RETRO-FITTING INCREMENTAL CLEARZONE WIDTHS TO EXISTING RURAL ROADS

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Paper Summary

The aim of this paper is to outline new alternative and pragmatic incremental clearzone widths that when retrofitted to existing high speed, undivided rural roads are expected to have a significant effect on reducing the road toll.

Although the percentage of run off road crashes varies according to individual routes, they usually form the major component of total road crashes on the rural road network. Run off the road crashes on high speed, undivided rural roads cost the NSW community about $360 million per year and result in approximately 80 deaths per year. One cost-effective way to reduce the high number of these types of crashes is to take a more pragmatic view of what is practical and achievable in reconstructing and maintaining the existing alignments and formations on the two lane rural road network.

Road Design Guides have tended to concentrated on "best practice" principles for designing *"greenfield"* type road projects. However, they have rarely addressed what was practical and achievable for upgrading existing road alignments and formations. Consequently, the application of full width clearzones of 10 metres to 12 metres are an exception on most existing rural roads throughout NSW. The development of incremental clearzone widths is an attempt to address this lack of design direction when confronted with what is regarded as acceptable and affordable practice on *"brownfield"* projects. It concentrates on reducing the severity of run off road crashes into objects as the major concern and not the total elimination of these types of crashes. It tries to achieve this by restricting the design parameters to a practical level of maximum safety benefit return for the minimum cost of construction.

This study is consistent with the safe systems approach to road safety which accepts that humans will make mistakes and that the road should be constructed and maintained to ensure these errors don't result in death or serious injury. Cost effective treatments such as applying incremental clearzones are expected to provide good safety benefits yet be less environmentally destructive than current "*Greenfield"* clearzone standards. If they are implemented throughout the NSW road network they will provide a more forgiving roadside environment than presently exists along the edge of most rural roads.

Introduction

An Assessment of the Rural Road Safety Problem

Crashes on country roads in NSW have been increasing in recent years. People living in rural areas are approximately three times more likely to be killed when involved in a road crash than people living in metropolitan areas.

The existing country road network in NSW is administered either by the State Government or by Local Councils. Many country roads were built many years ago to lower design standards that may have been appropriate for the time but are now inadequate to cope with the high-speed vehicles of today.

The NSW Roads & Traffic Authority (RTA) manages 17,624 km of State Roads, including 3,105 km of National Highways. It also manages nearly 3,000 km of Regional Roads and Local Roads in the unincorporated area of NSW where there are no local councils. There are also 162,268 kilometres of Regional and Local roads in NSW that fall under the authority of Local Government.

A study of current crash data shows a consistently high level of run off the road crashes on high speed (90km/hr plus), undivided roads in New South Wales. There has been an annual average of 3,230 run off the road crashes on this road type over recent years. These have resulted in high numbers of fatal crashes (Ave. 80 per year) and injury crashes (Ave. 1,500 per year) and all these crashes have a total annual average community cost of $362 million.

Many run off the road crashes involve vehicles striking a roadside object such as a tree, embankment, pole, fence or safety barrier. However, crashes into trees in rural NSW alone cost $156 million per year with this crash type making up 43% of all run off road crash costs per annum.

The road environment is considered to be a partial contributing factor in about 28% of all crashes, although it is only regarded as the sole contributing factor in about 4% of all crashes. However, the structure of the road and its surrounding roadside environment has a much greater impact on the severity outcome of run off road crashes.

Clearzones

Development of Current Clearzone Widths

In 2005, Dr David Saffron undertook a literary review of clearzone research to determine where and how the current clearzone standards originated. His review revealed a June 2002 paper entitled *"Review of the Development of US Roadside Design Standards"* by John McLean. This paper investigated the robustness of the initial US research used to determine the widths for clearzones. Mclean's conclusions were that the initial US research was an "article of faith" and that it had greatly over-estimated the benefits of installing wide, 9 to 11 metre clearzones.

His analysis of a number of other overseas studies on clearzone widths indicated that up to 75% to 85% of the safety benefits of clearzones were captured within the first 6 metres.

In NSW, the RTA continues to accept the US clearzone findings and has developed a detailed nomograph to calculate varying widths for different types of road alignment and design speed. It should be noted that the widths calculated by the RTA's "Road Design Guide" (RDG) nomograph are still considered to be appropriate for high speed freeway style "greenfield" road projects. However, these widths are not considered practical or affordable for retro-fitting to most existing rural roads. Because the widths calculated by the RDG nomograph are usually more than 10 metres for most rural roads, there has been little effort made to apply these clearzone widths to existing roads due to the excessive environmental impact and high financial costs.

Also, in many rural areas, especially west of the Great Divide, the trees in the road reserve are often the only remnant vegetation left standing and there is a large environmental cost involved in clearing these trees to a distance considered safe under the current RDG standards.

Current Study

In 2005 Road Environment Safety Section (RES) undertook a crash analysis study that looked at run off the road crashes into objects on high speed, rural roads for the years 2002-2004. The study was undertaken to see if a pattern of severity and/or travel distance for run off road type crashes could be determined. All run off road crash data where the vehicle hit an object in a speed zone 90kph or greater was downloaded from the crash database along selected sections of thirteen (13) NSW highways. The highways were the Pacific, Princes, Hume, New England, Newell, Mitchell, Bruxner, Federal, Barton, Golden, Great Western, Mid Western, and Snowy Mountains. These highway sections were chosen because video imaging data (Gipsicam) was available along the roads, the sites could be easily identified from the information given in the RTA's crash database and the distance to the object struck could be measured from the edgeline. The type of object struck and the curve radius of the road, if the crash occurred on a curve, were also noted.

The scenarios that were evaluated were fatal, injury and towaway off road crashes, run off road on a curve as against run off on a straight as well as those crashes designated excessive speed or fatigue in the crash database.

Crashes into Trees

Many objects that are hit within the clearzone are man-made, such as road embankments, power poles and safety barriers. Considering the above, it was decided to initially look at crashes into trees, as they are the object most likely to be struck on a rural road.

There were 185 off road into tree crash sites that could be identified well enough to determine how far the vehicle travelled before it hit the tree. These sites were analysed according to crash severity as well as whether they occurred on a straight or a curve.

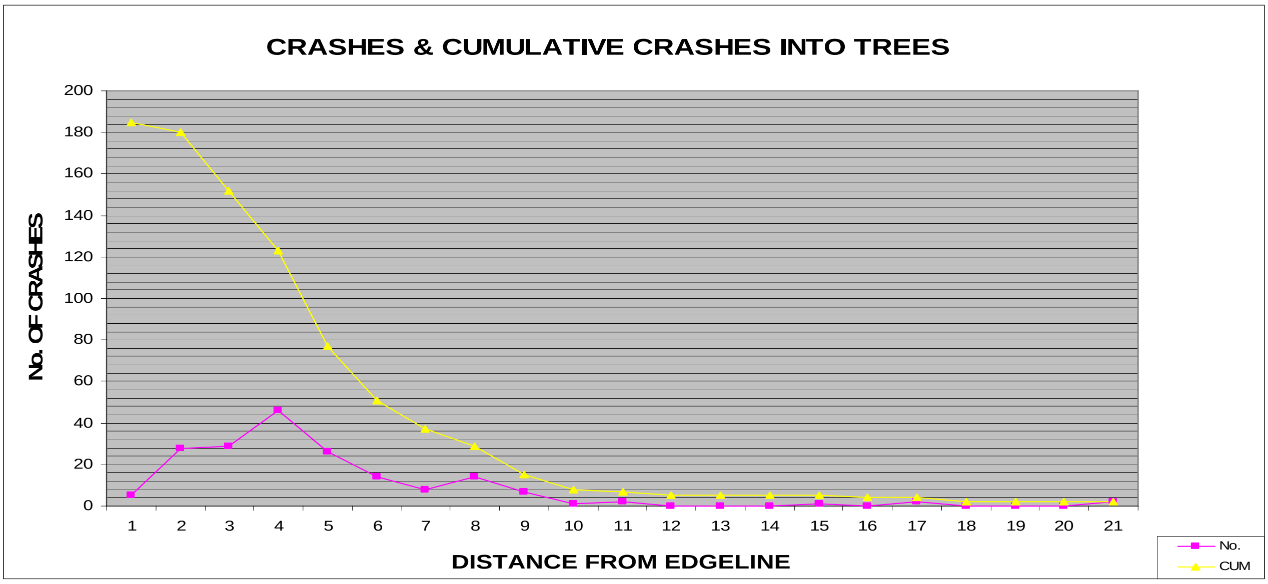

Figure 1

As can be seen from *Fig 1* the majority of vehicles leaving the carriageway have hit a tree close to the edge of the road. This indicates that there are very few highways in the NSW high speed, rural road network that have clearzones wider than 5 metres and that most have much less. The data also shows that there is a continuing reduction in crashes up to a distance of 10 metres from the edgeline, but it also shows that almost 80% of all these crashes occur within the first 6 metres. It is difficult to tell how many of these crashes would be eliminated if traversable clearzones were installed to a width of 5 to 6 metres, however it would be hoped that the severity of many of these crashes that were not eliminated would be certainly reduced.

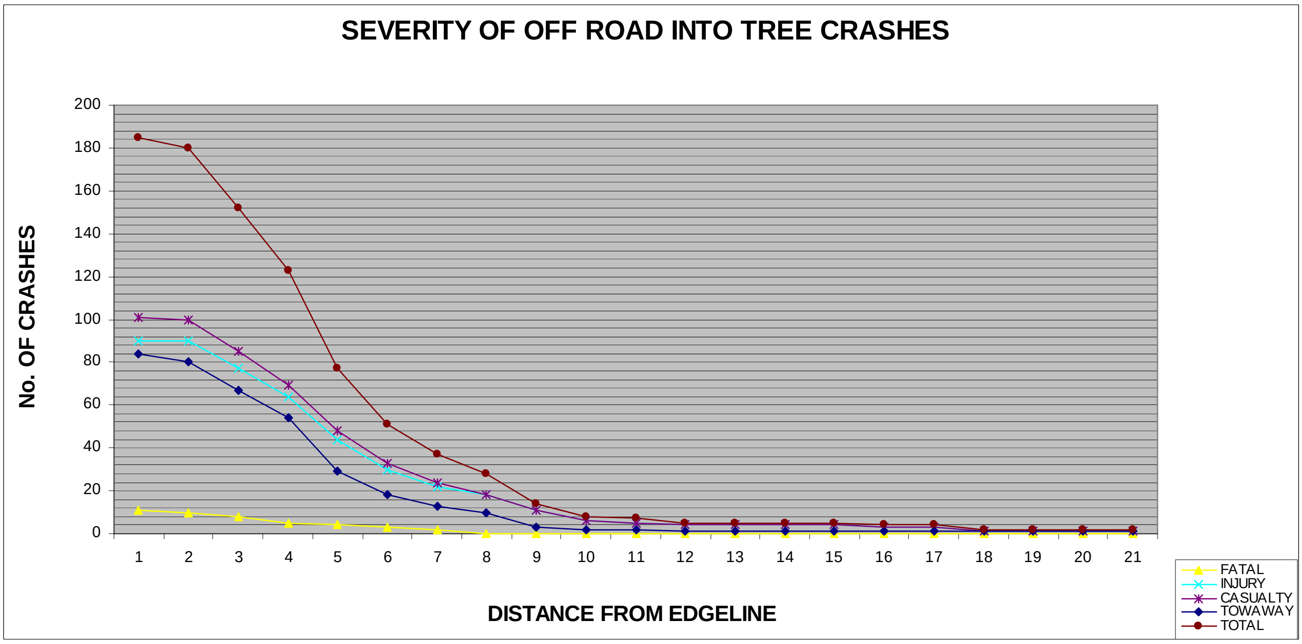

Figure 2

The graph in *Fig.2* showing severity of off road crashes into trees suggests that most crashes into trees result in some level of casualty. It confirms that only police recorded crashes are going into the crash database and that there could be many property damage only (PDO) crashes that go unreported. It could also be concluded from this information that crashes into trees are probably more numerous than the database shows or that they are a far bigger casualty problem than anticipated.

In recent years, crashes into trees have contributed to up to14% of the total fatal crashes on NSW roads. Analysis of the sites where a fatality into a tree occurred showed that all struck the tree within 7 metres of the edgeline, with 75% occurring within 5 metres of the edgeline. It also indicates that 64% of these crashes occurred on a curve.

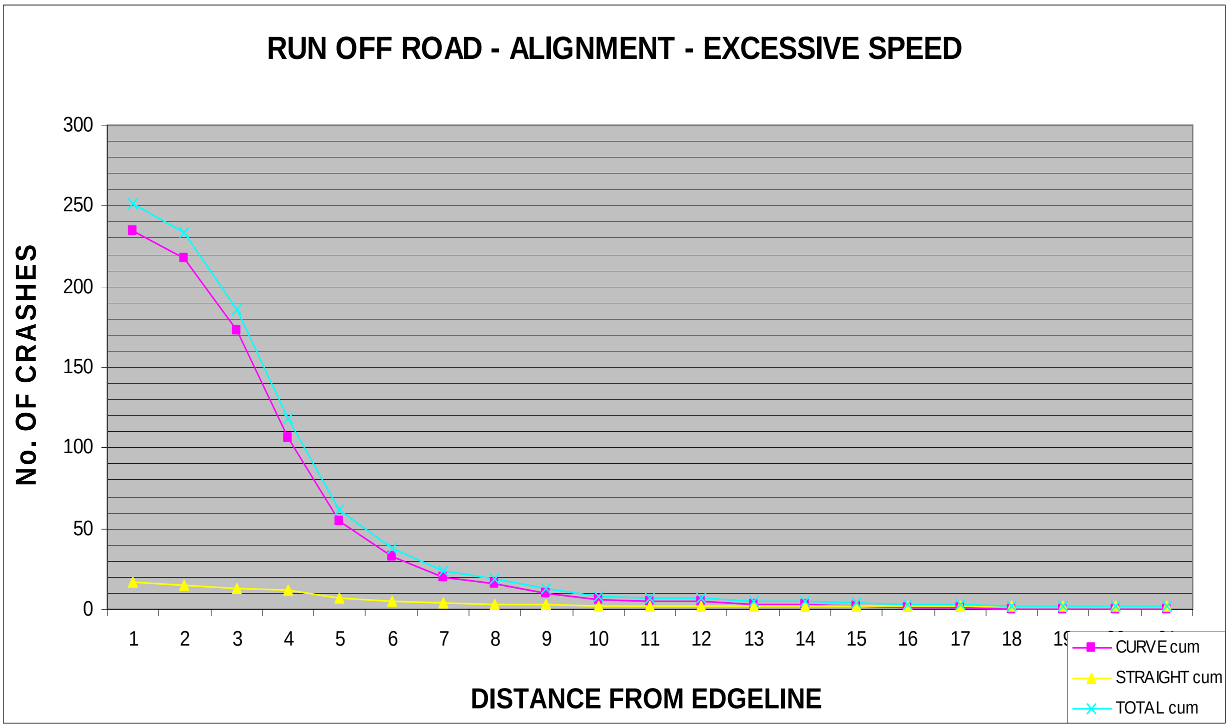

Figure 3

As can be seen from *Fig.3* nearly all run off road crashes that were designated as being caused by “excessive speed” occurred on curves. This may be partly a result of the way the crashes are coded into the crash database. However, it also fits intuitively with what could be expected with those drivers that are driving at excessively high speeds losing control due to a sudden change in the road’s horizontal alignment.

Fig.3 also shows that most crashes resulting from excessive speed loss of control occur within 6 to 7 metres of the edgeline. This indicates that the drivers were aware of their predicament and following the initial loss of control, are trying to regain control by braking before striking the object.

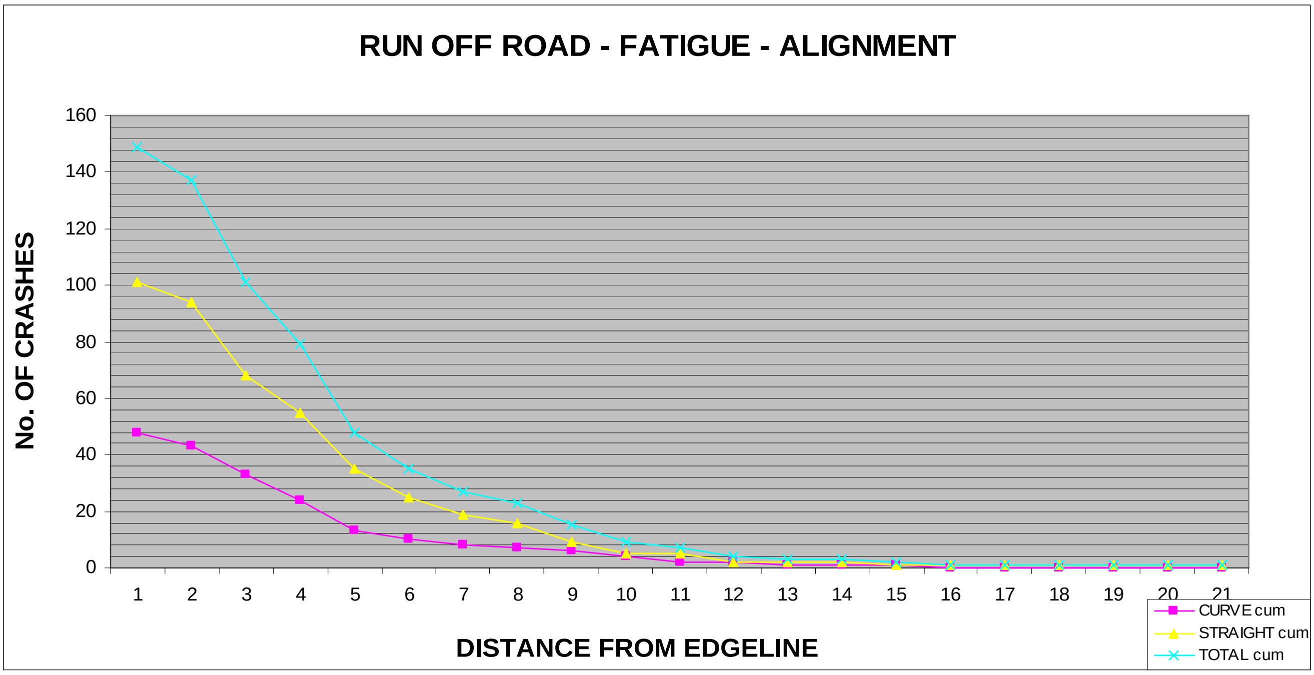

Figure 4

The analysis of runoff road crashes that are coded as being caused by “fatigue” as shown in *Fig.4* seem to be the opposite to the “excessive speed” crashes, with the majority occurring on straight sections of road. Again, this may be a result of the way the crashes are coded into the crash database, however the data shows that the vehicles generally travelled further (up to 12 metres) before hitting the object. This indicates that there was little driver awareness of the situation at hand (asleep) and that little braking was applied before the object was struck.

OFF LEFT ON A CURVE CRASHES

Figure 5

Figure 5

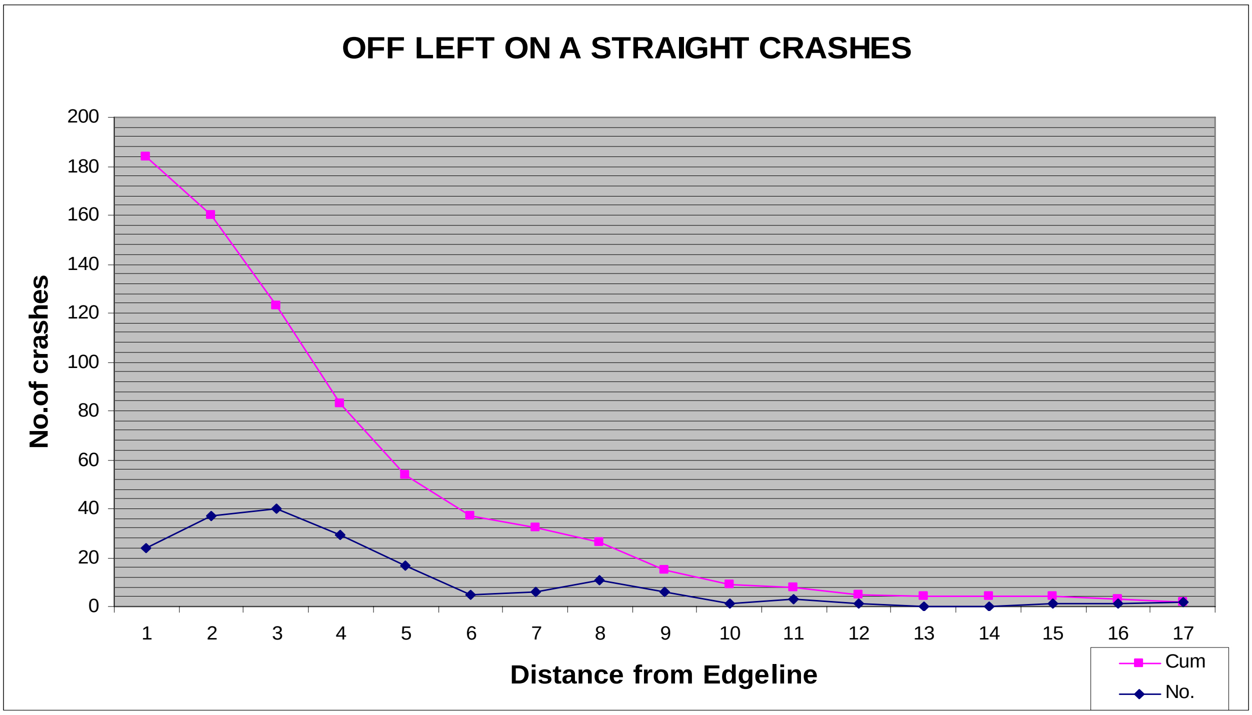

Figure 6

Figures 5 and *6* indicate that there is little difference between the distances the vehicle travelled off the road before the object was struck on either straights or curves with the majority hitting the tree before travelling much more than 5 to 6 metres from the edgeline.

The slight bump on the straights graph at 8 to 9 metres is probably a result of the greater number of "fatigue" coded crashes occurring on straights and these type of crashes travelling further before they hit the tree.

Incremental Clearzone Widths

This study of run off road crashes into trees and those attributed to “excessive speed” and “fatigue” shows that the retro-fitting of an incremental clearzone width of between 5 to 6 metres for both straights and curves may reduce the number but more importantly will hopefully reduce the severity of many casualty crashes occurring on rural roads.

The application of these incremental widths is not expected to stop run off road crashes occurring, but is primarily being proposed to reduce the severity of those crashes when they do occur.

Their application also acknowledges the environmental consequences of installing wide RDG width clearzones and concentrates on reducing crash severity as against actual crash occurrence.

Prioritising of Clearzone Treatments

Although incremental clearzones should be considered for implementation along all rural roads in NSW, they should be firstly installed on the outside of all curves with a radius of between 200 metres and 600 metres and where there is a traversable run off area. This is because the majority of run off road casualty crashes occur within this radii range. *(see fig.7)*

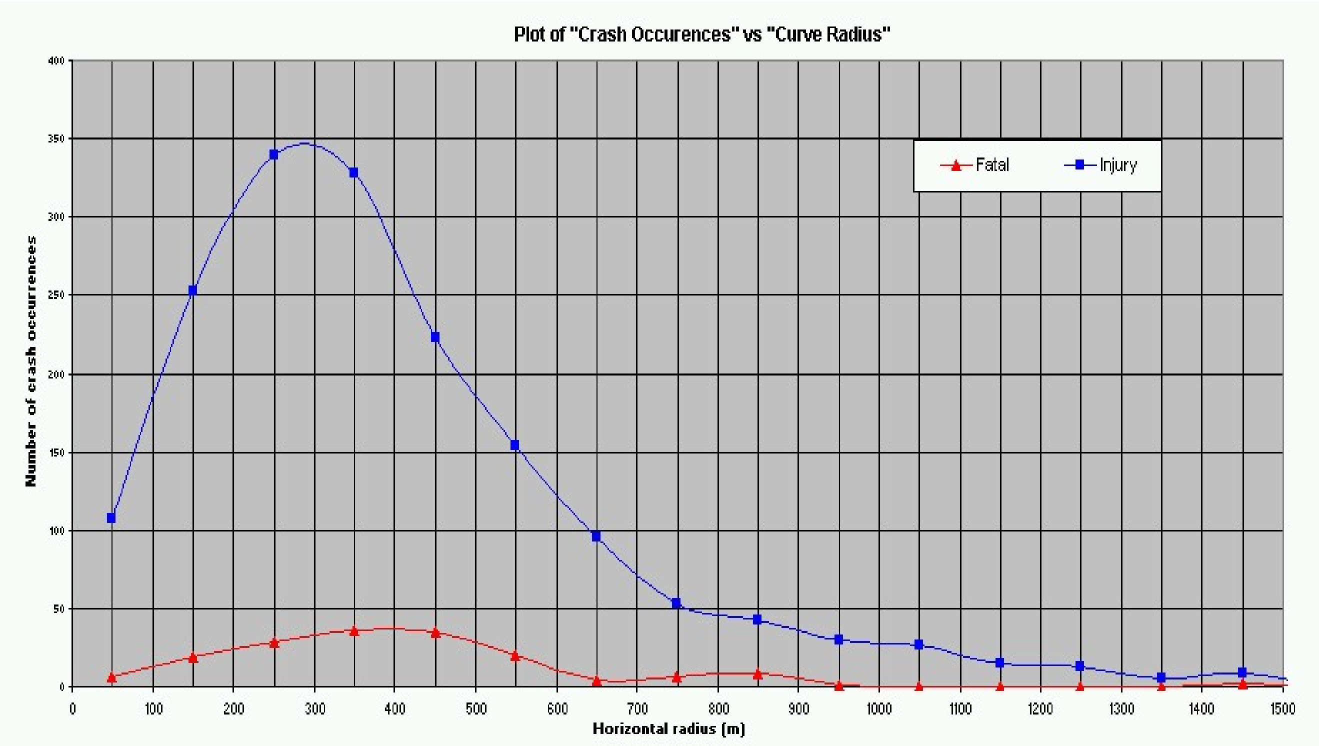

Figure 7

The prioritising of implementing of incremental clearzones can be broken down into the following range of curve radii.

PRIORITY 1 – Radius 200 metres TO Radius 600 metres
(10% of State RGA network – approx. 2,010 km)

PRIORITY 2 – Radius 10 metres TO Radius 200 metres
(3% of State RGA network – approx. 630 km)

PRIORITY 3 – Radius 600 metres TO Radius 1000 metres
(8% of State RGA network – approx. 1,520 km)

Crashes into Safety Barriers

Another outcome of the study into run off road crashes into objects gave an insight into the effectiveness of different types of safety barriers and their performance in a crash.

BARRIER TYPE	FATAL CRASHES	INJURY CRASHES	TOWAWAY CRASHES	TOTAL CRASHES	CASUALTIES CRASHES PER TOTAL (%)
GUARDRAIL	5	49	86	140	38.6%
CONCRETE	0	6	11	17	35.3%
WIRE ROPE	0	5	27	32	15.6%
BRIDGE RAIL	0	1	1	2	50%
	5	61	125	191	

Figure 8

Fig.8 shows that crashes into wire rope safety barriers resulted in half the casualty crashes of other types of crash barrier. Although the bridge rail crash numbers are too small to have any significance and the concrete barrier crash numbers are also small, the results show a definite trend towards wire rope being the safer option for reducing injuries for vehicle occupants.

Conclusions

Run off road crashes cost the NSW community approximately $360 million per year and result in approximately 80 deaths per year. It is now accepted that the safe systems approach is one of the best ways to reduce the road toll and this will be best achieved by making the existing road network safer by installing road safety engineering works that may not only both stop crashes from occurring but will also reduce the severity of those crashes that continue to occur.

In the past, Road Design Guides only concentrated on "best practice" principles for designing *"greenfield"* type road projects and did not address what was practical and achievable for retro-fitting safety onto existing road alignments and formations.

The study indicates that by installing traversable incremental clearzone widths of 5 to 6 metres along existing lengths of rural roads then crash trauma in regional NSW could be greatly reduced. Their application is also seen as an environmentally practical and a more economically viable alternative when applying road safety engineering to existing two lane rural roads and they are expected to have a major long-term impact on reducing casualty crashes in NSW.

References

"*Review of the Development of US Roadside Design Standards*" - Author: John McLean (June2002)

"*Country Road Safety Summit - Road Environment Safety Issues Paper"* – Author: Steve Levett (2004)

"The Application of Asymmetrical Design Principles to Existing Rural Roads" - Author: Steve Levett (2005)

"Review of Clearzone Widths" – Author: Dr David Saffron (2005)

Thanks
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BIOGRAPHY

The author has had 34 years of experience working for the NSW DMR - RTA in the areas of traffic analysis and geometric design; concept, preliminary and final road design; project development and analysis; and road environment safety.
Since 1994, he has work in the area of road environment safety, lecturing in road safety auditing and crash investigation and analysis and developing road safety programs, strategies and policies.
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