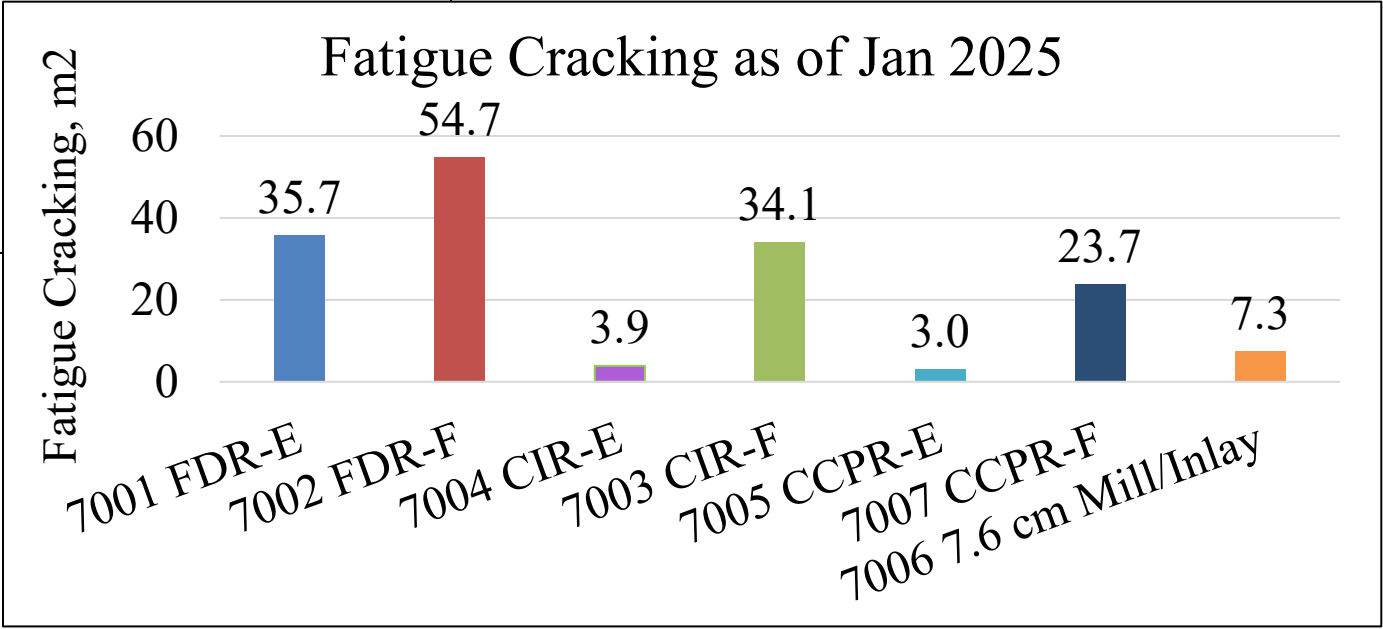
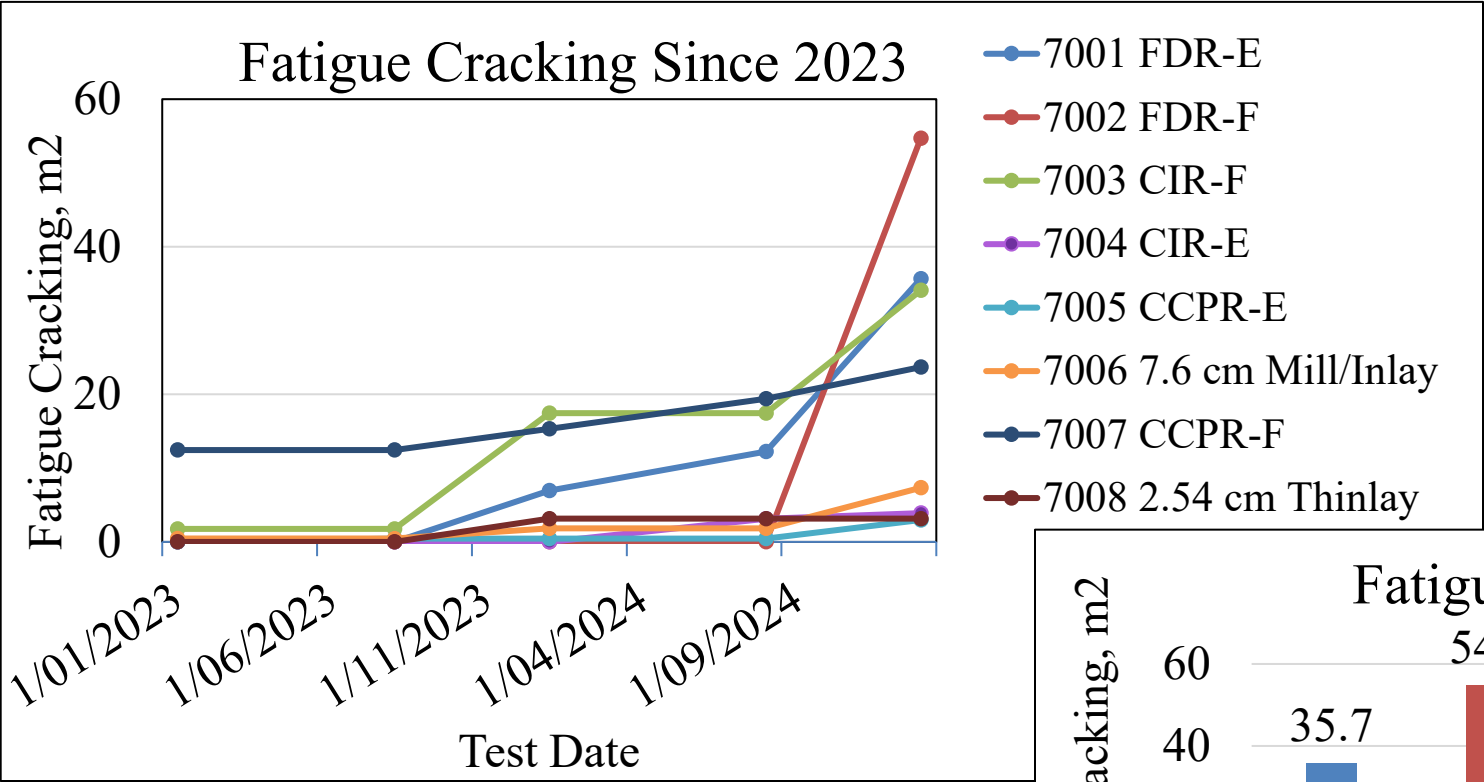
Results – Rutting Performance



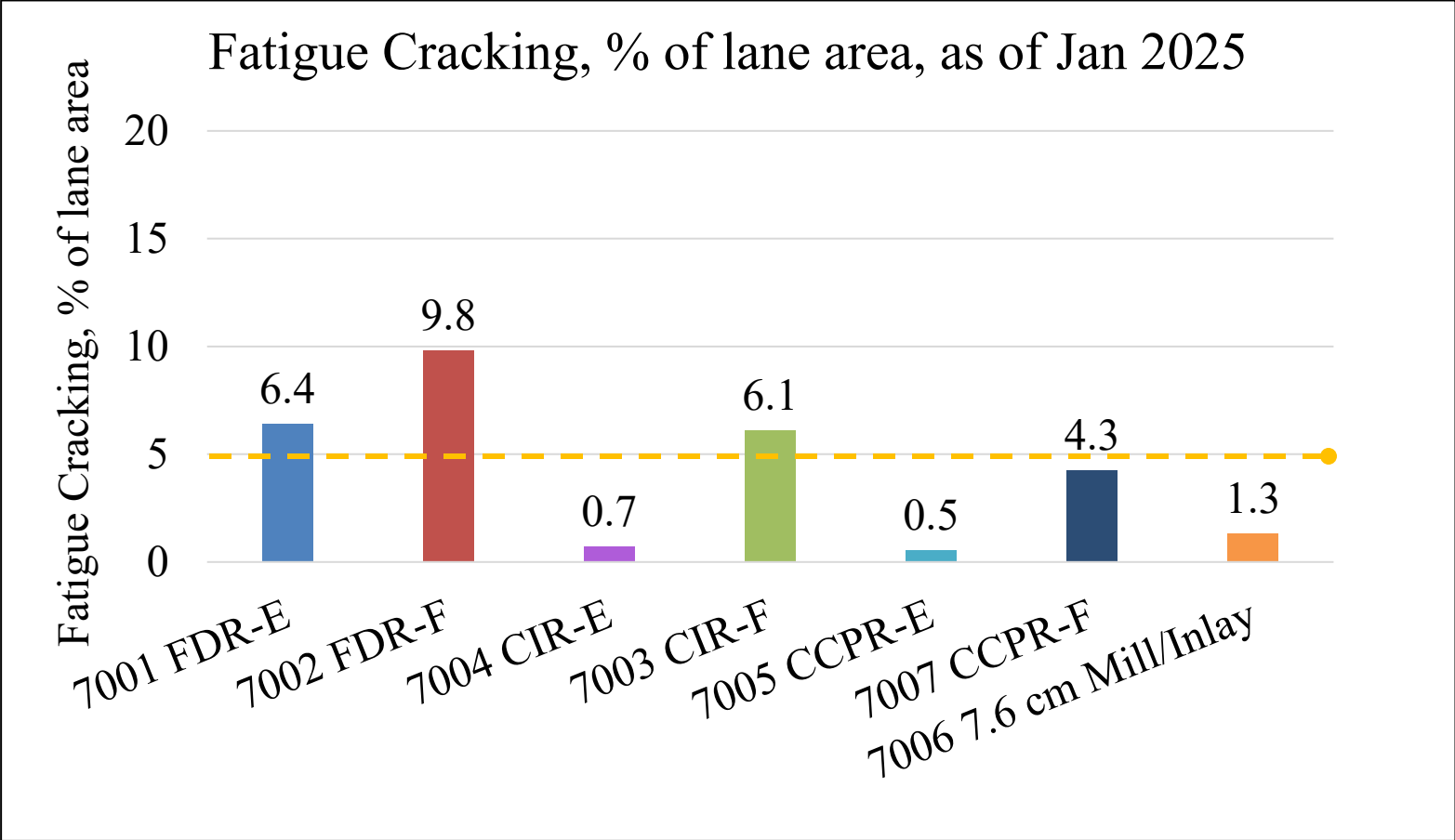
Results – Transverse Cracking Performance



Results – Fatigue Cracking Performance



Results – Fatigue Cracking Performance



MAP-21 Criteria

Good Condition: < 5% of the lane area exhibits cracking.

Fair Condition: 5% to 20% of the lane area exhibits cracking.

Poor Condition: > 20% of the lane area exhibits cracking.

Pictures of FDR Sections



Pictures of CIR Sections

7004: Emulsion CIR
Spring 2024



7003: Foam CIR
Spring 2024



Pictures of CCPR Sections



Pictures of HMA Sections

7006: 7.6 cm Mill/Inlay
Spring 2024



7008: 2.54 cm Thinlay
Spring 2024



Summary

The CIR and CCPR sections constructed in the cold region of Minnesota are still performing very well after 5 years.

Balancing both rutting and cracking could be accomplished by using a small amount of cement to reduce rutting potential and engineered emulsion to provide flexibility.

Cold recycling is a sustainable option for pavement rehabilitation (decreased GWP, cost reduction, and improved performance).



Thank You

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