*Category 4: Excellence in Pavement Recycling and Stabilisation in Local Government*

# City of Melville Foam Bitumen Stabilisation

Nathan Jacobs, Project Manager
WA Stabilising (Hiway Group)

WA STABILISING

*2022 AustStab Awards of Excellence*

*Proudly sponsored by* CATERPILLAR®

AustStab
Pavement Recycling and Stabilisation Association

Night Works with a limited operational window and complex stakeholder requirements

Preliminary testing and mix design by WAS (in conjunction with Hiways Tech team) to optimise the pavement and significantly reduce the carbon impact

Working with a Head Contractor to deliver client focused outcomes for the City of Melville

Working with the City in the early stages of their FBS journey to provide a high quality pavement and long- term confidence in FBS

# Project Overview

Our history of collaborating with the Head Contractor and positioning ourselves as a trusted advisor assisted in the delivery of a scope of works outside their capabilities locally on a 3-year contract with City of Melville.

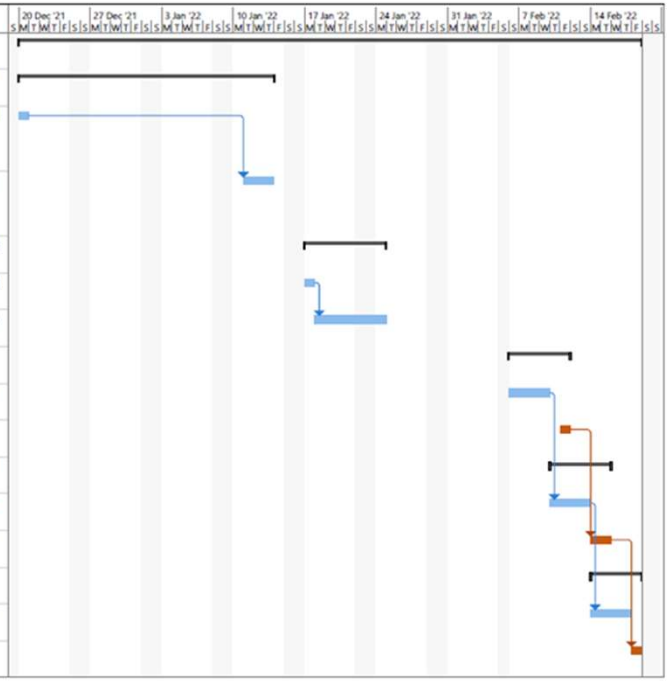
Delivering 16,000m² of Foam Bitumen Stabilisation on night shifts in a residential area over two weeks

*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*

# Project Program

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **City of Melville Stabilisation Projects 2021-2022** | **48 days** | **Mon 20/12/21** | **Fri 18/02/22** |
| 2 | **Preliminary** | **19 days** | **Mon 20/12/21** | **Thu 13/01/22** |
| 3 | Test pit sampling for design (Day Works Lane Closure) | 1 day | Mon 20/12/21 | Mon 20/12/21 |
| 4 | Service location and survey pick up (Night Works Full Closure) | 3 days | Tue 11/01/22 | Thu 13/01/22 |
| 5 | **Civil Works** | **6 days** | **Mon 17/01/22** | **Mon 24/01/22** |
| 6 | Murdoch A (Day Works Lane Closure) | 1 day | Mon 17/01/22 | Mon 17/01/22 |
| 7 | Riseley St (Day or Night Works TBC - Lane Closure) | 5 days | Tue 18/01/22 | Mon 24/01/22 |
| 8 | **Murdoch Drive B - Marsengo Road to Hawke Pass** | **6 days** | **Sun 6/02/22** | **Fri 11/02/22** |
| 9 | Stabilisation - NIGHTS full closure | 4 days | Sun 6/02/22 | Wed 9/02/22 |
| 10 | Asphalt Works - NIGHTS full closure | 1 day | Fri 11/02/22 | Fri 11/02/22 |
| 11 | **Riseley Street** | **6 days** | **Thu 10/02/22** | **Tue 15/02/22** |
| 12 | Stabilisation - NIGHTS full closure | 4 days | Thu 10/02/22 | Sun 13/02/22 |
| 13 | Asphalt Works - NIGHTS full closure | 2 days | Mon 14/02/22 | Tue 15/02/22 |
| 14 | **Murdoch Drive A - Hawke Pass to Leach Hwy** | **5 days** | **Mon 14/02/22** | **Fri 18/02/22** |
| 15 | Stabilisation - NIGHTS full closure | 4 days | Mon 14/02/22 | Thu 17/02/22 |
| 16 | Asphalt Works - NIGHTS full closure | 1 day | Fri 18/02/22 | Fri 18/02/22 |




# Construction

The project was scoped as 16,000m² of Foamed Bitumen Stabilisation between three sites:

- Riseley Street, Booragoon – Southbound lanes from Karoonda Road to Leece Place
- Murdoch Drive (B), Winthrop/ Bateman – Northbound lanes from Marsengo Road to Hawke Pass
- Murdoch Drive (A), Winthrop/ Bateman – Northbound lanes from Hawke Pass to Leach Highway

Due to higher traffic volumes, detours available, as well as the proximity to Leach Highway, the stabilisation works needed to be undertaken at night with working hours from 18:00 – 06:00 for Murdoch Drive (B) and 19:00 – 05:00 for Riseley Street and Murdoch Drive (A).

Whilst WA Stabilising were on site to complete a large portion of the works, we were not the only contractor on-site, thus requiring WA Stabilising to ensure no programme slippage due to its work being on the critical path for the project as shown to the left.

*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*

# In-house Expertise

- WA Stabilising utilised the in-house capabilities of the Hiway Group's expertise to conduct initial testing and develop a suitable mix design.
- Once constructed, the insitu strength of the FBB was to be 2000MPa – Hiways' philosophy is the FBB laboratory results should as a minimum double the nominated insitu design value – the target value for the laboratory results for this mix design was a minimum of 4000MPa.
- Liquidlabs WA undertook the foamed bitumen base testing for Hiways, using four different bituminous binder application rates, at 0.5% intervals. The bituminous and secondary binder application rates are shown in the table.
- Location 2 – 2.0%, 2.5%, 3.0% and 3.5% bituminous stabilising agent and 1% secondary stabilising agent (GP Cement).
- Location 3 – 2.0%, 2.5%, 3.0% and 3.5% bituminous stabilising agent and 1% secondary stabilising agent (Hydrated Lime).
- Different secondary binders were used – GP Cement and Hydrated Lime – to optimise the mix design.

| Foamed Bitumen Base - Mix Design Results | | | | |
|---|---|---|---|---|
| | GP Cement | | Hydrated Lime | |
| Binder % | Modulus (MPa) | | Modulus (MPa) | |
| | *Initial* | *3 Day* | *Initial* | *3 Day* |
| 2.0% Bitumen Binder | 525 | 3241 | 1096 | 5158 |
| 2.5% Bitumen Binder | 671 | 3473 | 1235 | 5393 |
| 3.0% Bitumen Binder | 759 | 3997 | 1431 | 5192 |
| 3.5% Bitumen Binder | 698 | 4321 | 1479 | 5892 |

The resultant data from the laboratory mix design process shows the hydrated lime offers a higher modulus over GP cement, when assessed against the same volume of binder used. At 2.5% bitumen content the average retained modulus is at the a maximum value. It is recommended the following mix design be adopted for the manufacture of the insitu FBB for this project.

- 2.5% bituminous stabilising agent and 1% secondary stabilising agent (Hydrated Lime).

# Innovative Pavement Design

## CHALLENGE

- Minimal design data at tender phase to assess best percentage of recommended binders to provide the desired outcome. The client did not have a design pavement strength that it required for the contractor to work towards
- Short design window between project award and required construction date. Contract award was late November 2021 with construction programmed to start early February 2022.

## INITIATIVES

- Pavement Investigation and sampling was taken immediately after award. Visual and photographic evidence along with early PSD and material strength testing allowed WAS to determine the material variability and ideal starting binder content point prior to commencing the design works.
- Research carried out on similar pavement types and loading characteristics allowed WAS to identify the nominal pavement strength required. WAS used its expertise to propose a constructed insitu FBB strength of 2000MPa with a mix design target of min 4000MPa.
- WAS managed to present the required design report to the Shire in a timeframe that allowed adequate time for a sufficient review prior to the construction date. WAS performed the required laboratory design work during the Christmas shutdown to allow time in early January to review the data and provide an appropriate design for the works.

## DESIGN DETAILS

- WA Stabilising utilised the in-house capabilities of the Hiway Group's expertise to conduct initial testing and develop a suitable Mix Design.
- As the sampled material was uniform through both locations, FBB testing was carried out using samples of insitu material from 2 of the test locations. Design testing was carried out using 0.5% bitumen increments.
- Testing was also carried out using 2 secondary binders – GP Cement or Hydrated Lime were used as secondary binders to optimise the mix design.

Table 4 – FBB mix design Modulus results

| Foamed Bitumen Base - Mix Design Results | | | | |
|---|---|---|---|---|
| Binder % | GP Cement | | Hydrated Lime | |
| | Modulus (MPa) | | Modulus (MPa) | |
| | *Initial* | *3 Day* | *Initial* | *3 Day* |
| 2.0% Bitumen Binder | 525 | 3241 | 1096 | 5158 |
| 2.5% Bitumen Binder | 671 | 3473 | 1235 | 5393 |
| 3.0% Bitumen Binder | 759 | 3997 | 1431 | 5192 |
| 3.5% Bitumen Binder | 698 | 4321 | 1479 | 5892 |

The resultant data from the laboratory mix design process shows the hydrated lime offers a higher modulus over GP cement, when assessed against the same volume of binder used. At 2.5% bitumen content the average retained modulus is at the a maximum value. It is recommended the following mix design be adopted for the manufacture of the insitu FBB for this project.

- 2.5% bituminous stabilising agent and 1% secondary stabilising agent (Hydrated Lime).

# Innovating Delivery

## CHALLENGE

- Given the location of works, the proximity to Leach Highway and the classification of all work areas as 'District Distributor A' roads by MRWA, the Traffic Management Plans provided us with 10- and 12-hour working windows from the site under traffic control to back under live traffic, the originally scoped by the Client had to be completed in the strict timeframes shown below.
  - Traffic Control Setup (by Others) – 1 Hour
  - Profiling (by Others) of 1,250m² at 40mm depth – 3 hours
  - Foam Bitumen Stabilisation and Compaction of 1,250m² – 3.5 hours
  - Final Trimming of 1,250m² – 1.5 hours
  - Production in situ testing – 1 Hour
  - Traffic Control Packdown (by Others) – 1 Hour
- During the pre-commencement meeting we were able to identify some opportunities to improve productivity and reduce the environmental impacts on residents.

## INITIATIVES

- Reducing initial milling depths from 40mm to 30mm, effectively brought WA Stabilising's site control time forward by an hour each shift, in addition to removing a window required for any import of top-up material.
- Institute Universal Total Station (UTS) Control for our Grader to reduce the requirement for pausing trimming to allow survey marks to be spotted and re-spotted (in addition to effectively taking another worker on foot out of the area).
- Utilise Quicklime as a substitute for Hydrated Lime, removing the need for on-site storage of lime products and allowing product transfers to take place in the WA Stabilising yard between shifts.
- Deployed a highly experienced and multi-skilled delivery team (crew comprised 3 Wirtgen Operators, 3 Spreader Operators, entire team certified on rollers)

# Innovating Survey

## CHALLENGE

- Working to WALGA Specification Appendix 7 – Pavement Rehabilitation by Milling and Recycling or Stabilisation requires a final surface tolerance of -5mm/+10mm for conformance to the specification.
- Working within the above tolerances, traditionally a surveyor would be surveying the work area throughout initial compaction and final trimming, spot marking heights for the grader operator to ensure compliance with the specification.

## SOLUTION

- Universal Total Station Control
- Takes the surveyor off the ground and out of the line of fire and People/Plant interface
- Very tight tolerances (0-10mm) – surveyor only required for final spot checks
- Significantly reduced Grader time (-33%) through not requiring re-spotting and re-marking of Final Trim heights
- Instant verification for the Client/Principal of work areas and lot sizes each shift

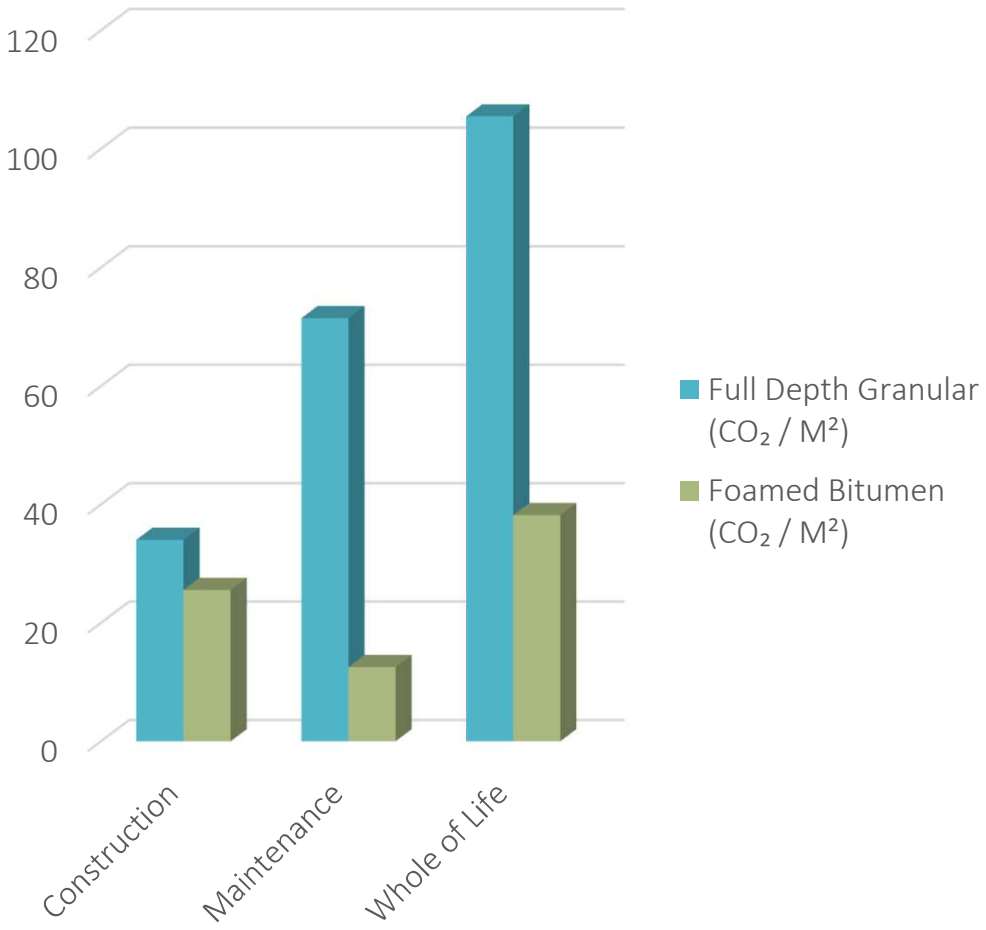
*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*

# Innovating Carbon

- The Hiways Group have developed a process to define the carbon impact for 15 different treatment options and how to continue to design for low-carbon performance in pavements. The calculation of the carbon emissions of the different pavement structures includes the emissions released throughout the supply chain of all inputs (including manufacture and transport). It also includes the carbon emissions of the construction process, its repairs and maintenance, and the end-of-life disposal and renewal.
- This high-level scan does not satisfy all the requirements of PAS 2050:2011 standard, as the purpose of the high-level scan is to elucidate those pavement designs that demonstrate better carbon performance than a business-as-usual (BAU, in this case Full Depth Granular) alternative. That is, the 'usual' design that a Hiways client might also be considering. As such, this high-level scan is delivered in a way that is consistent with PAS 2050:2011 standard and enables the detailed assessment of certain pavement designs to progress if needed.
- The outcomes of this high-level carbon scan can be seen on the following slide.
- Overall, compared to BAU, the best carbon saving overall comes from the Foamed Bitumen option due to its lack of maintenance.

# Innovating Carbon




- 25% reduction during Construction Phase (25.56 v 34.03)
- 82% reduction during Maintenance Phase (12.54 v 71.46)
- 64% reduction over a 40-year pavement life (38.20 v 105.49)

*Proudly sponsored by* CATERPILLAR®

AustStab
Pavement Recycling and Stabilisation Association


*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*

# Key Outcomes:
# Triple Bottom Line Assessment

ENVIRONMENTAL

- 25% reduction in $CO_2/m^2$ during construction compared to full dept granular equivalent
- 64% reduction in $CO_2/m^2$ over pavement life compared to full depth granular equivalent
- 85% reduction in Diesel Fuel used throughout the construction phas
- 100% re-use of materials – no imported material, all proposed expo material repurposed

SOCIAL

- 17% reduction in workdays – disruptions to residents
- 8.5% Indigenous Representation on Construction Team
- 8.5% Apprentice Representation on Construction Team

FINANCIAL

- 17% Reduction in Traffic Control Requirements for Principal
- 12.5% reduction in 'fresh' import material required
- 30% more area rehabilitated compared to business as usual

*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*


*Proudly sponsored by* CATERPILLAR®

AustStab
*Pavement Recycling and Stabilisation Association*