

Development and Implementation of Improved Asphalt Acceptance Specifications for Ontario Municipalities

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Collaborators: Campbell, Chan, Lane, Lee, Li, Lovisotto, Marks, Philips, Ponniah, Smith, Tam, VanBuren, Waechter, many others ...

Sponsors: Alberta Innovates, Durham, Kingston, MTO, NSERC, Peel, many others ...

Via Flamina Rome, Italy

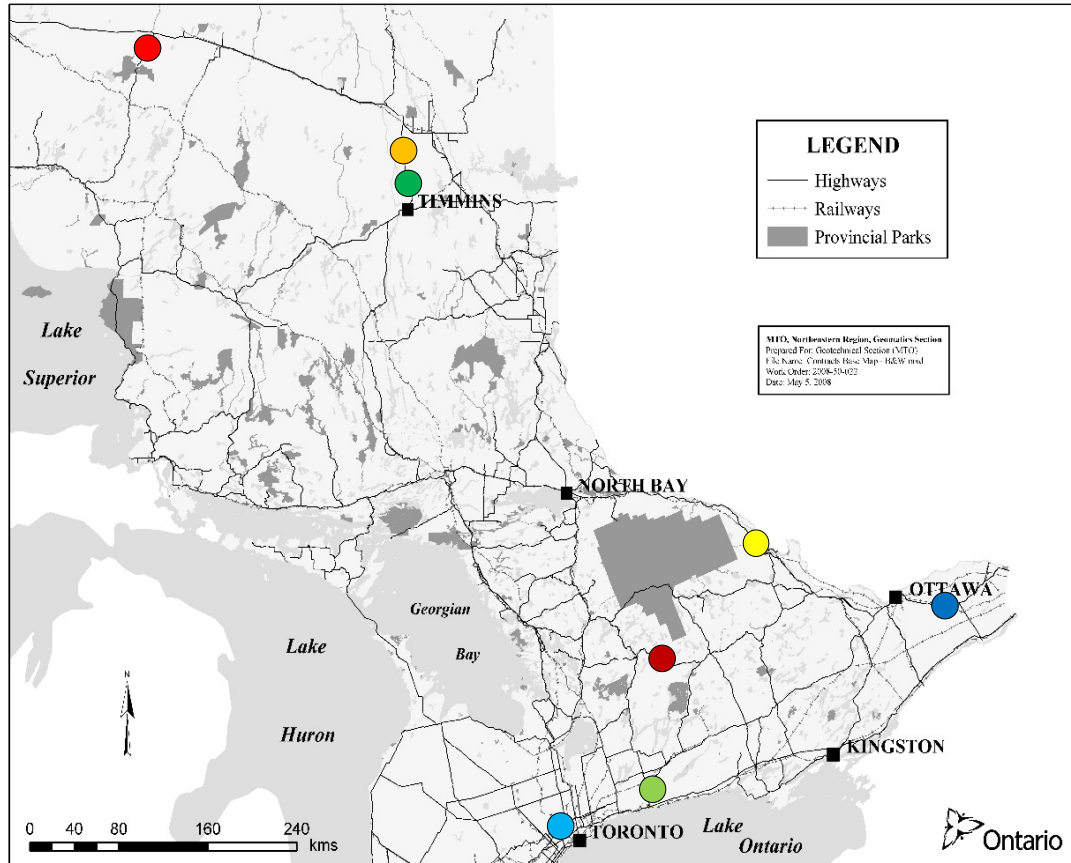
~ 250 BC

2,250 Lifespan!

Stiff base with
interlocking stones on
surface.



Ontario's Dedicated Pavement Trials



● Bracebridge (7)

● Hearst (4)

● Petawawa (6)

● Timmins I (7)

● Casselman (7)

● Timmins II (8)

● Toronto (5)

● Durham (5)

Total: 49 Sections

Highway 655 Phase I, Section 4 (2003)



PG 70-34

4-5% SBS, 10% REOB

Air Temperature -48°C

Reconstructed 2021

Lifespan = 12 Years



Highway 138 (2001 & 1999)

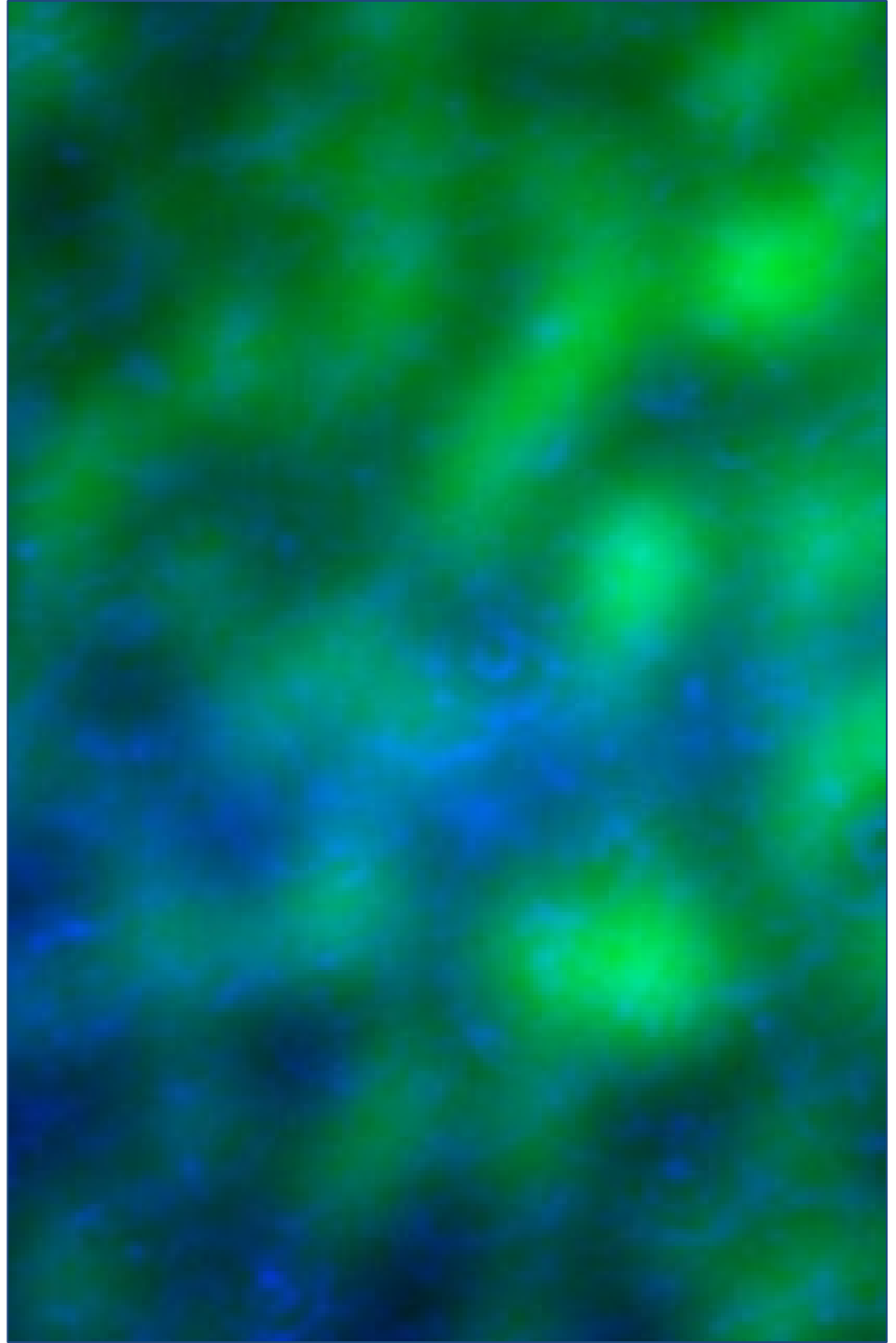
Two contracts of opposite performance ...



E-009 PG 58-40

**Phase Contrast
and Fluorescence
Microscopy**

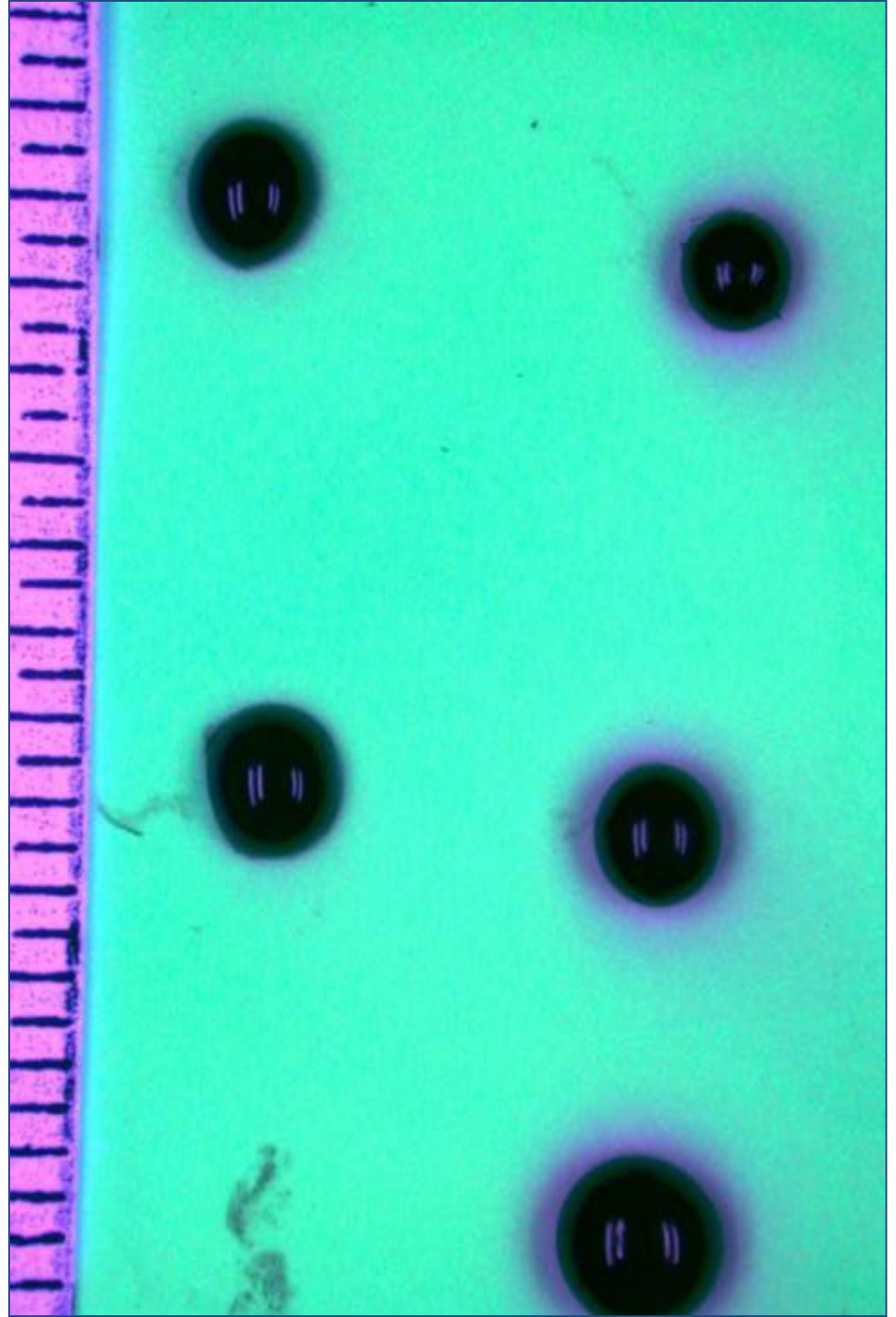
**Estimated REOB
content: 30-40%**



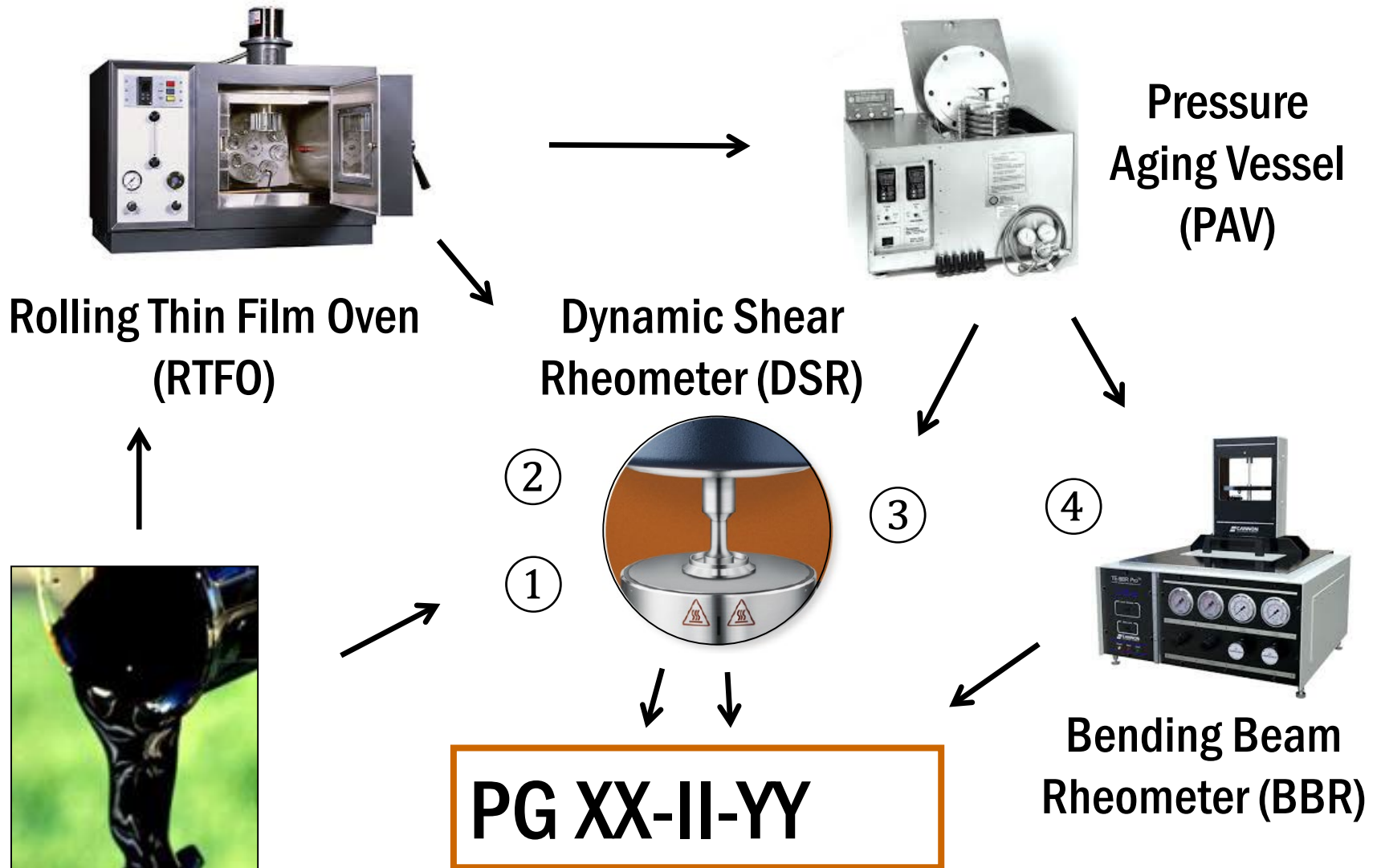
Australian Exudation Test

Fluorescence Microscopy

Cunningham, 1989



Performance Grading of Asphalt Binder (Superpave™ PGAC)



Commercial Superpave Grades PG XX-YY

		High Temperature XX from DSR, °C				
		52	58	64	70	76
Low Temperature YY from BBR, °C	-16	52-16	58-16	64-16	70-16	76-16
	-22	52-22	58-22	64-22	70-22	76-22
	-28	52-28	58-28	64-28	70-28	76-28
	-34	52-34	58-34	64-34	70-34	76-34
	-40	52-40	58-40	64-40	70-40	76-40

GRADE SPANS (HTPG + LTPG)



Regular Crudes (Grade Span < 86)



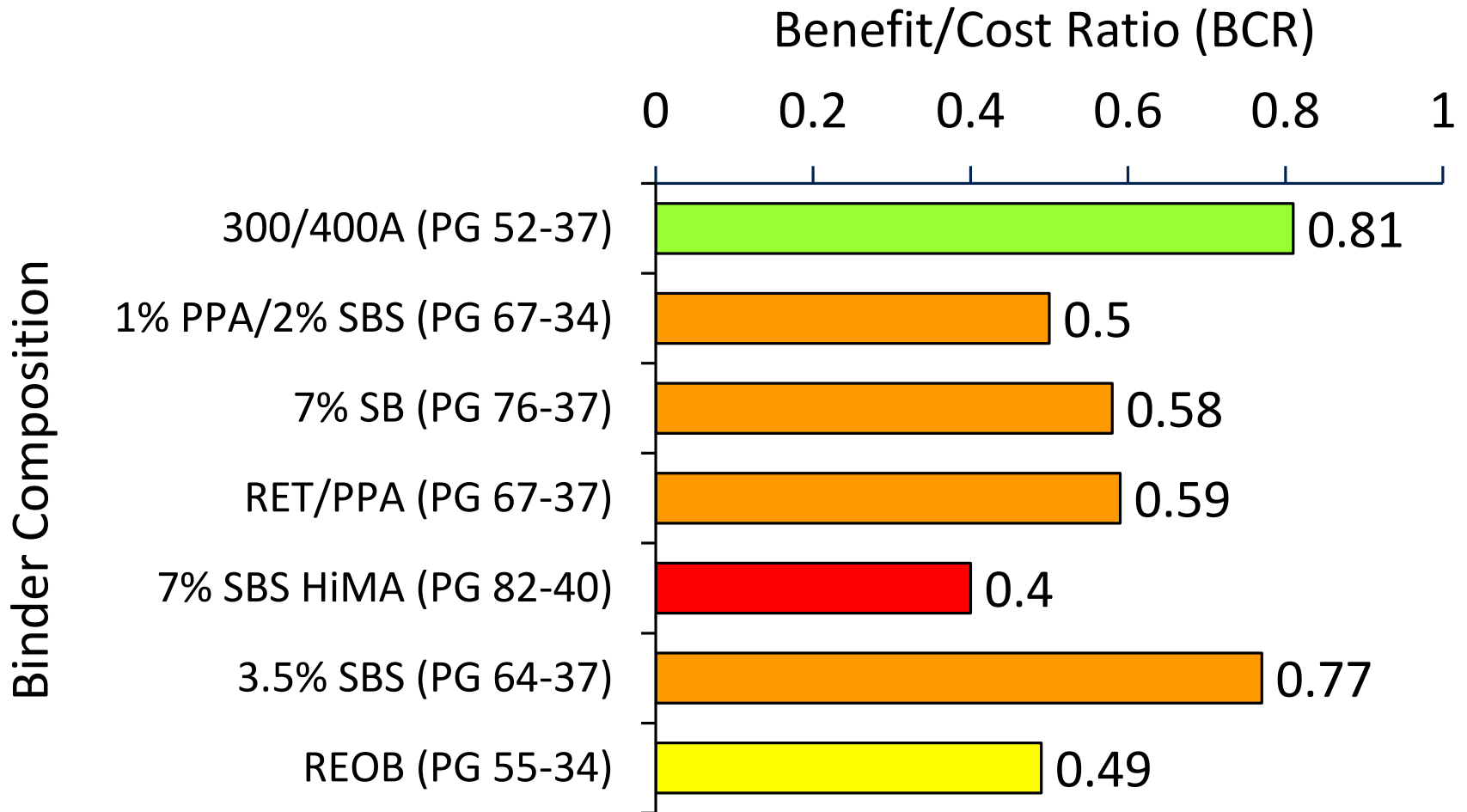
Superior Crudes (86 < Grade Span < 98)



Modification/Additives Required (Grade Span > 98)

Higher
Quality?

Highway 655 Phase II, 7 Sections (2007)



Modus Operandi

1. Ban all known offenders:

- Waste engine and other oils
- Waxes
- Oxidized residues
- Pig manure



2. Control sample chain of custody.

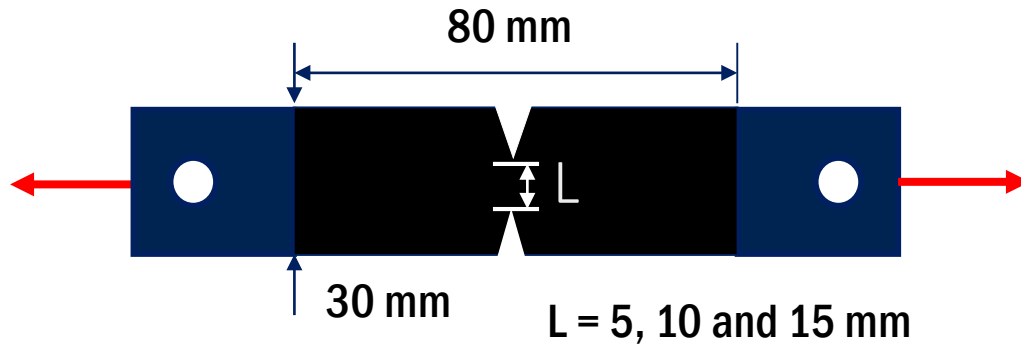
3. Test extracted and recovered binder.

4. Assess ductile failure (LS-299 DENT CTOD).

5. Assess true grade and stability (LS-308 EBBR).

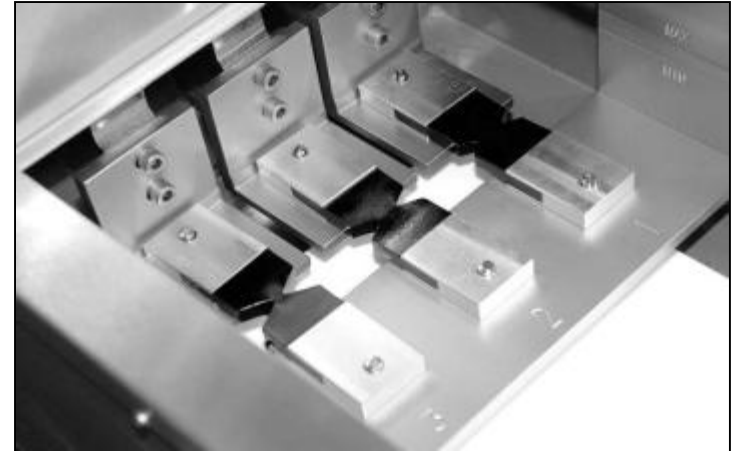
6. Neither underdesign nor overdesign (HiMA)!

LS-299 Double-Edge-Notched Tension (DENT)



T = 15°C and Rate = 50 mm/min

Improved Ductility Test



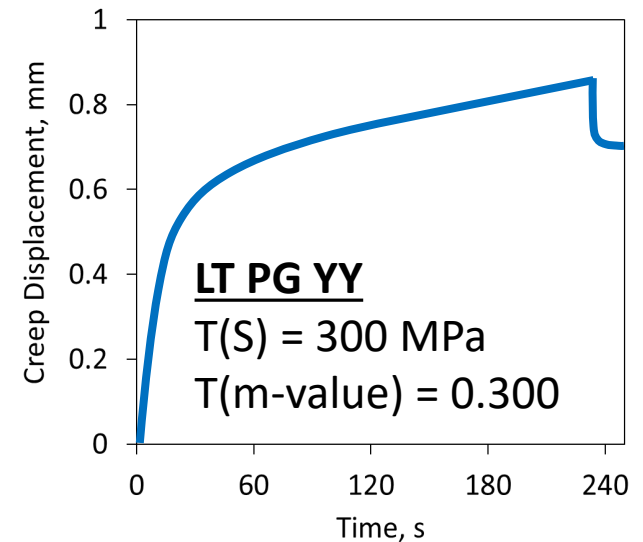
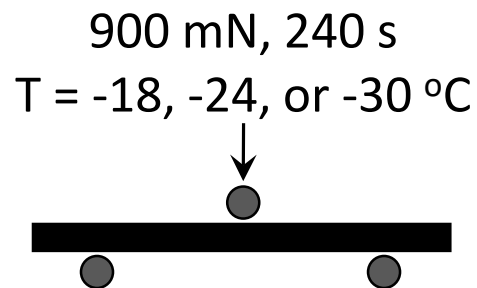
$$W_{\text{total}} = W_{\text{essential}} + W_{\text{plastic}} = w_{\text{essential}}BL + w_{\text{plastic}}\beta BL^2$$

$$w_{\text{total}} = W_{\text{total}}/BL = w_{\text{essential}} + \beta w_{\text{plastic}}L$$

$$\text{CTOD} \sim w_{\text{essential}}/\sigma_{\text{net section stress at 5 mm}}$$

LS-308 Extended Bending Beam Test (EBBR)

1. Conditions at $T + 10$ and $T + 20$ and measures grades after 1, 24 and 72 h of cold conditioning.
2. Measures grade loss from 1 h.



Winchester/Ritson, Durham Region (2016)

0 cracks/1,000 m



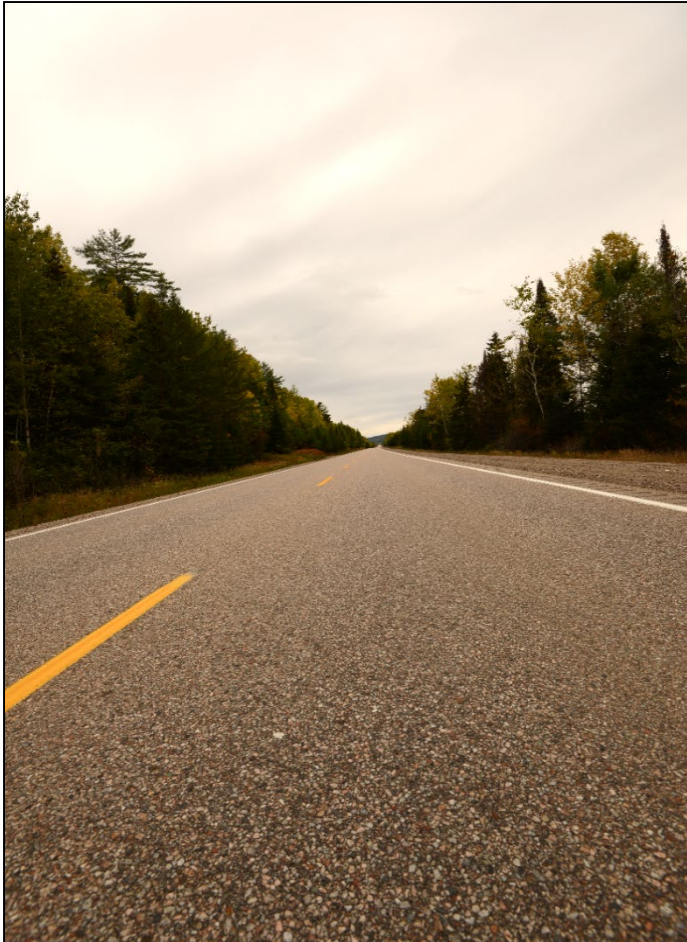
Derry Road East, Peel Region (2016)

0 cracks/2,800 m

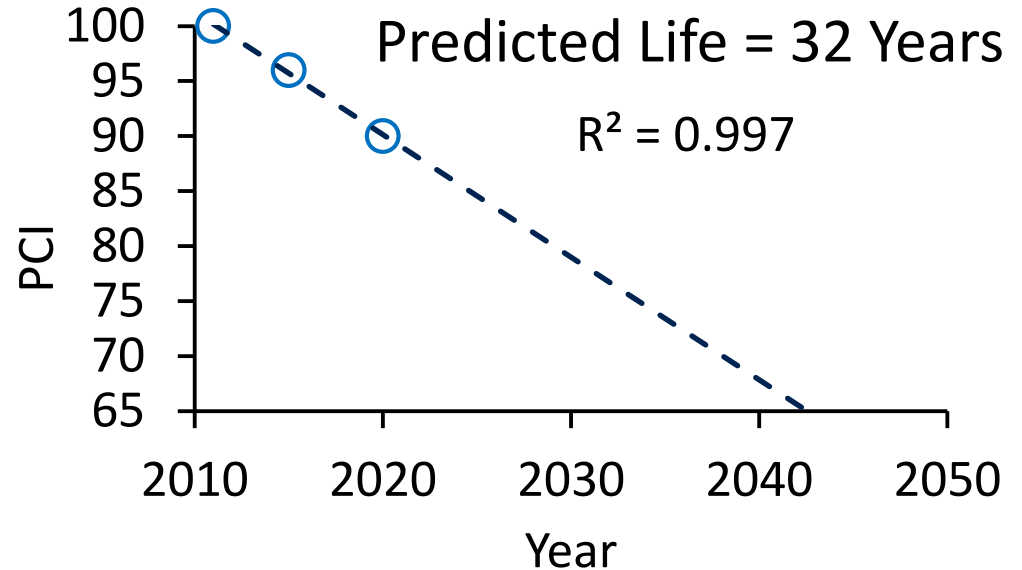


Highway 17, Deux-Rivières (2011)

0 cracks/10 km



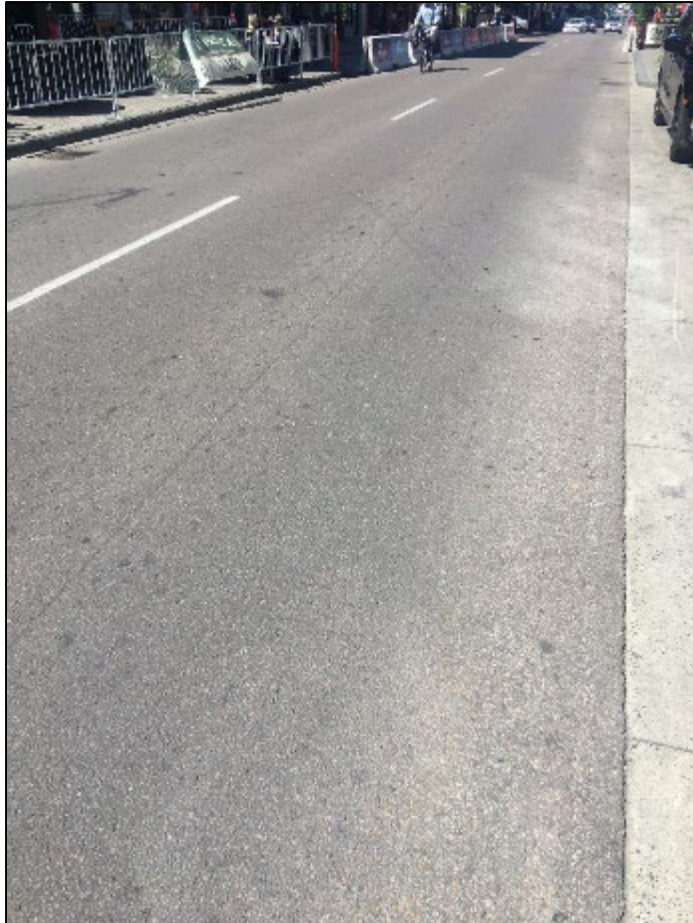
$T_{\min} = -37^{\circ}\text{C}$



5.4 % PG 58-34 binder

Princess Street, Kingston (2011/2012)

0 cracks/ 1,000 m



Princess Street, Kingston (2010)

40 cracks/100 m



Highway 655 Phase II, Section 9 (2007)



Cold Lake PG 52-37

0.3% PET fibers on HMA

Air Temperature $< -40^{\circ}\text{C}$

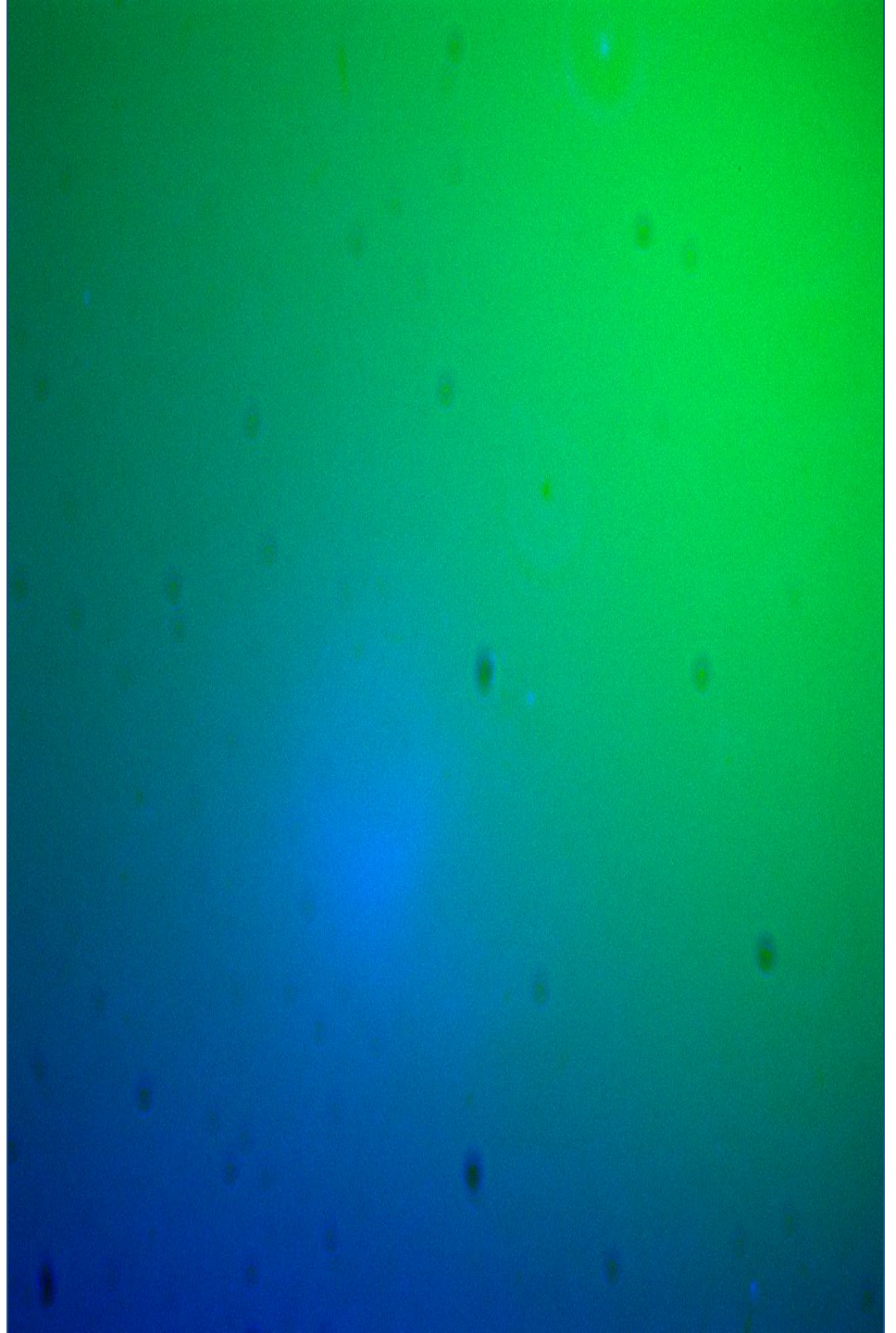
Predicted Life = 38 Years



Cold Lake, Alberta Binder

Phase Contrast and
Fluorescence
Microscopy

PG 52-37



Conclusions and Further Work

- DENT and EBBR tests are being implemented by user agencies for their sensitivity to quality and durability.
- DSR results can be obtained within 24 h on ~ 5 g of carefully extracted and recovered binder.
- With reasonable acceptance criteria, 30-year to 40-year lifespans are achievable.
- Alberta binder can pave all roads on earth for 100-200 years and generate over \$10 trillion in sales revenue!
- Potential major savings for infrastructure budgets ...

Questions?

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Third Crossing, City of Kingston



Newtonville Road, Durham Region

