MIDDLEBOROUGH ROAD RAIL GRADE SEPARATION PROJECT

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Introduction

The Middleborough Road level crossing, in Melbourne’s eastern suburbs is located between Box Hill and Laburnum stations on Melbourne’s busiest rail corridor carrying 250 trains per day. Middleborough Road carries some 35,000 vehicles per day, and the level crossing was closed for over 30 minutes per hour during the morning peak. This, combined with the adjacent intersection of Middleborough and Whitehorse roads, created a major safety hazard along with the ensuing road congestion and air pollution. Grade separation of the road and rail was carried out by the Middleborough Road Alliance, consisting of Vic Roads, John Holland Pty Ltd, Connex, and the Director of Public Transport during a shutdown in January 2007.

Figure 1: Melbourne Metropolitan Rail Network (courtesy of MetLink)

The First Challenge – How to Build a Bridge

Initial planning works were undertaken by VicRoads (the Road Authority) and Connex (the Rail Operator) between October 2005 and May 2006 and examined three options, a road overpass, a rail overpass and a rail underpass. The first two options would have required substantial land acquisition, permanent local road closures and the creation of substantial elevated structures and a subsequent loss of visual appeal.

A rail underpass therefore looked to be the most feasible option, involving:

- Creation of 1km long cutting, allowing for a future third track;
- Renewal of 1.8km of double track;
- New road over rail bridge at Middleborough Road;
- New rail over road bridge at Laburnum Street;
- New, realigned, DDA compliant Laburnum Station; and
- New CBI interlockings at Box Hill and Blackburn.

The constraints on the site were considerable, and included:

- Residential properties adjoining the rail corridor;
- Box Hill High School on north-west corner of the level crossing;
- Box Hill Cemetery on south-west corner of the level crossing; and
- Tightly curved rail easement.
A traditional staged construction approach, could have looked something like Figure 2, and would have involved:

- Temporary slewing of existing tracks to the south, including level crossing, overheads and signals;
- Construction of cutting and significant works adjacent to running railway lines;
- Construction right up to land boundaries or possible acquisition of up to 21 properties;
- A significant number of weekend occupations over a prolonged period (estimated minimum of 18 months); and
- Ongoing disruption and disturbance to the local community.

Additionally, further stages would be required to build the third track in the future.

The project team looked at all of the wasted temporary works in the staged approach, safety considerations and contemplated that following long term disruptions, such as an 18 month construction period, it can take up to two years to redress the loss of patronage and confidence in public transport. They then wondered how long the network could be shut down for.

Connex operations determined that a shutdown of up to an absolute maximum of six weeks timed to occur in January could be operationally accommodated. The timing is driven by the drop off in patronage during the holiday period, but could not be started earlier due to the need to provide services for the Boxing Day Test Match, one of the largest special events on the calendar. The maximum duration is driven by the need to maintain train servicing schedules for trains on the inner part of the network, which could not reach the Bayswater maintenance depot and would have to start being withdrawn from service after six weeks.

The project was formally announced in May 2006 with construction to take place in January 2007. The challenge for the construction industry was then set – complete the grade separation within a target timeframe of five weeks with an absolute maximum of six, to start in a few short months. It was acknowledged that traditional Construct Only or Design & Construct contract models would not be appropriate for completion of all the required design and approvals in the time required, even without the usual distractions of having to run everything through the commercial filters of all the organisations. An Alliance model was selected as the best way of delivering the project within the available timeframe.
Throughout the Alliance Partner selection process, John Holland maintained that it was possible to complete the works inside of four weeks, whereas others in the industry were sceptical that it could be achieved within the maximum six week timeframe. John Holland was selected as the preferred Alliance partner in August 2006.

**The Second Challenge – Integrating the Team**

Once selected as the preferred Alliance partner, hitting the ground running was essential and for this, fast establishment of the Project Team was the key. Initially the team started to assemble in John Holland’s head office, conveniently situated just 15 minutes from site. As the works were to be constructed using all of JH’s systems and expertise, all non JH Alliance personnel were put through John Holland inductions and training in all the Safety, Quality and IT systems to be used on the project.

Personnel from all organisations were positioned into the team on a best for project basis, ensuring that we had the right people in the right positions, regardless of their parent organisation. As soon as it could be established, all personnel were relocated to the site office, located at the Whitehorse Reserve adjacent to the construction site.

To augment the team, specialised resources and skills from outside of the Alliance partners were used to ensure the success of the project in all areas. This was particularly important with the development and operation of the temporary bussing system during the 27 day shutdown of the railway line. Operations and customer service staff from Connex developed and, as demand grew, modified train and bus timetables to optimise the flow of passengers between bus and rail. A total of 1530 project inductions were carried out, and at the peak, 90 staff and 250 workers were employed on the project.

Subcontractors, including design, signalling and major earthworks contracts were not selected not just price, but also in recognition of the skills, dedication and commitment they would bring to the Alliance. Major subcontractors operated from within the same open site office allowing instant communication with all required team members and ensuring that delays and miscommunications were kept to an absolute minimum.

**The Third Challenge – Busses for the Masses**

Having determined that the best way of constructing the project was via total shutdown the next challenge was how to get people across the break in the network. Projected passenger figures were for a peak of 7,000 people an hour, and this required two high-capacity modal interchanges. Clearly the shorter the distance between the two interchanges the fewer busses would be required and extra journey time would be kept to a minimum, so the location of these interchanges would be critical.

Blackburn

At the down end, Blackburn Station was the obvious choice, as it already had a third platform to cater for terminating down services. To make it suitable to terminate up services, two sets of signalled crossovers were installed during the early works shutdowns. Temporary ramps were then installed from the island platform to the station carpark, which was appropriated for the use of the busses.
Box Hill

The up end was to prove to be more of a headache. Box Hill Station was examined and quickly rejected as a viable option, as although like Blackburn it was already set up to terminate down trains, it is built under the Box Hill Plaza Shopping Centre. Box Hill Plaza already has a busy bus interchange built on the roof (a vertical separation of three levels) which was already close to capacity and adding thousands more commuters into the mix, moving through the shopping centre would have been a recipe for chaos.

The next idea was that a temporary, two-platform station could be constructed in the open at Box Hill East and busses run along Station Street. On the face of it, this was the easy option, however the proposed site was in a residential area and would be required to operate for all but about five hours a day. Understandably, this caused some concern to residents directly surrounding the area.

Over and above this, operating a temporary station at Box Hill East would have required a complete temporary re-working of the interlocking at Box Hill. Given the short timeframes, this would have diverted attention away from the main design task and cost in the order of $1.5M to design and commission.

So, back to Plan A, Revision 2, if we can’t get the people from the platforms to the busses, we will have to get the busses to the people. How do you build a temporary pavement suitable for large volumes of heavy busses over an operating railway line? The resourceful Perway Engineer would never resort to anything so mundane as thinking up a solution for themselves if they thought someone else had already done the hard work. Unfortunately we couldn’t find anyone who had ever been stupid enough found it necessary to cover their tracks with concrete and then dig it back out again.

With it now being close to Christmas, a solution was required that could largely be implemented in between the last and first trains. This was done by filling in any low areas with ballast and making a quick form that sat between the clips on the concrete sleepers and the fishing surface of the rail and blocked out the required flangeway gap, with a gap left on both sides of the rail. The five foot and six foot were then filled with unreinforced concrete. This was done one month prior to the main shutdown and trains continued to run over the concreted section without problem and this also allowed access for work trains and track machines.

Running 55 busses an hour through an underground facility created concerns over the resulting air quality at the interchange. In order to ensure adequate ventilation was available, the interchange design incorporated four industrial fans to provide air flow. Air quality monitoring was conducted on a regular basis throughout operation of the terminal, and the number of fans increased to six to ensure passenger comfort.

Modelling

Development of detailed design of the interchanges followed detailed research, planning, computer modelling and engineering investigations confirmed both the feasibility and capacity of the immediate road infrastructure to efficiently carry up to 55 bus movements per hour needed to replace train services.

For the first time, road authority traffic modelling systems were integrated with pedestrian modelling to determine total bus cycle times. This data was incorporated with rail movements to optimise timetables and to minimise the disruption to commuters. This research confirmed that the transfer of passengers could take place without compromising the safety or efficiency of the surrounding road and rail networks and with minimal disruption on passengers. It has provided a solution and framework that can be adopted for future projects.

VicRoads took responsibility for the local roads during the works period which allowed for the optimisation of traffic arrangements. Additional parking restrictions were introduced along with temporary conversion of some local roads to one-way operation and adjusted traffic signal phasing. As operations unfolded, further adjustments were made to signal phases as it was discovered that operating the busses in fleets regardless of how full they were was more efficient than waiting for busses to fill before departing.

The detailed design of traffic arrangements for the busses was undertaken by KBR and concerns were raised that the underground bus turning circle at Box Hill, whilst optimised allowing for the enclosed space and shopping centre pillars would not be easy for the bus drivers. A full scale test was arranged with the bussing subcontractor and the proposed layout mocked up in full scale at their depot and the practical operation of the layout confirmed.
The **End of the Line**

The temporary signalling at the interchanges was designed to protect the dead end arrival roads with speed proving train stops to guarantee maximum approach speeds. However, in order to provide greater protection to passengers using the temporary interchanges, rail operators and regulators decreed that a friction buffer be provided to stop any train that might overshoot the platform before it could come into contact with temporary structures or roadways.

With only a few weeks left and no time to import a type approved buffer from Europe, a new buffer was designed and fabricated and delivered to site for testing between Christmas and the start of the shutdown. When a test track panel was constructed on the Oval and two buffers assembled, it was immediately apparent that insulation of the all-steel buffers would present a problem. How to devise an insulation system that can be put together and tested on site the day after Boxing Day? With a cunning combination of cheap vinyl flooring from the local hardware store and some heatshrink wrapped bolts, that problem was solved. Or so we thought until we tried to fit the bolts through the holes, we now either needed 200 new bolts or 600 new holes. It seemed easier to get the bolts, so containers were raided and enough bolts were scrounged to bolt together two buffers to perform the tests.

Overall temporary works at the modal interchanges included:

- Laying 450m² of unreinforced concrete pavement around the existing operational railway line capable of withstanding up to 55 buses per hour at Box Hill whilst protecting the rail infrastructure from vehicle damage and ensuring ease of removal;
- Installation of a temporary pedestrian overpasses to allow for the efficient transfer of rail commuters;
- Provision of driver amenities including a temporary communication system;
- Integral cast in check-rail into the temporary slab to contain possible derailed trains;
- Design, fabrication and installation of temporary friction buffers to protect the interchange facilities;
- Installation of temporary crossovers at Blackburn, including overhead traction and modifications to the signalling systems at both ends; and
- Modifications to railway signalling to allow the stations to operate as terminal stations.

**The Fourth Challenge – Design Constraints**

The Alliance engaged Kellogg Brown & Root (KBR) as the track, civil, structural and overhead electrification designer, Westinghouse Rail Systems Australia (WRSA) as signalling designer and DesignInc as architect for Laburnum Station.

With construction due to start on New Years Day, all required materials and prefabricated elements needed to either be on site or complete and ready for transport prior to Christmas. This required tight control of design deliverables and in many cases letting of contracts on preliminary design information. All design activities were incorporated into the project programme and linked to key milestones and construction activities. The design management team worked closely with the project planners and designers to ensure that all required drawings were available on time.

The original alignment proposal was for 4.2m clearances from track centreline to the base of the cutting walls to allow a footpath along the side of the track to assist in maintenance. However an arborists examination of the 80 year old Cypress Pine trees growing along the eastern end of the cemetery determined that the top of the proposed batter would cut through the critical root zone, almost certainly killing the trees.
In order to protect the trees, the batter angle of the southern wall of the cutting was increased to 1H:7V, the base of the wall moved in to the minimum 3m clearance and refuges provided every 20m. Spacing of overhead portals was adjusted to fit between the trees and recesses created in the cutting wall to accommodate the portal legs. These changes complicated the design of the soil nails, which became longer and the top two rows were staggered so that the top row of nails could be angle further down to ensure that there was no danger of drilling into burial plots within the cemetery which were as deep as 12 feet.

Another substantial challenge for the design team was the mix of design and construction standards required. The old PTC Heavy Rail Track Design and other standards were under review and partially replaced with the new VRIOG standards. There was also some confusion over where rail standards and VicRoads standards should be applied. In a traditional contract model these arguments could have gone unresolved for months, but with all parties on board in the Alliance it was sorted out in a few short weeks.

In all, a total of twelve Engineering Change Submissions were prepared, submitted and approved in four months, including those for the track alignment and clearances, temporary modal interchanges, signalling changes and the new structures. Having representation from Connex within the project team streamlined the whole process as the issues were communicated as they arose and all potential solutions could then be contemplated.

Significant changes to the proposed retaining walls were made as a result of constructability and value engineering reviews of the design. Batter slope angles were optimised, bored pile walls were reduced as much as possible and the soil nail walls changed from traditional mesh reinforced walls to fibrecrete. Significant changes were also made to the Laburnum Street rail bridge abutments to allow construction prior to Christmas.

Coordination of changes between disciplines was maintained by ensuring that all details, including locations of signal masts, location cases and proposed cable routes were captured on the main drawings. This enabled early identification of potential conflicts particularly in regard to signal sighting and the location of assets both in terms of constructability and maintainability.

The Fifth Challenge – Connecting with the Community

Significant effort was invested in keeping the community informed. A 24 hour community hotline was established to handle any community enquires or complaints throughout the duration of the project. A website was established containing details of the proposed works including a high level construction program highlighting which works would be taking place during each week of the shutdown. Additionally, public information sessions were held at the local high school prior to construction to inform the community of work, scheduling and anticipated impacts, focussing particularly on the around-the-clock activities. A community meeting room was set up within the site office with plans and details of the works and those calling the hotline with queries or concerns about the works, with all residents directly abutting the railway line invited to one-on-one meetings to discuss how the works may impact on them.

With works planned to take place 24/7 during the major shutdown and night works a necessity for some of the early works, management of construction noise was recognised as a major issue. Noise mapping was carried out for activities in each week of the program to highlight any areas which would be likely to be affected beyond acceptable limits.

**Figure 3: Project Website**  
**Figure 4: Noise Map**
Lighting up worksites traditionally requires the use of multiple light towers, each with its own noisy generator. To reduce the impact of this, a series of permanent floodlights were set up along most of the corridor length, wired up and powered from a single high capacity, low noise generator, situated away from the residential areas.

Broadband reversing beepers were fitted to all mobile plant on site with over 200 beepers fitted. These beepers emit a broad spectrum “quacking” noise which does not travel as far as the traditional high-pitched beepers. Whilst it proved problematic to ensure all plant was fitted with machines moving on and off site, when any machine was found with a normal beeper it was stopped until the problem was rectified.

The construction community relations team also worked hand in hand with the Connex team operating the temporary modal interchanges, and instant responses were made to any issues affecting passenger safety or comfort at the interchanges. Posters showing progress on site were put up at the interchanges and refreshed every three days, allowing passengers to see the progress being made and updating them on the resumption of normal services.

Prior to the works, over 200 property inspections were conducted to provide a baseline for potential claims over damages from vibrations and ground settlement. Vibration levels around the worksite and movement of the retaining walls was monitored during and after the works.

In order to utilise the Whitehorse Reserve and oval for construction works, an agreement was entered into with the Box Hill East Cricket and Football clubs to provide alternative playing and training facilities for the cricket season and restore the oval to playing condition in time for the 2007 football season.

At the completion of the works and to mark the official opening of the bridge, a sausage sizzle was held on top of the bridge for the local community and the nearest resident to the bridge site was afforded the honour of being the first to drive across the newly completed bridge.

The Sixth Challenge – The Clock Is Ticking

Early Works

Clearly there was a lot of work to complete in the main shutdown, so the first order of business was to complete as much work as possible beforehand. To this end a series of five weekend shutdowns were planned in the period leading up to Christmas, enabling the following works to be completed:

- Installation of temporary crossovers at Blackburn, including signals and overhead wiring;
- Installation of piled abutments and capping beams for Middleborough Road bridge;
- Installation of piled abutments, capping beams and deck for Laburnum Street rail bridge;
- Construction of bored piles for the retaining walls;
- Excavation of upper portion of soil nail retaining walls, complete with soil nailing and shotcreting; and
- Service relocations and installation of new signalling trunk cables.

These works required electrical isolations, and to speed the process of isolating the required sections, especially if required for overnight works, new section insulators and switches were installed at Box Hill substation.
The old Laburnum Station sat over the top of both the old Laburnum Street rail bridge and the site of the new bridge, so temporary panels were created on the platform which could be easily lifted in and out in the minimum of time during the weekend shutdowns. Additionally removal and reinstatement of track panels over the site of the new bridge was required on three separate occasions.

With the learning curve required to be very steep, the early shutdowns allowed the construction team to get to grips with working in a rail environment as it was the first time for many. It also allowed the relationships within and between the sub-teams to develop to the stage where on 1st January everybody knew what was expected and what others would be doing. The first weekend shutdown achieved only modest productivity compared to those that followed but the lessons learnt were invaluable when applied to what followed.

The Major Shutdown

Planning of works within the major shutdown was done in a detailed manner for all activities, from removing the existing rail infrastructure and digging and moving the dirt to completion, commissioning and handback of the new railway and all activities in between.

The full-time project planners on site created, tracked and updated an hour by hour programme for the entire worksite. For the first two weeks, works were largely according to plan and any activities that slipped were accommodated by float in the programme, most importantly works mainly proceeded in the pre-planned and agreed order. The main challenge was to keep the construction traffic flowing through the site and particular attention was paid to the actual cycle times and adjustments made to keep these to a minimum.

After this and to an ever increasing extent as time went on, the need for works started to be performed out of the original sequence arose, causing unanticipated conflicts and congestion on site. To resolve this, several large laminated space-time diagrams of the whole site were created, covering a 24 hour period. Daily co-ordination meetings were then held, chaired by the planners to determine and mark up who would be working where and when to ensure that things did not get bogged down and critical activities were expedited. This was especially important once the track started to be constructed, restricting access still further.

The First Days

The first few days of the major shutdown were a frenzy of activity throughout the site. Following the passage of the last train at 2am on 1st January, possession of the site was taken and the removal and recovery of track, signalling and electrical infrastructure commenced with removal completed in 16 hours. At the same time the temporary facilities over the tracks for the modal interchanges were completed, including pedestrian bridges and an elevated bus platform at Box Hill along with the testing and installation of the temporary buffers. Also commencing at the earliest possible opportunity was the demolition of the old Laburnum Station and Laburnum Street rail bridge.
Moving the Earth

Clearly a key component of the works, was getting the dirt out of the cutting as quickly as possible. Heavy mining machinery including D10 and D11 equivalent bulldozers, 80t and 45t excavators and eight 40t dump trucks were used to rip and dig the dirt from the cutting and transport it to a temporary stockpile on the Whitehorse Oval. The dirt was then transferred into normal road-going tippers for transport to nearby abandoned brickworks for dumping. Excavation and stockpiling proceeded faster than removal with the stockpile peaking at over 18m high and a total volume of over 30,000m$^3$. The total volume of earth shifted during the shutdown would fill the MCG to a depth of 6.5m.

The Last Days

The major activities of the last days were completion and commissioning of the new OHW system, commissioning of the new signal arrangements completion of Laburnum Station and removal of the temporary modal interchanges including the removal of temporary pavement at Box Hill. By the end of the 28 days of heavy traffic, the thin layer of concrete did not take much breaking and the pavement was removed and the track cleaned up, given a quick tamp and broomed off to reveal no damage beyond a few easily fixed dislodged clips.

John Holland, WRSA and signalling contractor O'Donnell Griffin had been working together for the previous eighteen months commissioning the Regional Fast Rail Bendigo and Latrobe corridors, and the same teams were used to complete the Middleborough Road works, so the understanding and trust between team members had already been established. This allowed electrical overhead and track finalisation works to be integrated with “wheels free” signalling requirements without delays to either process.

All of work was completed in an orderly fashion with the first train running through the section on Sunday 28th January and normal operations resuming without any hiccups on the morning of Monday 29th January.

Signalling

While not a new technology in itself, the manner in which the Computer Based Interlocking (CBI) signalling system was installed and commissioned was unique to this project as the staging of the project required that the new system accommodate the existing relay based system, the two temporary terminating stations and the final arrangement.

The ability to commission the new and modified signalling systems within a matter of days rather than weeks was a significant achievement, minimising disruption to passenger rail services.
The new CBI signalling system was installed simultaneously with the new track, allowing most of the testing to be conducted in the factory with final testing and commissioning to start as soon as the equipment was installed and the track was available.

While this system was more expensive it was adopted due to the tight timeframes and the need to have certainty that the system would work, with little or no rework, when commissioned. The installation of the CBI signalling system required the conversion of signalling systems at Blackburn and major modifications to the relay interlocking at Box Hill. This modern signalling system is in line with future signalling upgrades for the corridor, able to accommodate future triple tracking.

The decommissioning of the old system and the commissioning of the new CBI system at Blackburn to operate as a terminating station was achieved in just 90 minutes on New Years Day 2007, between a gap in scheduled train services.

It was identified that early installation and partial testing and commissioning of the “backbone” of the signalling system was critical and needed to be completed far sooner than excavation would allow. All location cases, communication, signal power, cabling and fibre optic were installed outside the excavation area to allow early commissioning of the system. This enabled signalling works to proceed in parallel with civil works, ensuring rail services could be returned in just 27 days – a feat that would otherwise have been impossible.

**The Seventh Challenge – The Ghost Trains**

After 14 days of the shutdown, a problem on the inner network was apparent with several trainsets unavailable due to unexpected mechanical issues. Connex needed to move four trains (six car sets) from the outer network to the inner network. With a 1.5km hole in between there were two options available – trucking the carriages around at an estimated cost of $2M or plugging the gap. This was a BUGGER moment if ever there was one.

Plan A was to construct both tracks one after the other starting on day 19, when works in the cutting and at Laburnum Station had been completed. Constructing the track would cut the worksite in half lengthwise and create significant obstacles to completing the work. Nevertheless as a “best for project” outcome, alternative plans were made to lay the southern (up) track by the close of night 17, the walls on the south side being substantially more complete than on the north. All drainage and formation works on the south side were hastily completed and ballasting and track laying commenced.

The cutting had been a one-way traffic site since breakthrough under Middleborough Road, with plenty of width for vehicles to pass one another. Now it was a single lane one way system, and when one vehicle stopped, they all stopped. Obviously this is far from ideal when attempting to ferry in ballast, sleepers and rail for track laying.

By lunchtime on day 17, tracklaying still had some way to go, however progress was helped by commandeering the side-tipping semi-trailers for ballast drops and this proved to be far quicker and more efficient than the traditional truck and dog arrangement. Despite some concerns, the track was laid and joined up and clearances checked to allow trains through the site on the skeleton track with one hour to spare, a definite WINNER.
For the remainder of the project, all works to the walls on the south side of the cutting were conducted over the up track and all work planned in recognition of the now restricted access through the site.

Beyond merely laying the track, substantial works were required at both Box Hill and Blackburn temporary interchanges to allow the trains through, including adjustments to the pavement at Box Hill, removal and reinstatement of buffers and walkways at both ends.

One negative effect of early completion of track works was that access into the cutting was still required to complete various works and since it is well known that non-rail crews are notoriously cavalier about the carefully crafted ballast shoulders, the inevitable happened. This wanton destruction continued right up to the last two days with the result that substantial restoration work was required. In order to accommodate the “wheels free” commissioning requirements, the rectification was conducted by a hyrail mounted excavator with a tilting, swivelling bucket, an arrangement that is just as efficient as a ballast regulator. Unfortunately it is just as effective at destroying train stops, and when one popped up just in front of the excavator, both the train stop and the special sleepers were destroyed on the morning of the final day, BUGGER.

With meticulous planning comes foresight, and we had thoughtfully arranged spare sleepers for the train stops and had an agreement in place with the maintainers allowing us to borrow a train stop and the commissioning was able to proceed as planned without any delay.

**Project Highlights**

The achievements of the Middleborough Road Alliance in five short months are considerable and include:

- 73,000m$^3$ of earth moved in seven days;
- 9,000m$^2$ of retaining walls constructed;
- Two new bridges constructed;
- 1km of cutting constructed;
- 1.8km of new electrified double track constructed;
- Two new interlockings designed, constructed and commissioned;
- Laburnum Station demolished, rebuilt and reopened in 28 days;
- No late handbacks, no delays following occupation handback;
- Bus operations added only eight mins to journey time; and
- 24% positive feedback received by Connex (compared to 2% for normal operations).

**Community Benefits Delivered**

By eliminating the level crossing and grade separating the road, rail and pedestrian crossings at Middleborough Road, safety has been enhanced for the 35,000 vehicles, 250 trains and countless pedestrians and cyclists – particularly school children – that pass through the area daily.

Removing the level crossing and effectively concealing the railway line within a one kilometre long cutting, has improved the long term visual amenity and significantly reduced train noise for the hundreds of properties adjacent to the rail reserve. Noise from level crossing warning bells has been permanently eliminated.

With the removal of the level crossing, traffic congestion has eased, decreasing travel times, reducing fuel consumption and improving local air quality through the reduction in vehicle emissions. In the months following completion of the bridge, traffic on Middleborough Rd was up 20% on pre-existing levels, with many of the extra vehicles removed from the local rat runs and nearby Blackburn Rd which also suffers from level crossing delays.

Prior to construction, the grade through to Laburnum Station was 1:40 and on a tight 300m radius back to back reverse curve. As a result it was relatively common for approaching trains to overshot or fall short of the platforms when attempting to stop. It was also relatively common for excessive wheel spin to occur during acceleration, resulting in noisy and uncomfortable wheel burns.

Following the completion of the project, speed restrictions between Box Hill and Blackburn have been increased from 35km/h to 65km/h as a result of the removal of the level crossing and improvements to the track grade and alignment.
The project also involved the demolition of the 50-year-old Laburnum railway station buildings and platform. These were replaced with new facilities, with additional safety improvements provided by straightening the platform (with a level surface and tactile indicators), installing platform safety zones, and modernising the lighting system. The reconstructed station complies with the Disability Discrimination Act (DDA), with improved access to the station, particularly for those with mobility issues.

As part of the improvements at Laburnum Station, the tracks were straightened through the station area to remove the curve in the platform, improving site distance to signals for drivers. It has also allowed drivers to have an unimpeded view of the full length of the train, providing them with a clear view of passenger loading and unloading activities.

The project also provided space for ease of tripling for a future centre express track, by completing the bridge design, clearances and capping layer ready for construction. A future third track will have an 80km/h speed limit due to increased cant.

In addition to reducing the long term disruption on rail passengers, completing the project in 27 days rather than over 18 months of night time and weekend works significantly improved the ongoing quality of life for nearby residents.

Completing the project in 27 days not only avoided the “return to school peak” on both the rail and road networks, while reducing the impact of 24-hour-a-day work on neighbouring properties, but also provided rail operator Connex with access to its fleet and maintenance centre at a time of higher than expected mechanical failure.

There was no drop off in rail patronage following the works which was an important objective for Connex. This is an outstanding outcome, particularly as Connex advised that following long term disruptions, such as an 18 month construction period, it can take up to two years to redress the loss of patronage and public confidence.

**Conclusion**

The project achieved what many thought was impossible. Told by some within the industry that the project couldn’t be delivered in such a short timeframe, comprehensive planning by all Alliance partners identified challenges and solutions to ensure that project goals were achieved and exceeded.

To date the benefits, innovations and success of the Middleborough Road project has been widely recognised through industry awards and coverage in state media and national industry publications. The project has won industry awards for outstanding achievement in rail and civil construction, environmental and social management, safety, and alliance contracting, including:

- 2007 Australasian Railway Association – Award for Excellence;
- 2007 National and Victorian CCF Earth Awards;
- 2007 Victorian Engineering Excellence Award for Infrastructure;
- 2007 National Alliance Contracting Excellence;
- 2007 Alliancing Association of Australasia Excellence Award;
- 2007 VicRoads Safety Excellence;
- 2007 Master Builders - Civil Construction; and
- 2008 RTSA Railway Engineering Industry Award.
It is believed that the compressed program and shutdown methodology adopted for the Middleborough Road Rail Separation Project is a world first. It has demonstrated the national and international possibilities to redevelop critical transport infrastructure in a busy urban environment where prolonged disruption to the community and transport services must be minimised.

With the reliance on public transport increasing and the triplication of rail lines an option to meet future demands, road networks will be significantly impacted at level crossings, creating a need for grade separations. The shortened delivery approach developed by the Alliance offers an effective solution to what was once considered too difficult to achieve, particularly in Melbourne where there are several hundred road/rail intersections.

During construction, the project attracted many visitors from within the industry and Victorian, interstate and overseas government departments interested in the innovations, planning, methodology and logistics behind delivering this groundbreaking result.

Thanks to the fast track delivery adopted for the Middleborough Road project these economic benefits are being enjoyed considerably earlier than would be the case with more traditional project delivery methods. With construction taking place during a traditional industry closure period (New Year’s holidays) plant, materials and other construction resources were more efficiently used and vital employment opportunities created in a ‘down time’ for the industry, with associated benefits for our economy. Projects of this nature will need to take place during off-peak periods on the road and rail networks, providing an opportunity for future utilisation of scarce resources.

The project has provided a new method of delivery that has set the benchmark for future grade separation projects, not only locally but throughout Australia and the world.

The project demonstrated innovation and originality in developing solutions to complex challenges in terms of its rail, signalling and civil construction components, passenger transfer facilities and managing environmental and community impacts.

The alliance contract model and total commitment to working as a team by all project partners was instrumental to the success of the project. The “can do” approach was evident throughout all levels of the Alliance.

Alliance partners were able to work together to streamline rail access and construction approvals to reduce approval times and minimise the impact on operations. Many of the decision making and communication impediments that are typically present outside of this type of contract were removed. “Best for Project” decisions were able to be made quickly and decisively by the Alliance Leadership Team.