WARRIP
WESTERN AUSTRALIAN ROAD RESEARCH AND INNOVATION PROGRAM

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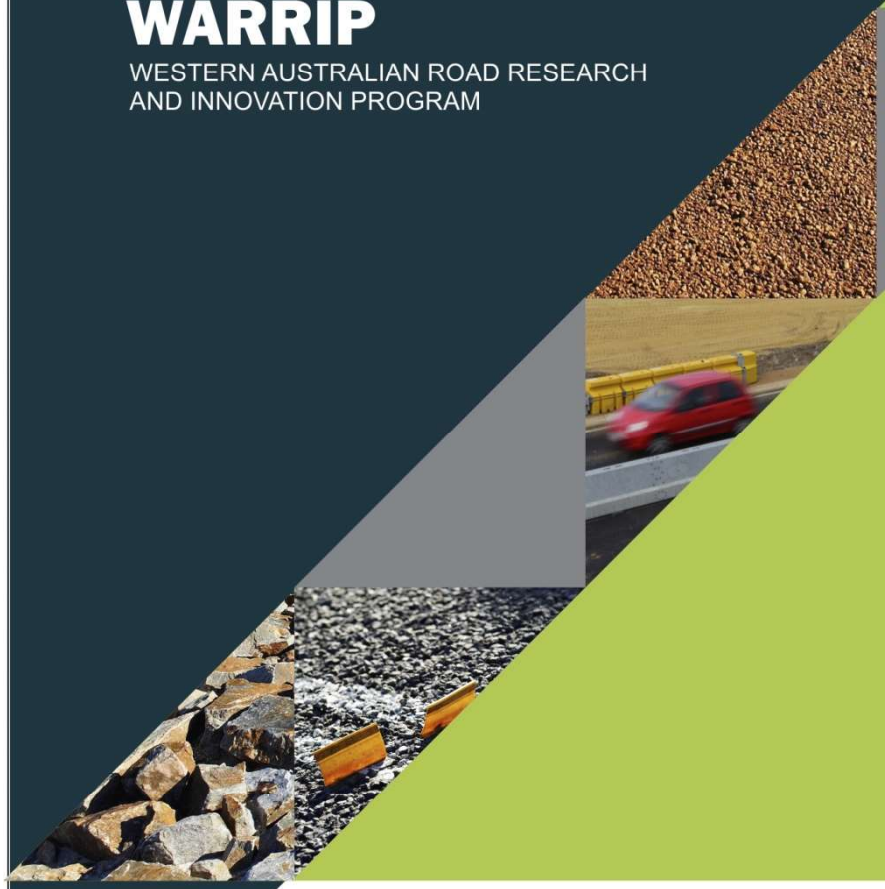

Investigating the use of recycled and reclaimed plastic in safe, sustainable future road infrastructure

Presented by:
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Collaboration between WARRIP and NACOE

Problem Statement

- Widespread national interest in developing uses for waste plastics.
- Some companies in the asphalt industry have responded with pioneering work on the use of recycled plastics in asphalt.
- No consistent holistic assessment methodology or standard has been developed to assess these products.
- Guidelines and standards for the use of recycled waste plastic materials in pavements are needed.
- This will enable greater use of recycled materials in road infrastructure without adversely affecting service life, user safety, connectivity-enabling ability, workplace health and safety (WHS) and environmental impact.

Project Objective

- This research is expected to define which waste recycled plastics can be used for which applications.
- It will try to target problem waste streams, in so doing helping to produce fully functioning road infrastructure with properties at least the same or better than the non-recycled plastic containing alternatives.
- It will also develop a framework for monitoring the implementation, performance and environmental impact of road infrastructure materials containing recycled plastic.
- This work will pay attention to bitumen and asphalt products modified with waste recycled plastics, but this will not be the sole focus of the work. More suitable and viable options for the recycling of waste plastics will be considered and assessed.

Methodology

- Step 1: A comprehensive review of relevant local and international work on the use of waste plastics in road construction and transport infrastructure
- Step 2: Build a database of information about waste streams in Qld and WA
- Step 3: Investigate the health and safety requirements and environmental impacts associated with the use of waste plastics in road construction, including those associated with microplastics
- Step 4: Assess engineering properties and impact on durability of various plastics in asphalt

Context

- Each year Australia generates significant quantities of waste plastics; in 2017-18, 3.4 million tonnes of plastic was used, with only 9.4% recycled.
- Allied to this, Australia has a road network of almost 875,000 km - represents a great opportunity.
- Large variety of literature in this space; spanning Europe, USA, Asia, South Africa, Australia & New Zealand and more. However, not always high quality.

Roads and applications

- Accessories and aesthetics
  – bollards, furniture, noise walls etc.
- Bike paths and footpaths
- Geotextiles and geogrids
- Recycled plastic pipes
- Concrete – fibre reinforcement, fine aggregate replacement
- Railway sleepers
- As stabilisers or dust suppressants
- As bitumen modifier or in asphalt

Due to the amounts and types of waste plastic generated, to ensure significant impact on the waste stream multiple applications will need to be considered and applied in parallel – no application can tackle the challenge alone.

Waste plastic to modify bitumen and asphalt

- Modification through wet, dry, or hybrid processes – number of ways plastic can be applied in pavement applications.
- The wet process blending conditions (time, temperature etc.); can significantly impact final properties of the bitumen.
- Key challenges with storage stability and opportunities for tackling this problem.
- End-of-life and reuse, e.g. as RAP; there is limited information in this space.
- Combination with other materials; glass, rubber, RAP – already trialled across Australia with promising results.

Quantities - Hypothetical calculations

- Approximately 800 000 tonnes of bitumen are supplied per year in Australia for road pavement applications
- If all bitumen incorporated a recycled plastic component of 6%, this would represent approximately 48 000 tonnes of plastic
- This amount equates to less than 2% of Australia's entire annual plastic consumption

Key findings from Literature review

- Knowledge gaps

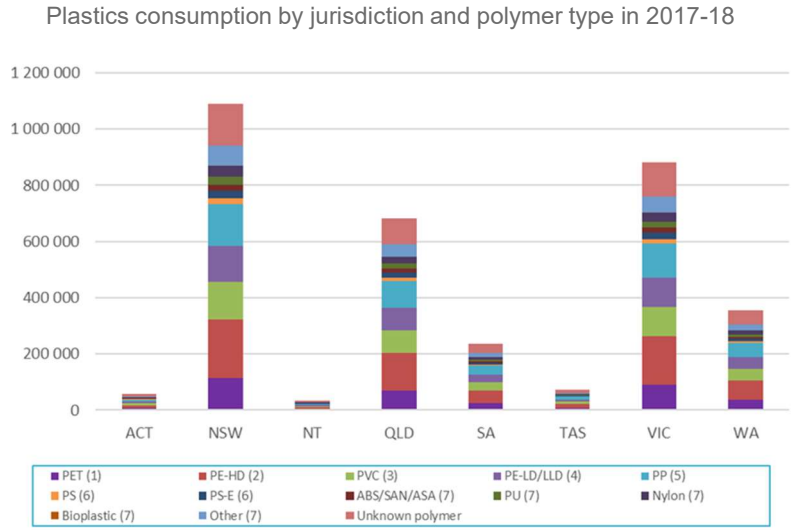
- Environmental impacts; microplastics, leaching
- Clearly defined engineering properties based on plastic type and incorporation method
- Re-recyclability of infrastructure containing recycled plastics
- Full potential for use with other recycled materials
- Best method and most suitable waste stream for use in asphalt; current research spans variety of options
- Long-term performance testing

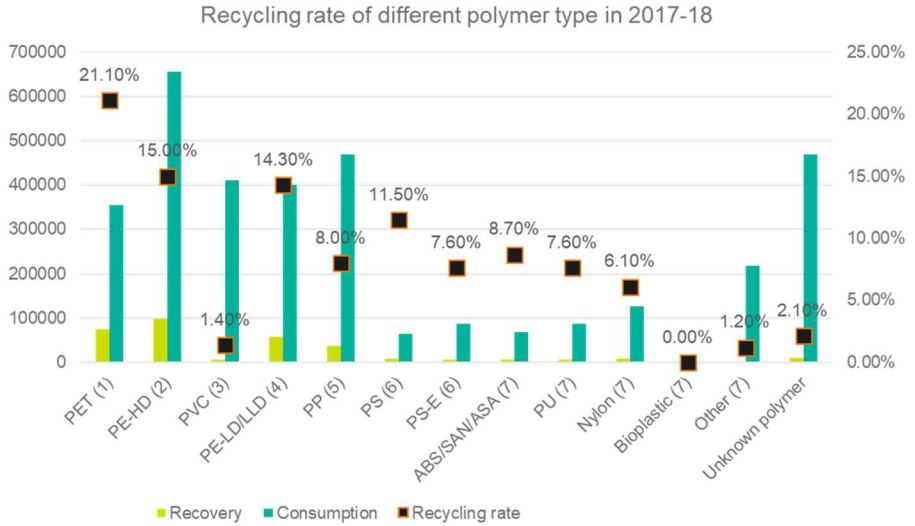
Waste stream management review data collection & analysis

Currently in Australia, the waste plastic recycling program includes:

- ***Kerbside recycling:*** contractors/council collectors taking recyclable plastics to MRFs, where it is sorted, compacted, and baled for sale.
- ***Commercial and industrial.*** Contractors collect from workplaces are sorted in MRFs
- ***Container deposit schemes:*** collection of selected plastic drink containers (made of PET and HDPE plastics). Currently operating in SA (Since 1977), NT (2012), NSW (2017), QLD (2018), and WA (2020).
- ***Collect and return to store:*** Companies like REDcycle collect soft, single-use plastic that consumers return to major supermarkets and on-sell to other companies such as Replas.

146 LGAs (about 27%) in Australia have no infrastructure for kerbside collection of plastic waste





WH&S, Environmental Impacts - Approach

- Framework for assessment developed
- Look at road infrastructure containing waste recycled plastic
- Consider life phases for example waste plastic modified asphalt
  - Product manufacture
  - Road construction (laying)
  - In-use lifetime
  - Maintenance interventions
  - End-of-life rehabilitation
- Considerations and risks during each phase
- Develop Test Protocol:
  - Several laboratory test methodologies have been considered to assess the concentration of contaminants of concern and microplastics in surface and groundwater running off or leaching from road products containing plastics and traditional material.
  - Consulting with SQP regarding the test protocol, criteria and thresholds to evaluate the results

Qualitative Sustainability Assessment – SAT Tool

- To establish emission factors for material production, impacts can be assessed by comparing the energy use between different production methods:
  - Dry method: using high melting point plastics
  - Wet method: using low melting point plastics
  - Hybrid method: using low melting point plastics
- The wet (dry) method is expected to result in the most (least) GHG emissions and energy costs due to the difference in the heating required to melt plastics
- Increased energy cost may be offset by lower material costs

Likely Future Plan – Short-term

- Plastic waste streams to be chemically characterised
- Blending trials with bitumen
- Produce a register of ‘plastic in road construction’ projects

Long-Term Five-stage Approach

- Background and Establishment
- Environmental and WHS Impacts – Laboratory Testing Development
- Engineering Performance – Laboratory Assessment
- Full Scale Construction and Trials
- Guidelines and Standards Development

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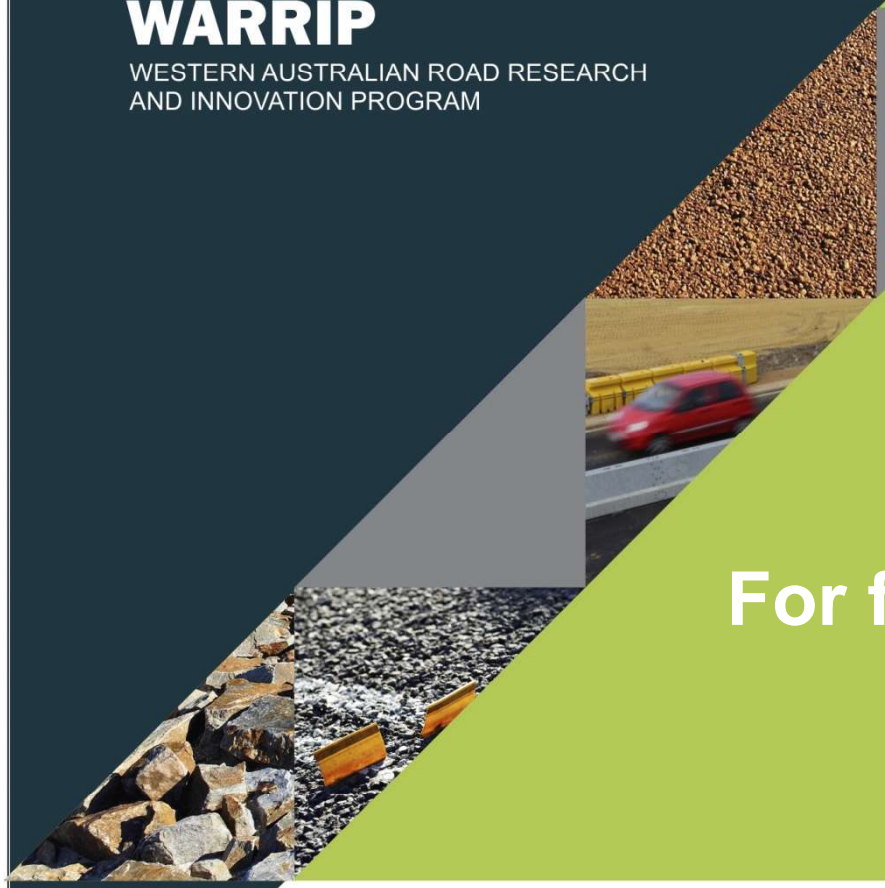

Questions

For further information visit the WARRIP website www.warrip.com.au

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