



WARRIP

WESTERN AUSTRALIAN
ROAD RESEARCH &
INNOVATION PROGRAM



WARRIP 2021-23

PROGRAM HIGHLIGHTS

TO FIND OUT MORE
GO TO WARRIP.COM.AU OR
EMAIL INFO@WARRIP.COM.AU

A JOINT INITIATIVE WITH:



ABOUT THE PROGRAM

THE WESTERN AUSTRALIAN ROAD RESEARCH AND INNOVATION PROGRAM (WARRIP) IS A JOINT INITIATIVE BETWEEN MAIN ROADS WESTERN AUSTRALIA AND THE AUSTRALIAN ROAD RESEARCH BOARD. OUR MISSION IS TO POSITIVELY CONTRIBUTE TO THE DESIGN, CONSTRUCTION AND MAINTENANCE OF TRANSPORT INFRASTRUCTURE IN WA, THROUGH THE DELIVERY OF PERTINENT, COLLABORATIVE RESEARCH.



Innovation

Be curious. Contribute to the body of knowledge.



Collaboration

Share our learnings with industry, government and academia.



Sustainability

Advocate for a better future. Seek value in all endeavours.

VISION

To be a leading voice enabling the development of sustainable solutions for a safer transport sector.



Implementation

Support and champion the uptake of good ideas.



Quality

Strive for excellence in all that we do.

A JOINT INITIATIVE BETWEEN



MEET THE BOARD



John Erceg

MANAGING DIRECTOR, MAIN ROADS
WESTERN AUSTRALIA



Doug Morgan

EXECUTIVE DIRECTOR PLANNING AND
TECHNICAL SERVICES, MAIN ROADS
WESTERN AUSTRALIA



Michael Caltabiano

CHIEF EXECUTIVE OFFICER, ARRB



Richard Yeo

CHIEF OPERATIONS OFFICER, ARRB

PROGRAM SNAPSHOT

AS OF 2023, THE WARRIP'S RESEARCH OUTCOMES HAVE RETURNED AN ESTIMATED DIRECT AGENCY COST SAVINGS OF BETWEEN \$43.7 - \$75.5 MILLION AGAINST PROGRAM COSTS TOTALING \$5.7 MILLION.

62

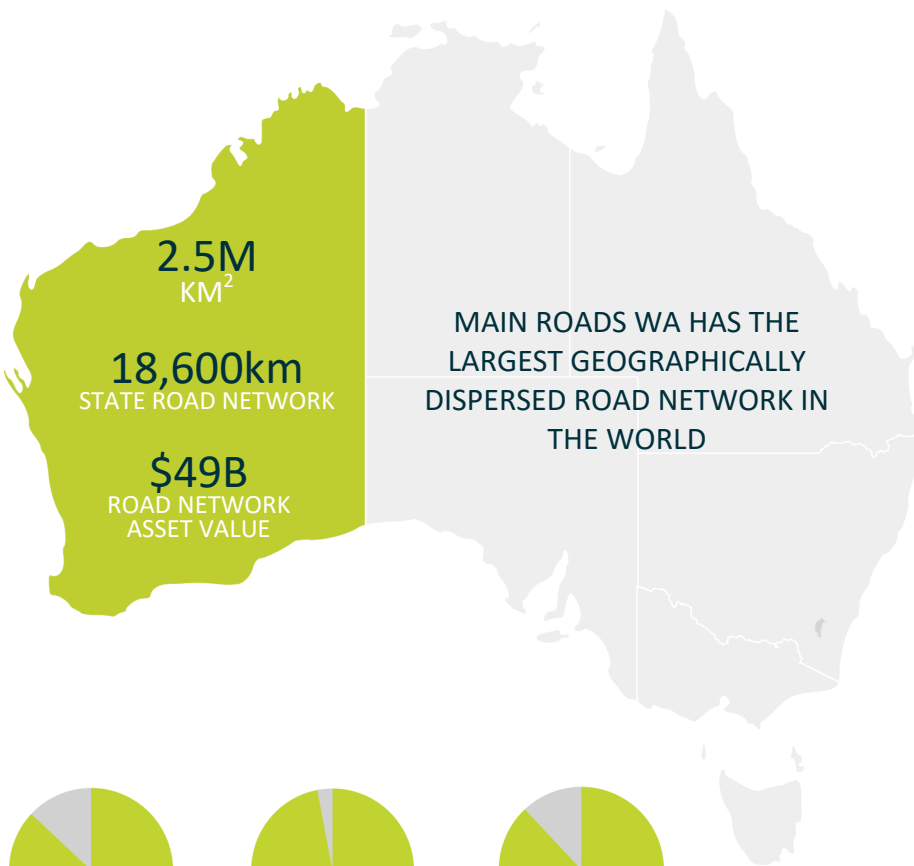
RESEARCH TOPICS INVESTIGATED

86

TOTAL PROJECTS

73

PROJECTS COMPLETED



4 INDUSTRY PARTNERSHIPS



3 JOINT RESEARCH PROJECTS



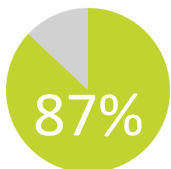
2 UNIVERSITY COLLABORATIONS

8

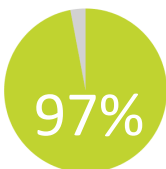
YEARS ACTIVE

790

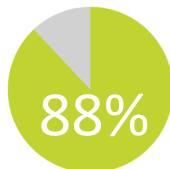
MILESTONES DELIVERED



ON TIME



ON BUDGET



TO REQUIRED QUALITY

>5.7

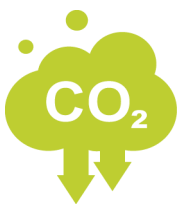
ACHIEVED BCR (2021-2023)

39

REPORTS PUBLISHED

RESEARCH OUTCOMES

THE WARRIP CAN MEASURE ITS SUCCESSES NOT ON THE STATISTICS OF ACHIEVEMENTS AS CONTAINED HERE-AFTER, BUT ON ITS ABILITY TO DISSEMINATE THE FINDINGS FOR EASE OF ADOPTION AND IMPLEMENTATION.



SUSTAINABILITY

Sustainable outcomes are one of the drivers behind the WARRIP research. Ongoing research topics include recycled materials, the impact of climate change and evaluating optimal choices to support lower emissions.

Crumb Rubber

WARRIP continues its research into recycled rubber use in road grade bitumen with a stage 2 project that will investigate recycling end-of-life rubber from vehicle tyres and industrial functions into crumb rubber modified (CRM) binder technology for road building applications. Results from this project are intended to assist the development of improved technical guidelines that would facilitate an improvement in product performance and an increase in the number of suitable applications for usage of CRM in Western Australia.

Climate Change

Extreme climatic or weather events have the potential to damage and/or disrupt the operation of road infrastructure. WA's road network comprises more than 18,500 km of

major roads, highways and various assets which are becoming increasingly vulnerable to future climate hazards or events.

WARRIP recently conducted research into understanding and responding to the vulnerability of the road network against impacts of climate change and extreme weather events.

A vulnerability assessment approach to support network planning and resilience investments for managing future climate threats and natural hazards was developed as a result of the project.

This project is ongoing with a baselining activity currently underway and further work anticipated in this vital area over the coming years.

Climate Change Continued

Between the months of October and March, parts of Australia can experience extreme heat and increasingly higher temperatures due to climate change effects.

These shifts in weather patterns saw a string of unprecedented bushfire events across Australia from 2018 to 2020 which devastated many of our communities.

In a joint initiative with the National Asset Centre of Excellence (NACOE), WARRIP worked together to develop a framework for Incorporating Bushfire Resilience into Road Infrastructure.

The framework will assist road agencies with bushfire resilience strategies to incorporate into road network planning, design, construction, maintenance, and operations.



SAFETY IMPROVEMENTS

WARRIP projects with safety benefits have shifted to focus on reviewing recent strategies to determine whether current safety strategies can be improved.

Our research into understanding right-turn thru crashes occurring at filtered traffic signals in Western Australia aims improve the understanding of factors that contribute to crashes by examining the nature and timing of right-turn thru crashes at signalised intersections and how to manage filtered traffic signals to minimise the risk of this crash type.

WARRIP is also reviewing low cost urban road safety treatments including mini-roundabouts, road safety platforms and compact roundabouts to assess their effectiveness. WARRIP will also provide insight into potential improvements to maximize the potential impact of these treatments in future.

Future work in this space includes a review of low cost regional safety treatments undertaken through the Regional Road Safety Program.



WARRIP PROJECT

INVESTIGATING THE USE OF RECYCLED AND RECLAIMED PLASTIC IN SAFE, SUSTAINABLE FUTURE ROAD INFRASTRUCTURE

TECHNICAL AREA: SUSTAINABILITY

YEARS: 2019- 2023

Queensland Department of Transport and Main Roads (TMR) and Main Roads Western Australia (MRWA) have collaboratively delivered this joint project under the NACOE and WARRIP programs. The aim of this project was to increase awareness of the potential uses of recycled materials in transport infrastructure construction and maintenance. The project addressed some of the questions that need to be answered in order for plastics to be introduced in safe and sustainable applications it is important to answer the following questions:

- Are the products safe for the environment, community and workers?
- Do they have any long-term operational implications?
- Are the products recyclable at the end of their life?
- Do the products perform as well or better than currently used materials?

The project has determined that there are great opportunities for exploring use in geosynthetics such as geogrids, geotextiles and geonets. WA is exploring incorporating recycled plastics into products used in road construction and maintenance such as traffic management and temporary traffic management devices such as bollards, wheel stops, speed bumps, barriers and rumble bars are an excellent option for incorporating recycled plastics into WA road construction and maintenance.



ASSET MANAGEMENT

Main Roads WA asset management teams continue to seek better ways of managing and monitoring the performance of the network. They are committed to continuous improvement and the WARRIP program is supporting these efforts with some targeted research.

WARRIP is undertaking research to review Main Roads' regional maintenance management operations. The project is looking to improve efficiency by maximising the effective use of existing systems and tools in planning cyclic and reactive routine maintenance works, including the Road Maintenance Investigatory Parameters (RMIP). Main Roads' operational asset management framework and maintenance management system needs will be reviewed, and recommendations presented to optimise, educate, and improve efficacy.

Many bridges across WA are constructed with Jarrah and Wandoo piles, and have been in operation for more than 60 years. To mitigate localised deterioration and extend the useful life of these structures, epoxy fill/injections have been successfully used as a semi-structural solution for the past 20 years. WARRIP has been exploring the application and efficacy of epoxy resins on timber pile bridges. The next stage of this research will undertake testing to further

validate this application.

Cantilever signs have been installed as part of the smart freeways in Perth. WARRIP has investigated the best approach to look after these structures. Current practices and procedures will be updated to incorporate the necessary testing, maintenance and replacement schedules.

Recent recruitments and changes to Main Roads in-house maintenance offering means that there are many people with diverse knowledge and expertise within the organisation. Ensuring all the lessons learnt are passed on to up and coming staff is key to retain and build capability within Main Roads. WARRIP is supporting these efforts by providing training and guidance on best practice knowledge transfer methods.

This diverse range of projects seeks to service many branches within Main Roads connecting staff with information they need to do their jobs with excellence.





WARRIP PROJECT

IMPROVING DECISION MAKING AND WORKS PROGRAM DEVELOPMENT WITH CONTINUOUS NETWORK STRENGTH AND CONDITION DATA

TECHNICAL AREA: ASSET MANAGEMENT

YEARS: 2019- 2021

WARRIP developed and validated an improved rutting deterioration models that allows Main Roads WA to better predict rutting on the full network and each link category. Rutting was identified as one of the main contributing factors to the initiation of rehabilitation work. Being able to predict rutting across the network will allow for strategic planning to apply the correct level of rehabilitation at any given location.

Developing the rutting model was an iterative process where different techniques were tested to generate suitable models. The validation of the models was done in two steps using the datasets used in the model development as well as an independent dataset not used during the model development. The dataset used in the model development produced more accurate results but the independent test data still predicted rutting well.

Approach 1 was a comparison with the rate of rutting progression for selected WA regions - similar matrices for 2 regions and review of the proportions in different rut ranges using both observed and predicted data. Approach 2 was a comparison of the predicted rutting using existing MRWA rutting deterioration rate, and the new model developed for the project. For all the years compared, the predicted rutting using the project stage 3 model is much closer to actual observed data.

Although the differences between actual and observed data and predicted rutting widen over time, the new developed model still predicted rutting with a $\pm 1\text{mm}$ accuracy for 56% of the testing segments.



TOOLS, TECHNOLOGIES & TESTING



WARRIP is always on the look out for tools, technologies and methods that will improve efficiency, reliability and accuracy of the tests routinely undertaken to understand the condition of WA roads.

The following are snapshots of the projects undertaking this type of research:

How to mitigate moisture ingress risks during the construction of pavement to avoid premature deterioration by minimising the effects of moisture caused by pavement design, asphalt mix design and construction standards.

Investigating a method of nuclear density for testing asphalt density as a reliable, non-destructive and rapid test that delivers results comparable to pavement coring.

Understanding the potential to use ground penetrating radar to answer the question of what lies beneath the asphalt surface of a road pavement. This technique is non-destructive and can also be undertaken at traffic speeds, reducing the need for traffic management, lane closures and increasing safety for operators. Giving asset managers information in order to select the best rehabilitation or maintenance treatments for an existing road.

For pavement to perform optimally, adjacent pavement layers need to be fully bonded together otherwise the full structural capacity will not be realised. WARRIP has developing a standard test method that will assess the bond strength between two asphalt layers (new and existing) using the Leutner shear test

apparatus. This new test method will be used to investigate the effects of temperature, surface texture and tack coats on bond strength.

Characterising pavement materials correctly is essential to pavement design and making sure our roads last well into the future. This means reviewing common laboratory test methods and making sure they suit Western Australian materials. WARRIP is currently reviewing the California Bearing Ratio test method to make sure it provides representative strength outcomes when used in conjunction with our common pavement gravels from around the state. Being such a large land mass Western Australian geology differs from region to region and therefore regional adaptations to test methods are often needed.





PAVEMENTS

In order to better understand how well we are transitioning towards a circular economy and to support this project WARRIP has been undertaking work to create a database of all the locations and constructions records where recycled materials have been used. This will support the development of a framework for monitoring the long term performance of pavements and other road assets incorporating recycled and conventional materials.

This long term monitoring will provide evidence needed to understand and evaluate how these materials have performed. Identifying areas for new research or supporting the implementation of unconventional materials.

The second part of the research undertaken has resulted in a framework for the assessment of new waste materials for suitability in road construction. WARRIP acknowledges particularly the large mining sector that has many waste materials that are produced. This sector now has a pathway for assessing their materials for incorporation into road construction.



WARRIP has begun work to better understand asphalt design moduli. To date a review has been undertaken of the various approaches to design modulus across Australia. Understanding whether the Western Australian approach differs at any critical phases and the considering the impact this might have on the pavement construction will help guide the next stages of investigation.

The goal of this project is to understand the scale of the fatigue and modulus concerns and the impact they are having on the performance of newly constructed pavements. This may lead to some recommendations for specifications or contract clauses to mitigate the risk of project failing to achieve design modulus.



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