Use and Validation of Risk-Weighted Speed Observation Data for Countermeasure Evaluation

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Abstract

In the absence of suitable crash data, speed observation data can give an indication of the effectiveness of speed-related road safety countermeasures. It is proposed that the use of risk-weighted data is more appropriate. The aim of this investigation was to develop a method for risk-weighting speed observation data in both urban and rural areas for use as an evaluation tool. Speed observation data was weighted by the appropriate risk of a casualty crash. This enabled the magnitude of the reduction in casualty crashes that could have been expected from a change in the on-road speed distribution to be estimated. The outcomes were validated against the results of a crash-based evaluation of a speed-related enforcement package that was implemented in Victoria from December 2000 until July 2002. They were generally consistent with the crash-based evaluation after the degree of representation of the collected speed observation data was taken into account.

Keywords

Speed, Risk-Weighting, Countermeasure Evaluation

Introduction

We have sufficient knowledge of the link between travel speed and casualty crash risks in urban and rural areas to make an approximate estimate of the expected magnitude of the reduction in casualty crashes from a change in the on-road speed distribution, especially the change in the proportion of vehicles exceeding the speed limit. Kloeden *et al.* [1] has established the relationship for the risk of involvement in a casualty crash in urban 60 km/h speed zones, and Kloeden *et al.* [2] has quantified the relationship between rural travel speeds and the risk of involvement in a casualty crash in 80 km/h or greater speed zones.

On this basis, it is possible to analyse speed observation data, especially the proportions of vehicles travelling above certain excessive speed levels, weighting the speed levels by the appropriate risk of a casualty crash, to estimate the changes in casualty crashes that could be expected from the speed behaviour changes. This type of analysis is likely to provide more sensitive estimates than could be expected from an analysis of the road trauma effects of changes in mean speed by appealing to Nilsson's [3] laws. In addition, numerous MUARC studies of the introduction of new speed limits and speed enforcement programs have found substantial reductions in severe crashes at the time of little or no reduction in mean speeds, but substantial reductions in excessive speeds.

The objectives of this research were to develop a method for risk-weighting speed observation data in both urban and rural areas for use as an evaluation tool; and to validate the outcomes against results of a crash-based evaluation performed by D'Elia *et al.* [4] of a speed-related enforcement package that was implemented in Victoria from December 2000 until July 2002. The ultimate aim is for the work to lead to risk-weighted speed observation data serving as a more appropriate proxy for the evaluation of speed-related road safety countermeasures where there is a lack of suitable crash data.

Method

The following method considers changes in the on-road speed distribution within fixed speed zones. As such, it uses the relative risk curves established by Kloeden *et al.* [1] and Kloeden *et al.* [2] and tests the validity of using such an approach, i.e. one based on risk related to relative speed, rather than one based on absolute speed. In addition, the method measures changes that could be expected from changes in the speed distribution only, and not from changes in exposure. Comparing expected changes in casualty crashes resulting from changes in the speed distribution against outcomes of the crash-based evaluation was considered valid as the crash analysis took exposure into account through the inclusion of an appropriate covariate in the regression model.

For metropolitan Melbourne, raw speed observation data was received from VicRoads for 60, 70, 80, 90 and 100 km/h zones, and for rural Victoria aggregated raw data was acquired for 60, 70, 80, 90, 100 and 110 km/h speed zones. In metropolitan Melbourne, small samples (100-130) of vehicles travelling at free speed have been measured at sites during weekday off-peak daylight hours. This has occurred in May and November of each year since November 1994. For this study, data from January 1999 to December 2004 inclusive was chosen to cover the analysis period of the crash-based evaluation. In rural Victoria, there are 64 permanent counting telemetry sites where on-road speed data is continuously collected. Data has been collected for rural strategic traffic monitoring programmes since 1998 however data in standardised speed bins is only available from 2001 onwards. Due to the large quantity of information, the raw data was aggregated into 6 month periods of January to June inclusive and July to December inclusive prior to being received.

The Melbourne speed observation data is limited. There are relatively few sites and they have not been chosen to be representative of traffic in Melbourne. Sufficient data for analysis has only been collected for 60, 70 and 80 km/h speed zones. The proportion of vehicles observed in the speed categories of 1-9, 10-14, 15-19, 20-24, 25-29 and 30+ km/h above the speed limit were compiled for each speed zone (Appendix A).

Each category was risk-weighted using the following relationship for the relative risk (*RR*) of casualty crash involvement established by Kloeden *et al.* [1] for urban 60 km/h speed zones:

$$RR(V) = e^{-0.822957835 - 0.083680149V + 0.001623269V^2} \qquad (1)$$

where V is the free travelling speed in km/h. The "Not Exceeding" category was given a risk-weighting of 1, whilst the excessive speed categories were given risk-weightings based on the mid-point of their respective speed ranges except for the category "30+ km/h" where the risk-weighting was based on a speed of 30 km/h above the limit. The risk-weightings that resulted from this approach are shown in Table 1. For each excessive speed category, the proportions given in Appendix A were multiplied by the corresponding risk factor to produce risk-weighted speed observation data.

Table 1: Risk-Weightings for the 60 km/h Speed Zone

		Excessive Speed Range					
		1-9 km/h	10-14	15-19	20-24	25-29	30+
Mid-mark	0	5	12	17	22	27	30
Speed	60	65	72	77	82	87	90
RR(V)	1	1.82	4.79	10.57	25.28	65.59	120.82

It is important to note that the relationship established by Kloeden *et al.* [1] was derived for an urban 60 km/h speed environment. However in order to obtain an approximate indication of the possible effect of speed changes on crash outcomes in 70 and 80 km/h metropolitan speed zones, it was desirable to apply risk-weightings to the speed categories for these zones also. The most direct way to do this was to apply the same risk-weightings to the equivalent speed categories for 70 and 80 km/h speed zones as were calculated for the 60 km/h speed zone, i.e. the shape of the risk curve was maintained, but the reference point was shifted from 60 km/h to 70 or 80 km/h as appropriate.

The Victorian rural speed observation data is greater in volume than the metropolitan data, but the representativeness of the sites is unknown. Sufficient data for analysis has only been collected for 80, 100 and

110 km/h speed zones. The proportion of vehicles observed in the speed categories of 1-5, 6-9, 10-14, 15-19, 20-24, 25-29 and 30+ km/h above the speed limit were assembled for each speed zone (Appendix B).

Each category was risk-weighted using the following relationship for the relative risk of casualty crash involvement established by Kloeden *et al.* [2] for rural speed zones:

$$RR(\Delta V) = e^{0.07039\Delta V + 0.0008617\Delta V^2} \qquad (2)$$

where ΔV is the difference between free travelling speed and mean traffic speed in km/h. The "Not Exceeding" category was given a risk-weighting of 1, whilst the other speed categories were given risk-weightings based on the mid-point of their respective speed ranges except for the category "30+ km/h" where the risk-weighting was based on an excessive speed of 30 km/h. It should be noted that median rather than mean speeds were used in the application of the risk function. Victorian rural median speeds for the 80, 100 and 110 km/h speed zones are provided in Appendix C. As median speeds vary by observation period it follows that the calculated risk-weightings also vary. They are presented in Table 2 for the 80 km/h speed zone and in Appendix D for the other speed zones. For each excessive speed category, the proportions given in Appendix B were multiplied by the corresponding risk factor to produce risk-weighted speed observation data.

Table 2: Risk-Weightings for the 80 km/h Speed Zone

			Excessive Speed Range						
			1-5 km/h	6-9	10-14	15-19	20-24	25-29	30+
	Mid-mark	0	3	7.5	12	17	22	27	30
	Speed	80	83	87.5	92	97	102	107	110
RR(ΔV)	**Period** 2001_1	1	1.38	1.99	2.98	4.86	8.28	14.71	21.20
	2001_2	1	1.39	2.01	3.00	4.90	8.34	14.82	21.36
	2002_1	1	1.45	2.11	3.17	5.19	8.88	15.87	22.94
	2002_2	1	1.48	2.16	3.25	5.33	9.15	16.37	23.71
	2003_1	1	1.54	2.24	3.39	5.60	9.64	17.32	25.14
	2003_2	1	1.55	2.27	3.43	5.67	9.77	17.57	25.52
	2004_1	1	1.54	2.24	3.39	5.59	9.62	17.28	25.08
	2004_2	1	1.52	2.21	3.34	5.49	9.44	16.95	24.58

Results

For metropolitan Melbourne, Figure 1 shows the proportion of vehicles observed in the speed categories of 1-9, 10-14, 15-19, 20-24, 25-29 and 30+ km/h above the speed limit and the proportion of vehicles not exceeding the speed limit after each category was risk-weighted using the relationship established by Kloeden *et al.* [1] for urban 60 km/h speed zones. Figure 2 shows risk-weighted proportions for the 70 and 80 km/h speed zones.

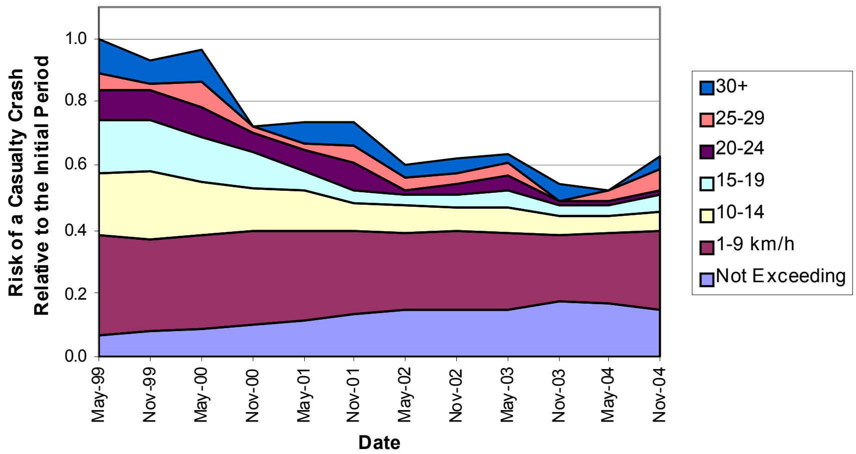

Figure 1: Risk-Weighted Proportions of Vehicles Observed in the 60 km/h Speed Zone

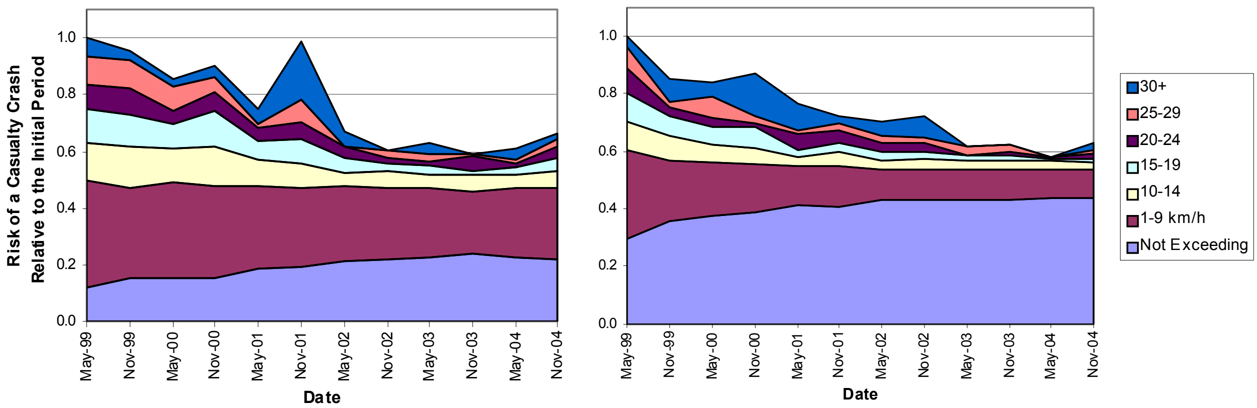

Figure 2: Risk-Weighted Proportions of Vehicles Observed in the 70 (left) and 80 km/h Speed Zones

For rural Victoria, Figure 3 shows the proportion of vehicles observed in the speed categories of 1-5, 6-9, 10-14, 15-19, 20-24, 25-29 and 30+ km/h above the speed limit and the proportion of vehicles not exceeding the 80 km/h speed limit after each category was risk-weighted using the relationship established by Kloeden *et al.* [2] for rural speed zones. Similarly, Figure 4 shows risk-weighted proportions for the 100 and 110 km/h speed zones.

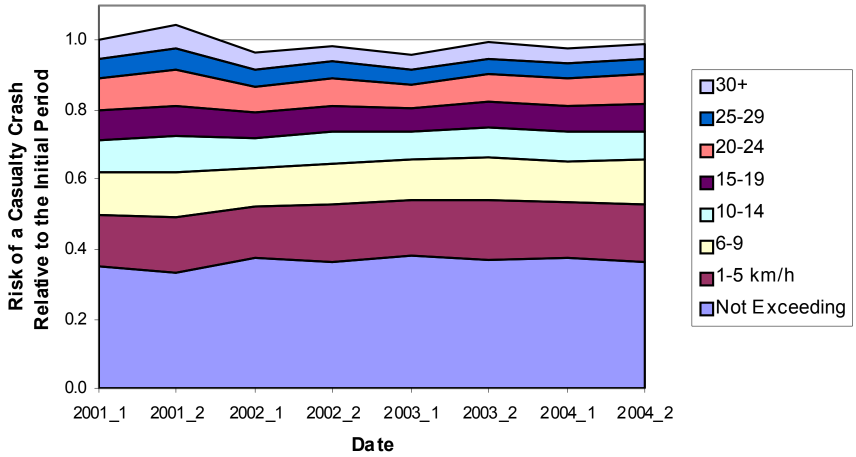

Figure 3: Risk-Weighted Proportions of Vehicles Observed in the 80 km/h Speed Zone

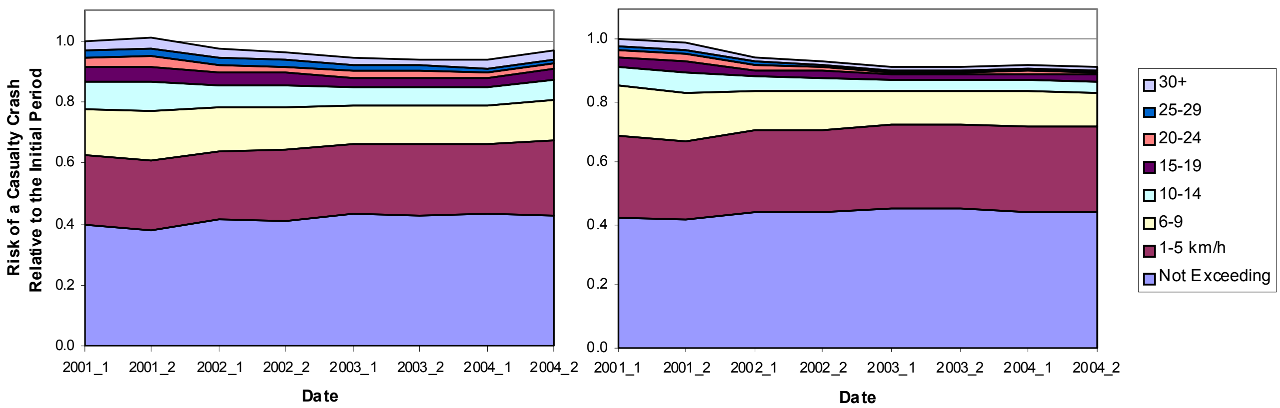

Figure 4: Risk-Weighted Proportions of Vehicles Observed in the 100 (left) and 110 km/h Speed Zones

Validation and Discussion

Weighting speed observation data by the appropriate risk of a casualty crash enables the magnitude of the reduction in casualty crashes that could be expected from a change in the on-road speed distribution to be estimated. The risk-weighting takes into account the exponential rise in the risk of involvement in a casualty crash that occurs according to Kloeden *et al.* [1] and Kloeden *et al.* [2] as the level of excessive speed increases. Figures 1 and 2 show that for metropolitan speed zones, a reduction in the number of casualty crashes should be expected over the analysis period. The risk-weighted proportions of vehicles observed in the 60 km/h speed zone (Figure 1) illustrates that the total expected casualty crash risk associated with speed appears to have fallen substantially during 2000, before the speed-related initiatives commenced, but then decreased again by 17% between November 2001 and May 2002 when most of the speed-related initiatives had come into effect.

The crash-based evaluation by D'Elia *et al.* [4], which defined the speed-related package to start from August 2001 for the purpose of assessing its overall impact, showed a reduction in the number of casualty crashes in

40, 50 or 60 km/h speed zones of 6.14% (and a reduction of 4.62% in metropolitan Melbourne) associated with it. Therefore the expected reduction in casualty crashes estimated from the speed behaviour changes would appear to be larger than those estimated from the crash analysis. However it is difficult to draw a conclusion from this result if we note the following points. Firstly there are relatively few speed observation sites and they have not been chosen to be representative of traffic in Melbourne. In particular, they measure vehicles travelling at free speed during weekday off-peak daylight hours. Secondly the risk curves developed by Kloeden *et al.* [1] for an urban 60 km/h speed limit environment were developed for South Australia and were mostly based on the crash types oncoming vehicle turning right across the path of the free travelling speed vehicle and vehicle turning right from the side street on the left of the free travelling speed vehicle. In Victoria however the most common type of casualty crashes in 60 km/h speed zones (which are predominantly located in metropolitan Melbourne) are rear end crashes followed by those involving vehicles turning right across the path of another vehicle.

In contrast with the risk-weighted proportions of vehicles observed in metropolitan speed zones (Figures 1 and 2), Figures 3 and 4 for rural speed zones do not give a clear indication of whether a reduction in the number of casualty crashes should be expected. The total expected risk of a casualty crash in the 80 km/h rural speed zone (Figure 3) is generally stable, with Figure 4 for 100 and 110 km/h rural speed zones showing a small reduction over the analysis period except for late 2004 for the 100 km/h speed zone. The risk-weighted speed observation data for rural speed zones appears to be in contrast with the crash-based evaluation, which showed an estimated increase in casualty crashes of 1.53% for the non-metropolitan region, however this result was non-statistically significant. On the other hand, disaggregated casualty crash results for 100 or 110 km/h roads, which showed a statistically significant estimated reduction in casualty crashes of 4.93%, do seem to be consistent with the risk-weighted speed observation data if we consider that a majority of casualty crashes on these roads occurred in the non-metropolitan location (2004 data). Exactly how representative the rural speed observation data is of overall rural speeds is unknown, however it is greater in volume than the metropolitan data and for this reason might be expected to be more reliable. With regards to the application of the risk curves for rural speed zones, an alternative approach might see the mean (or median) speed from the initial period being held constant over time for the purpose of calculating risk-weightings, however the issue of whether risk is more related to the mean speed than the speed distribution is a complex one that has not been clearly established and would require further investigation beyond the scope of this paper.

As mentioned above, the crash-based evaluation showed a highly statistically significant 4.62% estimated reduction in casualty crashes for the metropolitan location associated with the implementation of the speed-related package. Certainly a general reduction in the number of vehicles exceeding the speed limit in the metropolitan region seems to have contributed to the estimated reduction. In terms of crash severity, it should be expected that casualty crashes involving pedestrians (which mainly occur in Melbourne) should benefit from a reduction in excessive speed, as our knowledge of biomechanical tolerances suggests that such crashes are associated with greater decreases in serious injury risk for a given decrease in impact speed. For such crashes, an estimated reduction of 20% associated with the speed-related package in both the proportion of casualty crashes that were fatal and the proportion of fatal or serious injury crashes that were fatal seems to be consistent with this hypothesis however these results were non-statistically significant.

Regarding the level of uncertainty in the results, the large amount of speed observation data collected means that its variability is likely to be small. Rather, variability is more likely to arise from the use of the relative risk curves established by Kloeden *et al.* [1] and Kloeden *et al.* [2]. A consideration of the confidence limits on the risk-weightings was outside the scope of this paper, however confidence intervals surrounding the larger risk-weightings do become quite wide. Although this was not taken into account, if the method was to be used as a definite proxy for a crash-based evaluation then confidence limits for the expected reductions in casualty crashes should be calculated.

A key assumption of the paper was that the relative risk curves were appropriate for use. Despite being developed for a different road environment, reasonable consistency between results derived from the risk-weighted speed observation data and the crash-based evaluation was achieved, suggesting a degree of robustness to the method. Nonetheless, inadequacies in applying the relative risk curves to Victorian speed observation data were highlighted above. It is recommended that risk curves be developed for use in different road environments.

Conclusion

A method for risk-weighting speed observation data in both urban and rural areas for use as an evaluation tool has been developed, with the outcomes validated against results of a crash-based evaluation of a speed-related enforcement package that was implemented in Victoria from December 2000 until July 2002. The results were found to be generally consistent with the crash-based evaluation after the degree of representation of the collected speed observation data was taken into account. However, if the method is to be used as a definite proxy for a crash-based evaluation, it is recommended that risk curves be developed for the specific road environment. In addition, further work should be performed to quantify the level of uncertainty, something that was beyond the scope of this paper. It is hoped that this work will lead to risk-weighted speed observation data serving as a more appropriate proxy for the evaluation of speed-related road safety countermeasures where there is a lack of suitable crash data.

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References

1. Kloeden, C. N., McLean, A. J. & Glonek, G. (2002). *Reanalysis of Travelling Speed and the Risk of Crash Involvement in Adelaide and South Australia*, Report No. CR 207, Australian Transport Safety Bureau.

2. Kloeden, C. N., Ponte, G. & McLean, A. J. (2001). *Travelling Speed and the Risk of Crash Involvement in Rural Roads*, Report No. CR 204, Australian Transport Safety Bureau.

3. Nilsson, G. (1984). *Speeds, accident rates and personal injury consequences for different road types.* Rapport 277, Swedish National Road and Transport Research Institute (VTI), Sweden.

4. D'Elia, A., Newstead, S. & Cameron, M. *Overall Impact of Speed-Related Initiatives and Factors on Crash Outcomes*. 51st Annual Proceedings, Association for the Advancement of Automotive Medicine, 15-17 October, 2007, pp. 465-484.

Appendix A – Proportion of Vehicles Observed Exceeding the Speed Limit (Metropolitan Melbourne)

60 km/h Speed Zone

Excessive Speed Range	Period											
	May 1999	Nov 1999	May 2000	Nov 2000	May 2001	Nov 2001	May 2002	Nov 2002	May 2003	Nov 2003	May 2004	Nov 2004
1-9 km/h	55.9%	51.6%	53.0%	53.2%	50.8%	47.7%	42.1%	43.4%	42.5%	37.8%	39.0%	43.0%
10-14	13.3%	14.6%	11.4%	9.1%	8.6%	5.9%	6.0%	5.2%	5.5%	3.9%	3.9%	4.4%
15-19	5.1%	5.0%	4.2%	3.5%	1.8%	1.2%	1.1%	1.4%	1.8%	1.2%	1.0%	1.6%
20-24	1.2%	1.2%	1.3%	0.8%	0.9%	1.1%	0.2%	0.4%	0.6%	0.1%	0.1%	0.2%
25-29	0.3%	0.1%	0.4%	0.1%	0.1%	0.3%	0.2%	0.1%	0.2%	0.0%	0.2%	0.3%
30+	0.3%	0.2%	0.3%	0.0%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%

70 km/h Speed Zone

Excessive Speed Range	Period											
	May 1999	Nov 1999	May 2000	Nov 2000	May 2001	Nov 2001	May 2002	Nov 2002	May 2003	Nov 2003	May 2004	Nov 2004
1-9 km/h	55.3%	47.3%	49.0%	47.8%	42.6%	40.6%	38.1%	36.9%	34.5%	32.2%	35.2%	36.0%
10-14	7.4%	7.9%	6.6%	7.4%	5.1%	5.1%	2.7%	3.1%	2.9%	3.0%	2.6%	3.6%
15-19	2.9%	2.7%	2.1%	3.2%	1.6%	2.1%	1.3%	0.7%	0.8%	0.6%	0.6%	1.1%
20-24	0.9%	1.0%	0.5%	0.8%	0.5%	0.6%	0.4%	0.2%	0.1%	0.4%	0.2%	0.4%
25-29	0.4%	0.4%	0.3%	0.2%	0.0%	0.3%	0.0%	0.1%	0.1%	0.0%	0.0%	0.1%
30+	0.1%	0.1%	0.0%	0.1%	0.1%	0.4%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%

80 km/h Speed Zone

Excessive Speed Range	Period											
	May 1999	Nov 1999	May 2000	Nov 2000	May 2001	Nov 2001	May 2002	Nov 2002	May 2003	Nov 2003	May 2004	Nov 2004
1-9 km/h	34.2%	22.6%	20.3%	17.9%	14.9%	16.1%	12.2%	11.8%	12.0%	11.3%	10.5%	10.7%
10-14	4.4%	3.7%	2.6%	2.5%	1.3%	1.9%	1.2%	1.7%	1.0%	1.2%	1.2%	1.2%
15-19	1.8%	1.4%	1.1%	1.4%	0.4%	0.7%	0.6%	0.5%	0.4%	0.4%	0.2%	0.2%
20-24	0.7%	0.3%	0.3%	0.1%	0.4%	0.3%	0.2%	0.2%	0.0%	0.1%	0.0%	0.1%
25-29	0.2%	0.0%	0.2%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%
30+	0.1%	0.1%	0.1%	0.2%	0.2%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%

Appendix B – Proportion of Vehicles Observed Exceeding the Speed Limit (Rural Victoria)

80 km/h Speed Zone

Excessive Speed Range	Period: 2001_1	2001_2	2002_1	2002_2	2003_1	2003_2	2004_1	2004_2
1-5 km/h	18.6%	19.1%	17.5%	18.8%	17.9%	18.8%	17.9%	19.0%
6-9	10.7%	10.8%	9.2%	9.5%	8.9%	9.1%	9.0%	9.5%
10-14	5.4%	6.1%	4.6%	4.7%	4.1%	4.4%	4.3%	4.4%
15-19	3.0%	3.2%	2.4%	2.4%	2.1%	2.2%	2.2%	2.4%
20-24	1.9%	2.0%	1.4%	1.5%	1.2%	1.4%	1.4%	1.5%
25-29	0.7%	0.8%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%
30+	0.4%	0.5%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%

100 km/h Speed Zone

Excessive Speed Range	Period: 2001_1	2001_2	2002_1	2002_2	2003_1	2003_2	2004_1	2004_2
1-5 km/h	22.5%	23.3%	22.2%	23.2%	21.9%	22.8%	22.5%	23.2%
6-9	10.7%	11.8%	9.7%	9.4%	8.1%	8.2%	8.2%	8.3%
10-14	4.0%	4.3%	3.3%	3.2%	2.6%	2.6%	2.5%	2.6%
15-19	1.3%	1.5%	1.1%	1.1%	0.9%	0.9%	0.8%	0.8%
20-24	0.5%	0.6%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
25-29	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
30+	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%

110 km/h Speed Zone

Excessive Speed Range	Period: 2001_1	2001_2	2002_1	2002_2	2003_1	2003_2	2004_1	2004_2
1-5 km/h	23.8%	24.3%	24.0%	24.5%	24.2%	24.4%	25.1%	25.8%
6-9	9.9%	10.2%	8.0%	7.9%	6.7%	6.8%	7.2%	7.1%
10-14	2.6%	2.8%	1.9%	1.8%	1.4%	1.4%	1.5%	1.5%
15-19	0.8%	0.9%	0.6%	0.5%	0.4%	0.4%	0.4%	0.4%
20-24	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%
25-29	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
30+	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Appendix C – Median Speeds by Speed Limit (Rural Victoria)

Speed Zone	Period: 2001_1	2001_2	2002_1	2002_2	2003_1	2003_2	2004_1	2004_2
80 km/h	78.6	78.6	78.0	77.8	77.3	77.2	77.3	77.5
100	97.6	98.0	97.4	97.4	96.9	97.1	97.1	96.5
110	106.4	107.0	106.5	106.6	106.3	106.4	106.5	106.7

Appendix D – Risk-Weightings for the 100 and 110 km/h Speed Zones

100 km/h Speed Zone

			Excessive Speed Range: 1-5 km/h	6-9	10-14	15-19	20-24	25-29	30+
	Mid-mark	0	3	7.5	12	17	22	27	30
	Speed	100	103	107.5	112	117	122	127	130
RR(ΔV) Period	2001_1	1	1.50	2.19	3.31	5.44	9.34	16.76	24.29
	2001_2	1	1.45	2.11	3.17	5.19	8.89	15.88	22.96
	2002_1	1	1.53	2.23	3.37	5.56	9.56	17.17	24.91
	2002_2	1	1.52	2.21	3.34	5.51	9.47	16.99	24.65
	2003_1	1	1.58	2.32	3.51	5.81	10.04	18.10	26.32
	2003_2	1	1.56	2.29	3.46	5.72	9.87	17.77	25.82
	2004_1	1	1.56	2.28	3.46	5.71	9.85	17.74	25.77
	2004_2	1	1.63	2.40	3.65	6.06	10.50	18.99	27.67

110 km/h Speed Zone

			Excessive Speed Range: 1-5 km/h	6-9	10-14	15-19	20-24	25-29	30+
	Mid-mark	0	3	7.5	12	17	22	27	30
	Speed	110	113	117.5	122	127	132	137	140
RR(ΔV) Period	2001_1	1	1.66	2.43	3.71	6.16	10.69	19.37	28.25
	2001_2	1	1.58	2.31	3.50	5.79	9.99	18.01	26.18
	2002_1	1	1.64	2.41	3.67	6.09	10.56	19.11	27.86
	2002_2	1	1.62	2.38	3.62	6.00	10.40	18.80	27.38
	2003_1	1	1.67	2.46	3.74	6.23	10.81	19.61	28.61
	2003_2	1	1.65	2.43	3.70	6.14	10.65	19.30	28.14
	2004_1	1	1.63	2.40	3.65	6.06	10.49	18.99	27.66
	2004_2	1	1.61	2.36	3.58	5.93	10.25	18.52	26.96