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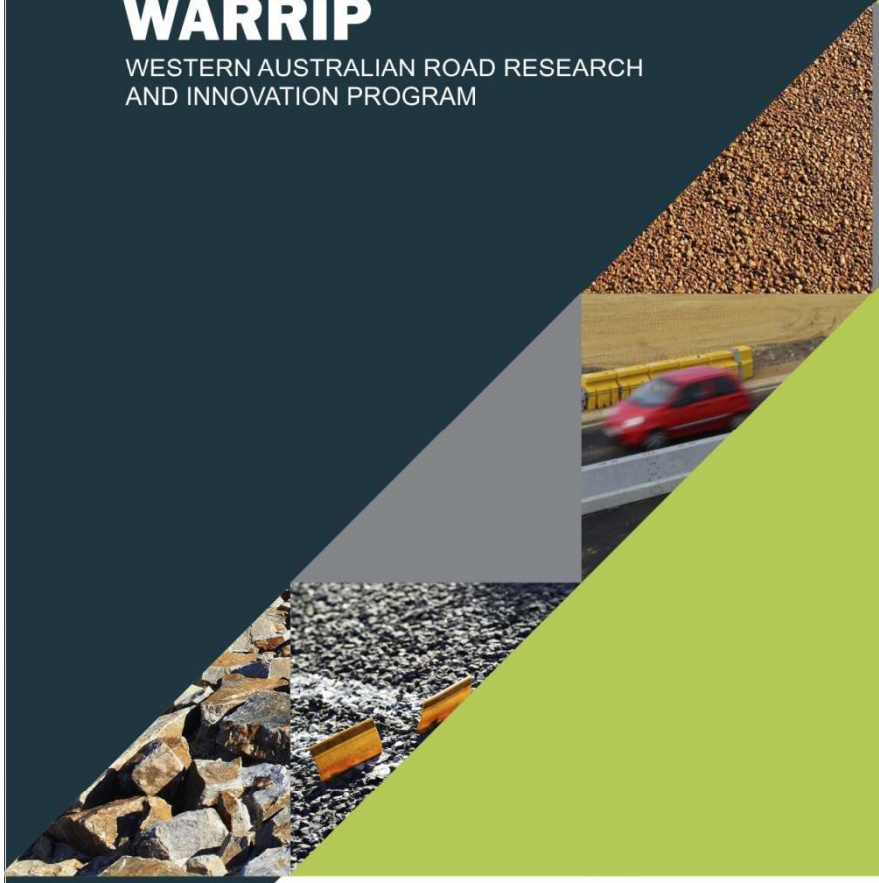

The Use of Reclaimed Asphalt Pavement from Crumb Rubber Modified Asphalt

23 June 2020

AN INITIATIVE BY:

THE GOVERNMENT OF WESTERN AUSTRALIA

mainroads WESTERN AUSTRALIA

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Rosemary Pattison

Webinar Moderator

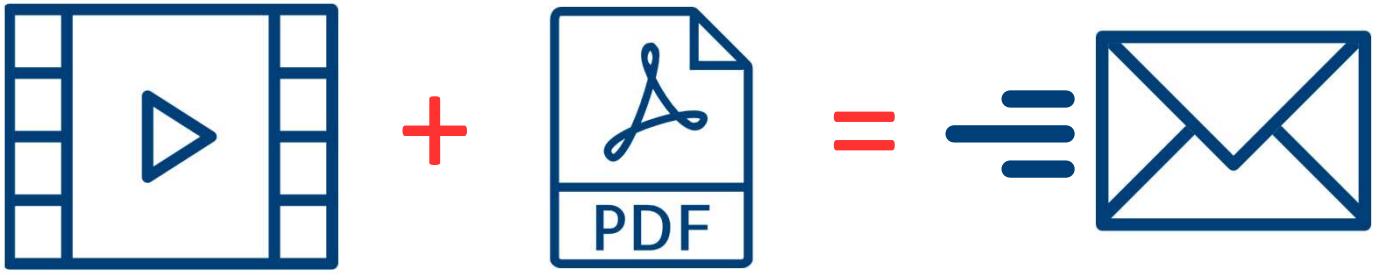
Professional

- Knowledge Hub - ARRB Group

- P: +61 3 9881 1590
- E: training@arrb.com.au

Housekeeping

- Webinar is 60 mins
- inc. question time of 15 mins



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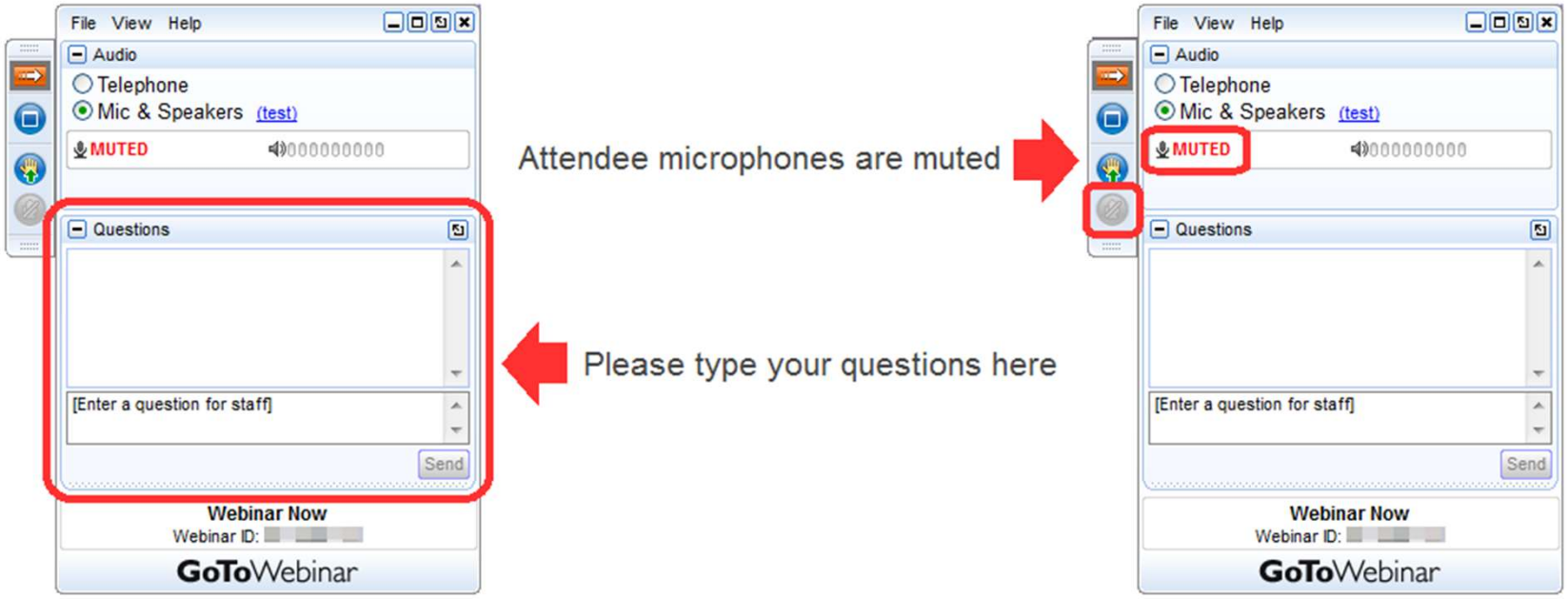

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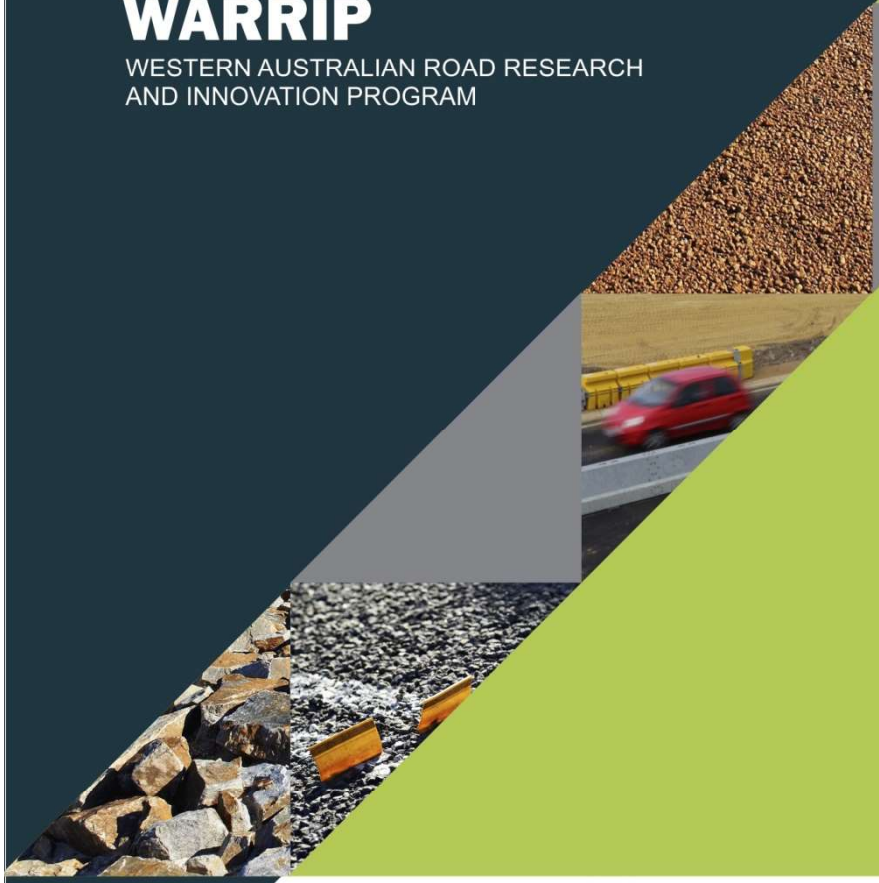

Today's Presenters

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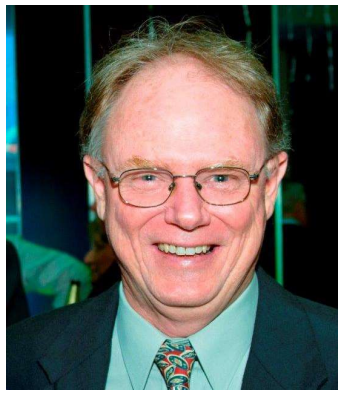
Zia Rice has worked at ARRB for just over 4 years and leads the Perth Pavements team. Zia has undertaken several WARRIP projects with a focus on asphalt fatigue design, characterisation of materials and material performance. She has over 5 years previous experience as a Geotechnical Consultant. Zia was the ARRB Project Leader for this WARRIP project.



Steve Halligan is the Bituminous Products Consultant and is based at the Main Roads Engineering Branch. Steve provides expertise in the surfacing discipline including bituminous material, spray seals, asphalt, road marking material and properties of road surfaces. He has over 40 years' experience in materials engineering and road construction.

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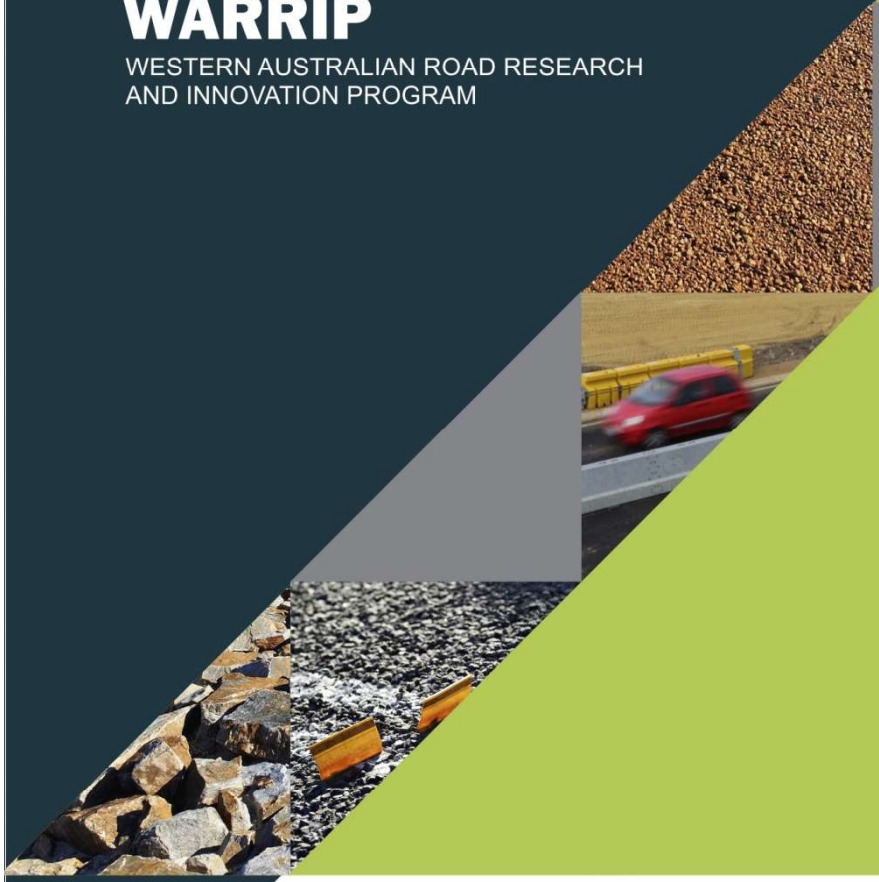

Presentation outline

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1

Project Introduction

2

Literature review

3

Laboratory investigation

4

Practicality Studies

5

Summary and next steps

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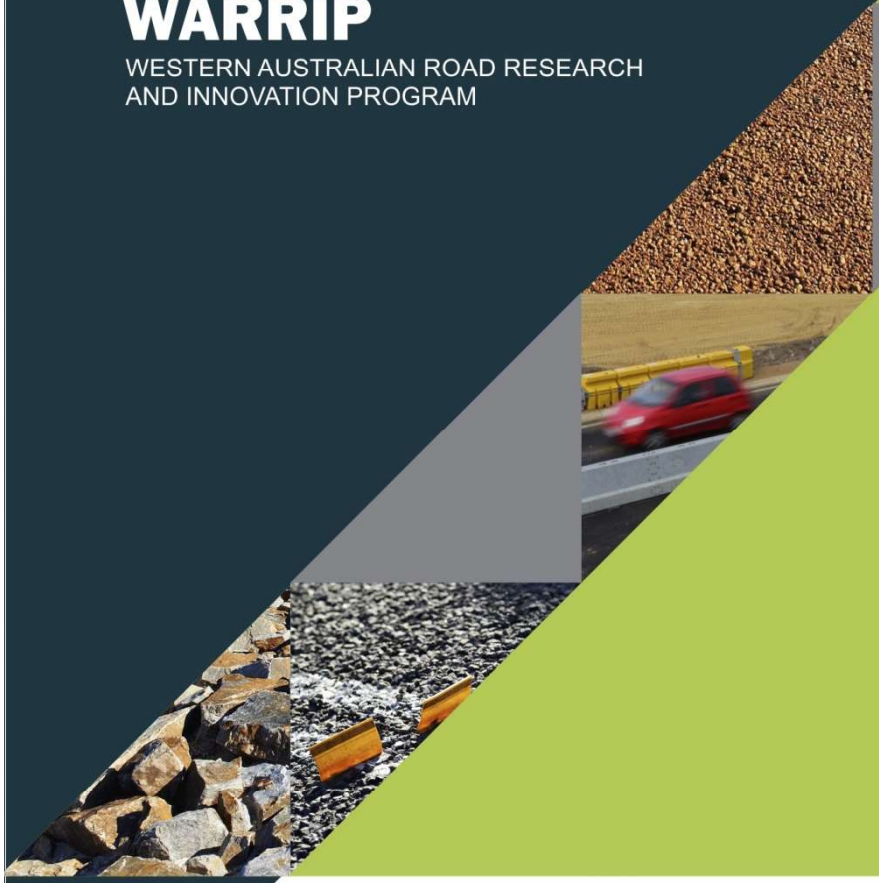

Project Introduction

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WARRIP

A collaborative research agreement between MRWA ARRB

Identify innovative practices and guide implementation to deliver superior technology and cost savings in road infrastructure

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Project background

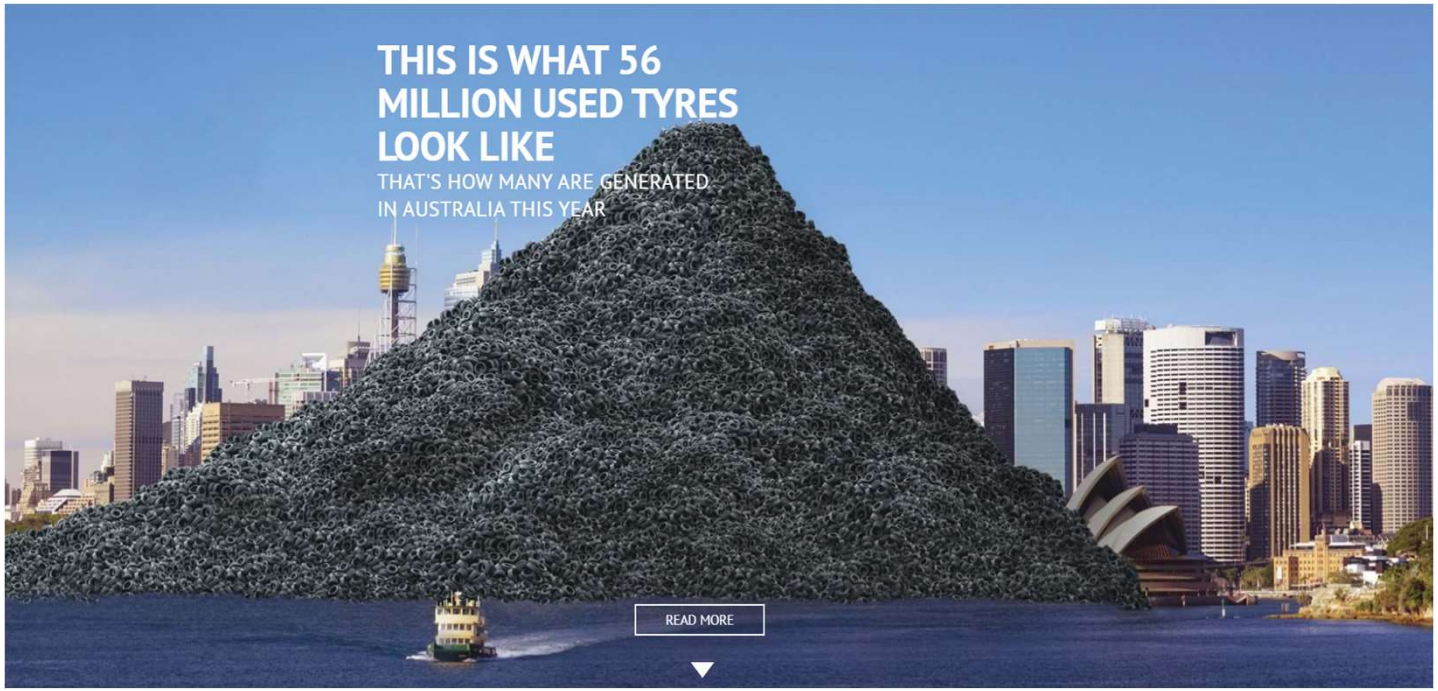
- Increased use of RAP nationally
- Increased use of recycled materials in asphalt mixes
- Investigate implications of RAP containing CRM asphalt
  - Reclamation
  - Processing
  - Plant mixing
  - Laboratory characterisation
  - Mix design using target viscosity blend

Literature review
- International practice
- Identify potential issues
- Identify possible solutions
- Identify positive outcomes

Laboratory investigation
- Identify potential issues
- Identify possible solutions

Practicality study
- Industry partners
- Test process of reclamation through to new mix manufacture and placement

CRM Asphalt



- Reuse of discarded tyres
- Rubber processed into crumbs
- Crumbs mixed with bituminous binder
- 18% rubber by mass of binder
- Rubber digested by binder
- Modifies binder properties
- Produces a CRM-binder

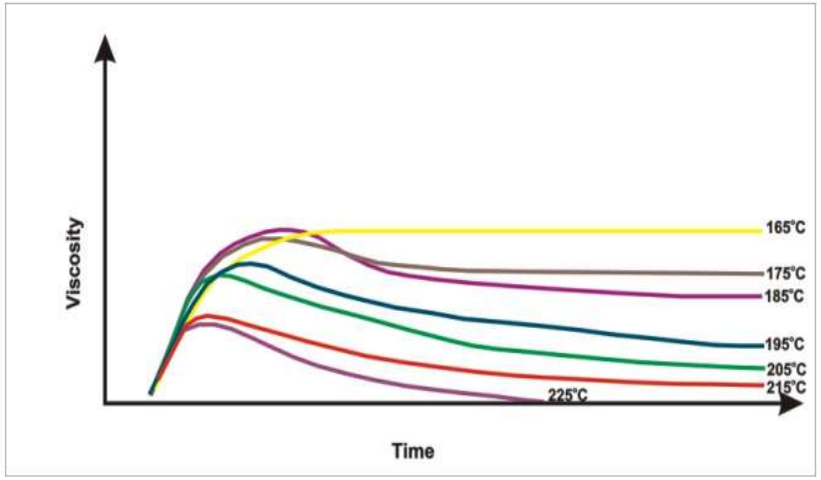
Modification and digestion

Wet Process

Crumb-rubber modified binder (CRM)

- CR digested into binder
- Final properties depend on digestion time
- Digestion depends on temperature, size/shape of rubber particles and blending oils
- Digestion tracked by measuring viscosity
- Some undissolved rubber

CRM-binder viscosity variation with digestion time and temperature



Source: Sabita (2016)

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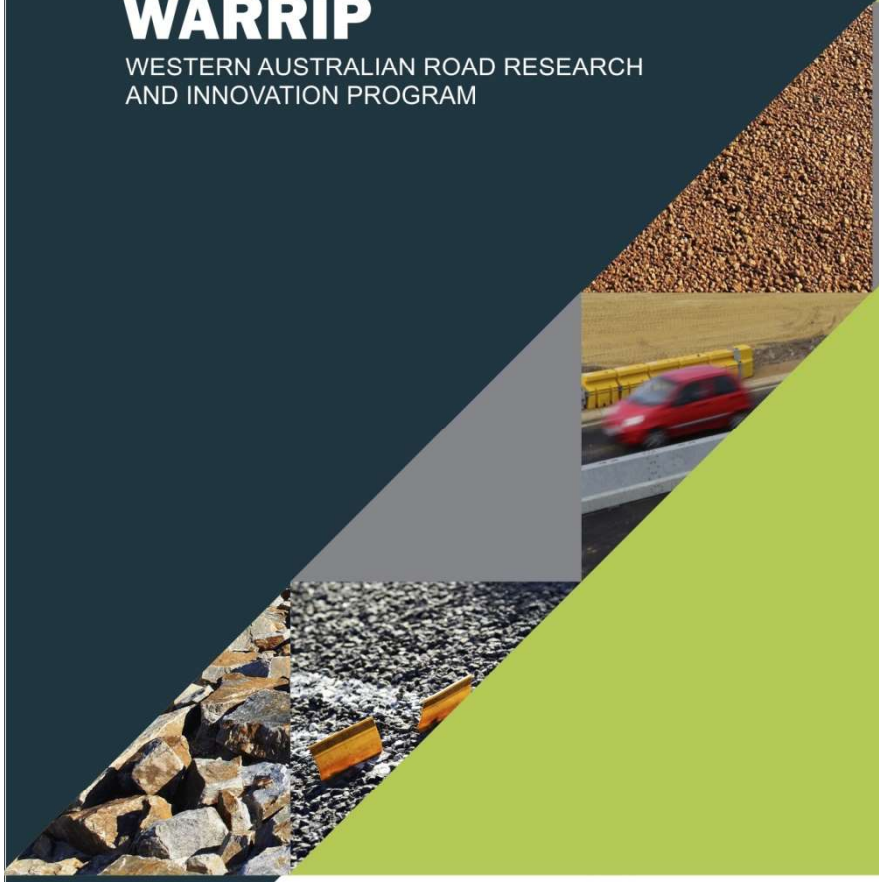

Literature review

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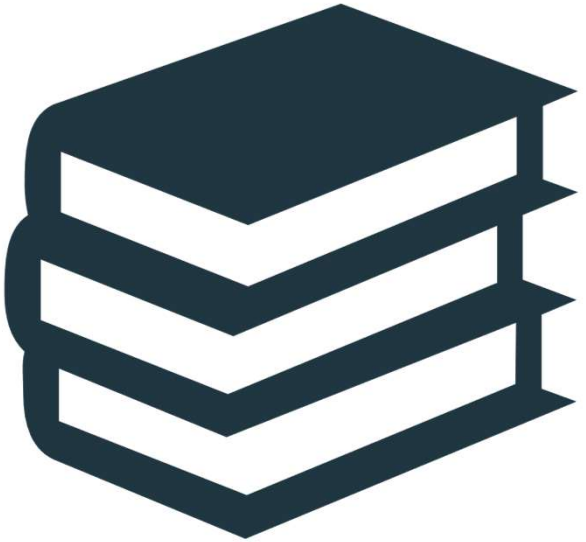
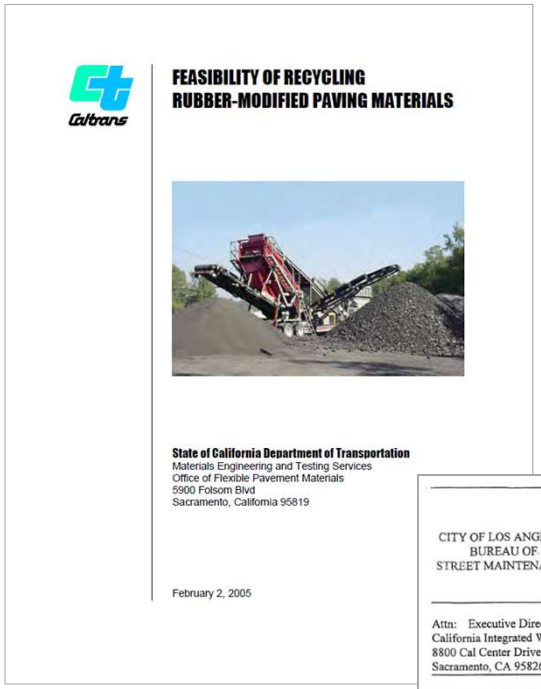
Literature review

- Limited international literature
  - California DOT
  - Los Angeles City
  - Wisconsin DOT
  - Mississippi DOT
  - Texas Transportation Institute
- Identify potential issues
- Identify possible solutions
- Identify positive outcomes



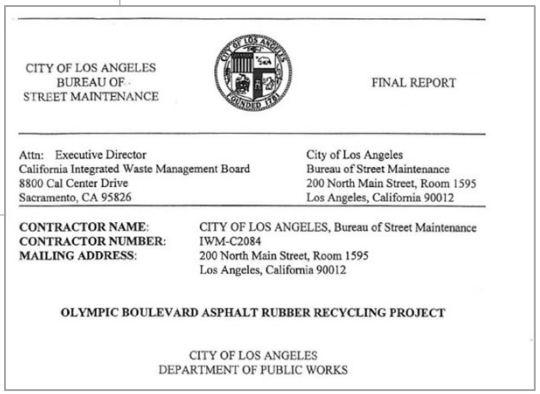
California DOT and City of Los Angeles


Caltrans

FEASIBILITY OF RECYCLING
RUBBER-MODIFIED PAVING MATERIALS

State of California Department of Transportation
Materials Engineering and Testing Services
Office of Flexible Pavement Materials
5900 Folsom Blvd
Sacramento, California 95819

February 2, 2005


CITY OF LOS ANGELES
BUREAU OF
STREET MAINTENANCE

FINAL REPORT

Attn: Executive Director
California Integrated Waste Management Board
8800 Cal Center Drive
Sacramento, CA 95826

City of Los Angeles
Bureau of Street Maintenance
200 North Main Street, Room 1595
Los Angeles, California 90012

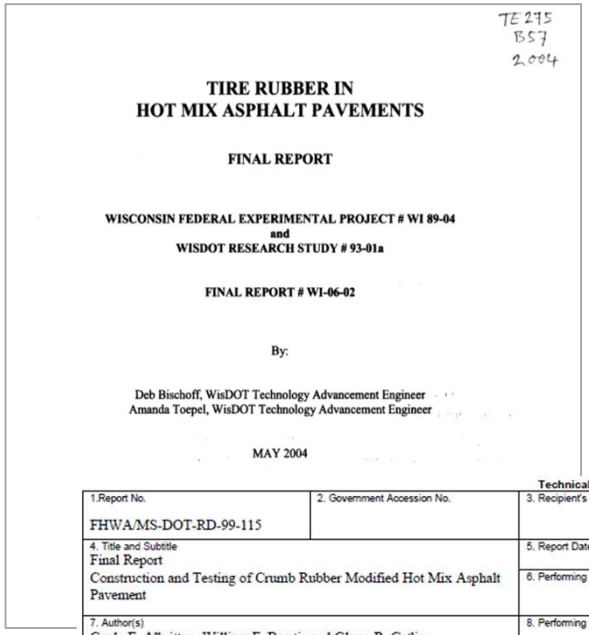
CONTRACTOR NAME: CITY OF LOS ANGELES, Bureau of Street Maintenance
CONTRACTOR NUMBER: IWM-C2084
MAILING ADDRESS: 200 North Main Street, Room 1595
Los Angeles, California 90012

OLYMPIC BOULEVARD ASPHALT RUBBER RECYCLING PROJECT

CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS

- CALTRANS
  - Could be plant-produced
  - Final mix met specifications and tests
  - Could be placed and compacted using conventional equipment and practices
  - Perform at least as well as conventional mixes that included conventional RAP
- City of Los Angeles
  - Air quality monitoring during plant production and paving
  - Exposure to contaminants were well below permissible exposure limits

Wisconsin and Mississippi



TE 275
B57
2004

**TIRE RUBBER IN
HOT MIX ASPHALT PAVEMENTS**

FINAL REPORT

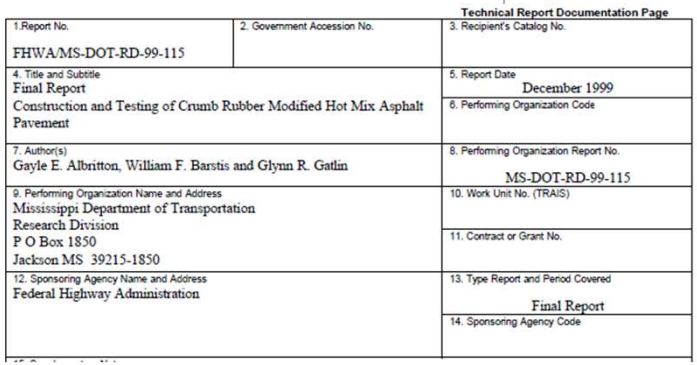
**WISCONSIN FEDERAL EXPERIMENTAL PROJECT # WI 89-04
and
WISDOT RESEARCH STUDY # 93-01a**

FINAL REPORT # WI-06-02

By:

Deb Bischoff, WisDOT Technology Advancement Engineer
Amanda Toepel, WisDOT Technology Advancement Engineer

MAY 2004



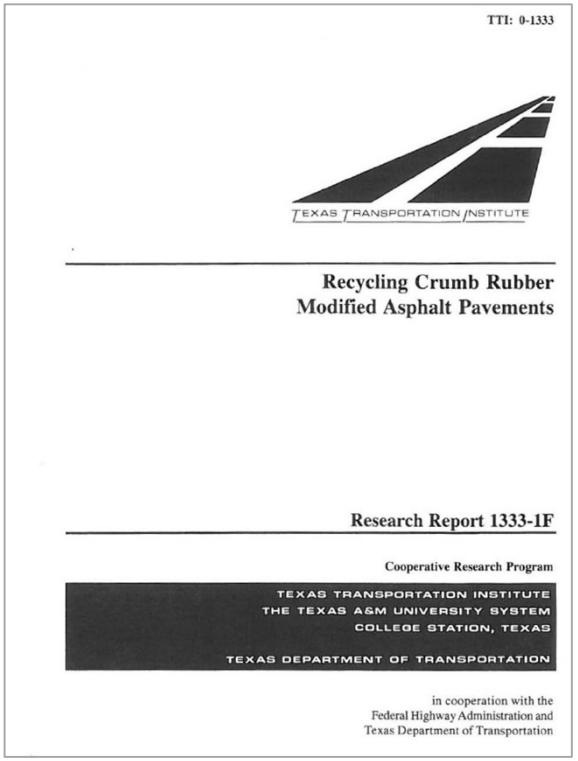
Technical Report Documentation Page

1.Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/MS-DOT-RD-99-115		
4. Title and Subtitle Final Report Construction and Testing of Crumb Rubber Modified Hot Mix Asphalt Pavement		5. Report Date December 1999 6. Performing Organization Code
7. Author(s) Gayle E. Albritton, William F. Barstis and Glynn R. Gatlin		8. Performing Organization Report No. MS-DOT-RD-99-115
9. Performing Organization Name and Address Mississippi Department of Transportation Research Division P O Box 1850 Jackson MS 39215-1850		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Federal Highway Administration		13. Type Report and Period Covered Final Report 14. Sponsoring Agency Code

- Wisconsin
  - Operator noted CRM-RAP was slightly harder to mill
  - Still removed with conventional equipment
  - CRM-RAP mix handled in a similar manner to a conventional RAP mix
  - No increased emissions during plant production

- Mississippi
  - Conventional equipment used with no issues during process
  - No increased emissions during plant production

Texas Transportation Institute


TTI: 0-1333

TEXAS TRANSPORTATION INSTITUTE

Recycling Crumb Rubber
Modified Asphalt Pavements

Research Report 1333-1F

Cooperative Research Program

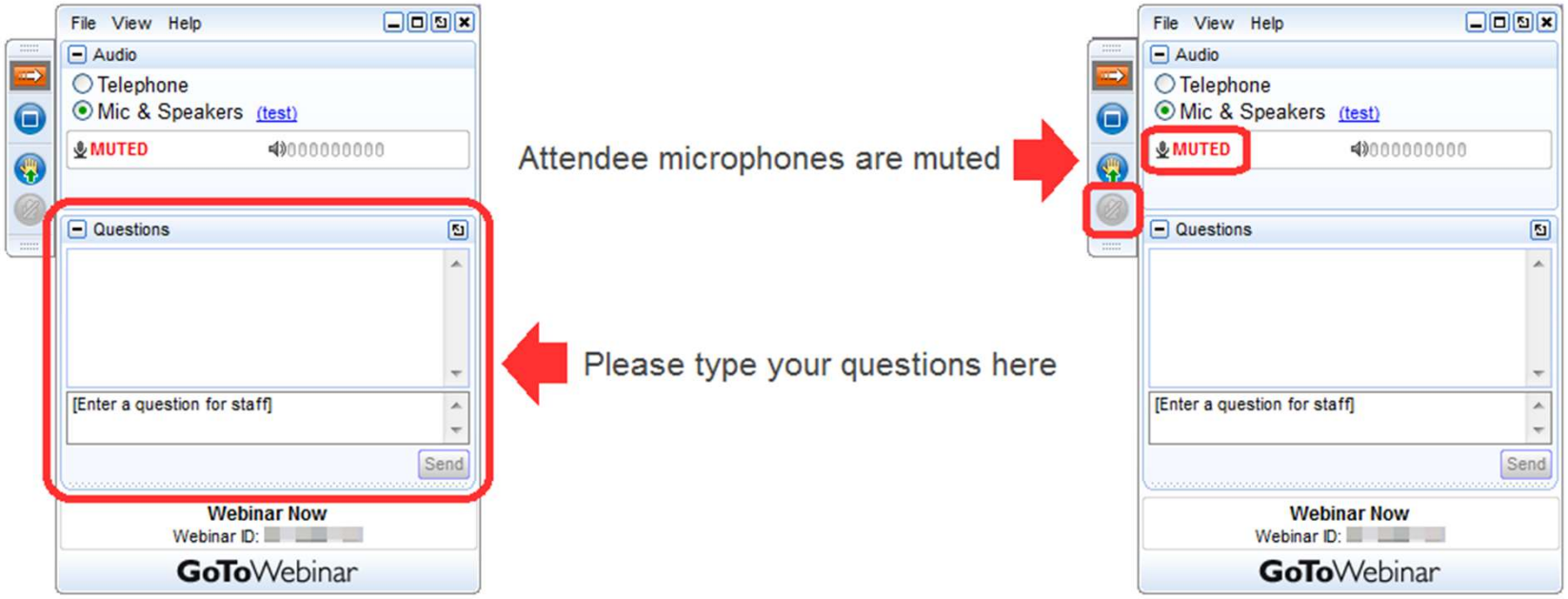
TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the
Federal Highway Administration and
Texas Department of Transportation

- Texas
  - CRM material is recyclable
  - Mix design must consider the rubber
    - Gradation
    - Binder blending
  - Characterisation of the binder
    - Separate the rubber through flotation method and re-blend

Please send your questions with slide number



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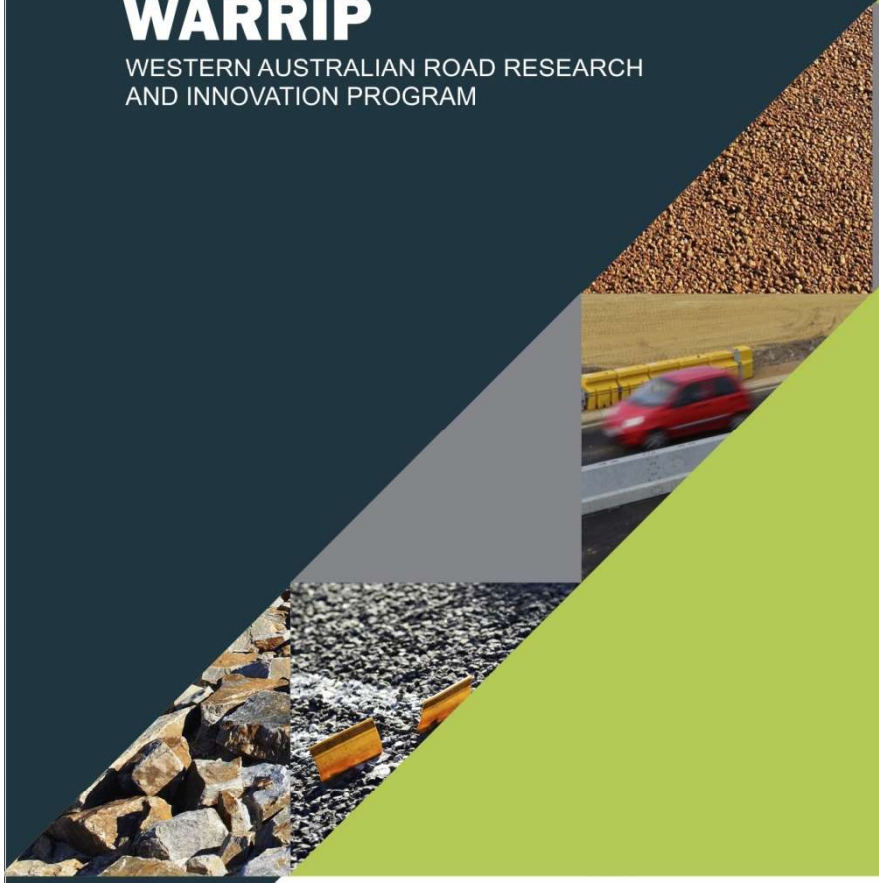

Laboratory investigation

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Laboratory investigation

- **Aim**
  - examine CRM-RAP binder characterisation.
  - quantifying the CRM-RAP binder viscosity
  - assess repeatability and representative nature of the viscosity results
- Option 1:
  - Characterising recovered CRM binders like non modified binders (i.e. viscosity of extracted CRM-RAP binder without reblending recovered rubber).
- Option 2:
  - Reblending of recovered rubber and recovered binder for characterisation

Option 1: Characterising as non-modified

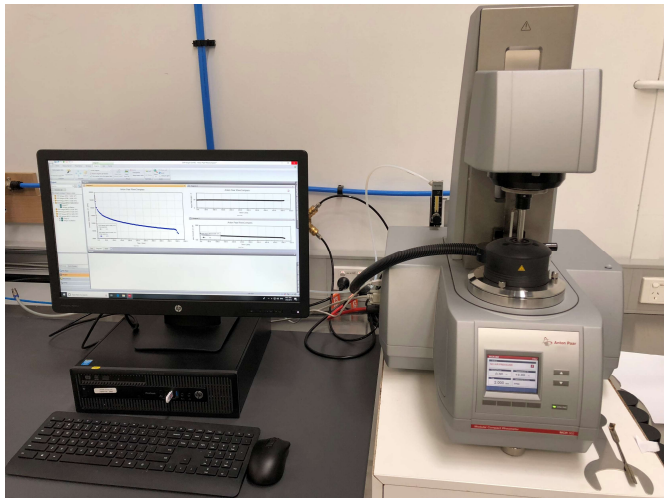
- Extraction of binder from CRM-RAP
  - AGPT/T191 *Extractions of Bituminous Binder from Asphalt*
  - Removes solid component including undigested rubber
  - Trialled various soaking times and solvent types to understand repeatability and rubber interaction

- Issues
  - disparity was seen with the volume of binder and solids extracted
  - not matching the actual known rubber content

Option 1: Characterising as non-modified

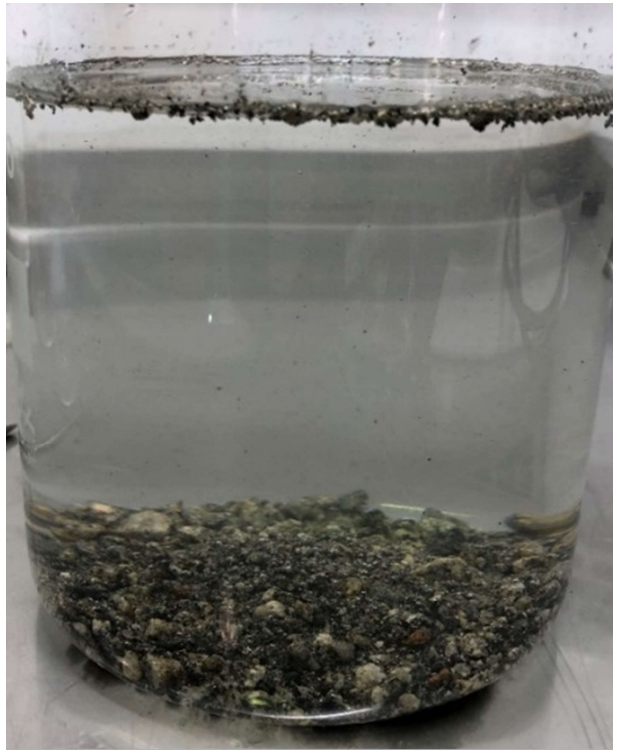
- Characterisation of binder viscosity
  - AGPT/T192 *Characterisation of the Viscosity of Reclaimed Asphalt Pavement (RAP) Binder Using the Dynamic Shear Rheometer (DSR)*

- Issues
  - The removal of the rubber particles decreased the viscosity of the CRM-RAP binder by an unquantifiable amount
  - Soaking time and solvent type influenced final viscosities
  - poor repeatability



Option 2: Characterising with reblend

- Extraction of binder from CRM-RAP
  - AGPT/T191 *Extractions of Bituminous Binder from Asphalt*
  - Reblended extracted rubber by heating binder
- Issues
  - difficulty separating rubber and fines due to similar density



Option 2: Characterising with reblend

- Characterisation of binder viscosity
  - AGPT/T192 *Characterisation of the Viscosity of Reclaimed Asphalt Pavement (RAP) Binder Using the Dynamic Shear Rheometer (DSR)*

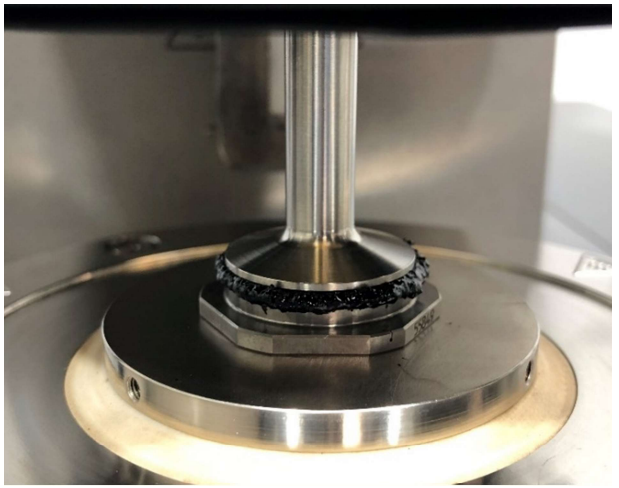
- Issues
  - irregular sized lumps, fibrous material, fines
  - reblending required heating of binder
  - toluene or heat affect the properties of the crumb rubber which is to be reblended
  - type of solvent impacted the size of the crumb rubber particles through swelling

Viscosity summary

Trial	Solvent	Soak time	Option	Complex viscosity at 60°c (pa.s)
N/A	N/A	N/A	18% CRM binder (virgin)	2508.44
A	Toluene	2 hours	Option 1	280.14
			Option 2	1057.18
C	Toluene	1.25 hours	Option 1	622.79
D	Toluene	Overnight	Option 1	63.82
			Option 2	4217.90
E	Toluene (binder) and Mineral turpentine (CR)	Overnight	Option2	15410.00
F	Toluene	Overnight	Option 1	870.18
			Option 2 (17% CR)	6406.42
G	Toluene	1.25	Option 1	786.79
			Option 2 (25% CR)	97681.60

Summary

- Characterisation of CRM-RAP is a variable, unrepeatable process which does not provide representative results.
- Inability to accurately use the viscosity blend method to design level 2 and level 3 CRM-RAP mixes
- May not present an issue if the CRM-RAP is diluted with conventional RAP
- Further investigation
  - alternative design approach
  - Understand viscosity effect of performance



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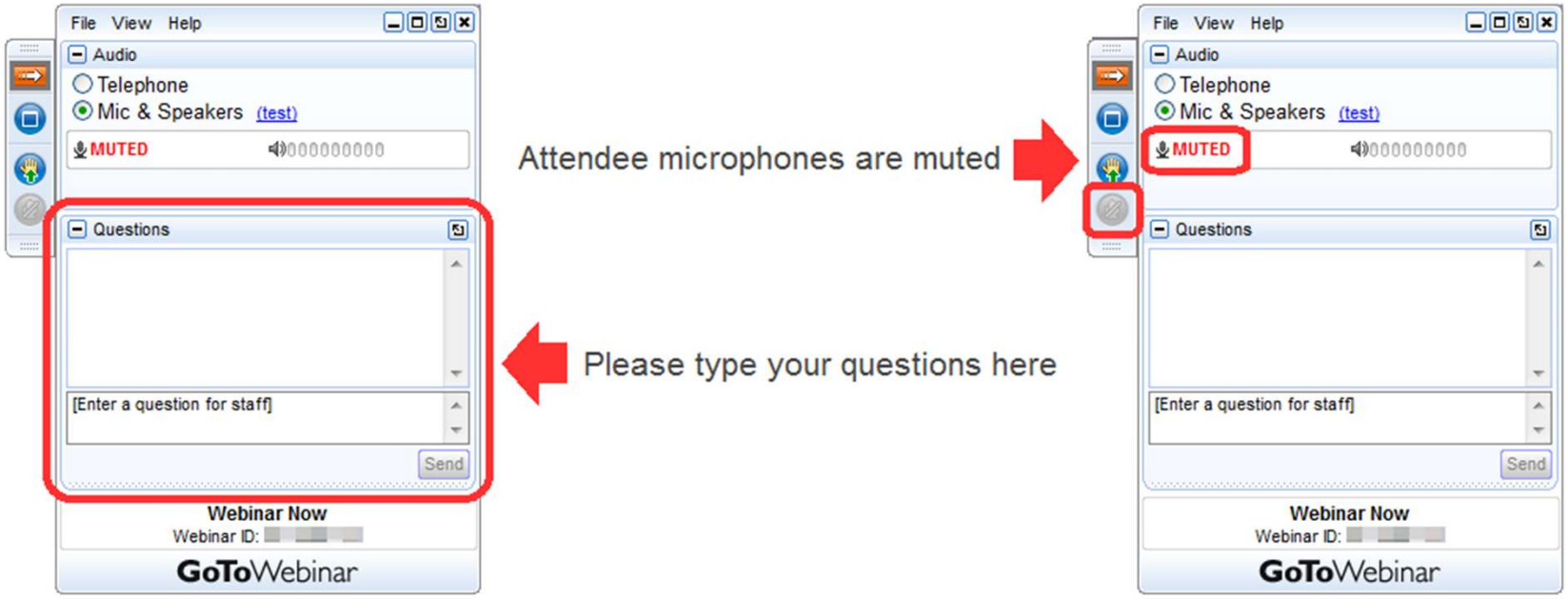

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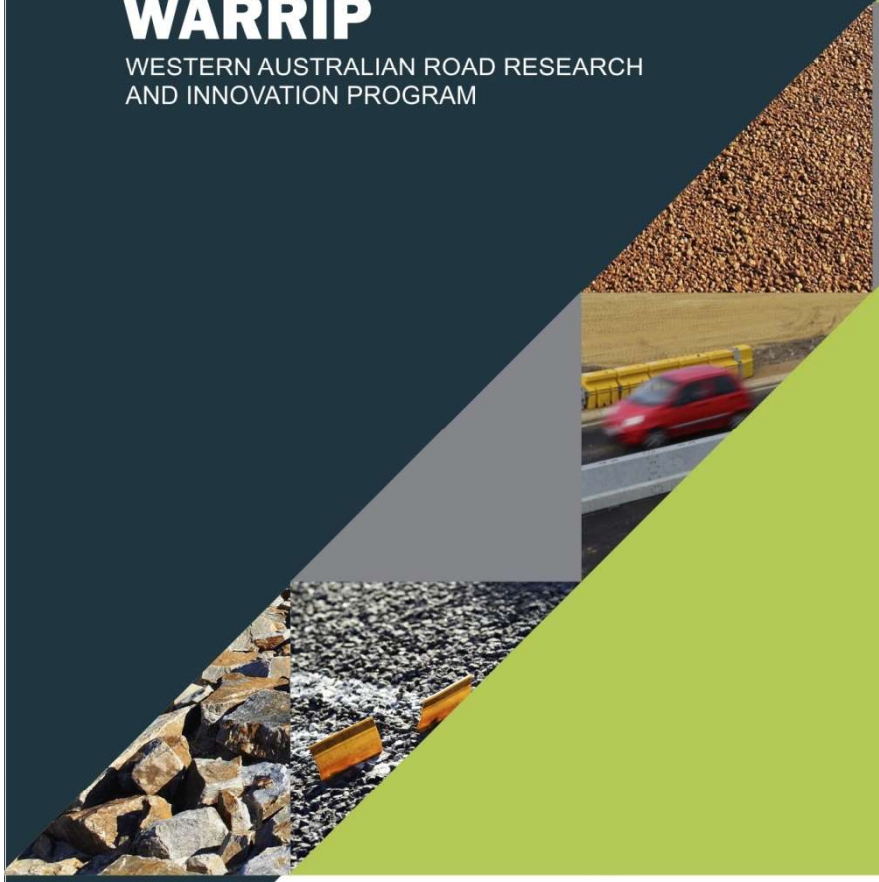

Practicality studies

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Practicality studies

- Investigate implications of RAP containing CRM asphalt
  - Reclamation
  - Processing
  - Plant mixing
  - Paving

- Trial 1 –2019
  - Fulton Hogan
  - Batch plant
  - 10% CRM-RAP via substitution
- Trial 2 – 2020 (ongoing)
  - Downer
  - Drum plant
  - 25% CRM-RAP

Source of CRM-RAP

- Yard trial laid as part of GGA-CRM WARRIP project
  - Paved March 2019
  - Fulton Hogan yard
  - Binder content 8% (by mass)
  - CRM-binder 18% CR (by mass) with a C170 binder

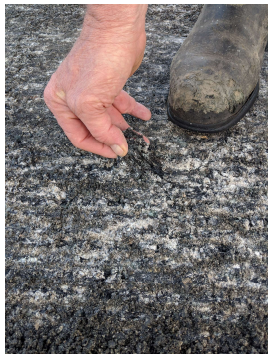
- *WARRIP Transfer of appropriate crumb rubber modified bitumen technology to WA, Stage 2: Gap graded asphalt*

Trial 1 – 10% CRM-RAP

- Reclamation
  - May 2019
  - 10 tonnes
  - Wirtgen W200
- Processing
  - June 2019 by Asphalt Recyclers Australia
  - Impact crusher
  - As per MRWA specification 511 (-9.5mm)
- Plant trial and paving
  - August 2019 by Fulton Hogan
  - Batch style plant
  - 10% via substitution
- Issues and observations
  - No major issues encountered during process
  - Some CRM-RAP remained on processing screens, but no more than conventional RAP

Trial 2 – higher volumes of CRM-RAP

- Reclamation
  - March 2020
  - 20 tonnes
  - Wirtgen W120
- Processing
  - May 2020 by Asphalt Recyclers Australia
  - Impact crusher
  - As per MRWA specification 511 (-9.5mm)
- Plant trial planned
  - 25% CRM-RAP
  - Drum style plant
- Issues and observations
  - Some stickiness during reclamation
  - Build up during processing causing stoppages



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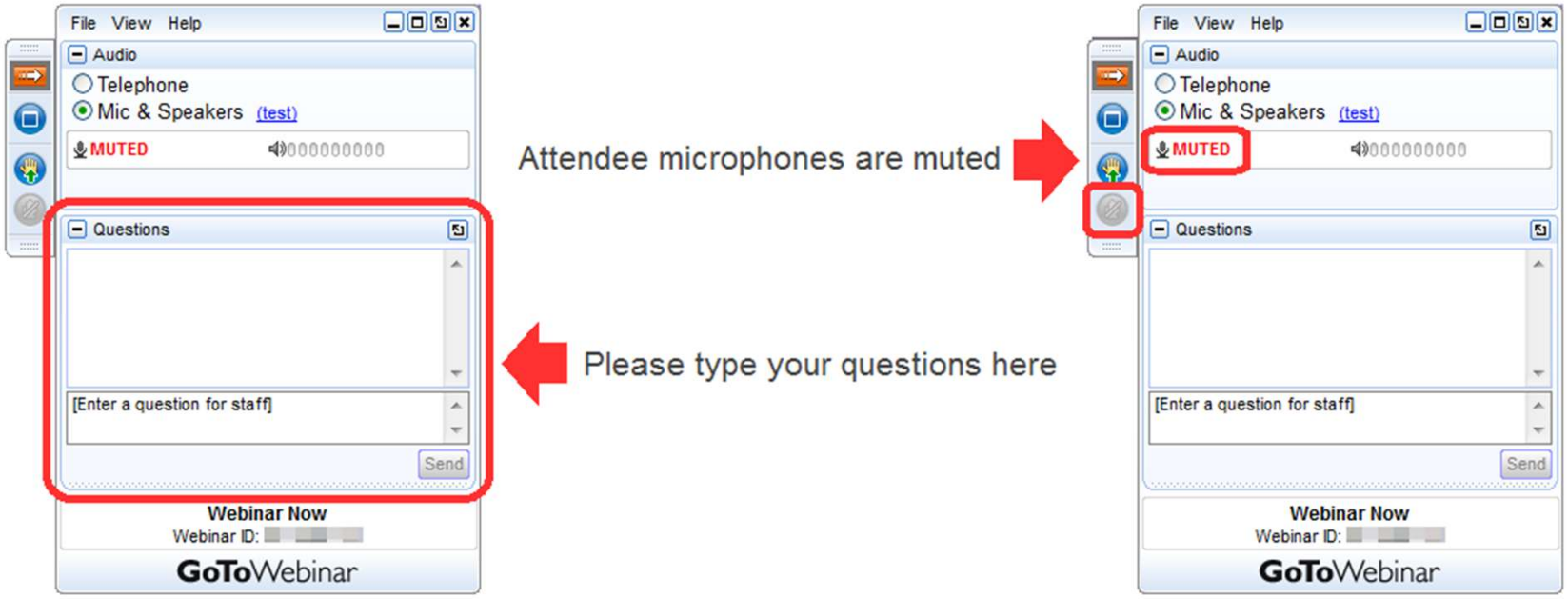

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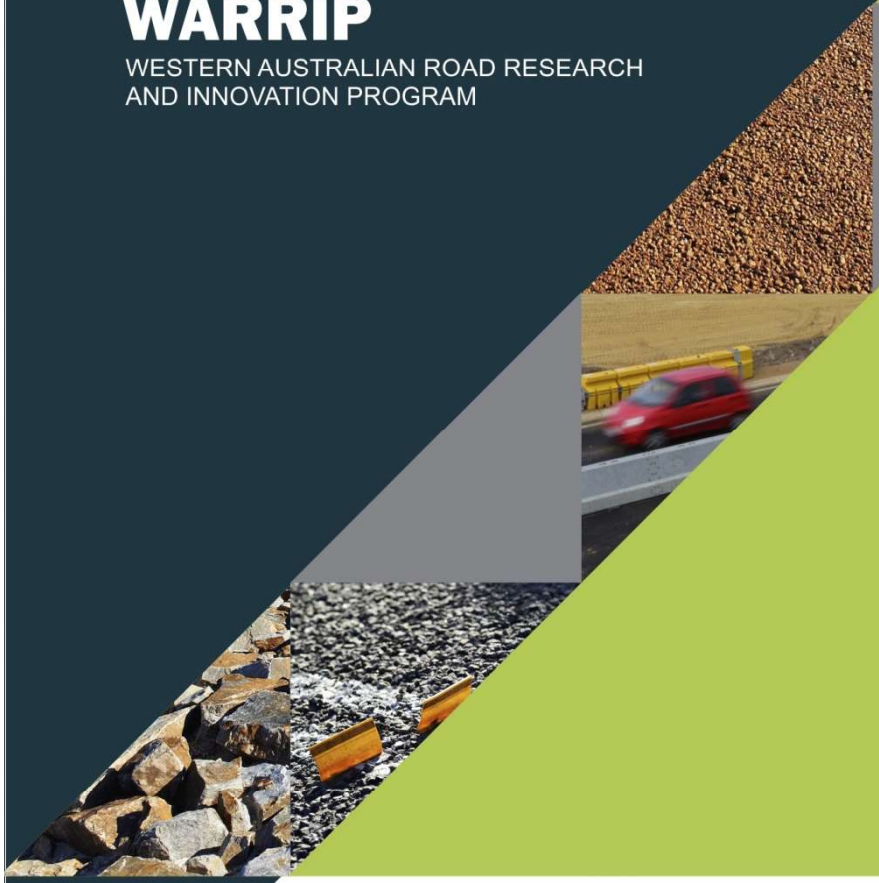

Summary and Next Steps

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Summary and next steps

- Issues identified
  - some practical issues especially at high volumes
  - characterisation difficulty
  - traceability implications and dilution

- Further investigation:
  - viscosity and characterisation
  - alternative design methods
  - performance implications
  - dilution and traceability solutions

Industry partners

TyreStewardship AUSTRALIA

ASPHALT RECYCLERS AUSTRALIA Pty Ltd

Fulton Hogan

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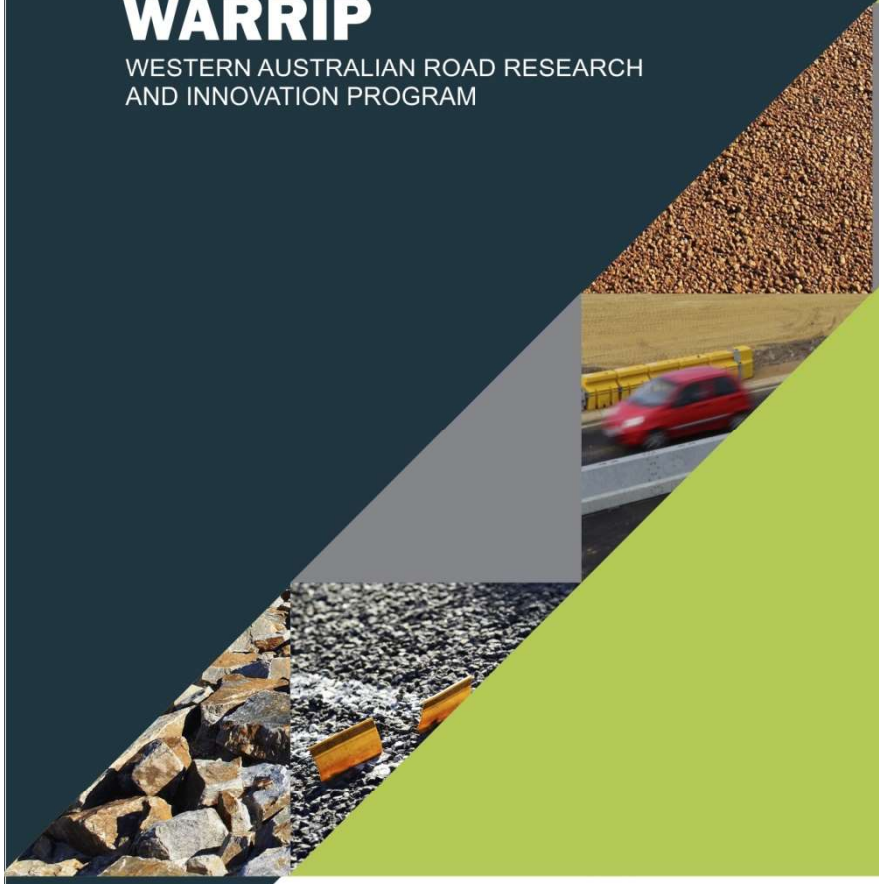

Q & A

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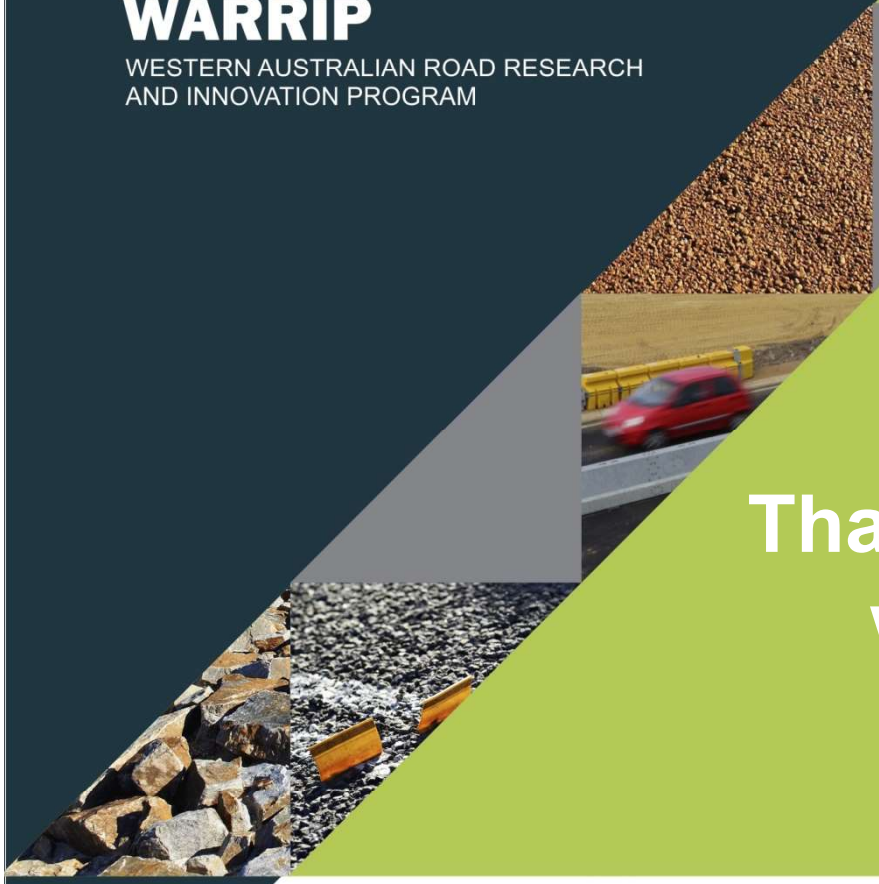

Thanks for listening!
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