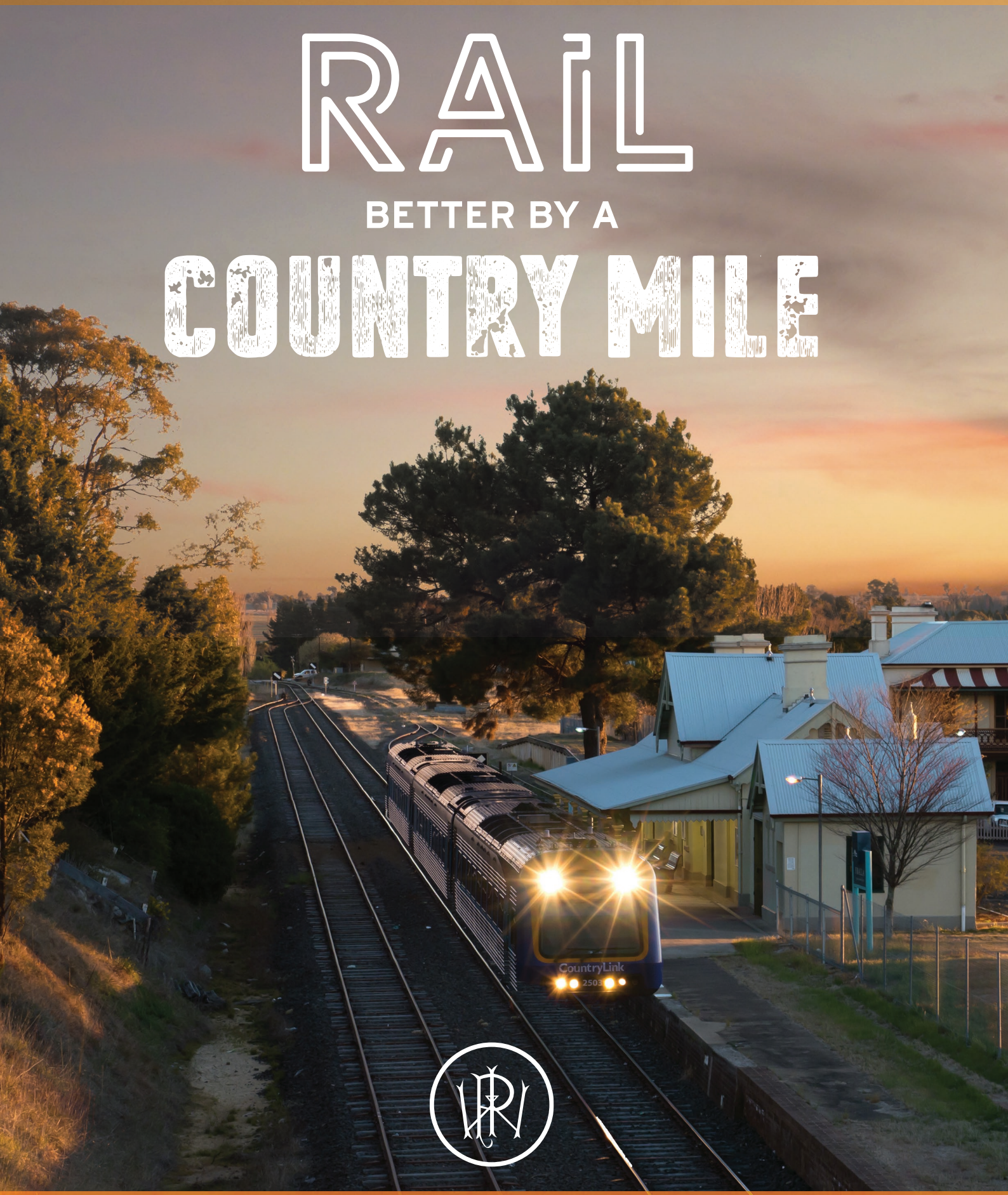
2019 PWI NSW ANNUAL CONVENTION

RAIL
BETTER BY A
COUNTRY MILE



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Background of Permanent Way Institution NSW Inc.

The Institution was formed in 1884 in England by a group of dedicated railway personnel, who were responsible for development of railway track across the British Isles, and who felt the need for an avenue for exchange of track design, construction and maintenance. They realised the educational and social value of communications between all levels of personnel engaged on the railway tracks and associated structures. The safety of rail travel has been brought to the present standards because of a better understanding of the behaviour of the tracks under load; the Institution has played a vital part in gaining this understanding. Realising this, the New South Wales section was formed in 1974, not only to benefit from those who had gone before, but also to add to the development of still more efficient rail transportation in the years ahead.

Attending the Luncheon and Networking Event

Members, particularly those in New South Wales, are reminded of the responsibilities legislated under the Rail Safety Act 2008 with regard to the definition of "rail safety worker". Members also need to consider respective employer drug and alcohol policies.

Disclaimer

The views expressed by authors and/or presenters are not necessarily the view of the PWI Committee or PWI Members.

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AND CORPORATE MEMBER ADVERTISEMENTS

Established NSW 1974
Founded 1884

RAIL
BETTER BY A
COUNTRY
MILE

President's Welcome Address 2019

Welcome to the 2019 NSW Permanent Way Institution Annual Convention.

I'd like to begin by acknowledging the Traditional Custodians of the land on which we meet today, the people of the Wiradjuri nation, and pay my respects to Elders past and present and emerging.

It is a pleasure to extend a warm welcome to all our special guests from industry and Government; our key note speaker the Honourable Paul Toole MP, Minister for Regional Transport and Roads and Member for Bathurst; our panel of speakers and all our award entrants who have also joined us today.

The theme of this year's conference is *"Rail: Better by a Country Mile".* This is reflected in the location of our conference this year, and the important role this region played in the development of our industry. It also acknowledges the significant indigenous culture and history of the area and the people of the Wiradjuri nation.

The Wiradjuri people were known as the people of the three rivers: the Wambool (now known as the Macquarie River), the Kalari (the Lachlan River, from which the electorate takes its name) and the Murrumbidjeri (the Murrumbidgee River).

Wiradjuri country is the largest in NSW, stretching from the eastern boundary of the Great Dividing Range and drawing a line from the present towns of Hay and Nyngan at the western boundary. Gunnedah and Albury mark the northern and southern boundaries of Wiradjuri country.

Located 219 kilometres from Sydney, on the Main Western line of NSW, is the historically important railway station of Bathurst and former yard, which still sees regular station commuter services today.

The Sydney Railway Company, a private company established to serve the interests of the port of Sydney, announced proposals to build a railway line to Bathurst in 1848. The company was taken over by the New South Wales Government in 1854. Construction continued and the line over the Blue Mountains to Bathurst was opened in 1876 and continued the same year to Blayney. Bathurst had already been established as a major agricultural and economic town due to the large pastoral holdings and the 1850s gold rush which boosted the population of the town.

Proposals for the first railways in NSW were largely driven by the interests of large land holders seeking improved transport for their wool from the inland centres of Bathurst, Goulburn, Muswellbrook and Singleton. The town received a sustainable boost in activity and development from the arrival of the railway which allowed the townspeople to commute and trade with Sydney. In 2019, the 'Bathurst Bullet' train service provides a fast link to Sydney and has facilitated the town's development into the thriving regional centre it is today. With the help of Minister Toole, a new service, an "extra Bullet Train" is being introduced to give commuters a lot more flexibility.

Our industry continues to play a crucial role in supporting the growth and prosperity of regional New South Wales, and towns like Bathurst.

The Federal and State Governments have committed to a substantial infrastructure investment to create better, safer, more comfortable and reliable services for customers travelling long distances.

Some of these projects include:

- The Regional Rail Fleet project, worth $2.8 billion, for the design, build, and ongoing maintenance of the new regional rail fleet.
- The Regional Digital Connectivity Program, worth $400.0 million over four years to provide mobile black spot towers and data centres to improve internet connectivity, speeds and reliability in regional areas; and
- Major regional hospitals in locations including Tweed, Shellharbour, Dubbo and redevelopment of the Griffith Base Hospital.

There has also been an allocation of $677.5 million towards a range of regional road, rail and bridge projects from Restart NSW since the 2018-2019 Budget.

This includes additional funds now specifically allocated to these programs including:

- Regional Road Freight Corridor ($353.9 million)
- Fixing Country Rail ($73.4 million)
- Fixing Country Roads ($138.3 million)
- Regional Growth Roads ($8.7 million).

2019 Convention Program – Rail: Better by a Country Mile

The biggest question facing our industry, at the moment is, who will build it and who have we got to maintain these new assets in the future?

At the recent Inland Rail Conference in Toowoomba, Andrew Hart from BIS Oxford Economics said that new rail construction in Australia is expected to double in the next 5 years from $7.9b in 2019 to over $13.5b in 2024/25.

He stated that the current analysis shows that an extra 72,000 construction and manufacturing people will be required during the heart of the construction to support these projects. Let's also not forget these new assets need to be operated and maintained and on current trends there will be a skills gap of over 12,000 people. As an industry we need a fresh approach to attracting and retaining more people into the Rail Sector and I applaud the work that the ARA and Danny Broad's team are doing in this area. We also need to do our bit for the industry, and so the PWI is currently working on a program that will encourage resource growth in the perway space, including the allocation of funds to support education and work opportunities. Stay tuned for more development on that in the near future.

We also need to do our bit for the industry, and so the PWI is currently working on a program that will encourage resource growth in the perway space, including the allocation of funds to support education and work opportunities.

To those attending their first PWI convention, we're delighted to have you here. At today's conference, in keeping with the convention theme "Rail: Better by a Country Mile", Frank Johnson will talk about the history and importance of the Regional Rail Network and its contribution to the economic development of the country. We will hear from Dave Mackney, from John Holland who maintains the Country Rail Network and some of the challenges they face. We will hear from Jim Modrouvanos from Transport for NSW about what is planned to re-invigorate the Country Rail Network and Graham Nelmes and Melissa Jovic also from Transport for NSW will be presenting "A Fast Rail Future for NSW" on Regional Fast Rail. Tony Frazer, Inland Rail's Director of Asset Management, will give us a brief presentation on the progress and status of the Inland Project.

After lunch Simon Berry from Amey will talk about Autonomous Vehicles and Alan Swaby from voestalpine VAE will provide a paper on Switch Condition Monitoring. The Permanent Way Institution is an extremely successful institution that has been running the Annual Convention now for well over 40 years. The NSW Section of PWI is still one of the strongest groups of 'rail-minded' members in the PWI worldwide. From today's conference, I hope all delegates will better understand what is happening in the regional sector of our industry, and to build relationships with key industry players.

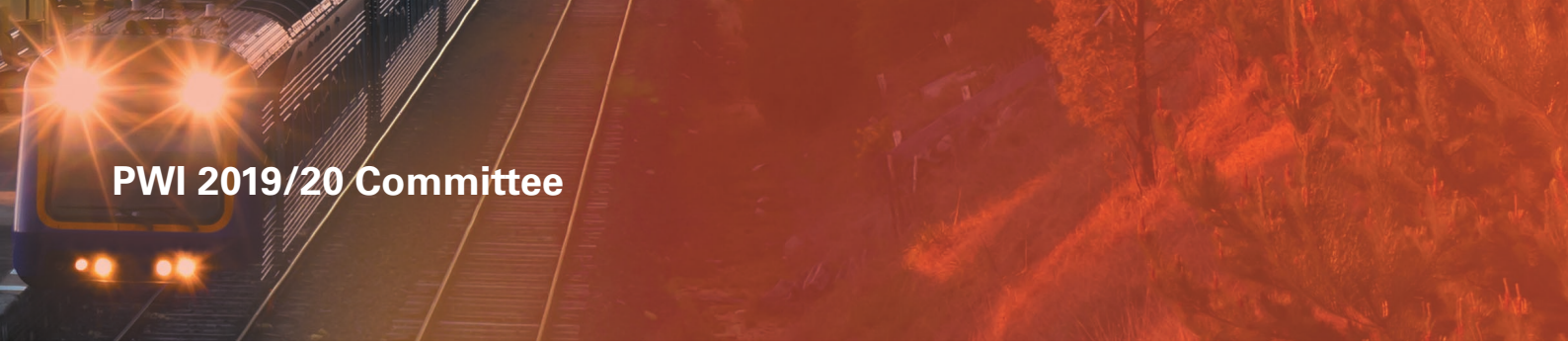
In closing, I wish to thank the hard-working committee, volunteers, sponsors and others who have worked to make the PWI's activities during the year such a wonderful success. I would also like to thank Sydney Trains and NSW Trains for jointly sponsoring the train that carried delegates from Sydney to Bathurst yesterday, in particular, Howard Collins, Stewart Mills and Peter Allaway for organising the NSW Train service. Finally, a big thank you again to VAE for hosting the conference pre-registration event and for opening their Bathurst workshop last night.

My thanks also to our Corporate Members and Enhanced Corporate Members who enable us to make our events affordable, allowing as many of our personal members to participate as possible. I wish to thank them as they continue to recognise the PWI as the peak rail industry body and provide the financial support needed to keep it there.

It is now my pleasure to acknowledge and introduce our Keynote Speaker today, the Hon. Paul Toole, Minister for Regional Transport and Roads and Member for Bathurst. Under his leadership, Bathurst has become the fastest growing inland regional city in NSW. His influence has supported the economic development of our regional areas, including record investment into roads, education and infrastructure.

Please welcome Minister Toole.

Mark Harris – President, Permanent Way Institution, New South Wales



PWI 2019/20 Committee

President	Mark Harris	**Editor**	Mark Xerri
Treasurer	Claudine O'Donoghue	**Membership Secretary**	Peter Boonstra
Secretary	Patrick Man	**Website Manager**	Dan Collison

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	Ken Sherwood	Ken Swan	

Emergency Procedures

Please take a few moments to familiarise yourself with the following emergency procedures:

- Observe the locations of emergency exits and assembly points that are advertised inside the venue
- If the alarm sounds, or a dangerous incident takes place, please follow instructions from staff or voice-over
- A strict no smoking policy is enforced both **inside** and **outside** the venue

Drugs and Alcohol

- For those of you who are classified as Rail Safety Workers under the Rail National Safety Law and who are 'on duty' please be aware that the Drug and Alcohol provisions of the Act apply whilst attending this Convention.
- The Institution is committed to the responsible service of alcohol and expects all delegates to be moderate in their alcohol consumption.

The Evacuation Alarm

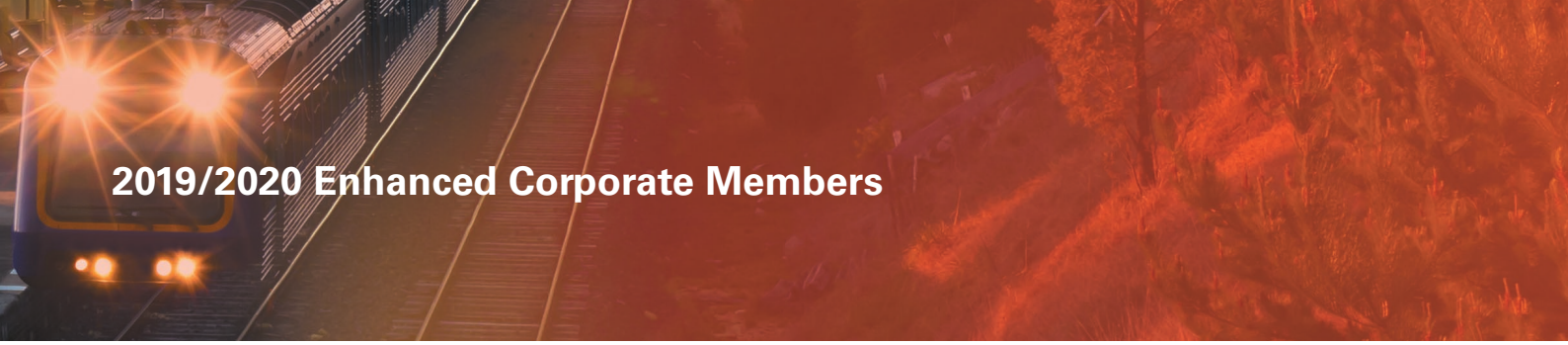
- Alert alarm (BEEP BEEP BEEP) prepare to evacuate
- Evacuation alarm (WHOOP WHOOP WHOOP) – Evacuate and follow voice-over instructions
- When the evacuation alarm sounds, evacuate by nearest exit and head to assembly point

Security

Delegates leaving the venue at any time after the morning session will not be re-admitted unless special arrangements are made with a Committee Member.

2019 Convention Program – Rail: Better by a Country Mile

THURSDAY 31 OCTOBER, 2019 – VAE Rail Fabrication Centre, Bathurst		
From 11.00	Arrival for boarding the PWI Train	
11.30 – 15.30	PWI Train departs Central Station for Bathurst Station	
15.30 – 16.00	Bus Transfer – Bathurst Station to VAE Rail Welding Depot	
16.00 – 19.00	Pre-registration, Site Tour, Networking Event	
19.00 – 19.30	Bus Transfer – VAE Rail Welding Depot to Bathurst Town Centre (various drop offs)	
FRIDAY 1 NOVEMBER, 2019 – Bathurst Panthers Club, Bathurst		
From 07.00	Registration Desk Opens	
08.00 – 08.15	Welcome Address	NSW President Mark Harris
08.15 – 08.45	Keynote Address	Hon. Paul Toole MP
08.45 – 08.50	Donation Presentation to Hon. Paul Toole MP	Mark Harris
SESSION 1:	**Chaired by Laing O'Rourke**	
08.50 – 08.55	Session 1 Introduction	Session Chair
08.55 – 09.15	1855 and All That – 164 Years of the New South Wales Rail Network	Frank Johnson
09.15 – 09.35	Challenges of Maintaining a Regional Rail Network	David Mackney
09.35 – 09.45	Discussion / Questions for all papers	Session Chair
09.45 – 10.05	Welders Award Presentation	Mark White
10.05 – 10.25	Young Achiever Award 2019 Presentation	Julian Sharp
10.25 – 11.05	MORNING TEA	
SESSION 2:	**Chaired by Lendlease**	
11.05 – 11.10	Session 2 Introduction	Session Chair
11.10 – 11.30	The Fixing Country Program – Unlocking the Productivity of our Regions	Jim Modrouvanos
11.30 – 11.50	A Fast Rail Future for NSW	Graham Nelmes and Melissa Jovic
11.50 – 12.05	Inland Rail Program Update	Tony Frazer
12.05 – 12.15	Discussion / Questions for all papers	Session Chair
12.15 – 12.35	Steve Maxwell Platelaying Award (Minor)	Steve Fleck
12.35 – 12.55	Ken Erickson Innovation Award	Sunail Hasnain
12.55 – 14.25	LUNCH	
SESSION 3:	**Chaired by Sydney Trains**	
14.25 – 14.30	Session 3 Introduction	Session Chair
14.30 – 15.20	Alan Barham Maintenance Team Award	Scott Chapman
15.20 – 15.30	Donation Presentation to TrackSAFE Foundation	Mark Harris
15.30 – 15.50	Transforming Switch Maintenance to 'Predict and Prevent' System	Alan Swaby
15.50 – 16.10	Addressing Future Transport Needs in Regional Australia	Simon Berry
16.10 – 16.20	Discussion / Questions for all papers	Session Chair
16.20 – 16.40	Steve Maxwell Platelaying Award (Major)	Steve Fleck
16.40 – 16.50	Endnote and Announcements	NSW President Mark Harris
2019 PWI CONVENTION ENDS		
POST-CONVENTION EVENT: Sponsored by VAE Rail Systems		
17.00 – 19.00	Networking Event	
BUS TRANSFER OPTION TO SYDNEY		
17.00 – 21.00	Bus Transfer – Bathurst Panthers to Central Station (via Katoomba, Penrith & Strathfield Railway Stations)	
SATURDAY 2 NOVEMBER, 2019 – Bathurst		
BUS TRANSFER OPTION TO SYDNEY		
10.00 – 14.00	Bus Transfer – Bathurst Panthers to Central Station (via Katoomba, Penrith & Strathfield Railway Stations)	



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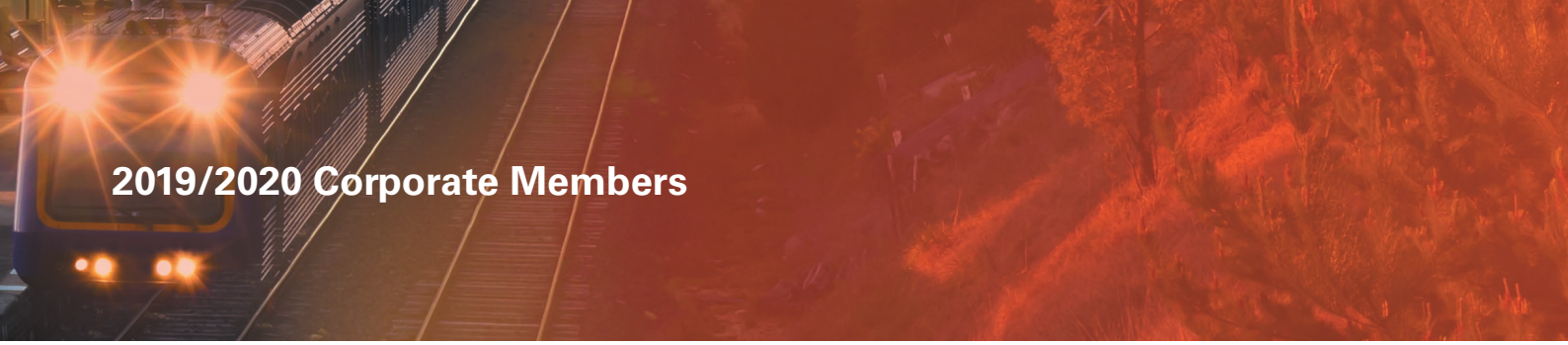

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PWI NSW would like to thank all its Corporate Members for their support. We look forward to your continued sponsorship in the future.

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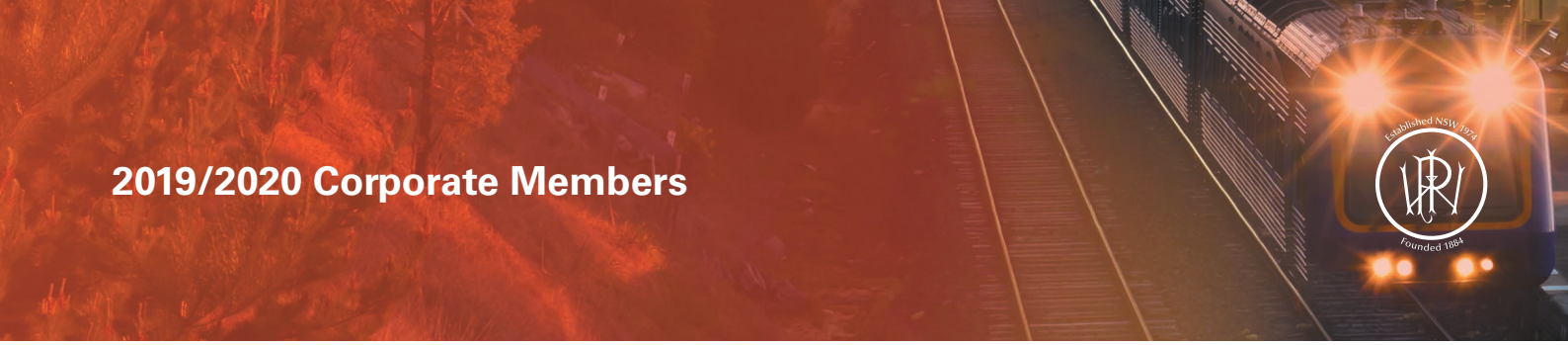

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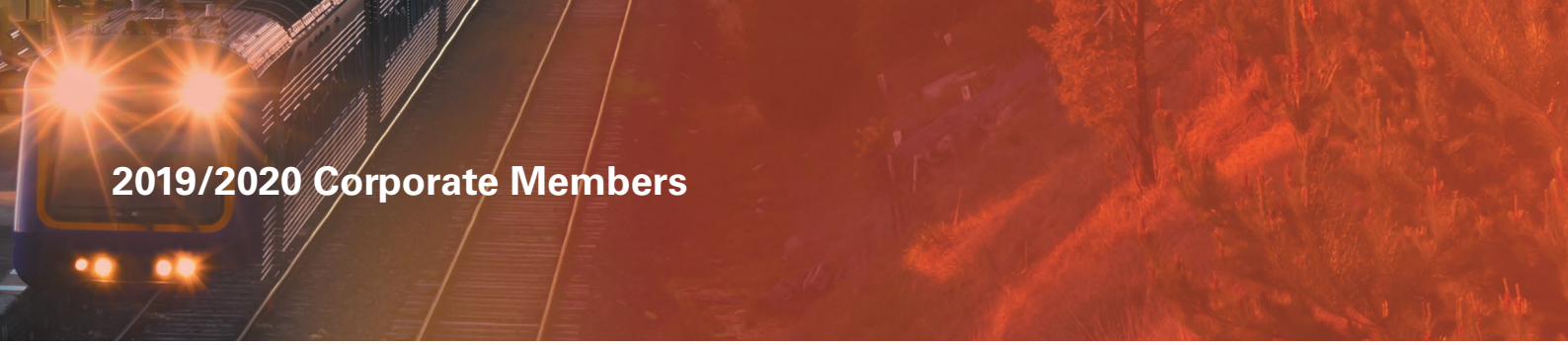

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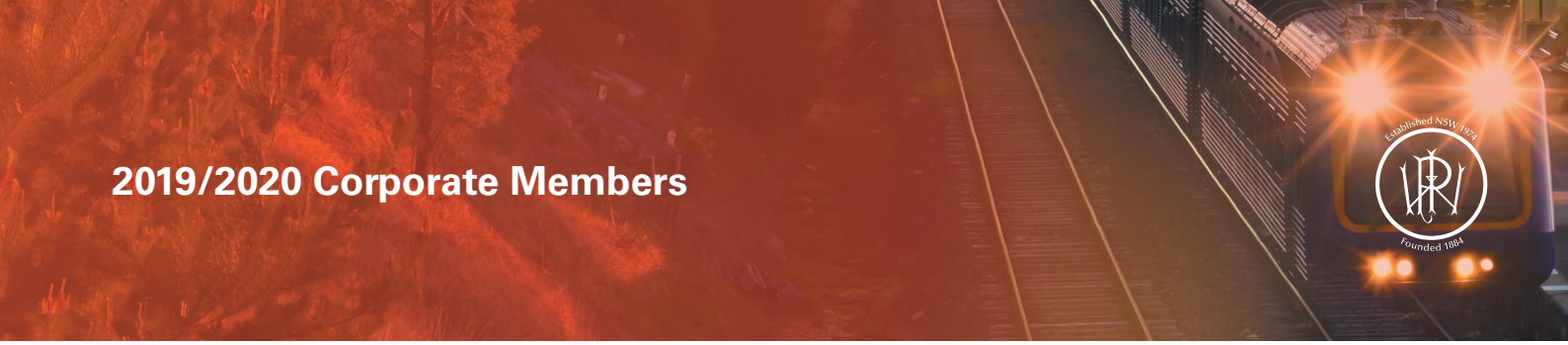

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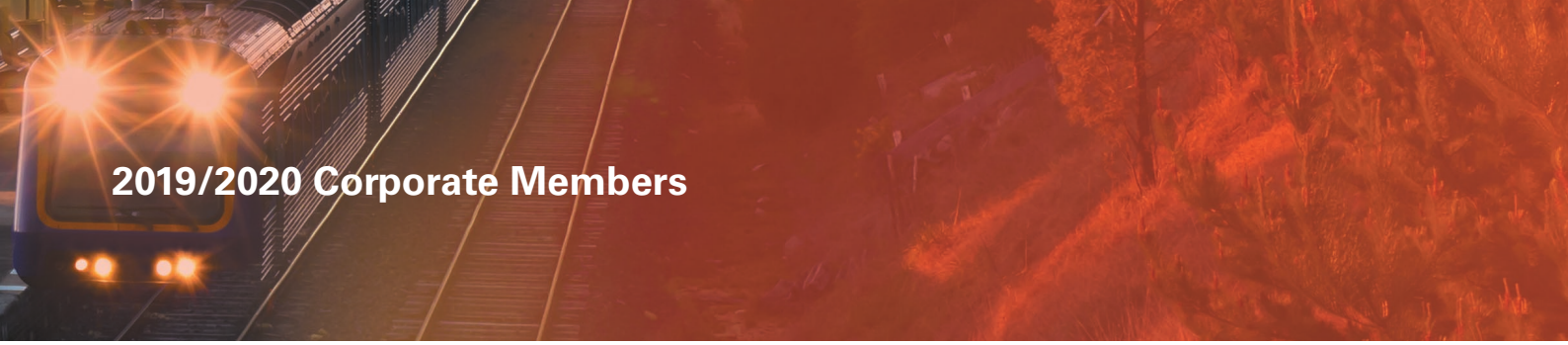

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FRIDAY 19 June 2020

Save the date for the NSW Permanent Way Institution Winter Dinner!

Join 300 colleagues and friends for fine food, drinks, networking and premier entertainment at Doltone House Hyde Park.

Sponsorship still available - contact info@pwinsw.org.au or 0425 262 356

FIRST SESSION

PWI Annual Convention 2019

Chairman: **David Robotham (Laing O'Rourke)**

Paper 1: **1855 And All That – 164 years of the NSW Rail Network**
Frank Johnson – Chair, Engineering Heritage Sydney, Engineers Australia, Sydney Division

Paper 2: **Challenges of maintaining a Regional Rail Network**
David Mackney – Manager, Maintenance Delivery John Holland Group – Country Rail Network

2019 Welders Award Presentation

2019 Young Achiever Award Presentation

1855 And All That – 164 years of the NSW Rail Network

Frank Johnson – Chair, Engineering Heritage Sydney, Engineers Australia, Sydney Division

Introduction

With the inaugural PWI Annual Convention in a NSW regional location, it is appropriate to reflect on how the NSW country railway network developed, what drove this development, what it achieved and some of its "ups and downs" over time.

Many books have been written on this subject and certainly much could be said. However, by necessity this paper and presentation will be a very high-level overview, or in railway terminology, a VFT ride through over 160 years of the history of the railway network in NSW. As this is a per way conference, the emphasis is on the track, so only one illustration with a locomotive will be allowed.

In the beginning – 1855

The year 1855 must be firmly etched in NSW railway history, for on 26 September that year the first line opened from Sydney to Parramatta, or more correctly, from Redfern to Granville. The initial terminus was chosen to be Granville, for this would allow extension of the new railway southwards to Goulburn and westwards to Bathurst, routes that generally followed the Great South and Great West Roads of that time.

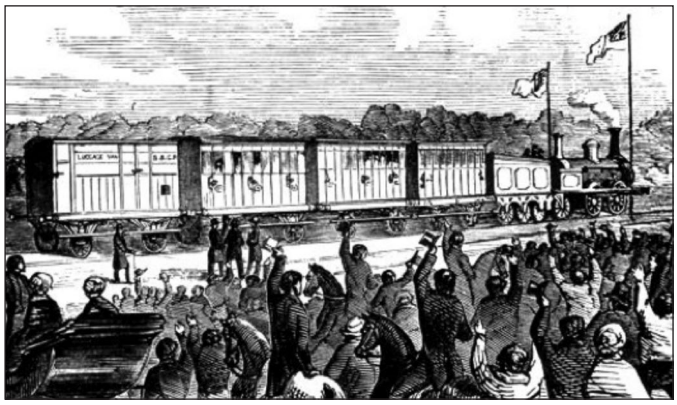

Figure 1: The first train in NSW – 1855

Surely, the first railway must rate very high on the scale of significant events in the history of social and industrial development in NSW. 1855 was just 67 years since the foundation of the penal Colony of New South Wales, and by then the population had grown to a mere 266,000.

Further, NSW's achievement took place only 25 years after the first passenger railway in England, with the line from Liverpool to Manchester being opened on 16 September 1830. However, by then the Industrial Revolution in England had been in full flight for some 70 years, while Australia was still very much a rural / pastoral economy. Indeed, the last convict transportation to Sydney was in 1840, and Western Australia continued taking convicts until 1868.

Not that NSW's first line was without problems, of course. The initial scheme was raised at a public meeting in 1846 and a survey of the line to Goulburn undertaken in 1848. Following approval by the Legislative Council, the Sydney Railway Company was set up to construct the line to Parramatta. However, financial problems soon loomed and the initial good rate of progress was severely hampered by the discovery of gold at Bathurst, which caused increases in prices of labour and materials.

The directors of the Sydney Railway Company struggled with these unprecedented difficulties and the Government effectively took over the railway. Thus, the main railways right across NSW all came under and were run by the government, a situation that lasted for some 140 years. However, this meant that the railways were (and still are) subject to government financing, which has always been restricted and variable.

And then…John Whitton

Fortunately for the railways, 1856 saw the appointment of an Englishman, John Whitton, as Engineer-in-Charge of the New South Wales Government Railways. Whitton served in this role until 1890 and is considered the "Father of New South Wales Railways". This is certainly a well-deserved honour, for what other chief engineer or commissioner/ chief executive since that time has come anywhere near 34 years in their role? For a start, no NSW Government railway organisation has lasted more than about 15 years since the dissolution of the then NSW Government Railways in 1972, so achieving a Whitton scale tenure would be well-nigh impossible these days, with such frequent changes in government policies.

When Whitton arrived in Sydney, the Colony had just 23 miles of 4 ft 8 1⁄2 in standard gauge railway, four locomotives, 12 passenger carriages and 40 trucks. He then set about extending the railway into the city and resisted pushes for 4,000 miles (6,400 km) of cheaper, light tramways, such as horse drawn lines with wooden rails.

This was proposed by Governor William Denison, who had served in the British Army's Royal Engineers and one

would think he should have known better. Even in Sydney for the Blacktown to Richmond extension, the government wanted to trial horse drawn trains but Whitton refused to be associated with the project. Later Whitton crossed swords with Governor Denison on extending the railway across the Blue Mountains, where Denison sided with his army engineers saying it was impossible. Whitton persisted and the route was constructed, proving the superiority of railway engineers in areas such as this.

Whitton also stood up to the Government and strongly opposed its uncritical acceptance of the lowest tenders for railway construction. One might see some personal characteristics here similar to that of the equally famous 20th Century railway engineer, John Job Crew Bradfield and wonder if we will see a 21st Century equivalent of these two?

Whitton retired on 31 May 1890, having supervised the laying of 2,121 miles (3,410 km) of track on which no accident had occurred attributable to defective design or construction. Parkes regarded him as 'a man of such rigid and unswerving integrity, a man of such vast grasp, that however his faults may occasionally project themselves into prominence, it would be difficult to replace him by a man of equal qualifications'. What more can one say?

However, even after Whitton's departure, the NSW rail system continued to grow, as will now be seen.

Expansion of the Network

The overall expansion of the NSW rail network can be seen in the following two graphs. One might think that the NSW rail network would have a definite engineering basis, but in practice the political, social and economic factors often took precedence, as we shall see.

Figure 2 shows the total size of the network, including some private lines, such as collieries. This shows the NSW network peaked in the 1940s and has since declined, with closures of country branch lines, etc, far outweighing any new lines constructed.

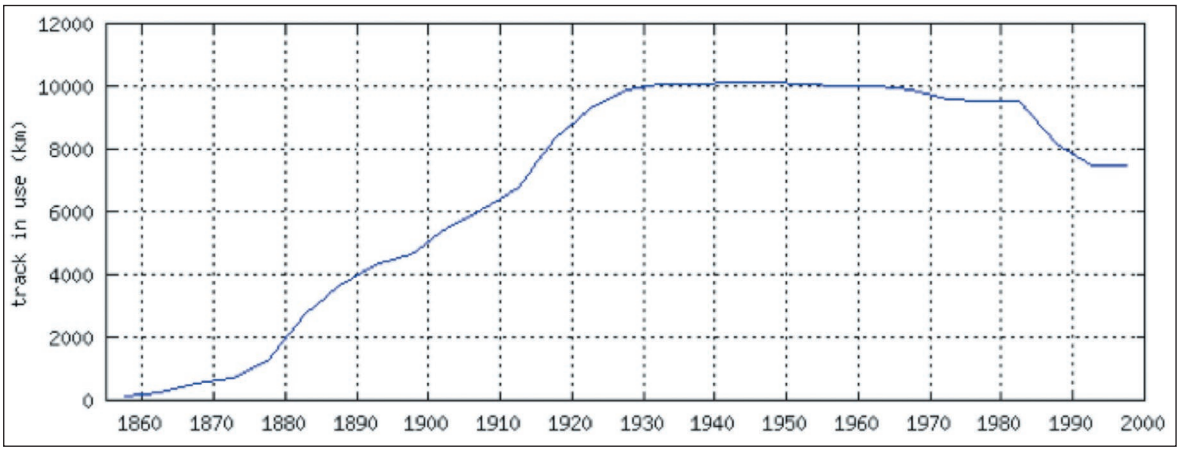

Figure 2: Available track in the NSW rail network (from nswrail.net)

Then Figure 3 shows the length of lines opened and closed each five-year period since 1855, together with the net result. It is notable that such was NSW's obsession with developing new lines that for some 80 years there was a continual increase (albeit erratic at times) in the network, despite the 1890s Depression and the Federation Drought. However, following the Great Depression and impact of the motor car, the total rail network has been in continuous decline since the late 1940s.

Figure 3 shows two distinct peaks in line openings, around 1880 and then around 1920. These will be looked at in the next two sections, as illustrations of why and how the NSW rail network developed.

Inter-colonial Lines

The early development of the NSW rail network should be considered in light of the colonial history of the east coast of Australia. NSW was, of course, the first colony, with Victoria being formed as a separate colony in 1851 and Queensland following in 1859.

In this context, the railways were to form a key part of inter-colony transport, access to the developing interior of NSW, and the transport of produce from the expanding pastoral economy. While the railways linked the east coast colonies, there would also have been a degree of self-interest as the colonies sought to establish rail links to bring produce back to their ports, rather than let it cross the borders to Melbourne and Adelaide. This was an enduring principle, for even in the 1990s, the NSW Railways had special freight rates from the area near the border with Victoria, which is much closer to Melbourne than the ports of Sydney or Port Kembla.

Thus, during the Whitton era, the NSW rail network was extended to:

- South: To Goulburn in 1869, Wagga Wagga in 1879, Albury in 1881, and Hay in 1892.
- West: To Bathurst in 1876, Dubbo in 1881 and Bourke in 1885
- North: Newcastle to Scone in 1871, to West Tamworth in 1878 and to Wallangarra in 1888.

Even by 1886, just 30 years after the first NSW railway was opened, the network comprised of 1,732 miles or almost 2,800 kilometres of track. A comparison could be made with the current Inland Rail Project, linking Melbourne to Brisbane, with a route of 1,700 km and a construction period of seven years, but with a substantial portion of this on existing rail alignments.

However, one should remember that the original NSW rail network (and those in the other Australian colonies) was constructed purely with man power and horse power, without mechanical equipment or road motor vehicles, and over vast uninhabited areas. Considering this, the much-vaunted achievements of any current rail project would really pale into insignificance.

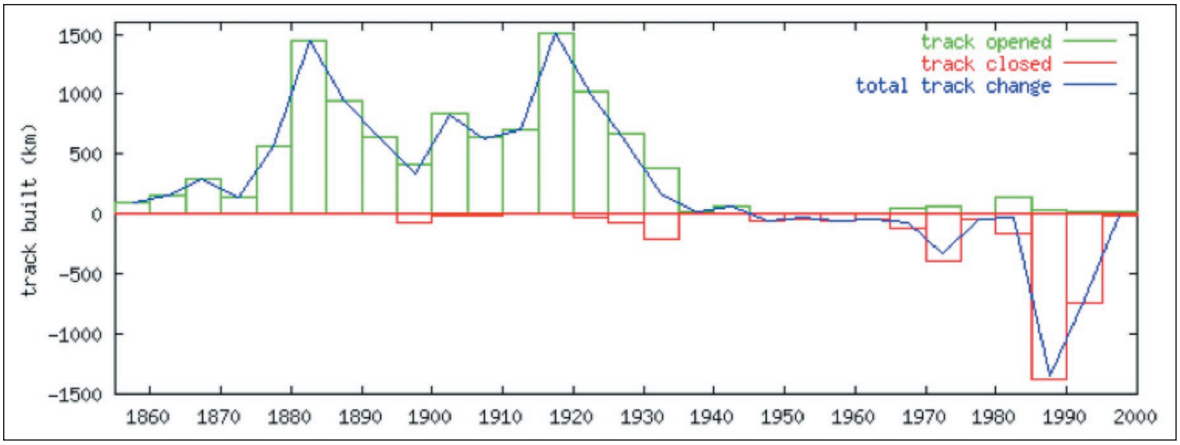

Figure 3: Rate of opening /closing track on NSW rail network by five-year periods (from nswrail.net)

One might wonder why the line to Bourke, way out beyond the "Black Stump", was given priority in the construction of the fledgling NSW rail network. The Railway Guide of 1886 sheds some light on this:

> *"It (i.e. Bourke) lies on the River Darling, but it is only in certain periods that the river is navigable, and in times of drought the town has almost been reduced to famine, stores being so scarce and transit so difficult; but the railway puts an end to all such contingencies, and the Bourke people are now brought within a day's journey of the metropolis.*
>
> *The traffic from Bourke is entirely of pastoral nature, wool and cattle being sent away in immense quantities, as Bourke is the entrepot for a pastoral district that stretches through the heart of Australia away to the far north of Queensland; and at times wool is brought by river to this station."*

A similar situation applied to the extension to Hay, in the south-west of the state, on the Murrumbidgee River and close to the Victorian border. In 1871, there were only 664 people living in the Hay township, and yet its railway station was indeed very grand, as Figure 4 shows. Hay Station was obviously designed to show the people in the surrounding areas how substantial the Colony of NSW was, and so direct their business to the merchants and wool brokers in Sydney rather than Melbourne. This was despite the fact that Hay is some 725km from Sydney but only 420 km from Melbourne. As an aside, the advent of the railway was also the beginning of the end of the river trade from Hay to the Murray River.

Despite the developmental nature of the network and the small population of the Colony, the NSW Railways performed quite well. The year 1886 saw 13,500,346 passengers carried, 3,273,004 tons of freight moved, and a profit before interest of over £700,000.

The Railway Guide to New South Wales of 1886 included the following map showing the state of the network and planned lines:

Figure 5: NSW rail network in 1886 – showing existing lines, and proposed lines in red

Figure 4: Hay Railway Station in 1991

There are some interesting aspects to the network in 1886, showing the railway thinking in those days:

- There is no line up the coast from Newcastle towards Brisbane, no doubt because of all the major rivers that had to be crossed. However, there was a proposed route from Glenn Innes down to Grafton and thence to the Queensland border.
- Another proposed route went from Orange to Forbes and Condobolin, and thence to Wilcannia, another Darling River port. The Condobolin to Wilcannia route of course never eventuated either, being supplanted by the line to Broken Hill.

NSW Developmental Lines

As Figure 3 showed, railway construction activity slowed at the end of the 19th Century. Although Australia had developed with a population of more than three million, infrastructure works required British investment. Beginning in 1890, Australia suffered a drought (the "Federation Drought") that sent it spiralling into an economic depression and with the decreased demand for wool (Australia's core industry), public works projects fell like dominoes, as banks closed their doors.

However, as Australia eventually emerged from the depression, there was a significant change in rural industries that would impact on the rail network. Up until the 1890s, pastoral holdings were predominant, and wheat-growing had been somewhat neglected. Then, improvements in machinery, wheat varieties and methods of cultivation stimulated a general overhaul of farming practice and NSW became a constant exporter of wheat after 1898.

Wheat was a much lower value product than wool, so farmers were after the lowest possible freight costs to get their wheat to the mills and export ports. This led to the renewed demand for rail transport, and hence the proliferation of the country branch lines. Figure 6 shows the "wheat belt", the prime wheat growing area on the western slopes and plains, and the railway branch lines that were built to service this demand.

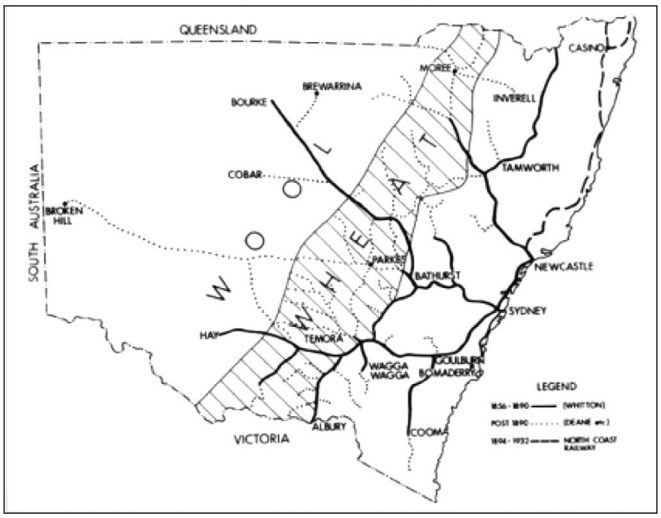

Figure 6: Branch Lines through the wheat belt (from Fraser, after Jeans and Spearritt)

As examples, branch lines opened in this period included (from north to south):

- Moree to Inverell (154km): 1901
- Narrabri West to Walgett (180km): 1903 – 1908
- West Tamworth to Manilla: 1899, and then to Barraba in 1908
- Dubbo to Coonamble (150km): 1903
- Bogan Gate to Tottenham (115km): 1907 – 1916)
- Orange to Broken Hill (804km): 1885 – 1919
- Temora to Roto (306km): 1906 – 1931
- Wyalong to Lake Cargellico (113km): 1917
- The Rock to Oaklands (124km): 1901 – 1912

It was said that the requirement in rural communities was for a farmer to be able to take his wheat to the silo at a railway siding and return home within daylight hours. The proliferation of minor branch lines constructed in this period certainly bears testimony to this.

Figure 7: Farmers delivering wheat to silo at Finley Railway Station (SNSW 394004)

Pioneer Lines Concept

The need for cheaper freight rates for the rural rail network drove a rethink of rail track design and construction. In 1894 the then Engineer-in-Chief, Henry Deane, visited the United States of America and Europe to look at track construction. Deane found that "the conditions in America, especially in the west, seemed to most nearly approximate those of New South Wales, and it therefore seemed that the experience there gained would afford the desired type." Thus, NSW moved away from its traditional reliance on British track and bridge design and adopted American practices.

For NSW Railways, this led to the pioneer lines concept, which Deane set out as:

- Wherever possible, the railway is carried on low embankments, between 150mm and 375mm, and cuttings are avoided if at all possible;
- The formation is carefully rounded, so the water falling on it may readily run off;
- Ballasting was dispensed with, so with the embankments often being soft, sufficient sleepers were laid to provide a proper supporting area. Deane used 14 sleepers for each 30-foot rail (no welded rail here, of course), with an average spacing of 2 feet 2 inches;
- Selected earth was used to form a mound along the centre of the track, with a space under the flanges of the rail to allow water to run off;
- Sleeper quality was rougher than that of main lines, with round back sleepers being allowed and sap wood did not have to be cleaned off.

An example of finished pioneer line track is shown in Figure 8.

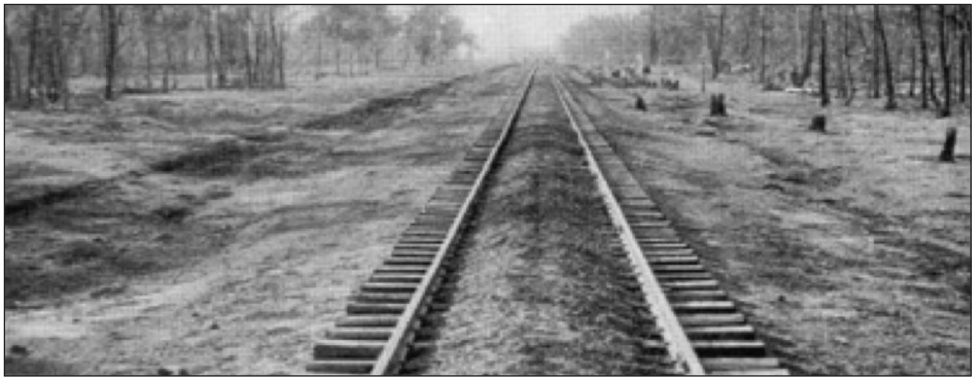

Figure 8: Pioneer Line track – from NSWGR Annual Report 1899

Construction of these lines would not have been an easy task. Deane noted that: *"A good deal of the country traversed is somewhat thickly timbered, in which case it has to be cleared and stumped, and, owing to the existence of roots, the excavation and filling are done with picks, shovels and barrows"* – i.e. all manual labour.

It was also recognised that there was a down side to the pioneer line concept, as these tracks would require more maintenance and eventual upgrading, and would be more susceptible to washaways, etc. However, it was considered that this was still an economical proposition, and when the lines generated more revenue, then additional works could be undertaken.

Figure 9 below shows one of the outcomes of this concept, an extensive washaway on the Walgett Line in January 1971, with Inspecting Engineer, Ken Swan, up to his knees in Pioneer Line economical construction.

Further Developments

The above sections have outlined the major early developments in the NSW rail network, as the focus of this paper. However, for reference a few more significant events should be mentioned, as these have certainly impacted on the way the NSW rail country network operates.

- 1910: The original Main West alignment descending the Blue Mountains from Mt Victoria to Lithgow through a zig zag was replaced with a new alignment, using 10 tunnels;
- 1919: The original Main South Line from Picton to Mittagong via Thirlmere was replaced by a new alignment through Tahmoor, although the original line was retained at the time;
- 1932: The North Coast Line from Maitland to Kyogle and South Brisbane was completed, with the construction of the bridge over the Clarence River at Grafton;
- 1962: Standard gauge line from Sydney to Melbourne finally completed, obviating the need for passengers changing trains and freight transshipping at Albury;
- 1970: Standard gauge line from Sydney to Perth via Broken Hill opened for freight and passenger trains, changing Parkes to Broken Hill from a branch line to main interstate route.
- 1970s onwards: expansion of the coal industry in the Hunter Valley, Ulan and Narrabri areas, leading to new lines and upgraded tracks.

Figure 9: Washaway on Walgett Line, January 1971 (Frank Johnson)

Case Study – Boorowa Line

One might think that with the pattern of lines constructed across NSW to develop the state and its industries, there must have been some sort of a grand plan behind all that trackwork. Sadly, this was never the case and, just like in the 21st Century, the railways of the 19th and 20th Centuries were equally subject to political promises, vested interests, delays, lack of funding and local pressure groups. The history of the Main South branch line from Galong to Boorowa provides some insights into the machinations by which lines and routes were determined.

The Main South Line had been extended from Yass Junction to Cootamundra, through Galong, in 1877 and in 1884 the residents of Burrowa (as Boorowa was called then) held a public meeting to press for a line from Galong to their village. A deputation, led by the local Member, was dispatched to see the Minister for Works, who said he would instruct the Commissioner for Railways to arrange surveys.

The matter was discussed in parliament later in 1884 and, despite delaying tactics by the Premier, Sir Henry Parkes, the Burrowa Line was approved as part of railway policy but no funds were allocated. The matter was further investigated and progress appeared to being made but then the residents of Bowning also held a meeting. They maintained that the line should be from Bowning, as the route to Burrowa was shorter, and it would run through numerous small orchardists, whereas the Galong option would run through two huge squatting runs. This sounds like the Galong option would have been beneficial to the influential "big-end-of-town".

The Galong to Burrowa Line was mentioned in the official Railway Guide of New South Wales 1886, and local residents were optimistic, as the concept of light railways was supported in a report by Sir John Fowler. However, in 1888 Burrowa residents were amazed and horrified to hear that their line had disappeared from the railways' construction schedule.

And then… one could go on and on about more delays, alternative routes, a visit by the Railway Commissioners ("useless" according to locals), visit by Examiner of Public Works, more alternative schemes, more surveys, reviews by the Public Works Committee, and so on. The following map shows the alternative schemes that were considered and surveyed – just to get a 30km branch line from the Main South Line to Burrowa.

In the end, the original proposal for Galong to Burrowa was approved by Parliament in 1912, at a cost of "eighty-one thousand six hundred and seventy-five pounds" and "shall not under any circumstances exceed the estimated cost by more than ten per centum". However, the completed cost was £114,000 – which is more like 40% over approved cost, by my calculations.

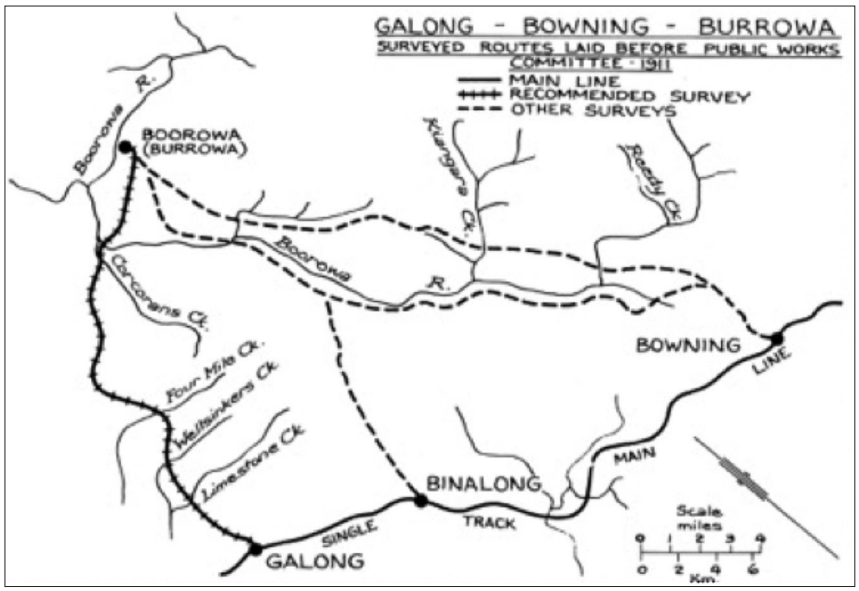

Figure 10: Alternative routes for the Galong to Burrowa Branch Line (from Pollard)

The Act of Parliament gave a detailed description of the route to be followed by the branch line to Burrowa, so there was no doubt where it was to go.

SCHEDULE.

The proposed railway commences at the north-western end of Galong Station on the Great Southern Railway, at 215 miles 72 chains 83 links from Sydney, and in proceeding in a generally northern direction to about 220 miles, crosses the main road to Harden, and follows its eastern side for about a mile, and crosses Limestone Creek. From 220 miles it takes a north-easterly bearing for about 2 miles, and crosses Wellsinker's Creek. Thence the line proceeds slightly west of north to 225 miles, crosses Four and Five Mile Creeks, and traverses the head of Flat Rock Creek on its left side. It then takes a generally north-easterly course on the south-eastern side of the main Harden-Burrowa-road, crosses it at about 227 miles, follows the north-western side of that road for about 1¼ miles, crosses Corcoran's Creek, and descends its right bank for about a mile, crosses Burrowa River near its confluence with that creek, approximately 3½ miles beyond which it reaches the southern boundary of the town of Burrowa, curves nearly due north, and terminates in that township near Ryan's Creek at 233 miles 56 chains 83 links from Sydney, being a total distance of 17 miles 64 chains, and subject to such deviations and modifications as may be considered desirable by the Constructing Authority.

Figure 11: Schedule from the Galong to Burrowa Act of 1912

The Galong to Boorowa branch line was officially opened on 10 October 1914, around 30 years after it was first agreed to by the Railways. The official opening was performed by the Chief Secretary of NSW, as usual the local member took full credit for getting the line built, and then everyone adjourned to the Guild Hall for a banquet – which all sounds strangely familiar, even 100 years on.

Galong to Boorowa was officially classified as a "Pioneer" Line and subject to a maximum speed of 25mph (about 40kmph) for mixed (goods and passenger), or 20mph for goods trains and light engines. There was initially only one station along the line, at Gooramma, besides Boorowa Stockyards. There were eventually five "stations" between Galong and Boorowa, including the Oreston "milk platform". Boorowa gained a wheat silo and the transport of wool was a key part of the goods traffic on the line.

But then… the final passenger service was in 1983 and the last goods train traversed the branch line on 23 October 1987. The branch line closed during early December 1987, so after all the efforts by the locals, the Boorowa Branch Line lasted just 73 years. The station building was demolished and there are now no traces of any of the railway infrastructure, save for a forlorn looking water column.

However, the line is still fondly remembered by the locals, a group of whom, "the Railway Mob", constructed a display on the history of the Galong to Boorowa Line adjacent to the Court House, and this was opened by the Hon. Tim Fischer AC in 2016.

Figure 12: Boorowa – Station and loading wool in the "old days"

Figure 13: Boorowa Station site and a bridge along the line in 2019

Impacts on the Communities

The railways enormously improved the inland economy and contributed to the general growth of towns. However, favours were differentially distributed when the government built the lines to serve the strategic trading interests of Sydney rather than the needs of local country communities. Thus, some towns flourished and some, like Harden and Nevertire, were created by the rail network, let alone the major rail towns like Werris Creek, Goulburn and Junee.

While the primary focus of extending the railway network into regional NSW was to take rural produce to the markets and export, the railways also served a vital role in supplying the country towns with all manner of goods and passenger transport. Rail provided a cheaper form of transport and, for example, this allowed the efficient supply of corrugated iron to country towns and contributed to the adoption of this ubiquitous element of rural architecture.

For over 100 years rail was the predominant means of transport to rural NSW. Rail freight covered everything from parcels to major farm machinery, from fuel to household goods, and everything else in between. Every major town on the rail network had a goods shed, and parcels could even be left at unattended wayside platforms. I recall that when I bought furniture from Grace Bros at Roselands in 1972, it was shipped up to Narrabri by rail, and unloaded at the Goods Shed.

The same was true for passenger travel, with the railways providing an extensive range of services, from air-conditioned long-distance and interstate trains, through the overnight mail trains, to the rail motors on the remote branch lines. While the increase in car ownership after World War 2 led to a decline in passenger demand for rail travel, even in 1972 there were 22 long distance passenger trains departing Central each day, plus many more local services on branch lines.

Then there was the "human side", considering the employment that the railways supplied, which sustained many country towns and villages. For example, in 1975 there were 767 railway staff in Goulburn, but this would have been significantly less than in its heyday, as by then dieselisation had reduced locomotive operating and maintenance staff. However, even in 1975, this staffing level meant that about 15% of the population was dependent on the railways. Obviously, this situation would be very much different in 2019.

The impact on communities was not just in the major railway towns like Goulburn, Werris Creek and Junee, for operating and maintenance staff were scattered right across the rail network. When I was District Engineer at Goulburn in 1968 – 1969, mechanisation of track maintenance was just taking shape but there were still some 50 fettling staff on the district, most in small villages between Goulburn and Yass, and at Tarago. The Way & Works Branch provided training for these staff, and no doubt this would have made them better supporters of their own local communities.

The training and experience that came with a state-wide network also extended to engineers. I was fortunate to be able work across the NSW Railways, with high levels of responsibility from an early age. At 23 I became Division Engineer, Narrabri, with some 1,000 kilometres of track, bridges and buildings, and 350 staff on the area north-west of Werris Creek. This may seem unusual in today's railway organisation, but it was the standard Way & Works Branch approach at the time. A previous Chief Civil Engineer to my time, Major-General A.C. Fewtrell, was once asked whether his subordinate officers in the railways assumed a lot of responsibility. His response was: *"That is my method. It is army organisation – delegation of commands."* – and that was certainly what we got!

Decline and Current Status

The adverse financial impact from uneconomic branch lines has always been of concern to NSW State Governments, with the pressure being there to close down these lines. For example, between 1946 and 1962, the NSW Government contributed £14.4 million towards losses on these lines but closed only 76 miles of track in this period, which represented just 1.2% of the system length in 1946. In 1962, the State Government continued to regard country branch lines as developmental lines which it was prepared to heavily subsidise.

After this time, the road system and car ownership continued to grow, with significant impact on railway revenues. This is an interesting reversal in the road vs rail competition. In the early days of rail, expenditure on roads dropped, as rail became the predominant mode. However, with the advent of the internal combustion engine, road again became predominant, leaving rail very much as the poor relation.

1855 And All That – 164 years of the NSW Rail Network

One only has to look at the Hume Highway, which now has dual highway all the way from Sydney to Melbourne. In contrast, the Main South rail line has had no alignment improvements in the last 100 years and some of the changes in the early part of the 20th Century, 14 chain (or 280m) radius curves were introduced in order to improve the gradients.

During the infamous Shirley era of the NSW railways (then known as the Public Transport Commission of NSW), overall track length was reduced but the extent of track closures has markedly increased since the early 1980s. As Figure 2 shows, the amount of track in use by the start of the 21st Century dropped by over 2,000 km since the peak of the network in the 1940s. Figure 14 shows the current network across NSW.

This is, of course, much more complicated than previous network configurations, with control of the NSW network now split between Sydney Trains, John Holland Country Regional Network (CRN) and the Australian Rail Track Corporation (ARTC). Analysis of this diagram shows the amount of track now out of service totals about 3,000km.

The construction of NSW railway lines has always been subject to the passing of an Act of Parliament, and likewise a railway line can only be formally closed by another Act. To date, only eight lines have been closed, with a total length of about 200km. These range from the Ballina Branch in 1948 to the Dorrigo Branch in 1993. Bizarrely, the formal closures also include the Campbelltown to Camden Branch Line in 1963, which shows how short sighted the government of the day was.

Discussions on the outcome of this split and the future of the NSW rail system are beyond the remit of this paper, but will no doubt be covered very well in the next Convention Paper by David Mackney, from John Holland – Country Regional Network.

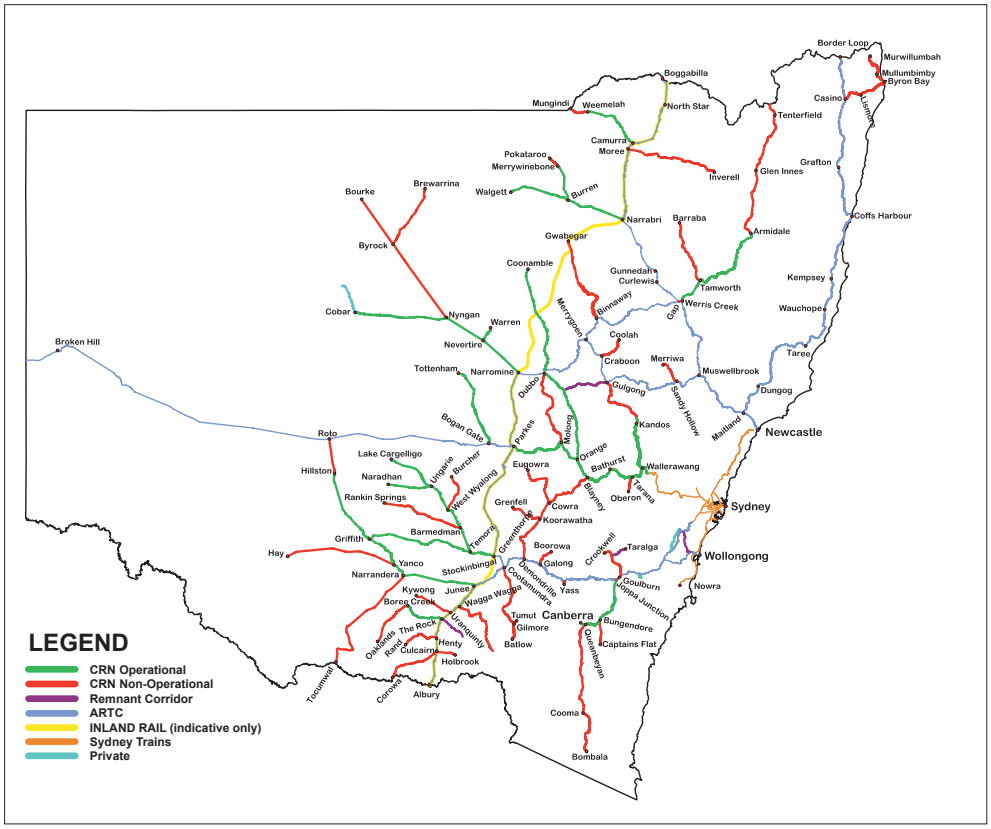

Figure 14: Current NSW rail network – 2019 (CRN)

However, I must say that the state of the track between Burren Junction and Walgett Grain Terminal (the line being closed between the Grain Terminal and Walgett Station) under John Holland Country Regional Network in 2018 was much better than when I left it as Division Engineer, Narrabri, in 1972 – as Figure 15 shows.

Figure 15: Track between Burren Junction and Walgett in 2018

Conclusion

This has been a very basic and high-level outline of the development of the NSW rail network, particularly in its earlier days, with such a rich history. I hope that as much of this network as possible is kept for the future, and perhaps even expanded. One shall have to wait and see if such proposed developments as the Very Fast Train to Canberra and Melbourne, a line from Canberra to Eden (using the existing Queanbeyan to Bombala alignment) and the re-opening of the Blayney to Demondrille cross-country line ever attract enough political will to eventuate – I hope they do!

So far as the currently non-operational lines are concerned, there is no doubt that many of these will never warrant re-opening. However, from a railway heritage viewpoint, it would be good to see some of these retained or at least some parts of them. Structures like the 500m long Manilla Timber Viaduct and Steel Bridge over the Namoi River are a testament to the skills of the constructors and maintainers over the years. The skills of maintaining bridges and track while keeping trains running (no closedowns in those days) is surely an art that should be recognised and recorded.

If you wish to know more on the history of the NSW Rail Network, the Department of Railways, Centenary book, *The Railways of New South Wales 1855 – 1955*, gives a good overview, albeit with the typical government "all-good-news" spin.

On the other hand, David Burke's book, *Along Parallel Lines*, provides a more detailed, "warts-and-all" history and analysis.

If these arouse your interest, then the Australian Railway Historical Society NSW (ARHS) has a lot of material in their Railway Resource Centre. While one may think of these groups as merely "train spotters", the ARHS runs a very comprehensive and professional archives, which is used, for example, by Sydney Trains and consultants in the rail industry.

Acknowledgements

Preparation of any conference paper like this is always made easier with the willing assistance one receives from others. For this paper, my thanks are to James Dalton, Manager of the ARHS Railway Resource Centre and the very helpful people at the Boorowa Museum. Thanks also to Dr Stuart Sharp and David Mackney for their sharp eyes and very useful peer review.

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Challenges of maintaining a Regional Rail Network

David Mackney – Manager, Maintenance Delivery

John Holland Country Regional Network

Introduction

With Bathurst hosting the 2019 PWI NSW Annual Convention, the perfect opportunity has been provided to highlight the regional rail network that passes through the township and the challenges involved. This paper covers the following:

- A brief outline of the Country Regional Network (CRN)
- A brief outline of John Holland Operations and Maintenance
- Maintenance challenges whilst efficiently and safely delivering 'bigger, faster, heavier' train operations
- Case Study – Junee to Griffith

The term 'bigger, faster, heavier', from the authors vernacular is used to describe the potential trifecta of operational enhancements that have been realised or currently in the pipeline to be realised on parts of the network. Fundamentally this relates to longer train consists, higher average speeds and heavier axles, on a network that has a variety of track classifications, configurations and condition.

Country Regional Network (CRN)

The CRN is operated and maintained by John Holland as the accredited rail infrastructure manager (RIM), on behalf of Transport for NSW under a 10-year contract that commenced in January 2012.

The CRN links broad areas of regional NSW to interstate and metropolitan rail systems and in addition supports customers transporting coal, grain, cotton, minerals and containerised freight to domestic and export markets.

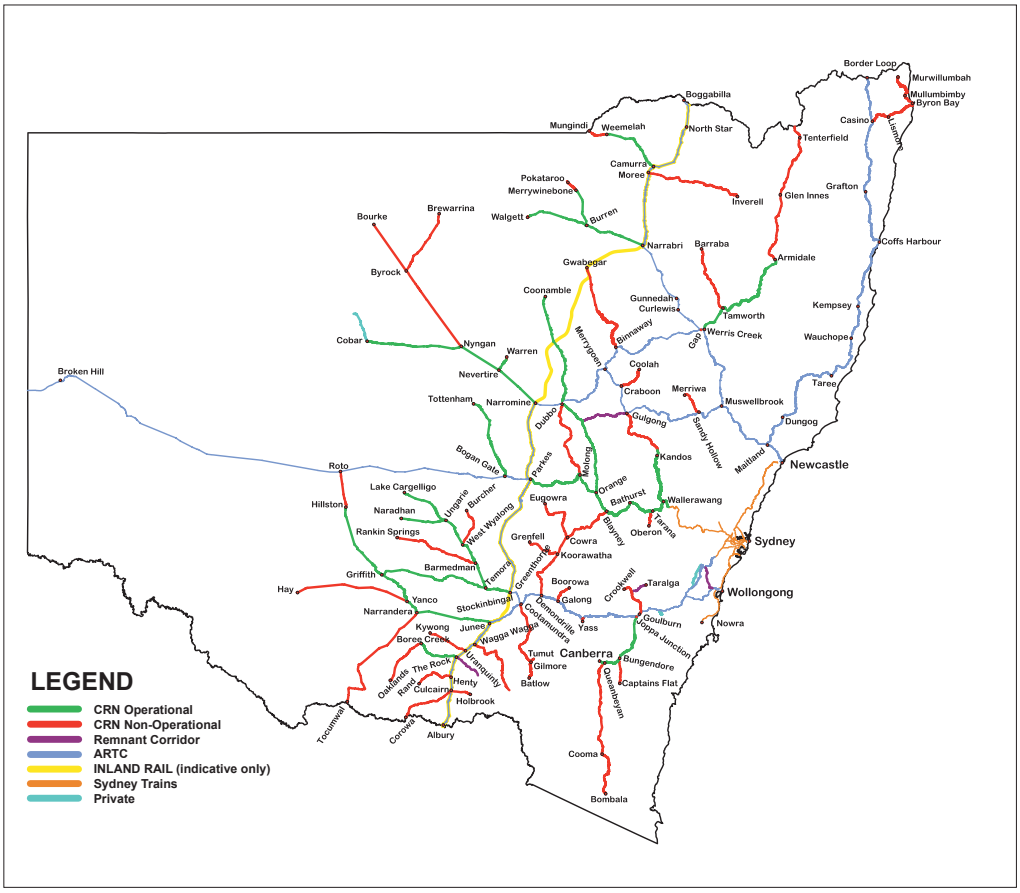


Figure 1: NSW Rail Network Map

Challenges of maintaining a Regional Rail Network

The CRN includes the following:

- 2,470 km of Operational Lines (Fig 1) – including track classes 1, 2, 3 and 5.
- >3,100 km of Non-Operational Lines (Fig 1) plus remnant corridors and deviations.
- 364 mainline turnouts with no diamonds, slips or expansion switches
- 1,137 Level crossings on Operational Lines (136 active)
- 150 km of Rail Vehicle Detection (RVD) on the Main West between Bowenfels and Orange, Baal Bone and Parkes.
- 2,250km of Train Order Working (TOW) over the remainder of the Operational Lines
- 235 Rail bridges on Operational Lines (32 timber) plus over 4,500 culverts.
- 359 Road over rail bridges (91 timber) including locations over other rail networks, plus 17 footbridges.
- 269 Geotechnical sites on Operational lines
- Property management of 282 million square metres of land divided into 14,670 land parcels.
- Other assets such as communications towers, buildings, cranes, dams, water towers, turntables etc

John Holland Operations and Maintenance

Our purpose: To keep people and freight moving safely in regional NSW.

John Holland has a team of 380 located across NSW (Fig 2) with domains covering

- Maintenance (track, structures, right of way, signalling, facilities, plant and logistics)
- Projects (Major Periodic Maintenance, Capital and External Projects)
- Operations – Network Management Centre based in Mayfield (Fig 3)
- Asset Management and Engineering
- Risk and Assurance
- Business Services (Finance, Reporting, IT, Property)
- People and Culture (HR, Environment, Work Health Safety, Communications)

Eighty five percent (85%) of the team are regionally based.

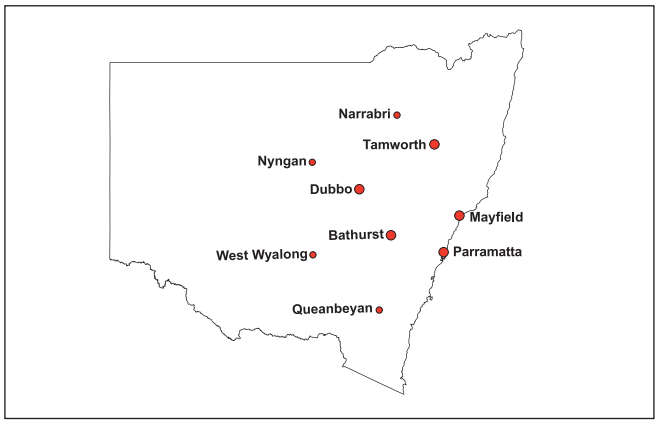


Figure 2: JHR Office and Depot Locations

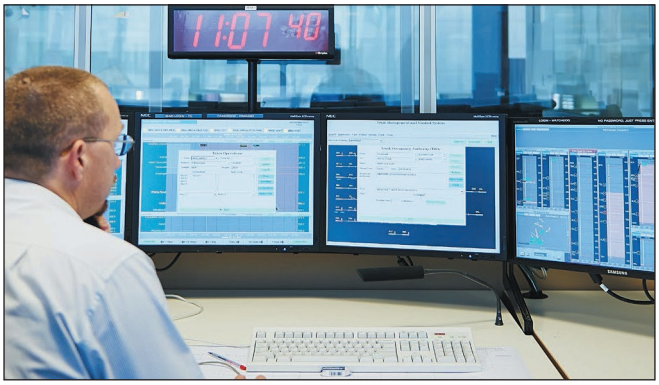


Figure 3: JHR Operations Staff at the Mayfield Network Management Centre

Challenges of maintaining a Regional Rail Network

Challenges of Maintaining a Regional Rail Network

The challenges described below are not comprehensive, in any priority order or specifically unique to the CRN and may well be experienced by other rail networks across the country. The opportunity to share and collaborate between operators and other networks can sometimes offer up the best solutions.

Operating within constrained budgets

Since 2011, the NSW Government has invested over $1.65b into the CRN and its assets. This includes ongoing maintenance, upgrading and capital works. Budgets are constrained across the transport portfolio which requires careful asset management practices.

Maintainers are constantly seeking new and innovative ways to do more with less. Some of the current challenges faced by maintainers in respect to this are,

- Year on year cost increases in labour, materials, plant and sub-contractor costs.
- Additional assets added to the network – new loops, turnouts, track work and signalling.
- Increases in service operation – i.e. 'bigger, faster, heavier'.
- Managing multiple asset and stakeholder priorities.

People

With the boom in rail projects across NSW, attracting and retaining skilled resources is becoming one of biggest challenges for current day rail organisations. While this issue provides great opportunities for the individual, it often results in inconsistent remuneration packages being offered by employers. Roles in Engineering, Supervision and Project Management are currently difficult to fill due to a low supply and high demand. Individuals working in rail now have a great deal of choice.

For regional locations where the roles are required there are a few specific challenges including:

- attracting people to the area from other regional centres, cities, interstate or overseas on a permanent basis.
- providing sustainable training centres that complement the experience gained in the field.
- developing a core base of skills that can be transferrable to other industries when the boom subsides.

Regional rail networks do now provide great employment and development opportunities for workforce roles. A potential positive out of the boom of rail projects for the maintenance domain will be a steady stream of pre-qualified staff in regional centres.

The Country Mile

The daily commute for the workforce can literally be a day. Careful planning by grouping maintenance activities together assists with this. Response times to incidents is particularly challenging in more remote areas of NSW.

Interfaces and Stakeholder Engagement

The CRN has a significant number of internal and external interfaces that require constant stakeholder engagement, some with competing interests. The CRN interfaces with 59 local government areas (LGA), road authorities, numerous above and below rail operators. A unique challenge for CRN teams is gaining access to assets over and around other rail networks. Figure 4 is a typical road over rail bridge on the North Coast Line. Gaining access to these assets requires a level of planning to conform to the requirements of the RIM which can be different from those on the CRN.

Figure 4: Timber Road over Rail bridge – 668.040km Kungala over North Coast Line

Repetition Breeds Complacency

Rail maintenance by its very nature is often repetitive year on year. The approach does provide a level of comfort in that inspections and repairs will be done relatively consistently. However, with repetition does come a level of unease around complacency.

Rail organisations must have robust assurance, verification and auditing programs to support their operations. As part of the overarching assurance program, a simple yet effective approach is to mix up maintenance examinations with 'another pair of eyes' utilising people not familiar with the area. This can often pick up on the things missed by others who do these activities routinely.

Figure 5 is a simple example where a level crossing speed sign, installed many years ago, then inspected year on year was identified by 'another pair of eyes' as fundamentally not complying with the requirements for which it was intended. Can you spot the issue?

Loss of Knowledge – Understand the History

The last three decades has seen several changes to the maintenance guard on the CRN, both with individuals and organisations. When this occurs, there is always the risk of corporate knowledge loss when it comes to individual assets. An example of this is the Tamworth Viaduct (Fig 6), originally built in 1885 as a 2nd generation wrought iron structure with timber approach spans, later replaced with steel spans in 1910 and 1928.

A recent project to determine the remaining life of the structure and assess for potential axle load increases spent a significant amount of time contacting, locating, researching and reviewing past documents, reports and plans that were scattered across numerous organisations and individuals. This type of information is vital for the 'future versions of ourselves' who may need to make key engineering decisions based on the actions undertaken today.

The solution to this is robust asset information and record keeping systems that can be universally accessed by all stakeholders. This type of information should be readily available at users' fingertips.

Figure 5: Does this long-standing level crossing signage appear correct?

Figure 6: Tamworth Viaduct – 2nd Generation wrought iron spans circa 1885, other steel spans are circa 1910 and 1928

Challenges of maintaining a Regional Rail Network

Seasonal and Low Use Lines

Considering the current drought conditions experienced across NSW, seasonal lines are especially challenging when trains are not operating.

At present eight sections of the network are effectively 'booked out' pending the return of the grain harvest. This level has not been seen during the term of the current contract.

In previous years only a very small number of sections have literally gone years with little to no train services, see (Fig 7) – last train on the Weemelah Line, with no trains for the 12 months prior.

Figure 7: Weemelah Line February 2019 – Last Train to use the line was a rail set cascading stockpiled 53kg rail to Griffith

For seasonal lines, maintainers must minimise unnecessary examinations and repairs while at the same time work closely with the operations team to have the assets ready at a moments notice. Figure 8 shows the decline in gross tonnes moved across the Coonamble corridor over the last three years. Low use lines are not typically seasonal in nature and only have a few regular services per day or week. On these corridors, maintenance practices must be tailored to reflect the operation while still retaining a safe network.

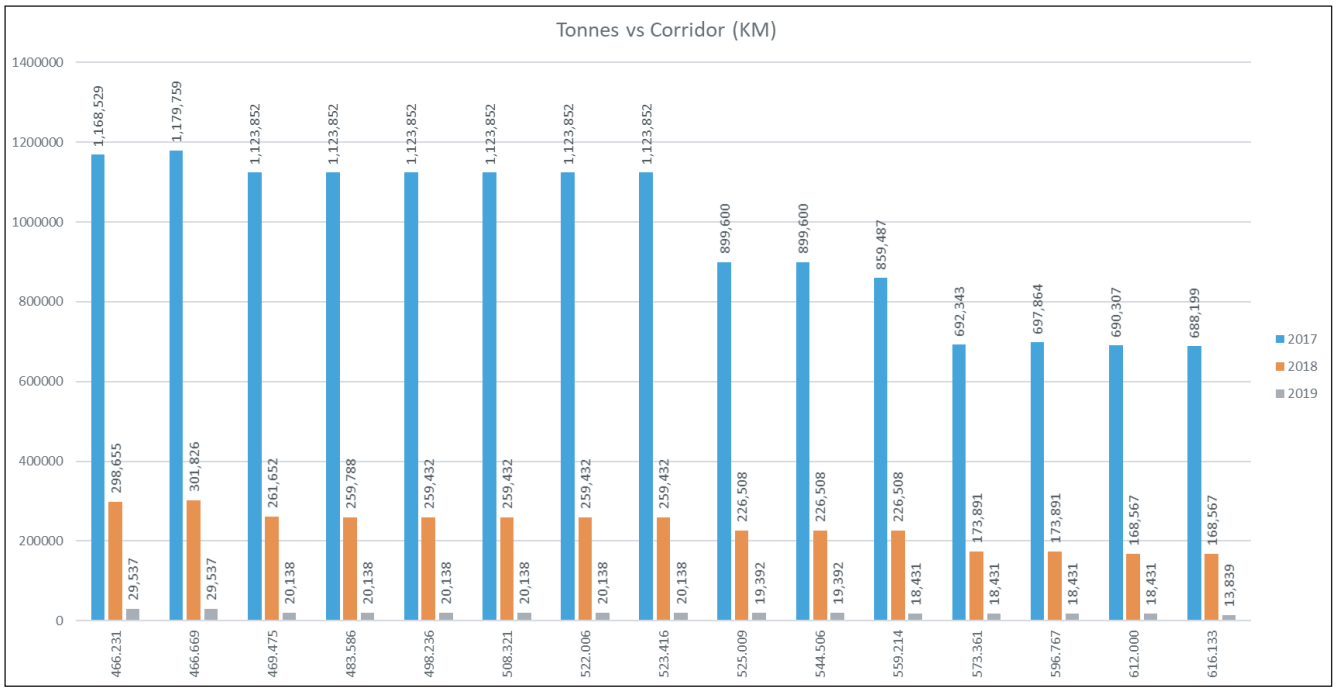


Figure 8: Coonamble Line – Annual Tonnage Data 2017, 2018 and up to Aug 2019 – impact of drought

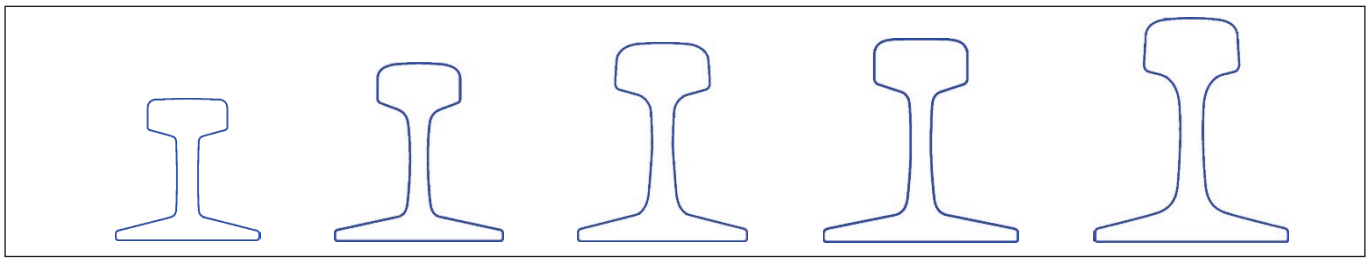


Figure 9: Typical variety of rail sizes on the CRN –from left to right 31kg, 41kg, 50kg, 53kg, 60kg/m rail sizes

Recycling Assets

The practice of recycling rail, turnouts, bridges and other components has been undertaken by railways in NSW since its inception. The benefits of the practice far outweigh the negatives. Cascading partially used rail from higher classed lines to regional branch lines also can provide the added benefits of being able to operate 'bigger, faster, heavier' services. Figure 9 shows the typical rail sizes used on a regional network.

The challenge for maintainers is understanding the risks associated with recycling. Knowing the previous service life, wear patterns and pre-existing defects can assist in determining the expected remaining asset life. If this is unknown, then processes for assuring the suitability of the component is required. Due to the varied rail section sizes scoping up the correct sleeper assemblies is an activity that must also be undertaken.

A recent example of successful recycling was the rail removed in Newcastle to make way for the new light rail system. This has now been installed near Wallerawang on the CRN. Other examples of upcoming recycling opportunities are discussed in the attached case study.

Ageing Assets on Non-Operational corridors

With some corridors ceasing operations over the past four decades there is an ageing portfolio of assets that are still required to be managed. A portion of these assets are heritage listed. This is certainly not unique to the CRN, the size of the portfolio though does effectively compete with operational line assets for resources.

Figures 10 and 11 are two examples of large rail bridges no longer in use but requiring a level of diligence to ensure the safety of the structures. Out of the portfolio of assets that fall into this space, assets with structural timber components are of a higher concern due to the degradation rate of the material.

Figure 10 – Heritage Listed Narrandera Viaduct – Wrought Iron – potential to be repurposed as a cycleway

Challenges of maintaining a Regional Rail Network

Figure 11: Heritage Listed Bredbo Rail Bridge – Timber Queen Truss

How to meet the Challenges

As previously mentioned, with constrained budgets rail maintainers should always be seeking innovative ways to do more for less and to provide fit for purpose solutions to the NSW community. This requires the overall maintenance system to be broken down and analysed in its respective components. Figure 12 provides a simplistic view of some key maintenance topics to consider when dealing with challenges.

People (The Who) – has the most influence over the other two elements. People design, build, operate, maintain, dispose the assets. People also develop and implement the processes. Have the right mix of people, who fully understand the needs and the requirements. 'Another pair of eyes' can provide new ideas and innovation.

Process (The How) – this area includes systems, standards, procedures, methods, safety, assurance and verification. This area needs continual review and refinement to optimise the effort required.

Assets (The What) – things to look after that have varying configurations, conditions and ages. Some are built to past standards, some with a maintenance backlog, others are located in sparsely populated areas across NSW. The challenge is to keep these assets maintained fit for purpose for which they are currently intended.

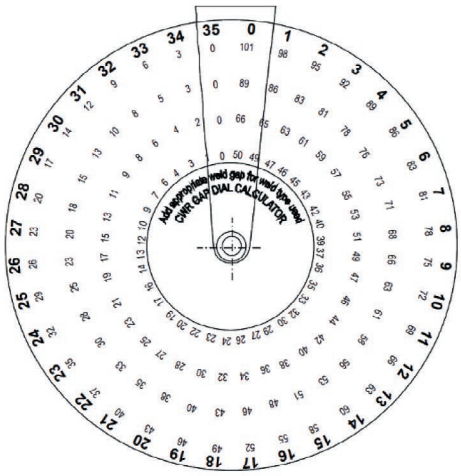
Figure 12: A simplistic view of key maintenance 'cogs' to analyse

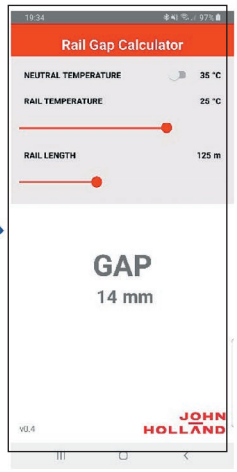
Innovations – is there an App for that?

A few of the innovations that have been developed on the CRN include the following:

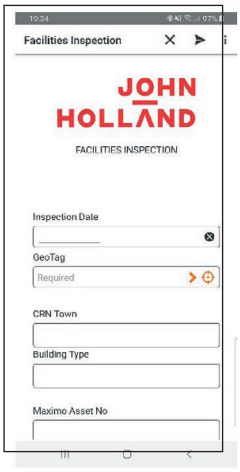
Electronic Track Work (ETW) app – introduced in 2017, this app has revolutionised the way track work authorities are issued on the network by virtually replacing all paper-based forms. The next evolution of the app is due out in late 2019 for use in track maintenance vehicles to prevent limit of authority over runs.

Rail Gap Dial Calculator – replaced the manual gauge and / or gap tables with a simple app.

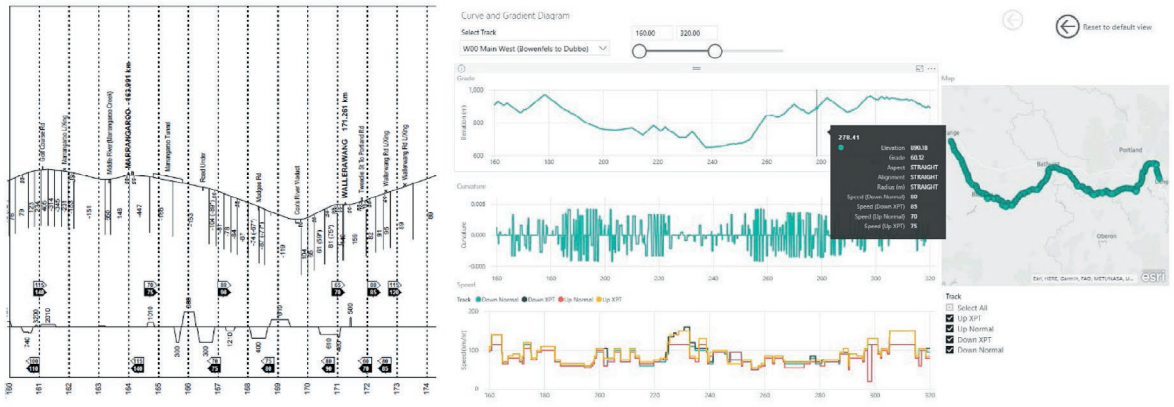




Asset inspection apps have been developed in house.



In the development pipeline is a replacement for the curve and gradient diagrams using up to date data from the asset information systems. This allows the user to view whole corridor or smaller sections as needed and can be made portable.



Case Study: Junee to Griffith (J2G) – 'Bigger, Faster, Heavier'

While the CRN has already celebrated the introduction of numerous operational enhancements over the life of the current contract, an upcoming major project is set to commence in the first quarter of 2020 between Junee and Griffith (Fig 13).

Figure 13: Imagery near Wumbulgal on the Junee to Griffith Line – recycled rail laid out ready for installation

The line currently allows for a maximum axle load of 20.25t at up to 60km/hr and has been identified as a priority line for infrastructure upgrade works. The line is situated in Southern NSW and currently supports two passenger services and twenty-two freight, grain and light engine services a week (see Fig 14 for annual average tonnages).

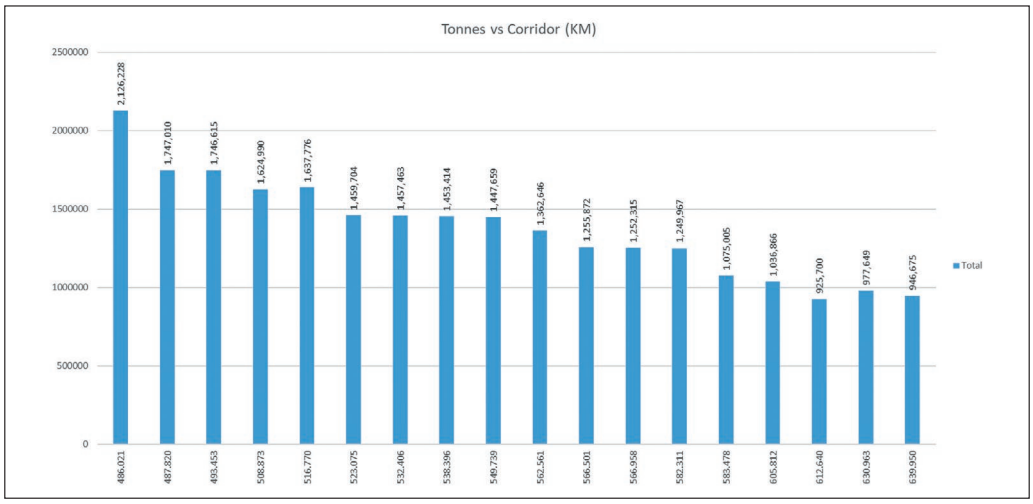


Figure 14: Junee to Griffith average annual tonnage data 2012-2018 (7years) along the corridor

Funding has been secured via the NSW Government's Fixing Country Rail program to upgrade the existing smaller 80lb/yd rail size found across most of the corridor with larger rail sizes at least equivalent to 47kg/m, 50kg/m and 53kg/m. Most of the rail will be cascaded second hand from Parkes to Narromine, west of Broken Hill and from a stockpile on the Weemelah line originally sourced from the Illawarra. There will also be other upgrading works including turnout refurbishments, rail bridge strengthening, ballasting, resurfacing, formation works, culvert improvements. These works will allow the gross allowable wagon tonnage to increase from 81 t (20.25TAL) to 100 t (25TAL) at up to 50km/h.

The existing corridor is a mix of class 2 and 3 track configurations. The project will uplift the assets to just under class 1 standard having a smaller rail size, thus the proposed limited speed for 25TAL. For this operational enhancement to occur, John Holland holds engineering authority under its accreditation and has assessed this change as appropriate without requiring the need to fully rebuild the track structure to meet class 1 standards. This decision is linked to the current and future operational requirements of the corridor.

The upgrade will assist customers, network operations and other key stakeholders in sustaining value for money, freight and grain haulage in regional NSW.

Improvements on the Junee to Griffith line are anticipated to increase train capacity utilisation over the long term. With lower operating costs, there is scope to increase the volume of intermodal and grain freight moved by rail, subsequently reducing road transport by a similar amount. The transfer of freight to rail provides an indirect benefit of reducing greenhouse gas emissions, and reducing a loss of road amenity, congestion, noise, road maintenance, accidents and trauma. These indirect benefits provide a substantial positive outcome for the community.

Acknowledgement must go towards previous years' activities which enabled the proposed outcomes of the upgrade project as follows:

- Past maintenance and upgrading – including face steel resleepering, turnout refurbishment, ballasting and resurfacing
- Asset configuration and condition investigation and optioneering undertaken some years prior to securing of funds. This includes independent reviews and assessment.

As a final point, the 80lb/yd rail planned to be replaced is already proposed to be cascaded to another corridor to allow 'bigger, faster, heavier' operations.

Conclusion

Regional Rail Networks such as the CRN have experienced and will continue to experience investment in alignment with strategic objectives. This investment needs to be balanced between existing operations and maintenance requirements as well increasing the capacity of the network for future operations to support regional communities, businesses and industries.

While this paper primarily focusses on operational rail corridors an issue that needs careful consideration is the aging infrastructure on non-operational corridors that in some cases last saw a train over four decades ago.

The CRN shares numerous similar challenges to that of its neighbours in the city or other regional networks. Jointly with various stakeholders these challenges can be met with new and innovative ideas, the right mix of people, sustained budgets and the supporting systems for the retention of knowledge.

References

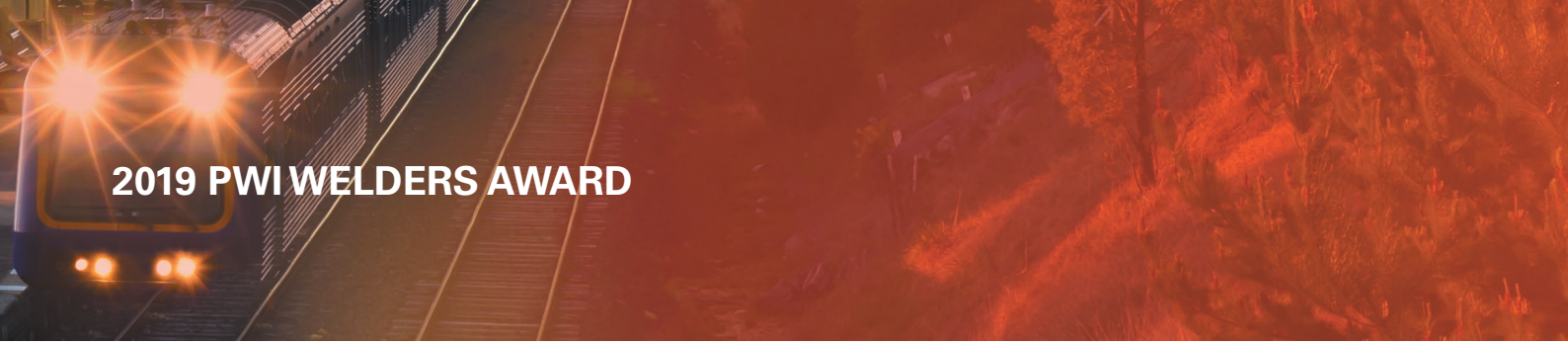
2019 CRN Annual Contract Report (Aug 19, John Holland)

20/21 CRN Asset Management Plan (Sep 19, John Holland)

2019 CRN Asset Condition Report (Mar 19, John Holland)

Railways of NSW Map 2018 v0.7 (modified Sep 19, John Holland)

CRN Tonnage Data Extract (Aug 19, John Holland)



2019 PWI WELDERS AWARD

Judges

Ross Ginn, Rojin Pty Ltd

Ben Muscatt, Sydney Trains

Steve Maddock, Sydney Trains

Mark White, Speno Rail Maintenance Australia Pty Ltd

The PWI introduced this Award in 2002 to recognise the efforts of field workers in the area of rail welding.

This award attracts entries from all over the State, which is testimony to the wide geographic base of PWI members. This Award is proudly sponsored by two of our Corporate Members, Pandrol and Thermit.

Judging Criteria is based on:

- Must be a qualified Welder with a minimum of 70 welds in the previous 12 months
- Ultrasonic Failure Rates Percentage
- Alignment Rejection Rate Percentage
- Site clean up/consideration of the environment
- Difficulties overcome
- Safety/LTI (Lost Time Injury) Rate for nominees' welding gang

Nominations for 2019 PWI Welders Award

NAME	COMPANY
Sitiveni Kisina	Quickway P/L
Kassem Chamas	Laing O'Rourke
Geoff Hopkins	MP Rail
William Stapley	MP Rail
Lani Alipate	Quickway P/L
Dwight Williams	Quickway P/L

2019 PWI YOUNG ACHIEVER AWARD

Judges

Julian Sharp – CPB Contractors
Prath Nanthakumaran – Transport for NSW
David Spiteri – Transport for NSW
Anna Murray – Sydney Trains
Matt Jones – John Holland
Rebecca Coffey – Lycopodium
Lee Taylor – Laing O'Rourke
Nagajyothi Lolla – Transport for NSW

The PWI Young Achiever Award is a prize of up to $10,000 for the winner to go towards the cost of attending a relevant international railway conference. To be eligible for this award, an entrant must be 35 or younger at the 1 January of the year of entry. The aim is to encourage younger members into our industry and promote knowledge sharing. We have now broadened the judging criteria to make it more multi-disciplinary so that it includes for all members who are involved in the numerous rail infrastructure projects that are being delivered at the moment.

Judging Criteria

Judging is based on:

Relevant Criteria	Available Score
Relevance to Perway	10
Difficulties Overcome	20
Quality of Paper and/or Presentation	20
Amount of Innovation	15
Ongoing benefit to the transport industry	25
Technical Excellence	10
Total Score/Marks:	**100**

The Award is judged on either a Technical Paper that has been written (and preferably presented) or a Project or Program of Works that has been completed, within the last 18 months.

Following the initial judging of the applications, between 3 and 5 applicants are shortlisted to then present their paper to the judging panel. Each applicant has 20 minutes to present their paper and then answer questions for a further 10 minutes. The judges then make their final determination.

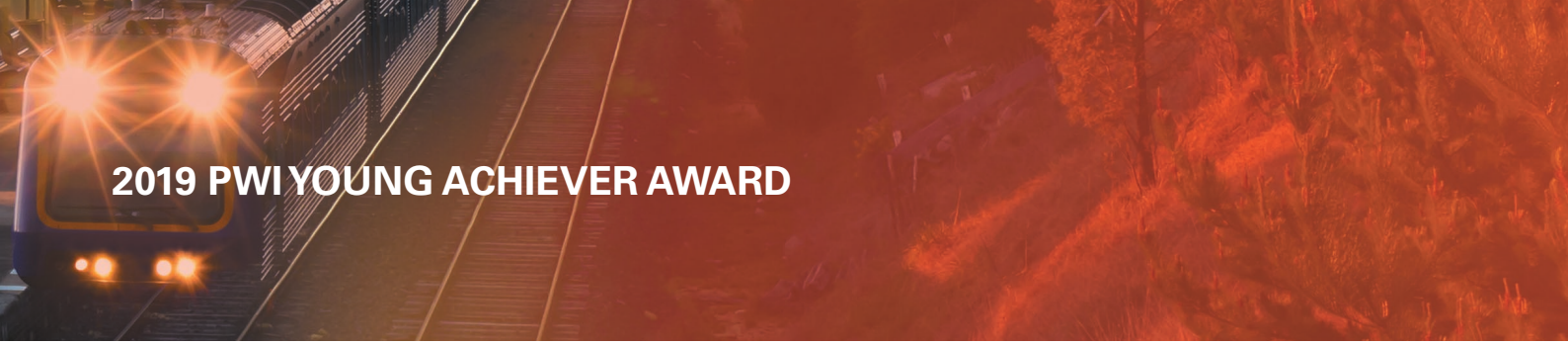
Award

Up to $10,000, to cover:

1. Transport, registration, insurances and accommodation to a relevant railway conference (PWI approves the attendance at the nominated conference).
2. Award must be taken within two years of being presented or agreement reached with the PWI Committee to be deferred for a longer period.
3. The award may not be presented in a given year if entries are not considered suitable.

Conditions

Previous winners of this award (or similar such awards, e.g. the RTAA Frank Franklyn Award) will be excluded from re-submitting an application for this award for a period of no less than five years from the time of submitting their application for their winning award. The subject of the award must relate to the applicant's current employer who will be required to provide a reference. The successful candidate will present at the next relevant Technical Meeting, a summary of the attended conference and any associated industry visits.



2019 PWI YOUNG ACHIEVER AWARD

Delivery of Asset Management Plan and Surface Affected Rail Rerailing Programs For Sydney Trains

Mary-Ann Freeburn
Senior Program Manager, Major Works
Sydney Trains

Abstract

- Delivery of 1718 Financial Year Asset Management Plan and Surface Affected Rail Rerailing Programs
- $33 million program of works delivered achieving 50.170km of track kilometres rerailed – 20% over the target. This includes 60.056km of CWR adjustment
- The rerailing program addresses both life expired rail – rail which has worn down over time due to normal use – and surface affected rail – degraded surface condition due to squats or more broadly, rolling contact fatigue.
- Stand out project – Sydney Harbour Bridge Stage 1 Rerailing Works undertaken in May 2018

Sydney Metro Northwest Viaduct Type 1 Track Slab

Thy Pham
Bachelor of Engineering, Civil
CPB Contractors Pty Limited

Abstract

The Sydney Metro Northwest project is the first stage of the Sydney Metro: the first fully automated metro rail system in Australia. This project will deliver eight new railway stations and 4000 commuter car parking spaces to Sydney's growing North West, new metro trains and upgrade the railway between Chatswood and Epping.

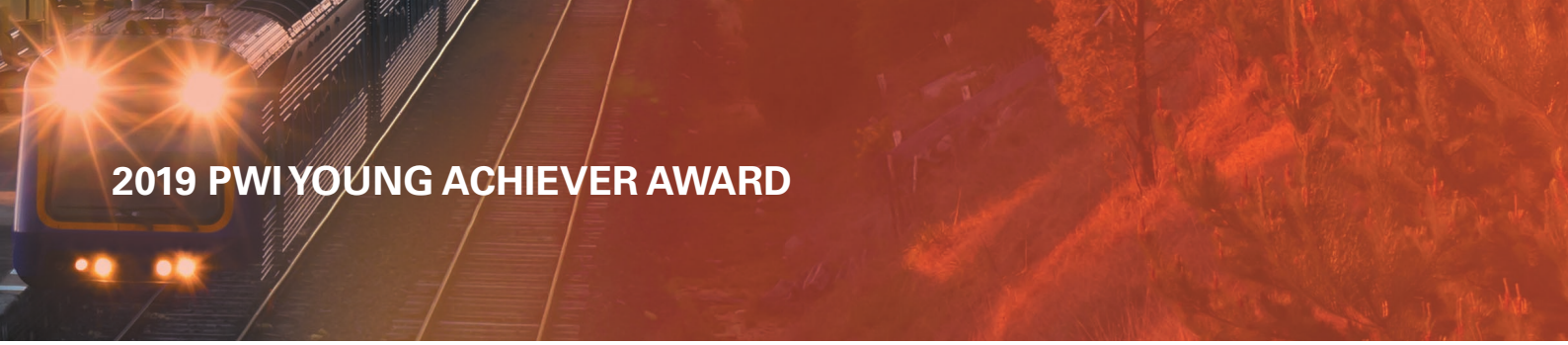
I was part of the Sydney Metro Northwest delivery team for the viaduct portion of works, and was embedded within Sydney Metro's internal track team. As Track Team Junior Engineer, I represented the primary interface between the Track Team, design teams, and plant and equipment subcontractors, and was a key driver to ensuring a successful delivery of the track. I also drove the team to hit all milestones and tranche dates set by Transport for NSW (TfNSW).

This technical paper, Sydney Metro Northwest: Viaduct Type 1 Track Slab, illustrates the technical stages and building activities for the viaduct and Type 1 Track Slab portion of works. The paper covers the entirety of the viaduct's lifecycle, including its corresponding subsystems, and innovative mitigations that addressed project challenges, including late handover of the asset from the Surface and Viaduct Civil Works (SVC) contractor in early-mid 2017.

The technical paper outlines the incorporation of major design changes, defects management, construction and delivery of the track, and finalisation of commissioning and testing in readiness for handover to the Services Joint Venture (SJV).

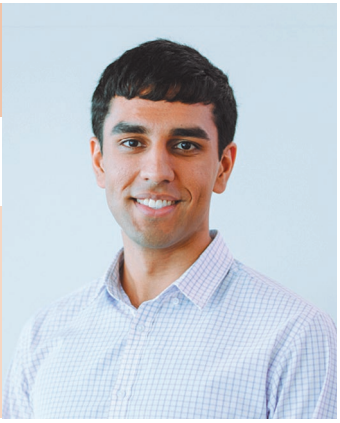
The successful delivery of the viaduct track slab was performed against a demanding schedule, within a highly congested project footprint, and required all works to meet complex specifications and high standards, at a minimum. These elements were achieved despite a number of significant challenges, including late handover of the viaduct, never before tested working methodologies, and the added pressure of delivering an iconic infrastructure project within a capital city.

Meeting a minimum standard of technical excellence was inherent to a successful delivery, and is best demonstrated by the ontime, on budget handover of the viaduct to the TfNSW/SJV.



2019 PWI YOUNG ACHIEVER AWARD

Desktop study of PTI Solutions applicable for The Regional Rail Network



ARUP

Opinderjit Samra
Bachelor of Engineering (Civil) with 1st Class Honours
Diploma in Engineering Practice
Arup

Abstract

Opinderjit completed a desktop study commissioned by TfNSW on solutions to improve the platform train interface (PTI) on the regional rail network. The PTI is the gap between the edge of the platform and the train door threshold, expressed as a horizontal and vertical stepping distance.

The PTI poses a challenge in terms of accessibility for passengers, with larger gaps leading to a greater risk of injury and a reduced customer experience. The regional rail network presents large gaps and steps at a number of platforms. During the procurement of the new regional rail fleet, TfNSW identified an opportunity to address the problem and was seeking advice on solutions that have been implemented globally. TfNSW also needed to understand it's legal obligations to address platform gaps under legislation for disabled access.

Opinderjit researched and benchmarked Australian standards on disability access and platform gaps against global standards in the USA, EU and UK. He received data from TfNSW on their platform infrastructure which he analysed to understand the problem in the context of the regional rail network. He then researched a number of fleet, platform and infrastructure based solutions that had been deployed around the world and analysed their relative advantages and disadvantages. He assessed their suitability in the regional rail context through an evaluation framework and identified what was potentially the most suitable solution.

Holistic Possession Performance Framework

Maythee Varayudej
Masters Engineering Asset Management, UOW
Bachelor Engineering, UNSW
Bachelor Commerce, UNSW

Abstract

The appropriate planning of track possessions is crucial to a Railway operator/maintainer in order to meet maintenance, growth, budgetary requirements and upholding public reputation. Based on shutdown planning from other industries, traditional possession planning and management considers the costs and benefits of possessions to the organisation, focusing on value, asset condition and satisfying maintenance requirements for access. However, in transport, unlike many other industries, there is a cost to customers or the public that is difficult to quantify, such as inconvenience to customers and congestion caused on other modes of transport. While in most cases they are measured and are subjectively taken into account, there is no framework guiding the application and usage of customer or transport network impacts.

Research into the area of performance measures for possessions was disparate and lacking a fully defined framework to enable benchmarking as well as having very limited research into the indirect impacts on customers and on a city's wider transport network.

The original contributions of this project primarily focused on three areas. Firstly, the novel quantification of impacts of rail track shutdowns on road traffic (confirming correlation and causation) and secondly the development of a proposed shutdown performance model with case study and analysis (this included formalising many novel components and metrics tailored for Transport shutdowns). For example, the metrics around network impacts were developed after an in-depth quantitative analysis of three-years of Sydney Trains' possession and RMS's road traffic data. For example, the analysis found a strong correlation between Central track possessions and increased road traffic (increasing by more than five-percent on the Sydney Harbour Bridge). Because of these findings, the metrics around Transport Network impacts were developed. Lastly, the paper has been used to develop Sydney Trains' Possession Performance Framework that took the research and recommendations and refined further into a practical framework that could be applied across Sydney Trains' Trackwork Possession Program.

The Possession Performance framework takes into account various factors found through research and industry practice to form a holistic view of trackwork possessions. The aim of the framework was to encompass relevant metrics including both direct economic factors and indirect or non-economic factors, enabling improvements in the process of possession planning.

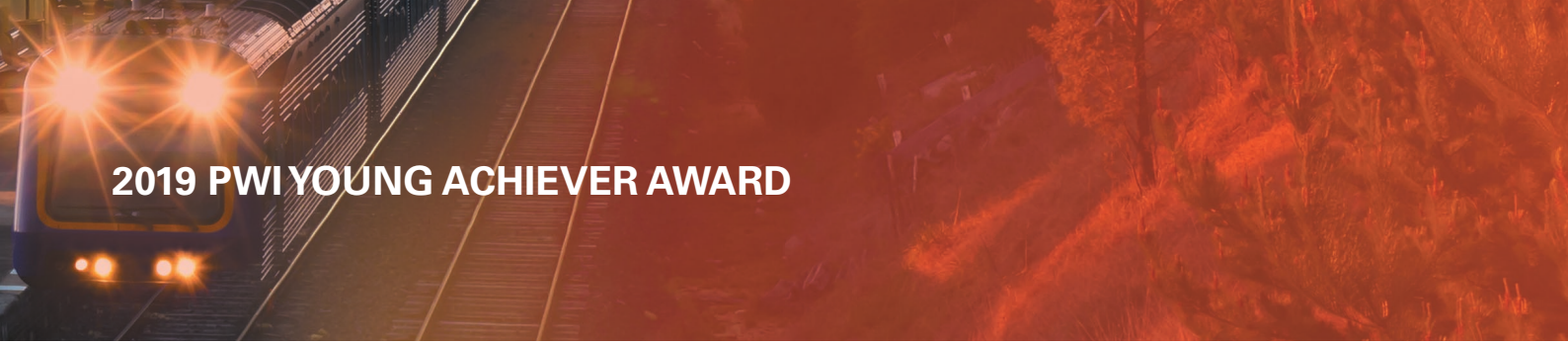
The table below illustrates the application of the framework compared with past methods on an actual options analysis completed in the past, for the purposes of decision-making (note that metrics that were equivalent in this scenario were omitted from the table below).

	Prior Method		Possession Performance Framework	
	7-Day Closedown	2x 4-Day Closedown	7-Day Closedown	2x 4-Day Closedown
Supporting Metrics Note: Metrics that were equivalent in this scenario were left out	1. Lower outright Org. Economic Costs (9.9% less)	1. Lower total number of Passengers impacted (39% less)	1. Lower outright Org. Economic Costs (9.9% less) 2. Higher Access Utility (40% higher)	1. Higher Value Ratio - Value for money (7% more) 2. Lower Weighted Passenger Impacts (44.8% less) 3. Higher Access to Assets (62.2% more) 4. Lower impact to Transport network – i.e. Roads (39% less)

Case Study Table – Comparison of past methodology to Sydney Trains' Possession Performance Framework

The formalisation of this framework will provide a standard platform for railways within the industry to benchmark their possession performance.

With 1.2million passenger trips each weekend and delivery of upwards of $10mil of work for major weekend possessions, Sydney Trains will use the framework as a mechanism to drive change to long-held assumptions around the planning of possessions in terms of timing, duration and location of possessions in order to minimise stakeholder impacts while delivering more usable track time to complete maintenance and project work.



2019 PWI YOUNG ACHIEVER AWARD

Converting Brown into Green

Jarod Wakefield
Project Engineer – Track
John Holland Group
Bachelor of Engineering (Civil)(Hons)
Diploma in Engineering Practice
Diploma in Project Management

Abstract

- Successfully delivering all ECRL segregation possessions to allow Sydney Metro Northwest to operate;
- Building a young team to teach the ways of constructing trackform in both a Brownfield and Greenfield environment;
- Developing an innovative track support system for concreting turnouts and catchpoints;
- Developing and proving a new concrete shuttle for concrete transportation on rail; and
- Successfully reviewing and maintaining the existing ECRL tunnels to meet Sydney Metro Northwest Standards.

Ballast Glue as a Boghole Maintenance Strategy

Transport Roads & Maritime Services

Lexie Reynolds Walsh
Graduate Engineer
University of Sydney – Bachelor of Civil Engineering
University of Sydney – Bachelor of Arts (Anthropology & History)

Abstract

- The report provides information on a ballast glue trial undertaken at Waterfall, NSW, on the Sydney Trains Illawarra Main Line in 2018.
- The purpose of the trial is to test whether the application of ballast glue after tamping will prevent or reduce the rate of recurrence of a given boghole. It was expected that the ballast glue will provide added track stability and reduce or eliminate the need for maintenance works over the 12-month period following the application.
- At the time of writing, results indicate that the trial may be successful: no maintenance interventions have been required to address track defects, and measurements taken since the glue application show less vertical displacement of the track when compared with historical measurements in the same location. However, the lack of rain during 2018 in NSW may have had a significant effect on these results, as water is known to increase the rate of recurrence of bogholes.
- Further monitoring of the trial site is recommended to confirm these findings.
- In the process of undertaking these works, the Project Team identified a need for a modelling system to better assess the condition of the track. A rail profile mapping system was developed in response to this issue and is also presented in this report. It is proposed that this system can deliver more detailed information on the condition of the track when compared to existing monitoring systems, and can therefore be used as an aid in a condition based monitoring approach to asset maintenance.

SECOND SESSION

PWI Annual Convention 2019

Chairman: **Paul Feris (Lendlease)**

Paper 3: **The Fixing Country Rail Program**
Jim Modrouvanos – A/Executive Director Freight Industry
Transport for NSW

Paper 4: **A Fast Rail Future for NSW**
Graham Nelmes – A/Director Strategic Rail Transport,
Transport for NSW

Melissa Jovic – Associate Director, Corridor Development,
Strategic Rail Transport, Transport for NSW

Inland Rail Program Update Tony Frazer, ARTC

2019 Steve Maxwell Platelaying Award (Minor)

2019 Ken Erickson Innovation Award

The Fixing Country Rail Program – Unlocking the Productivity of our Regions

Jim Modrouvanos – A/Executive Director Freight Industry, Transport for NSW

Fixing Country Rail is a NSW Government program providing $400 million of targeted Restart NSW funding for regional freight infrastructure projects. The program aims to improve freight connectivity and effective freight movement.

Food, produce and raw materials feed and power the State – and their efficient movement to market is critical to economic growth in rural areas.

In 2016, there were around 255 million tonnes of freight in regional NSW. This is forecast to increase by 12 per cent to 286 million tonnes by 2036.

Fixing Country Rail supports regional NSW jobs, growth and economic productivity by reducing the cost of getting goods to market. As costs come down, consumers benefit at the till of their local supermarket and exporters become more competitive.

Projects with clear network wide freight benefits, solid business cases and industry support are prioritised.

Fixing Country Rail

- Provides targeted funding to rail infrastructure owners and managers, for projects to improve freight connectivity on the regional rail network.
- Funds projects such as new or extended rail sidings, the opening of non-operational rail lines, and network enhancements which allow the use of faster, longer and heavier trains.
- Fixing Country Rail 2019 funding decisions will be informed by the Regional Rail Corridor Strategy and NSW Freight and Ports Plan 2018-2023 developed by Transport for NSW.

Suggestions for projects can be emailed to freight@transport.nsw.gov.au

Fixing Country Rail funding is $400 million of which up to **$210.9 million**** has been made available for **20 projects.**

** Fixing Country Rail Pilot Round had an additional $15 million made available for 10 projects.
Fixing Country Rail 2019 has an additional $815K Business Case Funding amount made available for 13 projects.

Freight is worth **$66 billion** to the NSW economy

Regional NSW produces **255 million** tonnes of freight a year

Transport from paddock to port is **18%** of the cost of grain sold by regional farmers

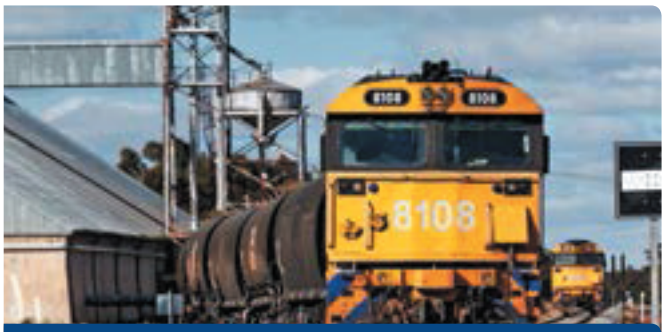
Regional NSW freight will **grow by 12%** between 2016 and 2036

6,400km of rail lines in NSW

92% of the NSW road network is Local and Regional roads

8,000 local government bridges in NSW

40% of the NSW population live in Regional NSW



53% of all freight moved in regional NSW is moved by rail. An average container train carries 120 TEU which removes over 80 truck movements from our roads.

Fixing Country Rail – successful projects

A Fast Rail Future for NSW

Graham Nelmes – A/Director Strategic Rail Transport, Transport for NSW

Melissa Jovic – Associate Director, Corridor Development, Strategic Rail Transport, Transport for NSW

Our vision for NSW

The NSW Government has a vision for vibrant and growing regional economies, providing NSW residents with more jobs, greater opportunities and better quality of life.

Many of our state's regional areas have room to grow and are keen to draw in more investment, generate job opportunities and attract skilled workers. The government wants to make it easier and provide more choice for people to live and work in regional NSW.

In July 2018, the government released *A 20-Year Economic Vision for Regional NSW,* a comprehensive vision for regional NSW for the next 20 years and beyond. One of the key elements of the vision is better connectivity between regional centres, and from cities and international gateways.

Designing a fast rail network

The NSW Government has appointed Professor Andrew McNaughton to lead an expert panel to provide advice to the Premier and Deputy Premier on how the government should best deliver a fast rail network to connect the state. The panel will identify opportunities for regional growth and improved services, and present the blueprint for how the government will deliver the network.

Four potential routes have been identified as the starting point for investigation into a NSW fast rail network. The panel will consider the possible network and advise on staging and delivery options.

A NSW focus for fast rail

Long-distance fast and high-speed rail studies have been undertaken in Australia over many years. These studies have usually focused on linking the major Eastern Seaboard cities of Sydney, Brisbane, Canberra and Melbourne. These studies focused on rail as a competitor to air and road transport options. Most of the studies found that the costs and required ticket prices of an interstate high-speed rail network would be insurmountably high compared to likely customer volumes.

Until now, limited work has been done on the potential for a fast rail network connecting regional cities within NSW. The Fast Rail Network Strategy will, for the first time, provide a comprehensive assessment focused on connecting regional cities.

Improving connectivity in regional NSW

The objectives of the Fast Rail Network Strategy will reflect A 20-Year Economic Vision for Regional NSW. Thousands of people travel along passenger rail corridors in NSW every day, moving within regions, or between major regional centres and Sydney. Passengers travel for work, education, tourism, and to attend events or access services. Our major regional centres and communities along rail corridors are important and vibrant parts of NSW. They offer diverse and affordable housing, access to employment and education, and lifestyle opportunities. The strategic planning and delivery of faster rail connections within regional NSW will increase the number of commuters, connect more people with regional NSW and alleviate growth pressures in Sydney.

Potential travel times from Sydney

The delivery of fast rail has the potential to slash travel times by up to 75 per cent. A selection of approximate travel times could be:

	Current	Faster rail <200km/h	High-speed rail >250km/h
Canberra	**4:07** hours	**3:00** hours	**1:00** hours
Newcastle	**2:35** hours	**2:00** hours	**0:45** hours
Nowra	**2:39** hours	**2:00** hours	**0:45** hours
Goulburn	**2:31** hours	**1:45** hours	**0:30** hours
Wollongong	**1:25** hours	**1:00** hours	**0:30** hours
Gosford	**1:19** hours	**1:00** hours	**0:30** hours

A Fast Rail Future for NSW

Learning from international experience

Japan: The Shinkansen, or bullet train, opened in 1964 and was the world's first high-speed rail line. The network has grown in phases and continues to expand after more than 50 years. The network has changed the pattern of business in Japan and increased tourism. It is estimated to have a US$19 billion economic impact per year.

France: The TGV opened in 1981 and connects more than 150 cities and towns in France, as well as cities in neighbouring countries. The combination of dedicated high-speed lines and mixed conventional lines has enabled the incremental growth of the network, increasing connectivity and improving regional services.

United Kingdom: High Speed 1 (HS1) in the UK has transformed the prosperity of small towns and cities 100–150 kilometres from London. HS1 has been a catalyst for growth in the regions it serves, increasing the regional talent pool, and attracting investment and business into the regions.

From strategy to delivery

The government is committed to moving from high-level vision to planning and on to delivery.

The Fast Rail Network Strategy will present a blueprint for how the network could be delivered. Having a strategy will ensure future investment decisions on fast rail are well considered.

Preparing the Fast Rail Network Strategy in 2019 is the first significant step in taking the network from vision to delivery.

The government will commence work on the first stage of our fast rail network in the next term of government.

Short to medium-term focus

Upgrades and optimisation of existing rail routes and new fleet, with services of at least 200 km/h

- Dedicated track improvements on existing routes will enable faster journey speeds, improve reliability and enhance comfort. These track improvements could include junction rearrangements, curve easing, deviations, passing loops and level crossing removals.
- There are also opportunities for new technology and train options that may reduce journey times.

Medium to long-term focus

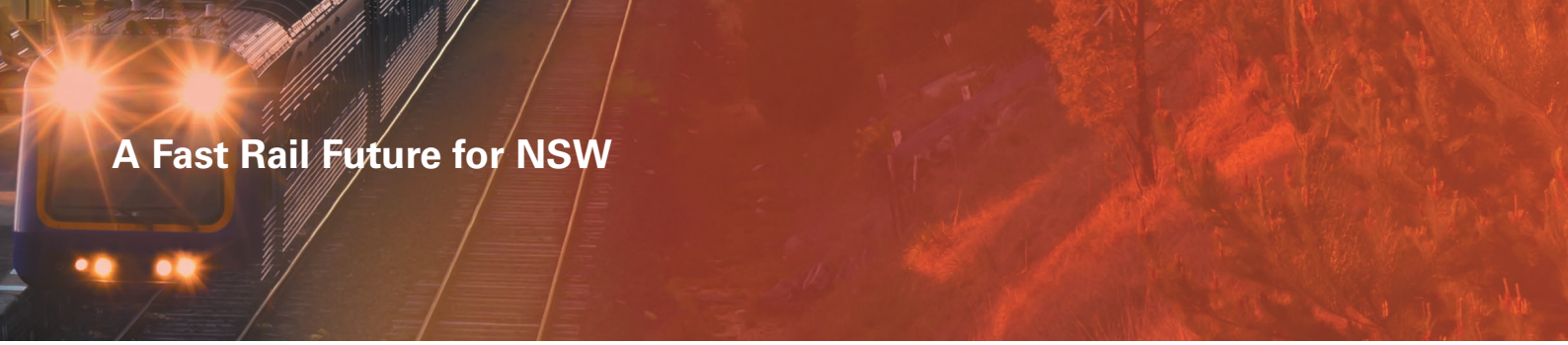
Dedicated high-speed rail, with new lines and routes, and possible speeds of over 250 km/h

- A high-speed rail network would require a new dedicated and purpose-built line, and new rolling stock.

A staged approach to delivery

International experience has demonstrated that fast rail networks can be delivered in stages. Each stage delivers immediate benefits while stepping closer to the game-changing vision. We will start delivering improvements that step us towards the vision for a fast rail future.

Potential routes identified for investigation



A Fast Rail Future for NSW

Funding fast rail

The Fast Rail Network Strategy will examine a range of funding options and smart staging to ensure each part of the fast rail network provides value for money and continues to progress the project.

Each funding option considered as part of the strategy will be assessed based on the estimated cost of the project in light of economic and other benefits to the community, and complementary revenue-generating opportunities. This is why is it essential for governments to map out options, identify priorities and plan for future stages of investment.

The NSW Government has an unmatched record for identifying and funding infrastructure. Our infrastructure program is designed to make communities more liveable, connected and productive today, while laying the foundations for the NSW of tomorrow. This investment pipeline, of $87.2 billion over four years to 2021–22, is the largest program ever undertaken by any state in Australia.

This record infrastructure program is possible because, since 2011, the government has worked tirelessly to rebuild the state's economic fundamentals – bringing the budget back to strong surplus, eliminating government net debt and securing our Triple-A credit rating.

Off the back of this financial strength, we have reshaped the role of government as an enabler. There are more than 600 infrastructure projects underway or in planning and development, and long-term plans are in place through to the middle of the century.

The NSW Government will continue to invest in infrastructure to make our communities great places to live, now and into the future.

Our other passenger rail programs for intercity and regional customers

Regional rail fleet program

Procurement is underway on new diesel trains to replace the ageing XPT, Xplorer and Endeavour rail fleets. These trains service passengers travelling between Sydney, Canberra, Melbourne, Brisbane and major regional centres.

They will be serviced by a new maintenance centre in Dubbo. The government is proceeding with this major investment, which will complement the future fast rail network.

New intercity fleet

Brand new intercity trains will replace the 40-year-old silver sets that currently operate electric rail services between Sydney and the Central Coast, Newcastle, the Blue Mountains and the Illawarra. These new trains will provide more comfortable and modern features for intercity customers. The first of these trains will be arriving in 2019.

STEVE MAXWELL PLATELAYING AWARD

MINOR WORKS CATEGORY

Judges

Mark Harris – Lendlease
Stephen Fleck – John Holland
Gareth Beynon – LINK Rail and Civil

Steve Maxwell

Steve Maxwell was a Member of the Permanent Way Institution Committee for many years, and his hard work and dedication enabled the PWI to continue during some difficult times. Steve was an informed Judge of the Platelaying Award, and also an entertaining speaker and presenter.

Steve's rail career began in NSW after graduating in Civil Engineering in 1970 and he progressed from District Engineer to become General Manager Engineering for CityRail, covering the suburban and interurban areas of Sydney. He made a huge contribution to the rail industry through his early advocacy of asset management as a key part of the rail engineering discipline, and with the introduction of numerous new infrastructure maintenance and asset management techniques and capabilities.

Steve's untimely and premature death in 1997 was a great loss to the PWI and took from the industry a great engineer, friend and personable and supportive leader.

The Committee deemed it appropriate to name the prestigious Platelaying Award after Steve Maxwell.

This annual Award is made to encourage excellence in platelaying, and to bring to public notice the skills required to gain such excellence. The Award is made to the staff responsible, who in the opinion of the Judges, best demonstrate this excellence. In other words, the Award will indicate a permanent way job well done.

Eligible projects are any track renewal, or construction work, completed in the last financial year by, or under the control of, a Member of the NSW Section, whether on a government or private railway system.

There are two Platelaying Awards – one for Minor Works (less than $3m in value) and one for Major Works (greater than $3m in value).

Judging Criteria:

Scoring Category	Available Score
Accuracy to Design and Survey	50
Site Presentation	50
Neatness of Fit of Components	50
Difficulties Overcome	25
Safety	25
Consideration of the Environment	25
Closeness to Planning and Timetable	25
Closeness to Budget	25
Level of Client Satisfaction	25
Total Score/Marks:	**300**

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

Minor Works Entries – < $3m

Mount Victoria Area Remodeling
John Holland
Cory Gray – General Superintendent
David Nguyen and Stephanie Raad – Track Engineers

Cockle Creek Bridge Transoms, Reconditioning and Rerailing
John Holland and Sydney Trains
Owen Seabury – Project Manager, John Holland
Heath Broom – Project Manager, Sydney Trains

Polymer Block Installation along the Eastern Suburbs Railway (ESR)
Rhomberg Rail Australia
Hus Dervis – Project Engineer

Koolewong Track Reconditioning
John Holland
Adam Broome – Project Engineer

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

Mount Victoria Area Remodeling, Mount Victoria – WE10

John Holland
Cory Gray, General Superintendent
David Nguyen & Stephanie Raad,Stephanie Raad,Track Engineers
Value of works $0.95M

JOHN HOLLAND

Executive Summary

In January 2019, Sydney Trains appointed John Holland to deliver the Mount Victoria Area Remodeling (MVAR) Project. The Project will be delivered in two distinct phases; Phase 1 involves the upgrade of rail infrastructure including track, overhead wiring, platform modification and civil works to enable operations of New Intercity Fleet (NIF). Phase 2 involves remodeling of the Mount Victoria area, upgrading existing infrastructure which is reaching the end of its operational life and is not compatible for remote control operation.

On the weekend of 7-8 September 2019 (WE10), as part of phase 1, NIF enabling works, John Holland completed its biggest track scope on the Project to date. John Holland renewed the existing 41 points crossover, removed (plain-lined) existing mechanically operated 8/11 single slip and completed 1,400 meters of major track slews.

John Holland self-preformed majority of works including, use of the Pem Lem Turnout Installation System, John Holland tampers, internal OHW and signal-mechanical resources. Our client Sydney Trains also played a vital role in the successful delivery of the scope providing critical signaling resources to support commissioning of the works, which was successfully commissioned allowing the possession to be handed back on time.

PROJECT SCOPE

Pre-possession scope of work included;

- Pre-build and dismantle of 41 points; and
- Stockpiling of capping and ballast.

The scope of work completed on WE10 included;

- Removal of existing points motors and mechanical rodding;
- Removal of concrete crossover bearers and steelwork;
- Bulk excavation;

Figure 1: Down Goods Siding pre-assembly of 41 Points

- Placement and compaction of bottom ballast;
- Installation of crossover using Pem Lem Installation System;
- Lowering of existing plain line track;
- Resurfacing works, welding and rail adjusting; and
- Overhead wiring adjustments.

PROGRAM OF WORKS

The works including, renewal of 41pts, plain-line 8/11pts and major tracks slews, were all completed during a config 7 - 48hr possession environment. 41pts renewal being the most critical scope, was completed on time and only 17 minutes behind the planned programme, see below for a list of key millstones:

Saturday

0530	Possession Granted
0626	Electrical Power-out Permit Issued
0800	Completed Pem Lem movements on up and down mains
1200	Track removal and bulk excavation works complete
1500	Bottom ballast placed
0000	Cross-over installation complete

Sunday

0200	Top ballast complete
0600	Lowering of existing track complete
1600	Resurfacing complete
2000	24 welds complete
2100	Overhead wire adjustments complete
2200	All signalling and mechanical works complete

Monday

0017	Commissioning complete and possession handback

During the course of the weekend, the program fell behind schedule due to a number of issues including; late possession and power-out. The team regained some time savings by assessing the existing track formation, which was still in very good condition, thereby optimising the amount of excavation required. This was then verified by visual assessment, proof rolling and compaction testing by an onsite Geotechnical Engineer.

SAFETY

The works were planned with the Project team developing scope specific Activity Method Statements (AMS), Task Risk Assessments (TRA), diligent implementation of the John Holland's Global Mandatory Requirements (GMRs), Rail Mandatory Requirements (RMRs) and Traffic Management Plans (TMP's). With strong leadership at all levels from management to onsite supervisors, in conjunction with specific site controls including additional physical barriers and spotters these works were safely delivered with zero safety incidents.

ENVIRONMENT

The station precinct is a State Significant Heritage Item and as such the works must be delivered in compliance with heritage approvals. To highlight the risk of unexpected heritage finds in the area, during the bulk excavations the team encountered a potential heritage find (i.e. old brick wall), the team immediately stopped works and protected the site until our heritage consultant provided further direction to proceed. Adding to environment complexity of the Project, the land to the east of the rail corridor consists of the Blue Mountains National Park which is listed as a UNESCO World Heritage site. With proactive engagement and consultation, well-established Environmental Management Plan (EMP), Site Erosion Plan (SEP) and due diligence from the delivery team these works where delivered with zero environmental / heritage incidents.

Figure 2: Pem Lem's transporting panels on up main

Fig 3: 41 Points Commissioned

ACCURACY TO DESIGN AND SURVEY

Works were completed in compliance with the relevant Technical Standards. During bulk excavation of 41pts, it became apparent that the earthworks design did not complement the existing drainage in the area. As such, with approval from designers, a decision was made to modify the design track formation to improve the tie-in to ensure suitable drainage. There were also height constraints due to the Patrick St over-bridge and therefore it was critical 41pts was installed as per design levels provide OHW with adequate clearance to the over-bridge.

DIFFICULTIES OVERCOME

The installation site had restricted access as it was located inside a cutting and beneath an over-bridge, as such, the crossover was assembled on the country-side of the station, approximately 0.6km from the site and the turnout panels were transported from the down goods siding to the up and down mains using Pem Lems.

Additional challenges for the team included multiple, adjacent work groups working in the same location, limited laydown/stockpile areas, working within a heritage curtilage, works adjacent to a National Park, sub-zero temperatures and intention to re-use existing set of in-bearers and all mechanical points rodding with new points.

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

Cockle Creek Bridge Transoms, Reconditioning and Rerail

Sydney Trains and John Holland
Owen Seabury (JHG) and Heath Broom (ST)
Value of works: $1.69M

Executive Summary

John Holland and Sydney Trains are jointly submitting for the PWI Steve Maxwell – Minor works category. As part of the Master Services Agreement commencing in August 2015, the agreement's objective is to focus on **Safety, Environment, Delivery, Quality, Value, Innovation and Customer Service.**

Cockle Creek Railway Bridge is a steel bridge structure across Cockle Creek at Argenton. It is a double track, 2-span, riveted steel Pratt truss bridge.

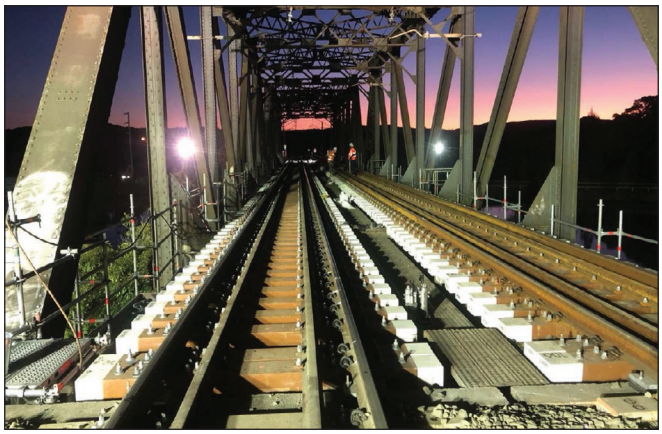
The project was successfully delivered in WE49 and WE2 on the configuration 9 possession on time and to budget. The team (both John Holland and Sydney Trains) have been delivering transom projects for the last 4 years. The lessons learnt and efficiencies have enabled the team to deliver more work in a shorter time frame without compromising safety and caring for the environment.

PROJECT SCOPE

The project scope completed over two possessions included:

Possession 1 (WE49 – 3 day Possession) – 5 shifts
- 186 FFU transoms installed
- 440m of rerailing
- 440m of guard rails replaced with new fastening
- Bridge end reconditioning
- Tamping and track re-alignment
- 4x weeks of scaffolding works leading up to the possession
- 2600 holes drilled

Possession 2 (WE2 – 2 day possession) – 4 shifts
- 186 FFU transoms installed
- 440m of guard rails replaced with new fastening
- Bridge end reconditioning
- Tamping and track re-alignment through 112 crossover
- 2600 holes drilled
- Install scaffolding and dismantling



PROGRAM OF WORKS

The works were programmed over two config 9 possessions. Due to the sheer amount of work on the Down Main including the scaffolding, rerailing, tamping and signal testing, it was decided to deliver this scope WE49 (3 day possession).

For both weekend 49 and 2, full scope was achieved with nil impacts to possession hand back.

ACCURACY TO DESIGN AND SURVEY

The drilling pattern on this bridge is slightly different due to the guard rail configuration. Only partial drilling could be achieved prior to the possession. All transoms were drilled perfectly to suit the existing holes on the top flange and no re-drilling was required. The vertical and horizontal alignment is within 3mm of design. This was achieved through real time survey and marking of each transom for heights and centreline. With the assistance of Sydney Trains staff, the premeasuring, prior marking up and site dilapidation of the bridge ensured the team was fully prepared for the possession. Their past knowledge, sharing of lessons and previous issues allowed to team anticipate issues and develop solutions to overcome challenges.

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

DIFFICULTIES OVERCOME

The original JHG scope of works was to replace the transoms and complete rerailing on the Down Main only. A variation to erect scaffolding was granted to JHG which required further management of design, temporary works, access, and installation.

To combat this JHG relied on proven design from past projects which was then tailored to suit the location. To meet the tight timeframe, the reliance on reliable and proven subcontractors was key to streamline the process.

Post the WE49 possession Sydney Trains awarded JHG with the scope for WE2 (3 weeks turn around). The team devised a plan to shift the scaffolding from one track to the other saving our client a total of $300k.

To deliver the scope in the tight timeframe was a challenge for both parties however with detailed planning and communication, the team delivered scope in full without any safety, quality or environmental issues.

SAFETY AND ENVIRONMENT

Working over water and working at heights is a significant risk for both JHG and Sydney Trains. The team developed specific controls to manage these severe hazards on site.

A detailed scaffolding design was developed to fulfil temporary works requirements. The team installed the scaffolding via barges and working underneath the bridge. Sydney Trains operations were notified of the works and adequate safe working was established for the duration of the works.

During the possession a fall specialist team and standby scaffolding crew were available to repair any potential damage of the scaffolding and to manage any edge protection issues.

Dropped objects and pollution of waterways were identified as significant risks during the planning phase.

The team notified RMS and sought to close the channel. Additionally, a spotter boat with full time communication with the crew on the bridge was deployed to ensure nil potential of falling objects.

All refuelling of plant and equipment was carried out off the bridge to prevent potential spillage. For any potential spillages such as damaged hydraulic hoses, spill kits were available on the bridge deck as well as a marine spill kit on a designate barge below.

Managing the community is very important to both Sydney Trains and John Holland. The car parking at Cockle Creek was shared, however designated parking was clearly assigned, and members of the public were managed through our site representative and traffic management.

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

Polymer Block Installation along the ESR

Rhomberg Rail Australia
Hus Dervis – Project Engineer
Value of works: $1.5M

RHOMBERG RAIL AUSTRALIA
Member of the RHOMBERG SERSA RAIL GROUP

Executive Summary

Over the 18/19 FY Rhomberg Rail Australia were contracted to undertake Polymer Block replacement of life expired timber sleepers along the Eastern Suburbs Railway line for Sydney Trains. The tunnel sites were located at Redfern Platform 11 and Town Hall Platform 4. Through the duration of the works, multiple constraints and complexities were involved with both the planning and delivery of the works. During the Easter 2019 shutdown the renewal of Town Hall Platform 4 track was undertaken – consisting of a complete removal of 235 timber sleepers (concrete embedded), and reinstatement of track with new Polymer Half Blocks – completed to design and program, with nil safety incidents.

Challenges faced throughout the works were implementing a way to adjust & reinstate track, while maintaining gauge, super-elevation, alignment and height – all in accordance with design and the possession time constraints, as well as completing the scope within the given time frame. The program proposed challenges given the nature of the works and the unpredictability of services like power, water and compressed air supply in the aged Sydney Trains tunnels.

Difficulties overcome during the works were planning and coordinating the removal of a complete platform length of concrete embedded timber sleepers and replace with Polymer Blocks & Delkor Alt1 plates. This process required mechanically jackhammering out the timber sleepers, without damaging surrounding existing slab and other infrastructure like drainage and signaling equipment. Due to the width and depth of polymer blocks, additional concrete breaking was a constraint factored into the delivery of the works. In addition to this a supplementary dry coring system was utilized for installation of the hold down bolts and minimizing water within the work area.

The project was delivered with a record-breaking amount of Polymer Blocks replaced in a single weekend possession – 470 (which includes an additional 30 blocks that were added to scope during the possession!). Between both locations there has been a total replacement of 433 sleepers replaced with 866 Polymer Blocks. All scope was delivered with no delays to operations and nil safety incidents.

1819FY Polymer Blocks Town Hall – Platform 4

PROJECT SCOPE

RRA was contracted to undertake the renewal of life expired timber sleepers throughout the ESR with Polymer Blocks. This consisted of removal of concrete embedded sleepers on a face 1:1, Installation of Polymer Half Blocks and Alt 1 Plates, Adjust Track alignment and heights, Core hold down/ anchor bolts, install Megapoxy around each pad and grout infills of all sleeper bays.

STEVE MAXWELL PLATELAYING AWARD

MINOR WORKS CATEGORY

PROGRAM OF WORKS

The works were initially programmed as 310 sleepers replaced with 620 Polymer Blocks over 2 stations and RRA finished the project with replacing 866 Polymer Blocks over these 2 stations due to being rewarded with additional scope based on performance. 4 x weekend possessions were utilised to complete the works with material delivery and superficial grout installation undertaken outside of these possession windows.

Plant consists were a key component in completing the works within the given time frame. In conjunction to the plant on site, multiple work groups were allocated with staggered shifts to compensate for heavy labour phases during the program. As placement of the Polymer Half Blocks and Alt1 Plates is a labour-intensive process, a heavy resource presence was required for the works to occur. In addition to this, programming the Megapoxy works with enough curing time was essential for running Hirail plant over the newly installed system. Factoring in ample time for site demobilisation and clean up, meant all Megapoxy works were limited to a constrained time frame.

A substantial amount of coordination and logistics were required due to the challenges faced with site access. Other work group access requirements were a challenging factor throughout the planning and delivery, especially when accessing the tunnel. Given the constraints and site access, all scope was delivered within programmed time frame, including complete platform and track clean (in preparation for commuters the following morning).

ACCURACY TO DESIGN AND SURVEY

Given the works undertaken were through a platform, tolerances were +/-6mm for lateral clearances and +/-15mm for height tolerances. With all timber ties removed and polymer half blocks installed, the RRA RhoFAS System was installed to hold/rectify gauge and realign track. All Half Blocks installed, were installed to design and not a single block was required to be removed after Megapoxy works were completed. This is due to the countless quality checks undertaken during installation and method of track adjustment by way of RhoFAS – Rhomberg's own track adjustment system. This system was utilised in construction of 30km off track within the NorthWest Rapid Transit component of the Sydney Metro. Our teams underwent internal training from Europe during those works which enabled us to utilise this system during a time constrained weekend possession.

DIFFICULTIES OVERCOME

Time Constraints & Access – RRA had to comply with Power out permit constraints for access and egress to and from the Hi-Rail pad into the tunnel. Multiple work groups would require access through the Art Gallery Hirail pad, leading to heavy coordination and logistics during planning and executing plant consists entering the ESR.

Material Distribution – Materials required for the works included 866 Polymer Blocks, 866 Alt1 Plates and HDPE Pads and also 1,732 Threaded rods, Coach Screws, Spring & Structural Washers. There was over 2,000 kits of Megapoxy Epoxy resin and hardener used for securing the block to the concrete. Materials were required to be laid out along the platform length in preparation for install and managed carefully to ensure no delays occurred.

Preparation – Materials and Gear required inspections before entering the tunnels, to ensure the correct quantities and working conditions were in place. Due to the large number of materials required during the possession, organising materials in lots before the possession ensured that packs were delivered to the platform in the correct order and quantities.

Complexity of Work/Removal on a Face 1:1 – From previous experiences, RRA had a good indication of our capabilities. From past works, it was grasped that water severely impacted the works program, due to drying time required in the bays. From this RRA implemented a supplementary Coring method – utilising a dry corer, which additionally minimises dust.

Innovation – RRA Mechanised the removal process for the concrete embedded timber sleepers – Excavators with hammer attachments were utilised to reduce manual handling and additional fatigue typically associated with jackhammering works.

SAFETY/ENVIRONMENT

Additional air monitoring controls were put in place to monitor the exposure of silica and other airborne dust hazards, as well as exhaust fumes. As well as the live monitoring RRA supplied the client with a Hazardous Materials Exposure Assessment monitoring report. This was provided to Sydney Trains to assist further works that may occur within the stations. In addition, RRA ensured dust was maintained to the Platform only, by isolating the works with Echo Barriers, plastic tarps and isolated water suppression. Other platforms at Town Hall during the Easter Possession were open to commuters and RRA managed all safety and environmental constraints to the satisfaction of the Station Manager. The works undertaken by RRA were delivered to program and to standards, with nil safety or environmental incidents.

STEVE MAXWELL PLATELAYING AWARD
MINOR WORKS CATEGORY

Koolewong Track Recondition

John Holland Pty Ltd
Adam Broome – Project Engineer
Value of works: $0.74M

JOHN HOLLAND

Executive Summary

In July 2018, John Holland was awarded package 1841 under the Master Services Agreement to deliver two track reconditioning package at Koolewong in WE15 and WE30.

Koolewong is suburb located in the Central Coast of NSW between Gosford and Woy Woy. Koolewong was originally known as "Glenrock" but the name Koolewong was selected by the NSW Railways for the station and the locality subsequently also became known as Koolewong.

The site was constrained by the platform, level crossing, signal locations, embankments and the public carpark.

The key challenges on this project was the access to the site for the stockpiling of materials, laydown area, machine route (plant and people separation), traffic management and managing the community.

The challenges were overcome through detailed planning and communication with all key stakeholders. Involving the Sydney Trains team throughout the planning process instilled in the team the importance of safety, community management and quality of the work.

PROJECT SCOPE

The project scope completed over two possessions included:

Possession 1 (WE15 – 4 shifts) –

- 200m full reconditioning of the Up Main
- Reuse existing sleepers
- Rerailing with 60kg/m rail
- Remove and reinstate the level crossing
- Provisions of all traffic management including road diversions

Possession 2 (WE30 – 4 shifts) –

- 250m full reconditioning of the Down Main
- Reuse existing sleepers
- Rerailing with 60kg/m rail
- Remove and reinstate the level crossing
- Provisions of all traffic management including road diversions

PROGRAM OF WORKS

WE15 was challenging due to encountering wet weather. Fortunately, the rain was not prominent during the excavation and backfilling however it impacted the track construction and welding. The forecast was closely monitored during the night and enough contingency was allocated the program if welding was affected. The tamping was completed ahead of time and to a high quality which allowed for CWR and the level crossing restoration on the Sunday night.

WE30 was delivered in full and to possession program. The team established they had gained 2 hours in the program between the laying of bottom ballast and building the skeleton track which allowed them to bring forward the tamping start time. This key communication point with Sydney Trains and the Resurfacing contractor allowed the team to complete the CWR and asphalting works during daylight hours on the Sunday hence improving the overall quality of the works and no pressure on handback.

STEVE MAXWELL PLATELAYING AWARD

MINOR WORKS CATEGORY

ACCURACY TO DESIGN AND SURVEY

The key to this project was the accuracy of the bottom ballast placement and the skeleton track. In conjunction with the survey crew, the focus to build the skeleton track as close as possible to horizontal alignment and height enabled the tampers to produce a quality track in lesser time.

For both possessions, the quality of the resurfacing crew was to the highest quality and professionalism.

The track was handed back with nil defects.

DIFFICULTIES OVERCOME

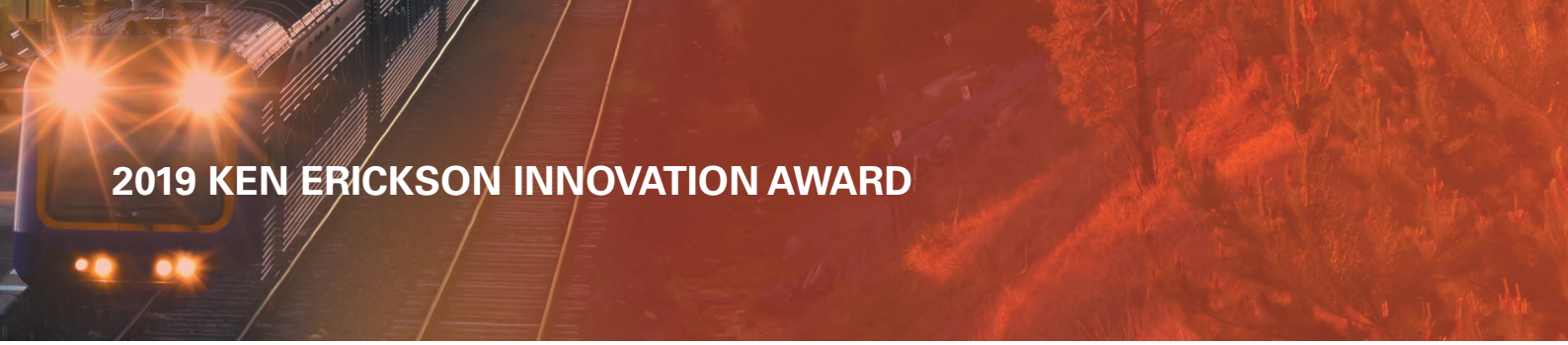
The key challenge for this project is logistics. The site was constraint by the platform, signalling equipment, infrastructure and level crossing. To overcome the challenges, the team with Sydney Trains developed a detailed plan to manage every aspect of the job from where should machines be parked and access, where to place reused sleepers, how to cart capping and ballast to rail handling. This detailed planning is useless without clear and concise communication to all the key stakeholders such as supervisors, leading hands and the workforce.

SAFETY/ENVIRONMENT

The team implemented the JHG SQE risk management system from the AMS, TRA and other safety documentation additional to the Sydney Trains SMS.

The team used the JHG Global Mandatory Requirements (GMRs) and Rail Mandatory Requirements (RMRs) in the planning to ensure all key risks are managed and controlled.

As a result, the project had no safety or environmental incident.



2019 KEN ERICKSON INNOVATION AWARD

Judges

Gareth Beynon – LINK Rail and Civil
Peter Boonstra – Lendlease
Sunail Hasnain – Sydney Trains

Ken Erickson was elected as a Fellow of the New South Wales Permanent Way Institution on 30 November 1981. He was a member of the Committee from 1981 until his untimely death on 25 November 1988. In his 7 years on the Committee he was an Editor, with wry humour and then Secretary, with sparkling wit.

Ken was a dynamic member of the committee and a gifted speaker. His "summing up" of our only conference at Kings Cross will always be remembered by those lucky enough to be present.

Ken was always trying to provide new ideas or concepts to the PWI, hence it is fitting that this Achievement Award, which particularly looks for new ideas, is named in his honour.

This Annual Innovation Award has been incorporated in the PWI Awards to recognise an initiative or significant advance in rail technology which has promoted improvement in any part of the Rail Industry during the last year. The Award recognises the contribution of a business or individual who has implemented a novel approach, strategy, or tool that has improved outcomes in the rail industry. Successful applicants are not necessarily required to have generated a new product, rather, this award equally considers the use of current technologies and approaches in new ways to solve problems within the Rail Industry.

The field is open to all relevant disciplines within the rail industry, this could include perway, stations, systems, management, design, electrical and signaling. Eligible entries may focus on areas such as design, componentry, techniques, construction, maintenance, mechanisation, or automation.

Entries must have been completed in the last financial year by, or under control of, a member of the NSW Section, whether on a government or private railway system.

Judging is based on:

Scoring Category	**Available Score**
Difficulties overcome	10
Contribution / Impact to Rail	20
Technical Input	20
Degree of innovation in Rail aspects	20
Contribution to Safety	10
Systems Assurance	10
Commercial benefits	10
Total Score / Marks	**100**

2019 KEN ERICKSON INNOVATION AWARD

2019 Ken Erickson Award Nominations

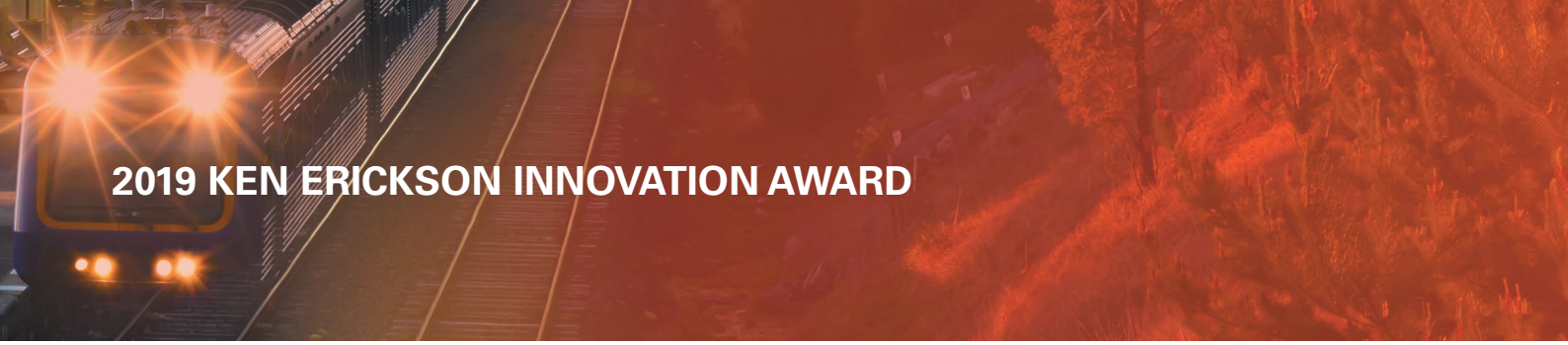
Toolbox Spotter
Company: Presien / Laing O'Rourke
Entrant: Kieran MacKenzie (CEO Presien)

Newcastle Light Rail Design
Company: Aurecon / WSP
Entrant: Robert Angus (Technical Director)

IVES and V-TRAS Installation for a Weighbridge and Monitoring System
Company: Rhomberg Rail Australia
Entrant: Calum Blair (Project Engineer) & Henrik Vocks (Manager Technical Services)

Lambton Road Overbridge Refurbishment
Company: Brefni Pty Ltd
Entrant: Stuart Robertson (Project Manager)

US7 Automated Non-Destructive Testing System
Company: Speno Rail Maintenance Australia
Entrant: Anthony Lombardo (Managing Director)



2019 KEN ERICKSON INNOVATION AWARD

Toolbox Spotter

COMPANY: Presien / Laing O'Rourke
ENTRANT: Kieran MacKenzie (CEO Presien)

Executive Summary

Laing O'Rourke's Toolbox Spotter technology is a world-leading artificial intelligence computer vision system. It sees objects, understands what they are, and what actions to take. In safety applications it is designed to eliminate the people-plant, plant-plant, and plant-infrastructure accidents and near-misses that are all too common in heavy industries. It is a step-change in safety technology and is being embraced by Australian rail operations since its recent launch.

However, the technology is capable of much more. It is already being applied to a wide range of applications, such as creating smart security solutions, providing real-time assurance and reporting, frictionless QA/QC, and enhanced productivity.

BACKGROUND

There are roughly 200 workplace deaths and 100,000 serious workplace injuries per year in Australia, costing the nation an estimated $62 billion every year. Being struck by an object is by far the leading cause of serious accidents, and the heavy industries – construction, logistics, mining, manufacturing, and agriculture and forestry – disproportionately contribute to these statistics. **There is a moral and economic imperative to do better.**

SOLUTION

Toolbox Spotter is a set of intelligent eyes, optimised for heavy industries: It sees objects, understands what they are, and what actions to take, seamlessly and in real-time, with no special tags or changes in normal site operating procedures.

To oversimplify, Toolbox Spotter has 5 elements: 1) a control app on a mobile device, 2) sensors/cameras, 3) the artificial intelligence 'brain' box, 4) alerts, and 5) a data and analytics platform. The alerts can be visual, aural, haptic, or electronic, with most users adopting unobtrusive flashing lights and haptics for the operator and larger lights for external users. Users can easily select to be alerted based on people, heavy plant, and light vehicles (or combinations thereof). Toolbox Spotter can be installed on mobile plant or fixed infrastructure, depending on the desired outcome.

The genuinely world-leading technology was developed in Australia by Laing O'Rourke's R&D group over 4 years, including >100,000 hours of real-world use, with ~$7m investment. Generation 1 systems are now being deployed on Australian rail sites – Laing O'Rourke operations in Adelaide, Melbourne, and Sydney; MTM in Melbourne; QR in Queensland; and ARTC in Newcastle – in a range of safety applications. For example, one configuration alerts the plant operator when a person, and only a person, is in their blind spot using a flashing light and haptic (vibrating) wrist band, while simultaneously flashing lights on the ground to alert bystanders.

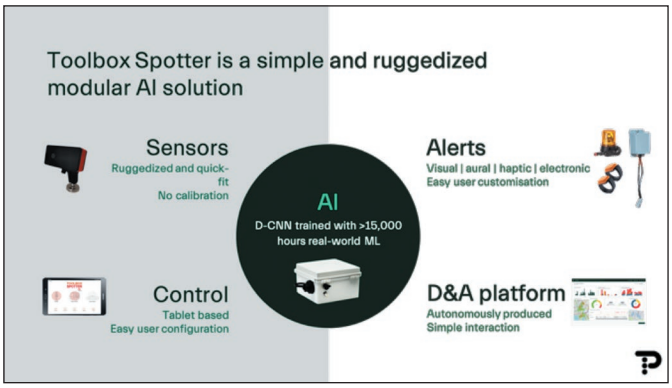
THE BENEFITS

Internal HSE data reviews suggest that Toolbox Spotter technology can reduce accidents by 15%, reduce fatal and severe risks by 20%, reduce prevention costs by 5%, and improve on-site relationships.

Toolbox Spotter's intelligence and ability to frictionlessly capture data about site operations is also already being used for a wide range of other applications:

- **Assurance**. Alert if an object enters of leaves a restricted area; ensure claimed objects were present/absent.
- **Security**. Alert if a person is detected in an exclusion zone or at a certain time; alert if an object leaves a zone.
- **Productivity**. Alert if a customer or delivery vehicle enters; optimise works using real data.
- **Reporting**. Automate health and safety reporting, including benchmarking; automate data collection and interrogation.

2019 KEN ERICKSON INNOVATION AWARD

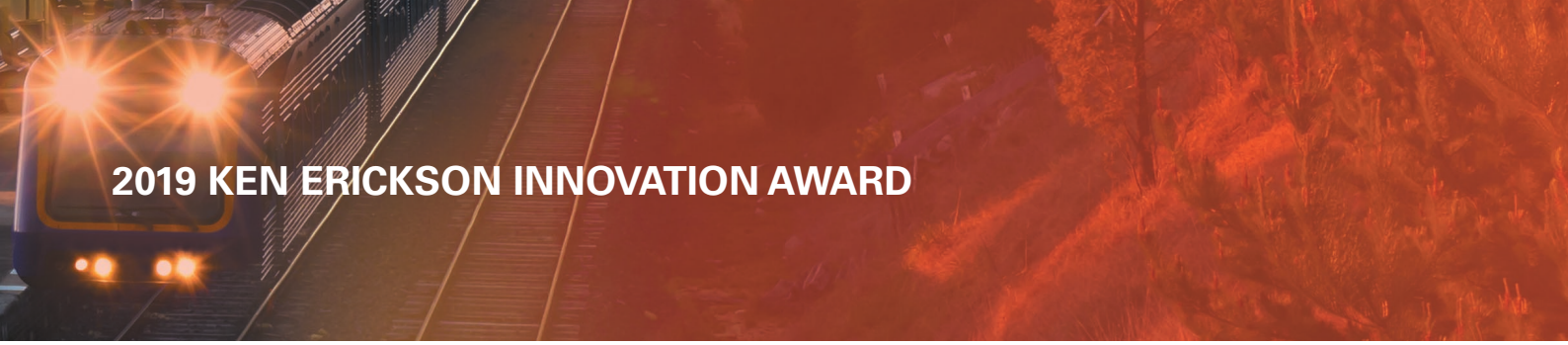


The 5 elements of the Toolbox Spotter technology.

A common Toolbox Spotter safety use case to detect people, and only people, in the operator's blind spot and alert with flashing lights and haptics.

What the Toolbox Spotter artificial intelligence system sees and understands.

Toolbox Spotter automatically and frictionlessly captures data about site operations that can be visualised and interrogated in the data and analytics platform.



2019 KEN ERICKSON INNOVATION AWARD

Newcastle Light Rail Design

COMPANY: Aurecon / WSP
ENTRANT: Robert Angus (Technical Director)

Executive Summary

1. INTRODUCTION

The 2.7km light rail line connects Newcastle Interchange with Newcastle Beach. It is the first in Australasia to be entirely "catenary-free" – meaning that it has no overhead wires that many light rail systems employ for traction power. The high-frequency, turn-up-and-go services during peak times can transport 1,200 people per hour. In the first month of operation alone, patronage numbers on the network were almost double the amount forecast.

Aurecon with joint venture partner WSP, and urban design and architectural sub-consultants Cox and Context, were supported by Transport for New South Wales (TfNSW) and Downer EDI to deliver the light rail system, which forms a key part of the NSW Government's Revitalising Newcastle program.

The light rail line is a key part of Revitalising Newcastle, a NSW Government initiative to transform the city – attracting more people, creating job opportunities, building public spaces, and delivering more integrated transport. Less than a year since it first began operating, the project is already helping the city to make great progress as a global gateway for economic activity.

To quote the NSW Minister for Transport and Roads, Andrew Constance:

"This is a game changer for the urban amenity and sustainability of Newcastle. Light rail has been the impetus for the complete revitalisation of the city."

A DESCRIPTION OF THE ENTRY

2.1 Difficulties Overcome

Maintain priority of service

The design team worked very closely to ensure the project delivered a priority of service despite competing demands from the levels of service at road intersections. This was critical to uphold the hierarchy of transport modes within the city and to encourage the use of public transport.

This was further supported by TfNSW, who delivered a single contractor to operate and maintain not just the light rail, but the bus network and ferry system together, providing better modal interchange, mobility and user experience as an outcome.

Figure 1: One of the first light rail vehicles leaves Newcastle Interchange at the opening of Newcastle Light Rail

Figure 2: The CAF Urbos running at Worth Place

Overcome the unknowns

Light Rail projects have significant risks with unknowns, particularly unknown buried services. Aurecon and WSP collaborated closely with Downer to conduct an extensive site investigation program prior to construction. Full width slit trenching was performed to help identify and plan for the main works.

This willingness to focus on activities prior to major construction shutdowns of the CBD was critical for design and construction planning. To complement this the design team was resourced appropriately for the known and unknown peaks as the project works were opened.

The design team developed the design change "rules of racing" to enable fast effective and flexible solutions. It keeps the project team agile and able to overcome the unknowns efficiently when site conditions and assets were different to expectations.

There was a supportive culture throughout these challenging times, led from the top.

Program was the number one driver

The construction program required an accelerated delivery program to meet pre-election government commitments.

To meet this challenge required serious collaboration and a strong fearless working culture. Garry Lomas, Project Director for Downer, fostered and nurtured this culture for both the design and construction teams together with the client and stakeholders. "We're all in it to win it!" was the mantra.

Having a focused delivery team enabled better decision making and resolution of design and construction issues as the works progressed with the desire to minimize disruption to the public.

2.2 Contribution / Impact to Rail

Create a legacy

Newcastle City had the opportunity to deliver a project which was a catalyst for urban renewal and a vision for the future smart city. Newcastle Light Rail delivered both. The inclusion of new smart street lighting poles, the latest wire-free technology and a fresh, vibrant public domain and streetscape was a winning formula.

The project not only brought people back to the city, it also created more job opportunities, new public spaces and opened the city up to the water front. It provided a frequent and reliable travel option throughout the City Centre, connected key precincts, reinvigorated the CBD, and opened urban renewal opportunities.

Catenary-free solution sets a new benchmark

Newcastle Light Rail is Australasia's first wire-free system. Not only does it demonstrate world class technology that is a benchmark for other future Australian light rail systems, it reimagined the role light rail plays in an urban environment.

Newcastle Light Rail incorporates six new stops, 16 at-grade signalised intersections, and a new maintenance and stabling facility. It required significant road works, and truncation of the Newcastle branch line's former heavy rail services.

Figure 3: A free community day just before the official opening attracted 15,000 people

Eliminating the need for traditional tramway overhead wires and poles dramatically improves the new infrastructure's look and feel while preserving aesthetics and heritage architecture in the heart of Newcastle city.

This was evidenced to stakeholders through applying the Aurecon digital strategy and promoting our Navisworks fly through of the proposed alignment with all key infrastructure modelled to LOD 200.

The wireless operation creates an aesthetic that reflects a connected and thriving mixed-use global city. Not only that it uses less energy, enables regenerative braking and most importantly improves safety by removing live electricity and declutters in the urban environment. The outcome actively aligns with the NSW Government's vision for the city as a vibrant, connected and inclusive urban centre for people to live, work and play.

Opening a wire-free and sustainable light rail transport option in Newcastle has laid the foundation for a broader integrated rail, ferry and bus service in the Hunter region, dramatically increasing the region's inter-modal public transport efficiency.

Asset management in rail

The project team developed data modelling and architecture behind the project's asset register (using a GIS database) that reflected TfNSW's ASA asset classification standards.

This was a significant achievement and a result of strong collaboration between the project teams, the ASA and TfNSW. Now that the project is completed, comprehensive asset knowledge will be available to the operator for maintenance and management, and to set up long-term asset planning.

Sustainability

The project's contractual requirements stipulated a highly sustainable solution – "Gold" in terms of the TfNSW Sustainability Design Guidelines. Aurecon and WSP together with Downer provided a new benchmark in light rail with a "Platinum" response at detailed design.

The light rail system recharges during operation via the vehicle's regenerative braking. All up, it is a more efficient and sustainable solution than traditional wired technology that must continuously feed the light rail vehicles.

Some of the key sustainable design initiatives included:

- Solar Power and PV cells
- Passive energy and conservation through durable insulating and reflective materials
- Recycled trackwork and pavement materials
- Green concrete utilising recycled fly-ash
- Ability to dis-assemble the Maintenance Building structural shell
- Re-use of existing bridge infrastructure
- Recycled water at the depot and stabling facility

Aurecon's long standing and direct contribution to the planning, design and execution of the Newcastle Light Rail Project as a new piece of sustainable public transport infrastructure has resulted in very positive social, environmental and economic outcomes.

2.3 Technical Input

Wide range of skillsets required for the Light Rail

Aurecon and WSP provided all engineering services on the project right from the get go in definition design / feasibility through to construction phase services. This included:

- Track and Road Alignment
- Rail Encapsulation
- Noise and Vibration
- Trackform
- Bridges, Civil and Stop Structures
- Pavements
- Flooding and Drainage
- Geotechnical investigation and design
- Contamination
- Utilities Design (Detailed design for Non-Contestables)
- Combined Services Route (CSR)
- Traction Power
- HV Supply
- LV supply
- Communications
- Earthing and Bonding
- Light Rail Signal Detection (together with LRV supplier)
- Traffic Control Signalling
- Street Lighting
- Road Furniture (Line marking and signs)
- Depot Building Structures and Services

A full multi-disciplinary team was involved in the project, using key staff around ANZ.

Collaboration and governance is king

A culture of integration and collaboration between JV partners Aurecon and WSP was essential and fundamental from the outset of the project. This was one of the key success factors for the project.

The team collaborated on design packages across offices in ANZ, RSA and Asia. The regional Newcastle office seized the opportunity to play a key role in the delivery of a brand-new transport mode in their own backyard.

Strong project governance was the next most important attribute. Both Aurecon and WSP provided experienced major project managers and steering committee members who had the skillset to pre-empt and mitigation significant risks during design and delivery.

It was the established relationships held across the businesses at senior management level which enabled pragmatic solutions and well-articulated technical understanding to translate into sensible decision making. The process was associated with challenging delivery timeframes, clear compelling design assumptions and real action to resourcing requests during program spikes.

Definition of the joint venture project team's roles and responsibilities was key in the coordination with the client project team, ensuring effective, agile and collaborative communication and teamwork.

Co-location gets results

Co-location of the project team with the client team during design (in Sydney) and construction (in Newcastle) ensured that both teams operated as one. The benefits of this approach cannot be understated. It gave the project team the ability to provide quick and efficient assistance to the client which in turn enabled cost and time effective outcomes.

The JV project team collaborated whole-heartedly and intimately with Downer EDI and TfNSW, RMS and Newcastle Council.

2.4 Degree of Innovation in Rail Aspects

Completely "wireless" light rail a reality

The Newcastle Light Rail is the first in Australasia to be completely "catenary-free" – without the overhead wires along the entire route.

The catalyst for the introduction of this innovation came from Aurecon and WSP's study into the technology following a reset during preliminary design. The client wanted to look beyond the first horizon and explore best practice around the world so that the light rail would support Newcastle's aspirations to be recognised as a "smart city" of the future.

The system uses contact wire-free operation, where each light rail vehicle houses an onboard energy storage system (battery). The Newcastle Light Rail system uses CAF's On-Board Energy Storage System (OESS) to travel between stops. The latest generation super capacitor and batteries on the roof of the vehicle OESS enables it to travel through on-board energy rather than continuous electrical supply through a copper wire. Charging is completed through the vehicle's pantograph making contact with an elevated charge bar at each of the passenger stops. Each light rail vehicle can transport the equivalent of four full busloads of passengers and the system can carry 1,200 people per hour.

Figure 4: Catenary Free charging at a Newcastle Light Rail Stop

Aurecon and WSP's traction power subject matter experts were fundamental is designing the novel traction power system to support this new rollingstock technology as a first in Australia and New Zealand. This technology, using CAF's OESS and customised charging bars as part of the fixed infrastructure, was adapted to suit the Newcastle urban environment. Only two other operational systems of similar profile existed worldwide in Spain and Taiwan.

The innovative design approach extended to the CSR, avoiding return current in the rails and bespoke detailing of the reticulation in and around the stops. The novel system required a great collaboration of minds between the structural engineers, architects and electrical teams to provide the unique overhead charging points.

2.5 Contribution to Safety

Visible leadership towards safety

More than simply achieving compliance, Aurecon and WSP worked closely to develop a collaborative safety culture. The Newcastle survey team were exemplary with their approach to safety for the field and site investigation works.

The project had a top down approach to safety. Safety moments/ safety shares were BAU for all workshops. Lessons learnt from other projects fed effectively into our design. Safety KPI's were set and reported to the Steering Committee on site walks, safety observations and incidents, particularly during the construction phase services.

Aurecon and WSP performed their services for TfNSW and Downer EDI under the framework of an Authorised Engineering Organisation. Under this framework, we assured the project was designed by:

- meeting Safety in Design obligations
- applying competent staff assessed as right for their role
- aligning with TFNSW's safety and system assurance standards
- evidencing all derived safety requirements
- tracing and validating our design against all technical contractual requirements
- actively engaging with the end users to define an engineering product which was functional, addressed human factors in operation and most importantly one to be proud of.

A comprehensive testing and commissioning phase formed part of the project, and the system was assured by the Managing Contractor and TfNSW as safe and reliable, prior to opening to the public in February this year.

With no wires in the public domain, this energy system is inherently safer, both during construction, and daily operation.

Figure 5: Inside the new Light Rail Maintenance Facility where human factors influenced spatial layouts

2.6 Systems Assurance

Both JV partners Aurecon and WSP performed their services as an AEO under the TfNSW framework for a light rail project. They supported TfNSW through the feasibility, business case, procurement and early design assurance processes for Gate 1 and 2 submissions for CCB approval.

Following novation to Downer EDI as the successful Managing Contractor, they worked closely with Nova Systems during detailed design to develop the final delivery Strategy for Gate 3, 4 and 5.

The assurance process was performed in alignment with the Design Safety Assurance Plan (DSAP).

A Design Safety Assurance Report was finalised for the Stage 3 CCB submission to enable the project to continue through construction.

Complementing this key assurance documentation was contributed by:

- Human Factors Integration Report – ensuring human factors considerations were integrated into the design and operations
- RVTM – demonstrating all technical and process contractual requirements were validated and evidenced
- Project Hazard Log – source for demonstrating the design, construction and subsequent operation of the light rail system were safe through the identification of key hazards, mapping and tracing the applicable controls to the appropriate project lifecycle, so far as is reasonably practical

2.7 Commercial Benefits

The light rail line is a key part of Revitalising Newcastle, a NSW Government initiative to transform the city – attracting more people, creating job opportunities, building public spaces, and delivering better integrate transport. The old heritage heavy rail station has been re-purposed into markets, community events successful pop-up shops improving business sentiment following revenue service and the accompanying increased footfall traffic throughout the CBD. These are all tangible outcomes from the light rail investment underpinning the wider Revitalising Newcastle program's success.

The light rail project interfaces with one of the biggest regional sporting events in Australia, the Supercars Australia – Newcastle 500, which is taking place in November 2019. The V8 Supercars race alignment in 2018 during construction required specific tie-in requirements for the road pavements surrounding the alignment for some of the Newcastle CBD intersections. Now completed, this year the light rail operating in event mode provides the perfect public transport solution for moving large volumes of people in and out of the Newcastle Beach and surrounding headland during the weekend event.

Less than a year after the project completion, the project is already helping the city make great progress as a global gateway for economic activity. In the first month of operation alone, the network patronage numbers were almost double the forecast, an average of 4,259 trips were taken each day, making that over 108,000 trips in the month and local businesses reported higher customer numbers. By all accounts, adding light rail has been a resounding success.

Appendix – Video: https://www.youtube.com/watch?v=yFQRo3I15fY

IVES and V-TRAS Installation for a Weighbridge and Monitoring System

COMPANY: Rhomberg Rail Australia
ENTRANT: Calum Blair (Project Engineer) &
Henrik Vocks (Manager Technical Services)

RHOMBERG RAIL AUSTRALIA

Executive Summary

1. INTRODUCTION

The key individuals and organisations involved in this project are:

- Calum Blair Project Engineer, Rhomberg Rail Australia
- Henrik Vocks Manager Technical Services, Rhomberg Rail Australia
- ARTC Hunter Valley Network

2. SUMMARY

The Australian Rail Track Corporation (ARTC) had been looking for innovative ideas to install an improved weighbridge system within their Hunter Valley network. ARTC had experienced an increase in track maintenance activities in order to continue achieving reliable measurement results with their existing weighbridges. In-motion weighbridges require a very good track quality, allowing rolling stock to run smoothly (up to 80km/h) leading up to the weighing sensors without any rocking or rolling of wagons which would negatively impact the weighing results.

Rhomberg Rail Australia (RRA) proposed the installation of our track slab system called IVES and transition system called V-TRAS to replace existing ballasted track over multiple possessions near Branxton station, NSW. Both systems were developed by the Rhomberg Sersa Rail Group. The existing design for IVES and V-TRAS had to be reviewed to accommodate for 30 Tonne axle loads (TAL) and to meet all ARTC requirements leading to a type approval. All construction works had to adhere to ARTC's closedown schedule.

3. CATEGORIES

3.1. DIFFICULTIES OVERCOME

The IVES and V-TRAS system had previously been approved for various European network owners, type approval was also for ARTC's network. An extensive ARTC process for both systems IVES and V-TRAS had to be completed before type approval was granted in late 2017. Additionally, the previously approved design capacity of 25 TAL was required to be increased to 30 TAL to meet ARTC requirements. Additional and reviewed load cycle tests were required to be undertaken by the fastening supplier, Vossloh Fastenings, to proof the higher axle load suitability. This was undertaken in their test laboratories in Germany. Once type approved the IVES and V-TRAS had to be installed during ARTC's regular possession windows, ranging from 58 to 96 hours. Fully loaded coal trains would have to be able to pass the worksite after each possession window. This presented the largest challenge in planning the works stages so that the track would be open and fit for use after each possession window.

3.2. CONTRIBUTION / IMPACT TO RAIL

The innovative approach for installation of IVES and V-TRAS during the possession windows was structured as follows:

a) Installation of two pre-cast abutments for transition structure V-TRAS in a 62 hrs shutdown. Existing track was temporarily removed at each end of the eventual location of the IVES. The 5m long abutments were delivered to site, placed to design then embedded in cementitious grout. The temporarily removed track was re-instated incl. resurfacing works.

Figure 1: Placement of pre-cast abutment elements

b) Placement of 1st and 2nd base asphalt layer in a 72 hrs shutdown over the 204m long section. Existing track was temporarily removed. The two asphalt layers were installed then ballasted track was re-instated with a reduced bottom ballast layer, resurfacing works included.

Figure 2: Asphalt layer joining pre-cast VTRAS abutment elements

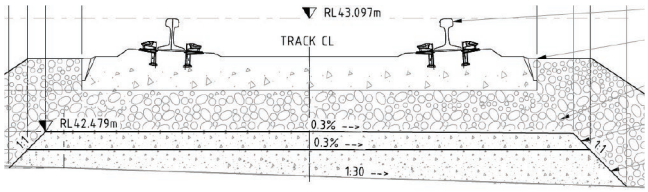


Figure 3: Cross section of completed track after 2nd shutdown, top to bottom: rails and sleeper, bottom ballast, 2 x Asphalt layers (Railpave)

c) Placement of 3rd asphalt layer, installation of 204m of IVES system and two V-TRAS systems in a 96 hrs shutdown.

- Removal of ballasted track and geofabric and stockpile components on site.
- Placement of 3rd layer asphalt (Railpave) to final tolerances (approx. 100mm thick, with top of asphalt tolerances +10/-20mm and 0.3% crossfall)

Installation of IVES, DFF304 fastenings, rails and weighbridge rail components. This step included the installation of dowels in the asphalt layer to allow for lateral stabilisation of IVES, final adjustment of track panels using Rhomberg Fine Adjustment (RhoFAS) equipment and survey trolley HERGIE, followed by pouring of grout into the DFF304 baseplates. Curing of epoxy grout was recommended to be 6 hrs prior to open for 30T axle load traffic.

- Install VTRAS transition steel structure and compact ballast.

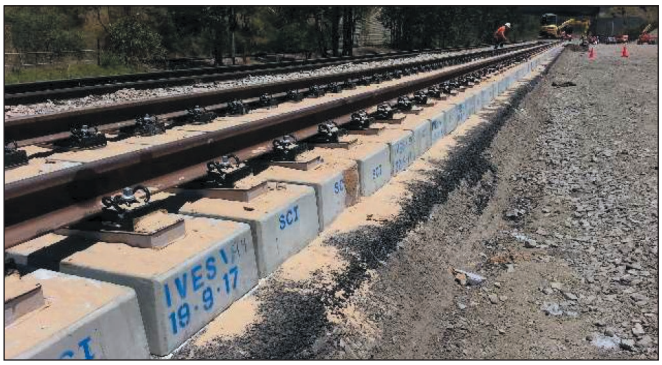


Figure 4: Asphalt layer with sufficient shoulder width

Figure 5: Completed IVES with customised spacing to suit the weighbridge transducer sets.

Figure 6: VTRAS support structure prior to ballast placing

The methodology above shows impressively, that a ballasted track system can be replaced with the IVES track slab system in short possessions with no impact on operations, even in high traffic heavy rail environments. The 204m track section and the two transition structures were installed within the planned possessions and the full scope was completed with track handed back in time.

The new track benefits from all the advantages of track slab systems like track quality, track stability, riding comfort, reduced maintenance tasks. The transition system V-TRAS contributes in a similar way providing a smooth transition from ballasted track to track slab and still being able to be tamped if required.

3.3. TECHNICAL INPUT

In order to hand back the 204m of IVES track in time after the final possession (96 hrs) certain methods and materials had to be reassessed. The track on top of the IVES had to be adjusted to very tight tolerances to provide the track quality leading towards the weighbridge sensors. Rhomberg's own lightweight track adjustment system RhoFAS was used to support and align the track prior to pouring of grout around the fastenings.

The final aligned track and clipped up fastenings (DFF304 from Vossloh) were cast in grout. The baseplates are designed in a way that grout can be poured through an opening on one side with the air to be released at the opposite end. The formwork around the baseplate contains the grout. In this project an epoxy grout was used to achieve the required compressive strength and pull out resistance of the dowels after 6 hours of curing time.

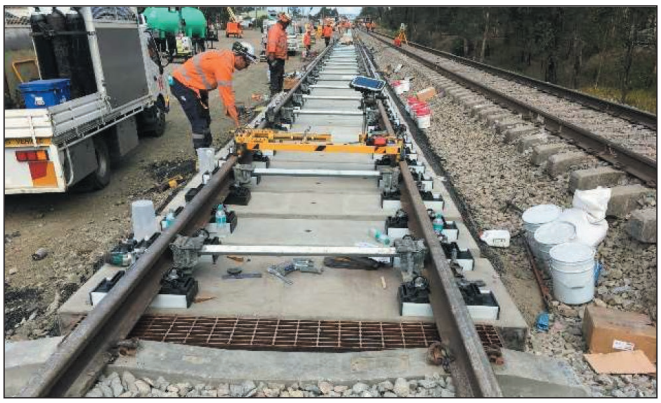


Figure 7: Final track adjustment with RhoFAS and HERGIE prior to grout pouring

Pull-out tests with dowels and epoxy grout were completed to AS 1085.18-2003, App. D prior to the installation to determine the earliest possible time for the track to be handed back to operation.

The V-TRAS transition module works like a ramp. The bearing of the module sitting on the ending of the track slab or bridge abutment cannot settle relative to the track slab because they are jointly supported at that point. However, the rest of the steel structure follows the settlement behaviour of the ballasted track by providing a smooth transition over 8m rather than an abrupt dip.

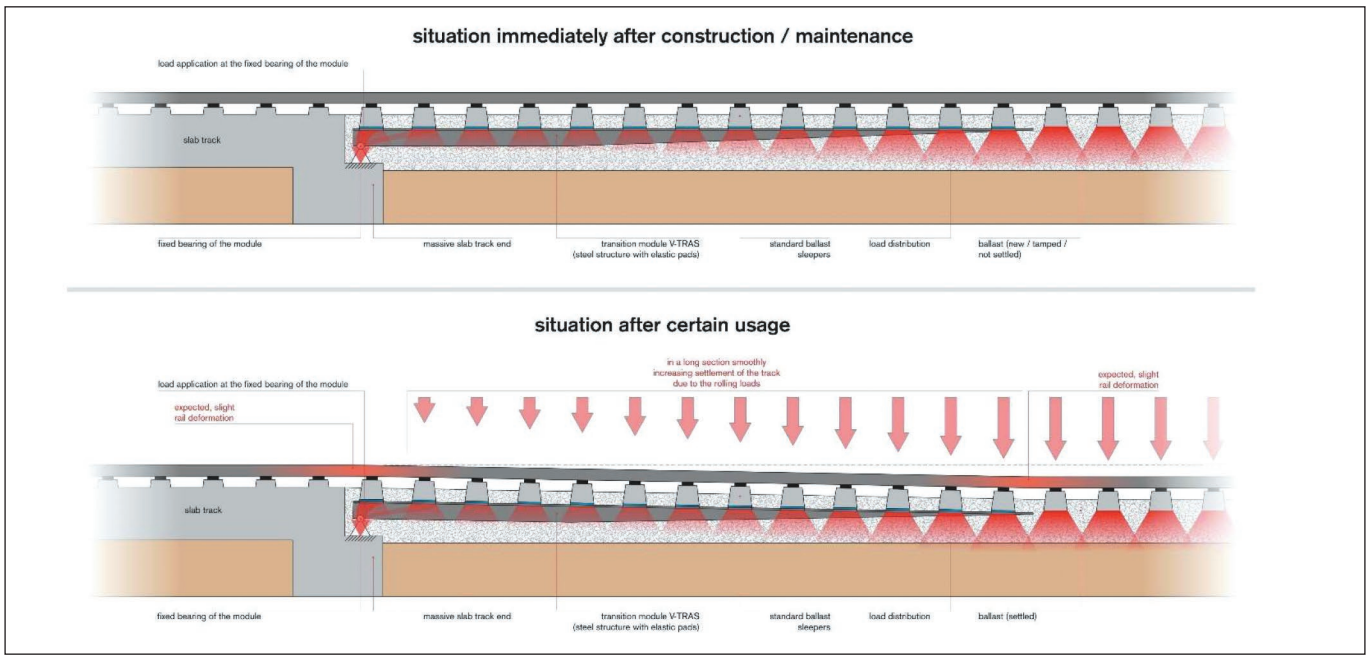


Figure 8: V-TRAS immediately after construction and after time with settlement in ballasted track.

3.4. DEGREE OF INNOVATION IN RAIL ASPECTS

IVES

One aspect of the IVES system was to provide a track system that allows for a simple installation process with easily available components:

- Local manufacturing of IVES elements (pre-cast concrete elements);
- Well-proven asphalt placement methods (road finisher);
- Easily achievable construction tolerances for all layers below the rail (asphalt layer, placement of IVES elements) to optimise placement methods (faster placement), the IVES system permits a lateral tolerances of ± 50 mm and a height tolerance of +10/-20 mm for placement of elements;
- Tight construction tolerances only for the last layer (rail) to meet track construction tolerances, including capability of compensation of tolerances of underlying layers.

Figure 9: Typical road paver to place asphalt layers

Apart from the innovative IVES system the construction method implemented for the Branxton weighbridge project demonstrated several innovative approaches, based on the "construction kit" of IVES:

- Staged installation method as described in item 3.2 with the ability to plan interruptions of the installation process at any time;
- Use of completed stages as temporary track or use of completed sublayers to allow for rail operations;
- Once the asphalt layer has been placed and rolled this layer can be used as an access road and is capable of supporting all other stages following installation processes. There is no need for extended curing times and the following tasks can start immediately. This results in a shortened construction period.
- Track tolerances achieved were well within the construction limits, resulting in very good measurements of the weighbridge results.

V-TRAS

Compared to the original design of an in-situ concrete V-TRAS abutment, the weighbridge project required a faster installation method to reflect the limited possession duration. Therefore, a pre-cast abutment solution was designed, consisting of two elements per abutment. These elements were placed and adjusted prior to pouring fast curing cementitious grout around the abutments. The construction tolerances were easily achievable with the final adjustment of the bearing component at a later stage; an adjusted steel cross-beam cast into two epoxy grout pads. Therefore, the relatively heavy pre-cast concrete elements could be handled in a much more effective way with no need to achieve tight tolerances. The precast abutment design for V-TRAS is a world's first application.

Figure 10: V-TRAS abutment pre-cast components

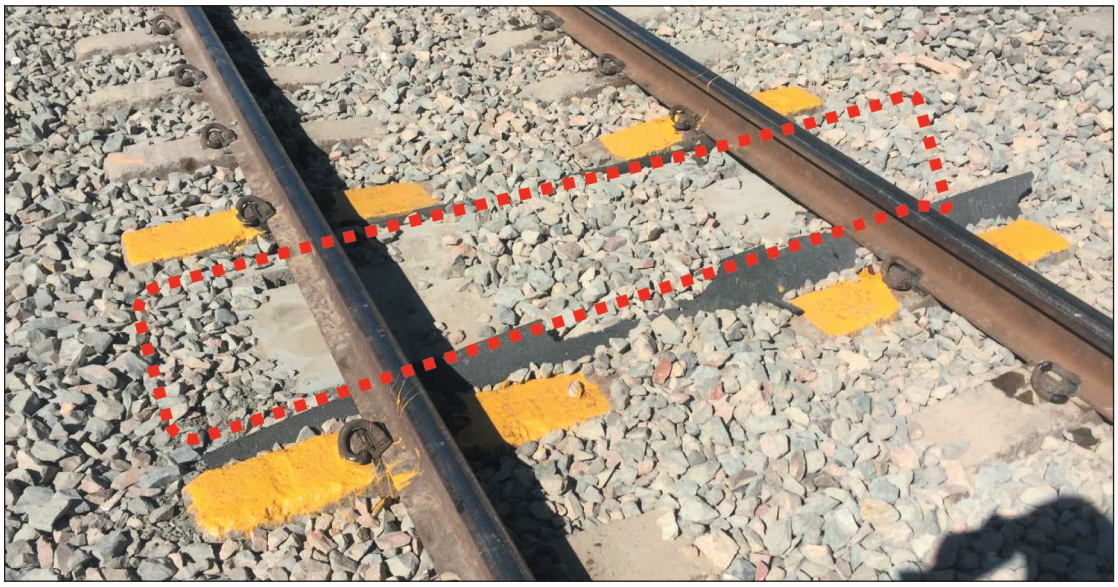


Figure 11: Top of V-TRAS abutment (red mark) with temporarily reinstated ballasted track

The V-TRAS steel structure had been pre-assembled with Getzner pads already applied. The existing ballasted track components, rails, sleepers and ballast can be re-used for the V-TRAS installation. The installation of V-TRAS was completed using standard plant and equipment such as; Franna cranes, excavator with tamping head attachment and minor hand tools, reflecting the initial idea to only use existing plant with no need for specialised equipment. This resulted in reduced material costs, optimised material handling and overall reduced project costs.

3.5. CONTRIBUTION TO SAFETY

The use of pre-cast elements for IVES and V-TRAS allow for simple placement methods without the need to place large quantities of in-situ concrete with all its associated tasks. A smaller work crew is required to complete the actual task of installing the slab track component with less interfaces compared to in-situ concrete placement when concrete delivery, concrete testing, concrete placement, finishing and curing must be coordinated and managed on site in short time frames. The pre-cast elements were transported to site prior to the actual possession and placed near the installation position, therefore less plant movements during the time constrained possession were necessary, resulting in a more effective and safe work environment.

The work program for the weighbridge project was planned with safety in mind:

- Reduced program risk of overlapping tasks due to the IVES' ability to use various stages for temporary ballasted track reinstatement;
- Controlled material movements;
- Minimal use of heavy plant at the same time and location;
- Immediately available asphalt road for continuation of works resulting in less stand down times and better utilisation of smaller but multi skilled work crews.

The V-TRAS and IVES system provide a much better track superstructure with improved track quality and riding comfort, resulting in a safer track environment. The dramatically reduced requirement for maintenance tasks (e.g. resurfacing, ballast cleaning, etc) contribute as well to the overall safety of the weighbridge project.

3.6. SYSTEMS ASSURANCE

Part of the ARTC type approval specification is the continued monitoring of the V-TRAS and IVES system.

Currently monthly inspections are being undertaken to monitor the impact of the predicted 120 MGT of traffic per year.

Visual inspection as well as measurements of track parameters (gauge and superelevation) are being undertaken and stored in a database for monthly comparison to assure the systems' performance. The V-TRAS and IVES have been installed for the first time in Australia under 30 TAL therefore the idea to monitor their performance is understandable and provides a greater confidence in the system by all parties involved. To date, with almost 2 years in operation, the IVES and V-TRAS systems have performed as per design.

3.7. COMMERCIAL BENEFITS

The commercial benefits for the weighbridge project will be the dramatically reduced maintenance tasks.

There is no requirement for the typical ballasted track maintenance tasks, like resurfacing, ballast cleaning,

and complete track replacement after approx. 25-30 years. The IVES and V-TRAS have a design life of 50 years. Hence the availability and reliability of this section of track has been improved with all the associated benefits described above and below.

As already mentioned in the beginning the track quality (horizontal and vertical alignment) is crucial for the accurate results of the weighbridge system. The accurate measurements of the weighbridge provide ARTC with a better understanding of the rail traffic on its network, a basis to plan for future maintenance works, upgrades and renewals. The extensive maintenance tasks undertaken especially at the ballasted track weighbridge installations are now being reduced to a minimum for the Branxton weighbridge installation. In conclusion the costs to install the IVES and V-TRAS system with the minimal maintenance costs will break even in the future with the much higher maintenance costs for the ballasted track weighbridge installations.

4. CONCLUSION

The installation of the IVES and V-TRAS for the weighbridge project at Branxton has shown that a transformation from ballasted track to track slab is achievable, even in short possessions. The continued inspections and monitoring show that both the IVES and V-TRAS systems perform very well and based on these results another operator has installed a video monitoring system for rolling stock at the same section of IVES, benefitting from the excellent track quality that the IVES and V-TRAS systems are providing.

Figure 12: Video Monitoring system by Aurizon installed at the IVES section in Branxton

Lambton Road Overbridge Refurbishment

COMPANY: Brefni Pty Ltd
ENTRANT: Stuart Robertson (Project Manager)

Executive Summary

SUMMARY:

In 2017, Brefni commenced refurbishment works for client – Sydney Trains – on the Lambton Road Overbridge, located in Broadmeadow, NSW. Brefni, in partnership with Sydney Trains and Designer SMEC, delivered an innovative engineering solution for the project which, not only saw the works delivered ahead of time, but without impact or delay to the client, rail passengers and the local community. Further, the project was delivered without incident and/or injury.

The overbridge was originally constructed in circa 1916 and forms part of the heritage-listed Broadmeadow train station on the Central Coast-Newcastle line. In 2018 alone, the line saw over 19,000 passenger journeys and represented some 4.8% of NSW's total rail passenger travel. As such, Broadmeadow Station has been a focus for Sydney Trains; with the Lambton Road Overbridge a priority for refurbishment works following condition assessments undertaken in 2008 and 2012.

Sydney Trains determined the programme of works across the following 4No. Separable Portions:

- SP1 – Beam & Girder Replacement to City Side
- SP2 – Beam & Girder Replacement to Country Side
- SP3 – Bridge Bearing Replacement Works
- SP4 – Bridge Deck Resurfacing Works

Key Highlights and Project Outcomes

As per the original scope and programme, the rail span Beam & Girder Replacement works were scheduled across four individual rail possession outages. Through the delivery of an innovative and holistic approach to the long-term durability of the refurbished overbridge, Brefni delivered the project in three possessions, without accident and Lost-Time Injury free. Sydney Trains benefited from a reduced downtime of rail operation, in turn delivering less impact to the passenger and freight services through Broadmeadow Station. Namely, an estimated 77K tonnes of freight was not impacted, representing two-days of the 14.08 million tonnes of freight transported through this line on an annual basis. Further, the avoided rail-outage also allowed Sydney Trains the potential to realise savings associated with bussing and community notification costs.

Throughout the programme of works, Brefni worked with Sydney Trains in the identification of continuous improvement measures in order to overcome known challenges through proactive planning, but also provided the client with reactive solutions for challenges which were uncovered as the construction works to this key 100 year old rail asset progressed.

Figure 1: Overhead country side finishing works

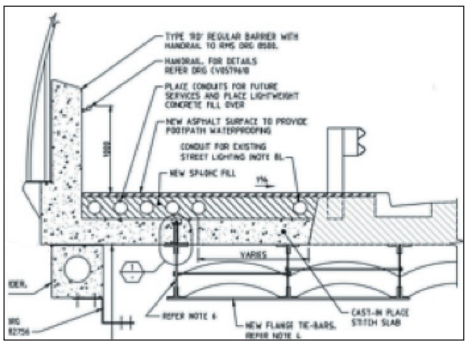


Figure 2: Refurbishment construction detail

Figure 3: Lambton Road overpass refurbishment works Broadmeadow, NSW

Figure 4: Cross section of demolished girder

2019 KEN ERICKSON INNOVATION AWARD

US7 Automated Non-Destructive Testing System

COMPANY: Speno Rail Maintenance Australia
ENTRANT: Anthony Lombardo (Managing Director)

Executive Summary

1.0 INTRODUCTION

Speno Rail Maintenance Australia Pty Ltd (SRMA) would like to nominate for The Permanent Way Institution (PWI) – New South Wales Incorporated – 2019 Ken Erickson Innovation Award.

SRMA's Latest Hi Speed platform "US7" has an automated non-destructive testing (NDT) system on board. This system has new technology which has eliminated the need for hand testing to be performed to size, and classify a defect after it is detected by the on-board system.

SRMA has reduced its risk profile, by eliminating the Fatal and Severe Risks of rail safety workers being struck by Rail Traffic and reducing the Fatal and Severe Risks of Rail Traffic Collision and Vehicle Accidents (incl RRV) with the automated, non-destructive testing system.

2.0 ELIGIBILITY

SRMA has financial PWI NSW memberships for the following people;

Anthony (Ben) Lombardo – Managing Director

Mark White – East Coast Ultrasonic Testing Manager

3.0 A DESCRIPTION OF THE ENTRY

SRMA has developed its NDT technology to include automated sizing and classifying of rail defects to its high speed automated detection system. This technology is the latest progression in NDT technology for SRMA.

The result of the automated system is the elimination of hand testing which eliminates the Fatal and Severe Risk of the rail safety worker being struck by Rail Traffic while reducing track time with non-stop high speed operational platform.

3.1 DIFFICULTIES OVERCOME

The automated sizing and classifying of rail defects is a new technology and will replace the common method of detection by an onboard system followed up by sizing and classifying by hand testing.

With a new system comes testing, commissioning, safety assurance and approval from all interested parties prior to going live. The interested parties include;

- Rail Infrastructure Managers
- Asset Standards Authorities
- Office of the National Safety Regulator

SRMA is currently working with these interested parties to approve the new technology through a series of acceptance tests.

Figure 1: showing progression of SRMA's NDT vehicles

3.2 CONTRIBUTION/ IMPACT TO TRACK

SRMA's Automated NDT system offers a high speed solution to Rail Infrastructure Managers to complete their mandatory NDT Testing with minimal disruption to the network with an increased safety benefit. The US7 Platform SRMA is using to complete the NDT Testing can also accommodate other rail inspection services such as geometry systems, head loss systems, vision systems and more.

3.3 TECHNICAL INPUT

SRMA's US 7 platform meets the AS7500 Series of standards for a track machine and has also met the site acceptance criteria set by the Asset Standards Authority and Rail Infrastructure Managers including but not limited to;

- Signal Testing
- Static and Dynamic Brake Testing
- Twist Testing
- Kinetic outlines
- Engineering compliance

SRMA's Automated NDT trolley is currently undergoing site acceptance testing to meet the criteria set by the Asset Standards Authority and Rail Infrastructure Managers including but not limited to;

- Twist Testing
- Kinetic outlines
- Engineering compliance

SRMA's Automated NDT system is currently undergoing site acceptance testing to meet the criteria set by the Asset Standards Authority and Rail Infrastructure Managers in identifying, sizing and classifying rail defects equal to the current method.

3.4 DEGREE OF INNOVATION IN PERWAY ASPECTS

Automation of the NDT system has allowed Rail Infrastructure Managers to complete mandatory NDT testing in a faster, safer more efficient way to reduce track time and increase revenue.

3.5 CONTRIBUTION TO SAFETY

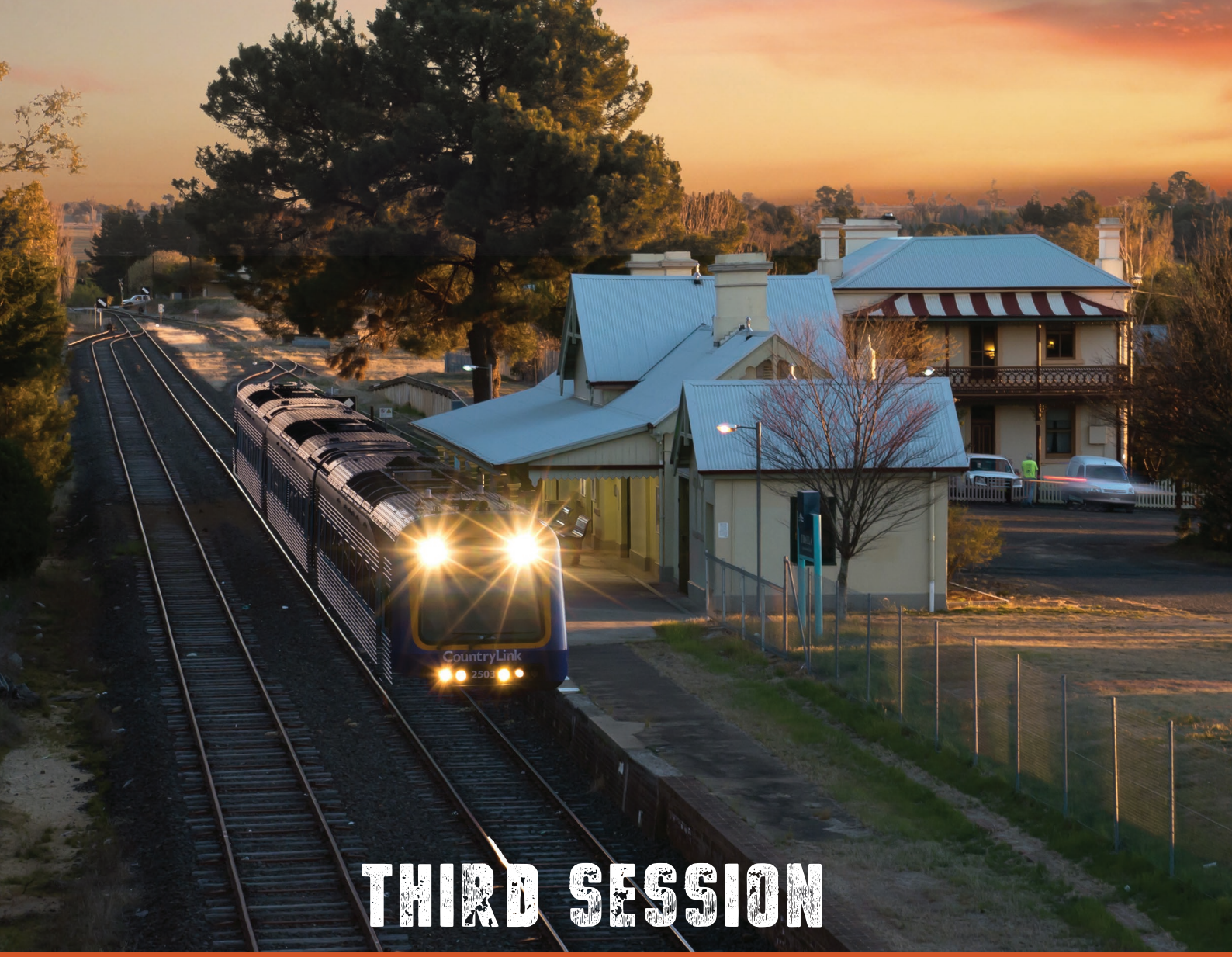
SRMA's Latest high speed platform "US7" has an automated non-destructive testing (NDT) system on board. This system has new technology which has **eliminated** the need for hand testing to be performed to size, and classify a defect after it is detected by the on-board system.

3.6 OH&S SYSTEMS

SRMA through its robust integrated HSEQ management system has assisted Rail Infrastructure Managers in amending NDT processes to include the automated system and assist in providing safety assurance statements and evidence to Rail Infrastructure Managers to present to the ONRSR with their notification of change to maintenance operations under their accreditation with the regulator.

3.7 AMOUNT OF LOCAL/ AUSTRALIAN INPUT

SRMA's US 7 Platform is 100% Designed, Manufactured, Assembled, Operated and Maintained in Australia. SRMA has procured certain items from overseas vendors but has utilised local items wherever possible.



THIRD SESSION

PWI Annual Convention 2019

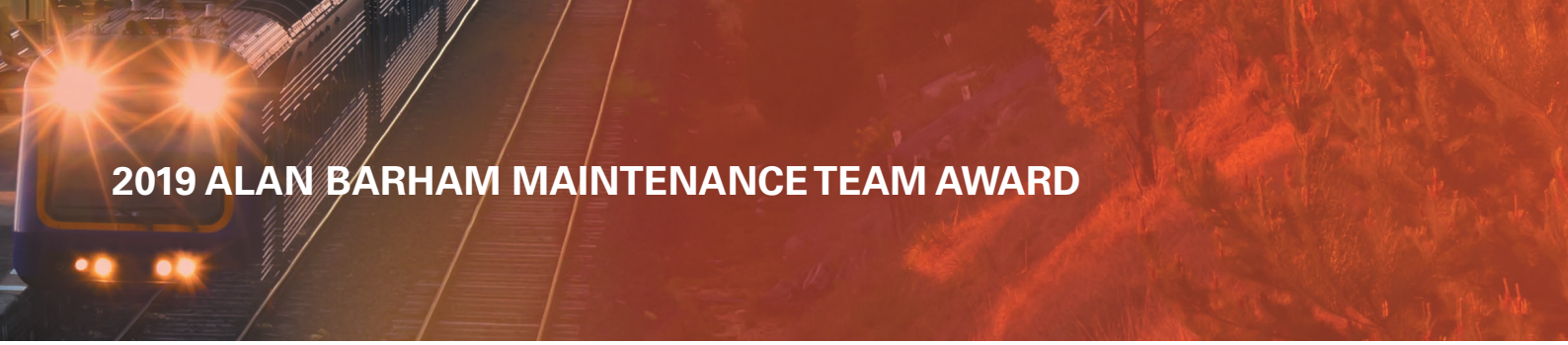
Chairman: **John MacLeod (Sydney Trains)**

2019 Alan Barham Maintenance Award

Paper 5: **Transforming switch maintenance to 'predict and prevent' system**
Alan J Swaby, Head of Business Development
voestalpine Signaling Fareham Ltd

Paper 6: **Addressing Future Transport Needs in Regional Australia**
Simon Berry, NSW Business Leader – Highways, Amey

2019 Steve Maxwell Platelaying Award (Major)



2019 ALAN BARHAM MAINTENANCE TEAM AWARD

Judges

Ken Lingabala, PWI Member

Scott Chapman, General Manager Operations Services Hunter Valley, Australian Rail Track Corporation

Rodney Masman, Civil Maintenance Engineer Country Regional Network, John Holland Group

Kirsty McGeachie, Maintenance Operations Manager – City North, Sydney Trains

Anthoni Elmargi, Maintenance Operations Manager, Sydney Trains

Alan Barham

Alan Barham commenced service as a trainee Civil Engineer with the NSW Government Railways in 1965.

He spent time at Cowra as a District Engineer before becoming Division Engineer Tamworth, a position he held for several years.

When FreightRail was created in 1989 Alan became the Infrastructure Engineering Manager and continued in that position until June 1996 when he joined the newly created Rail Access Corporation as Senior Asset Manager for the Hunter, North Coast and North West areas.

Alan died in early 1997 from cancer.

Alan was an advocate of the importance of the local routine maintenance performed by fettling gangs to deliver safety and reliability for the Railway. It was for this reason that the PWI named the Maintenance Team Award (or Best Kept Length as it was formerly known) in his honour.

The Award was established to recognise Maintenance Teams and the pride taken in maintenance of the track and associated structures. While Alan was a Committee Member of the PWI he promoted this Award throughout New South Wales and was also involved in the judging.

A typical Routine Maintenance team undertakes surveillance inspections, servicing, minor corrective maintenance and emergency response, for track, bridges, right of way assets and possibly signal assets. The team needs to be operating in NSW.

Judging Criteria

The period under consideration is based on the financial year preceding the annual convention (2018/2019). Applicants are assessed against People, Safety, Organisation and Leadership, and Achievement criteria. Judges evaluate outcomes and conditions which are within the Maintenance Team's control as far as possible. It is recognised that track configuration, investment programs, operating parameters, and to a large extent general infrastructure condition are outside the Maintenance Team's control.

The Judges seek to identify the best use of management and technical expertise, and the most effective use of resources in maintaining the track to meet operational requirements. This year the judges also attended the Visual Management Centre (VMC) meeting for each nominee, giving an opportunity to see how teams were engaged from the commencement of their shift.

Both with their nomination and during judging Maintenance Teams describe the reasons why they deserve to be recognised for excellence in Routine Maintenance, and provide supporting documentation where available. The judging criteria is detailed on the following page.

2019 ALAN BARHAM MAINTENANCE TEAM AWARD

1. Team Leadership, Readiness and Engagement

- Capability
- Responsiveness and Commitment
- Engagement
- Succession Planning
- Leadership

2. Productivity (Effectiveness and Efficiency)

- Scoping
- Short term work plan (2-3 weeks)
- Long term work plans (12+ months)
- Strategic Engagement
- Efficiency Strategies

3. Compliance and Assurance

- Workplace Safety
- Infrastructure Compliance
- Operational Assurance
- Environmental Compliance

4. Achievement

- Innovation
- Challenge

Alan Barham Maintenance Team Award – 2019 Entries

This year, five teams nominated; two each from Sydney Trains and ARTC, as well as one nomination from John Holland Group CRN. The track maintained by the nominated teams varied from probably the most high intensity rail trafficked area in Australia (Sydney Trains City East) to a regional location which due to the current drought conditions have a low volume of rail traffic (Nyngan). The length of track maintained was also at both ends of the spectrum, with City East maintaining 74km of track, and Broken Hill maintaining 705km across two states. As always, the judges were extremely pleased with the calibre of the teams judged, and their commitment to work was outstanding. All the teams who have nominated for this year's award are to be congratulated for their outstanding performance.

Metropolitan

Sydney Trains – City East Track Team

Sydney Trains – Western Territory Civil Team

Regional

ARTC – Taree and Dungog Provisioning Centres

ARTC – Broken Hill Provisioning Centre

JHR CRN – Nyngan Routine Maintenance Team

2019 ALAN BARHAM MAINTENANCE TEAM AWARD

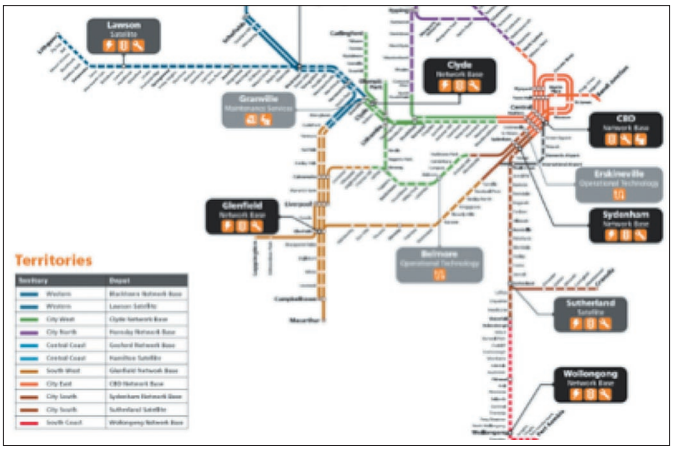
Sydney Trains – City East Track Team

The Sydney Trains City East Track Team are located at the multi-discipline CBD Sydney Trains Network Base. The team is made up of 28 staff that is responsible for 74km of mostly heavy traversed track, of which 33km is underground. As well as this, the team's maintenance area includes over 252 turnouts and catchpoints, four yards and four critical junctions.

The City East team achieved 99.8% compliance of over 7600 safety critical inspections and almost 5500 safety significant inspections. The team improved their LTI and MTI numbers from previous years through demonstrated attitudes to safety, staff engagement and the use of safety coaches and professionals throughout the period.

Team Leaders at City East are responsible for managing short-term work plans and do this through a production planning board in their VMC room, planning a fortnight ahead. Each day they communicate the plan to all staff. Team Leaders have taken ownership of these plans, and this is demonstrated through the effort they spend carefully planning works and optimising resources.

Defect removal is a strong focus for the City East Team, with the team working through planning stages of a Defect Reduction Plan. This allows identification and review high-priority defects, and work with the Engineering teams to complete them.



2019 ALAN BARHAM MAINTENANCE TEAM AWARD

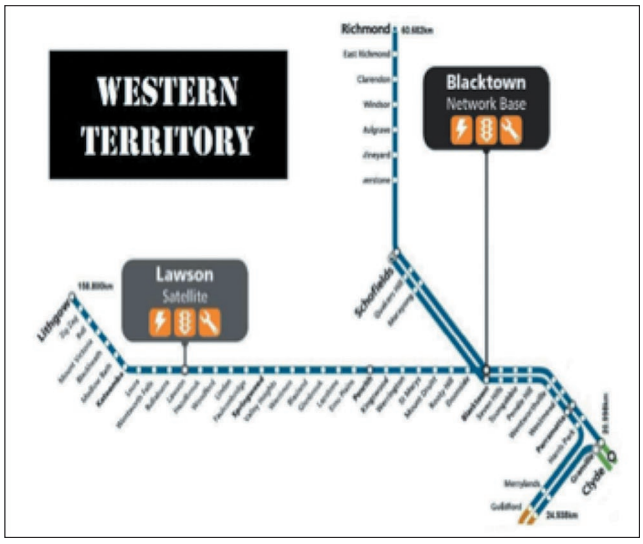
Sydney Trains – Western Territory Civil Team

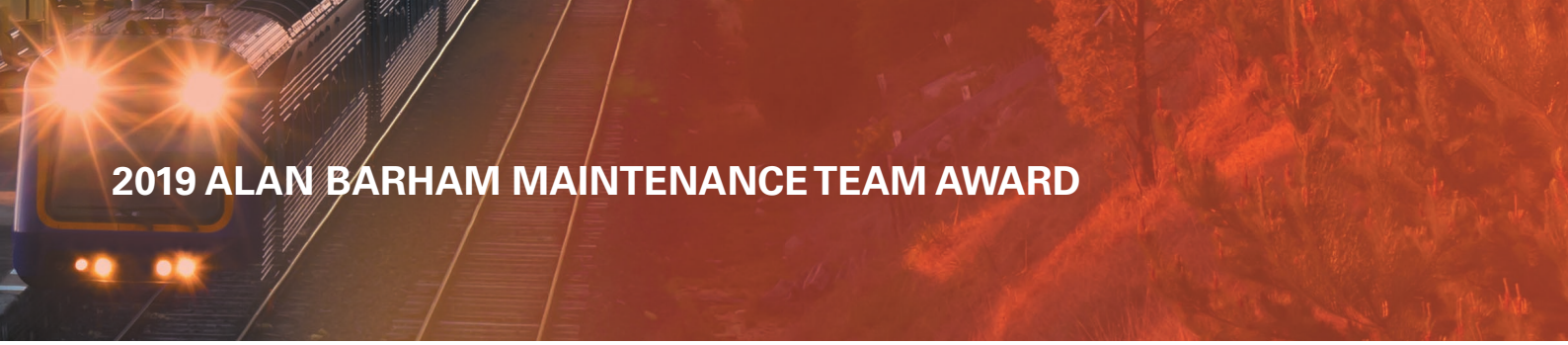
The Western Territory Civil Team comprises of two teams located at Blacktown and Lawson, along with Signals and Electrical Maintenance Teams. The Western Territories cover from Clyde 20.998km city through to the Blue Mountains and Western Plains 158.800km. This area includes: Main Western Line (Granville to Bowenfels), Richmond Branch Line, Old South Line (Granville to Guildford, 383km of Main Line Track, 320 Turnouts, six Maintenance Yards and they often support other Sydney Trains Civil Teams when required.

The Team is made up of highly qualified Supervisors, experienced Infrastructure Workers, and a number of new starters. Mentoring new team members in the field and exposing them to a wide range of tasks is a of particular importance to the Western Territories team.

The two Western Territory teams regularly work together to create a more efficient and effective maintenance team. This has generated a sense of accountability, optimism and belief in themselves.

Pre-planning for emergencies has been a focal point for the team. This has reduced response time to incidents and reduced delays to the Network. The teams responded to a 20-tonne rock fall at Glenbrook which endangered rail services and critical infrastructure. During the response, the team discovered Aboriginal artwork inside the cave which resulted in a several day emergency recovery operations. The team were commended for their precision planning, safety and restoration to services by the Sydney Trains CEO.





2019 ALAN BARHAM MAINTENANCE TEAM AWARD

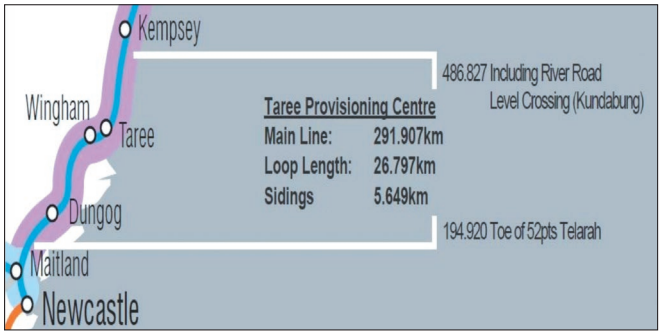
ARTC – Taree and Dungog Provisioning Centres

The ARTC Taree and Dungog Maintenance Teams consist of 13 civil and 7 signal staff, maintaining 291.907 kilometres of bi-directional track on the North Corridor of the ARTC Interstate Network, along with 26.797km of main line loops and 5.649km of sidings. Located at the Southern end of the Interstate Network North and bordering the Hunter Valley Network, the team have many challenges posed by distance, the spanning of two Provisioning Centres and the remote nature of much of the track to safely maintain reliability.

The Team focus on the ARTC value of 'No Harm' which they understand to be about ensuring we keep people safe; not only those who are working on their network but also those who use their network and the public in general. The team do this through: Safe Work, focus on quality of work site briefs and hazard identification consistently reviewed, consistent hazard reporting, consistently high lead indicator scores, and engaging in toolbox meetings. The team are currently celebrating 2800 LTI Free Days as at 19 July 2019.

In the past eighteen months the Taree and Dungog teams worked to combine their daily pre-start and close-out meetings through the use of a digital VMC. The teams continue to drive improvements through culture innovation exercises, group activities outside of works, family days in the PC and encouraging honest and open feedback as part of their working day.

The team maintain a strong focus on innovation, and through the judging period are particularly proud of an improvement to the safety of Signal Maintenance. Through some research by a team member a supplier was found that enabled retro fitting to replace LED's on gantry signals from behind resulting in minimal disruption to services



2019 ALAN BARHAM MAINTENANCE TEAM AWARD

ARTC – Broken Hill Provisioning Centre

The ARTC Broken Hill Provisioning Centre maintains a total of 705.526km of track between Coonamia, South Australia and Ivanhoe, New South Wales. The team is comprised of 13 Civil and 4 Signal staff based out of Broken Hill.

The infrastructure maintained by the team includes 146 bridges, 482 culverts, 168 turnouts, 203 level crossings, and 35 sidings. The team holds themselves to high-standards, and places an emphasis on training plans to ensure all required skills are covered. The team have proven to be flexible and agile, often fulfilling roles outside their regular duties. This also enables future leaders of Broken Hill to have the skills required if their peers retire. Due to the remoteness, rosters and fatigue management are closely monitored to ensure team members have a healthy work/life balance.

Commitment to the ARTC Value of 'No Harm', the Provisioning Centre is currently celebrating over 2000 days LTI free. This has been testament to the ever-improving safety practices being implemented. The team also focus on safety critical compliance and have introduced a new Technical Maintenance Plan to further improve.

A multi-pronged approach to both short and long-term planning has been key to recent success. This has been aided by the use of a digital VMC, and the use of iPad's to allow for remote access to real-time information and data.

The team are especially proud of their project work this year, all of which were delivered efficiently and with no incidents or injuries. These included: Turnout component replacement for 6 turnouts, resurfacing of over 60km of track, 6 Level Crossing upgrades, 100m of Ballast Undercutting, installation of 5 tilt masts and the track maintained through the hot summer period with zero misalignments.

2019 ALAN BARHAM MAINTENANCE TEAM AWARD

John Holland Country Rail Network – Nyngan Routine Maintenance Team

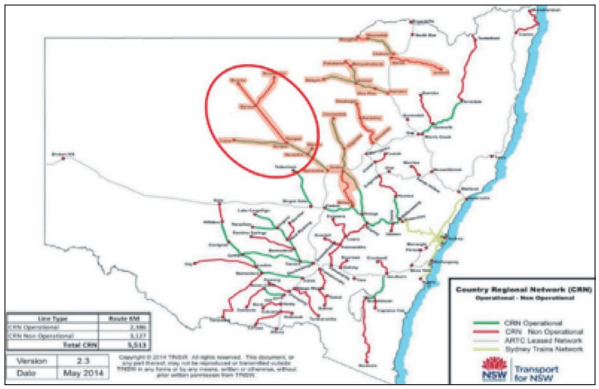
The Nyngan Routine Maintenance Team maintain 278.926km of freight line from Nevertire to Warren, Nevertire to Nyngan and Nyngan to Cobar lines, all of which are freight lines. Nevertire to Warren, and Nyngan to Cobar are classified as Class 3G track, with Nevertire to Nyngan Class 3 track.

The team is made up of a mix of younger and older team members who offer a diverse range of skill sets and backgrounds. This allows them to support each other and provide insight to alternative methods of carrying out tasks. The team share the pride and enthusiasm they have in what they do which ensures the track is maintained to a consistently high-standard.

A strong emphasis on safety is evident within the Nyngan Team, they recognise that every worker should come home the same way as they left for work. Safety in ingrained in the team's practices and work ethics, which is evident through the use of 'Start Cards'. Team members fill out a card before a task to record specific details about the site and the work being conducted. The team continue to maintain a zero LTI and MTI record since the previous judging period and is proud of their 100% safety critical and safety significant compliance.

The Asset Management System Maximo is the driving force behind short-term planning at Nyngan with scheduled reports generated each week for the following fortnight. Alongside Dubbo and Narrabri, the team continue to strive to plan and stay ahead of schedule. The team also work with their peers on longer-term planning.

There is a strong sense of community focus within the Nyngan team. One of their proud achievements for the judging period was providing bottled water to the Central North town of Walgett who had been surviving on bore water only for the past eighteen months.



Transforming switch maintenance to 'predict and prevent' system

Alan J Swaby, Head of Business Development, voestalpine Signaling Fareham Ltd

Introduction

ARTC does not operate any trains, but provides and maintains the infrastructure for train operators to run on. The tracks controlled by ARTC for this presentation are located in the state of New South Wales.

ARTC continues to focus on driving an ever-increasing value proposition for Hunter Valley customers, supply chain peers and other stakeholders, to sustain and grow long term supply chain competitiveness through operational improvement initiatives.

During recent times there have been a number of initiatives introduced to improve operational performance aligned with capacity assumptions.

The focus of interest here is the:

- Optimising asset performance through an integrated whole of asset lifecycle strategy and the improved use of reliability and condition monitoring data to improve decision making.
- Improved response to failures on the network.

The technology of interest is Switch Condition Monitoring.

Background Information

Prior to 2013 there had been very little interest within ARTC for the monitoring of the performance of switch machines and turnouts.

During October 2013 the first introduction of switch condition monitoring was made to ARTC.

During the early part of 2014 further presentations and meetings were held to enable ARTC staff to gain a better understanding of the equipment required, the monitoring operation and the potential benefits.

At the end of 2014 a tender was issued for the Proof of Concept trial of Switch Condition Monitoring.

The trial was twice extended to allow ARTC to better evaluate the benefit of operating Switch Condition Monitoring.

In August 2018 another tender was issued for the supply of equipment and a monitoring server to satisfy the monitoring of an additional 253 switch machines at 106 different location across the Hunter Valley.

Road Map

The Road Map for the ARTC route from a Find and Fix type of maintenance system to a Predict and Prevent type maintenance system is no different to the map for this type of transition.

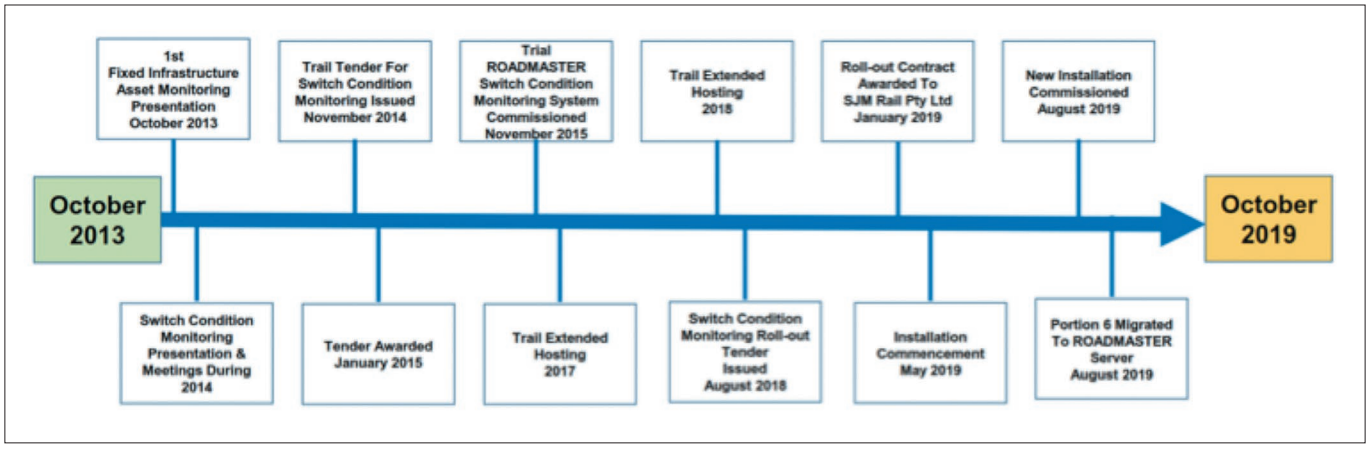


Fig 1. The ARTC Road Map

Transforming switch maintenance to 'predict and prevent' system

The Change Process

With any managed transition from one method of working to another method of working, there are always a number of steps that must be taken to achieve the main goal. The ARTC transition situation was no different.

The steps to move from the old to the new process will always be something similar to the following:

- Old Status Quo (Find and Fix Maintenance)
- Resistance (establish form of work, resist change)
- Delivery Challenge (data, information, resource, process)
- Adoption (utilisation, improvements, success)
- Transforming (expanding, predictions, improved resource)
- Integration (ownership, dedicated resource, standard practice)
- Moving forward (other applications, data warehouse)

The biggest hurdle with moving from the 'Find and Fix' system to the 'Predict and Prevent' system is the buy-in from staff. In general the business case will stand up to scrutiny and move forward but for change and the ongoing process to work, the staff must be aligned with the shift to the new system to ensure success.

- Resistance

When introducing any new processes or system into an operational business there is always a certain amount of resistance.

The problems to overcome related to the following:

- Established customs and practices
- The fear of change
- Lack of knowledge

In some organisation this can be a big problem. However, within ARTC there were some very early converts to utilising monitoring, linked with support and education from voestalpine Signaling Fareham the resistance was removed.

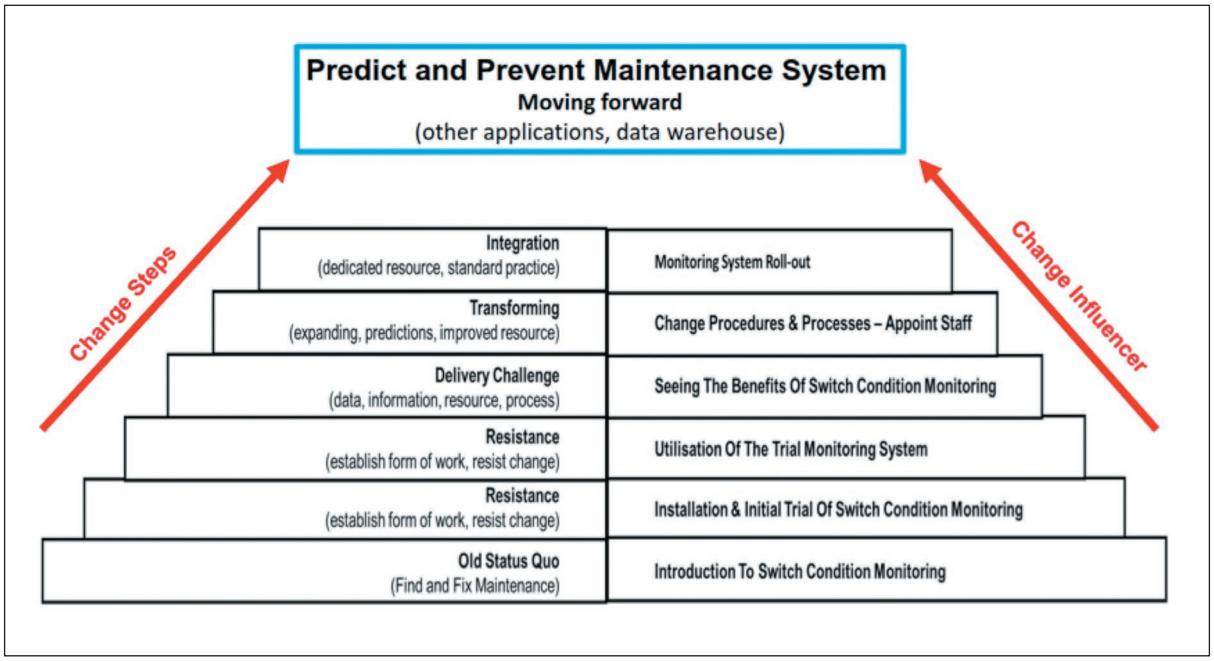


Fig 2. The Change Process

Transforming switch maintenance to 'predict and prevent' system

• Delivery Challenge

With such a dynamic change there is always a certain amount of challenge or upset. This is due to some management or existing processes. The challenge arises because it has been agreed that a change should take place but how that will happen or be supported is not always fully considered. With a trial of Switch Condition Monitoring the impact of the trial, new technology, additional information, alarms and how to use the system are not always considered.

In the case of ARTC some of the important items had been considered, however, there was still some minor lack of clarity caused by the monitoring system and the volume of information generated. This situation is normal in any organisation when such a step change is introduced.

With support from voestalpine Signaling Fareham this step in the change process was quickly and proactively overcome and ARTC went to the adoption phase.

The support given by voestalpine Signaling Fareham during this phase was the following:

- Train ARTC staff on the utilisation of the system
  - ROADMASTER Software
  - Data screens
  - Trends
- Weekly reports
- Monthly reports

• Adoption

The adoption of the ROADMASTER system was achieved by ARTC becoming very competent in utilising the software and the acknowledging the benefits of utilising a monitoring system.

This was achieved by the following steps:

- Learn to use the system
- Read the reports
- Use the data
- Start to predict potential failures

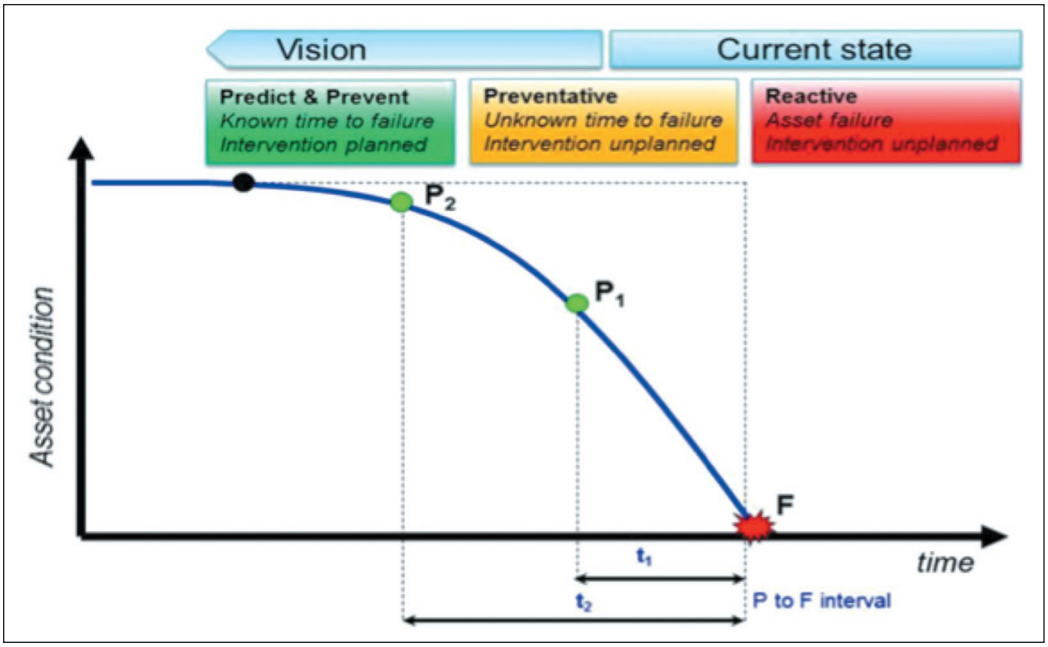


Fig 3. P-F Curve

Transforming switch maintenance to ‘predict and prevent’ system

The information from the Roadmaster helped with the adoption. Here are some examples that assisted with the move to adoption.

Example 1.

Compared to the previous week, the number of faults which have occurred this week is minimal, affecting only two sites. Below are the two affected swings and their profiles to match:

- Switch 114B under Ravensworth was the cause for the one alarm over the last week, likely due to some slider issues with the swing on the rollersystem. It has affected both TA1 and TA2 and occurred on 20th November.

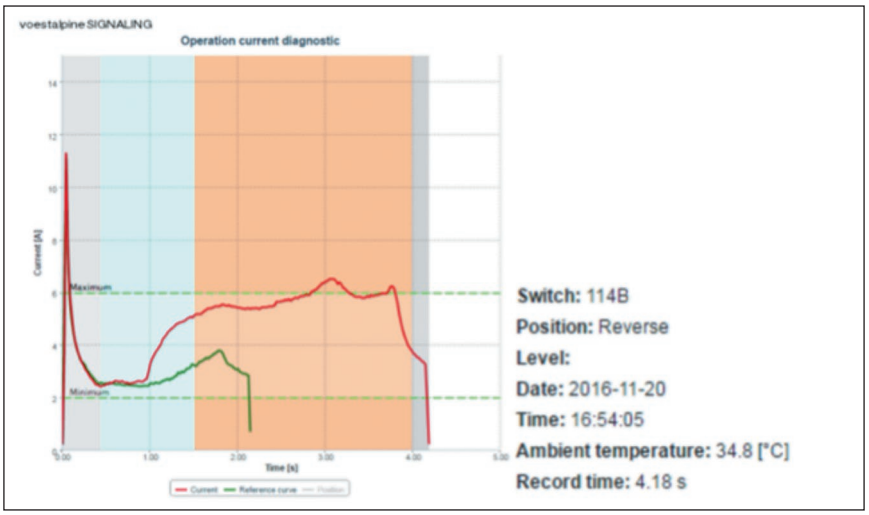


Fig 4: Report Extract 1

Example 2.

- Switch 59C for Singleton was affected by an event which caused the current to spike out of the maximum range and maintain at a level of 900W whilst fluctuating constantly before the switch times out after 10 second during the locking stage of the swing.

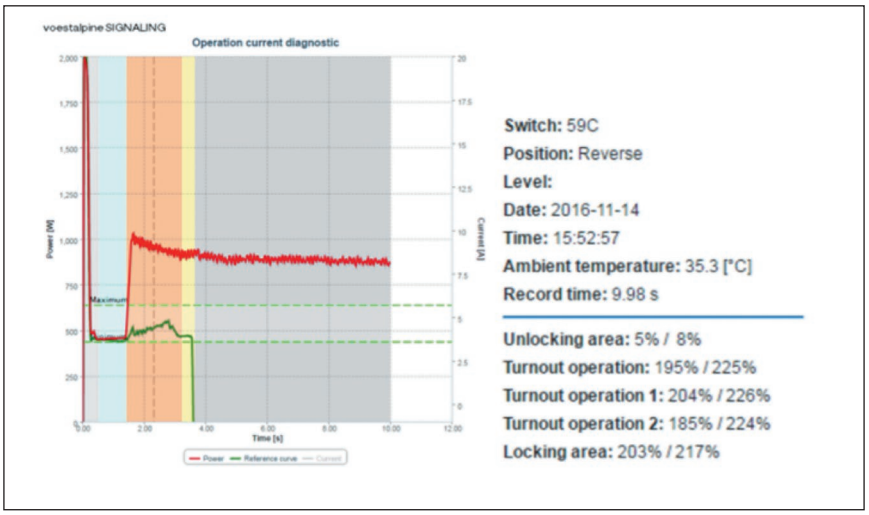


Fig 5: Report Extract 2

Example 3.

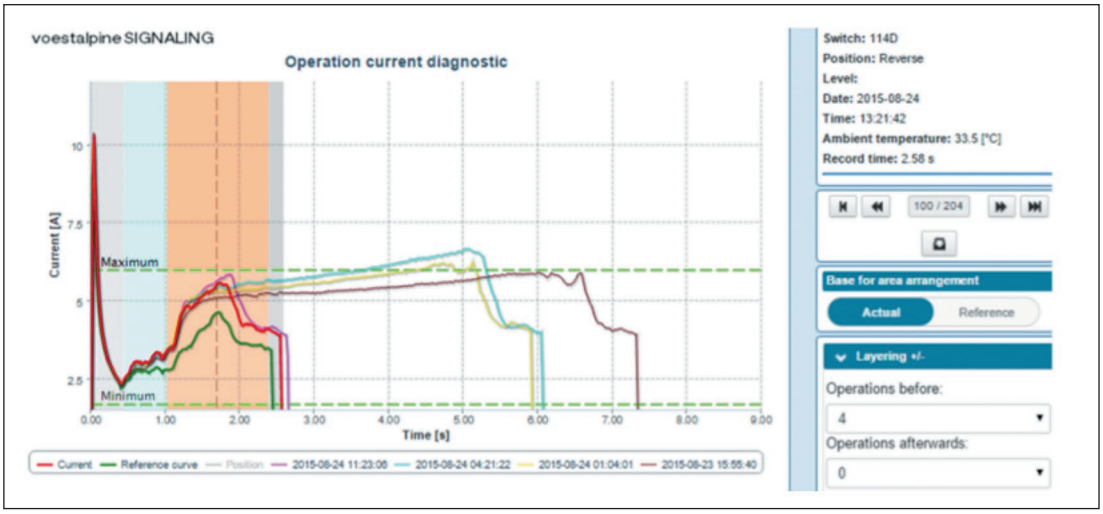


Fig 6: Report Extract 3

Example 4.

1.2.2. 114D

This machine appears to have a failing motor which can be seen by looking at the profile below.

The saw tooth shape in the current nearly always indicates a motor problem, and this is reinforced by the fact that the problem can be seen in the current spike at the start of the profile. The motor is drawing current here without any other equipment impacting the system.

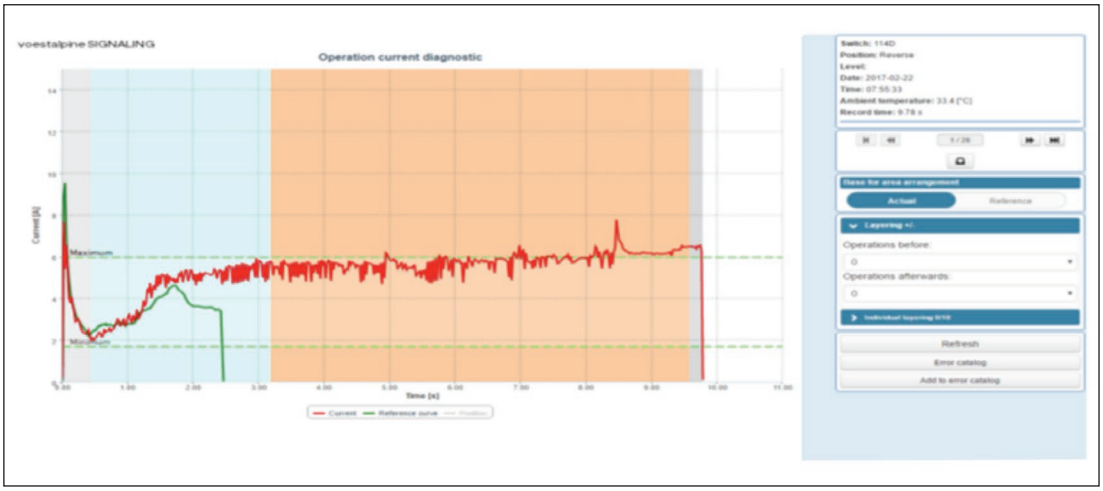


Fig 7: Report Extract 4

- Transforming

This transforming or the transition from a Proof of Concept trial to a ROADMASTER User came from the following:

- Appoint staff – Asset Management
- Use the generated data
- Start to predict potential failures
- Decision to expand the system
- Decide which locations
  - Tender
  - Roll-out additional monitoring

Transforming switch maintenance to ‘predict and prevent’ system

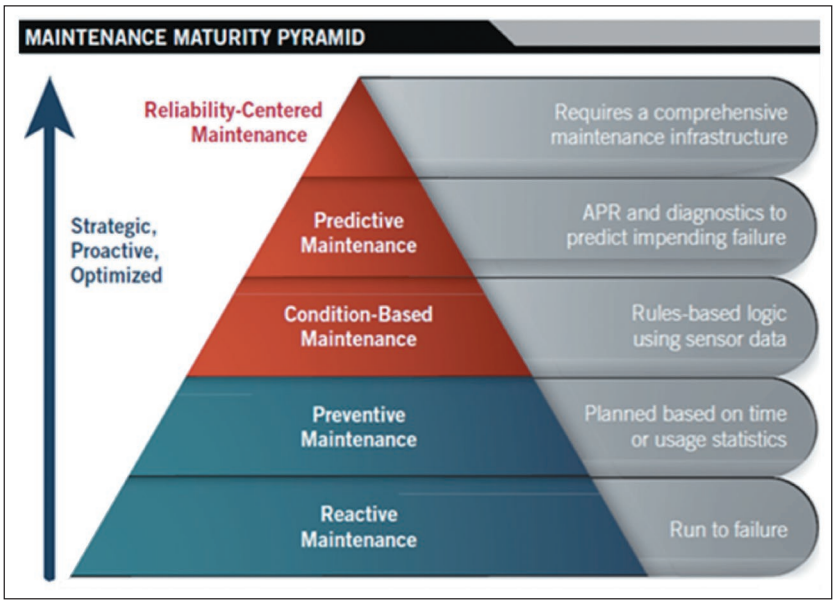


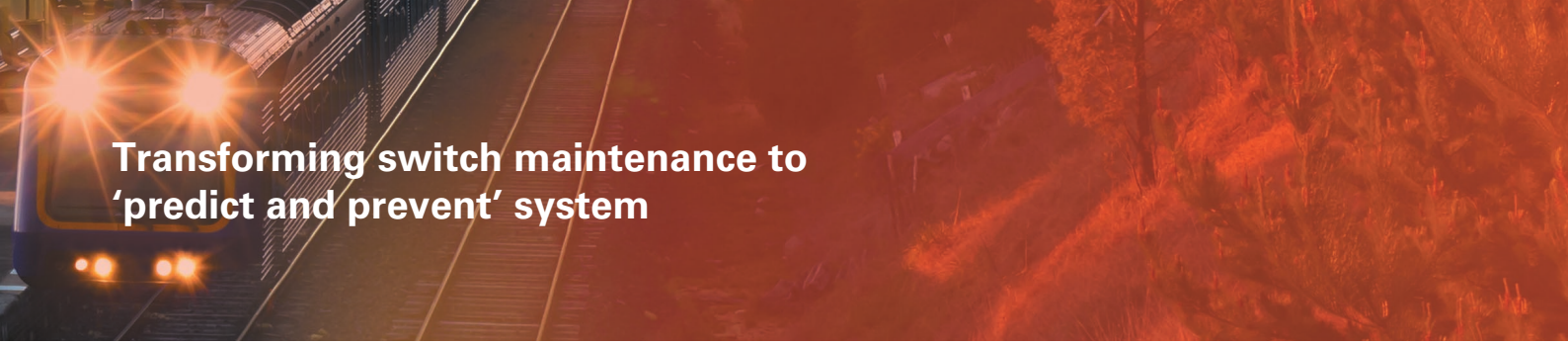
Fig 8: The Maintenance Maturity Pyramid

• Integration

This was achieved when the following occurred:

- Ownership of Switch Condition Monitoring
- Dedicated people
- Utilisation of data
- Move to a ‘Predict and Prevent’ maintenance system

Fig 9: Joined-Up Process



Transforming switch maintenance to ‘predict and prevent’ system

- Moving Forward
  - There has already been some discussion about additional monitoring applications. These include:
    - Power supplies
    - Rail Temperature
    - Track Circuits
    - Level Crossings
  - Also there has been ongoing discussions about integrating ROADMASTER with other software platforms and forming a ‘Data Warehouse’

Conclusion

The process change from a ‘Find and Fix’ maintenance system for switches to a ‘Prevent and Predict’ maintenance system which ARTC decided to embark on back in 2014 has been a long and interesting process. In many respects this is not dissimilar to those rail networks around the world that have previously embarked on such a change.

Unfortunately, many organisations believe that installing a monitoring system will solve their maintenance problems overnight. This clearly is not the case. Therefore, it is important to select the correct monitoring partner to assist with transition and to install a product that has proven capabilities, quality and sustainability.

In the case of ARTC their confident and capable staff were prepared to try new technology and acknowledge the support, assistance and input from a monitoring system manufacturer.

Addressing Future Transport Needs in Regional Australia

Simon Berry, NSW Business Leader – Highways, Amey

Introduction

Transport for New South Wales (TfNSW) wants to lead the way in the application of new technology to the planning and management of future transport systems to ensure the best outcomes for transport customers across NSW. As part of its Draft Future Transport 2056 Strategy, TfNSW recognises that the current transport response needs to adapt in regional centres to accommodate NSWs' changing demographics, population and the needs of these areas. To do this TfNSW is seed funding a number of automated vehicle trials in regional NSW, with objectives including:

- maximising the benefits to customers and industry;
- leading the way in applying the latest technology safely and with tested outcomes;
- providing a better understanding of the challenges of automated vehicles in regional areas;
- providing lessons learned in identifying and implementing new ways of delivery to help shape future trials or rollouts; and
- enabling TfNSW to build and grow relationships in this emerging sector.

It's hard to predict what transport of the future looks like, there is, however, significant public and private investment and wide-ranging publicity in new technologies such as drones, driverless cars and trains and investing in old technologies that seem new, such as vacuum tubes (Hyperloop). As technologies develop, human drivers of vehicles (be it road, rail or aeroplane) are being removed from controlling the vehicle. What is evident in all these solutions is the need to have connections to major hubs by rail and air, and smaller modes of transport providing the local journeys.

We are seeing shared mobility services such as e-bikes and e-scooters be a more popular solution in built-up environments to complete the mobility as a service (MAAS) transport model. These modes are not really practical in regional settings as they require large populations in very dense environments to be both financially viable for the providers and practical for the customer.

The Amey driverless vehicle trial looks into some of these issues, ensuring that safety is of paramount importance in every decision that is made throughout the trail.

The trial:

- is a complex project integrating multiple forms of new technology within a regional setting;
- is to provide valuable insights to TfNSW regarding autonomous technology and its ability to support regional mobility;
- is not a final solution, nor the right answer for the regions but it is a step towards learning what the right answer is and will give valuable insights for future planning and investment;
- has gathered partners which are a varied group of organisations specifically chosen for their skillsets and industry understanding to inform a successful trial.

Amey's trial sees value in offering something different to what the emerging automated vehicle market already has. The need to modify existing vehicles that use the network in the short term will ultimately lead to long term gains in acceptance of this technology. With acceptance comes refinement, the more research and development is undertaken, the more efficient the technology becomes. The take-up and acceptance of automated vehicles will be a very similar journey to the personal computer from the 1960's.

Addressing the Transport Need in Regional NSW

Smart Technology serving our community

With every step we take the needs of the communities we serve remain firmly in our sights. Despite the rapid change in technology and demand that society is faced with, some things never change. The community still needs to travel to live productive, connected lives; government still retains a public expectation to offer ways to maintain access to essential services such as health, education and emergency services; and the economy requires infrastructure to facilitate supply and stimulate demand.

With the boom in obtaining technology at your fingertips such as mobile phones, human distractions have increased significantly. This is evident in the spike in vehicle crashes due to inattentive drivers. Although the human brain is very good at making quick decisions, humans are very poor when it comes to keeping focused for prolonged periods. Thus, future transport will need technology in these vehicles that are perceived as safe for the user and for the communities they operate in.

Scalable Connected Solutions

Given Regional NSW is forecast to grow by 400,000 people by 2036 and then a further 200,000 by 2056, being able to scale up any automated vehicle solutions to meet the changing and growing demands is an important aspect of the trial.

This scalability also extends to the services we wish to explore commencing with a defined route of controllable destinations that can be expanded to include town-to-city movements and inter-city transport. We are interested in the logistics, economy and effectiveness of these services and how the business of autonomous vehicles will shape the services it can efficiently offer.

We are also interested in the adjacent value that autonomous vehicles provide that support the broader community service functions of the public sector. Examples include the capture and monitoring of data, assessment of off-peak demand services that maximise the value and utilisation of the assets when not required for peak transportation demand.

Customer Led Design

Expectations of any service is shaped by the community and these expectations reshape over time with shifting community patterns and needs. This is driven by changes in demographics, greater connectivity and availability of information, political discourse, economic changes and social and cultural reform.

This trial focuses primarily on our perception of the underlying needs of Dubbo and focuses on supporting the key local and inter-regional connections in the first instance. This includes connecting the central rail hub, local university and key tourism destinations including the airport and popular zoo destinations.

Staying ahead of the change

As NSW grows, our Regional Cities will become more important as key linkages and centres for economic activity, education and services. Much of the value of these centres is lost if efficient transport connections are not provided, either to improve inter-regional movement of people, goods and services, but also connecting surrounding populations based in more remote areas or towns to the central regional hub.

We recognise that existing public transport is both ineffective and unreliable given the distances it needs to travel, and its relatively poor ability to efficiently connect with other mass transport systems, such as regional rail and bus routes. Insufficient local transport options in regional towns present difficulties for local communities, leading to a large number of cars per capita and low vehicle occupancy.

Our vision of the future starts with the main transport hubs, extending the hub and spoke model to short distance demand and mid-level travel systems and address last mile requirements, initially within the major regional cities and progressively into smaller towns.

We believe that this approach will address the more economically viable demands of the regions, while assessing the best models and arrangements to effectively meet the expansion of any services, and at what point economic viability both from a private and public perspective remains positive. This approach aims to recognise that transport has a key role to play in levelling the playing field for the broader population, irrespective of location and offering an alternative to those who do not have access to private vehicles or no longer are able to drive.

Why Amey Chose Dubbo

Approximately 400kms west of Sydney, Dubbo has an estimated population of just over 51,000, and 65,000 people if the surrounding satellite cities are included. Dubbo has an airport, train services, regional, inter-city and inner-city bus services and a taxi service. Three high speed highways meet in Dubbo, shaping the city as a hub to satellite towns. Dubbo is also an innovative city, they are currently working with NRMA on electric charging stations for electric vehicles and they are investigating automated vehicles in agriculture.

Dubbo has unique challenges in their current transport system: it is a car-centric city where public transport usage is for those who cannot afford a car or do not have a driving licence. The bus patronage is low and irregular, the services are scheduled two hours and carry no more than 5 passengers at a time. Many low-income workers choose to walk to work alongside roads that have a posted speed limit of 100km/h. The train to and from Sydney is scheduled once a day, also with low patronage. Most people who catch the train are from the satellite towns.

The airport services a vast amount of regional NSW. The Regional Fire Services has a training facility at the airport, with many firefighters flying in and out for training or to help out if there is a major fire in the region.

Addressing Future Transport Needs in Regional Australia

The Flying Doctors Service also has a base out of Dubbo Airport and many doctors from Sydney travel to Dubbo to either work for the Flying Doctors Service or to stay in Dubbo treat the sick in the local hospital or work in one of many specialist medical services in the CBD.

There is a taxi service from the airport, however no other public transport is offered. This forces people to drive to the airport and park in the car parking facilities. This is often overcrowded with little choice but to leave the car in an area that is vacant. With some people travelling to and from other regional hubs or Sydney, their cars are often left for days. The carpark at the airport is a crime hotspot, with cars being stolen or broken into.

Dubbo's age demographics is "top and tail" so to speak. They have a young population with a large number of primary and secondary schools in Dubbo. It also has a significant university campus at Charles Sturt University and two TAFE campuses. One of the booming industries in Dubbo is aged care facilities and retirement homes. Before retiring, residents surrounding Dubbo become familiar with the Dubbo city, use the professional services, shop at the vast retail outlets and use the medical services Dubbo offers, thus choose to retire there.

Dubbo has a large tourism attraction, Taronga Western Plains Zoo which attracts over 260,000 people per year. It also hosts a number of other tourist attractions which help retain tourists. A large percentage of tourists stop in Dubbo on their way to other regional events in surrounding regional hubs such as music festivals and agriculture festivals.

Dubbo has a large agriculture industry which services the high-end restaurant businesses in Sydney. They have Australia's largest abattoir on the outskirts of the city which employs 450 staff. Logistics is a big issue for their growing industry as a lot of this produce is spoilt by the time it arrives in Sydney.

With the amount of agriculture in and around Dubbo, there is a high volume of heavy vehicles that pass through the city. There are many crash blackspots in and around the city centre.

Although this Trial will not address all of these issues, there is a long-term vision that this technology can be adapted to suit Dubbo's greater needs.

Trial Differentiators

This trial demonstrates the viability and desirability of using vehicles that can be retrofitted to operate as an AV to handle transportation requirements for both urban and regional journeys – with full interaction with other road users. Most AV initiatives to date have looked at urban first and last mile challenges using bespoke vehicles limited to 10kph. We are also delivering a world first: an autonomous pick-up truck for public transport use.

A key aspect is that currently there is no widely known solution to automated vehicles being able to deal with kangaroos coming in from the side and jumping into the road, one specific research area we have built into our trial is to explore how automated vehicles can learn how to deal with this by noticing the movements of a kangaroo before it becomes a problem in the road.

Highlights of the trial include:

- Business travel – to and from the airport, with and without luggage
- Tourism – to and from the zoo
- Commuting – between the three key destinations
- Day and night time operation
- Wide range of environmental conditions – Temperature between 2.6 and 33 degrees Celsius, rainfall averaging 3.7 and 60.7 mm in a month
- Ridesharing to increase the productive capacity of regional transport modes
- Existing support for the vehicle that is a full production vehicle.

Extended use cases include:

- Commuting – to/from the train station
- Student travel – to and from the university campus

A key innovation on this project is to apply vehicle automation technology to an existing production vehicle that is familiar to local residents. In our previous experience, automated vehicle "pods" gain significant attention because of the different look and feel of the vehicle, by using a vehicle that people are used to allows the passenger to focus on the automation of the vehicle.

The selected utility vehicle:

- is a production platform with high reliability;
- has been designed for environments similar to regional Australia;
- benefits from an existing service, maintenance and parts infrastructure;
- uses a traditional powertrain (eliminating the range and charging issues of electric vehicles) with an existing fuelling infrastructure; and
- allows both passenger and freight delivery operations to be undertaken if required.

The retrofit approach also leads to a scalable roll out of automation to the wider vehicle fleet, enabling an accelerated adoption and application of automated vehicles by government organisations, fleet operators and private users. This early adoption will allow TfNSW to realise benefits from this technology for NSW citizens.

Technical Details of the Trial

The scope of this trial falls under three broad categories: technology and application; customer focus and how we engage with the community; and route and service validation.

These activities have been separated to ensure that the technology being developed is focused on solving an actual problem for the Dubbo community. The customer focus strand includes obtaining user feedback and working with the community to engage them in the development of the trial and build confidence in the solution. This fits with our overall objectives to maintain a strong focus on the users and the issues that AVs are solving rather than retrofitting an off-the-shelf solution.

Enabling driverless vehicles

The technology

This trial provides one, self-contained vehicle that can operate on regional roads. The vehicle doesn't need connectivity to WIFI or networks to drive automated, the major benefit of this technology is that it is self-contained within the vehicle. AVs operate according to three principles (outlined below), using a combination of sensors and computational systems to understand more about their environment:

Where am I – AVs have to have some idea of where they are to help them operate. This is provided by a combination of GPS and cell phone sims to accurately triangulate the vehicle's location down to the nearest metre.

What is around me – AVs need to understand their surroundings to operate. This is provided through multiple sensors. Light Detection and Ranging (LiDAR) is the most common type which creates a 3D point cloud of the environment so that the vehicle can 'see' the surrounding objects (See diagram on the following page). This is supplemented by vehicle radar so that the vehicle can understand how close it is to objects ahead and its surroundings. Cameras are also attached to the vehicle to help it interpret objects around it.

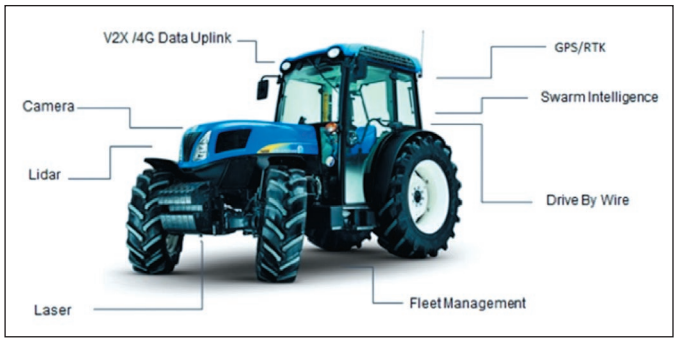
Where am I going (and how to get there) – Providing the vehicle knows where it is and what its surroundings are it can then navigate to a new location. Automated vehicles are fitted with navigation units, based on GPS data, which provide the vehicle with directional information, inputted by the user or fleet manager. These units also combine traffic and road closure data to provide vehicles with the guidance information to get them from A to B.

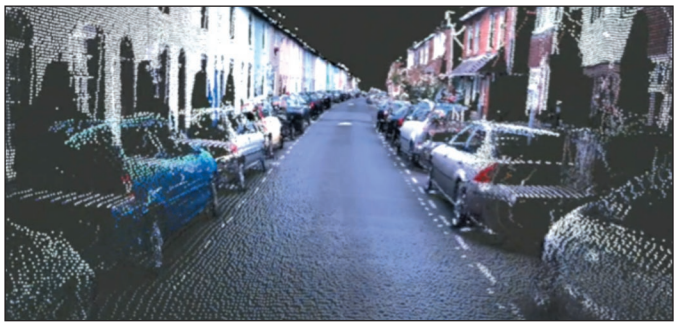
Automated control

The vehicle automation system consists of a number of elements:

1. Sensors – Sensors are selected from a pool of familiar technologies as required for the application, these include GPS, LIDAR, Radar, Cameras and Ultrasonics. The actual sensors selected are dependent on the operating conditions and system use cases. Sensors are used to detect objects (animate and inanimate) around the vehicle.
2. Vision module – The Vision module undertakes sensor fusion and world mapping to classify objects and create a dynamic representation of the environment around the vehicle. The Vision module will also provide trajectory information for objects (i.e. it monitors objects over time and predicts future positions based on observed dynamics).
3. ACU (Automated Control Unit) – The ACU is the brains of the automation; given journey targets it works out a set of waypoints and the "normal" path required to transition between them.

4. **VCU** (Vehicle Control Unit) – The VCU converts the target vehicle speed and heading into setpoints the vehicle modules (e.g. Engine Management System) can understand. A human driver will automatically adjust pedal position or steering wheel location to achieve desired setpoints, the VCU will provide the same functionality based on the ACU setpoints received. The VCU also controls vehicle lights, indicators and horn when in automated mode.
5. **Data Logger** – The data logger is an essential requirement for AVs and will capture key data when in normal operation and higher resolution when an incident or near incident occurs. Logged data includes sensor values, control values and if appropriate video footage.





Source: Oxbotica Amey Sheffield Scan

Communication Methods

Social Media

Interacting with local customers will allow them to feel a part of the project, and it is important to deliver the project based on the customers' expectations and needs. As well as this, it provides a key opportunity to open communication channels with customers and provide safety updates, economic benefits and updates on the project as it progresses.

Newsletters

Amey and its partners are working with the local council to provide the public with updates via local newsletters. Each of these updates within the newsletters will provide the valuable opportunity of highlighting key milestones, safety updates and changes based on customer feedback. This keeps customers engaged and informed on the project as it progresses, acting as a platform for those customers that do not have access to social media.

Local Community Meetings

Amey is working alongside the local council and will be attending meetings with key community members, to address any concerns and have 1:1 feedback sessions with the end users of the AV project to drive improvements to the project

Focus Groups

There will also be the opportunity for different members of the public to join focus group sessions for the AV project, encouraging more diverse and focused involvement on its progress. The purpose of these sessions will be to obtain feedback and move the trial forward. This will encourage the community to own the project and be an integral part of its ongoing development.

Surveys

The Operator will develop and undertake surveys capturing multiple scenarios including; pre-trip, getting on board, during the trip and post trip.

Consistent Customer Engagement

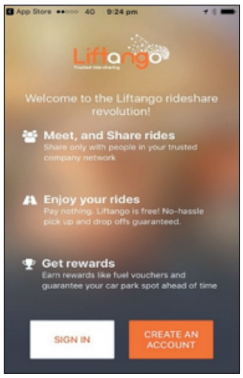
Some residents may be uncomfortable with technology and using smart-phones, tablets and now automated vehicles. Our vehicle supervisor will be a trained member of staff provided by the local transport operator. Also, for the first two weeks of any station being launched, there will be a marquee set up on site to support people in ordering the car which aims to help with customer engagement and allow people to ask questions about the app and how to download it / use it. The app will also have built in feedback functions for users, so they can comment about their trip. These activities provide feedback and guidance to improve the service and put the user at the heart of the service design.

Connecting Key Points in the City

The trial will provide up to 5 fixed points for the vehicle to drive between. The fixed-point nature of this trial allows us to easily scale the solution by adding additional points whilst obtaining user buy-in at the same time. People can use the vehicles and feedback into the development of them, by doing this they will feel a part of the growth of the trial and will be more likely to accept the vehicles as a valid form of transport.

The trial has a dedicated free App (Google & Apple stores) for on demand bookings, social media promotion and real time tracking and feedback plus in vehicle feedback devices. Our approach includes an education program before and during the trial and our social media strategy includes post evaluation feedback as well.

Develop user interface app



Given that mobility projects are about getting people from A to B, the experience of the person (user) should be among the first considerations in designing projects. The first user experience has a significant impact on a person's response to a new service, and therefore to future patronage. The user interface (UI, typically around a mobile application) is the interaction during which first impressions of a mobility service are made. Research shows that this first experience sets the tone for their reaction to the service.

While a positive experience during a person's first interaction keeps their mind open, allowing them to judge the actual mobility part of the service, a negative experience during their first interaction colours the remainder of their perception.

Passenger Interface Application – How does it fit into the project context?

Phone and Tablet

The Passenger Interface Application will be the centre of the passenger experience before the trip commences. To ensure a positive experience, and provide the best flexibility of service, the passenger will be able to book trips through the interactive tablet screen interface (a tablet mounted on fixed infrastructure at the pickup station) and have the ability to book trips 'on-the-fly' using a free application on their mobile phone.

Book-on-the-fly

This ability to book-on-the-fly is vital to provide the flexibility and convenience of service, so that passengers don't have to physically go to the station to book the trip, only to have to wait for a returning vehicle. They can instead book ahead using their phone, and be given a departure time, allowing them to make their way to the departure 'station' at their convenience.

Ticketing

The mobile phone application also allows the project to test the ticketing aspects of the automated and autonomous vehicle projects. Ultimately when the vehicle is fully autonomous, without a driver on-board to validate passengers match the trip manifest, a robust ticket validation process is required, to ensure that only passengers with a valid ticket have boarded. The mobile phone app provides an ideal platform on which to base the ticket system to a number of approached, such as pin-codes, QR scanner codes and other methods, and assessing viability of integrating with sensors aboard the vehicle.

Cashless Payment

The use of a mobile phone app, enables the project to integrate a Cashless Payment Module at some stage in the future. This would allow a future service to charge passengers flat rate fares based on the trips undertaken.

Data Insights

The geo-localisation capabilities of the mobile phone app also allows the project operations to collect data on passenger behaviours around where, when and how they book their trips. This capability verifies that the passenger is co-located geographically with the location of vehicle during the trip duration, to validate 'trip end' when the passenger alights and moves away from the location of the vehicle, and a myriad of other opportunities to help assess the service.

Real-time Geo-Location

The mobile phone app also provides the passenger an additional value-add feature, allowing them to see in real-time the location of their booked vehicle as it approaches the booked departure station. User experience research shows that this capability significantly improves the overall user experience, placing the passenger at the centre of the service.

Addressing Future Transport Needs in Regional Australia

Trial Outputs

The expected results of this trial will be to develop a viable, scalable and valuable solution for regional Australia, contribute to the body of knowledge and experience of automated vehicles within NSW, and generate uptake, excitement and acceptance of automated technology by the citizens and tourists of Dubbo.

Develop a Viable Solution for Regional Australia

A key focus is how to ensure that the trial can be built upon after the official trial phase is complete. We focused on ensuring that the solution is scalable and built with the goal of customisable, individual journeys in mind. This ensures that the work is not geared toward only completing a successful trial but that it can be used as a platform to build and trial in other regions.

Consumer Acceptance of Automated Vehicles

A pivotal part of this trial is to focus on user acceptance of the AVs. We understand that the public may have broad concerns about AVs and how they will be used in their area. A key focus of this bid is educating the public around AV use and how this technology can have positive societal impacts. We aim to involve the public in the development and roll out of the trial through community outreach events, local news stories, user feedback and more. By allowing the locals to contribute to the development of the trial we hope to generate buy-in and excitement. We will monitor the occupancy of the vehicle throughout the trial phases and have data on the number of app downloads we get. We expect that both measures will increase throughout the trial period as residents become increasingly aware of the vehicle and it integrates into their lives. We can ultimately use data about trip requests and journeys to implement smart routing such that the vehicle can be available in certain places at peak times. This will all be led by actual usage data to ensure the consumer is at the centre of the trial and should support user acceptance.

Developing the Body of Knowledge

Initially we want to prove the capability of the technology in the market and demonstrate that it is fit for purpose in the regions. We want to show that AVs can operate on roads with other vehicles and prove that within our team we have a technical offering that is not currently available on the market in Australia and that the offering works. A key aim of our trial is to explore the challenges encountered by AVs operating in a regional environment and work to develop solutions to these challenges.

Partnerships

There are many complex issues that this project is addressing and as such, the trial has 23 major stakeholders and 10 different service providers are required with many interactions between parties. There are a lot of unknowns for a trial like this to be undertaken in regional NSW, so the trial project has put together a partnership model as shown below. This allows for all parties to share information between themselves to mitigate any major issues that may arise.

Future of Transport

Transport is changing focus to a customer user experience, with TfNSW leading the way in ensuring all projects meet this requirement. You can see this with the Western Sydney Airport development, no longer is it a place where you catch a plane, it is a retail outlet, technology learning hub, intermodal and education centre. You can also see user experience designs in the latest Metro platforms and rolling stock.

Transport solutions in regional settings will require building flexibility into vehicles to utilise demand throughout the day that could unlock potential revenue generating options. Due to lower patronage, altering focus on services during the day would allow operators to create an even spread of vehicle utilisation and could potentially have a multi-purpose asset that could be financially viable.

The future of transportation is changing, private ownership of vehicles could disappear in 20-30 years' time. There will be a reliance on other forms of transport as this ownership changes. Rail will play a significant part in this change, as it will not be practical for fleet operators to have smaller vehicles spread out across Australia. Trains will need to become faster to regional towns to ensure connectivity to the cities not only exists, but for the trip to be an attractive option of travel between cities and rural towns.

There will be a significant impact to the energy sector. This sector will need to adapt to accommodate higher demand for energy to power rail, air and vehicle travel. Renewable energy must be the primary source of fuel. This will require significant overhaul of the existing infrastructure.

STEVE MAXWELL PLATELAYING AWARD

MAJOR WORKS CATEGORY

Judges

Mark Harris – Lendlease
Stephen Fleck – John Holland
Gareth Beynon – LINK Rail and Civil

Steve Maxwell

Steve Maxwell was a Member of the Permanent Way Institution Committee for many years, and his hard work and dedication enabled the PWI to continue during some difficult times. Steve was an informed Judge of the Platelaying Award, and also an entertaining speaker and presenter.

Steve's rail career began in NSW after graduating in Civil Engineering in 1970 and he progressed from District Engineer to become General Manager Engineering for CityRail, covering the suburban and interurban areas of Sydney. He made a huge contribution to the rail industry through his early advocacy of asset management as a key part of the rail engineering discipline, and with the introduction of numerous new infrastructure maintenance and asset management techniques and capabilities.

Steve's untimely and premature death in 1997 was a great loss to the PWI and took from the industry a great engineer, friend and personable and supportive leader.

The Committee deemed it appropriate to name the prestigious Platelaying Award after Steve Maxwell.

This annual Award is made to encourage excellence in platelaying, and to bring to public notice the skills required to gain such excellence. The Award is made to the staff responsible, who in the opinion of the Judges, best demonstrate this excellence. In other words, the Award will indicate a permanent way job well done.

Eligible projects are any track renewal, or construction work, completed in the last financial year by, or under the control of, a Member of the NSW Section, whether on a government or private railway system.

There are two Platelaying Awards – one for Minor Works (less than $3m in value) and one for Major Works (greater than $3m in value).

Judging Criteria:

Scoring Category	Available Score
Accuracy to Design and Survey	50
Site Presentation	50
Neatness of Fit of Components	50
Difficulties Overcome	25
Safety	25
Consideration of the Environment	25
Closeness to Planning and Timetable	25
Closeness to Budget	25
Level of Client Satisfaction	25
Total Score/Marks:	**300**

STEVE MAXWELL PLATELAYING AWARD
MAJOR WORKS CATEGORY

Major Works Entries – > $3m

Newcastle Light Rail – Track Slab Works
Rhomberg Rail Australia
James Reed – Project Manager
Brody Merritt – Project Engineer

Homebush 613/616 Double Diamond Crossover Renewal
Sydney Trains
Caleb Pace – Project Engineer

Sydney Metro Northwest ECRL Segregation works
"the final piece in the puzzle"
Northwest Rapid Transit (NRT) – John Holland and CPB JV
John Wims, Jarod Wakefield, Cory Gray

STEVE MAXWELL PLATELAYING AWARD
MAJOR WORKS CATEGORY

Newcastle Light Rail – Track Slab Works

Rhomberg Rail Australia
Company representatives – James Reed, Brody Merritt
Value of works: $20M

RHOMBERG RAIL AUSTRALIA
Member of the RHOMBERG SERSA RAIL GROUP

Executive Summary

Rhomberg Rail Australia (RRA) completed the track construction scope for the Newcastle Light Rail project constructing 2.7 kilometres of double tracked line through Newcastle's CBD ending 200 metres from Newcastle Beach. The track was to facilitate the new light rail/tram service replacing the train line in Newcastle and in turn revitalizing the heart of the city.

All construction works were completed to design drawings, on time and compliant with Transport for NSW's Code of Practice. The program was challenging given the busy nature of the CBD and the overall impact to the city and community during the construction phase.

A rotation of 3 RRA teams worked alongside multiple contractors and sub-contractors working on the project during construction.

The new light rail follows the old rail corridor for approximately a third of the route, then crosses onto both Hunter and Scott Streets. At peak times the tram runs every 7.5 minutes and transports up to 1200 people per hour, making it one of the most important infrastructure projects for Newcastle in recent history.

PROJECT SCOPE

RRA was contracted to deliver the installation of all rail and special track including turnouts, crossovers and insulated rail joints. The installation of all connections and cast-in items within the track slab were also within the scope. Additionally, RRA delivered all track related concrete, reinforcement works, earthing and bonding elements as part of the project, making RRA the whole of track slab construction provider.

PROGRAM OF WORKS

Works commenced late November 2017 and finished late September 2018.

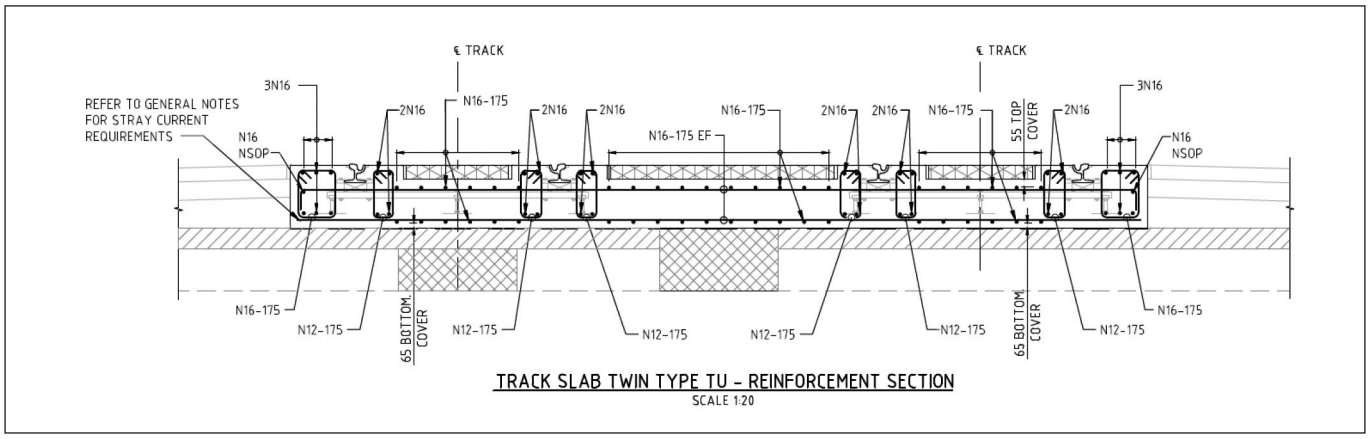
The works were completed across multiple work fronts with multiple subcontractors, working in a sequence. For example, Sacrificial Beam and Rail Placement Day 1, Rail Welding Day 2, Steel Fixing Day 3, Formwork Day 4, Earthing and Bonding Day 5, Concreting Day 6 etc. Each work front completing 50-70m a day and moving forward on a face.

The project was tendered to be completed as one work front moving from Newcastle West to Newcastle East. However, with over 3 months of delays to design and early works within the NLR depot, RRA were tasked with completion of the NLR track slab in a severely reduced timeframe with multiple work fronts, working out of sequence.

At time of tender the NLR project practical completion date was September 2018. Even with these major delays, the final practical completion date for the project was achieved one week after anticipated practical completion date on 28 September 2018. The Transport for NSW team were extremely happy with this outcome.

STEVE MAXWELL PLATELAYING AWARD

MAJOR WORKS CATEGORY



TRACK SLAB TWIN TYPE TU – REINFORCEMENT SECTION
SCALE 1:20

ACCURACY TO DESIGN AND SURVEY

Tolerances for the Newcastle Light Rail were extremely tight. RRA were required to construct the light rail track to within +2mm, -1mm for gauge, ±3mm for Horizontal Alignment, with a maximum rate of change of ±1:10,000.

RRA found this difficult to achieve as the sacrificial beams that supported the rail, did not have the strength to hold the rail in position as the rail moved with the changing temperatures throughout the day.

In some cases, the rail was set out of position and monitored until it achieved tolerance. RRA would then plan pours for the next date and time the temperature was anticipated to reach the same temperature as the in-alignment temperature. RRA would then plan to quickly pour concrete at this temperature to hold it into place.

The final result was compliant to Transport for NSW's Code of Practice, and no re-works were required.

DIFFICULTIES OVERCOME

Political pressure: On several occasions RRA would be provided with little notice of the requirement to open a new station. RRA would remobilise an existing work crew to the required location adding additional staff in order to handover the works in time, working days, nights and weekends, achieving all significant dates on the project.

Public interaction: The NLR project ran through the Newcastle CBD with high interaction with the public. The project team delivered the works ensuring the site was always left safe to public, well presented during construction and received positive columns from local newspapers.

Acceleration: In order to combat the delays felt early on in the project, the project was accelerated requiring RRA to triple its workforce from April 2018 to August 2018.

Interface with other contractors: Due to the compressed timeframes RRA were required to manage the interface with multiple other contractors, working together with others to allow all to complete their required scope.

GFRP: The track circuitry installed within the circuited sections of the track slab required that no steel reinforcement be used within the slab. This called for a design change to the use of Glass Fibre Reinforced Polymer reinforcement to complete the track slabs in these locations.

Weather: RRA had to install a track slab through Stewart Avenue, a major road through Newcastle. The road was closed over the June Long Weekend to complete works under shutdown conditions. Over this weekend, we experienced close to 100mm of rainfall having to complete all concrete works under gazebos and tarpaulins.

SAFETY/ENVIRONMENT

With well over 140,000-man hours worked on the project, with the majority of work conducted in a very challenging and hazardous work environment, RRA successfully carried out the work safely with no lost time injuries.

Additionally, work involved work over water and in close proximity to heritage listed buildings and sensitive receptors working nights and weekends with no environmental incidents on the project.

STEVE MAXWELL PLATELAYING AWARD

MAJOR WORKS CATEGORY

Homebush 613/616 Double Diamond Crossover Renewal

Sydney Trains
Caleb Pace – Project Engineer
Value of works: $5.5M

Executive Summary

Homebush 613/616 Double Diamond Crossover Renewal was a highly complex brownfield renewal project made more difficult by a tight delivery timeframe and constrained track access. A project of this complexity would normally be delivered over multiple weekend possessions. In this case, however, it was delivered successfully in an optimised Christmas to New Year's Eve possession. In addition to the typical challenges of a multi-disciplinary diamond crossover renewal, the Homebush 613/616 Pts delivery team was obliged to carry out a significant portion of the work adjacent to live running lines in Australia's busiest rail corridor. This renewal required the development of specific construction methodologies for the multiple stages between Christmas and New Year's Eve and utilisation of both Sydney Trains' DESEC and John Holland Group's PEM/LEM's to maximise production and ensure on-time (3 hours early) delivery. Late handback of the track would have had major adverse impacts, as it would have inconvenienced thousands of people heading into the city for Sydney's NYE celebrations.

The Homebush 613/616 Double Diamond Crossovers are located west of Homebush Station, in a highly congested rail corridor carrying passenger and freight trains. The scope of the project consisted of renewing the existing timber conventional diamond crossovers to 60kg tangential switches, concrete bearers and a highly reliable Electro Pneumatic Spherolock (EPS) actuation system that is used in junctions requiring high levels of operational reliability.

This renewal was an enabler for Transport's 'More trains, more services' program, by improving the functionality of critical junctions and allowing (for the first time) trains to pass parallel to each other through the diamond crossovers. This was the major driver of the project. Realigning the track to allow for these parallel movements called for substantial changes to the OHW and installation of new OHW structures. New signalling routes and ULX's had to be constructed and tested for all the new electrical and compressed-air cabling for the EPS actuation system and the new signals.

The possession management, rail operations and delivery teams devised a strategic, one-off possession which allowed trains to run for a 48-hour period through the worksite while the renewal works were in progress. The delivery team successfully developed various strategies to overcome the challenges of the restricted possession timeframes, the risks of the congested worksite, and the complex coordination of multiple work train movements (the turnout panels could not be transported on one train due to the limited capacity of the tilt wagons). Working adjacent to live tracks and live OHW was a key risk that needed to be closely managed to ensure safe and incident-free delivery. Major signalling changes and commissioning of four point ends, complex plant and work train co-ordination, and extreme weather combined to make this the most challenging track project undertaken by Sydney Trains in recent years.

The scale of the project (over 450 concrete bearers) panel break up and layout of the site required utilisation of both Sydney Trains' DESEC and John Holland's PEM/LEM's to guarantee that all track work could be installed within the tight possession windows available.

PROJECT SCOPE

- Replace 616ABD with 2 x Left hand 60kg R250:8.25 turnouts with Special 1:8.25 diamond crossings.
- Replace 613ABD with 2 x Left hand 60kg R250:8.25 turnouts with Special 1:8.25 diamond crossings.
- Replace timber bearers with concrete bearers.
- Resurfacing of full crossover.

- OHW adjustments and structures to suit major track re-alignment.
- Install new signal cable route.
- Install new signal.
- Upgrade signal equipment to Electro Pneumatic Spherolock and commissioning.

PROGRAM OF WORKS

- 29 Oct 2018 – 7 Dec 2018: Prebuild Diamond Crossovers at Chullora.
- 10-13 Dec 2018: Load tilt trains with first half of turnout panels and undergo weight testing required for TOC waiver.
- 15 Dec 2018: First half of crossover transported to Flemington Maintenance Centre via programmed train path and unloaded using the DESEC (train was required back at Chullora the same day).
- 17-20 Dec 2018: Load tilt trains with second half of turnout panels. Undergo weight testing required for TOC waiver.
- 21 Dec 2018: Shunt trains in Chullora Yard and ensure all consists are as planned and in correct orientation for arrival at worksite.
- 25-26 Dec 2018: Install 613BD and 616B during Stage 1, 4-track possession. Possession had to be handed back by 0200 27 Dec to run passenger services.
- 27-28 Dec 2018: Complete welding, adjusting, signal restoration, OHW works during Stage 2, 2-track possession on newly installed track. Work trains required to leave possession to be loaded with new material at Chullora ready for Stage 3 possession.
- 29-31 Dec 2018: Install 613A 616AD during Stage 3, 4-track possession. Track was required to be handed back at 0400 for NYE services. The job was successfully handed back early at 0049 Monday 31 Dec with all welding scope completed.

The project was delivered by about 500 on-site personnel; with track, signals, resurfacing and OHW resources supplied internally by Sydney Trains. Degotardi Smith & Partners, John Holland, Rhomberg Rail Australia and MP Rail were contracted to support delivery of the project.

ACCURACY TO DESIGN AND SURVEY

613 points was installed on both ends within 13mm from design. Height was within 11mm from design and line was within 15mm from design. 616 points was installed on both ends within 10mm from design. Height was within 20mm and line was within 15mm, meeting ASA standards. Turnout out gauge measurements were within 4mm and within 2mm at the crossings. The project was handed over to the Sydney Trains Asset Management Division with no defects, on time and within budget.

DIFFICULTIES OVERCOME

This project had a range of complex difficulties to overcome including; coordination of multiple stages in order to transport all track panels to site; multiple stages in relation to the possession arrangements and track access; running passenger services for 48hrs in the middle of construction; working adjacent to (within 2 metres) live track and (within 4 metres) OHW; a severely congested worksite and materials delivery constraints (the wagons did not have the capacity to carry all the turnout panels); coordinated construction methodology using two different types of specialised track installation equipment (DESEC and PEMLEMs); 72hrs of no trains running on infrastructure requiring significant signal testing and close coordination between Lidcombe and Strathfield. These challenges were addressed through conducting thorough risk assessments to identify and control all risks when working next to live infrastructure; conducting detailed methodology reviews with SMEs for each discipline to ensure track access was suitable; coordination with internal and external stakeholders to ensure that methodology was not only suitable but achievable; documented construction and tamping methodologies; and detailed briefings to construction teams. Co-ordinating possession arrangements and engaging with Safe-working experts to ensure that the strategies we developed would be suitable and compliant to Network Rules.

SAFETY/ENVIRONMENT

Given the location, hot weather, congested worksite and working adjacent to operational lines, safety and environmental controls were paramount for this project. The project team developed a comprehensive WH&S and environmental management plan in conjunction with all stakeholders to ensure that every aspect of the project was considered. An extensive traffic management plan was developed ensure safe approach distances and people / plant separation were maintained throughout the duration of the project. Internal safety and environmental audits were conducted on site and the positive result received for both reflects the high quality safety and environmental management of this site. There was no safety or environmental incidents during the construction period and no delays to operational services.

STEVE MAXWELL PLATELAYING AWARD

MAJOR WORKS CATEGORY

Sydney Metro Northwest – ECRL Segregation Works 'Final piece of the puzzle'

Sydney Trains
John Wims, Jarod WakefieldJarod and Cory Gray
Value of works: $10M

Executive Summary

The $8.3 billion Sydney Metro Northwest is Stage 1 of Sydney Metro, Australia's biggest public transport project.

The Northwest Rapid Transit (NRT) consortium has delivered the $3.7 billion Operations, Trains and Systems (OTS) contract, the largest of the three major delivery contracts for the project. This included the delivery of eight new railway stations, 23km of new track (46km Up and Down Lines), 4,000 commuter parking spaces and upgrading the 13km Epping to Chatswood Rail Line to metro status.

Sydney Metro Northwest is the first fully-automated metro rail system in Australia and was successfully opened to passenger traffic in May 2019.

PROJECT SCOPE

Upon the successful completion of the greenfield works from Rouse Hill to Epping the challenge for the team was to connect the new greenfield tracks to the existing Epping to Chatswood Rail Link (ECRL), which became part of the Sydney Metro Northwest Line. The new driverless trains terminate at Chatswood and then return to Rouse Hill. The ECRL tracks which became part of Sydney Metro Northwest were segregated from the Sydney Trains network at Chatswood and Epping over a series of weekend possessions. The scope can be summarised as follows:

- 2 new track slab turnouts EPP 12 and 22 at Epping Stub; Tunnel, connecting the greenfield Sydney Metro to ECRL;
- 240m of track slab, connecting Sydney Metro to ECRL;
- 2 new track slab catchpoints EPP 13 and 23;
- Straight rail of 84, 85 and 86 pts at Chatswood, removal of Chatswood Turnback and drivers' walkway, and associated reconditioning and drainage modifications;
- Installation of two 200m Turnback Sidings at Chatswood
- Straight rail of 92, 93, 95 and 96pts in Chatswood RES, special plates required for straight railing track slab turnouts;
- Removal and straight rail of 111pts at Epping; and
- Removal of 60 GIJs throughout the ECRL tunnel.

PROGRAM OF WORKS

There were two discrete elements to the scope – Epping stub tunnel works connecting the greenfield tunnel to ECRL, and the Epping and Chatswood segregation works. The Epping stub tunnel scope was delivered in a shutdown over a 10 week period working 24/7. The team developed day by day staging diagrams for this critical scope and all work was delivered on programme. The segregation work at Chatswood and Epping were possession dependent and were delivered over a series of 5 possessions between August to November 2018 – WE8,14,15,16 and WE18.

INNOVATION

Key areas of innovation included:

Straight railing 4 track slab crossovers

The straight railing of the crossovers in Chatswood RES presented a challenge. In order to segregate the Metro tracks (formerly ECRL) from the North Shore Line, special plates were manufactured. Each plate was unique with the plates designed to bolt onto the Delkor eggs and the lugs designed to suit the new straight rail alignment and 1:20 rail cant. As the rail cant orientates the rail 7.3mm, the lugs were designed to take this into account. Critical survey works were undertaken to review the current track position and build a model to build the new special plates.

Concrete Turnout Installation

The two turnouts and catchpoints in Epping Stub Tunnel were installed using PEM LEMs. This was the first time PEM LEMS were used to install turnouts in a tunnel in Australia. Pre-building the turnouts was critical to achieving the programme. The turnouts were designed to be transported with PEM LEMs, the design comprising 1 in 4 bearers and Delkor eggs. Once the turnouts were built, the team proceeded with steel fixing in and around the bearers. The prebuild allowed the team to confirm track geometry, as well as reinforcement tolerances and starter bar lap lengths prior to bringing the turnouts into the tunnel.

Concrete shuttle for Track Slab

To minimise the concrete pumping lengths and to take advantage of the existing siding access into ECRL, a concrete shuttle was developed by the track team. The shuttle was mounted on a trailer and towed by a hi-rail machine. By having the machine on rail, it made the travel time extremely quick and simple. The dual access to the shuttle's agitator was also another strong design feature as it allowed the team to ensure the agitator was always full before letting it travel into the tunnel.

Track top down equipment – ponies & covers

After several months of research and development to design and manufacture bespoke ironhorse for the Sydney Metro Northwest Viaduct, the team revised the design for the Epping Stub Tunnel turnouts and catchpoints. These ponies supported 1 rail only and the 1:4 bearers held gauge. "Ponies" were designed and manufactured to hold the track on design line and level prior to pouring concrete in our top down methodology. Special ponies were also designed to support the crossing due to its wider footprint.

Concrete Bearer design

The design of the turnouts and catchpoints called for 1 in 4 bearers to be cast into the concrete track slab. This opened an opportunity for a new design to be developed with Rocla, a trowelled pattern on the soffit of the bearer and tapered edges ensured the bearer would bind to the concrete in the track slab.

DIFFICULTIES OVERCOME

Delivery of 855m3 of concrete into the ECRL tunnel presented a challenge, our solution is outlined below.

Concrete Delivery Methodology

Investigating concrete pump locations was an area of concern on NRT as site access was restricted by the ARTC viaduct at Epping. To save costs, suit site conditions and reduce the potential safety hazard of breeching live adjacent rail traffic, a gooseneck pump stand was developed to pump concrete into the concrete shuttle. The solution worked extremely well and was commended by the project safety team and client. The gooseneck eliminated the need for a boom pump and decreased the overall site footprint allowing other work groups access and also delivered a cost saving.

Voids underneath pads

All track slabs constructed in ECRL were installed using the top down method, with voids underneath HDPE pads being a key focus. When placing concrete in track slab it is critical that the vibration and concrete discharge speed is managed.

It was concluded from the trial slab that a defined concrete placement methodology was the most reliable way to manage voids. Through trial and error, it was noted that voids were minimised when concrete head was built up on the high side of the plate/pad and pushed across the pad by vibration. It was noted that trowelling a channel parallel to the rail on the low side of the plate encouraged the concrete to move as it created a space for it to flow to.

This method was used while installing turnouts and catchpoints. Concrete was pumped into the 4 foot and pushed to the outside edges using shovels and rakes. Once the concrete built up high enough, the team would vibrate it across the pad, from the high side to the low side. By controlling the speed at which concrete is pumped and placed, and educating the concreters with the importance of getting it right, voids can be eliminated underneath the HDPE Pads. It is important to note that all track slab pours in the ECRL Stub Tunnel has pads with void less than 25%, which is less than the allowable recommendation of 30% suggested by Delkor.

ACCURACY TO DESIGN

Tolerances achieved on NRT include:

- Track Alignment – +/- 8mm
- Track Height – +/- 20mm
- Track gauge – +3/-2mm
- Concrete finished height – +0/-5mm

SAFETY / ENVIRONMENT

The TRIFR for trackwork across the ECRL segregation works was 0 for 45,000 hours work at a rolling 8-month average.

Whilst pouring concrete in the Epping Stub Tunnel a series of environmental control were needed to manage the concrete waste and works overnight. As a result, concrete waste was managed in a purpose built wash out centre in Epping. Out of hours works were limited to no more than 4 consecutive nights in a week. This meant planning was critical when scheduling concrete pours.

The PWI is proudly supported by its Platinum members

CPB CONTRACTORS

JOHN HOLLAND

LAING O'ROURKE

lendlease