Category 3: Excellence in Sustainability

Healesville Kinglake Road Pavement Rehabilitation

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Downer
Relationships creating success

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Overview – Summary

- Pavement rehabilitation of 3.2km of Healesville Kinglake Rd
- Original scope → No in situ stabilisation works
- Poor quality lower subgrade material identified
- Proximity of underground services limiting excavation
- 3% GB cement stabilisation undertaken
- Conforming subgrade compaction results achieved
- Multiple asphalt pavement layers able to be constructed above

Figure 1: Geographic Location of Works

Overview – Detail

- The works were taking place along Healesville Kinglake Road, Chum Creek. The road is a two-way, two lane road, at an approximate pavement width of 6.2m.
- Original scope of pavement works required Downer to remove the existing asphalt pavement and subgrade material to a depth of 325mm, and then replace this with a 150mm layer of Class 4 FCR and 175mm of asphalt (various mix types) for the 3.2km length of the road.
- Our initial methodology noted that once all removal/profiling works were complete, the existing subgrade material would be shaped and compacted to achieve a consistent height of 325mm below FSL.
- Once a consistent subgrade height was achieved, the 150mm Class 4 FCR sub-base layer was to be constructed.
- Conditions were also placed upon Downer whereby no section of pavement could remain unsealed post completion of each working shift. This would mean that the process of profiling, subgrade preparation, sub-base construction, and intermediate asphalt layer construction had to be completed in one shift. This was deemed unachievable given the disjointed nature of how the works would have been conducted.
- Downer had raised concerns around trying to remove the existing pavement material to a depth of 325mm, and then constructing a Class 4 FCR layer above a saturated subgrade with a poor wet CBR value as highlighted in the geotechnical report.
- Further investigation through the use of DCP testing revealed that the lower subgrade was of a very poor quality and did not possess the strength properties required for us to reach the required compaction.
- Downer then proposed to VicRoads to supply and place a nominal 100mm layer of Class 3 FCR over the existing subgrade material at a depth of 175mm below FSL and then stabilise the subgrade with 3% cement to a depth of 200mm to try and bridge the lower lying strength issues.

Initiative Description

Removal of Existing Asphalt Pavement to a depth of 175mm below FSL completed first

Further removal of subgrade material to 325mm below FSL halted due to concerns over in-situ subgrade CBR

Insitu Subgrade Compaction Results Fail. Unable to construct original design pavement layers above saturated subgrade

Design Change, No further subgrade material removed. 100mm of Class 3 Rock imported and mixed into insitu material

3% Cement Stabilisation of Subgrade and Imported Class 3 to a depth of 200mm

Subgrade Compaction Results Pass. 175mm Asphalt pavement to be constructed above stabilised subgrade

Operating Environment

- Environmentally and culturally sensitive area
- High traffic area with primary school in close proximity
- Experiences both extremes of weather systems
- Fragility of underground services
- Shallow depth of underground services
- Working under lane closures

Figure 2: Working in Close Proximity to Native Vegetation

Figure 3: Locating Underground Services within pavement construction envelope

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Key Challenges

- COVID 19 – Regional Border Restrictions in Victoria
- Presence of native/protected flora and fauna
- Working with live traffic
- Demonstration of the value of the initiative to client
- Demonstration of the design suitability to client
- Fragility and shallow depth of underground services
- Keeping the road open to traffic at all times throughout the works

Figure 4: No Go Zone Fencing Installed

Points of Interest

- Initial client position → no design change necessary, in situ subgrade strong enough to support multiple granular and asphalt pavement layers above
- Client not traditionally receptive to pavement recycling techniques
- Client raised concerns regarding fatigue cracking

Initiative Testimonials

"Poor performing lower subgrade results will affect our ability to get compaction and also compromise the integrity of the finished product." ***(Matt Billings, Downer Stabilisation Manager VIC/TAS)***

"Big part of the problem will at 600 – 700mm depth, our previous experience suggests this is an issue that will keep reflecting through upper layers of pavement." ***(Tony Egan, Construction Manager VIC/TAS)***

Evidence of Success

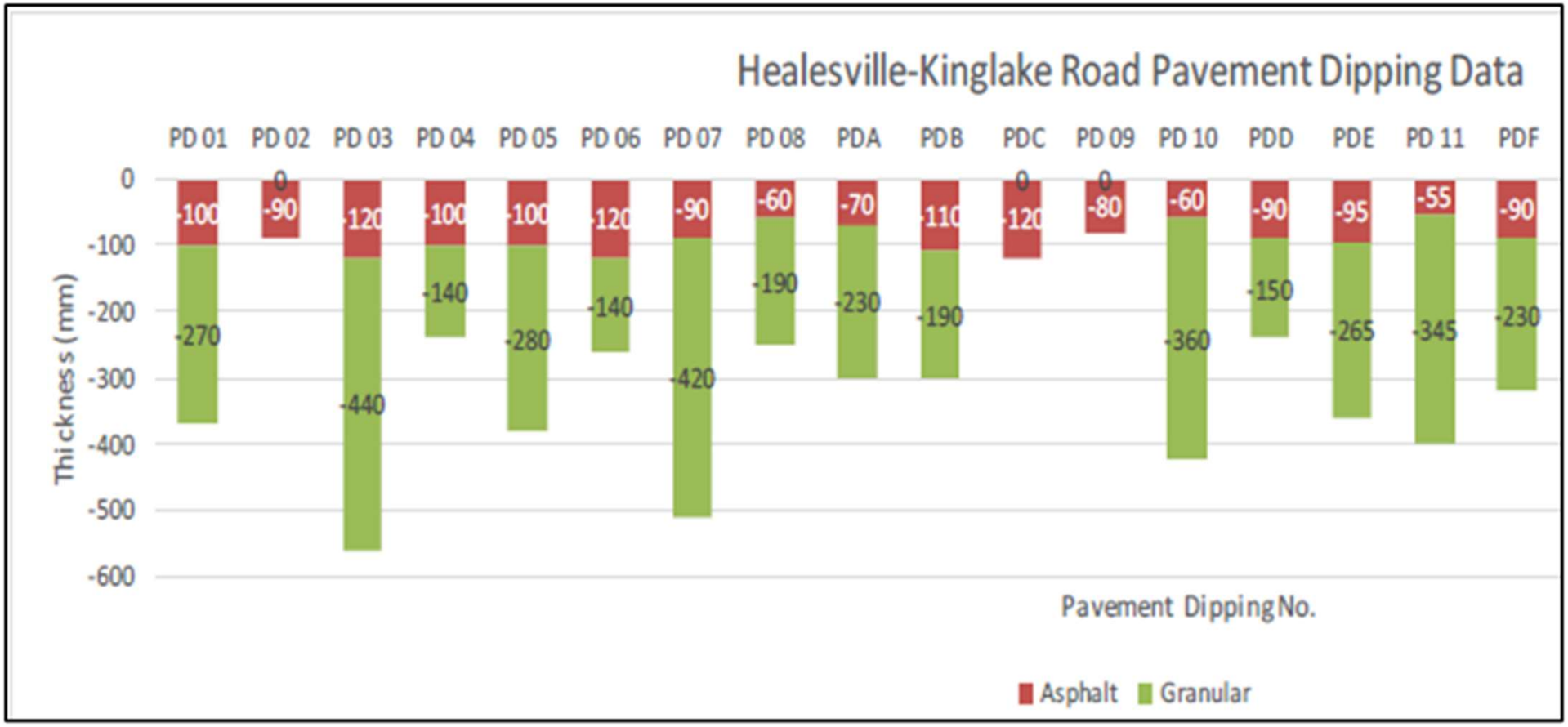

Table 1: Pre-commencement geotechnical report indicates presence of granular pavement beneath existing asphalt. This pavement dipping data proved to be inaccurate, with saturated clayey silt being noted once the existing pavement material was removed.

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Evidence of Success

Test Request #/Location	HEALSVILLE-KINGLAKE ROAD STAGE TWO	HEALSVILLE-KINGLAKE ROAD STAGE TWO	HEALSVILLE-KINGLAKE ROAD STAGE TWO	HEALSVILLE-KINGLAKE ROAD STAGE TWO	HEALSVILLE-KINGLAKE ROAD STAGE TWO	HEALSVILLE-KINGLAKE ROAD STAGE TWO
Chainage (m)	5650.2	5854.8	6059.2	6263.8	6468.2	6672.8
Location Offset (m)	5.4	3.9	0.9	4.9	1.9	3.4
Layer / Reduced Level	SUBGRADE	SUBGRADE	SUBGRADE	SUBGRADE	SUBGRADE	SUBGRADE
Thickness of Layer (mm)	200	200	200	200	200	200
Soil Description	Clayey Gravel	Clayey Gravel	Clayey Gravel	Clayey Gravel	Clayey Gravel	Clayey Gravel
Test Depth (mm)	175	175	175	175	175	175
Fraction Tested (mm)	19.0	19.0	19.0	19.0	19.0	19.0
Oversize (wet basis) %	3	5	5	4	3	4
Oversize (dry basis) %	3	6	6	4	4	4
Curing Hours	**	**	**	**	**	**
Method used to Determine Plasticity	**	Visual	**	**	**	**
Field Wet Density t/m^3	2.29	2.29	2.29	2.29	2.29	2.29
Field Moisture Content %	5.6	5.0	5.3	5.2	4.8	5.0
Field Dry Density t/m^3	2.17	2.18	2.17	2.18	2.18	2.18
Maximum Dry Density t/m^3	**	**	**	**	**	**
Adjusted Maximum Dry Density t/m^3	2.23	2.23	2.22	2.24	2.24	2.23
Optimum Moisture Content (OMC) %	**	**	**	**	**	**
Adjusted Optimum Moisture Content (OMC) %	7.5	7.0	7.5	7.5	6.5	6.5
Moisture Variation %	2.0	1.5	2.0	2.5	2.0	1.5
Moisture Ratio %	74.5	75.0	72.5	67.5	71.0	77.0
Density Ratio %	97.0	97.5	98.0	97.5	97.5	97.5
Compaction Method	Modified	Modified	Modified	Modified	Modified	Modified

Table 2: Compaction results post stabilisation works demonstrate improved strength of subgrade layer using a mixture of in-situ material and Imported Class 3 FCR.

Supporting Data

Table 3: Cost Analysis

1.0	Stabilisation of In-Situ Material				
Item	Description of Work	Estimated Quantity	Unit	Rate ($)	Extended Amount ($) (excl GST)
1.1	Stabilise the in-situ subgrade layer with 3% **GB cement** to a depth of **200mm** and width of 6.2 metres	23,100	m^2	$9.92	$229,152.00
2.0	**Remove and Replace Failing Subgrade Material**				
2.1	Supply, Place and Compact 150mm thick Size 20 Class 4 crushed rock/ reclaimed granular material.	23,100	m^2	$14.53	$335,643.00

Table 4: Time/Production Analysis

1.0	Stabilisation of In-Situ Material				
Item	Description of Work	Estimated Production	Unit	Actual Area to Treat	Duration of Works
1.1	Stabilise the in-situ subgrade layer with 3% **GB cement** to a depth of **200mm** and width of 6.2 metres	4000m^2	m^2	23,100m^2	6 days
2.0	**Remove and Replace Failing Subgrade Material**				
2.1	Supply, Place and Compact 150mm thick Size 20 Class 4 crushed rock/ reclaimed granular material.	1050m^2	m^2	23,100m^2	22 days

- As evidenced through Table 3, the option to stabilise the pavement was more cost effective than removing the existing material and replacing with virgin material.
- The rate of $9.92 for cement stabilising was provided as a variation on request from VicRoads.
- Both of these options were provided to VicRoads for consideration prior to the works being completed.
- The productivity of both the stabilising and remove and replace options were calculated based on previous experience when completed similar works.
- The combination of the time and cost saving demonstrated a clear value proposition for the initiative.
- This allowed VicRoads to approve the works in a timely manner.
- This was also a positive from a sustainability perspective as we did not have to replace the existing material with virgin quarry material in order to achieve the desired outcome.
- The quantity of rock saved through pavement recycling techniques equates to approximately 8300T.
- Broken down further, this saving in virgin quarry material equates to approximately 260T of material per 100m section.
- The implementation of the initiative also eliminated approximately 600 truck movements required to deliver virgin quarry material to site, which subsequently has a positive impact on the carbon footprint of the project.

Practical Application

Table 5: Excerpt of Healesville Kinglake Road Construction Program

Stage 3 (Ch.6596 to Ch.7740)	Tue 11 Jan '22	Wed 9 Feb '22	22 days
Stripping Topsoil (Ch.6596 to Ch.7740)	Tue 11 Jan '22	Wed 12 Jan '22	2 days
Excavate Inlays to 125mm Depth (Ch.6596 to Ch.7096)	Tue 11 Jan '22	Tue 11 Jan '22	1 day
Pulverize remaining 25mm of Existing Pavement and windrow to form Pavement Boxing (Ch.6596 to Ch.7096)	Tue 11 Jan '22	Tue 11 Jan '22	1 day
Excavate Inlays to 125mm Depth (Ch.7096 to Ch.7740)	Wed 12 Jan '22	Wed 12 Jan '22	1 day
Pulverize remaining 25mm of Existing Pavement and windrow to form Pavement Boxing (Ch.7096 to Ch.7740)	Wed 12 Jan '22	Wed 12 Jan '22	1 day
Rework and Compact Subgrade Layer to 150mm below FSL (Ch.6596 to Ch.7740)	Thu 13 Jan '22	Thu 13 Jan '22	1 day
Place 100mm Depth Class 3 FCR Subbase Layer and Shape to 50mm below FSL (Ch.6596 to Ch.7740)	Fri 14 Jan '22	Tue 18 Jan '22	3 days
Cleaning/Re-Shaping Table Drains (Ch.6596 to Ch.7740)	Fri 14 Jan '22	Tue 18 Jan '22	3 days
Cement Stabilise Subgrade with 3% Cement to 200mm depth (Ch.6596 to Ch.7740)	Wed 19 Jan '22	Fri 21 Jan '22	3 days

- Actual time taken → Aligns with estimate
- AADT of Healesville Kinglake Rd is 1300 Vehicles
- No. of Vehicles affected <u>during initiative</u> → 6 days x 1300 Vehicles = 7,800 Vehicles
- Vehicles affected <u>without Pavement Recycling</u> → 22 days x 1300 Vehicles = 28,600 Vehicles
- Produced safe and trafficable unsealed surface
- No Road Closures or Safety Incidents

- Healesville Mean Rain Days (Aug) = 12.2 days
- Healesville Mean Rainfall (Aug) = 99.1mm
- Time savings through Stabilising initiative → Less Risk with leaving poor subgrade open to adverse weather

Downer

FM051 Extension of Time Register

PROJECT NAME: HEALESVILLE KINGLAKE RD – PAVEMENT REHABILITATION						CONTRACT NUMBER: 10245	
EOT CLAIM #	DATE	REASON FOR EXTENSION OF TIME CLAIM	TIME CLAIMED	REPLY DATE	TIME APPROVED	AMMEND CONT COMPLETION DATE	NOTES
1	20/09/2021	Adverse weather at Healesville Kinglake Rd, Chum Creek on Monday the 20th of September 2021.	0 days		-	30/11/2021	Adverse weather day 1/5
2	21/09/2021	Mandatory Construction Industry closure due to COVID 19.	9 days		-	13/12/2021	21/09/2021 to 4/10/2021 (excluding Grand Final Public Holiday)
3	5/10/2021	Adverse weather at Healesville Kinglake Rd, Chum Creek on Tuesday the 5th of October 2021. Works to remove the existing pavement material could not commence.	0 days		-	13/12/2021	Adverse weather day 2/5
4	6/10/2021	Adverse weather at Healesville Kinglake Rd, Chum Creek on Wednesday the 6th of October 2021. Works to remove the existing pavement material could not commence.	0 days		-	13/12/2021	Adverse weather day 3/5
5	7/10/2021	Adverse weather at Healesville Kinglake Rd, Chum Creek on Thursday the 7th of October 2021. Works to remove the existing pavement material could not commence.	0 days		-	13/12/2021	Adverse weather day 4/5
6	8/10/2021	Adverse weather at Healesville Kinglake Rd, Chum Creek on Friday the 8th of October 2021. Works to remove the existing pavement material could not commence due to rising water table from previous heavy rain events.	0 days		-	13/12/2021	Adverse weather day 5/5

Table 6: Excerpt of Extension of Time Register

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Supporting Visual Content

Figure 5: DCP Testing on Lower Subgrade Layer

Figure 6: Struggling to keep the Subgrade Trafficable

Figure 7: First run of Cement Stabilising Completed

Supporting Visual Content

Figure 8: Compaction Effort on treated Subgrade Layer

Figure 9: Proof Roll of Subgrade Layer & ITP Sign off with VicRoads

Figure 10: The Team delivering a quality result