Innovative and low cost safety works, including median wire rope safety barriers and narrow centrelines

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Abstract

In November 2010 Roads and Maritime Services (RMS), with the NSW Centre for Road Safety started a road safety and speed zone review for the Pacific Highway from north of Nambucca Heads and the southern entrance of Urunga. This review was in response to a number of crashes on the highway in this area. The project team wanted to find out if there were low cost safety works that could be implemented to improve the highway before construction of the dual carriageway upgrade, through this area. In determining appropriate remedial actions the project team was mindful that the section was to be bypassed in the future by the Warrell Creek to Urunga upgrade project. Notwithstanding this, the team looked to implement about forty short term safety measures to reduce the incidence and severity of crashes on the existing highway. One of the treatments recommended was the installation median wire rope safety barrier (WRSB) to separate the opposing flows of traffic. With some already existing wide painted medians ranging from 0.8m to 1.8m in width, the decision was taken to trial the installation of WRSB into the existing narrow medians without undertaking any further widening. This was done to reduce installation costs yet still provide the physical separation between opposing flows of traffic. Austroads currently specifies a minimum median width of 1.6m whilst RMS design documentation is even more conservative with a width of 2.0m. This paper outlines the review process and summarises the works undertaken under the safe systems approach.

A vision to achieve low cost road safety results

In November 2010, Roads and Maritime Services (RMS) and the NSW Centre for Road Safety started a road safety and speed zone review for the Pacific Highway from north of Nambucca Heads to the southern entrance of Urunga. This 17km section is a typical two-lane single carriageway with at-grade intersections and direct private access to adjoining properties.

This review was in response to the number of crashes on the highway in this area. In the six years to the end of 2012, there were a total of 112 recorded crashes:

- 8 were fatal crashes and 58 were injury crashes.
- 33 crashes were in the 80km/h zone north of Hungry Head Road. (3km section).
- 79 crashes were in the 100km/h zone south of Hungry Head Road. (15km section).
- 56 crashes were on a wet road surface.
- 43 crashes occurred in darkness.
- 44 crashes occurred on a curve.

The project team wanted to find out if there were low cost safety works that could be implemented to improve the highway in this area before construction of the dual carriageway. In determining appropriate remedial actions the project team was mindful that the section was to be bypassed in the future by the Warrell Creek to Urunga upgrade project. Local residents had also been calling on the NSW Government to undertake interim improvements. The team looked to implement about forty short term safety measures to reduce the incidence and severity of crashes on the highway.
One of the treatments investigated was the installation of median wire rope safety barrier (MWRSB) to separate opposing flows of traffic. With some already existing painted medians ranging from 0.8m to 1.8m in width, the decision was taken to trial the installation of MWRSB into the existing painted medians without undertaking any further formation widening. This was done to reduce installation costs yet still provide the physical separation between opposing flows of traffic. Austroads currently specifies a minimum median width of 1.6m whilst RMS design documentation is even more conservative with a width of 2.0m.

Photo 1 – The installed MWRSB south of Urunga

This paper outlines the review process and summarises the works undertaken under the safe systems approach.

Vision for low cost solutions

In November 2010, Roads and Maritime Services (RMS) and the NSW Centre for Road Safety carried out a road safety and speed zone review. As a result of the review, a report was prepared that examined crash data to establish possible causes and trends. The report identified specific sites where intervention could be effective in reducing road trauma.

The safe systems model was adopted for this review. This model recognises that a highway is a system with many inputs: the vehicle, the driver and the road environment.

The safe systems model aims to promote safe travel, yet recognises that drivers will make mistakes; however these mistakes should not result in serious injury or death.

The system aims to provide a roadside environment response to driver error that reduces the occurrence and severity of road crashes (Figure 1).
On 7 March 2011 the then Minister for Roads announced a $10 million package of road safety measures for this stretch of the Pacific Highway.

The Minister also announced two speed limit reductions on the Pacific Highway between Nambucca and Urunga. The changes had been supported by the group ‘Doctors for a Safer Pacific Highway’ who had been campaigning for speed limit reductions to reduce the number of injuries and fatalities.

Other road safety measures recommended by the review included improvements to intersections, the installation of median wire rope safety barriers, upgraded warning signs and the installation of vehicle and weather-activated variable message signs.

While the major of safety works were planned for delivery over three years, several low cost solutions were implemented immediately:

- Two short overtaking lanes north of the Valla Beach intersection were removed and painted central medians installed.
- Overhead speed limit signs were erected.
- Warning signs were upgraded.
- Vegetation was removed to improve sight at intersections.
In addition, the previously planned $3 million safety work at the Martells Road and Pacific Highway intersection about two kilometres south of Urunga was started.

RMS implemented a number of other safety works, including:

1. Reflectors on guardrail and guideposts were cleaned or replaced.
2. Roadside vegetation (including grass) that interferes with a driver’s view of guardrail was removed.
3. Missing retro-reflective pavement markers were installed and enhanced maintenance was implemented to ensure continuity of guidance on centrelines and edge lines.
4. Centreline markings were changed to make them consistent.
5. Short sections of broken centreline where overtaking had been permitted were closed with barrier lines.
6. Table drains were inspected and roadside drainage improved where needed.
7. Advisory speed signs associated with curve warning signs were reviewed.
8. ‘Slippery when wet’ red background signs were installed.
9. Additional chevron alignment markers were installed and the height of some markers increased at Ballards Road intersection.
10. Drainage and pavement shape issues at Ballards Road were improved.
11. U-turn facility for southbound traffic was installed.
12. Curve warning and advisory speeds signs were reviewed, including the distance from the curve.
13. Regular speed zone repeater signs were installed.
14. Innovative advisory signposting to highlight hazards and provide a reason for the reduced speed limit were installed to increase driver awareness of potential hazards. Trailer mounted variable message signs were also installed for three months.
15. Vegetation on the inside of the curves near Hungry Head Road was heavily trimmed to improve sight lines through the curves.
16. Pacific Highway widening project at Martells Road was completed.
17. Median wire rope safety barrier was installed over the section where the overtaking lanes had been removed (more details below).

**Review of speed limits**

The speed limit on the Pacific Highway between south of the Valla Beach Road intersection to near the Hungry Head intersection was reduced from 100km/h to 90km/h.

The speed limit on the Pacific Highway from south of the Hungry Head intersection to near Urunga was changed from 80km/h to 70km/h.
Safe systems approach

Specific strategies and priorities were developed to improve road safety on this segment of the Pacific Highway, including:

- Improving guidance and road delineation for motorists.
- Implementing safety measures that target wet weather crashes.
- Reviewing road maintenance practices to achieve and maintain a good level of guidance for traffic and a safe road surface that can withstand the traffic demand.
- Providing sufficient width (or stopping bays) for maintenance vehicles.
- Changing the speed zones to reflect different standards of travel conditions and crash rates.
- Providing enforcement bays for mobile speed cameras.
- Liaising with NSW Police to increase enforcement activities.
- Identifying locations to separate opposing traffic.

Crash statistics prior to the project

The original crash analysis focused on a five year period to November 2010. The graph (Figure 2) shows a significant increase in incidents between 2008 and 2010. Prior to 2008 some minor safety improvements had been undertaken and this could explain a short-term reduction in incidents during 2006/2007. The increase in incidents after 2008 prompted RMS to commence investigations and undertake the road safety review.

At the northern end of the Highway (between Valla Beach Road and Hungry Head Road, the yearly crash comparisons (Figure 3) shows a concentration of incidents. This area was the focus of additional road safety investigations.

![Figure 2. Yearly crash comparisons showing crash statistics along the entire stretch of highway from Nambucca Heads to Urunga](image-url)
Figure 3. Yearly crash comparisons showing crash statistics along the northern section of the Highway from Valla Beach Road to Hungry Head Road

In the four years from January 2005 to the end of 2008, there were 49 crashes:

- 2 were fatal crashes and 22 were injury crashes.
- 16 crashes were in the 80km/h zone north of Hungry Head Road. (3km section).
- 33 crashes were in the 100km/h zone south of Hungry Head Road. (15km section).
- 11 crashes were on a wet road surface.

Then, in the following two years, there were a further 63 crashes:

- 6 were fatal crashes and 36 were injury crashes.
- 17 crashes were in the 80km/h zone north of Hungry Head Road. (3km section).
- 46 crashes were in the 100km/h zone south of Hungry Head Road. (15km section).
- 26 crashes were on a wet road surface.
- 16 crashes occurred in darkness.
- 33 crashes occurred on a curve.

From 2005 to 2010, there were eight fatal crashes, with 4 of these crashes (five people killed) occurring in 2010.

Speed survey review 2013

An interim speed survey was carried out in January 2013 to determine the compliance to the 90km/hr speed zone.

The speed logger was located at the speed camera sign south of Wenonah Close. It measured speeds for southbound vehicles for the period from 11 January 2013 to 17 January 2013.
The results of the interim survey indicate that the Average Daily Traffic was 6642 for southbound traffic volumes. The 85th percentile indicated a travel speed of 86km/hr, 4km below the 90km/hr posted speed limit over the survey period of one week in the school holiday period. Another traffic data survey (volumes, classification and speed) is scheduled for June 2013.

Median wire rope safety barrier strategy

Median wire rope safety barrier (MWRSB) has been installed at a number of locations between Valla and Urunga. The MWRSB is a four wire Sentryline TL4 system. Median cross over points have been provided between Ballards Road and Hungry Head Road to allow contra flow during maintenance in the event of lane closure (Photo 2).

Sections of the existing highway had painted median ranging from 0.8 metre to 1.8 metre wide. It was agreed that road safety could be improved by reducing/eliminating the cross median crash risk with MWRSB. This could be achieved without the need for the high costs of formation widening if a narrower painted median was trailed.

Figure 4. Speed survey

Photo 2 – Maintenance of median wire rope safety barrier
The Austroads Guide to Road Design indicates that 1.6 metres is the minimum painted median width to be used for normal installations of median wire rope safety barrier. However, RMS typically uses a 2 metre median.

It was estimated that widening the road formation to provide a 2 metre central painted median would typically cost $3M / km. As a result, a trial of MWRSB within narrow medians (< 1.6 metre) in the Nambucca Heads to Urunga stretch of the highway was initiated. The trial is limited to approximately a 2 km length located along the Pacific Highway within a speed zoned of 90km/h.

There are many uncontrolled variables in the trial area (e.g. traffic, speed, alignment, grading, shoulder width, clear zone, etc.). This means that the outcomes of the trial will be treated as an indicative guide rather than conclusive evidence to assist with planning similar works in the future.

This trial comprises two sections:

**Section 1** - The southern section adjoins the, previously installed, MWRSB south of McGraths Creek and extend to Wenonah Close – a distance of 620 metres.

**Section 2** - The northern section commenced near Ballards road and terminated near Hungry Head Road – a distance of 1580 metres.

The project team considered risks and potential extra maintenance costs that could arise from both the “nuance” hits to the MWRSB and any significant impact damage. Concerns were raised about the difficulty in carrying out routine maintenance on a single carriageway with a narrow median and narrow shoulders restricted by safety barriers.

Concerns were also raised about the potential for long traffic delays and the need to implement tidal traffic control if a significant crash occurred or extensive maintenance was required.

At the time when the safety review was being prepared extensive and successful community involvement was sought. Following the initial invitation for feedback and input, a number of local community members have maintained contact with the project team. These community members have provided ongoing positive feedback to RMS on the progressive implementation of the safety upgrade works.

The implementation of the MWRSB trial was completed in July 2012. Part of the trial now involves monitoring crash damage, assessing repair difficulties and reviewing traffic management during emergencies.

Community feedback supports the views of RMS and NSW Police, that indicate the MWRSB has helped change the road environment and driver behaviour has altered, leading to better compliance with speed limits.

RMS Traffic Operations, based in Grafton’s Regional Office, is of the view that the number of emergency incidents has significantly reduced and those that have occurred resulted in shorter delays and less interruption to traffic flow. Previously, full road closures were implemented to allow emergency response teams to work at the crash sites and these closures sometimes extended for several hours to allow Police crash investigation work to be undertaken as well as vehicle recovery.

Traffic management during incident response has been judged relatively straight forward but performance queue management and safety will continue to be monitored.

The response from RMS road maintenance team has been positive. The repairs have not proved difficult to carry out and except in one case the repair has been completed while maintaining two
way traffic flows under traffic control. This issue will continue to be closely monitored as more complex repairs may be required in the future.

**Results of narrow median central wire rope safety barrier (MWRSB)**

As part of the field trial, traffic data and crash statistics have been carefully documented for the period before installation. Since installation, monitoring has been on-going.

Monitoring has included crash damage, issuing repair defects and reviewing traffic management during emergencies.

The installation of the MWRSB was relatively inexpensive, costing about $90/metre, which included traffic control and contract management.

Alternatively, to widen the existing Pacific Highway road pavement to provide the desirable 2.0 metre median, would have added about $3,000/metre to the total project costs.

However, the implementation of the MWRSB in the narrower painted median has raised some issues:

- The road environment now looks and feels tight.
- Minor vehicle scrapes with the MWRSB are occurring.
- Repairs to the MWRSB requires time and resources. Some repairs need to be carried out promptly as the damaged posts and wire can easily encroach onto the travel lane/s.

Positive outcomes from the trial has included:

- Travel speeds have reduced. This may be due to driver’s perception that the road environment looks and feels tight and therefore more caution is exercised.
- Risky overtaking by motorists is not possible due to the MWRSB.
- Safe work methods have been developed and refined to allow management of incidents to be promptly carried out.
- It was a very low cost project that has delivered encouraging outcomes and has reduced serious crashes.

**Crash statistics since completion of the project**

Over the section of the Pacific Highway covered by the safety review (Nambucca Heads to Urunga) only 3.6km has MWRSB installed.

The first two lengths installed were sited within the area of the short overtaking lanes and the total available sealed pavement width was redistributed to provide a 2.0m wide painted median.

The sections to the north of this initial MWRSB had the narrow exiting median with a total length of 2.2km

The five year crash data, prior to the installation of the MWRSB, for these sections of the Pacific Highway show: 3 fatal crashes, 4 injury crashes and 16 non-injury crashes.
The current crash data, since the installation of the MWRSB, only covers a one year period. However, during this time no fatal crashes have occurred and only one reported injury crash.

Four non-injury crashes have been reported, but the damage to the MWRSB suggest that minor unreported crashes have occurred.

The crash data will continue to be monitored. However, the reduction in the severity of crashes is very encouraging.

**Conclusion**

Implementing changes to contribute towards a safer system can range in cost from multi-million dollar new road works to improved signposting to driver education and enforcement techniques.

One option which is continuing to make a contribution to a safer system is the MWRSB and when the barrier is installed on an existing formation the costs are relatively low.

A reported comment of one driver whose vehicle collided with the MWRSB provides a succinct conclusion:

> "OMG – The fellows that put that fence in the middle of the road saved my life, the cars coming the other way were so close and my car was scraping down the fence”.

Upgrading the Pacific Highway in this area to provide a divided four lane carriageway to bypass this low standard two lane rural section is starting later this year with a target completion of late 2016.

The safety improvements implemented as a result of the 2011 review, including the MWRSB, will continue to contribute to road safety well into the future.