

Western Australian School Crossing Safety Initiatives

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Abstract

Western Australia is continuously attempting to improve the already excellent safety record of incidents at warden controlled school crossings. Recent initiatives have included the use of flashing amber lights at crossings in various locations and newly developed flags for the traffic wardens. A literature review concerning colour, contrast and brightness of the new flags was conducted. This project was supplemented with a recognition study of the conspicuity of the flags in the field. It was found that both traffic wardens and motorists agreed that due to the colours and contrasts of the new flags, motorists were able to see them from further away and were able to be better prepared to stop at the crossing. It is recommended that the flags be tested for luminosity and contrast and be presented to Standards Australia for inclusion into the standards. Another study was conducted to assess the safety of using flashing amber lights at school crossings. The study assessed differences in location of the lights and when they were activated, against motorist behaviour as seen on video. The evidence suggested that the safest behaviour was evident when the lights were installed at the crossing site itself and activated by the warden for each individual crossing. This paper is a brief review of the three projects and includes recommendations from the three studies.

1 Introduction

Thirteen hundred new school crossing flags are in use on Western Australia's roads today. The colours of the flag have been utilised to improve recognition by motorists in an effort to increase safety at school crossings. As yet, the flags are not recognised by Australian Standards and thus the effectiveness of the flags must be assessed. As the colour combinations chosen for the flag differ from those previously used, a review of the literature on colour contrast and visual recognition is required. This is the basis of the first study. The second study was performed to identify the level to which motorists identify the new school crossing flags. The third study is focussed upon a re-assessment of the use of flashing amber lights at school crossings, previously undertaken by Morgan (1994).

2 LITERATURE REVIEW OF 2001 SCHOOL CROSSING FLAGS

2.1 Colours and Materials

2.1.2 Fluorescent Colours

As the 2001 school crossing flags are made from materials that have fluorescent colour pigments, this report will focus upon fluorescent colours only. The ICI report (1978) offers a more technical explanation of how fluorescent colours create the perception of colour that they do.

They absorb energy from daylight in the shorter wave-length regions of the visible spectrum and/or in the ultra-violet regions and re-radiate some of this energy at longer wave-lengths, producing narrow bands of emission in the visible region. The phenomenon can considerably increase the luminance factors, and usually also the purities, of fluorescent colours relative to the values obtainable for ordinary colours, and it is most effective for red, orange and yellow (p. 2).

Colour limits are placed on the luminance factor of each surface colour. The ICI (1978) reports minimum luminance levels for all fluorescent colours. Those applicable to the 2001 school crossing flags are yellow and red. The minimum level for red is 0.25 and for yellow, 0.60.

2.2 Conspicuity and Recognition

Jenkins (1979) offered an operational definition of conspicuity such that "...visual conspicuity is defined as being that property of an object in a complex background which makes it seen with certainty anywhere in the visual field without the need for searching (p. 23)". Cole and Jenkins (1979) suggest that to be conspicuous, the target should be seen with more than 90 percent probability of detection within a 250 millisecond time frame, regardless of its location in the subject's visual field.

Humans do not search in an exhaustive fashion (Wickens, 1992). This is confirmed by a study by Stagar and Angus (1978, cited in Wickens, 1992), whereby pilot subjects only searched 53% of the available terrain in their search for crash sites. This is important within the driving task as visual clues provide the majority of driving

information for motorists (Frenk, Skaar & Tennant, 1972, Knipling & Wierwille, 1994). The motorist must also extract the relevant information from the unwanted signals that constitute 'noise' in the environment (Cole, 1972).

2.3 2001 Flag Colouration, Size and Symbol

The 2001 school crossing flags are slightly larger than the dimensions of the previous flags, with the flag being 630 millimetres square. The 'stop' symbol within the flag is octagonal in shape and measures 500 millimetres across. The yellow background is fluorescent cocktail yellow and the 'stop' symbol fluorescent flame red. The legend on the 'stop' symbol is 'children stop crossing' and is in black. The words 'children' and 'crossing' are 60 millimetres in height, while the 'stop' legend is 160 millimetres high. All legend is 'C' letter series with 'N' (narrow spacing). In Table 1.2 'Legibility Distance of Letters' in AS 1742.1 (1991), the legibility distance calculated for 60 CN legend is 30 metres and 160 CN is 80 metres. Therefore, the 'stop' symbol will be legible from 80 metres and the other two words from 30 metres. The bright red 'stop' symbol and contrasting yellow background are utilised for added conspicuity.

The ICI (1978) report asserts that for road traffic safety, the identification of the information to be relayed to the driver can be assisted by: *combinations of contrasting areas of colour, by the use of distinctive symbols and by the shape of the sign itself* (P.4). The report also mentions that the most clearly recognised and thus, preferred colours are red, yellow, green, blue, black and white.

In choosing the colours to be used in a signalling system, it is important to take into consideration the inter-relations between the colours themselves and the relations between the colours and the natural surroundings of the signs. The detection of a sign, as well as the recognition of its shape, require that there should be a good contrast between the luminance and/or the chromaticity of the sign and its surroundings. Likewise, the legibility of lettering and symbols is dependent on the contrast between them and their backgrounds. (P. 4).

The colours chosen for the 2001 school crossing flags more than meet the above criteria. That is, the bright yellow border contrasts highly with the general road environment. Further, the contrast between the bright yellow border and the bright red 'stop' symbol, enables the 'stop' symbol to stand out from the flag and be easily discernible as a regulatory 'stop' message.

A study by the Rutley (1964) found that by having a fluorescent yellow border with a fluorescent red ring on a 'stop children' sign, was preferred alongside a fluorescent red sign to all other combinations (eg. 1: black legend on white with a red ring; 2 - as 1 but with fluorescent yellow background; 3 - as 1 but with a fluorescent red ring; and 4 - as 1 but with a fluorescent red background). A study by Forbes, Fry, Joyce and Pain (1968, cited in Cole & Jenkins, 1979) compared different coloured signs for conspicuity. The findings were that white, yellow and red were the most easily conspicuous colours compared to all others tested.

Frenk et al. (1972), Cole and Jenkins (1979) and Jenkins (1982) state that the primary factor governing detection capability is brightness contrast between the target and the background. Contrasts in brightness are much more important than contrasts in colour at the level of visual detection (Middleton, 1958, Hardy, 1963, cited in Frenk, Skaar and Tennant, 1972). Hills and Freeman (1970) share the same views and go further to say that colour is important and effective in transmitting coded meanings.

Red is one of the most effective colours (Aoki, et al. 1989, Hills and Freeman, 1970) due to its association with danger and the mandatory nature of its use in 'stop' signs and other danger signs (Hills and Freeman, 1970). Further, a symbol with large critical detail may require little luminance for it to be legible (Mace, Garvey and Heckard, 1994). The arousal levels of the driver and foreknowledge of the nature and location of targets must also have a bearing on detection of the target (Cole and Jenkins, 1978 & 1979). The use of warning flags prior to school crossings allow foreknowledge of the crossing site and thus, increase the arousal to detect the crossing flags.

Mace, Hostetter, Pollack and Zweig (1986) report on a study whereby a yellow diamond of 76.2 cm was recognised anywhere between 182.8 metres and 426.7 metres, dependent upon the luminance of the sign and the complexity of the visual surroundings. Cole and Jenkins (1982) conducted research whereby it was concluded that white signs such as give way and regulatory signs, were noticed less frequently than coloured signs such as stop and warning signs.

3 RECOGNITION STUDY OF 2001 SCHOOL CROSSING FLAGS

3.1 Subjective Questionnaires

Subjective questionnaires were designed by ARRB Transport Research Ltd. to elicit information from both traffic wardens and motorists that have yielded to the school crossing flags. The questions related to conspicuity of the flags and the resulting behaviour of motorists approaching the crossing. The questionnaire was designed to be administered to traffic wardens and drivers in around a 15 second period, so as not to disturb traffic or the warden's duties.

3.2 On-site Survey of Lead Vehicles

A member of the Western Australian Police Service (School Crossing Section) and the ARRB Project Leader delivered the questionnaires to drivers at school crossing locations. The lead vehicles that were stopped by the traffic wardens were directed by the Police officer to the side of the road and asked if they were willing to participate in the study. If agreeing to participate, they were then asked the relevant questions. Drivers were administered the questionnaire once the traffic flow past the stopped vehicles was deemed safe by the interviewers.

The lead drivers were chosen as they were the drivers in the traffic flow that were presented with the flags by the traffic wardens. Traffic wardens generally attempt to choose adequate gaps in the traffic flow so that drivers have considerable time to react and slow to a stand-still in a safe manner. The raised flag by the traffic warden is their direction to stop the vehicle prior to the crossing 'stop' control indicated by a solid white line painted on the pavement surface. This being the case, the lead drivers have the best opportunity to visualise the flag and recognise the control that the flag represents.

3.3 Results

3.3.1 Lead Vehicle Drivers

A total of 47 lead vehicles were stopped at the school crossings with only one driver refusing an interview (consent rate 97.87%). The one refusing driver was in a hurry to get his child to school on time. Drivers were asked if this was the first time they had seen the new school crossing flag. Thirty seven percent (17) of the interviewed drivers had seen the new flag for the first time. A further 59% (27) of the drivers had seen the flags prior to the interview. The remaining two drivers admitted not noticing the flags at all. They both stated that they stopped due to the traffic warden being on the road.

Drivers were asked if they considered the school crossing flags from last year adequate in terms of the safety of the school crossing. One driver could not remember the flags or what they looked like. A further 48% (22) believed that the old flags were adequate and 39% (18) thought they were not. Five drivers believed the old flags were not as good as the new flags. One driver admitted driving through a school crossing last year with the traffic warden having extended flags at the time.

Drivers were asked if they thought they could see the new flags from further away than they could with the old flags. A total of 85% (39) of the interviewed drivers mentioned that they thought they could see the new flags from a greater distance compared to last year's flag. Four drivers said they could not see the new flags from further away, one couldn't say, one couldn't remember and one thought it was about the same.

When asked what drivers thought were the most positive change to the school crossing flags, one thought they were no different, one believed that any change was good and one driver thought that the colours of the new flag blended into the environment too much. A total of 85% (39) of the drivers mentioned positive aspects in any one (or more) of the following responses: Brighter colours; contrast, visibility, recognition and/or fluorescent border.

Six of the drivers believed that the new flags were either bigger or looked bigger, than the old flags. However, the two flags are the same dimensions. It is possible that the border around the 'stop' shaped sign gives the appearance of the flag being bigger. One driver mentioned the 'stop' sign within the flag being highly visible.

The final question related to drivers having any issues or problems with the new flags. One driver thought that the old flags were more recognisable than the new flags. The remaining 98% (45) of the interviewed drivers stated that they had no issues or problems with the new flags.

Overall, most drivers thought very highly of the new flags, both in terms of visibility and safety. Most drivers believed they see the new flags from further away than they did with the older flags and most perceived there to be benefits with the colour scheme and use of fluorescent colours.

3.3.2 *Traffic Wardens*

A total of 28 traffic wardens were interviewed. Data for three of the wardens were omitted due to the warden being a traffic warden for the first time this year and thus not having experience with the 2000 school crossing flags. Responses for the remaining 25 wardens follows.

Asked whether they believed the crossing flags from 2000 were adequate in terms of motorists seeing the flags early enough, responses were divided. Ten wardens believed that the old flags were adequate and 11 thought they were not. The remaining four were either undecided or thought that most drivers were too blasé to care. All of the 25 wardens responded that the new school crossing flags are easier for motorists to see than the previous flags.

Wardens were asked if they believed the motorists were slowing down further away from the crossing as they approached the flags than they were with the previous flags. This question was designed to determine if motorists reacted to the new flags differently than they did with the previous flags. Sixty eight percent (17) of the wardens stated that they did not slow down further away, while 32% (8) suggested they did.

Wardens were asked what they believed were the most positive changes to the new flags over the previous flags. Clearly, the three major responses pertained to brightness, colour and contrast of the new flags. These responses reflects those of the motorists, who also made the same points.

Wardens were asked what problems they may have with the new flags. Over 50% of the wardens stated that the new flags are too heavy and especially in windy conditions. One warden also mentioned that the flag filled with wind and looked like a cushion. Other problems related to the handles either being too short (and hard to balance) or the grips were too big to be comfortable in their hands. Forty percent of the wardens mentioned that they had no problems at all with the new flags.

In summary, all of the wardens believed the new flags are easier for motorists to see than the previously used flags. However, responses were divided as to whether this caused motorists to change their behaviour and slow down further from the crossing. Traffic wardens perceived the brightness, colour and contrast of the new flags as being a positive change to the new flags.

3.4 Discussion and Recommendations

The 2001 school crossing flags exceed the dimensions of the pre-existing flags and have the added benefit of eye-catching contrasting colours and the 'stop' symbol. Further, they meet the essential criteria as stated by Freeman (1993). The colours chosen for the 2001 school crossing flags more than meet the criteria for contrast and conspicuity. That is, the bright yellow border contrasts highly with the general road environment. Further, the contrast between the bright yellow border and the bright red 'stop' symbol, enables the 'stop' symbol to stand out from the flag and be easily discernible as a regulatory 'stop' message. Overall, the 2001 school crossing flags are an eye-catching device that can be seen from a long distance. The inclusion of the 'stop' symbol further instructs the motorists of their requirements to stop when the flag is shown. The previous result show that 85% of interviewed drivers and 100% of interviewed traffic wardens shared the belief that the new flags are easier to see for motorists. The results support that this has been due to the change in colour, brightness and contrast of the new flags. Forty percent of wardens and 98% of drivers had no problems with the new flags.

A thorough evaluation of crash data is not practical at this stage and is unlikely to be in the future due to the low incidence of school crossing accidents. However, the responses made by both the traffic wardens and motorists that were stopped by raised flags clearly indicates that the new flags are an improved design and are more conspicuous to motorists. It is unfortunate that not all motorists will alter their behaviour and slow down further from the crossing.

Consideration needs to be given to the fact that the new flags have been used in bright, sunny conditions thus far and the responses may reflect this. Whilst we should not assume that the responses may be different in darker, rainier conditions, it may be possible. It is recommended that the issue with the handles on the flags be addressed. It is also recommended that the new flag be put to Standards Australia for adoption into Australian Standards.

4 FLASHING AMBER LIGHTS AT SCHOOL CROSSINGS

Flashing warning lights at school crossings are being used on WA roads at five select locations with a history of operational difficulties. The three original sites are located at Canning Highway in East Fremantle, Guilford Road in Bayswater and Kalamunda Road in Kalamunda. Two new crossings have been treated with flashing units and are located on Albany Highway in Kelmscott and Nicholson Road in Lynwood.

Three of the crossing have flashing lights that continually flash throughout the operating periods on school days. The devices are turned on at the start of the period and off at the end of the period by the traffic warden. These devices are at the Canning Highway, Guilford Road and Kalamunda Road crossings. Another two are activated by wardens for each crossing of children, requiring a special key to activate the device. At all other times during the operating period the lights are inactive. These two sites are at the Albany Highway and Nicholson Road crossings.

A brief literature review was conducted, followed by liaisons with stakeholders in other Australian jurisdiction. They were questioned on their use and experiences of the devices. Data pertaining to accidents at the sites where the devices have been installed were gathered and analysed to determine if any conclusions on their effectiveness can be drawn. This study also analysed video data from the Guilford Road, Kalamunda Road, Albany Highway and Nicholson Road crossings. There are several reasons for doing this:

- ?? Allows comparison to the Guilford Road and Kalamunda Road sites that were evaluated by Morgan in 1994;
- ?? Enables comparisons to be drawn between flashing lights installed on the approach to the crossing and at the crossing, and
- ?? Allows comparisons to be drawn between constant flashing units and units activated for each crossing.

4.1 Literature Review

Bishop and Harwood (1978) report on the importance of safety devices and road rules as the child's journey to and from school represents a large portion of children's exposure to road traffic. They mention that one of the reasons for the use of flashing lights at school crossings in South Australia is the high observance level by both motorists and pedestrians. The statement arose from an earlier report by Gelston and Spangler (1976; cited by Bishop & Harwood, 1978), whereby 15 flashing school crossing were evaluated for driver observance of the 25 km/h speed limits. The proportions of motorists conforming substantially to the limits were 69% in the morning and 63% in the afternoon. Further, 95% and 90% were observed to noticeably reduce speed.

Uber (1992) reported on a trial of part time speed restriction zones in Victoria. The zones included a reduction in speed limits through 'flip-open' speed signs and the operation of flashing amber warning lights. They were implemented at sites whereby the normal operating speeds of 100 km/h or 80 km/h were reduced to 60 km/h, and an operating speed of 60 km/h was reduced to 40 km/h. Results of the trial indicated that the normal operating speed zone of 100 km/h was reduced by around 30 km/h in mean vehicle speeds and 28-29 km/h in 85th percentile speed. The normal operating speed of 80 km/h was reduced by around 13-19 km/h in mean vehicle speeds and 7-15 km/h in 85th percentile speed. The normal operating speed of 60 km/h was reduced by around 20 km/h in mean vehicle speed and 14-18 km/h in 85th percentile speed. Although the results from this study are very promising, more than half of all free speed vehicles were exceeding the part time speed restriction limit.

A similar trial was conducted in NSW and reported by Swaminathan (1992; cited in Uber, 1992). An 80 km/h zone was changed to 60 km/h part-time with signs and flashing lights. There was a 7 km/h reduction in 85th percentile speed and 35% of drivers complied with the speed zone limit.

One of the major issues noted in the Bishop and Harwood (1978) report was the amount of pedestrian accidents that occurred while the crossing lights were not in use. To this extent it is assumed that a small number of pedestrians believe they have protection on the crossing whilst the lights are not in use. This is indicated in crash statistics showing that 42% of the accidents occurring on the crossings are when the lights are not in use. The authors suggest that it would be safe to assume that a lower proportion than 42% would use the crossing when the lights were not activated.

Bishop and Harwood (1978) indicate that children crossing near to a flashing light crossing were more at risk of being involved in an accident than those traversing the crossing itself. Whilst this statement is not novel, it is possible that children crossing near a flashing light crossing may be at an increased risk due to the effects of the flashing lights. As the flashing lights are installed to draw attention to the crossing, the motorist may channel out much of the other visual information within the roadway. Hence, avoiding an accident with a child stepping out onto the roadway may be dependent upon the driver's ability to detect secondary stimuli. The use of fences to deter children from crossing near the site might improve the safety of the crossing.

4.2 Liaison with Australian Jurisdictions

The following table shows the results of liaisons with state road authorities.

Table 1: Liaison with State Road Authorities on the use of Flashing Amber Lights at School Crossings

State	Comments
SA	South Australia has utilised flashing lights at school crossings since 1960. The lights are located at the crossing and is activated to operate during the peak travel times of school children. A child monitor uses a stop banner to control vehicular traffic for crossings of children. SA has never had a fatality or serious injury at any of the school crossings with flashing lights. Warrants for their use include 50 children and 200 vehicles in each of the two one-hour time periods.
Victoria	Victoria uses flashing warning lights prior to school crossings in a considerable number of locations. The units are used in conjunction with 'flip-out' signs indicating that the 40 km/h limit period applies while sign is displayed. Flashing units are installed approximately 150-200 metres prior to the crossing site. They appear to reduce vehicle speeds.
NSW	NSW do not utilise flashing lights at school crossings unless there is an issue with sight distance. As such, any flashing units are placed prior to the crossing. There have been no formal evaluations of their safety benefits.
ACT	Flashing warning lights are not utilised at school crossings in the ACT.
Queensland	Flashing lights at school crossings are only used to mark the approach of school zones where sight distance is an issue. No formal evaluation of the safety benefits has been made to date.
NT	NT does not use flashing warning units at school crossings.

4.3 Accident Data and Video Evidence

Accident data was gathered for sites that include school crossings with flashing amber signals for the period between 01 January 1993 and 29 March 2001. This includes periods after the earlier signals were installed at Canning Highway, Guilford Road and Kalamunda Road. These signals had crash data collected from 1989 to 1993 for the Morgan (1994) study. There was only one pedestrian accident that occurred at one of the sites. This was within a five year period prior to installation of the flashing lights. Therefore, crash data is not useful to determine any significant changes from installing flashing amber lights and will be omitted from further discussion.

4.3.1 Guilford Road – Guilford

The Guilford Road crossing has flashing lights installed prior to the site which flash continuously throughout the operating periods. As was previously mentioned by Morgan (1994), vehicles travelling west in the morning are often travelling in platoons and moving at a relatively slow speed. Vehicles moving in an easterly direction tend to be moving at a faster speed. Unfortunately, the video evidence did not capture the movements of vehicle travelling east prior to the crossing, so it is impossible to assess the behaviour of the drivers.

The video in the morning session showed 11 warden-assisted crossings and seven unassisted crossings. One of the unassisted crossings was after the warden turned off the flashing light. It was not possible (from the video) to determine why the other six pedestrians crossed without the assistance of the traffic warden. All crossings appeared to be safe, however, on two occasions cars failed to stop when the warden raised the flag, indicating the drivers should stop. The first car had plenty of distance to the crossing when the flag was raised and appeared to disregard the meaning of the raised flag. The second car had very little time to react and slowed before slowly driving through the crossing. On both occasions the traffic warden did not move onto the road until the vehicles were completely stopped.

The video of the afternoon period appeared to show five warden-assisted crossings and a total of nine pedestrians crossing unattended. However, as vehicles were often masking the view of the traffic warden, it may be that the warden was simply not visible on the video footage. It appeared that no vehicles were driven through the site when a warden's flag was raised. In summary, the Guilford Road crossing was hard to assess using the video footage gathered. It appeared that either turning the flashing lights on or off had no impact on vehicle speeds. No other assessment is given due to the lack of visibility of driver behaviour.

4.3.2 Kalamunda Road – Kalamunda

The Kalamunda Road crossing has flashing lights installed at the crossing location and are continuous throughout the operating periods. In the morning there were 35 pedestrians who crossed the road in 18 warden-assisted crossings. On several occasions, vehicles were slowing down or stopping at the sight of the traffic warden stepping toward the edge of the road. It would be feasible to suggest that this may be in anticipation of the warden raising the flag indicating the drivers must stop. On one of these occasions, a vehicle changed lanes

and drove past a stationary vehicle. There was no safety issue on this occasion as the warden had not even commenced raising the flag and pedestrians were held back from the crossing.

It is normal for children to cross in larger volumes, using less crossings in the afternoon periods. At the Kalamunda Road site, 26 pedestrians crossed the road in nine crossings. Driver behaviour appeared similar to that in the morning with the exception that only one driver stopped prior to the warden raising the crossing flag.

In summary, it appeared that most vehicles approached the crossing with caution through the periods that the lights were activated. It also appeared that the vehicles showed more caution as they got closer to the crossing itself. This may explain why many of them stopped prior to the warden raising the flag and indicating they must stop. Overall, the crossing appeared to operate in a very safe manner, as was previously suggested in the Morgan (1994) report.

4.3.3 Nicholson Road – Lynwood

The Nicholson Road crossing has flashing lights installed at the crossing which are activated by the warden when a crossing is about to commence. Unfortunately, there were only seven pedestrians who crossed in six warden-assisted crossings in the morning. There were five pedestrians who crossed in four crossings in the afternoon. There were three pedestrians who crossed together approximately 100 metres away from the crossing location.

The video showed that whenever the lights were activated, vehicle drivers became cautious and slowed considerably on the approach to the crossing. Drivers also tended to stop a reasonable distance from the crossing stop line. In summary, although the volumes of pedestrian movements and crossings were low, the level of safety of the crossing appeared high for the crossings captured on video.

4.3.4 Albany Highway – Kelmscott

The Albany Highway crossing has flashing lights installed at the crossing which are activated by the warden when a crossing is about to commence. Vehicular movements from both directions were well spaced, thus not allowing long gaps between vehicles. In this situation, the safety of the crossing relies upon drivers of vehicles complying with the caution from the flashing lights and the raised flag of the traffic warden. A total of 33 pedestrians crossed the road in 18 warden-assisted crossings in the morning period, while 20 pedestrians crossed in 13 warden-assisted crossings in the afternoon session.

Most drivers exercised caution as soon as the flashing lights became activated. Most cars reduced speed and several stopped in anticipation of the warden raising the crossing flag. Even after the crossing was complete, several cars would not drive away until the flashing lights were deactivated. This was despite the crossing becoming clear to drive through and the fact that drivers had no further obligation to remain stationary.

In summary, the Albany Highway crossing appeared to be very safe, judging by the video evidence obtained. Drivers appeared to be cautious to the extent of some level of overkill. However, this level of caution is of particular benefit to the safety of the crossing.

4.4 Summary of Motorist Behaviour at Different Sites

4.4.1 Flashing Lights Prior to Crossing

At sites with signals installed in advance of the crossing, drivers appeared to make no changes to vehicle speeds. In operation, the crossing was similar to that of a warden-assisted crossing on most dual lane carriageways. The motorists appeared to not change any behaviours prior to the crossing and acted in the same manner as would be expected at a dual lane crossing with a traffic warden.

4.4.2 Flashing Lights at the Crossing

Having the flashing lights installed at the actual crossing site appeared to have a positive safety effect on the behaviour of motorists. Motorists appeared to drive with caution through the crossing site and on many occasions slowed or stopped in anticipation of the traffic warden raising his or her flag. The operation of both of the sites examined with flashing lights at the crossing appeared to be safe for the children.

4.4.3 Continuous and Warden Activated Crossings

Three of the crossings had flashing lights that were activated at the start of the peak school travel period, whilst the other two had flashing lights that were activated for each particular crossing. Motorist behaviour appeared

different for the two types of crossings. Whilst the Kalamunda Road crossing appeared to have safe crossings, drivers appeared to exercise more caution at the two crossings that had lights activated for crossings only. The normal flow of traffic appeared uninterrupted until the warden activated the lights. At this point, motorists immediately slowed down and many stopped even before being required by law to do so. Although there is a level of overkill in these cases, the operational safety of the crossings appeared very high. The difference may be due to the random use of the flashing lights instead of continuous use. Research often indicates a declining level of safety where there is overuse of flashing amber lights.

4.5 Recommendations

The recommendations for this report are limited to the safe operation of the school crossings and do not include recommendations on warrants for their installation. There were considerable differences in the behaviour of motorists at school crossings with the flashing lights installed at the actual crossing site. In these cases, motorists were more cautious and the safety of the children appeared to be very good. The safest behaviour displayed by motorists, however, was when the flashing lights at the crossing were operated only when a crossing was about to be made.

Recommendation 1

Where a school crossing is to be treated with flashing lights, they should be installed at the crossing site and activated by the warden for each particular crossing. The exception to this recommendation is when there are sight distance issues.

Recommendation 2

Where there are sight distance issues, an advanced flashing amber system is recommended in conjunction with flashing amber lights at the crossing site. They should be activated as in Recommendation 1. An advanced warning of the crossing appears to reduce the surprise factor for motorists and assists the crossing to become operationally similar to normal warden-assisted crossings on dual lane roads.

Research indicates that a high number of children are injured attempting crossings near school crossings. This is similar for all pedestrian crossings. However, where flashing lights are used to draw attention to the crossing itself, there may be an even greater safety risk for those crossing near the site. The flashing lights may draw attention to the site, thus drivers are less likely to see pedestrians crossing the road elsewhere until too late.

Recommendation 3

The use of channelisation fences to deter children from crossing near a site with flashing lights is recommended to improve the safety of the crossing.

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