The Australian Road Assessment Program (AusRAP)

John Metcalfe[1] and Greg Smith[1]
[1] Australian Automobile Association

1 Introduction

In Australia, Europe, Japan and the United State of America, the New Car Assessment Programs (NCAP) have been awarding star ratings to new cars based on their performance in crash tests for more than ten years. In Europe, this philosophy of independent assessment has been extended to roads, with the European Road Assessment Program (EuroRAP). EuroRAP employs two key protocols: mapping death and serious injury on main roads, to see where risk is high and where it is low, and assessing how well the user is protected when a crash does occur.

AusRAP is designed to build on the European equivalent, by applying the philosophy of independent assessment in the Australian context, which in many ways has distinct road environments, traffic patterns and governance. AusRAP's model for reducing death and injury aligns closely with Sweden's Vision Zero. It is based on roads and vehicles that have forgiving designs so that when a crash does happen, both road and vehicle work together to mitigate against injury.

The purpose of this paper is to describe the methodology and early results of the application of the two AusRAP protocols: risk mapping, which assess historical crash rates; and the Road Protection Score (RPS), which assesses the inherent safety of roads. The paper is organised into three sections. First, we discuss some of the forces driving the development of AusRAP, which include community perceptions about road safety and the scale of the road safety problem in Australia. Following this, we discuss the methodology used for the first AusRAP protocol; risk mapping, using recent results for Queensland as an illustration. Finally, we briefly describe the work that has been completed thus far in developing a methodology for the second AusRAP protocol; the Road Protection Score (RPS). At this stage, a detailed discussion on the RPS is not possible, as much of the methodology is still being finalised.

2 The driving forces behind AusRAP

The target of Australia's National Road Safety Strategy is to reduce the annual road fatality rate per 100,000 population by 40 per cent between 1999 and 2010 (ATC, 2000). Since its inception however, the actual fatality rate has been 'behind target'. By August 2005, the national fatality rate was approximately 8.07 fatalities per 100,000 population (ATSB, 2005; BTRE, 2002). If we assume the target is to be met by a simple linear rate of reduction over the period to 2010, then the target rate for April 2005 was 7.38 fatalities per 100,000 population.

Admittedly, there will always be variations around the trend, but the fact that the national fatality rate is now, and always has been, 'behind target' suggests that even greater gains (and efforts) will have to be made in the ensuing years if the target is to be achieved.

ANCAP has shown that a consistent system of star-rating crash protection in cars has encouraged manufacturers to raise standards quickly. Informed consumers demand cars that provide crash protection which meets modern safety standards. At the 2003 Technical Conference on the Enhanced Safety of Vehicles (ESV) in Japan, Werkmeister and Borchers of BMW said:

> *With established consumer tests like IIHS, Euro NCAP, US NCAP, Japan NCAP and Australian NCAP (which are well received by the public) the general vehicle passive safety performance considerably exceeds current legal requirements. For example, European legal requirements would receive a 1.3 star rating by Euro NCAP standards. However, current state of the art rating is a 4 star rating. Today more and more vehicles are even achieving the highest scores, with 5 stars. This shows one important trend in automotive business: it's not just legislation but mainly a private/public partnership, which paves the way to successful results* (Werkmeister and Borchers, 2003).

It is hoped that AusRAP will have a similar impact for roads. By 2010, the National Road Safety Strategy anticipates a 40 per cent reduction in the road fatality rate. It also identifies the means by which this improvement might be achieved. It is expected that by 2010 around 700 lives can be saved every year by improving the safety of the roads (332 lives), improving the safety of vehicles (175 lives), improving driver behaviour (158 lives), and adopting smarter safety technology (35 lives) (ATC, 2000).

Thus, nearly half of the targeted improvement in road trauma can be achieved by upgrading Australia's roads. However, Australian Automobile Association research shows that the public is unaware of the significant contribution that road improvements can make to road trauma, despite the fact that thousands of deaths and injuries can be prevented by improving road crash protection standards and providing safer roads. By providing a consistent safety rating system for Australia's roads, AusRAP is a critical step towards raising the public's road safety awareness.

3 Risk mapping

AusRAP's first protocol, risk mapping, is based on real crash and traffic flow data. Risk maps illustrate a road's safety performance by measuring and mapping the number of casualty crashes along a route. To date risk maps have been produced for the rural lengths of the AusLink National Network highways.

3.1 Casualty crash data

Crash data is supplied by the State and Territory road authorities. This data includes information on each casualty crash, including the crash date, location, severity, type, numbers of people killed or injured, and the speed zone in which the crash occurred.

Unlike EuroRAP, which assesses roads according to *serious* casualty crashes, we have assessed roads according to *all* casualty crashes. A casualty crash is defined as being any crash in which at least one person is killed or injured (as opposed to seriously injured). This decision was made on the basis that while *fatal* crashes are well defined among the jurisdictions, as Liew (cited in Daly, Metcalfe and McLean (2003)) argues, there is not a functionally consistent definition of serious casualty crashes across jurisdictions. Hence, as AusRAP is a national program, serious casualty crashes do not provide a reliable basis for analyses.

Nevertheless, in order to produce meaningful results, samples sizes that are larger than could be provided by using fatal crashes alone are required. On the other hand, AusRAP is specifically designed to assess roads for risk of injury, so using all crashes recorded by road authorities (including property damage) is not ideal. Hence the use of casualty crashes represents a balance between these competing factors.

Unfortunately, like *serious* casualty crashes, there is the possibility that casualty crashes are also inconsistently defined. To test whether or not this is the case, we examined the ratio of fatal crashes to crashes in which, at worst, a person was injured, in jurisdictions. Because fatal crashes are consistently defined among the jurisdictions, it was expected that, allowing for geographic and demographic variations, the ratios would be similar if injury crashes were also consistently defined. The results of this analysis are shown in Table 1.

Table 1 Ratios of fatal crashes to injury crashes by jurisdiction (2002)

State	Fatal Crashes	Injury Crashes	Ratio
New South Wales	501	21798	0.023
Victoria	361	17104	0.021
Queensland	283	13351	0.021
South Australia	138	7453	0.019
Western Australia (2001)	151	8745	0.017

Sources: Jurisdiction road authority websites (June, 2005).

As Table 1 shows, in jurisdictions for which data is readily available, the ratios range from 0.017 for Western to Australia to 0.023 in New South Wales. On the basis that these ratios are reasonably consistent, and given the lack of alternatives, we have assumed that the use of casualty crashes provides a reasonable basis for analysing crash rates.

3.2 Traffic volume data

Traffic volume data is also supplied by the jurisdiction road authorities. For the most part, data is in Annual Average Daily Traffic (AADT) format (that is, the number of vehicles travelling past a particular point on a road in a year, divided by the number of days in a year), though some data from New South Wales is also in axle counts format. In this case, based on RTA advice, an estimate of AADT is calculated based on an assumed average 1 to 1.1 axle pairs per vehicle. On routes carrying high volumes of heavy vehicles (which is often the case on the National Network), a higher average of up to 1.3 axle pairs per vehicle is used.

The way in which data is supplied by the road authorities varies. In Western Australia and Queensland for example, data is supplied in “traffic estimate sections” whereby traffic volumes have been allocated to a specific length of road (that is, volume *a* applies to road *b* from point *c* to point *d*). In other cases, such as New South Wales and Victoria, data applying to the point along the road at which the data was collected is supplied. This required an additional level of analysis compared to the Western Australia and Queensland data, because volumes needed to be allocated to lengths of road.

3.3 Geographic data

Crash rates and risk maps have been produced using a Geographic Information System (GIS) which allows road maps, crash locations and other geographic information to be plotted on an electronic map. The road map used in the latest round of analyses was from the National Geosciences Dataset, obtained from Geosciences Australia. The strength of this dataset is that it provides a nationally consistent basis for undertaking these analyses. In instances where it is clear that a road has been realigned, or that the Geosciences dataset is not up to date—indicated in most instances by a consistent significant deviation of crash locations from the Geosciences road alignment—the road map has been adjusted.

3.4 Methodology

Using this data, risk maps have been produced by following a number of steps.

Initially highways are divided into 'links', using four criteria (which are not necessarily applied in the order in which they are listed here). The first criteria involves looking at the number of crashes on a length of road. That is, links should have a minimum five-year total of 20 crashes resulting in death or injury over a five year period. This criteria is based on work by Daly, Metcalfe and McLean (2003) and is a reflection of the fact that the actual number of crashes that occur on any given length of road at a given time is highly variable. The selection of 20 crashes as the minimum represents an attempt to find a balance between the probability that a link might be misclassified because of this variation, and the need for road links to have meaningful and useful lengths. Interestingly, EuroRAP also has a requirement for a minimum of 20 crashes, but is able to achieve this using a smaller sample period; typically three years. This is because crash rates per kilometre of road tend to be higher in Europe than Australia; a reflection of the higher population densities in Europe than in Australia.

The second criteria is that road links should be meaningful and distinct to road users (that is, start and end at identifiable locations). Third, they should have broadly similar characteristics, such as single lane or dual carriageway, over their entire length. Finally, links should be 'rural' in nature. For the purposes of this study, rural roads are defined as being those that are outside of cities and significant towns, and have a speed limit of greater than 90 km/h. However, some lower-speed limit sections where these form an integral part of higher speed inter-urban routes are included.

To some extent, these criteria represent conflicting priorities. For example, the need for each link to contain at least 20 crashes sometimes requires that links be long in length. However, this conceivably comes at the expense of the need to ensure links are meaningful to motorists and are of consistent characteristics. Hence, each of the criteria needs to be somewhat flexible.

It is also conceivable that substantial roadworks aimed to improving road safety could be undertaken on a link during the five year sample period. Hence, a risk rating for that link would essentially be a composite of pre and post construction crash rates. To address this, we intend to publish results annually, such that ratings represent a five year moving average. By doing this, the impact (if any) of roadworks will gradually become apparent as ratings change over the years.

The Sturt Highway, New South Wales, between the Hume Highway and the Newell Highway, provides an example of how the four criteria are used. This section of road is approximately 140km long, and between 1999 and 2003 experienced 182 casualty crashes. Wagga Wagga is the only major town along this section of road, and so is isolated as an urban link approximately 15km in length (in line with speed zoning). This leaves two rural links on either side of Wagga. The first, from the Hume Highway to Wagga is around 34km in length and experienced 19 casualty crashes and the second, from Wagga to the Newell Highway, is around 90km in length and experienced 30 crashes. While the first link does not quite satisfy the first criteria of having at least 20 crashes, it does satisfy the other three criteria. Given that the end points of this link are fixed, there is no opportunity to increase its length to increase the number of crashes. Therefore, as 19 crashes is only marginally below the 20 threshold, it was decided that this link definition was appropriate. Similarly, the second rural link satisfies each the criteria and is therefore retained as is.

Having defined the links, the number of crashes that occurred along each link is counted. As noted earlier, a five-year sample period is currently used. This counting is initially done automatically in the GIS, by first assigning each link a unique code and then labelling each crash along that link with the relevant code. Crashes with the same link code are then grouped and counted. This data is later analysed in Microsoft Excel and Microsoft Access.

A traffic volume for each link is also estimated. To accommodate for the prospect that the recorded volumes supplied by the jurisdictions might vary within a link, a weighted average (based on length) of a number of volumes is calculated for each link. That is,

$$\text{Weighted AADT estimate} = [\ \sum (AADT_i\ L_i)\ ] / L$$

where:
$AADT_i$ = average daily traffic volume on sub-section i;
L_i = length of sub-section i; and
L = length of link.

The summation is taken over i = 1 to N_{ss}, where N_{ss} is the number of subsections with different AADT estimates in a link.

Because of limitations in the availability of data, traffic volumes from the middle year of the crash data sample period are used in calculating crash rates. For example, when the crash sample period is 1999 to 2003, traffic volumes from the year 2001 are used. In cases where data from that particular year are not available, data from adjacent years is adjusted according to compound growth rates.

Using this information, two types of crash rate are then calculated for each link. The first is known as 'individual risk' which measures the average annual number of casualty crashes per 100 million vehicle kilometres travelled (per 100m veh-km). That is:

$$\text{Individual risk} = (\text{casualty crashes} / N_y) / [(365 * L * AADT) / 100{,}000{,}000]$$

where:
N_y = number of years (five);
L = length of link; and
AADT = weighted AADT estimate for link.

By controlling for varying traffic volumes, this measure essentially represents the risk that individual drivers face on a length of road. The second measure of risk is known as 'collective risk', which measures average annual number of casualty crashes per kilometre of road (per km). That is:

$$\text{Collective risk} = (\text{casualty crashes} / N_y) / L$$

where N_y and L are as above.

Collective risk represents the total risk along a length of road, as opposed to the risk faced by each individual driver. For example, a link might experience a relatively low number of crashes. Other things being equal, this low number of crashes would equate to a relatively low collective risk. However, if this link also carried very low traffic volumes, then the few motorists that use the link might actually face a relatively high personal risk. Conversely, if that link carried a high traffic volume, then the risk to each individual motorist would be low.

Having calculated the risk of a casualty crash for each link, the links are then assigned a risk rating. The risk ratings, shown in Table 2, were determined using the results published in the 2004 AusRAP report, entitled *How Safe Are Our Roads?* The results, which included rural links on the National Highway System, were allocated to one of five bands (quintiles) such that the first 20% of links are allocated to the low risk category, the next 20% to the low/medium risk category and so on up until the top 20% of links with the highest risk are allocated to the high risk category. The five risk categories are also colour coded (see Table 2) and these colours are used in the maps to highlight the different levels of risk.

Table 2: AusRAP risk bands (lower thresholds)

Risk Rating	Percentage	Collective risk (per km)	Individual risk (per 100m veh-km)	Colour
Low	Best 20% of links	0	0	Dark green
Low / Medium		0.0323	6.8488	Light green
Medium	Middle 20% of links	0.1045	9.5570	Yellow
Medium / High		0.1745	12.3352	Red
High	Worst 20% of links	0.2853	16.4423	Black

It is envisaged that these risk bands will remain fixed, so that changes in a link's crash rates in the future can be illustrated by changes in its risk rating. It is also noted that as the network of roads assessed by AusRAP increases, the proportions of links within each rating band will change. Given that the National Highway System notionally includes the highest quality rural highways in Australia, the addition of new highways is likely to result in an increase in the proportion of links rated in the higher risk categories. For example, in 2005 the analysis is being extended to the AusLink National Network, which includes the Pacific Highway in New South Wales. It is highly likely that, at least in terms of collective risk, the inclusion of the Pacific Highway will result in an increase in the total number of links rated in the higher risk bands.

Finally, an analysis of the types of crashes that occurred along each link is conducted. Analysing crash types provides insight into ways to prevent casualties. For example, because divided roads ensure that lanes of opposing traffic are separated by a median, and because they typically have wide shoulders, few intersections and barriers around roadside hazards, the risk of being involved in a crash when driving on a divided road is much lower than that of a normal two-lane two-way road.

Crashes are grouped into six categories, as follows:

- run off road on straight;
- run off road on curve;
- head on;
- rear end;
- intersection; and
- other (which includes crashes involving u-turns, parking, pedestrians and cyclists).

Crashes are assigned to these categories according to each crash's description (which is in Definition for Coding Accidents (DCA), Road User Movement (RUM) or some other format). Unfortunately, because crashes are described differently by the jurisdictions, assigning crashes to one of the six classifications is difficult. For example, a crash described as being a head on (vehicles from opposing directions) is assigned a DCA of 201 in Queensland, but in Victoria that same crash type is assigned a DCA of 120. Thus, additional analysis is required to assign various crash types from each of the states into the six categories. As an example of the way in which DCA's are grouped, Table 3 shows the crash categorisation used for Victoria and Queensland.

Table 3: Crash types in Victoria and Queensland

Crash type	Victoria DCA	Queensland DCA
Run off road on straight	170-173, 175, 179	700-704, 706-708
Run off road on curve	180-183, 189	800-804, 806-808
Head on	120, 150	201, 501
Rear end	130-132	301-303
Intersection	110-119, 121-125, 129	100-109, 200, 202-206
Other	All others	All others

3.5 Results

For the purposes of illustrating typical risk map results, we focus on Queensland crash rates for the period 1999-03 in this paper.

The AusLink National Network in Queensland consists of the Bruce Highway, Pacific Highway, Warrego / Landsborough / Barkly Highway, Gore Highway, New England Highway and Flinders Highway. With the exception of the Pacific Highway, rural links on each of these highways has been examined. The Pacific Highway has been excluded at this stage because it has recently undergone a major upgrade, such that crash data for the current alignment is not available. In total, 4,705 km of the Queensland National Network has been analysed.

The collective risk map for Queensland for the period 1999-03 is shown in Figure 1. The map indicates that in terms of collective risk, the five riskiest links are: Bruce Highway from Bald Hills to Caloundra; Warrego Highway from Helidon to Toowoomba; Bruce Highway from Caloundra to Cooroy; Warrego Highway from the Cunningham Highway to Gatton; and Bruce Highway from Cooroy to Gympie.

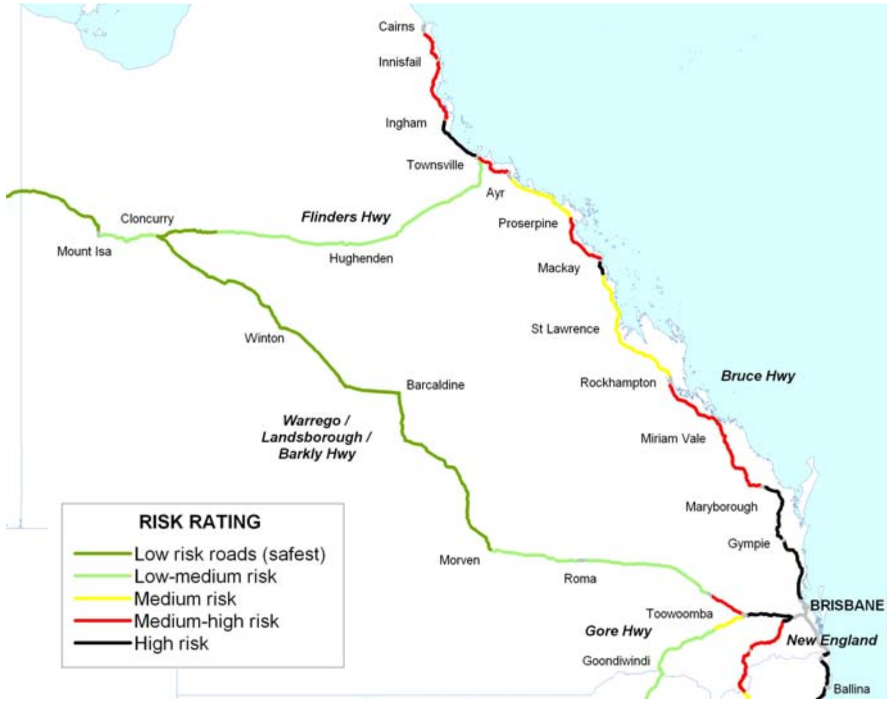


Figure 1: Collective risk ratings, Queensland, 1999-03 (casualty crashes per km)

Figure 2 shows the individual risk map for Queensland for 1999-03. This map indicates that in terms of individual risk, the five riskiest links are: the Barkly Highway between Mt Isa and the Northern Territory border; Flinders Highway between Richmond and Julia Creek; Flinders Highway between Julia Creek and the Barkly Highway; New England Highway between Stanthorpe and the NSW border and the Warrego Highway between the Flinders Highway and Mount Isa.

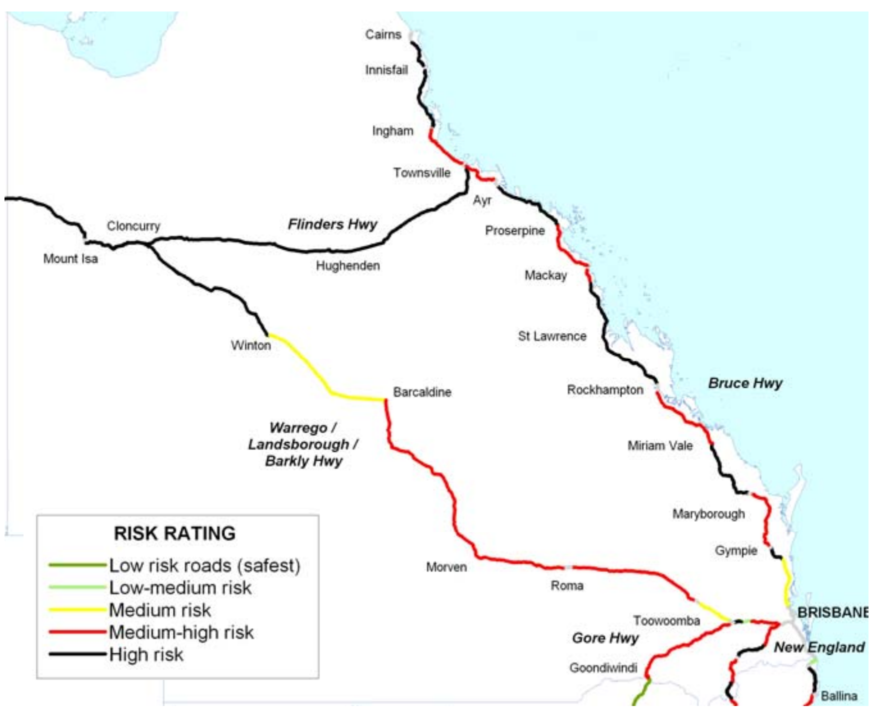


Figure 2: Individual risk ratings, Queensland, 1999-03 (casualty crashes per 100m veh-km)

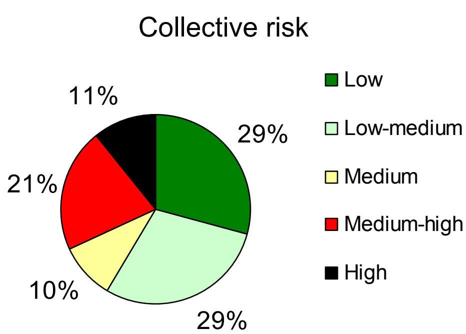
On both maps, the Bruce Highway generally has medium-high and high risk links. However, the Warrego / Landsborough / Barkly Highway (at least to the west of Toowoomba) for example, is rated as being relatively low risk in collective terms but relatively high risk in individual terms. This indicates that although this highway experiences relatively few crashes overall, when it's traffic volume is taken into account (which is relatively low), the highway is actually quite risky for the individual motorist.

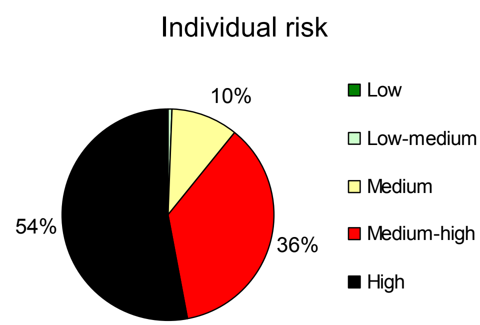
In terms of raising awareness for the average motorist, this feature of the maps can be quite difficult to digest. To address this issue, in the first AusRAP report ("How Safe Are Our Roads?") we attempted to combine the results, such that roads which rated poorly on both collective and individual risk could be considered priorities for investment and highlights roads on which motorists should exercise care. Alternatively, roads which rate well on both collective and individual risk are those that might not require additional attention in the short term.

An example of a link which scored poorly on both measures, such that it might be a candidate for investment and extra care by motorists, is on the Bruce Highway between Cooroy and Gympie. This link is rated as being high risk for both the collective and individual measures.

It is perhaps appropriate at this stage of the paper to reinforce that the results produced by AusRAP are far more than just statistics; they are a reflection of very real road trauma. At the time of writing, for example, the Cooroy to Gympie section of the Bruce Highway was the scene of a double fatality in which a 51 year old man and a 54 year old woman were killed (Chilcott-Moore, 2005). The road toll is not just a statistic—it involves sudden loss, suffering and financial hardship, and changes the lives of thousands of Australian families forever. This is the central concern of AusRAP.

Apart from analysing risk according to specific road links, it is possible to examine results on state-wide level. For example, crash rates can be examined according to the percentage length of road classified in each risk rating. This type of analysis provides a basis for overall snapshots of how well or poorly a jurisdiction is progressing in terms of road safety from year to year. An example of this is shown in Figures 3a and 3b. Figure 3a shows that on a length basis, 29 per cent of the National Network highways in Queensland are classified as having low collective risk, 29 per cent low-medium, 10 per cent medium, 21 per cent medium-high and 11 per cent high risk. Figure 3b shows that on a length basis, none of the highways are classified as having low individual risk, less than 1 per cent low-medium, 10 per cent medium, 36 per cent medium/high and 54 per cent high risk.





Figures 3a and 3b: Lengths of road classified by risk rating, Queensland, 1999-03 (%)

Finally, an examination of the types of crashes that occur provides an insight into what types of road safety treatments might be required. For the purposes of this illustration, links along the Warrego / Landsborough / Barkly Highway (which runs from Ipswich to the Northern Territory border) are examined, as shown in Figure 4.

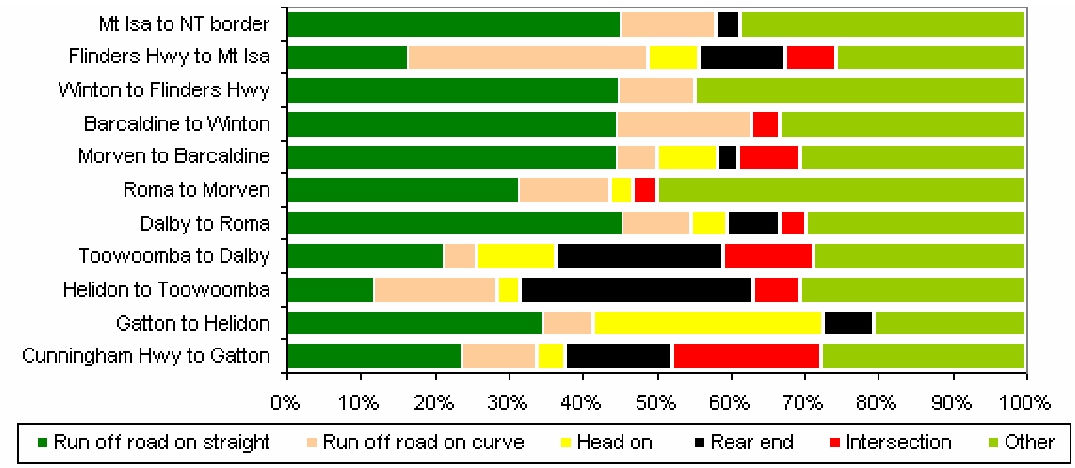


Figure 4: Crash types by link, Warrego / Landsborough / Barkly Highway, 1999-03 (%)

Figure 4 shows crashes on each of the links classified into the six categories. As can be seen, run off road type crashes are the most prevalent type of crash, particularly on the roads west of Toowoomba which tend to traverse more sparsely populated regions. In these areas, run off road crashes typically account for more than 50 per cent of crash types, with run off road on straight type crashes typically forming the majority of these. According to research published by the RACV (2003), the types of treatments that are effective in reducing the severity of run off road crashes include installing safety barriers, removing specific roadside hazards, sealing road shoulders and adding overtaking lanes.

The links to the east of Toowoomba, which have lower proportions of run off road crashes, tend to have higher proportions of intersection and rear end crashes, which are typical of roads that carry higher traffic volumes, where the opportunity for interaction between vehicles is higher. Hence, the types of treatments that might be considered would be along the lines of those employed in more urbanised areas, such as the installation of deceleration and acceleration lanes at intersections.

3.6 Conclusion

One of the initial aims of this research was to test whether producing risk maps nationally was feasible. Despite a number of what might be called 'teething' problems, which are often associated with new programs such as this, the work to date indicates that risk mapping is indeed feasible. Notably, while EuroRAP provides a useful basis for this type of analysis, some significant adjustments were needed to accommodate Australian conditions.

Nevertheless, we face a number of challenges in ensuring the accuracy and reliability of results, many of which stem from the fact that data supplied by the individual jurisdictions is of varying quality and format. In addition to the fact that crash severity, crash types and traffic volumes are coded differently by jurisdictions, there are a number of other differences which complicate the process. For example, the majority of jurisdictions assign spatial coordinates to crashes, which allows them to be plotted on an electronic map. However, there is often a proportion crashes that do not have this information attached, and therefore must be manually placed on the road network—this is a time consuming and sometimes imprecise process. The proportion of crashes without this spatial data tends to vary between jurisdictions.

Similarly, there are instances in which the spatial data and description of the crash location obviously differ. In these cases it is difficult, if not impossible, to be precise about the actual crash location. To assist us in addressing these kinds of challenges, we will continue to work closely with the road authorities, and are also developing a specialised data management system. However, national road safety would undoubtedly benefit from a program to address the fundamental cause of these issues—that jurisdictions employ different data management systems.

Overall, our research has shown that risk mapping has the potential to provide an insight into how well, or poorly, a length of road is performing in terms of road safety. However, the risk maps provide only a limited insight into the contribution that the actual road infrastructure has in respect to crash rates. This aspect is more adequately covered by the Road Protection Score (RPS).

4 Road Protection Score

The Road Protection Score is the second AusRAP protocol. ARRB Transport Research has been engaged to assist in the development of the RPS, which is an adaptation of ARRB's Road Safety Risk Manager research. Because of this, and because the protocol is incomplete, we have limited our description of the RPS to general terms. To date, pilot RPS projects have been completed by the RACV and VicRoads on four highways in Victoria.

The RPS measures the inherent risk of injury on a road according to an examination of the road's physical features, as opposed to examining crash rates as is the case in the risk maps. Data on the road's physical features is collected by conducting a "drive through" inspection in specially equipped vehicles to capture digital images of the roads. The process involves the collection of images at regular intervals (generally at 20m to 50m in length) from a number cameras mounted on the front, back and sides of the vehicle. This process is conducted at highway speed, which allows collection to be undertaken at no greater risk than normally present when driving along a road.

The images are able to be joined together to produce a "video" of the drive through inspection, which can be analysed at later time. Using specially developed software, the user is able to examine this video at normal driving speed, in slow motion or on a frame by frame basis. The software also enables reasonably accurate estimates of lengths (such as lane width) to be made.

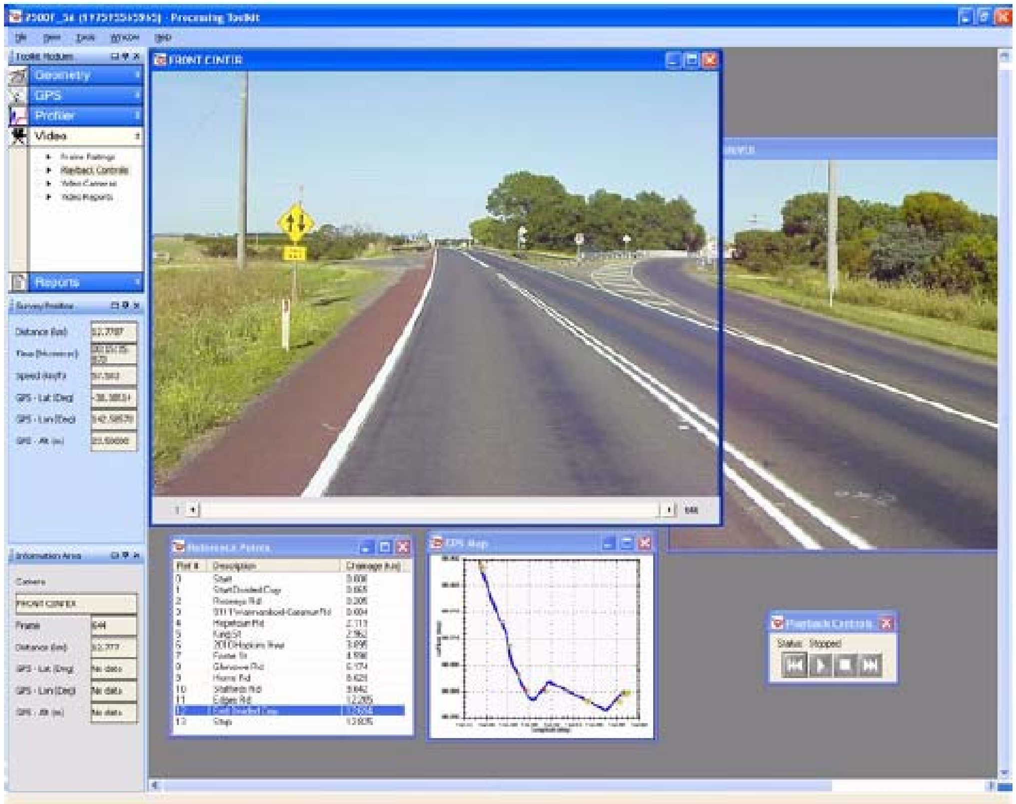


Figure 5: Sample image from ARRB Hawkeye equipment (ARRB, 2005)

The final RPS for a road link (which is defined along similar lines as in the risk mapping process) is a combination of weighted sub scores based on run off road crash type features of the road, head on features and intersection features. The principle behind using these three crash types (as opposed to say, pedestrian crashes) is that they represent the vast majority of crashes on rural highways. Thus the process is somewhat simplified by examining these types of features alone. On the Western Highway in Victoria, for example, these three crash types account for around 77 per cent of crashes.

Each of the RPS sub scores is calculated by considering road type, road engineering and severity factors which are known to influence crash risk and severity, and which are able to be examined using the video images from the drive through inspection. Road type factors include whether or not the road is divided, or for the case of the intersection sub score, whether the intersection is grade separated, 4-leg or 3-leg. Road engineering features include lane and shoulder widths, vertical and horizontal alignment, speed of traffic, overtaking availability and demand, delineation and skid resistance. Finally, severity factors include how far away particular hazards are away from the road and an estimate of crash severity if objects are hit.

The three sub scores for each road link are then combined to form an overall RPS. Hence, the safety of the road infrastructure, quite separate to whether crashes have yet actually occurred, or how many have in fact occurred, can be determined by a measure of relative risk. This measure can be converted into an easily communicated ‘score’ which allows for informed dialogue with the community on road infrastructure safety, through creating of a common ‘language’ for the discussion.

From a technical perspective, the research conducted so far on the RPS has shown its feasibility. It is hoped that the methodology will be finalised in coming months, and its application nationally will follow thereafter.

5 Conclusion

AusRAP is designed to build on the European equivalent, EuroRAP, by applying the philosophy of independent assessment in the Australian context, which in many ways has distinct road environments, traffic patterns and governance. AusRAP's model for reducing death and injury aligns closely with Sweden's Vision Zero. It is based on roads and vehicles that have forgiving designs so that when a crash does happen, both road and vehicle work together to mitigate against injury.

One of the initial aims of our research to date was to test whether the two AusRAP protocols: risk mapping and the Road Protection Score (RPS) are feasible in the Australian context. Results to date—namely the risk maps for the National Network and the completion of a pilot of the RPS in Victoria—indicate that AusRAP is indeed a feasible proposition.

Although we face a number of technical and communications challenges, if successful, AusRAP will, by giving roads across Australia a safety rating, make the risk of death and injury on different roads more meaningful and stimulate public discussion. It will help road users understand how risk can vary according to changes in the road environment. Risk-aware road users will be more likely to adapt their driving to reduce their risk of a crash. The ratings will also provide road planners and engineers with vital benchmarking information to show them how well, or badly, particular roads perform compared with others.

6 Acknowledgments

The authors would like to acknowledge Australia's motoring clubs and the State and Territory road authorities for providing technical assistance and data to AusRAP.

7 References

Australian Transport Council (2000) *The National Road Safety Strategy;* ATC.

Australian Transport Safety Bureau (2005) *Fatal Road Crash Database* http://www.atsb.gov.au; ATSB.

Bureau of Transport and Regional Economics (2002) *Greenhouse Gas Emissions From Transport, Australian Trends to 2020* Report 107 Canberra; BTRE.

Chilcott-Moore, T (2005) Two more lives lost on horror stretch of road *The Courier Mail* Tuesday 21 June 2005.

Daly, P, Metcalfe, J and McLean, J (2003) Development of Road Assessment Protocols *Papers of the 21st Australasian Transport Research Forum 25* Cairns: ATRF

Royal Automobile Club of Victoria (2003) *Lifeline: Situation Critical* Melbourne; RACV.

Werkmeister, K and Borchers, N (2003) A Balanced Active and Passive Safety Concept For New Vehicle Generations *Proceedings of the 18th International Technical Conference on the Enhanced Safety of Vehicles (ESV)* Nagoya, Japan.