Centreline Treatment Countermeasures to Address Crossover Crashes

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Abstract

Off to the Right and Head On Not Overtaking crashes are the most severe crashes on the NSW road network and indeed around Australian. Yet on most undivided two lane high speed rural roads, opposing traffic flows are separated by narrow painted white centre or barrier lines.
For many years wide shoulders and clear zones have been shown to greatly reduce serious crashes into objects off the road. However, except for a few cases on the Pacific and New England Highways, little has been done to apply alternative options for increasing separation of opposing flows on undivided roads.
Countermeasures that separate opposing streams of traffic on some undivided lengths of the Pacific and New England Highways in NSW indicate a dramatic reduction in cross-over crashes along lengths where they have been installed.
This paper will quantify the safety benefits generated by the implementation of variable width painted centrelines and wire rope median barriers and their effects on both the reduction of cross-over crash occurrence as well as the reduction of cross-over crash severity. This constitutes an important step towards a safe systems approach to our most severe crash types.

Keywords
Crossover crashes, centreline, audio-tactile delineation, median separation

Introduction

Current centreline widths on most two lane rural roads leave no room for driver error and only small lapses in concentration due to fatigue or distraction can lead to disastrous consequences. The two most severe crash types on NSW rural roads are Head-on and Off Road to the Right crashes and they result in the highest number of fatalities and serious injuries. Crash reduction figures from the Federal Highway Administration (FHWA) in the USA indicate that a wider centreline with rumble strips can be expected to reduce all crashes by 15% and crossover crashes by 55% (Grosse et al 2009). Rumble strips in the USA are either milled or pressed into the pavement and are much more tactile than the raised profile delineation used in NSW.
Wider painted centrelines of variable width have been installed along various two lane sections of the Pacific and New England Highways in NSW and provide a viable option between having no discernable opposing flow separation and the safety of dual carriageways. These wide centreline sections have been evaluated to determine at what width crossover crash reduction can be maximised. Thirteen (13) years of crash data along each section was extracted from the RTA's Crashlink database and evaluated to determine trends in crash reduction.

Centreline Treatments

Crash analysis of variable width centrelines installed on the Pacific and New England Highways show that certain centreline configurations have an impact in reducing all crashes as well as crossover type crashes such as Head On – Not Overtaking and Off to the Right crashes. Presently these centrelines act as a painted median which prohibits overtaking.

Centreline Evaluation

There were five different types of centrelines that were evaluated on the Pacific and New England Highways. These were:

Standard centreline and barrier line (Control Sites)
Pacific Highway…….24.87 kilometres
New England Highway…….18.37 kilometres

0.5 metre wide painted median
Pacific Highway……16.44 kilometres
New England Highway…… 5.27 kilometres

1.0 metre wide painted median
Pacific Highway……2.97 kilometres
New England Highway……1.88 kilometres

0.5 -1.0 metre wide profile painted median
Pacific Highway……1.16 kilometres

2.0 metre wide wire rope median barrier
Pacific Highway……11.15 kilometres

Control Sites

The control sites were chosen to replicate similar sections of Highway (Image 1) as to those that had been treated with a wider centreline. There were 6 different sites on the New England Highway totalling 18.37km and 14 sites (Figs.1 & 2) on the Pacific Highway totalling 24.87km (Figs. 3 & 4). The crash data were aggregated and analysed to determine if there had been changes in crash pattern over an 8 year assessment period. The analysis indicates that both total and crossover crashes have shown only minor variations over the 8 years of data which were assessed and that it can be expected that the same number and type of crashes will continue to occur at the same rate.

Image 1- Typical control site section of the Pacific Highway – South of Woodburn

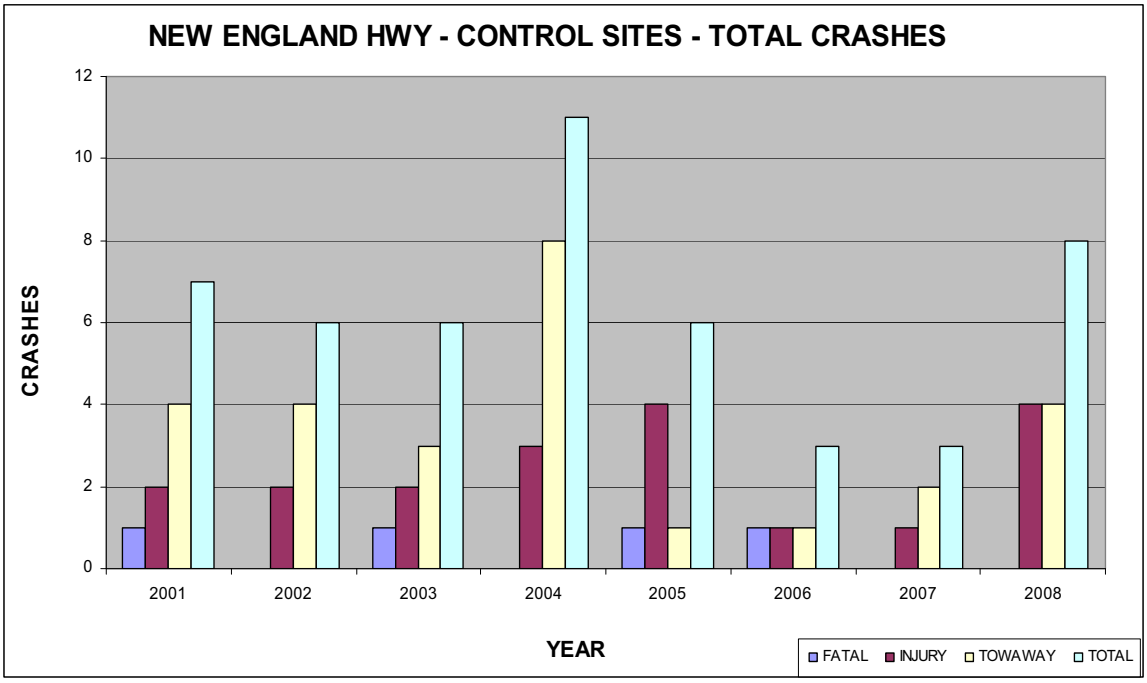


Figure 1 - New England Highway – Control Sites - Total Crashes

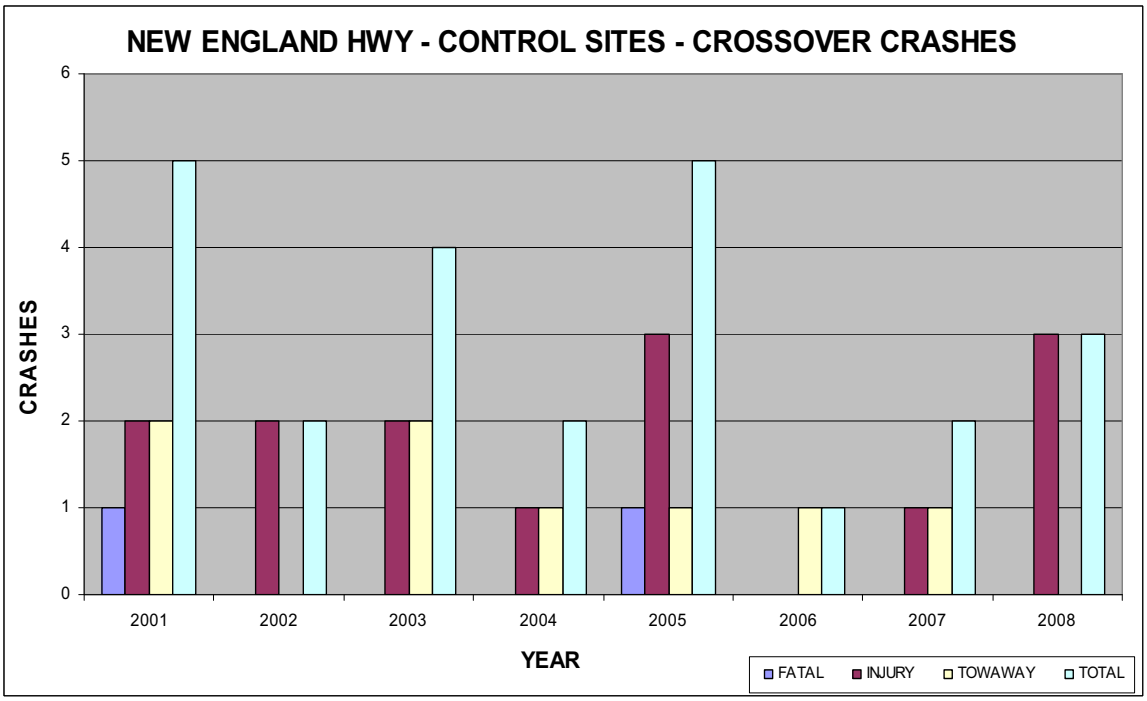
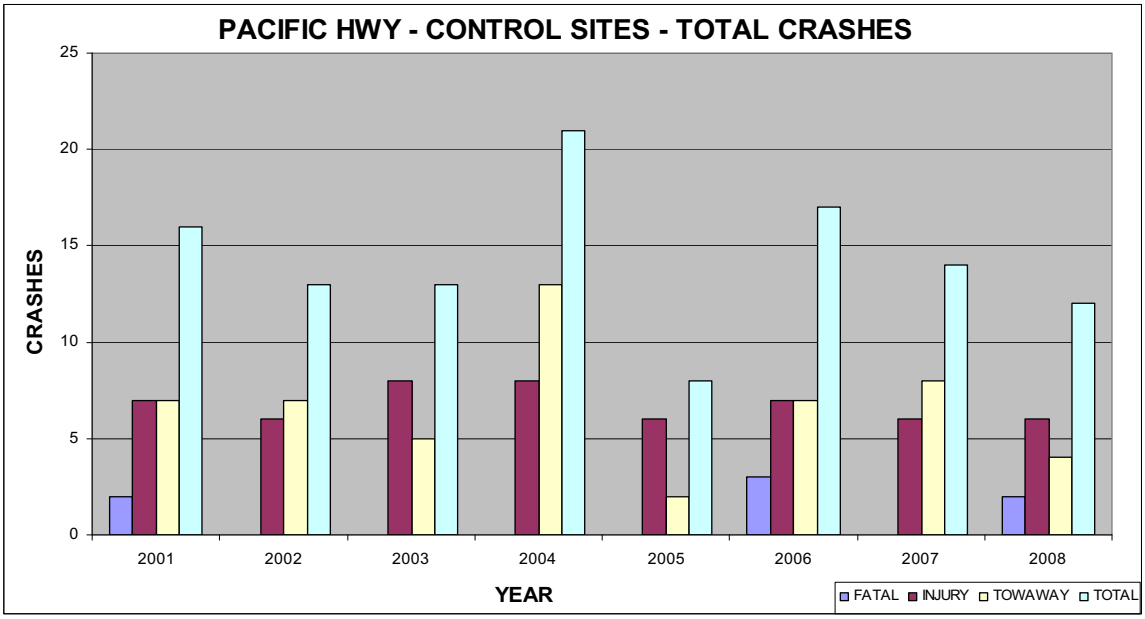


Figure 2 - New England Highway – Control Sites - Crossover Crashes



Figures 3 - Pacific Highway – Control Sites - Total Crashes

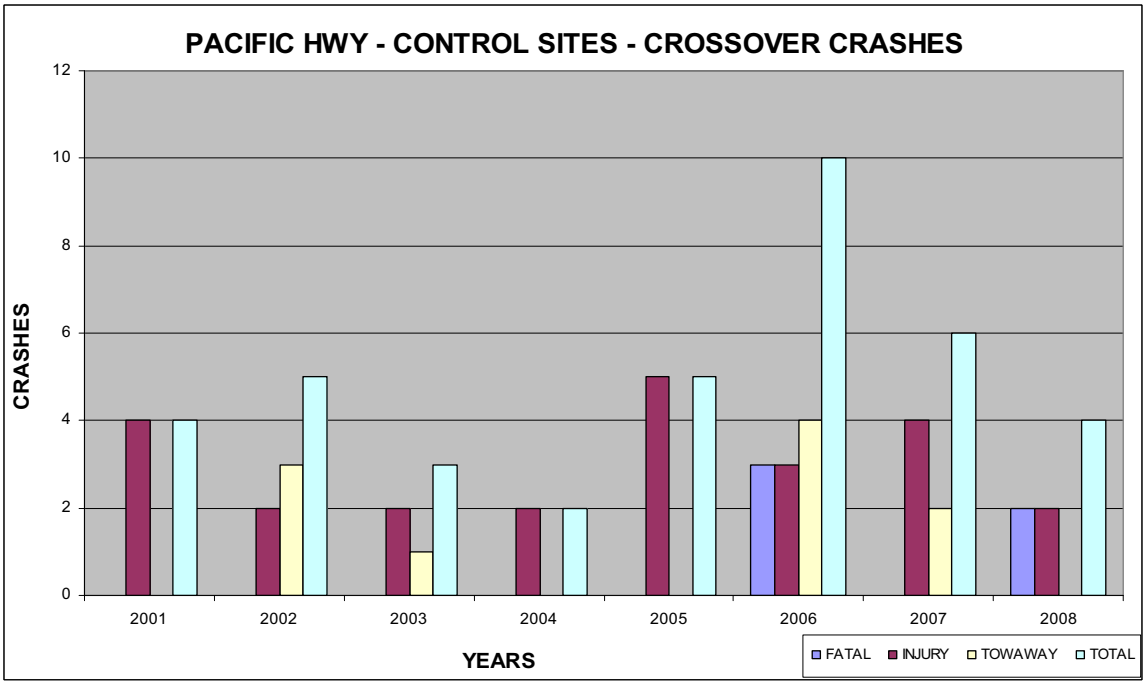


Figure 4 - Pacific Highway – Control Sites - Crossover Crashes

Painted Medians – 0.5m Wide

The crashes that occurred on the sections of 0.5m wide painted median were aggregated to determine if the slightly wider median had had an effect on reducing crossover crashes as intended. There were 5 sites on the New England Highway totalling 5.27 km (Figs. 5 & 6) and 10 sites on the Pacific Highway (Image 2) totalling 16.44 km (Figs. 7 & 8). As can be seen from Fig. 6 there were not a lot of crashes (Table 1) along the New England Highway sections although there was a noticeable reduction in crossover crashes.

NEW ENGLAND HWY			NEW ENGLAND HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
0.5m PAINTED MEDIAN			0.5m PAINTED MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	1	0	FATAL	0	0
INJURY	5	4	INJURY	1	0
TOWAWAY	8	8	TOWAWAY	2	1
TOTAL	14	12	TOTAL	3	1

Table 1 – New England Highway - 0.5m Wide Painted Median Crashes

This may indicate that lower traffic volume Highways get some safety benefits from the installation of 0.5m wide painted medians due to the less likelihood of another vehicle being in the opposing lane during total crossovers. Even though there were no crossover crashes in the last three years of data, there were not many in the before data either and the total crash numbers were too low to allow for any true definitive conclusions on the median's effect to be drawn.

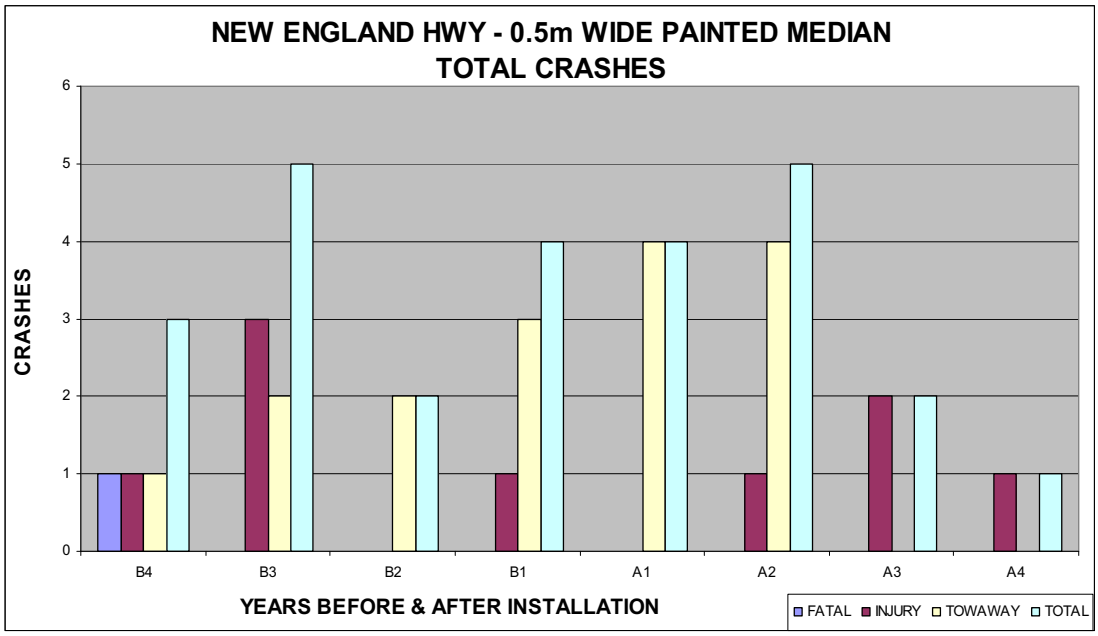
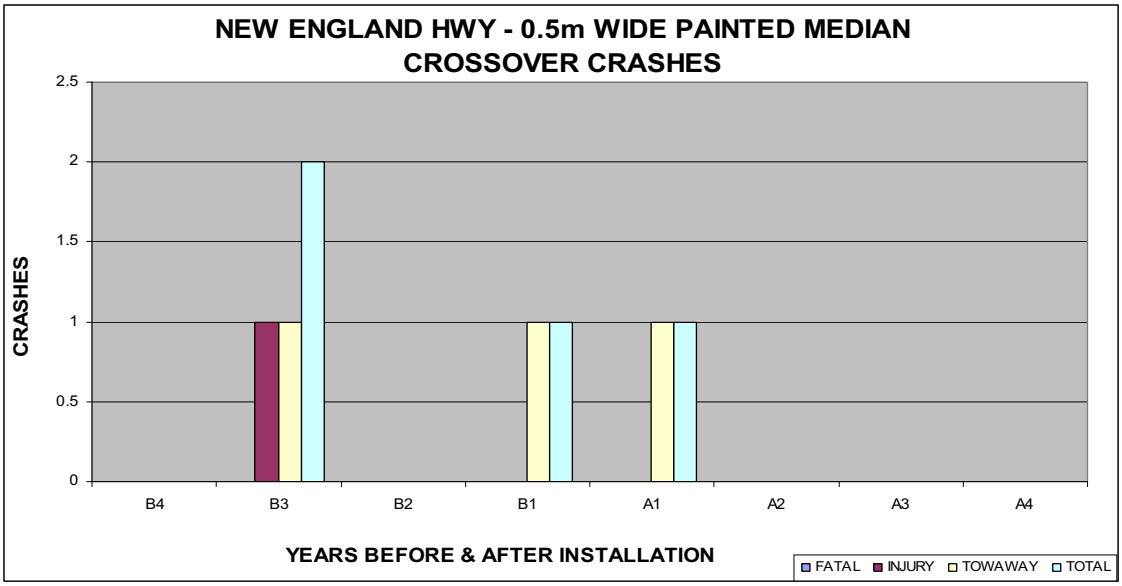


Figure 5 - New England Highway – 0.5m Wide Painted Median - Total Crashes



Figures 6 - New England Highway – 0.5m Wide Painted Median - Crossover Crashes

However, the Pacific Highway sections with their much higher traffic volumes show that the 0.5m wide painted median had some effect in reducing total crashes but no effect on crossover crashes (Table 2). These may have actually increased. Also the severity of the crashes seems to have increased after installation.

PACIFIC HWY			PACIFIC HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
0.5m PAINTED MEDIAN			0.5m PAINTED MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	0	2	FATAL	7	6
INJURY	20	12	INJURY	4	2
TOWAWAY	21	11	TOWAWAY	11	10
TOTAL	41	25	TOTAL	11	10

Table 2 – Pacific Highway – 0.5m Wide Painted Median Crashes

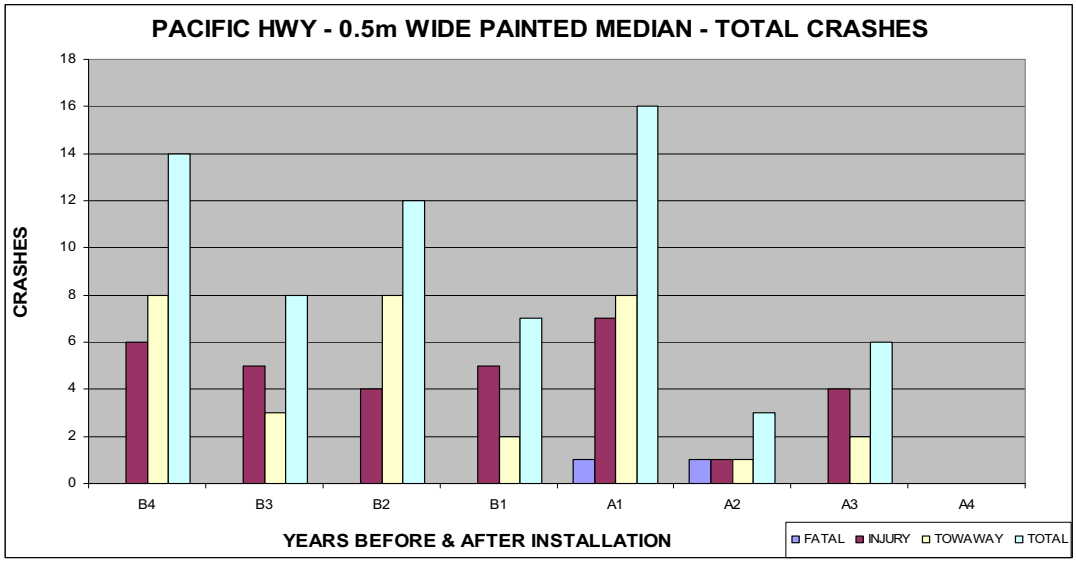


Figure 7 - Pacific Highway – 0.5m Wide Painted Median - Total Crashes

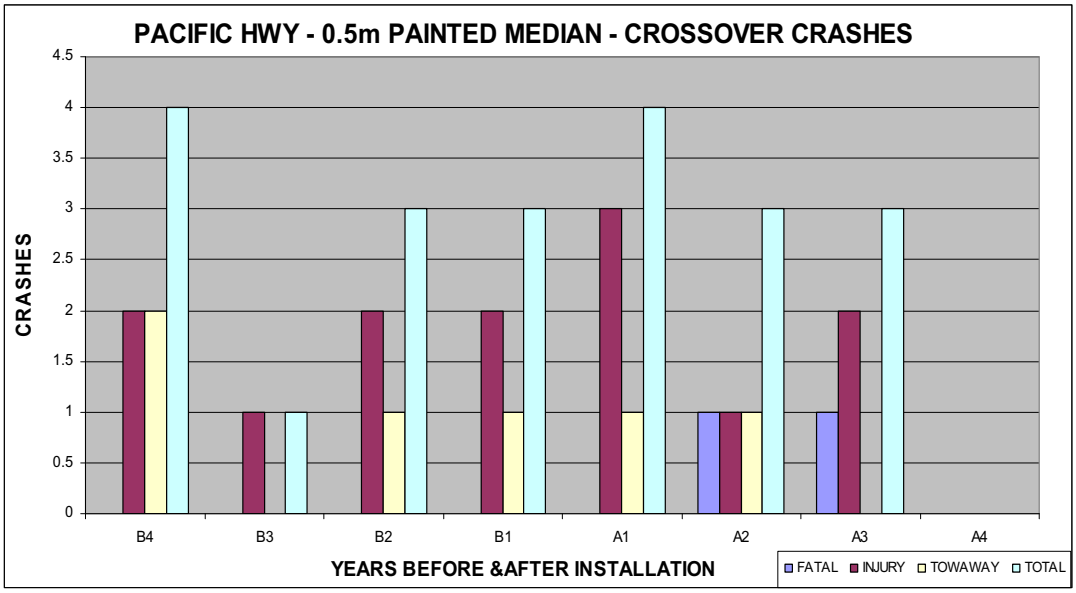


Figure 8 - Pacific Highway – 0.5m Wide Painted Median - Crossover Crashes

There seems to be evidence that the installation of 0.5m wide painted medians do not provide adequate separation of opposing flows to compensate for driver error from either fatigue or distraction on higher volume highways and therefore should not be installed.

Image 2 - 0.5m wide painted median – Pacific Hwy – north of Port Macquarie

Painted Median – 1.0m Wide

There was only 1 site of 1.88 km in length on the New England Highway and 5 sites on the Pacific Highway totalling 2.97 km. (Figs 9 & 10.) The single section on the New England Highway had only 7 crashes in the 8 years of data with only one of these in 2004 being a crossover crash. This data was not graphed.

NEW ENGLAND HWY			NEW ENGLAND HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
1.0m PAINTED MEDIAN			1.0m PAINTED MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	0	0	FATAL	0	0
INJURY	2	0	INJURY	0	0
TOWAWAY	3	2	TOWAWAY	1	0
TOTAL	5	2	TOTAL	1	0

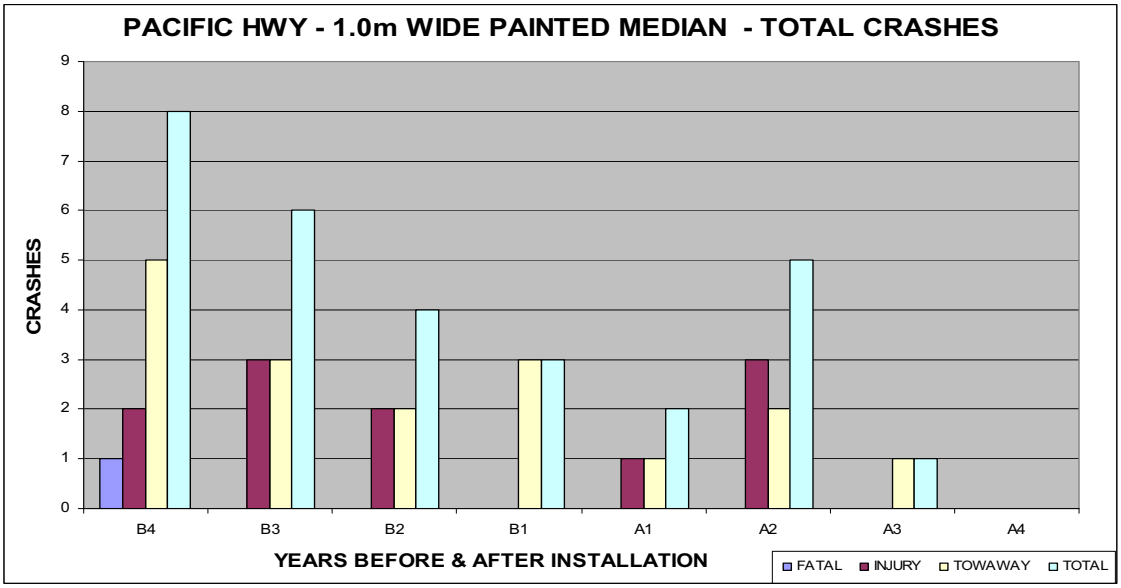


Figure 9 - Pacific Highway – 1.0m Wide Painted Median - Total Crashes

The sections on the Pacific Highway (Image 3) showed that crashes (Table 3) and crash severity were reduced after the 1.0m wide median was installed even though the crash data sets were not large enough to give a high level of confidence in the results.

PACIFIC HWY			PACIFIC HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
1.0m PAINTED MEDIAN			1.0m PAINTED MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	1	0	FATAL	3	1
INJURY	7	4	INJURY	5	3
TOWAWAY	13	4	TOWAWAY	9	4
TOTAL	21	8	TOTAL	9	4

Table 3 – Pacific Highway – 1.0m Wide Painted Median

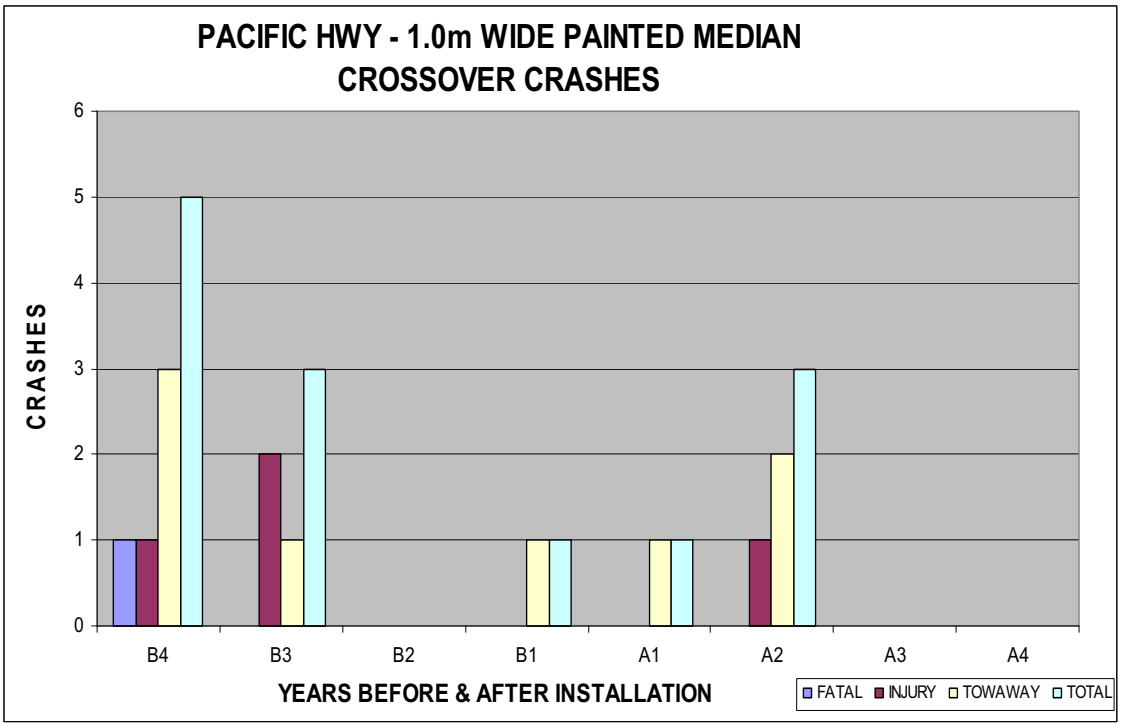


Figure 10 - Pacific Highway – 1.0m Wide Painted Median - Crossover Crashes

However Fig.10 indicates that there is a positive effect from the wider median separation and that fatigue, distraction and maybe speed crashes could be expected to be reduced with this centreline configuration.

Image 3 - 1.0m wide painted median, Pacific Hwy south of Urunga (note old line marking)

Profile Painted Median – 0.5m to 1.0m Wide

There were only two sections of the Pacific Highway totalling 1.16 km (Figs 11 & 12) that had median separation using audio-tactile profile line marking (Image 4). The width along these sections varied between 0.5m wide and 1.0m wide, however the variable width seemed to make little difference in the crash reduction. The crash data (Table 4) indicates that the audio tactile qualities of the median delineation had a beneficial effect in reducing both total crashes as well as crossover crashes.

PACIFIC HWY			PACIFIC HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
VARIABLE PROFILE PAINTED MEDIAN			VARIABLE PROFILE PAINTED MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	1	1	FATAL	0	0
INJURY	6	1	INJURY	7	1
TOWAWAY	12	3	TOWAWAY	7	1
TOTAL	19	5	TOTAL	7	1

Table 4 – Pacific Highway - Variable Width Profile Painted Median

It should be noted that two of the three crossover crashes that occurred after the profile median was installed involved fatigue and/or excessive speed and that only one resulted in a casualty.

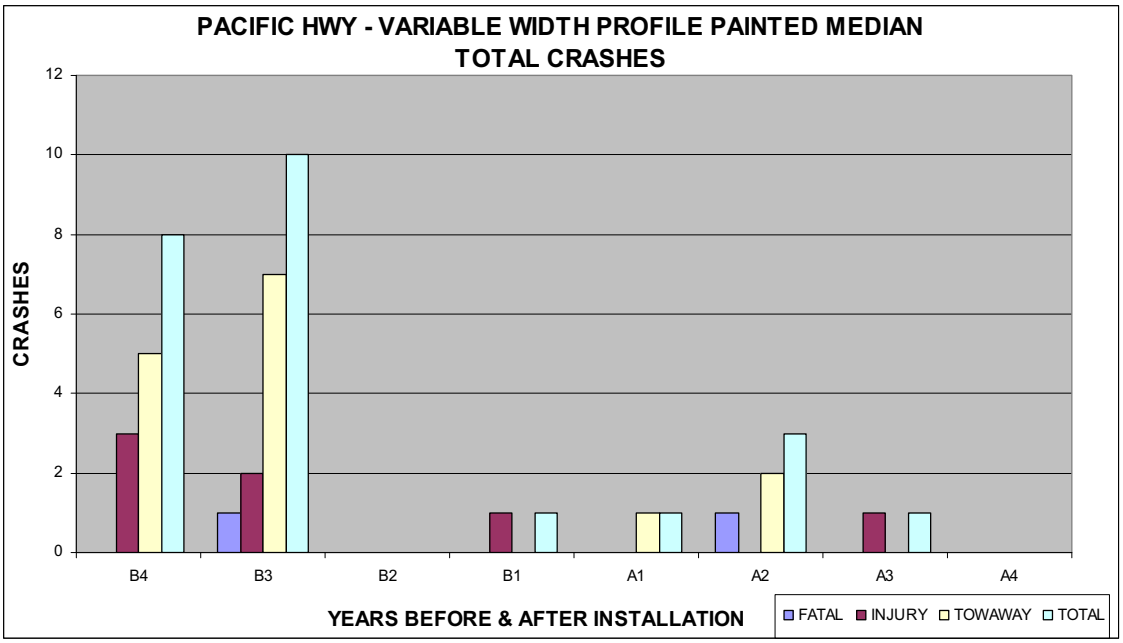


Figure 11 - Pacific Highway 0.5m - 1.0m Wide Profile Median -Total Crashes

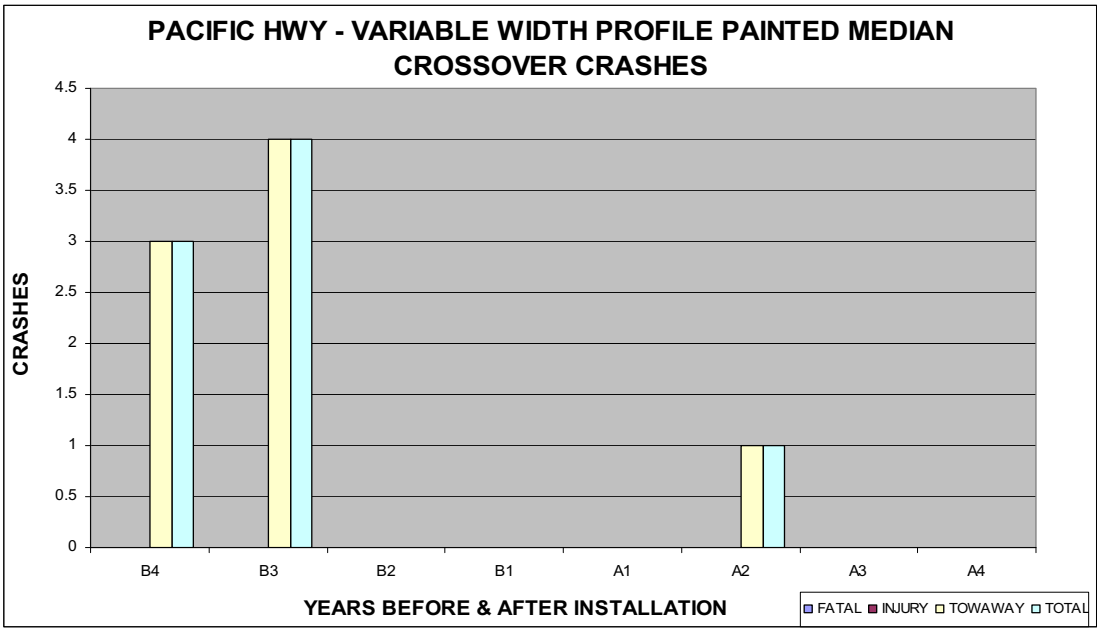


Figure 12 - Pacific Highway 0.5m - 1.0m Wide Profile Median - Crossover Crashes

Image 4 - Variable width audio-tactile profile median - Pacific Hwy south of Urunga

This outcome indicates that to maximise the reduction of both total and crossover crashes, an audio-tactile median of at least 1.0m in width should be installed on high volume highways.

Wire Rope Safety Barrier Median – 2.0m Wide

A study of the Wire Rope Safety Barrier (WRSB) medians on the Pacific Highway (Image 5) was undertaken recently for Austroads by ARRB (McTeirnan 2009). The findings from this study showed that although there was limited "after" crash data (Table 5) there was an indication that the WRSB median was reducing crash severity along the sections it had been installed on.

PACIFIC HWY			PACIFIC HWY		
TOTAL CRASHES			CROSSOVER CRASHES		
WIRE ROPE SAFETY BARRIER MEDIAN			WIRE ROPE SAFETY BARRIER MEDIAN		
	BEFORE	AFTER		BEFORE	AFTER
FATAL	2	1	FATAL	2	1
INJURY	17	5	INJURY	10	1
TOWAWAY	27	27	TOWAWAY	11	20
TOTAL	46	33	TOTAL	23	22

Table 5 – Pacific Highway -Wire Rope Safety Barrier Median

For this study there were 12 sections of WRSB median identified on the Pacific Highway with a total length of 11.15 km (Figs. 13 & 14). None of these sections had audio-tactile profile line marking either side of the wire rope barrier. The crash data indicates that there was both a reduction in total crashes and a reduction crossover casualty crashes after the WRSB was installed.

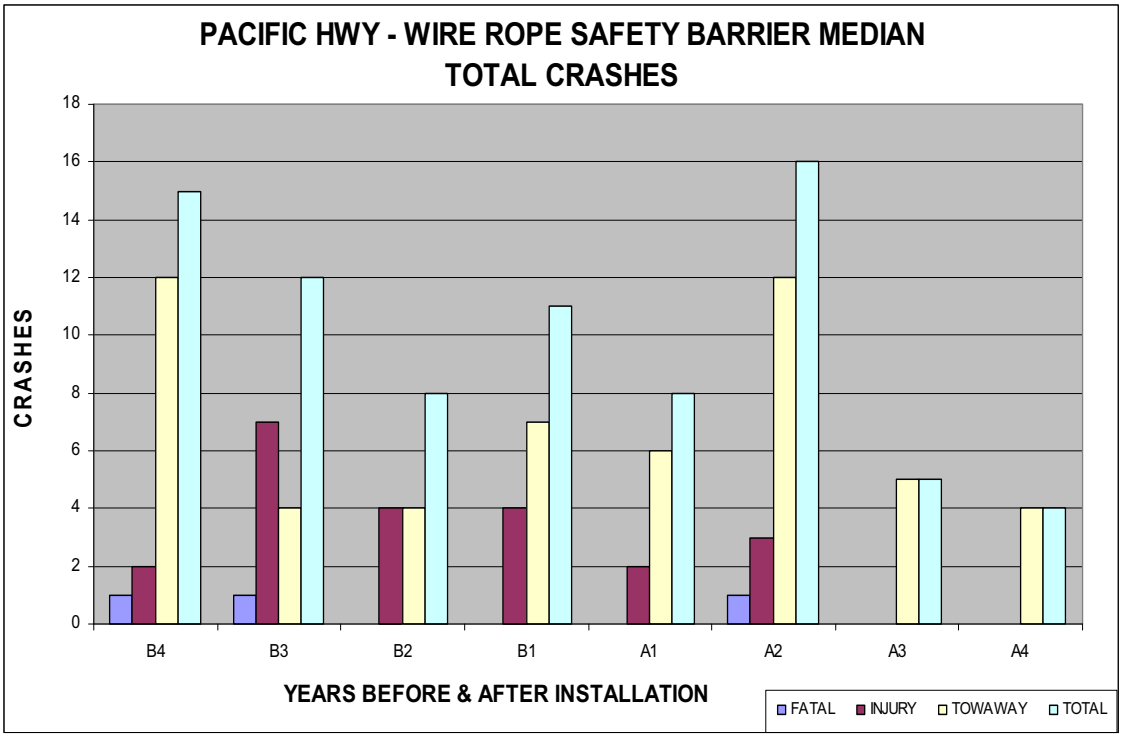


Figure 13 - Pacific Highway - 2.0m Wide WRSB Median - Total Crashes

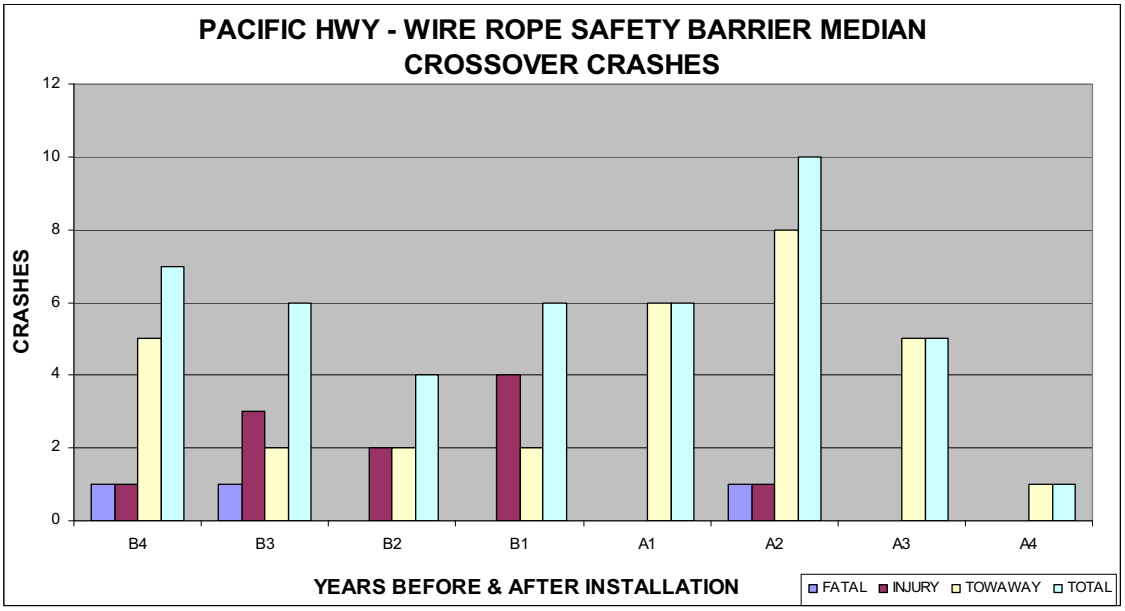


Figure 14 - Pacific Highway - 2.0m Wide WRSB Median - Crossover Crashes

The crossover crashes that occurred after the barrier was installed were actually towaway crashes into the wire rope barrier that could have resulted in much more severe Head-On or Off Road Right crashes if the barrier hadn't been there. The fatal crash in A2 occurred when the wire rope barrier was not functional having been hit by a truck only hours before the fatal crash. Regional maintenance records show that there are a large number of drive-off hits on the barrier that are not recorded.

Image 5 - 2.0 metre wide Wire Rope Safety Barrier median – Pacific Hwy, at New Italy

Also anecdotal evidence from a length of wire rope median recently installed further north of these sections indicates that the installation of audio-tactile line marking either side of the wire rope has had a big effect in reducing off right crashes into the barrier. This would help in reducing nuisance hits on the wire rope and thereby reduce maintenance costs.

Conclusions

Crashes involving loss of control to the right can be addressed in a similar fashion to loss of control to the left crashes. Most roads offer some protection if control is lost to the left but not for those that lose control to the right.

The crash data analysis indicates that to maximize the beneficial effect on reducing crossover crashes, the painted median needs to be at least 1.0m in width. It would also be further enhanced if the line marking incorporated an audio-tactile profile, and further still with a wire rope barrier in the median.

The lower hierarchy sections of the existing NSW State Road Network as well as local and regional roads managed by local government are not expected to receive sufficient funding in the near future to upgrade large lengths of these roads to a high speed standard. These roads are prime candidates for the application of wider centrelines as well as other incremental safety applications.

References

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3 Job R S F, Graham A K, Levett S P "Strategic Road Safety Successes from Multi Disciplinary Highway Safety Reviews" NSW Centre for Road Safety (2009)