

# STAR RATING SCHOOL WALKING ROUTES



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**Abstract:**

Walking is fundamental to human mobility, but its perceived importance as a transport mode has fallen dramatically in past decades. The benefits of walking for society are numerous, including improved health, reduced traffic and enhanced social connection. It has become a community health priority to introduce some of these benefits to primary school children by encouraging active transport to and from school. Consequently, it is vitally important to ensure that children are able to walk safely, with one of the biggest threats being the potential for injury at road crossing points.

A general method for rating the safety of individual road crossing points was devised, based on the 'star rating' concept familiar to many modern consumers of products and services. A model was developed that considered the main determinants of pedestrian crash and injury risk at a specified road crossing then, based on established relationships and expert consensus, mathematically combined them to generate a star rating between zero and five for each crossing point along a route. While the model is designed primarily for crossing points while recognising the abilities and limitations of children, it is intended to be generic in its application, subject to appropriate internal modifications.

This project demonstrated that it is feasible to objectively rate the safety performance of individual road crossing points, as well as to provide indications of overall route safety. Further work is desirable to improve both the robustness of the mathematical risk relationships utilised, as well as to broaden the applicability of the model to other walking populations and road environments.

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**Key Words:**

Walking, safety, children, pedestrians, road crossing, star rating, crash risk, injury risk, mathematical model

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# 1 INTRODUCTION

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Walking is the first and most fundamental means for humans to move. However, with the advent of motorised transport over the past century, its importance as a mode of transport has fallen dramatically. Indeed, among today's greatest global challenges are climate change, energy conservation and global health – in the Victorian context, inactivity and obesity among children have been identified as high priority concerns (Shilton and Naughton, 2001; Salmon, Breman, Fotheringham, Ball, and Finch, 2000). These challenges are due in large part to the rapid rise in motorised travel and the resultant decline in walking and cycling. There are many compelling reasons for affording walking a much higher priority than has occurred over the last half century.

In many parts of the developed world, there is growing concern about the physical and mental well-being of school age children who are reducing their number of trips to and from school on foot. Parents and carers are increasingly concerned about the safety and security of their children, preferring to drive them to school to protect them from the heavy traffic around schools! To address these health and well-being issues, the notion of a Walking School Bus (WSB) has evolved. The concept is being implemented, in one form or another, in many Western countries, including New Zealand, Canada, the USA and the UK, as well as in Victoria and other parts of Australia. The WSB program supports and encourages primary school children to walk to and from school in supervised safety. Children walk in a group along a designated route under the supervision of adult volunteers, picking up or dropping off children along the way at designated 'bus stops'. The benefits of the program include assisting children to become more active, encouraging social and community connections and a reduction in the number of cars on the road, bringing health, environmental, safety and social benefits to communities. For an example, refer to the WSB program evaluation in Auckland, New Zealand by Wong, Patterson, Fill, and Richards (2004).

With the increase in popularity of walking to school, issues of road safety naturally arise, along with concerns about personal security, convenience, comfort and enjoyment of school trips. Even under adult supervision, children are exposed to injury risk at each road crossing point along a chosen route. There can, of course, be wide variations in the safety of individual crossing points. At present, there is a lack of objective measures of safety for child pedestrians crossing either individually or in a group.

According to the Australian Transport Safety Bureau (Logan, 2008a), during the four-year period between 2002 and 2005 inclusive, 926 pedestrians were killed in Australia, around 14% of total road fatalities. Of these pedestrian deaths, 38 (an average of almost 10 per year) were between five and eleven years of age and of these almost half (16) were killed between the hours of 8 to 9 am and 3 to 4 pm. In Victoria during the same period, 321 child pedestrians aged between five and 15 were seriously injured (Logan, 2008b), with 118 of those (37%) during school travel hours.

Caulfield Community Health Service (CCHS), as part of its suite of health promotion programs, is supporting primary schools within its catchment to promote active travel by students to and from school. In order to achieve this with the highest practicable level of safety for children on their journeys to and from school, CCHS has initiated a study by Monash University Accident Research Centre that aimed to develop an easily used tool for rating the safety of individual road crossing points forming routes commonly used by students walking to school. This report describes the key elements of a systematic, evidence-based approach to achieving low-risk walking. If successful, the approach has the potential for widespread application and could be adapted for use with other pedestrian categories to promote more walking, with enhanced levels of safety. Healthier living and increased levels of transport system safety and sustainability should follow.

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## 2 PROJECT AIM AND SCOPE

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This project aimed to develop a concept for rating the safety of individual road crossing points forming a walk-to-school route in order to identify locations in need of safety improvements. The rating method was based on the familiar ‘star rating’ concept used in a wide variety of situations, such as to rate the amenity of hotel accommodation, energy efficiency of electrical appliances and the safety performance of cars. At this stage of its development, the rating system does not readily allow routes to be compared rigorously. It does, however, provide an objective basis for identifying road crossing locations with a poor rating, as well as the factors leading to this low rating. In this way, clear identification of the main issues is provided to help indicate what might be done to raise the rating of a particular crossing point to an acceptable, or better still, high level.

The star rating of a walking route has been defined here as the lowest value of the ratings among the individual crossing points forming the route. That is, the rating of the route overall is only as good as its lowest rated crossing point.

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## 3 MODEL DESCRIPTION

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### 3.1 Pedestrian crash and injury risk factors

The model has been designed to take account of five main factors considered the most influential in determining the risk of both crash and injury to a child pedestrian.

1. The speed limit applicable to vehicles at the crossing point during the periods when children walk to and from school;
2. The average number of vehicles per hour at the crossing point during the periods when children walk to and from school;
3. The width of road to be traversed to complete an individual crossing movement;
4. The number of directions of conflicting traffic that must be assessed by a pedestrian crossing at this point;
5. Whether there is a formal crossing facility provided, such as traffic signals, a school crossing, a zebra crossing, etc. to facilitate the crossing manoeuvre.

While the relationship between these factors and crash and injury risk for pedestrians tends to be self evident, these factors are also believed to be the major determinants of pedestrian safety (e.g. Jensen, 1999; Oxley, Corben, Fildes, O’Hare and Rothengatter, 2004). They have the additional advantage that measures can be readily collected by users of the rating system from a site visit and/or through information provided by the relevant road authorities.

These factors have been combined mathematically to produce star ratings for individual crossing points. This mathematical procedure is described in the following sections.

#### 3.1.1 Speed limit

Numerous studies have attempted to establish the relationship between pedestrian fatality risk and impact speed (e.g. Anderson, McLean, Farmer, Lee and Brooks, 1997; Ministry of Transport and Communications, 1997). The basic relationship determined by Anderson *et al* is shown in Figure 1 (after Corben, D’Elia and Healy, 2006).

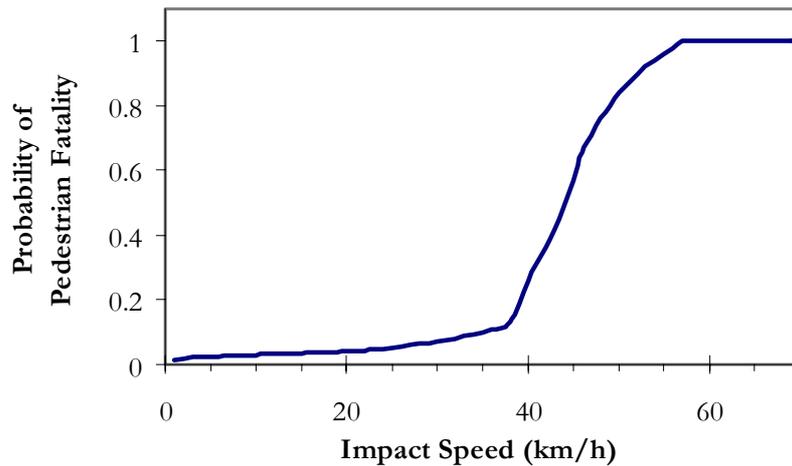


Figure 1. Relationship between probability of a pedestrian fatality and impact speed.

Corben *et al* (2006) combined the information on probability of a fatal crash, given that a crash occurred, with the overall probability of crash occurrence to derive a relationship between relative risk of a fatal pedestrian crash and driver speed choice, as shown in Table 1. A speed of 30 km/h has been used as the reference against which to scale risk for higher speed choices, since studies of the biomechanical tolerance of humans to violent forces have shown that an impact at this speed equates to a low risk (i.e. less than 10%) of death to a pedestrian (Anderson *et al*, 1997; Davis, 2001).

Table 1. Relationship between driver speed choice and relative risk of fatal pedestrian crash.

Speed choice (speed limit) (km/h)	Relative risk of a fatal pedestrian crash (compared to 30 km/h)
30	1.0
40	4.5
50	18.6
60	30.7
70	40.9
80 and above	>40.9

Speed choice, as represented by speed limit, is assumed to be the fundamental determinant of crash and injury risk. The following sections describe, both qualitatively and quantitatively, the effect upon crash risk of the other four factors taken into consideration by the model.

### 3.1.2 Traffic volume

Traffic volume is defined as the number of vehicles passing the crossing point during school trips. A larger number of vehicles passing a crossing point leads directly to increased crash risk, through increased exposure. With more vehicles, there are more opportunities within a given time period for a collision to occur with a pedestrian crossing during this period. The increase in crash risk due to increased traffic volume has been represented in the model by a direct linear relationship; that is doubling the traffic volume doubles the crash risk.

### 3.1.3 Road width

In general, wider roads make it more difficult for a pedestrian to select a safe gap in traffic. This is believed to be due, at least in part, to the greater difficulty for the pedestrian in judging where on their crossing movement they will be when an approaching vehicle reaches them. Wider roads add uncertainty to this critical judgement. Wider roads also mean that:

- The pedestrian needs to spend more time on the roadway and hence is exposed to crash risk for a longer period;
- There can be greater uncertainty about the lateral positioning of an approaching vehicle, especially where there are no marked traffic lanes or where drivers can change lanes during their approach to the crossing point;
- Higher mean travel speeds occur, an effect not captured fully in the speed limit factor;
- There will often be higher traffic volumes, an effect that *is* captured by the traffic volume factor above

The effect of road width on crash risk is represented mathematically by a power relationship where:

$$\text{crash risk} \propto (\text{road width})^{1.5}$$

In the current project, this mathematical relationship has been based upon expert judgement and should be reviewed in any further development of the model.

### 3.1.4 Number of directions of conflicting traffic

A pedestrian crossing a road is required to assess the approach of vehicles from a number of different directions. In the simplest case, on a one-way street or a divided road where a median or refuge island exists to enable a staged crossing movement, the pedestrian need attend to only one direction at a time. On two-way undivided roads, there is a substantial increase in the difficulty of safe gap choice because of the need to select coincident gaps from two directions of traffic. At common cross intersections, pedestrians can encounter conflict from vehicles approaching from four or more directions, depending upon the geometric layout and complexity of the intersection. Even when traffic signals or other types of crossing facilities are present, the safety of a pedestrian is never assured; it is common for pedestrians to be struck at formal pedestrian crossing facilities (Zegeer, Stewart, Huang, Lagerwey, 2001), though for children this is rare, especially for supervised school crossings.

The effect of a number of conflicting traffic directions on crash risk is represented mathematically in the star rating system by:

$$\text{crash risk} \propto (\text{no. of conflicting directions})^2$$

As for the risk-road width relationship, the current project proposes a mathematical relationship based upon expert judgement and would need to be reviewed in any further development of the model.

### 3.1.5 Crossing type

Due to a lack of reliable evidence allowing the relative safety levels of different types of crossings to be distinguished from one another, the specific type of crossing does not currently influence the star rating awarded to a particular crossing point. This decision would be reviewed as part of any future model development. However, as described in Section 3.1.1, the presence or absence of a pedestrian

crossing facility *does* influence the star rating through the use of a different relationship between pedestrian fatal crash risk and driver speed choice.

**3.2 Star rating method**

The crash occurrence and injury risk relationships developed in the previous section needed to be translated into more readily comprehensible measures. Given the current broad use of star rating scales (e.g. Alton-Scheidl, Schumutzer, Sint, and Tscherteu, 1997), generally operating over a five star range, the same format was adopted to rate the safety of pedestrian road crossings. A purely objective system was proposed, to eliminate the biases inherent in subjectively-derived scales (Nichols, 1997).

The star rating system was structured around a ‘base’ star rating, derived from speed choice, which was then modified by star rating corrections computed from the other four factors. As is shown in Table 2, two base rating scales were developed – one for crossings where a crossing facility (of any type) was provided and the other where no crossing facility was present. Both scales assigned the maximum five stars to a speed choice (as represented by speed limit at the crossing location) of 30 km/h. For convenience, the scale ‘saturates’ at this level, with no additional stars available for lower speeds, despite the continual lessening of risk. At the other end of the scale, crossings with a formal pedestrian crossing facility were assigned zero stars where speeds of 80 km/h and above were applicable, due to the low chance of a crash being avoided as well as the extremely high risk of a fatal outcome given a crash. Where no crossing facility was provided, the zero star rating applied from 70 km/h, due to the probable reduced likelihood of a driver being able to avoid a crash without the signage or lighting generally associated with a formal crossing facility.

Table 2. Base star ratings by speed choice.

Speed choice (speed limit) (km/h)	Base crossing star rating	
	Crossing facility present	No crossing facility
30 and below	5	5
40	4	4
50	3	3
60	2	1.5
70	1	0
80 and above	0	0

After the assignment of a base rating, the model allows this rating to be then modified by each of the other four factors described in the previous section, with the applicable correction for each modifier tabulated in the Appendix (p. 15).

The relationship between speed limit and crash risk has been used to define a somewhat arbitrary base scale for assigning star ratings to selected levels of risk. Consequently, the assignment of alternative base scales could be considered in order to reflect more or less conservative stances on acceptable safety levels for child or other categories of pedestrians.

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## 4 MODEL USAGE

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A spreadsheet-based model was developed to allow individual crossing points to be rated using the factors described in the previous section. The model, currently at version 1.14, is called X-Assessor and has been implemented using Microsoft Excel.

### 4.1 Basic requirements

In order to establish the required input parameters for X-Assessor, it is necessary to visit each road crossing location and collect the following data:

1. Posted speed limit (km/h). At an intersection crossing, use the speed limit of the road section over which the crossing is being made;
2. Road width (metres). This does not need to be measured accurately, but may be estimated or paced. If the road at the crossing location has a fenced median or other feature such that the crossing task is effectively divided into two separate decision-making processes, consider each crossing task separately;
3. Number of conflicting vehicle directions. This represents the number of different directions from which vehicles may appear to the pedestrian. This value would be one for a crossing on a one-way street; a two-lane road will have two conflicting directions and a T-intersection three. Figure 2 shows this diagrammatically.

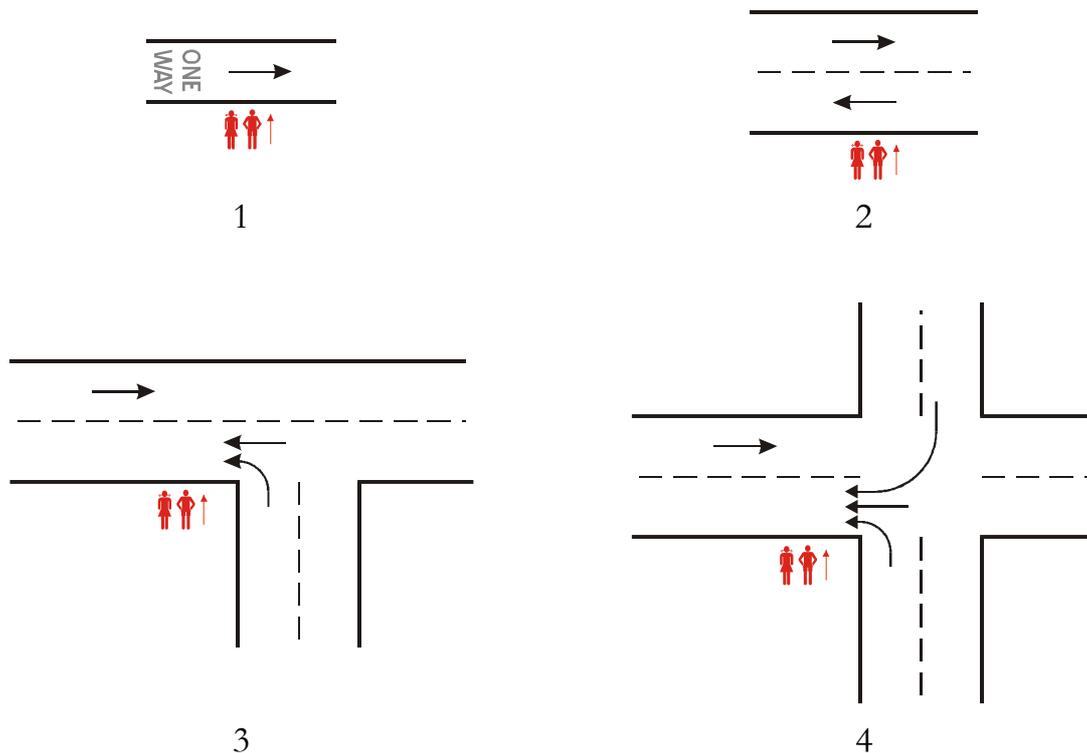


Figure 2. Number of conflicting vehicle directions for common road crossings.

4. Traffic volume (vehicles per hour). Traffic flow should be measured during school peak periods, either morning or afternoon. Vehicle counts should be the sum of all conflicting vehicle directions over at least 10-15 minutes, scaled up to one hour.

5. Crossing type. The crossing type (e.g. traffic signals, school crossing, zebra crossing, etc.) should be recorded. Where there are no specific road markings or signage, 'None' should be recorded. Vehicle slip lanes at intersections with no pedestrian signals or road markings should also be recorded as 'None'. The current version of the model does not discern between different crossing types, but may do so in future revisions.

## 4.2 Using X-Assessor

X-Assessor has six worksheets, two of which are available for user entry. These two are marked by the pink tabs and described below.

### 4.2.1 Crossing

Click on the tab labelled, 'Crossing'. This worksheet allows star ratings to be calculated for individual road crossings, as shown in Figure 3. Input areas are marked with a pale tan background, while model outputs are displayed on a pale blue background. To enter data for a crossing location, click on each input cell and choose a value from the list which best matches the collected data from Section 4.1 above. The overall rating, both numerically and using stars, is displayed at the top of the worksheet. The base rating, which depends upon speed limit, is displayed at Row 5, with the corrections to be applied according to the other characteristics of the crossing environment in the rows below. In addition, the red bars to the right provide a visual indication of the influence of the individual road and traffic characteristics on the overall rating, with negative to the left of centre and positive to the right of centre.



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Figure 3. Sample 'Crossing' screen from X-Assessor.

The presentation of correction factors in this format assists the user in identifying areas for improvement at the crossing point, or alternatively, selecting a new crossing point. At the point shown above, for example, the biggest penalty to the base star rating (of better than 3 stars) is the presence of four conflicting vehicle directions, meaning the crossing is likely to be at a cross intersection with turning traffic (See Figure 2). By moving to a dedicated crossing location away from the intersection, the number of conflicting directions would reduce to two and the subsequent rating (provided the other variables remained constant) would become 2.7 stars.

## 4.2.2 Route

Click on the tab labelled 'Route'. Count the number of crossings within each star level, neglecting any fractional star ratings. Enter the total number of each against the corresponding star rating in the pale tan highlighted area, as depicted in Figure 4. The overall rating of the route will appear on the pale blue background.

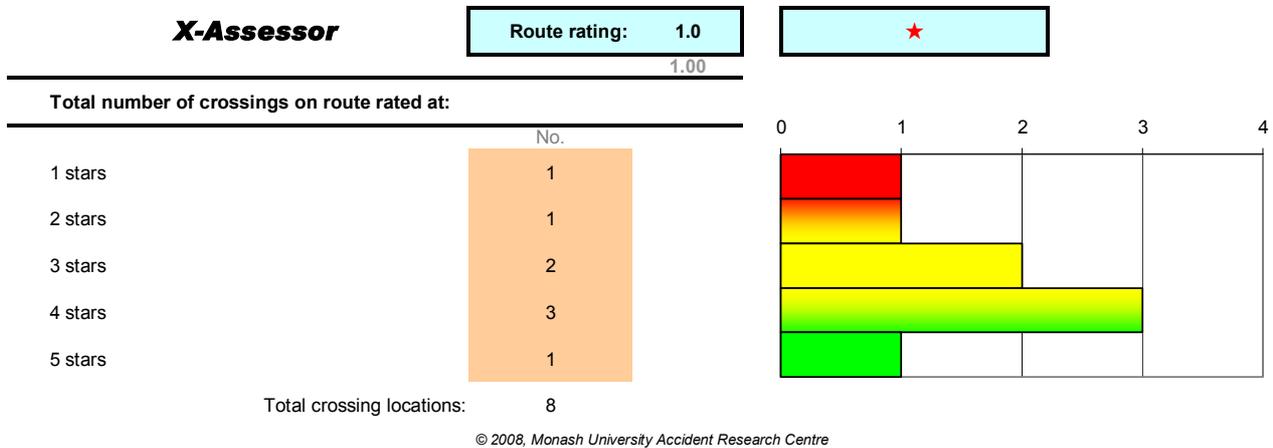


Figure 4. Sample 'Route' screen from X-Assessor.

As the rating of a route overall relates to the rating of its lowest-rated crossing location, it is straightforward to work out that the sample route above, presently one star-rated, could be improved by changing the two crossing points of one and two star level to three stars or better.

## 4.3 Sample calculation

Figure 5 shows a sample crossing location at a T-intersection. The yellow arrow represents the intended crossing point, while the two pink arrows show the two conflicting directions of traffic facing a pedestrian crossing at this point. The wide median island, allowing pedestrians to make the crossing in two discrete stages, means that traversal of the second road section would be counted as a *separate* crossing location. The speed limit applicable at the crossing is 60 km/h and the width of the road (to the median) is 3.5 m. A total of 387 cars were counted from all directions through the crossing location over a sample 15 minute period during school hours, equating to around 1550 vehicles per hour. Figure 6 shows the X-Assessor input screen as it should appear with the above data. The rating for this crossing location is 1.4 stars, which rounds to one star. The low rating for this crossing is based primarily on a speed limit unfavourable for pedestrian safety. A speed limit reduction to 50 km/h or the creation of a 40 km/h school zone would improve the rating of the crossing to 2.6 stars or 4 stars respectively.



Figure 5. Sample crossing location.

<b>X-Assessor</b>			Crossing rating: <b>1.4</b>	★
Parameter	Value	Base Rating	Notes	
Select speed limit (km/h):	60	2.02	Use speed limit of highest of all conflicting directions	-2 -1 +0 +1 +2
Select road width (m):	3.5	+0.36		
Select number of conflicting vehicle directions:	2	+0.00	Sum of all conflicting directions at crossing point	
Select traffic volume (veh/hr during school peak):	1001-3000	-1.00		
Select crossing type:	Traffic signals			

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Figure 6. Input screen for sample crossing location.

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## 5 DISCUSSION

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This report documents the development of a prototype method for assessing and comparing the safety performance of pedestrian road crossing points along a route used for walking to and from school. The model utilises the common star rating concept which assigns between zero and five stars for individual crossing points, based on factors known to contribute to pedestrian crash and injury risk. The factor of prime importance is driver speed choice, as reflected by speed limit. The base star rating derived from driver speed choice is then modified by other factors, namely traffic volume, road width, number of directions of conflicting traffic and the presence or absence of a formal pedestrian crossing facility. These factors have been combined mathematically to reflect known relationships connecting speed with fatal pedestrian crash risk, and for other factors, relationships derived from expert judgement of relative risk of a crash resulting in death or serious injury to a pedestrian. Although the model presents considerable opportunity for further enhancement, it is believed to be sufficiently developed to be used to assess the safety performance of individual crossing points, as well as to gain valuable practical experience with its use. This experience will inform future improvements to the model.

In its current form, the model can be used to assign star ratings to each of the road crossing points along a proposed or existing walking route in order to identify crossing points with a low star rating that should therefore receive priority attention. Attached to such crossing points will be information on the factors leading to their ratings. These factors can be used to guide the responsible agencies in identifying opportunities for raising safety to levels that are at least acceptable, but preferably commensurate with best-practice standards.

The goal should be to have all crossing points achieving four or five stars, with three star points acceptable but not desirable. It is proposed that crossings with star ratings of two or less would be unacceptable for inclusion on a walk-to-school route and would need to be either improved to at least three, and ideally four or five, star level or a new route defined to exclude these high risk crossing points.

For a more comprehensive assessment of the safety of an entire route, an objective indicator of the overall route safety performance can be obtained by preparing a histogram of the star ratings of the crossing points along a given route. While the overall rating of an entire route is only as high as its lowest rated crossing point (see Section 2), the histogram is useful in defining a profile for comparison with the profiles of alternative routes.

Road crossings were selected as the subject of the modelling exercise since they constitute a significant proportion of the risk to which children walking to and from school are exposed. However, due to the constraints of the development process, there are limitations of the model. The evaluation of a route involves navigating a number of hazards in addition to road crossings. In particular, the model does not attempt to rate driveway crossings, some of which provide access to schools or kindergartens, for example, and have the potential to carry sufficient – albeit generally low speed – traffic to constitute a significant risk during before and after school times. With regard to road crossings, only the core factors documented have been taken into account, excluding other factors such as sight distance, auditory information or potential distractions.

This study has demonstrated that it is feasible to objectively rate the safety performance of individual road crossings along routes used for walking to and from school as well as indications of overall route safety. Additional opportunities have been identified during the course of the study to improve the reliability of risk estimates as well as mathematical methods of combining their effects, beyond

those currently available within Victoria. These would need to be addressed as part of an extension to the current work, requiring a substantial increase in resources.

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## 6 CONCLUSIONS

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Walking is the most fundamental means of mobility for humans, but with the advent of the motor vehicle in particular, its importance as a transport mode has fallen dramatically. However, there are many compelling reasons, including health, energy conservation and climate change, for walking to be afforded a much higher priority than it has for the past fifty years or so. While undoubtedly valuable for adults, the benefits of walking for children are possibly even greater, encouraging them to become more active, encouraging social and community connections and reducing vehicular traffic.

The Walking School Bus and other active transport concepts are being implemented in Australia and other Western countries to help achieve some of these goals by encouraging primary school children to walk to and from school in supervised groups along designated routes. It is important, however, to ensure that this additional walking activity is able to be carried out safely, with one of the biggest threats to safety being the potential for injury at road crossing points.

This project developed a general method for rating the safety of individual road crossing points, based on the familiar 'star rating' concept used in a variety of areas to provide consumers with easily understood means for ranking the efficacy of products and services. A model was developed that considered the main determinants of pedestrian crash and injury risk at a road crossing, namely: vehicle speed, traffic volume, road width, number of conflicting traffic directions and the presence of a formal crossing facility. Based on established relationships and expert consensus, the model then used these characteristics to generate a star rating between zero and five for each crossing point along a route. While the model was designed primarily to generate star ratings which recognise the abilities and limitations of children, it is intended to be generic in its application, subject to the modification of internal weightings to suit other groups, including older people or the general population.

The study has demonstrated that it is feasible to objectively rate the safety performance of individual road crossing points, as well as provide indications of overall route safety. The model may be effectively used without the requirement for specific road safety expertise and is aimed at those personnel involved in evaluating or designing routes suitable for children to use to walk to and from school. Further work would be desirable to improve both the robustness of the mathematical risk relationships utilised, as well as to broaden the applicability of the model to other walking populations.

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## APPENDIX – TECHNICAL DETAILS

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For each of the main governing variables, the following section details the values assigned to relative risk and star rating. As described earlier, a base star rating is first assigned from the speed limit of the road. According to the other characteristics of the crossing location, individual corrections to the base rating are computed. Finally, based on a preliminary survey, the correction factors were weighted in order to yield sensible results when combined and applied to the base rating. At the time of writing, these weightings have been determined through expert judgement and site observations rather than from a strictly analytical base.

### Speed limit

Where a dedicated pedestrian crossing facility is installed, Table 3 shows the relative risk of a fatal pedestrian crash and base star rating assigned to the crossing. It has been assumed that the risk of a pedestrian crash involving a serious injury follows a similar relationship to that for fatal crash risk. Note that the star ratings reach a threshold point at either end of the scale – the maximum star rating is 5 and the minimum zero.

Table 3. Relative risk of a fatal pedestrian crash and star rating versus driver speed choice where a pedestrian crossing facility is present. Reference risk: 30 km/h = 1.

Speed (km/h)	Approx. relative risk	Star rating
<30	<1	5.0
30	1	5.0
40	4.5	4.6
50	18.6	3.2
60	30.7	2.0
70	40.9	1.0
>70	>40.9	0.0

At crossings where there is no dedicated pedestrian crossing facility, a different star rating scale is automatically applied, shown in Table 4. This scale awards a zero star rating for speed choices of 60 km/h and above, compared with 70 km/h and above when a pedestrian facility is present.

Table 4. Relative pedestrian crash risk and star rating versus driver speed choice where no pedestrian crossing facility is present. Reference risk: 30 km/h = 1.

Speed (km/h)	Approx. relative risk	Star rating
<30	<1	5.0
30	1	5.0
40	4.5	4.0
50	18.6	3.0
60	30.7	1.5
>60	>30.7	0.0

## Traffic volume

Table 5. Relative pedestrian crash risk and star rating versus traffic volume, measured in vehicles per hour during school peak periods. Reference risk: 101-300 vehicles/hour = 1; weighting factor: 0.50.

Traffic volume (vehicles/hour)	Approx. relative risk	Star rating adjustment	Star rating adjustment (weighted)
<100	<1	+1.0	+0.5
101-300	1	0	0
301-1000	3.3	-1.0	-0.5
1001-3000	10.0	-2.0	-1.0
3001-10000	32.5	-3.0	-1.5
>10000	>32.5	-4.0	-2.0

Note: risk and star rating values rounded to one decimal place.

## Road width

While road width is measured in metres, for practical purposes it can be assumed that a standard lane is approximately 3.5 m wide. The relationship between pedestrian crash risk and road width was assumed to be a 1.5 power.

Table 6. Relative pedestrian crash risk and star rating versus road width, in metres. Reference risk: 7 m = 1; weighting factor: 0.50.

Road width (m)	Approx. relative risk	Star rating adjustment	Star rating adjustment (weighted)
<3.5	<0.4	+0.7	+0.4
3.5	0.4	0.7	+0.4
7	1	0	0
10.5	1.8	-0.9	-0.5
14	2.8	-2.0	-1.0
17.5	4.0	-3.3	-1.6
>17.5	>4.0	-4.3	-2.1

Note: risk and star rating values rounded to one decimal place.

### Number of conflicting directions

The relationship between pedestrian risk and the number of conflicting directions of traffic faced at a crossing location was assumed to vary as a second power relationship.

Table 7. Relative pedestrian crash risk and star rating versus number of conflicting road directions. Reference risk: 2 conflicting directions = 1; weighting factor: 0.75

Number of conflicting directions	Approx. relative risk	Star rating adjustment	Star rating adjustment (weighted)
1	0.3	+0.5	+0.4
2	1	0	0
3	2.3	-0.8	-0.6
4	4.0	-2.0	-1.5
5	6.3	-3.5	-2.6
>6	>9.0	-4.5	-3.4

Note: risk and star rating values rounded to one decimal place.