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REVIEW OF THE SCHOOL BUS SAFETY ACTION PLAN — FINAL REPORT

AUSTROADS

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AUSTROADS
Sydney 2002

AUSTROADS PROFILE

Austroads is the association of Australian and New Zealand road transport and traffic authorities whose purpose is to contribute to the achievement of improved Australian and New Zealand transport related outcomes by:

- developing and promoting best practice for the safe and effective management and use of the road system
- providing professional support and advice to member organisations and national and international bodies
- acting as a common vehicle for national and international action
- fulfilling the role of the Australian Transport Council's Road Modal Group
- undertaking performance assessment and development of Australian and New Zealand standards
- developing and managing the National Strategic Research Program for roads and their use.

Within this ambit, Austroads aims to provide strategic direction for the integrated development, management and operation of the Australian and New Zealand road system — through the promotion of national uniformity and harmony, elimination of unnecessary duplication, and the identification and application of world best practice.

AUSTROADS MEMBERSHIP

Austroads membership comprises the six State and two Territory road transport and traffic authorities and the Commonwealth Department of Transport and Regional Services in Australia, the Australian Local Government Association and Transit New Zealand. It is governed by a council consisting of the chief executive officer (or an alternative senior executive officer) of each of its eleven member organisations:

- Roads and Traffic Authority New South Wales
- Roads Corporation Victoria
- Department of Main Roads Queensland
- Main Roads Western Australia
- Transport South Australia
- Department of Infrastructure, Energy and Resources Tasmania
- Department of Infrastructure, Planning and Environment Northern Territory
- Department of Urban Services Australian Capital Territory
- Commonwealth Department of Transport and Regional Services
- Australian Local Government Association
- Transit New Zealand

The success of Austroads is derived from the synergies of interest and participation of member organisations and others in the road industry.

Executive Summary

Background

ARRB Transport Research was commissioned by Austroads in 1999 to review current practice and research in relation to school bus safety and to identify new or proven safety measures that may be used as part of a national approach to school bus safety. The project was completed in 2000 and two project reports were published by Austroads in 2001 (refer to *AP-R186 School Bus Safety in Australia – Summary Report* and *AP-R186A School Bus Safety in Australia – Technical Report:* Austroads, 2001). The key outcome of the study was the development of a National School Bus Safety Action Plan. The Action Plan, which recognised initiatives being implemented by jurisdictions across Australia at the time, sought to provide a set of short, medium and long term measures designed to reduce the incidence and severity of crashes involving school children that were associated with bus travel.

In 2001 Austroads established a School Bus Safety Advisory Group to identify and progress issues raised in the School Bus Safety report including refining, prioritising and implementing the proposed Action Plan. The Advisory Group established a School Bus Safety Expert Working Group and ARRB Transport Research was subsequently commissioned to assist the Expert Working Group.

Purpose

The aim of this task was to review the actions in the School Bus Safety Action Plan based on the outcomes of the updated crash analysis, research findings and the initiatives in place across Australian jurisdictions.

The task comprised the following key objectives:

1. To review the level of implementation of School Bus Safety Action Plan measures by Australian jurisdictions (through consultation with relevant stakeholders).
2. To review the measures in the School Bus Safety Action Plan and refine proposed measures where appropriate.
3. To prioritise measures included in the School Bus Safety Action Plan.
4. Where necessary for prioritisation, undertake short term actions which require investigation of the feasibility of measures (through literature reviews, review of updated statistics and consultation).

Definition

In this report, a ‘school bus’ refers to designated school buses, general service buses used by school children, and buses used for the transportation of children in relation to school activities.

Method

To meet the objectives of this study, the following tasks were undertaken:

- To assist with the revision and refinement of the School Bus Safety Action Plan, the crash data analysed and reported in the previous study was updated.
- To ensure that current knowledge and developments related to school bus safety are identified a review of literature and research findings pertaining to the safety of travel in and around school buses was undertaken.

- To gain an understanding of the school bus safety practices and initiatives being implemented across Australia key personnel from Australian jurisdictions were contacted relevant stakeholders were consulted (by telephone and via email correspondence). This task also provided an understanding of the degree to which items detailed in the School Bus Safety Action Plan have been implemented.

- Based on the information obtained in the steps above, the School Bus Safety Action Plan was revised. A method for rating the priority and effectiveness of each action in addressing common causes of fatalities associated with school bus travel, and in terms of the resources and ease of implementation associated with undertaking the action was developed. The method and outcomes of this revision process are further detailed in this summary.

Key Findings

Analysis of Crash Data

The review of recent crash data undertaken in this study confirmed the summary and conclusions drawn in the original analysis of data as reported in *AP-R186A School Bus Safety in Australia – Technical Report (Austroads, 2001)*.

The update of crash data has revealed that:

(i) While the number of pedestrian fatalities has steadily fallen since 1995, total child pedestrians fatalities and child pedestrian fatalities during school commuting hours have plateaued.

(ii) The number of child pedestrian fatalities associated with school bus travel has continued to fall (this conclusion should be treated with caution, as the numbers involved are small).

(iii) The typical characteristics associated with child fatalities and school bus travel have not changed.

As identified in the earlier report, the typical crash scenario appears to be that the child is on his or her way home from school and is unaccompanied by an adult. After getting off the bus they are hit by another vehicle in attempting to cross a 2-way undivided road (mid-block and with no pedestrian crossing in the vicinity).

It appears that in most cases the child has attempted to cross the road without looking for oncoming traffic. This is occurring in both urban and rural areas, but in general on roads with speed limits of 60 km/h or more. Neither speeding nor alcohol intoxication was associated with any of the school bus related crashes identified in the database. Although it is difficult to determine the timing of the sequence of events from the crash records, it appears that in most cases the collision is occurring immediately after the child has alighted from the bus and presumably while the bus is still in the vicinity.

Further to this, this analysis highlights that the crash databases maintained by jurisdictions do not contain sufficiently detailed information for the evaluation of school bus safety. Auxiliary information is required to identify school children injured while using buses to commute to and from school. In particular there is a need for the following in both the fatal and hospitalisations crash databases:

- The intention of pedestrian movements (i.e. the pedestrian was crossing the road to board a bus when the crash occurred).

- The origin and destination of pedestrian trips (i.e. travelling home from school, travelling for extra curricula activities, etc.).

- Data on secondary vehicles not directly involved in the pedestrian impacts (eg presence of a bus, other vehicles).

Review of Relevant Literature

As exemplified by fatality and injury data, research evidence also indicates that bus travel is a relatively safe mode of transport. The risk of injury to occupants while travelling as a passenger of a bus is low. The greatest risk to children traveling to or from school is as a pedestrian moving around school buses. Despite the evidence that children as bus passengers are relatively safe, there remains a strong perception in the community, by parents in particular, that buses pose a greater risk than travel in the family car.

Debates over the safety of school buses, the benefits of compartmentalisation, the cost of installing seatbelts and other countermeasures relative to the safety gains that are likely to result are well-documented. The debate is discussed in detail in this report, indicating that research is mixed and the evidence is largely inconclusive due to the low crash risk associated with vehicles. Overall, the research indicates that initiatives aimed at increasing driver and pedestrian behaviour, improved vehicle maintenance and safer roadside environments offer greater potential for increasing the safety of children travelling in and around buses, as compared to the mandation of seatbelts, the abolishment of standees and the removal of 'three for two' seating in Australia.

Review of current practice in Australia

Risks associated with travel by school bus

The number of actions, programs and initiatives that have been undertaken in Australian states and territories to improve school bus safety is very large. However, all of these actions are designed to address a comparatively small number of actual and perceived risks associated with travel to and from school by bus.

The crash data presented in Section 3 of this report indicates that of a total of 50 child pedestrians fatally injured during school travel time for a five-year period, 23 were associated with travel by bus on the journey to or from school. An additional five children were killed as passengers of a bus during school commuting times in these years. This data illustrates that the risk of children being struck by passing traffic when crossing the road before boarding (4%) or after alighting from the bus (79%) is by far the greatest risk associated with travel by school bus. The data also indicates that the next greatest risk of fatal crashes, though less frequent, is associated with traveling as a bus passengers when children become trapped in bus doors when they close and are subsequently dragged by the bus (7%), or when children are injured within the bus when the bus is involved in a collision with another vehicle (7%).

A number of other perceived risks associated with travel to and from school by bus were identified in the literature and through consultation, however the low number of crashes and the absence of injury data at a national level preclude the actual risk of injury from being determined. These perceived risks include:

- Children injured by passing traffic while waiting for bus.
- School bus colliding with children before boarding or after alighting.
- Passengers injured by impacts inside the bus (as a result of collision with another vehicle).
- Other vehicles crashing into the school bus.
- Passengers distracting or interfering with bus driver.
- Collisions caused by mechanical fault or failure in bus.
- Sub-optimal management of passenger injuries after a crash.

To objectively rank these risks, it would be necessary to obtain and analyse information on school bus accidents resulting in injuries other than fatalities. However, this information is currently unavailable at a national level.

Implementation of countermeasures

The actions and programs that have been implemented or considered in Australia to address risks as pedestrians moving around school buses and to address risks as bus passengers traveling in school buses are summarised in this report. In addition, a summary of the state-by-state implementation of each countermeasure for dedicated and non-dedicated services (i.e. for school students travelling by scheduled route bus services) is presented in tabular format. These tables intend to provide an indication of the type of programs and initiatives operating to some degree across Australia to maximise the safe travel of school children in and around school buses.

Reviewing the School Bus Safety Action Plan

The National School Bus Safety Action Plan proposed in *AP-R186* and *AP-R186A* (Austroads, 2001) was revised in light of the outcomes of the updated crash analysis, research findings and understanding of the initiatives in place in Australian jurisdictions.

Refining the action items

Each action item of the Action Plan was examined and where necessary, the item has been amended or reworded to align with current research and to provide succinct, measurable action items for implementation. Where actions have been completed, these have been noted and removed from the Revised Action Plan.

Prioritising action items

Each revised action item was rated in terms of its priority and effectiveness in addressing common causes of fatalities and injuries associated with school bus travel, and in terms of the resources and ease of implementation associated with undertaking the action.

The rating method applied was developed in consultation with the Expert Working Group. This method required each action item to be rated across four categories (priority, effectiveness, resources and implementation) using the following rating levels:

Category	Rating	Rationale for rating
Priority	A	*Action that addresses the most common cause of school bus related fatalities (based on available fatality data)*
	B	*Action that may address potential cause of fatalities (where available data is less conclusive)*
Effectiveness	1	*Proven and effective action*
	2	*Unproven action offering promising results / some merit*
	3	*Unproven action, though unlikely to be effective*
	4	*Action proven to be unsuccessful*
Resources	*High*	*High level of resources required to undertake action*
	Medium	*Medium level of resources required to undertake action*
	Low	*Low level of resources required to undertake action*
Implementation	*Difficult*	*Difficult action to implement*
	Complex	*Complex yet achievable action to implement*
	Easy	*Easy action to implement*

Where an action does not specifically address common or potential causes of school bus related fatal crashes, but relates to data management or injury management practices, a 'Not applicable' (N/a) priority rating has been applied. Additionally, where actions call for a feasibility study to investigate the effectiveness of a given initiative, an 'N/a' effectiveness rating may have been applied.

Justifications for the ratings applied were made for each revised action item. These justifications are drawn on the available crash data, research findings and consultation reported in this and previous progress reports for this project.

Revised Action Plan

For ease of presentation and comprehension, the revised action items were presented in summary form in Section 5 of this report. The revised action items are presented in three categories, based on the priority rating applied. This allows those actions identified as addressing the most common causes of school bus related fatalities to be differentiated from those actions addressing potential causes of school bus related fatalities and those actions that relate to data management or injury management practices. Further to this, action items in each of these three categories are presented in order of the perceived or proven effectiveness of the action, the resources associated with the action and the ease with which the action may be implemented.

It is anticipated that the Revised Action Plan will be beneficial in assisting jurisdictions to give priority to those measures which address the most common cause of fatalities where the greatest gains can be made in school bus safety for children.

CONTENTS

1. INTRODUCTION

1.1. Background

Following community concern over school bus incidents resulting in death or serious injury to school children, the Australian Transport Council (ATC) requested Austroads:

- To review current practice and research in relation to school bus safety.
- To identify new or proven safety measures that may be used as part of a national approach to school bus safety.

ARRB Transport Research was commissioned by Austroads in 1999 to undertake this research. The project was completed in 2000 and two project reports were published by Austroads in 2001. The reports were *AP-R186 School Bus Safety in Australia – Summary Report* and *AP-R186A School Bus Safety in Australia – Technical Report*. It should be noted that while the reports were released in 2001, they reported upon bus safety strategies and actions only up to March 2000. Since that time, school bus safety strategies and actions across Australia have developed markedly.

The key outcome of the study was the development of a draft National School Bus Safety Action Plan. The Action Plan, which recognised initiatives being implemented by jurisdictions across Australia at the time, sought to provide a set of short, medium and long term measures designed to reduce the incidence and severity of crashes involving school children that were associated with bus travel. It should be noted that the Action Plan presented in these reports were based on information available during March 2000 and therefore revision of the Action items is warranted.

In response to the recommendations of the ARRB Transport Research report, Austroads established a School Bus Safety Advisory Group to oversee the development and maintenance of school bus safety issues across Australia. A National School Bus Safety Expert Working Group was also formed to commence the review and implementation of initiatives listed in the draft School Bus Safety Action Plan. This Expert Working Group sits under the Advisory Group with the initial tasks of:

- Determining the current extent to which jurisdictions across Australia have implemented the actions proposed in the draft School Bus Safety Action Plan.
- Refining and prioritising measures proposed in the draft School Bus Safety Action Plan.
- Where appropriate, determining the feasibility of short-term actions contained in the School Bus Safety Action Plan.

ARRB Transport Research was subsequently commissioned to assist the Expert Working Group to undertake these tasks.

1.2. Purpose

The purpose of the current project was to refine and prioritise the draft School Bus Safety Action Plan and comprised the following key objectives:

1. To review the level of implementation of draft School Bus Safety Action Plan measures by Australian jurisdictions.
2. To review the measures in the draft School Bus Safety Action Plan and refine proposed measures where appropriate.
3. To prioritise measures included in the draft School Bus Safety Action Plan.
4. Where necessary, undertake short-term actions which require investigation of the feasibility of measures (through literature reviews, review of updated statistics and consultation).

2. METHOD

To meet the objectives of this study, the following tasks were undertaken:

2.1.1. Analysis of Crash Data

To assist with the revision and refinement of the draft School Bus Safety Action Plan, the crash data analysed and reported in the previous study was updated.

The earlier analysis identified the relative fatal and serious injury crash risk and trend of children associated with bus travel based on data from 1990 up until the end of 1997. Due to data limitations, the analysis of fatal crashes that specifically relate to school bus travel carried out in the previous analyses was based on only three years of data: 1992, 1994 and 1996. Estimates of child pedestrian fatalities are now available up to and including 2000. Additionally, detailed coronial data is now available for 1997 and 1998. Together this data has been used to supplement data sets used in the previous analysis to better determine crash trends and fatal crash characteristics involving children and bus presence.

The key findings of this crash analysis are detailed in Section 3 of this report.

2.1.2. Review of Relevant Literature

To ensure that current knowledge and developments related to school bus safety are identified a review of literature and research findings pertaining to the safety of travel in and around school buses was undertaken.

The literature review component of the previous report was completed in early 1999 and reported in the final documents in 2001. This literature review sought to identify literature since early 1999 using the ARRB Transport Research INROADS library database. It is envisaged that a range of research findings and developments undertaken since the initial review may enhance our understanding of the factors associated with school bus safety and provide further evidence of the success of various safety practices and countermeasures.

The key findings of the updated literature review are detailed in Section 4 of this report.

2.1.3. Review of current practices across Australian jurisdictions

To gain an understanding of the school bus safety practices and initiatives being implemented across Australia key personnel from Australian jurisdictions were contacted and relevant stakeholders were consulted (by telephone and via email correspondence). This task also provided an understanding of the degree to which items detailed in the draft School Bus Safety Action Plan have been implemented.

Details pertaining to the school bus safety practices and initiatives being implemented across Australia are detailed in Section 5 of this report.

2.1.4. Revision of the School Bus Safety Action Plan

The current draft School Bus Safety Action Plan lists and briefly describes some 37 short term actions that focus on a range of factors associated with child safety and school bus travel. These factors include:

- Children (of all ages).
- Parents, carers and teachers.
- Bus owners, operators and drivers.

- Education and communication.
- Enforcement.
- Bus design and operation (both internal and external).
- The design and operation of bus stops and bus routes.
- Future research needs.

Based on the findings of the literature, crash analysis and understanding of current practice in Australia the draft School Bus Safety Action Plan was revised. The revision of the School Bus Safety Action Plan was undertaken in consultation with the Expert Working Group. The method and outcomes of this revision process are also further detailed in Section 5 of this report.

3. ANALYSIS OF CRASH DATA

3.1. Original crash analysis

3.1.1. Background

To determine magnitude and nature of the road safety problem associated with buses carrying school children an analysis of the crash data was undertaken as part of the previous *School Bus Safety in Australia* reports (AP-R186 and AP-R186A) released during 2001.

For the purpose of quantifying and characterising road crashes involving school children travelling to or from school, this analysis only deemed road crashes as relevant if the following conditions were met:

- a child aged 5-17 was killed or injured;
- the child was either going to or from school;
- the child was either a bus passenger, boarding or alighting a bus, crossing a road to board a bus or crossing a road after alighting from a bus.

This initial analysis used data from the following three national road crash databases collated by the Australian Transport Safety Bureau (ATSB): Monthly Fatalities Database, Serious Injury Database and Fatality File. Further, in this analysis a 'school bus' refers to designated school buses, general service buses used by school children, and buses used for the transportation of children in relation to school activities.

3.1.2. Key findings

The outcomes of this analysis are detailed in the earlier reports AP-R186 and AP-R186A. The analysis found that the number of fatal crashes identified as being related to school bus travel were small. However, some features of these incidents were more common than others.

> *The typical crash scenario appears to be that the child is on his or her way home from school and is unaccompanied by an adult. After getting off the bus they are hit by another vehicle in attempting to cross a 2-way undivided road (mid-block and with no pedestrian crossing in the vicinity). It appears that in most cases the child has attempted to cross the road without looking for oncoming traffic. This is occurring in both urban and rural areas, but often on roads with speed limits of more than 60 km/h. Neither speeding nor alcohol intoxication was associated with any of the school bus related crashes identified in the database. Although it is difficult to determine the timing of the sequence of events from the crash records, it appears that in most cases the collision is occurring immediately after the child has alighted from the bus and presumably while the bus is still in the vicinity. (AP-R186A, 2001, p13).*

3.2. Updated crash analysis

3.2.1. Background

Since the original crash analysis was undertaken there have been a number of changes to the road crashes databases collated by ATSB. The databases now have new names and have undergone a number of changes to the coding structure.

Therefore, the results detailed in this report are based on extractions from the following revised databases:

- Monthly Crash Database (MCD) - previously the *Monthly Fatalities Database*.
- Casualty Crash Database (CCD) - previously the *Serious Injury Database.*
- Fatality Crash Database (FCD) - previously the *Fatality File.*

Data Sources

The Monthly Crash Database contains the number of persons killed in crashes on Australia's roads each month. It is compiled from data obtained from each State and Territory every month. It is based on police reports and contains a small number of data items describing the crash (i.e. date, time, State/Territory, speed limit) and the persons killed (i.e. age, sex, road user type eg driver, passenger, cyclist, motorcyclist, pedestrian). The latest complete year for which this data is available is 2000.

The Casualty Crash Database contains details of all crashes resulting in death or hospitalisation across Australia. It is compiled quarterly from police report data coded by each State and Territory. As well as containing the non-fatal crashes, this database contains more detailed crash information than the Monthly Fatalities Database. In particular, it includes information on crash type, vehicle type and blood alcohol content (BAC) of the drivers involved. This database is currently complete for the period 1990 to 1997 inclusive.

The Fatality Crash Database is compiled from coroner's reports and police reports of fatal crashes occurring in 1988, 1990, 1992, 1994, 1996, 1997 and 1998. No compilations were conducted in the other years. This is an extensive database containing particularly detailed information on most aspects of each crash.

The Fatality Crash Database is the only one of these three databases with sufficiently detailed information to identify individual crashes associated with school buses. The other databases are used in this analysis to provide background statistics on children killed and injured as pedestrians or bus passengers during school commuting times in the period 1990-2000 inclusive. They were also used to estimate the extent to which school buses are associated with child hospitalisation numbers.

Despite the extensive scope of the data items in the Fatality Crash Database, changes in the coding frame and changes to the nature of the compilation process over time mean that crashes of interest could only be identified during the five one-year periods. Thus, the analysis that attempts to build a scenario of the various aspects of the school bus related crashes is based on a subset of crashes which were fatal and which occurred in the years 1992, 1994, 1996, 1997 and 1998.

3.2.2. Summary of changes

In sum, the crash analysis presented in this study reports on fatalities involving child pedestrians killed between 1990-2000 during school commuting hours. The previous study only reported results from 1990-1998.

In addition, this crash analysis also includes detailed information pertaining to individual crashes directly related to school buses for 1992, 1994, 1996, 1997 and 1998. Previously data for 1997 and 1998 were not available.

3.3. Results of updated crash analysis

In 2000 the Australian road toll included 176 school-aged children (5-17 years). Half of these were passengers in motor vehicles, thirty-four were pedestrians (19%) and less than 1% of children killed or hospitalised in this age group were bus passengers. National statistics on non-fatal injuries are not available for 1998-2000. However, data from previous years indicate that as many as 20 times this number (approximately 680 children) may have been hospitalised in 2000 as a result of injuries sustained as pedestrians (23%).

Examination of crashes occurring on weekdays within school terms[1] (and not on public holidays[2]) and during the periods prior to and just after school allows a more accurate estimate of the upper limit of the number of incidents involving school buses. The periods 8-10am and 3-5pm are used to approximate morning and afternoon school-commuting times.

3.3.1. Child pedestrian crashes during school commuting hours

Tables 3.1 and 3.2, and Figures 3.1 and 3.2 show the numbers of child pedestrians killed and hospitalised in road crashes at these commuting times, annually, since 1990. The data reveals that both the fatal and non-fatal numbers have decreased since 1990. The lowest numbers recorded were 4 fatalities and 213 hospitalisations in 1997. In the past five years the number of fatalities has fallen to under 10.

Table 3.1: Number of child pedestrians aged 5-17 years killed in road crashes in the morning and afternoon on school days, Australia 1990-2000

Year	Morning (8-10am)		Afternoon (3-5pm)		Total	
1990	5	19%	22	81%	27	100%
1991	4	22%	14	78%	18	100%
1992	4	24%	13	76%	17	100%
1993	4	27%	11	73%	15	100%
1994	1	7%	13	93%	14	100%
1995	1	9%	10	91%	11	100%
1996	4	57%	3	43%	7	100%
1997	1	25%	3	75%	4	100%
1998	0	0%	8	100%	8	100%
1999	0	0%	6	100%	6	100%
2000	5	56%	4	44%	9	100%
Total	29	21%	107	79%	136	100%

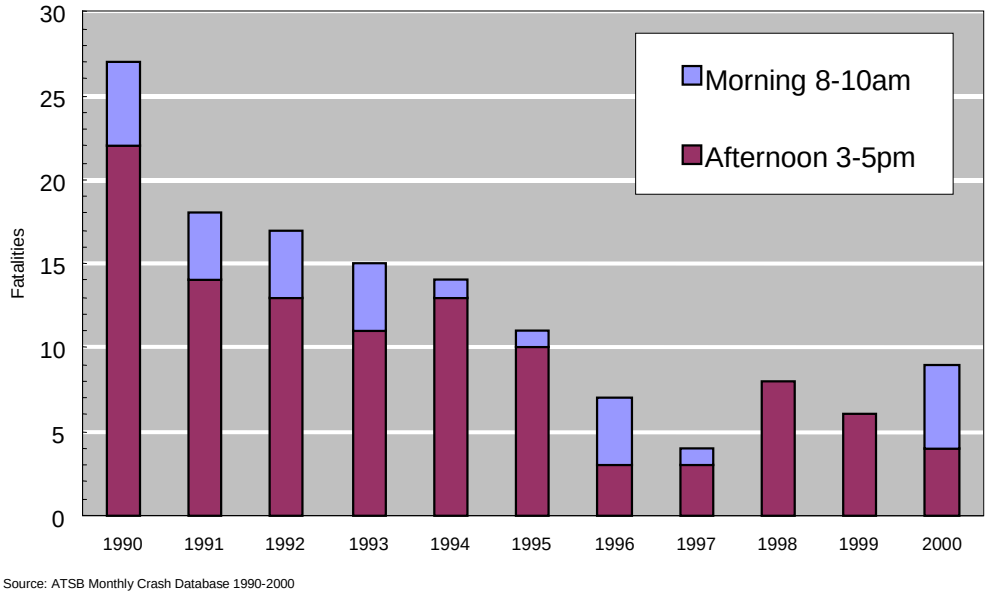
Source: ATBS Monthly Crash Database 1990-2000

Table 3.2: Number of child pedestrians aged 5-17 years hospitalised as a result of road crashes in the morning and afternoon on weekdays, Australia 1990-1997

Year	Morning (8-10am)		Afternoon (3-5pm)		Total	
1990	83	23%	277	77%	360	100%
1991	65	22%	230	78%	295	100%
1992	63	22%	226	78%	289	100%
1993	57	23%	192	77%	249	100%
1994	66	25%	201	75%	267	100%
1995	52	21%	192	79%	244	100%
1996	64	27%	170	73%	234	100%
1997	56	26%	157	74%	213	100%
1990-97	506	24%	1645	76%	2151	100%

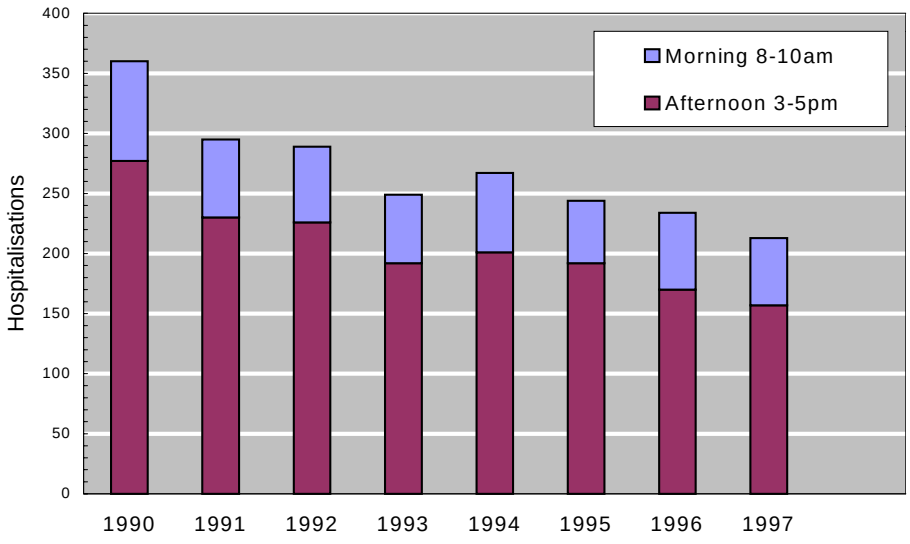
Source: ATBS Casualty Crash Database 1990-1997

[1] School terms for each State and Territory for each year in the period 1990-2000 were obtained from the respective Education Departments.
[2] Observance of public holidays such as Australia Day, Easter, Anzac day, Queen's Birthday, Labour day, Christmas and Boxing Day in each State/Territory in the period 1990-2000 were obtained from respective jurisdictions.



Source: ATSB Monthly Crash Database 1990-2000

Figure 3.1: Child pedestrians killed in the morning and afternoon on school days, Australia 1990-2000



Source: ATSB Casualty Crash Database 1990-1997

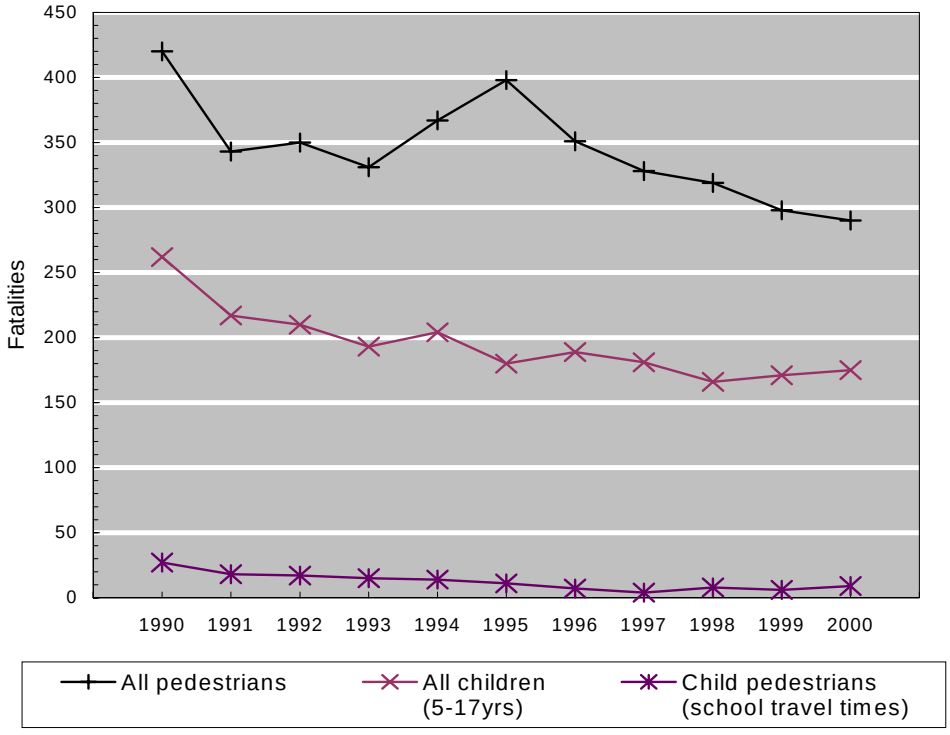
Figure 3.2: Child pedestrians hospitalised in the morning and afternoon on school days, Australia 1990-1997

The following figures, Figures 3.3 and 3.4, show decreasing trends for all pedestrian fatalities and hospitalisations (i.e. including adult and child pedestrians during non-commuting times and on non-school days) and all children (i.e. as pedestrians and as other road users including passengers and cyclists). The data also reveals a net decrease over the total time period for all groups (despite the spike in 1995 for pedestrians). The data further shows that since around 1997 child fatal crashes during commuting hours have plateaued as have child fatalities in total. During the same period the number of fatalities involving all pedestrians has fallen markedly.

In percentage terms however, the decreases for child pedestrians during school commuting times are larger than for the corresponding percentages for the other road user groups across the 10-year period. For example, the average percentage decrease in child pedestrians killed during school commuting times is 13% compared with 2% for all pedestrian fatalities and 3% for all child fatalities (Figure 3.3). For hospitalisations, the corresponding average percentage decrease is 6% compared with 2% for all pedestrians hospitalised and 3% for all children hospitalised (Figure 3.4).

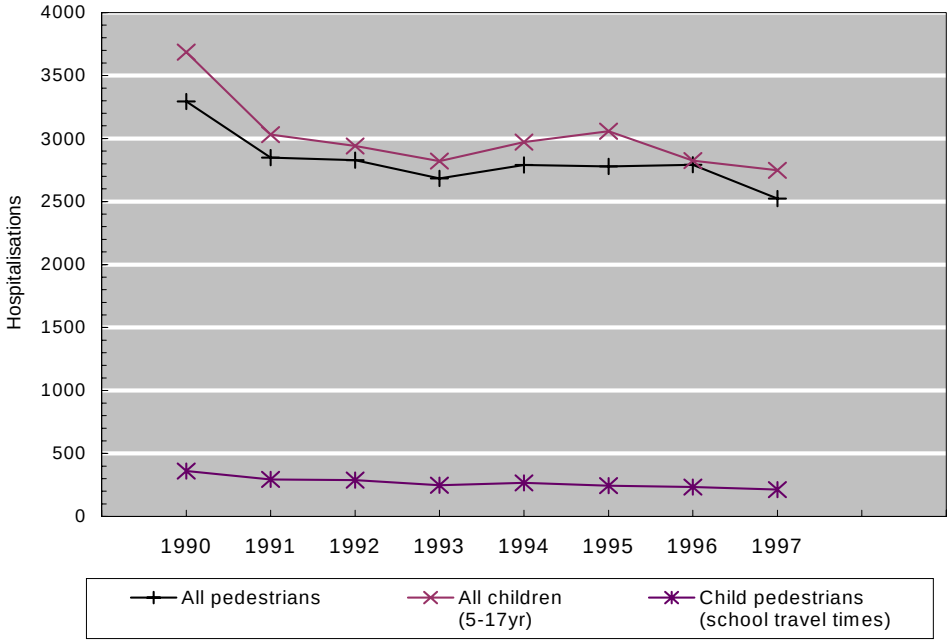
Tables A1 and A2 in the Appendix present the corresponding individual State and Territory figures for child pedestrians killed or hospitalised during school commuting times. The pattern in the larger States is consistent with the decreasing trends nationally. Small numbers of fatalities and hospitalisations in some jurisdictions prevent conclusions on trends to be drawn.

The other major feature of the figures is the preponderance of crashes in the afternoon compared with the morning. Seventy-nine percent of fatal crashes and 76% of non-fatal crashes occurred in the two-hour period 3-5pm. There appears to be no consistent change in this distribution over time.



Source: ATSB Monthly Crash Database 1990-2000

Figure 3.3: Fatality trends for pedestrians and children, Australia



Source: ATSB Casualty Crash Database 1990-1997

Figure 3.4: Hospitalisation trends for pedestrians and children, 1990-1997

3.3.2. Crashes involving child bus passengers

Tables 3.3 and 3.4, together with Figure 3.5 show the numbers of child bus passengers killed and hospitalised in road crashes during school commuting times between 1990 and 1997 inclusive. Over this eight-year period, 6 children were killed and 78 were hospitalised. Examination of the frequency of fatalities and hospitalisations since 1990 does not provide any clear trends. Although during 1997, the most recent year of data available, the lowest yearly total of child bus passenger fatalities and hospitalisations was experienced. Furthermore, the data reveals that 83% of fatal crashes and 73% of non-fatal crashes that occurred during school commuting hours occurred in the afternoon between 3pm and 5pm.

Table 3.3: Number of child bus passengers aged 5-17 years killed in road crashes in the morning and afternoon on school days, Australia 1990-1997

Year	Morning (8-10am)		Afternoon (3-5pm)		Total	
1990	0	0%	0	0%	0	100%
1991	0	0%	1	100%	1	100%
1992	0	0%	0	0%	0	100%
1993	0	0%	0	0%	0	100%
1994	1	25%	3	75%	4	100%
1995	0	0%	0	0%	0	100%
1996	0	0%	0	0%	0	100%
1997	0	0%	1	100%	1	100%
1990-97	1	17%	5	83%	6	100%

Source: ATSB Casualty Crash Database 1990-1997

Table 3.4: Number of child bus passengers aged 5-17 years hospitalised as a result of road crashes in the morning and afternoon on weekdays, Australia 1990-1997

Year	Morning (8-10am)		Afternoon (3-5pm)		Total	
1990	1	17%	5	83%	6	100%
1991	3	18%	14	82%	17	100%
1992	4	57%	3	43%	7	100%
1993	4	33%	8	67%	12	100%
1994	2	15%	11	85%	13	100%
1995	1	17%	5	83%	6	100%
1996	5	36%	9	64%	14	100%
1997	1	33%	2	67%	3	100%
1990-97	21	27%	57	73%	78	100%

Source: ATSB Casualty Crash Database 1990-1997

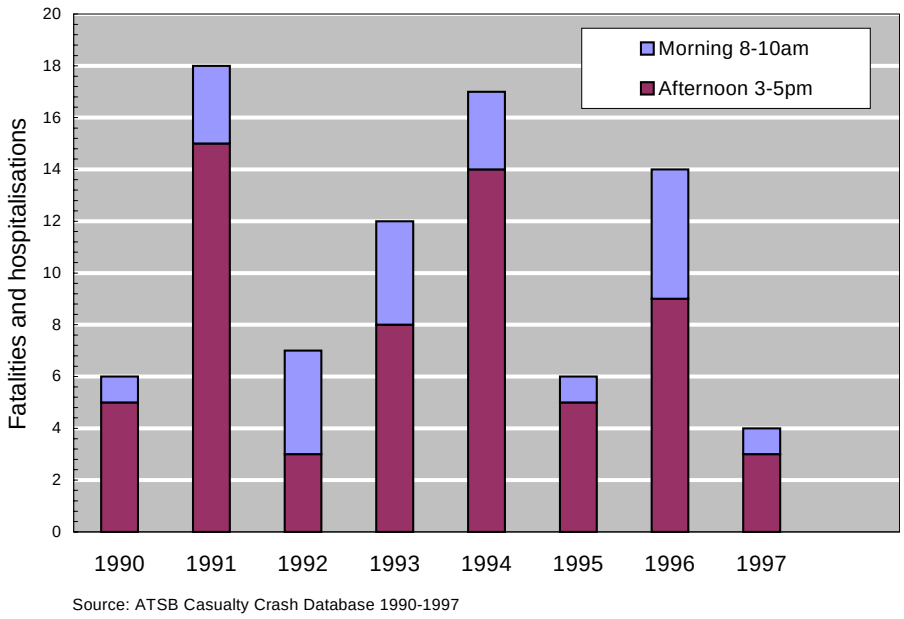


Figure 3.5: Child bus passengers killed or hospitalised in the morning and afternoon on school days, 1990-1997

3.3.3. Characterisation of fatal crashes involving school children and buses

Number of fatalities

Investigation of detailed fatality data for 1992, 1994, 1996, 1997 and 1998 indicated that 28 children were killed during bus travel to and from school in association with school buses (see Table 3.5).

During these years there were a total of 23 fatal crashes where a school-aged child was killed as a pedestrian associated with a bus on a journey to or from school. These fatalities comprise 46% of the pedestrian fatalities occurring during school commuting times in these years (based on estimates in Table 3.1).

Additionally, during these years six children were killed as passengers of buses during school commuting times (four in 1994, one in 1996 and one in 1997). Further investigation of the coding of these crashes indicates that only five of these occurred during travel to or from school. Three of these occurred at bus stops (two involved a child alighting from the bus and in one a child was killed while leaning out of a window), and two involved collisions between the bus and another vehicle.

The data also shows that the number of child fatalities associated with school bus travel has fallen substantially since the early 1990's. This finding however should be treated with caution as the number of fatalities that have occurred are small.

Table 3.5: Children aged 5-17 years killed during bus travel to and from school in Australia during 1992, 1994, 1996, 1997 and 1998

How the fatality occurred	1992	1994	1996	1997	1998	Total
As a *pedestrian* crossing the road						
-To board a bus	1	0	0	0	0	1
-After alighting from a bus	6[a]	9	4	2	1	22
As a *bus passenger*						
-Alighting	0	2	0	0	0	2
-Within the bus (collision with other vehicle)	0	2	0	0	0	2
-Other	0	0	0	1	0	1
Total	7	13	4	3	1	28

Source: ATSB Fatality Crash Database 1992, 1994, 1996, 1997 and 1998

[a] This includes one case where the DCA classification was ALIGHT. However, the supplementary DCA data items indicated that in this case the child had actually got off the bus and was crossing the road when the fatal incident occurred. Therefore this fatality has been classified as occurring as a pedestrian crossing the road after alighting from a bus rather than as a bus passenger alighting a bus.

While the small number of cases precludes a detailed analysis, a simple frequency table of characteristics provides some insight into a typical crash scenario (see Table 3.6 and Appendix Table A3). Details relating to the crash type, time and location, age and gender of children involved and other salient crash factors for 25 of the child fatalities (5 to 17 years of age) that occurred during school commuting hours during 1992, 1994, 1996, 1997 and 1998 are detailed in following sections.

NB: The two crashes involving a bus and another vehicle are excluded, since their characteristics are not expected to be related to the other crashes where the actions of the child were relevant to the crash. In both of those cases, the bus was hit when turning right; in one instance by an oncoming vehicle, and in the other, by a vehicle overtaking the bus. In each case, a number of passengers were injured in addition to the child who was killed. In addition, the case involving the child leaning out the bus window is also excluded.

Crash type

Table 3.6 indicates that of the 25 child fatalities that occurred during school comminuting times for the years examined, only one case (4%) involved a child crossing the road to board the bus. All other crashes involved the child alighting from the bus and in 22 of these, the child was attempting to cross the road after leaving the bus. Half of the crashes were classified as 'near side' or 'emerging' (child emerges from in front of the stationary bus). This means that these collisions occurred almost immediately after the child left the kerb. The remaining number entailed the child being struck on the far side of the road (i.e. after crossing halfway across the road).

In three cases the child was killed while alighting from the bus. Detailed crash records were only available in two of these cases. In each of these the fatality occurred when the child's leg became stuck in the doors and this was unseen by the driver. In all three cases the child was aged under 12 years.

It was not possible to determine for all crashes whether or not the bus was a designated school bus. In only one of the four 1996 crashes was it noted in the crash report that the bus had flashing lights which were automatically activated when the bus doors were opened.

Table 3.6: Characteristics of child fatalities associated with boarding/alighting a bus during school commuting hours in Australia during 1992, 1994 1996, 1997 and 1998

Crash characteristics	Crashes	% of total	Crash characteristics	Crashes	% of total
To/from bus			Road surface		
Cross road to bus	1	4%	Sealed	24	96%
Got off bus	24	96%	Unsealed	1	4%
Crash configuration(DCA)			Location		
001 Near side	4	16%	Mid-block	22	88%
002 Emerging	8	32%	Within intersection	2	8%
003 Far side [a]	10	40%	Related to intersection	1	4%
009 Boarding / alighting	3	12%	State/Territory		
Time			NSW	12	48%
Before school	5	20%	Vic	3	12%
After school	20	80%	Qld	5	20%
Urban/rural			SA	1	4%
Urban	12	48%	WA	3	12%
Rural	13	52%	NT	1	4%
Speed limit, km/h			Weather		
40	1	4%	Fine	22	88%
60	7	28%	Rain	2	8%
80-90	6	24%	Unknown	1	4%
100+	9	36%	Age, years		
Unknown	2	8%	5-12	19	76%
Road configuration			13-17	6	24%
2 way undivided	20	80%	Sex		
Divided	2	8%	Male	14	56%
Related to intersection	2	8%	Female	11	44%
Unknown	1	4%			

Source: ATSB Fatality Crash Database 1992, 1994, 1996, 1997 and 1998

[a] This includes one case in 1992 where the DCA classification was 'alight'. However, the supplementary DCA data items indicated that in this case the child had actually got off the bus and was crossing the road when the fatal incident occurred. Therefore this fatality has been classified as occurring as a pedestrian crossing the road after alighting from a bus rather than as a bus passenger alighting a bus. The other two cases fatalities related to disembarking the bus and are therefore classified as alighting incidents.

Time and location of crash

All but four of the crashes occurred in the afternoon on the journey home from school.

Half occurred in areas classified as urban and half were in rural areas. Only one crash occurred in a 40km/h school zone. Almost one third of the crashes (7, 28%) occurred at locations with 60 km/h speed limits and over half of the crashes occurred in areas with speed limits of at least 80km/h. (Speed limit was not recorded for one of the crashes, but this crash was on a divided road classified as a highway in an urban area). Eighty percent of crashes occurred on 2-way undivided roads. Only 2 crashes occurred within or near intersections. In only one case was there a pedestrian crossing in the vicinity (but this was 30 metres from the crash site).

Approximately half of the crashes occurred in NSW (48%).

Characteristics of the children

Primary school children made up 76% of those killed in the 25 crashes examined. In only one case was the child accompanied by an adult. Further, the number of boys and girls killed was similar (14 and 11, respectively).

Crash factors

Based on the information available, the most common factor coded as contributing to the crash was the child not seeing the vehicle. There were no cases of speeding or alcohol intoxication noted in any of the 25 crashes examined.

3.4. Summary

Overall, the current crash analysis has not altered the summary and conclusions drawn in the original analysis of data as reported in *AP-R186A School Bus Safety in Australia – Technical Report (Austroads, 2001)*.

The update of crash data has revealed that:

(i) While the number of pedestrian fatalities has steadily fallen since 1995, total child pedestrians fatalities and child pedestrian fatalities during school commuting hours have plateaued.

(ii) The number of child pedestrian fatalities associated with school bus travel has continued to fall. This conclusion should be treated with caution, as the numbers involved are small.

(iii) The typical characteristics associated with child fatalities and school bus travel have not changed.

As identified in the earlier report (AP-R186 and AP-R186A), the typical crash scenario appears to be that the child is on his or her way home from school and is unaccompanied by an adult. After getting off the bus they are hit by another vehicle in attempting to cross a 2-way undivided road (mid-block and with no pedestrian crossing in the vicinity). It appears that in most cases the child has attempted to cross the road without looking for oncoming traffic. This is occurring in both urban and rural areas, but in general on roads with speed limits of 60 km/h or more. Neither speeding nor alcohol intoxication was associated with any of the school bus related crashes identified in the database. Although it is difficult to determine the timing of the sequence of events from the crash records, it appears that in most cases the collision is occurring immediately after the child has alighted from the bus and presumably while the bus is still in the vicinity.

Although occurring less often, the other scenario is where a child dies after becoming stuck in the doors while attempting to get off the bus and is unseen by the driver. There were two cases of this type in the five years in which data was available. One further fatality involved a child leaning out the bus window, however further details were not provided.

The crash databases of jurisdictions do not contain sufficiently detailed information for the evaluation of school bus safety. Auxiliary information is required to identify school children injured while using buses to commute to and from school.

In particular there is a need for the following in both the fatal and hospitalisation crash databases:

- the intention of pedestrian movements (ie. the pedestrian was crossing the road to board a bus when the crash occurred);
- the origin and destination of pedestrian trips (ie. travelling home from school, travelling for extra curricula activities, etc.);
- data on secondary vehicles not directly involved in the pedestrian impacts (eg presence of a bus, other vehicles).

It is also recommended that additional information pertaining to the existence or absence of safety measures implemented within the vicinity of a crash and to the presence of parents/guardians during a crash be collected. For example, information on the presence of flashing lights, use of signs or school bus markings, the implementation of speed zones around schools, and the proximity of bus stops and pedestrian crossings to the crash scene would be of particular value in assessing the factors that led to the crash. Additionally, it would be useful to know whether a parent/guardian was present during the incident - in particular, whether a parent/guardian was waiting for the child on the others side of the road the bus - and whether the child went in front of or behind the bus.

The availability of the information will assist to better target school bus safety initiatives and programs. This will in turn better optimise the benefits that may be derived from resources expended in this area of road safety.

Despite the small number of crashes identified in this analysis, it is apparent that the children most at risk are those alighting from buses on their way home from school in the afternoon and crossing major roads. Further improvements in school bus safety to a large extent will not be achieved without special targeting of this crash profile.

4. REVIEW OF RELEVANT LITERATURE

4.1. Background

To determine current knowledge and practice relating to school bus safety in Australia and in overseas jurisdictions, an extensive literature review was conducted. This task sought to identify the outcomes of findings of recent research associated with school bus safety, crash risk/severity factors related to school bus safety and evidence of proven safety measures, which may be applied to improve school bus safety. The results of this review were documented in *AP-R186A.* The review reported upon available literature up until mid 1999.

Since this time further research into school bus safety has been undertaken. Relevant findings have been summarised and interwoven into the original literature review to provide a stand-alone, updated review of the literature pertaining to school bus safety. The structure of this review varies slightly from the original review with findings and research evidence presented under the following headings:

- Crash risk and severity
- Occupants in transit
- Community concerns and potential countermeasures
- Overseas practices in school bus safety

4.2. Crash risk and severity

4.2.1. School bus related injuries in Australia

In 1994 the Bus and Coach Association of NSW published a report titled the "Travel Safe Report". This report, which assessed the relative safety of all road travellers, in particular school children using buses, was based on statistical crash analysis completed by Professor Hensher and the results of a survey of parents in New South Wales conducted by Leading Edge. The results of Hensher's work suggested that the risk of death or injury to children whilst in a motor car was seven times greater than travelling on a school bus. Furthermore, the risk of injury whilst walking to school was suggested to be 31 times greater than the risk travelling by bus, while children cycling to school were reported to be 228 times more at risk of serious injury or death than travelling by bus. Despite this evidence, the report recognised that many parents view the family motor car as a safer mode of transport than a school bus, reporting that over 80% of parents of school aged children who were surveyed preferred their child to be driven to school by themselves or some other adult. The report further indicated that while these parents ranked cars, school buses and public buses as the safest means of transport, they ranked car travel as the safest of the three.

Despite low risk of injury associated with bus travel, the evidence suggests that the risk is greatest as children walk around school buses. Safety authorities have recommended a focus on the safety of children embarking or disembarking school buses and when crossing the road to board or after alighting (Fayhee, 1987). The crash statistics presented in this report indicate that a large proportion of child pedestrian fatalities and hospitalisations during school travel times occur in the afternoon period. Further to this, a greater proportion of school bus-related fatalities also occur in the afternoon, when children are crossing the road after alighting the bus in the afternoon.

A task force on school bus safety formed in 1990 by the Road Safety Bureau of New South Wales (now the Roads and Traffic Authority) investigated the relationship between students and buses and the anomaly between morning and evening casualty rates. It was determined that in the mornings, children are either crossing the road towards the bus, or are already waiting at the bus stop before the bus arrives. Under these circumstances the bus itself does not act to block the vision of pedestrians or motorists. However, in the afternoons children disperse in all directions after leaving the bus. If they cross the road before the bus leaves the stop, the view of pedestrians or motorists is potentially obscured by the bus, increasing the risk of a child being struck (RSB, 1992).

Further to this, Australian statistics indicate that fatalities recorded for children crossing the road after leaving a bus occur in both rural and urban locations, as evidenced in the crash analysis section of this report. Therefore, strategies to further reduce fatalities and hospitalisations need to consider the differences between urban and rural school bus safety, particularly in regard to children's safety when boarding and alighting. It has been noted elsewhere that school bus use and knowledge differs according to whether the bus travels in rural or urban areas. Children who travel by bus in rural areas may need to develop pedestrian, bus passenger, and road crossing skills at a younger age than metropolitan students. The operating environment, speed limits, types and conditions of roads, distances travelled, locations and signage of bus stops, and volumes of traffic, are just some of the other issues that may need to be taken into account when developing a school bus strategy. A consistency in school bus safety standards is necessary between metropolitan, regional and rural areas of each State or Territory (School Bus Safety Coordination Project Report, 1998).

4.2.2. School-bus related injuries in overseas jurisdictions

United States (US)

Findings in the US were similar to those in Australia. The National Highway Traffic Safety Administration (NHTSA) reported that up to 70% of child fatalities occur when children are returning from school rather than on their way to school, with the majority of injuries sustained after children have alighted the vehicle (1997). Furthermore, it is estimated that 58% of children who are killed while in a bus loading zone are hit by their own school bus. The style of much of the US school bus fleet, with a 'long-nose' deign has been considered by many commentators as a significant contributing factor.

Furthermore, the NHSTA (1997) suggested that approximately half of all school bus loading zone fatalities involve children aged between five and seven years. They suggested that this may be indicative of this group's increased vulnerability as at-risk pedestrians. Referring to research on the development of primary school children in relation to safe road use indicates that young children:

- Have undeveloped 'peripheral' vision resulting in a narrower field of vision than adults.
- Have difficulty determining the directions of sounds.
- Cannot accurately judge the speed or distance of moving vehicles.
- Lack the ability to understand what time and distance is needed for a vehicle to stop.
- Overestimate their own abilities.
- Are easily distracted.
- Tend to focus on one thing at a time.
- Are easily hidden by bushes, parked cars etc.

Canada

Like Australian and American research, Canadian research has identified that children disembarking from the bus appear to be at greater risk of injury than occupants travelling in a moving bus. Gardner (1999) conducted an investigation of 42 cases involving 567 school children between 1989-1997 where incidents involved injury or potential injury. Gardner reported a total of 12 students were killed after disembarking the vehicles, with 11 of these being run over by the bus in which they were travelling and one struck by a vehicle passing the bus. A further five fatalities involved occupants of a moving bus -–two of these were as a result of side-impact crashes, two from collision induced fires and one fatality to a pedestrian who had not been travelling on the bus

In a study benchmarking Canadian, American and Australian bus safety, Hildebrand (2001) identified additional information requirements and explored possible countermeasures critical to maintain high level of school bus safety. In this investigation, Hildebrand compared fatality data in Canada with Australia and United States estimates. The report indicated that Canada and Australia *school buses* have higher fatality rates than *all bus categories combined*. However, fatality rates are very low for occupants, and are even lower in the United States. When pedestrian and other vehicle occupants are included the United States estimates exceed Canadian and Australian estimates. Canada and America statistics also indicate that a significant number of school bus fatalities result from being passengers of another vehicle during a collision, whereas, in Australia the majority of fatal school bus related crashes involve pedestrians. Hildebrand (2001) explained that this difference may be explained, in part by differences in boarding and alighting procedures between Australian and American School Buses. For example, Hildebrand indicated that Canada and the United States have a dedicated school bus fleet, which is equipped with flashing lights that signal to oncoming traffic to stop as children are boarding and alighting, mirror to reduce blind spots around buses and greater visibility of pedestrians moving around vehicles.

Hildebrand (2001) further explored the pattern of school bus pedestrian fatalities in the three jurisdictions. He reported that in the US, 68% of the 237 pedestrians killed where a school bus was involved were struck by the school bus itself (NHSTA, 1999), with 80% of the 46 pedestrians killed in same situation in Canada were struck by the school bus (1987-1996). Hildebrand compared US and Canadian crash statistics with Australian data for 1992, 1994 and 1996 as reported in *AP-R186* and *AP-R186A (2001)*. He indicated that in these three years 22 school bus related fatalities occurred during school commuting times. Nineteen fatalities occurred as a result of a child being struck by a vehicle after alighting the bus, one while crossing to board the bus and a further two fatalities occurred while the vehicle was moving. Based on this data, Hildebrand concluded that children are three times more likely to be involved in a school buses related incident as a pedestrian in Australia than in Canada or the US.

New Zealand

Statistics provided by Transit New Zealand (J. Wilson, personal communication, 2000) revealed that over the decade of the 1990's there were 91 deaths and 4,570 reported injuries to children (aged 5 to 16 years) travelling to or from school, during school commuting times. However the number of these fatalities and injuries that relate directly to school bus travel are relatively small. Two of these fatalities and 32 reported injuries involved children as occupants of a school bus. A further 8 fatalities and 57 reported injuries occurred as a result of pedestrian incidents involving a school bus.

The most common circumstances surrounding these latter incidents involved a child running across the road, either in front of or behind a parked bus, into the path of a passing vehicle. Transit New Zealand concluded that there are relatively few crashes involving school children travelling in and around school buses.

4.3. Occupants in transit

Despite the evidence to the contrary (as detailed in Section 4 of this report), there remains a strong perception in the community, by parents in particular, that buses are less safe than a passenger vehicle. One potential reason for this is the fitment and use of occupant restraint systems (i.e. seatbelts) in passenger vehicles that are not generally offered in school buses or buses that transport children to and from school. There is documented evidence to support the use of restraints in passenger vehicles and evidence of their value in saving lives. Many parents report a desire to continue this safety regime from the family car to travelling in a bus.

Debates over the safety of school buses, the benefits of compartmentalisation, the cost of installing seatbelts and other countermeasures relative to the safety gains that are likely to result are well-documented. The research is mixed and the evidence is largely inconclusive due to the low crash risk associated with school buses.

4.3.1. Protection via compartmentalisation

The approach used in the US to maximise safety of school bus occupants is termed 'compartmentalisation'. This approach offers passive design protection to occupants and is defined as "the method used to provide a protective envelope consisting of strong, well-padded, well anchored closely spaced seats that have energy absorbing seat backs" (McCray, 2001, p1). This approach to occupant protection was investigated in a study undertaken by the Centre of Transportation Studies and Research (CTSR, 1989) where it was concluded that compartmentalisation, together with enhanced safety standards (i.e. joint integrity), offers adequate safety in frontal impact collisions.

In 1977 the NHTSA established new motor vehicle standards for school buses which included Federal Motor Vehicle Standard (FMVS) 222 for School Bus Passenger Seating and Crash Protection. While the standard did not require the fitment of seatbelts to school buses, it improved occupant protection in school buses via compartmentalisation.

4.3.2. Assessing the crashworthiness of school buses

Frontal impact crash tests

In 1984 Transport Canada (as reported by Farr, 1985) conducted full scale crash testing to determine the effectiveness of lap belts in three different sized school buses (two small and one large bus). In this study test three different sized Hybrid III dummies were fitted with lap belts and results of frontal impact crash tests were compared to dummies without any seatbelt protection. Farr (1985) reported results indicated that the restrained dummies experienced far greater head acceleration than the unbelted dummies. Based on these results it was concluded that the installation of seatbelts in school buses could result in an increase in the risk of head injures to belted occupants in a severe frontal collisions, as occupants "heads may strike seatbacks in front such that energy absorption was not possible" (NTSB, 1999, p2).

Subsequent to the above, in 1986 Transport Canada tested five different types of seats fitted with seatbelts for increased occupant protection. Transport Canada found that rear-ward facing seats provided greatest potential occupant protection during frontal collision and near-frontal collisions, as these allow the crash forces to "be spread over the back of the rearward-facing occupant instead of being concentrated on the head"(Canada Safety Council, 2000, p1).

However, it is important to note that there has been some debate regarding the validity of the testing and conclusions drawn as a result of the Canadian school bus crash tests. The National Coalition for School Bus Safety (NCSBS) has criticised the Canadian tests, suggesting that they were "set up to prove the unworthiness of seat belts"(Yeager, 1985).

The NCSBS argued that the results showed that the only dummy experiencing life threatening forces, (i.e. with Head Injury Criteria (HIC) levels below acceptable limits) was an unbelted dummy located in the front left-hand seat. The NCSBS states that all belted dummies in the test received HIC levels within acceptable limits. They reported that the Canadian tests used 5th percentile female test dummies which are of a height that target the seatback where the padding covers the metal bars of the seat in front. The NCSBS suggested that the use of these dummies in crash testing has been criticised elsewhere for resulting in excessive HIC readings. They highlighted that the tests did not provide information on neck and throat injuries as the necks of dummies were not instrumented. Further they reported that the style of seats used in the testing, Thomas seats, were seats that consistently register high HIC readings in testing procedures (up to two times greater than the HIC readings recorded by other seat types in comparative tests). Overall the NCSBS concluded that the Canadian tests demonstrate the chosen seat "in the best possible way, and, because of the high crash forces, the dummy height and stiffness, the Thomas seat, to show the use of seatbelts on school buses in the worst way" (Yeager, 1985, p2).

Crashworthiness of large school buses

During 1987, the National Transportation Safety Board (NTSB) in Washington commissioned a safety study into the *Crashworthiness of Large Post-standard School Buses* (NTSB, 1987). The crash performance of 44 school buses involved in 43 crashes, in which 13 passengers were killed and 1,119 injured, was investigated. These crashes involved frontal impact, side-impact and rollover crashes. The aim of the study was to evaluate how well Federal Safety Standards worked to avert injuries or fatalities to unrestrained occupants and determine the difference that lap belt use may have had on the severity of occupant injuries. It was concluded that of the 13 total school bus passenger fatalities, lap belt use would have probably prevented two deaths, made no difference in ten deaths, and could not be determined for one death. The study found that 90% of unrestrained passengers in the crashes examined received minor injuries. Therefore, the results indicated that that it way unlikely that the lap belts would have reduced these injuries, concluding no net benefit of lap belt use on injuries and potential negative effect on safety of restrained passengers. This latter inference is based on the opinion of experts who believe that because children have a small and yet to develop bone structure, seat belts can cause fracturing of the spine and intra-abdominal injuries, often referred to as 'seat belt syndrome,' that lead to a worse outcome than an absence of seat belts (NTSB, 1987; School Bus Fleet, 1999).

Based on the crashes examined the NTSB (1987) reported that death and serious injuries sustained by occupants were more likely to be attributable to occupant seating position being directly in line with the crash forces rather than a result of being unrestrained at the time of impact. Cases of occupant ejection were rare and serious injuries were generally sustained prior to the vehicle rolling over. Overall, the NTSB concluded that large post-standard school buses perform well in protecting passengers from injuries in a range of crashes and reflect an exceptionally safe form of transportation (NTSB, 1987). They reported that *"best, lap belt use probably would have reduced somewhat the injuries of less than third (8) of the 24 surviving school bus passenger injuries in the study and made no change for the majority (12). At worst, it might have increased the injury to almost as many passengers with serious injuries as it improved"* (Recommendation 16: NTSB, 1987).

Therefore, the NTSB recommended that Federal Safety Standards should <u>not</u> be amended to require lap belts for passengers in all new large school buses.

Crashworthiness of small school buses

As a follow up, in 1989 the NTSB undertook a similar investigation into the crashworthiness of small post-standard school buses and vans used to transport children to and from school. Based on the crashes examined, the NTSB reported that post-standard school buses (manufactured after 1977) also provided good protection towards school aged occupants. The investigation indicated that restrained and unrestrained occupants experienced similar patterns of injuries in small school buses, noting that seating position was a greater factor in determining level of injury sustained than belt status. The NTSB reported that passengers seated in the front rows of small buses were at greater risk of head or facial injuries than other occupants, attributing the finding to the absence of restraining barriers. Based on the crashes examined, they found that lap belted occupants experienced greater interaction with restraining barriers than occupants without lap belts.

With respect to the fitment of occupant restraints, the NTSB recommended that the feasibility of requiring lap - shoulder belts and other restraint systems that provide greater torso restraint for front seat passengers in small school buses be considered. The NTSB further recommended that computer simulations and sled tests be undertaken to determine the relationship between restraining barriers and injuries to unrestrained and lap-belted passengers of different sizes on small school buses with attention to appropriate height, width, padding, location and anchorage of barriers and spacing between barriers and front seats.

4.3.3. Current occupant restraint systems and standards

Despite considerable testing and research into the use and fitment of seatbelts, the debate as to whether they offer improved occupant protection has continued to increase. In response, the NTSB (1999) initiated a special investigation to determine the potential injury mechanisms involved in six recent accidents and identify whether currently available occupant protection systems might have mitigated injuries in cases of vehicle rollover and high lateral force. This investigation examined six crashes between 1996 and 1998: four involving side-impact with another vehicle of similar or greater mass and two involving rollover incidents. Three crashes were simulated to identify the dynamics of the vehicle and impact on occupants during the collision sequence. The results indicated that those occupants that were not in the area of intrusion but were retained in their seating compartment benefited from compartmentalisation. However, those who were not retained impacted on surfaces not designed to absorb energy. This finding raised concern that current compartmentalisation does not protect all passengers during lateral impacts with vehicles (i.e. in crashes where the bus impacts with heavy vehicles and in side-impact impact and rollover collisions). In these collisions many passengers do not remain within the designated seating compartment and often impact with objects other than seatbacks including other passengers, bus walls, windows and other seats.

Therefore the NTSB concluded that while compartmentalisation is highly effective for frontal impact collisions, the most common form of bus related crashes, this approach offers less adequate protection for side-impact collisions and roll-over crashes.

Based on this finding the NTSB (1999) investigated whether currently available restraint systems would improve occupant protection in these collisions. The current seats in school buses are designed to deform to absorb the energy of unrestrained occupants, however currently they cannot withstand the loading of three people. Therefore in frontal impact the loading of two belted occupants would deform the seats, rendering the energy absorption capabilities of the seat useless for any unrestrained passengers seated behind and thus increasing the risk of serious injury in the event of a collision. The NTSB (1999) identified that an integrated seat / lap-sash belt system that could withstand the loading of both restrained and unrestrained occupants is under development. At the time of writing their report, the NTSB indicated that this technology was undergoing frontal barrier testing, however further details were not provided.

In conclusion, the NTSB (1999) recommended that while the potential for occupant protection systems exists, their investigation failed to indicate whether current design of available restraint systems for large school buses would have reduced the risk of injury to the school bus passengers in the crashes examined.

As part of an extensive research program to develop the 'next generation occupant restraint system' the NHTSA are evaluating currently available and prototype safety restraint systems in large school buses (McCray, 2001). The NHTSA are using computer simulations to determine the effect of compartmentalisation, lap belt restraints and lap-sash restraints on occupant safety. To date these three occupant protection systems have been simulated for frontal impact collisions using under three loading conditions: (i) belted without any occupants seated behind; (ii) belted with loading from unbelted occupants behind; (iii) unbelted occupants into seat in front of them. The simulation used three different Hyrbrid III dummy models (a 6 year old, a 5^{th} percentile female and a 50^{th} percentile adult male) to represent an average sized 6 year old child, a 12 year old adolescent and a large high school male.

The key findings of the simulation study were that

- Compartmentalisation was most effective for smaller occupants while larger occupants who were located at the rear of the bus tended to override standard height seatbacks.
- Lap belt systems resulted in only slightly greater neck injuries than compartmentalisation and also prevented larger rear occupants from overriding the seatback.
- Lap-sash belt systems yielded greater safety performance than either compartmentalisation or lap belt systems. It was further noted that adjustable lap-sash belts may have provided better results for smaller children.

In their report, the NHTSA indicated that they are currently evaluating the effect of seatbacks, seat height and seat spacing on the performance of these occupant protection systems (McCray, 2001).

Cost effectiveness and safety gains

During 1986, Hatfield and Womack (1986) conducted a study for the Texas Transportation Institute, into *Safety Belts on School Buses: The Texas Experience*. School bus crash data was obtained from Texas police reports between 1975 and 1984. During this period, 12,669 crashes involved school buses, resulting in 19 fatalities.

It was determined that seat belts would have saved 12 lives, an additional four could also have been saved given better supervision of students during travel (eg. for three deaths resulting from children leaning their heads out of windows), and three deaths were deemed inconclusive. Hatfield and Womack concluded that on the basis of this data, that improved vehicle maintenance, bus driver training and rider training, may have a greater potential for crash frequency and severity reduction over time than the cost of seatbelt installation and relative safety returns (CTSR, 1989).

In 1989 the Transport Research Board (TRB) in the US released Special Report 222 into *Improving School Bus Safety* (TRB, 1989). The study investigated the cost effectiveness, injury reduction and life-saving potential of nine different safety measures. The safety measures, target populations, and effectiveness ratings (the predicted reductions in fatalities and injuries from an annual investment of $1 million per measure) are detailed in Table 4.1.

Table 4.1: The nine safety measures, effectiveness ratings and target populations

Safety Measures	Percent Effective [a]	Target Population (Students)
Seat Belts (lap-belts only) [b]	0 – 20	Passengers
Higher seat backs	0 – 20	Passengers
School bus monitors	25 – 75	Passengers and Pedestrians
Crossing control arms	5 – 25	Passengers struck by the front of school buses [c]
Electronic sensors	10 – 50	Pedestrians struck by school buses
Mechanical sensors	10 – 50	Pedestrians struck by school buses
Stop signal alarms	0 – 30	Pedestrians struck by other vehicles [d]
External loud speaker systems	0 – 20	Pedestrians struck by other vehicles
Pupil education programs	0 – 20	Pedestrians

[a] Percent effective at reducing fatalities or injuries of target populations

[b] 50% use rate assumed

[c] Approx. two-thirds of all pupil pedestrians killed by school buses are struck by the front of the bus

[d] Stop signal arms are not required in 22 of 50 States. Therefore it is assumed that 44% of children who are killed or injured when struck by other vehicles could potentially benefit from the installation and use of stop signal arms.

In this report the TRB identified that those measures offering the greatest potential safety improvement (per dollar invested) were higher seat backs (for reducing fatalities and especially reducing injuries) and pupil education programs. The least effective measures for reducing fatalities or injuries (per dollar invested) were deemed to be seat belts and school bus monitors. In addition, it was recommended by the Committee that to improve the safety of school bus passengers during crashes:

- standees should be prohibited on school buses;
- school bus seat back height should be raised to 24 inches (measured from the seating reference point);
- reflective markings should be placed on school buses to enable them to be more easily seen when travelling at night, which might reduce night crashes.

A study by Henderson and Paine (1994) specifically focusing on the fitment, effectiveness and cost of mandating seatbelts on school buses in New South Wales also highlighted mixed opinions regarding their effectiveness in reducing death or injury to school children. This study highlighted that in Australia, unlike America, very few buses are used exclusively as a school bus, but rather for the transportation of a varied range of passengers. Therefore many of the constructional and safety features that are found in the dedicated school bus fleet in America, such as seatbelts, cannot be simply applied to our situation. Researchers and advocates of seatbelts in the USA have concluded that the use of lap-belts alone, in the absence of high backed seats and appropriate seat padding can actually increase injury risk in frontal impacts and can increase belt-induced internal injury to children (NTSB, 1987).

In line with previous findings, Henderson and Paine (1994) noted that the effectiveness of seatbelts depends on a number of other vehicle design features. For example, the type of seat fitted, other vehicle designs employed to minimise risk (i.e. seat height, seat padding), the type of belt used (lap-sash or lap-belt) and the extent to which all passengers use belts and adhere to vehicle policies. As a result, the authors noted that 3-point lap-sash seat belts are the only effective seat belt for student transport. The same study also noted significant difficulties associated with retro-fitting seatbelts, acknowledging the technical difficulties related to seatbelt anchoring and unstable flooring in existing bus fleet. This highlighted the need for seatbelts to be considered and fitted in conjunction with other measures including floor strengthening and anchorage points.

Finally, the study estimated the cost of installing effective seatbelts to be very large. This cost would further increase as requirements permitting 3-for-2 seating and standing passengers would need to be revised if seatbelts were fitted. As a consequence of the issues highlighted in this study and the statistical evidence suggesting that very few injuries are sustained by passengers whilst on board a bus, Henderson and Paine (1994) concluded that modification to the seat design in Australian buses may be a more effective method of preventing injury than the fitment of seatbelts.

Henderson and Paine's (1994) research also highlighted that no specific safety standards apply to school buses in Australia. Although buses must comply with the relevant Australian Design Rules (ADRs) pertaining to bus occupant protection, no provisions apply specifically to school buses or to buses used in the transportation of children to and from school (Henderson, 1994).

A recent investigation undertaken by ARRB Transport Research (2001) into the feasibility of fitting seatbelts in school buses identified a number of ADRs as relevant to the provision of occupant protection and application of seatbelts in buses. These ADRs included ADR 68/00: Occupant Protection in Buses, ADR 66/00: Seat strength, seat anchorage strength and padding in omnibuses and ADR 4/03 Seat belts. The ARRB TR (2001) report summarised these ADRs as follows:

> *ADR 68/00 Occupant Protection in Buses*
>
> *"This ADR applies to omnibuses over 3.5 tonnes (MD3, MD4 and ME) which seat more than 17 persons (including the driver and crew), and in which all seats have a reference height (seat back height) greater than 1.0 metre. That is, high-backed bus seats. This is interpreted to mean that buses with low-back seats cannot be fitted with lap-sash seat belts. For lap-sash seat belts to be fitted to school buses…the buses must first be modified to incorporate high-back seats. ADR 68/00 specifies that in these vehicles (with seat backs greater than 1.0 metre in height), all front and rear seating positions be equipped with seatbelts. The ADR indicates that Route Service Buses are exempt from the requirements prescribed.*
>
> *The ADR specifies the requirements for seat belts in buses including the strength of seats, seat-anchorages, seatbelt anchorages and, child restraints anchorages, and the provisions for protecting occupants from impact with seat backs and accessories on seats and arm rests. The most relevant section of this ADR states that each seat is to be fitted with a Seatbelt Assembly (5.4.1)".*
>
> *(ARRB TR, 2001, p6)*
>
> *ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses*
>
> *"This ADR applies to all omnibuses with more than 17 seats (including the driver and crew) and in which all passenger seats have a reference height (seat back height) greater than 1 metre.*
>
> *This specifies the requirements for the strength of seats, seat-anchorages and seatbelt anchorages of certain omnibuses and for protecting occupants from accessories on the seats and arm rests. It also states that omnibuses complying with ADR 68/00 need not comply with this rule".*
>
> *(ARRB TR, 2001, p4)*

ADR 4/03 Seat belts

"This ADR specifies the requirements for seatbelts to restrain vehicle occupants under impact conditions, to facilitate fastening and correct adjustment, to assist the driver to remain in his seat and thus maintain control of the vehicle in an emergency and to provide protection against ejection in an accident situation. It was recently amended (1998) and now applies to all omnibuses manufactured after the 1st January 2000 (MD1 to MD4 and ME). For omnibuses complying with ADR 68/00 only the driver's seatbelt is required to comply with clauses 17 to 19 of ADR 4/03.

Essentially this ADR indicates that all omnibuses manufactured after January 1st 2000 must be fitted with seatbelts, for all seating positions for which seatbelt anchorage's are required (in accordance with ADR 5/04)".

(ARRB TR, 2001, p4)

However, as indicated in the feasibility study (ARRB TR, 2001) and reported by Henderson and Paine (1994) very few buses that are used to transport children to and from school are directly effected by the improved occupant protection measures that apply to buses under these ADRs. For example, the majority of contract school buses in Western Australia (ARRB TR, 2001) have seat backs of less than 1 metre and buses used on school and passenger services in Queensland are generally route service buses (QTSTST, 2001). Therefore, under current regulations both types of buses are exempt from the occupant protection requirements stipulated in ADR 68/00. Consequently, amendments to legislation pertaining to school buses or indeed changes to the structure or design of school buses themselves (i.e. height of seat backs) would be required in order for seatbelts to be fitted in buses used for the transportation of children to and from school.

In comparison to the research highlighting difficulties associated with seatbelts in school buses, seat belt advocates have indicated that such restraint systems have the potential to increase occupant protection, improve passenger behaviour (with potential spill over effect to other vehicles) and reduce driver distractions that may presently result in bus incidents (Irwin & Faulks, 2000). Irwin and Faulks (2000) suggested that appropriate restraint systems and seating for all children may reduce the severity of injuries that might otherwise be sustained. Therefore, as a minimum they suggest that bus seats and associated standards should be redesigned to ensure they are compatible for the fitment of seat belts in the longer term.

The research referenced in this review document a wide range of studies examining the safety of compartmentatlistion compared with the level of occupant protection offered by seatbelts. Compartmentalisation appears to offer adequate protection for occupants in frontal impact collisions, with some concerns as to its effectiveness in collision involving high lateral forces and cases of bus rollover. Further, there is difficulty in determining whether the addition of appropriate occupant restraint systems such as seatbelts will achieve the same level of occupant protection as that which could be achieved through number of other cost effective and practical measures.

4.4. Community concerns and countermeasures

4.4.1. Safety as an occupant

All states in Australia currently permit carriage of passengers who have to stand on route service buses, as these buses are designed with allocated standing areas. Due to their design, non-route service buses are not permitted to allow passengers to stand (Queensland School Transport Safety Task Force, 2001).

In 1996 Henderson undertook a review of community concerns regarding the risks facing students who are required to stand, rather than sit, during a bus journey to and from school. Henderson found very few evaluations have been carried out comparing the relative safety of seated versus standing bus passengers. As previously noted, in Australia there is a low risk of injury as a bus passenger, thus they concluded that the additional risk posed by a child standing during the bus journey is very small. He acknowledged that some vehicle countermeasures could be adopted at minimal cost, such as handholds, the stricter application of load restrictions and additional 'in vehicle' safety barriers. Finally Henderson noted that the cost of achieving a "zero standing risk" would be far in excess of the "value of the injuries that would be saved" (1996, p1), noting that such expenditure would perhaps be of greater value if directed towards addressing pedestrian and bus crashes.

Issues relating to standees and three-for-two seating policies are often mentioned by the community as needing a resolution. For example, in a study by Attwood Marshall Lawyers (see Davis, 1995), Parent and Citizen Associations were contacted in Queensland and Northern New South Wales to identify areas of concern about school bus safety. Of the schools to reply, 99 were from metropolitan areas or towns with a population greater than 20,000 people, and 167 were from rural areas or towns with fewer than 20,000 people. The study revealed that overcrowding, and problems relating to standees and the widespread three-for-two seating policy were of prime concern to the schools that replied. Thirty-eight percent claimed to have an overcrowding problem requiring some students to stand at least once a week when travelling by bus.

Despite these concerns, a NSW *Bus and Coach Safety Standing Committee Report* (Johnson, 1993) found that there was a lack of evidence indicating that keeping the three-for-two seating rule compromised safety levels of passengers, yet its abolition would lead to a 16% increase in additional bus travel costs per year. Similarly, eliminating child standees on buses poses a problem because 70% to 80% of Australian students travel on normal route buses. The cost impact of eliminating both standees and the three-for-two policy by requiring seat belts on all buses, could be as high as 55% (Johnson, 1993).

4.4.2. Safety as road user after boarding or alighting the bus

Supported by crash data, research also highlights community concern that children are at risk of injury when boarding or alighting a school bus.

A Victorian coordination project report into school bus safety, commissioned by the Department of Infrastructure, at the request of the Minister for Transport, and the Minister for Roads and Ports (School Bus Safety Coordination Project Report, 1998), identified a number of key issues considered important by the community for the on-board safety of school children. These included the need for seatbelts, two-way communication facilities, emergency procedures (i.e. crash, fire, flood, fog), bus monitors, school education and training campaigns and the introduction of advertising campaigns that focus on school bus safety. Further to this, a range of suggestions were also proposed by the community as being important for the overall improvement of safety of children as they board or alight school buses. These included the need for speed restrictions around stationary buses, hazard lights to be fitted on buses, increased bus visibility, the introduction of flashing lights and signs as part of bus stopping procedures, school education and training campaigns, the introduction of advertising campaigns that focus on school bus safety and the trial of an 'optic' device affixed to rear of bus.

During 1992, the Road Safety Bureau of the RTA (RSB, 1992) identified the countermeasures considered to be most applicable to NSW school buses to combat the number of pedestrians crossing in front of or behind a bus and being struck by a passing vehicle. The strategy was developed in consultation with key stakeholder groups and required their participation in the delivery of action items. These strategies are outlined in Table 4.2.

Table 4.2: Possible safety action items for reducing school bus-related fatalities in NSW

Target Group	Safety Action Items
Education	
School Children	• Wait until the bus has left before crossing the road. • Never cross the road from in front of the bus.
Bus Driver	• Know the hazards that can exist for child pedestrians. • Be aware of the correct behaviour for child pedestrians.
Parents / Carers	• Be aware of the limitations of a child's ability to cope with traffic at different stages of development. • Be aware of the correct behaviour for child pedestrians. • Wait at the bus stop, not on the other side of the road.
Motorists	• Be aware of children's behaviour and of the meaning of warning signs and lights. • Exercise caution when approaching a school bus from any direction.
Management of Students On or Near Buses	
Supervisors on Buses	• Reinforce education messages (older children and/or volunteers). • Prevent children crossing in front of the bus.
Drivers	• Reinforce education messages, especially crossing after the bus has left. • Prevent children crossing in front of the bus.
Parents / Carers	• Reinforce education messages. • Wait on the same side of the road as the bus stop.
School Bus Design / Mechanical Aspects	
	• Warning sign and flashing light system to alert oncoming motorists to the presence of child pedestrians. • Auxiliary mirrors to improve the bus driver's vision across the front of the bus. • Prohibit all advertising on the rear of any bus used to transport school students. • External loudspeaker to allow bus driver to communicate with pedestrians. • Warning / reminder stickers placed inside bus near bus exits.
Bus Stop / Route Environment	
Location of school bus stops	• Avoid locations, which exacerbate the visibility problems of drivers and pedestrians.
School bus routes	• Select the most appropriate route with respect to demand and bus stop locations to minimise pedestrian hazards and reduce the number of road crossings needed.

During investigations undertaken on other matters related to the travel of children on school buses in New South Wales during the early 1990's, significant concern was expressed by stakeholder groups (eg. bus operators, parents, teachers, etc) regarding the behaviour of school students. In response, an inquiry into this matter was conducted in 1994. A report based on the finding of this inquiry indicated that while instances of poor behaviour were few, compared to the number of students travelling by bus, these instances were frequent and serious enough to concern both operators and schools and pose safety risks to bus occupants and other road users (Henderson, Roberts & Sara, 1995). Issues identified as associated with this poor behaviour and thus worthy of attention under a road safety umbrella included "poor communications, problems with bus passes, lack of training and feelings of powerlessness among bus drivers, absence of a cohesive state-wide system to deal with poor behaviour and lack of support for measures by some schools, bus companies and parents" (Henderson et al, 1995, p1). In conclusion, the inquiry made several recommendations regarding the behaviour of school children, management by bus drivers and the need for support and attention by schools and parents. Recommendations included:

- A study of the task of the driver be undertaken, with an aim to develop reliable and valid criteria that may be used as selection procedure for bus companies.

- The development of guidelines for selection procedures for drivers suited to school bus conditions.
- The need for improved driver training in the area of behaviour management.
- Regular school education on the importance of safe on bus behaviour.
- Increased supervision whilst children are waiting to board and alight a bus.
- The encouragement of positive reward systems for preferable student behaviour in favour of punitive sanctions for poor behaviour.

In a 1993 *Review of School Bus Safety in Tasmania*, commissioned by the Department of Roads and Transport (School Bus Safety Review Committee, 1993) a number of recommendations were made in relation to increasing the safety of students alighting or boarding school buses. These included the implementation of new 'School Bus' signs with black letters on a fluorescent yellow-green background (as suggested by Cairney, 1992), the introduction of automatically activated hazard lights for when the bus door opens, and advance warning signs for up-coming school bus stops.

During 1994, the Department of Transport and Works in Tasmania trialed a range of flashing lamp options for school buses (1995). It was discovered that the most effective lamp comprised two bright, briskly flashing amber lights, incorporated with an international school sign (i.e. two school children).

In 1999 the Australian Plaintiff Lawyers Association Inc., proffered some suggestions for law reform to aid the quest for improved school bus safety across the country (Davis, 1999). In short, it was recommended that:

- Traffic regulations should be amended to make school buses more visible. (In a second stage of research by Attwood Marshall Lawyers [Davis, 1995], Gold Coast residents were randomly contacted by phone and asked how school buses are required to be identified by law. It was found that only about 10% of respondents with school-age children could correctly recount how school buses are identified. None of the respondents without school-age children could name any regulations).
- Regulation r(4) of the *Traffic Regulations 1962* document should be amended to clarify the legal meaning of a 'school bus' as, "being used exclusively for the carriage of school children to or from school," in order to avoid loose definitions of 'exclusively.'
- A law should be introduced to require drivers to 'give way' to children within a 25m radius of a stationary school bus.
- A public education campaign should be undertaken to make the public aware of any changes to the law.

In January 1999 New South Wales introduced a 40 km/h speed limit for vehicles travelling around school buses. Buses involved in the initiative were fitted with a 40 km/h speed sign and flashing lights on the rear of the bus. When activated the lights indicate to approaching drivers that a 40 km/h speed limit is applicable. While drivers travelling in the opposite direction are warned of the presence of a school bus by flashing headlights, there is no requirement for these driver to slow to 40 km/h. Following its implementation the RTA commissioned ARRB TR to evaluate the 40 km/h initiative around school buses. A community attitude survey, analysis of injury crashes for a period before and after the implementation of the 40 km/h initiative, and observations of driver behaviour following the initiative's implementation were undertaken, however results were not available at time of writing.

Recongising that road safety problems faced school children when crossing the road to board or alight the bus, Queensland Transport implemented a measure to improve the visibility of school buses. King (1999) noted that painting a single color is not favoured and following consultation and research a high visibility strip was developed. This involved marking school buses with a fluorescent color strip to draw drivers attending to the presence of the bus.

Subsequent to its development, a trial of the high visibility strip was conducted to determine whether drivers reported noticing the strips and changing behaviour and whether bus drivers, parents and school-teachers noticed any behavioral difference. However, the trial showed limited potential for the visibility strip to raise the awareness of school buses.

Queensland Transport also trialed the installation of flashing lights in three school zone locations (King, 1999). The school zones selected for the trial were known to have identifiable safety problems not easily remedied. The trial consisted of the installation of two yellow flashing lights used in conjunction with school zone signs at both entries to the school zone. These flashing lights operate as wigwag lights during the times specified on the school zone sign to alert motorists to the presence of a school bus and to the likely presence of children when the lights are flashing. To determine whether the flashing lights resulted in reduced speed, speed surveys were conducted prior to the installation of the flashing lights, one week after, one month after and six months after their installation. Vehicle speeds were recorded for vehicles travelling in both directions in the morning and afternoon, and in the middle of the day. Overall, average vehicle speed reduced significantly for all sites one week and one month following commencement of the trial although speeds were still higher than the 40km/h limit at these sites. The results indicated a small rebounded after six months, however the average speeds recorded for each site remained lower than the average speed prior to the introduction of the intervention (King, 1999). Queensland Transport concluded that other factors may influence the long term effectiveness of flashing lights and therefore recommended that further investigation be undertaken.

During 2001 the Queensland School Transport Safety Taskforce (QSTST) was established to review current research and practice and to obtain community and stakeholder views and analyse Queensland crash data pertaining to school transportation. Recongising that the majority of school transport-related fatalities occur as passengers in cars, as cyclists or as pedestrians, the Taskforce recommended that speed limits around schools be lowered. They further recommended that a comprehensive community awareness and education program be developed and implemented, and that partnerships among stakeholders and community members at school level be fostered. The Taskforce acknowledged that while few fatalities occur while travelling a bus occupant, a "serious bus crash could have devastating consequences for a community" (QSTST, 2001, p1). Consequently the following recommendations pertaining to school bus safety were proposed:

- *"staged introduction of a comprehensive upgrade of the Queensland bus fleet which will provide easily-identifiable school buses with rollover strength and padding, and appropriate seat and set anchorage strength and seat belts in specified environments;*
- *support for a proposal already in place to improve bus driver training, particularly in behaviour management.*
- *a statewide emergency action plan for buses used in school transport".*

(QSTST, 2001, p1)

4.5. Overseas Practices in School Bus Safety

This section provides a summary of some of the countermeasures employed in overseas jurisdictions aimed at providing safer transportation of school children to and from school via bus.

4.5.1. United States of America

In the United States of America, school buses transport over 23 million children to and from school everyday. Since the 1970's the number of children being killed in bus danger zones has more than halved. This trend has been attributed to improved bus equipment, better driver training, and more school-based safety lessons (Glamser, 1997). Specifically, in the U.S. the safety of school bus passengers is believed to have been enhanced following the implementation in 1977 of two federal mandatory safety standards relating to school bus roll-over protection and school bus body joint strength (TRB, 1989). Other standards vary between the States.

Additional practices employed in the US include:

Crossing Arms - In order to reduce the number of fatalities caused by front-end collisions (bus or car hitting pedestrian), 13 States in America require crossing arms be installed on school buses. Up to 50% of Canadian/U.S. school buses possess crossing arms already. The crossing arm is a metal bar, six feet long, that rests on the front bumper of the bus until the bus stops. Here the arm extends out in front of the bus so that students must walk to the end of the bar before crossing in front of the bus, giving the driver a clear view. In the past decade 90 students in the USA were killed as a result of being struck by the front of a bus, but only four fatalities have occurred involving buses with crossing arms (Glamser, 1997).

Swing-out STOP sign - A Texan study has found that the use of a swing-out stop arm activated during loading/unloading of passengers lowers illegal passing of cars by at least 30%. This 30% reduction was thought by the Texas Transportation Institute to be 50% effective in reducing collisions (Fayhee, 1987). Note: This approach is applied in USA jurisdictions where laws require motorists to stop and not progress past a school bus during loading and unloading. Some States require a 'stop' sign to swing out when the bus stops to prevent other oncoming or passing motorists from driving past while loading and unloading. Most school buses activate rear flashing red lights for when children are embarking or disembarking, and all school buses are free from visual advertising (RSB, 1992).

Seatbelts - In two states, New York and New Jersey, it is mandatory for large school buses to have seat belts. Federal law requires small school buses to have seat belts in all States (School Bus Safety Coordination Project Report, 1998). The issues pertaining to use and fitment of seatbelts have been identified in previous section of this report.

Passenger escort to vehicle - Under a 1950's law, Californian school bus passengers must be escorted across two-lane streets by the bus driver to ensure their safety.

Yellow bus sidewalk symbol - In Farmington, Connecticut, yellow school bus symbols are painted onto side walks as a marker behind which children should stand while waiting for buses. This allows children to be clearly visible to the driver as the bus approaches or leaves (Glamser, 1997).

Vehicle Identifiable - To enhance the conspicuity of school buses, the National Association of State Directors of Pupil Transportation Services developed a number of initiatives to make the school bus a highly identifiable vehicle on the road and to assist drivers to recognise the presence of a school bus and likelihood of school children (School Bus Fleet, 1996).

These included school buses to be "National School Bus Yellow", to have retro-reflective markings, strobe lights and daytime running lights.

4.5.2. Canada

Stop arms - Over the period 1996 to 1997, Canada introduced a number of new vehicle standards specifically related to school buses. A stop arm is now required on every school bus to complement customary flashing red lights and traffic regulations calling for other vehicles to stop when a school bus is loading or setting-down passengers.

Mirrors - A comprehensive mirror arrangement with defined fields of view must be fitted to all school buses, the specifications of which are unique to Canada (Transport Canada, 1998).

Vehicle Standards – Some Canadian standards are designed to reduce school bus-related injuries. These relate to roof strength (roll-over protection), joint strength (collisions), passenger protection (seats spaced and seat backs sized to resist throwing of passengers in an impact; barrier bounding first row of seats to balance energy absorption and strength), and window retention (to withstand an outward force indicative of possible ejection) (Gardner, 1999).

4.5.3. New Zealand

There has been some concern from road safety agencies in New Zealand who have requested improvements to school bus safety. However (as mentioned earlier in this report) fatality estimates indicate that there are few school bus-related crashes in New Zealand.

Like most of Australia, New Zealand does not have a dedicated school bus fleet. However, there are regulations in place for when coaches carry school children. These include the compulsory displaying of a highly visual sign saying *School Bus* on both the front and rear of the bus, and a requirement for motor vehicles to travel at a speed limit of 20 km/h when approaching a parked bus at the side of the road. While this speed limit has been plagued with major enforcement difficulties (M. Cummins, personal communication, May 26th 1999) the Land Transport Safety Authority (LTSA) reports that "the 20km/h speed limit past a school bus as consistent with protecting children and is therefore set to a reasonable level. A lower limit, or requiring traffic to stop completely, would not significantly improve the nominal risk" (LTSA, 2001, p5).

The LTSA further reports that the *School Bus* sign is the only feature that is common to all school buses in New Zealand (LTAS, 2001). Additional safety measures can be adopted by bus operators on a voluntary basis. For example, the use of flashing amber warning lights are permitted on school buses although they may only flash when buses are setting down or picking up children. The LTSA support the adoption of flashing lights on school buses, proposing that the amber flashing lights adopted by some New Zealand operators be replaced with the Australian combined warning sign / flashing lights system (LTSA, 2001).

In rural areas of New Zealand school buses currently operate under an informal system whereby senior school children (the equivalent of 6th grade in primary schools, and 8th grade in intermediate classes) are appointed as 'bus wardens'. The task of bus wardens is to assist the bus driver with maintaining control of passengers within the bus (M. Cummins, personal communication, May 26th 1999).

4.5.4. Europe

Little information is available on school bus safety in Europe, possibly because issues related to vehicles operating as school buses are dealt with at a local level (SBSC, 1997). While the safety of school transport has been in the spotlight for the United Kingdom in recent years, until 1996 the nation was unable to enforce legislation for the compulsory installation of seat belts, (an initiative believed to reduce the disproportionate number of fatalities resulting from passengers being ejected from the bus during a frontal collision or a roll-over crash), because seat belts were an area already covered by European Commission Directives. This problem has been overcome and since 1998, Great Britain requires all coaches and minibuses used to transport children (aged 3 – 15 inclusive) to have seatbelts (School Transportation News, 1998). Manufacturers are required to fit in all seating positions, 3-point seat belts for minibuses, 2-point seat belts in large coaches (in addition to energy absorbing seats), and 2- or 3-point seat belts in mid-size coaches (School Transportation News, 1996). It has, however, been noted elsewhere that buses used to transport children in Britain do not feature passive design protection (i.e. compartmentalisation: high seat backs, increased seat padding, and restraining barriers in front of seats) like in US buses (El-Faizy, 1994).

As part of the Walk to School campaign initiated by the Pedestrian Association in the United Kingdom in 1995, a primary school in London engaged a very imaginative approach to enhancing the safety of children journeying to and from school. The Whitfield Junior Primary School has engaged a scheme titled the "Walking Bus". This is a scheme where children are encouraged to walk to school in a group, with one parent acting as the "driver" who leads the bus and the another as the "conductor" who controls and monitors students from the rear of the "vehicle". The Walking Bus can accommodate 16 children, walking in pairs. The scheme relies on a ratio of 1 parent to 8 children and, should additional children wish to participate, a third parent supervises in the middle of the bus. A trolley is pushed by the driver, purposefully carrying school bags, whilst all passengers must wear fluoro safety jackets for increased visibility whilst on board the bus. Children are picked up and dropped off at designated "bus stops" on the route and, like a normal school bus, it will not wait for late passengers. The cost of running such a "virtual bus" is minimal and costs are covered at present by local sponsorship (Browne, 1999).

4.6. Summary

4.6.1. Crash risk and severity

The crash analysis presented in this report indicated that a significantly higher proportion of school bus-related deaths occur during the period when the bus is stopped and children are moving, as pedestrians, to board or alight the vehicle. The literature reviewed as part of this project also indicated a predominance of crashes occurring in the afternoon period.

The literature highlights that there are differences in the travel behaviour of children journeying on and around school buses in urban areas compared to those in rural environments. These differences relate to variations in traffic speed, traffic volumes and the location of bus stops. The research concludes that children need to obtain a range of skills to accommodate to these different traffic environments.

4.6.2. Occupants in transit

In terms of protecting occupants whilst on-board buses, research in the US indicated that "compartmentalisation", a passive design protection approach entailing high back seats, increased seat padding and restraining barriers in front seats, appears to offer the most cost-effective protection for frontal collisions.

The research examined in this review has evidenced conflicting views regarding the effectiveness, safety implications and cost of fitting seatbelts on school buses. Some research suggested that seatbelts, used in the absence of additional vehicle countermeasures (such as high-back seats, inappropriate seat padding and floor anchoring), can lead to increased belt-induced injuries, injuries more severe than those which may occur in the absence of these devices. Others cast doubt on the crash testing methods employed which arrived at these conclusions, advocating that occupant restraint systems do have a place in increasing safe travel of children in school buses.

Conflicting views were also noted in respect to the merits of abolishing standees on school buses. Few evaluations have been carried out to indicate that seated travel on a bus is significantly safer than travelling as a standee. Similarly, there appears to be a lack of evidence indicating that the 'three for two' seating policy, applied in many Australian jurisdictions, substantiality compromises passenger safety. However, the little evidence available does suggest that the costs involved in abolishing standees and the 'three for two' seating rule would lead to significant cost increases.

Available research indicated that initiatives aimed at improving driver and pedestrian behaviour, improved vehicle maintenance and roadside environments may offer greater potential for increasing the safety of children travelling in and around buses, as compared to the mandation of seatbelts, the abolishment of standees and the removal of 'three for two' seating in Australia.

4.6.3. Community concerns and potential countermeasures

A range of initiatives are presented which currently tackle issues related to the boarding and alighting practices of children, to maximise the level of safety around buses. These initiatives include a number of education programs targeting children's traffic behaviour – in terms of their road skills and their general behaviour whilst travelling on or around buses. Other initiatives, focused towards parents, schools, teachers and bus operators were also highlighted.

Many additional initiatives, which focus on improving the safety of the road environment, are also identified. These initiatives include the use of bus mounted flashing lights, local speed restrictions, swing-out stopping arms and bus route and bus stop audits.

4.6.4. Overseas practices

Available research on overseas practices reveals that America, unlike most of Australia, operates a dedicated school bus fleet, whereby vehicles are used exclusively as school buses and not for the transportation of a general passengers. Consequently, many more vehicle construction and safety features can be applied to maximise the safety of school children. For example, the installation of seatbelts and high-backed seats improved roll-over protection, the use of crossing arms and swing out 'stop' signs and retro-reflective vehicle markings. Similarly, Canada operate a dedicate school bus fleet and apply many of these safety techniques, noting that crossing arms are also complemented by customary flashing red lights and traffic regulations requiring other vehicles to stop when a school bus is loading or setting down passengers.

Like most of Australia, New Zealand does not have a dedicated school bus fleet. The crash data indicates that school bus-related crashes are not a significant problem in this jurisdiction. Despite this, there are a number of regulations in place for ensuring safe travel in and around school buses. These include the use of 'school bus' warning signs and speed limits of 20km/h for motor vehicles approaching a parked bus at the side of the road.

Limited information was available in relation to school bus issues and practices employed in Europe, perhaps because these issues are often dealt with at a local level. That said, the United Kingdom has recently passed legislation for the compulsory installation of seatbelts in some buses used for the transportation of children.

5. REVISION OF THE SCHOOL BUS SAFETY ACTION PLAN

5.1. Background

To gain an understanding of the school bus safety practices and initiatives being implemented across Australia key personnel from Australian jurisdictions were consulted (by telephone and via email correspondence). This task also provided an understanding of the degree to which items detailed in the draft School Bus Safety Action Plan have been implemented.

Based on the findings of the literature, crash analysis and understanding of current practice in Australia the draft School Bus Safety Action Plan was revised. This revision process was undertaken in consultation with the Expert Working Group and is detailed in this section.

5.2. Current Practice of school bus safety actions

5.2.1. Risks associated with travel by school bus

The number of actions, programs and initiatives that have been undertaken in Australian states and territories to improve school bus safety is very large. However, all of these actions are designed to address a comparatively small number of actual and perceived risks associated with travel to and from school by bus.

The crash data presented in Section 3 of this report indicates that of a total of 50 child pedestrians fatally injured during school travel time for a five-year period, 23 were associated with travel by bus on the journey to or from school. An additional five children were killed as passengers of a bus during school commuting times in these years. Based on this data, Table 5.1 presents the risks associated with travelling to and from school via bus to children during school commuting times.

Table 5.1: Children aged 5-17 years killed during bus travel to and from school in Australia during 1992, 1994, 1996, 1997 and 1998

How the fatality occurred	Total	%
As a *pedestrian* struck by passing traffic when crossing the road		
- to board a bus	1	4%
- after alighting from a bus	22	79%
As a *bus passenger*		
-Alighting (i.e. trapped in bus doors as they close)	2	7%
-Within the bus (collision with other vehicle)	2	7%
-Other	1	4%
Total	28	100%

Source: ATSB Fatality Crash Database 1992, 1994, 1996, 1997 and 1998
Note: Total does not add to 100% due to rounding

This illustrates that, based on the fatal crash data analysed in the course of this project, the risk of being struck by passing traffic when crossing the road before boarding or after alighting from the bus is by far the greatest risk associated with travel by school bus.

The available data also indicates that the next greatest risk of fatal crashes, though less frequent, is associated with traveling as a bus passengers when children become trapped in bus doors when they close and are subsequently dragged by the bus or when children are injured within the bus when the bus is involved in a collision with another vehicle.

A number of other perceived risks associated with travel to and from school by bus were identified in the literature and through consultation, however the low number of crashes and the absence of injury data at a national level preclude the actual risk of injury from being determined.

These perceived risks include:

- Children injured by passing traffic while waiting for bus.
- School bus colliding with children before boarding or after alighting.
- Passengers injured by impacts inside the bus (as a result of collision with another vehicle).
- Other vehicles crashing into the school bus.
- Passengers distracting or interfering with bus driver.
- Collisions caused by mechanical fault or failure in bus.
- Sub-optimal management of passenger injuries after a crash.

The fatal crash data available for this project fails to shed light on the rankings that should be assigned to the remaining seven risks. To objectively rank these risks, it would be necessary to obtain and analyse information on school bus accidents resulting in injuries other than fatalities. However, this information is currently unavailable at a national.

5.2.2. Countermeasures to the risks

The actions and programs that have been implemented or considered in Australia to address risks as pedestrians moving around school buses and to address risks as bus passengers traveling in school buses are listed in Table 5.2 and Table 5.3. These actions and programs have not all been implemented in Australia, and those that have been implemented have not been implemented uniformly throughout all Australian states and territories.

Table 5.2: Actions implemented or considered in Australia to address risks associated with child pedestrians moving around school bus

Risk	Counter-measure type	Countermeasures in use or under consideration
Children struck by passing traffic when crossing to board or after alighting the bus	Road User	• Education programs for school children • Require or encourage parents to pick up/drop off on same side as bus stop • Parental and school supervision • Education for all drivers • Mass media campaigns • Reduced speed limit when passing stationary school bus • Adoption of Stop Rule for passing traffic around a stopped bus
	Vehicle	• Flashing lights and warning signs on buses • External speakers • Reflective markers • Stop signal arms • Mechanical arms/barriers • Designated bus colour (i.e. national school bus yellow)
	Environment	• Audit of bus stops, interchanges and routes • Conspicuous identification of school bus stops by means of road markings, signs or flashing lights • Reduced speed limits in school zones
Children injured by passing traffic while waiting for bus	Road User	• Supervision at bus stop by adult or older student • Education programs for school children • Education for all drivers as part of GLS • Mass media campaigns
	Vehicle	--
	Environment	• Audit of bus stops, interchanges and routes • Pedestrian fencing at bus stops • Conspicuous identification of school bus stops by means of road markings, signs or flashing lights • Reduced speed limits in schools zones
School bus colliding with children as pedestrians before boarding or after alighting	Road User	• Supervision at bus stops by adult or older student • Education programs for school children • Training for bus drivers
	Vehicle	• External cross-view mirrors • Electronic pedestrian sensors
	Environment	• Audit of bus stops, interchanges and routes

Table 5.3: Actions implemented or considered in Australia to address risks associated with child bus passengers in school bus

Risk	Counter-measure type	Countermeasures in use or under consideration
Passengers attempting to board or alight while bus is moving or being trapped in doors when they close	Road User	• Education programs for school children • Passenger code of conduct • Supervision on bus by adult or older student • Supervision at bus stop by adult or older student
	Vehicle	• Buses have no rear doors • Rear door is not opened • Sensors and interlocks to immobilise bus if door is open or an object is trapped • Convex mirrors to allow driver to monitor rear door
	Environment	--
Passengers injured by impacts inside bus (as a result of collision with another vehicle or object)	Road User	• Training for bus drivers • Education programs for school children • Passenger code of conduct • School bus speed limit
	Vehicle	• Energy absorbing padding on internal fittings • Elimination of standing • Elimination of 3 for 2 seating • High back seats • Seat belts • Side impact padding/bags • Shatterproof windows
	Environment	• Guard rails designed for buses
Other vehicles crash into school bus	Road User	• Mass media campaigns • Education for all drivers as part of GLS
	Vehicle	• Reflective markings • Conspicuous colour schemes • Flashing lights and conspicuous signage
	Environment	• Audit of bus stops, interchanges and routes • Conspicuous identification of school bus stops by means of road markings, signs or flashing lights • Indented bus bays • Restrictions on vehicles using the same road (i.e. mountainous areas) • Bus zones – used in mountainous areas and on highly trafficked roads to restrict speed
Passengers distracting or interfering with bus driver	Road User	• Passenger code of conduct • Supervision on bus by adult or older student • Education programs for school children • Training for bus drivers
	Vehicle	--
	Environment	--

Table 5.3 (con't): Actions implemented or considered in Australia to address risks associated with child bus passengers in school bus

Risk	Counter-measure type	Countermeasures in use or under consideration
Collisions caused by mechanical fault or failure in bus	Road User	--
	Vehicle	• Dual circuit braking • Mandatory maintenance schemes • Regular and random inspections • Advanced testing equipment • Maximum age limit for school buses
	Environment	• Provision of guardrail to redirect buses in event of failure
Sub-optimal management of passenger injuries after a crash	Road User	• Bus driver first aid training
	Vehicle	• Emergency exits • Radio communications • Global positioning systems • Automatic crash notification system (using ITS)
	Environment	--

5.2.3. Implementation of countermeasures by each State and Territory

School Bus Safety in Australia – Summary Report (Austroads, 2001) sets out not only the proposed National School Bus Safety Action Plan but also includes tables summarising the implementation to early 2000 of actions and programs related to school bus safety in each state and territory of Australia. In October 2001, Rob Klein, the then chairperson of the Expert Working Group, e-mailed the proposed plan and the implementation summary tables to the members of the National School Bus Safety Advisory Group in each state and territory. Each jurisdiction representative was asked to provide comment on the Action Plan and an update of the implementation status of actions and programs in their own jurisdiction.

Since only three business days had been allowed for responses to the October request, it was not possible for jurisdictions to supply all of the details requested. Following the receipt of e-mailed responses to the October request, further consultations were undertaken via e-mail and telephone by ARRB Transport Research to gather additional information on the extent and nature of actions and programs implemented in each jurisdiction. The complete list of people who contributed information is shown in **Appendix B**. The authors gratefully acknowledge the assistance willingly and cheerfully provided by these people.

A summary of the state-by-state implementation of each countermeasure for dedicated school bus services is shown in Table 5.4 to Table 5.6. The state-by-state implementation of each countermeasure for non-dedicated services (i.e. for school students travelling by scheduled route bus services) is summarised in Table 5.7 to Table 5.9. The tables presented on the following pages are intended to provide an indication of the type of programs and initiatives operating to some degree across Australia to maximise the safe travel of school children in and around school buses.

Table Legend

The meaning associated with the responses presented in the following tables are as follows:

Response	Meaning
Yes (or Some)	Yes, programs / initiatives of this type apply/are *implemented to some degree* in this jurisdiction.
No	No, programs / initiatives of this type are *NOT implemented* nor apply in this jurisdiction.
N/A	Not applicable within the jurisdiction.
-	The presence of these programs / initiatives are unknown to jurisdictions OR a response by jurisdictions has not been provided.
Considered / Under Consideration	Programs / initiatives of this type are *under consideration* for implementation in this jurisdiction.

Table 5.4: Road User Programs and Initiatives — Dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Educational programs/training for[3]								
- School children	Yes[4]	Yes[5]	Yes[6]	Yes[7]	Yes[8]	Yes[9]	Yes[10]	Yes[11]
- Bus drivers	Yes[12]	Yes	Yes	Yes[13]	Yes	Yes[14]	Yes[15]	Yes
- Parents[16]	Yes	Some[17]	Yes[6]	Yes[18]	Yes	Yes	Yes[19]	Yes
- Motorists	Yes[20]	Yes[21]	Yes	Yes	Yes[22]	Yes[23]	No	Yes
- Teachers	Yes[24]	Yes	Yes[6]	Yes[18]	Yes	No	Yes	Yes
- Pre-schoolers	Yes[25]	No	Yes[6]	No	No	Yes[26]	No	No[27]
Parent behaviour:								
- Require vehicles to slow or stop near school bus	Yes	Yes	No	No[28]	No	Yes	Yes	No
- Require parents to pick-up on same side as bus	No	No	Considered	Yes[29]	No	No	No	No

[3] These educational programs are provided through a variety of approaches. For example, workshops, videos, school newsletters, school curriculum, licensing methods, etc.
[4] Bus safety is addressed in each of the three Stages of the primary school resource, *Move Ahead with Street Sense.* The main bus safety message for all three *Move Ahead with Street Sense* stages is: **"**Wait till the bus has gone and then use a safe place to cross the road".
[5] *Safe Routes to School*, including 'Road Ready' curriculum materials, relate to primary children only. Materials for secondary children are currently under development.
[6] *Safe Routes to Schools.*
[7] *Travel On* for primary students, teachers and parents; a leaflet from the Bus Association of Victoria for secondary students; a bus transition program from VicRoads and the TWU for students in years 6 and 7; VicRoads bus safety workshops for secondary schools.
[8] *Kids and Buses* program currently being trialed. Road safety curriculum units have been developed.
[9] Delivered on demand. Mainly primary school focus. Video called *Bus Zone*. Major message is "wait until your bus has gone".
[10] Aimed at primary years 4 and 5.
[11] Includes *5Bs* leaflet for primary children. Nothing for secondary students.
[12] Driver Authority Course – contains general customer safety. Driver Training currently covers areas such as managing passenger behaviour, door operation, wig wag lights operation and observing bus mirrors.
[13] Driver training is responsibility of operator (not mandatory). May include, briefings, handbooks, practice runs, drives with a supervisor.
[14] Required for bus driver licensing. Also considering accreditation scheme for school bus drivers, including training requirement.
[15] ACTION provides training for drivers, though not required under Bus Operator Accreditation.
[16] These may differ from the measures listed under 'Parent Behaviour'.
[17] Local DETE schools are preschools are encouraged to promote and organise school bus safety activities involving parents and other community members.
[18] VicRoads *RoadSmart* CD ROM.
[19] Students take home assignments to involve parents. Also messages to parents from police.
[20] Includes *Back to School* campaigns on radio and television at the start of each school year.
[21] A statewide awareness campaign for the 25 km/h speed limit around school buses that are stopped to allow children to board and alight safely was conducted prior to start of Term 1, 2002.
[22] *Back to School* and *Road Sense* mass media advertising. Also considering inclusion in learner driver manual.
[23] 40 km/h limit passing school bus incorporated in learner driver handbook.
[24] Items include road safety Take Home Notes, videos, and messages suitable for inclusion in school newsletters.
[25] Pre school children do not travel unaccompanied on school buses and are not subsidised under the School Safety Travel Scheme. Parents must accompany child inside the preschool and collect children in the same manner. Parents and teachers are educated on behalf of pre-schoolers to deliver pedestrian and passenger road safety messages such as "hold a grown ups hand" and "wear your seat belt".
[26] Included in primary school sessions when pre-school located on same site.
[27] Pre-school children are discouraged from travelling on buses.
[28] Unless in specified speed zone.
[29] Recommended in guidelines provided for contract services.

Table 5.4 (con't): Road User Programs and Initiatives — Dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
- Encourage parents to pick-up on same side as bus	Yes[30]	Yes	Considered	Yes	Yes[31]	Yes	No	Yes
Supervision of students by adults:								
- At bus stops at school	Some[32]	Yes	Yes	Yes[33]	Some[34]	Yes	Yes	Yes
- Bus stops away from school	Some[35]	No	No	Some[36]	No[37]	No	Yes	Some[38]
- On buses	No	No	No	No	No	No	Yes	No
Supervision by student monitors:								
- At bus stops at school	No	Yes[39]	Some	Considered	No	Some[40]	No	Some[40]
- Bus stops away from school	No	No	-	-	No	Some	No	Some
- On buses	No	Some	Some	Some[29]	No	Some	No	Some
Code of Conduct publications for:								
- Students, parents, guardians	Yes[41]	Yes	Yes	Yes	Yes	Yes[42]	Yes	Yes[43]
- Drivers	Yes	Yes[44]	Yes	Yes	Yes	Yes[42]	Yes	Yes[43]

[30] This is a major component of the *Back To School* media campaigns & educational programs for schools and children's services.
[31] Incorporated in *Back to School* road safety campaign.
[32] At some Catholic and independent schools but not at government schools
[33] Could be supervised by teacher, parent or student "bus captain".
[34] Mainly by teachers at independent schools. Some also at public schools.
[35] Although not a requirement, some campaigns and programs place substantial emphasis on this.
[36] Teacher supervision occurs at some rural bus interchanges, depending on distance from school.
[37] Nothing organised. Some voluntary supervision by parents at some locations.
[38] Adult supervision at interchanges in Darwin only
[39] Secondary and primary schools.
[40] Some supervision by bus monitors in some schools, both at stops and on buses.
[41] These guidelines apply to conduct and behaviour inside the bus only.
[42] Code to be released mid-2002.
[43] Under development.
[44] Principals of schools where buses are allocated are responsible for managing driver conduct.

Table 5.5: Vehicle-Related Programs and Initiatives — Dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Designated School Bus colour	No	Some	Yes	No	No	-	-	-
School bus signs on vehicle	Yes	Some[45]	Yes	Yes	Yes	Some[46]	Yes[47]	Yes
Flashing lights	Yes	Yes[48]	Considered[49]	Yes[50]	Yes	Yes	No	Yes
Hazard warning light	Yes	Yes[51]	No	Yes	Yes	Yes	No	Yes
Additional cross-view mirrors	Yes[52]	Yes	Yes[53]	No	No	No	No	Yes[52]
External speakers	No	No	No	No	No	No	No	No
Seat belts in front seats	Yes	Yes	Some[54]	No	No	No	Yes[55]	No
Seat belts for other seats:								
- Lap belts	Yes[56]	No	No	No	Yes[57]	No	No	No
- Lap-sash belts	-	No	Considered[58]	No	Yes[57]	No	No	No
Emergency exits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Roll over protection	No	Yes[57]	Yes	Yes	Yes	Yes	No	Yes[52]
Dual circuit braking	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Radio communication	Some[59]	Some	Considered[49]	Yes[60]	No[61]	Some	Yes	Yes
Pedestrian / Electronic sensors[62]	Yes[63]	No	No	No	No	No	Yes	No
Stop signal arms	No	No	No	No	No	No	No	No
Mechanical arms/barriers	No	No	No	No	No	No	No	-
Reflective markers	No	No	Some	-	Considered[64]	No	Yes	-
Side impact padding/bags	No[65]	No	No	No	No	No	No	No

[45] Signs and flashing lights on all DETE (yellow) and DETE contracted to and from school buses, which account for 50% of school buses. Other buses are not compelled although minority chose to fit signs.
[46] Required to be fitted with signs and flashing lights unless the route is contained entirely within urban area.
[47] Front destination sign only
[48] Warning lights as per SA Road Traffic (Vehicle Standards) Rules 1999; Division 18 (Rules 114-117) are being fitted on all DETE (yellow) and DETE contracted to and from school buses.
[49] Will be implemented when funding permits.
[50] The Department of Infrastructure has commenced implementation of flashing light warning systems.
[51] Drivers are permitted to use hazard warning lights (where fitted) when the school bus stops to allow children to board or alight. Daytime headlights on.
[52] Additional mirrors fitted on all new buses in NT and on all new buses since 1997 in NSW.
[53] Mounted in front of driver to allow driver to see children crossing in front of bus.
[54] Only in unprotected seats (seats with no panel or partition in front of seat).
[55] Driver seat belt only.
[56] On coaches in accordance with Australian Design Rules (ADRs). A bus passenger must wear a seat belt if one is available.
[57] Depending on size of bus, as per ADRs.
[58] Report by ARRB Transport Research under consideration by Road Safety Council.
[59] 80% of buses have some form of communication, most often back-to-base radios.
[60] Satellite communication equipment has been introduced for all dedicated school bus services in rural Victoria. Satellite phone functions as cell phone when within range.
[61] Some operators choose to install voice communications, but this is not required under legislation or regulations. A requirement for installation of GPS is being considered.
[62] Electronic devices installed on the vehicle to detect the presence of a child near a school bus.
[63] On door to detect the presence of pedestrians outside the bus.
[64] Results of recent trial under consideration.

Table 5.5 (con't): Vehicle-Related Programs and Initiatives — Dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
High back seats	No	No	Considered	No	Yes[66]	No	No	Some
Compulsory bus inspection:								
- Yearly	No	Yes	Yes	Yes[67]	No	No	Yes	Yes
- Six-monthly	Yes	Yes[68]	Yes	Yes[69]	Yes	Yes	Yes	Yes
- Random	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Specialised inspection equipment (roll-over brake testers)	Yes	Yes	Yes	Yes[70]	Yes	Yes	Yes	Yes
Mandatory maintenance by operators	Yes[71]	Yes	Yes	Yes[72]	Yes	Yes	Yes	Yes
Frame and chassis inspections:								
- Periodic or age	No	Yes	Yes	Yes[73]	Yes	No	Yes	No
- Random	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Rejection procedure:								
- List of defects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- Issue of defect notice	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Maximum age limit of bus	Yes[74]	Yes[121]	Considered	No[75]	Yes[76]	No	Yes	Yes
3 for 2 seating rule:								
- Scheduled runs	Yes	Yes	Yes	Yes	Yes[77]	Yes	No	Yes
- Excursions	Yes	Yes	Yes	Yes	Yes[77]	No	No	Yes
'No standing' regulation	No	No[78]	No	No[79]	Some[80]	No	No	No
Mechanical sensors to detect doors not fully closed	Yes[81]	Some[82]	Yes	-	No	No	Yes[83]	Some[84]
Ban use of buses with rear doors	No[85]	Considered	Yes	Yes	No[86]	Yes[87]	No[88]	No[89]

[65] Improved padding on seat rails and stanchions has been installed on new buses since 1997.
[66] On open category buses
[67] By licensed bus tester.
[68] Vehicles inspected monthly, three-monthly and 12-monthly in South Australia under mandatory maintenance scheme.
[69] 3-monthly inspection by qualified person using Dept of Infrastructure checklist. Also daily inspection by driver before operation.
[70] May also include lateral and longitudinal shaking, one axle at a time, to detect suspension wear.
[71] Required as part of accreditation.
[72] Mandatory maintenance requirements apply to all bus operators, whether for school services or any other kind of service.
[73] VicRoads Safety Standards require any bus more than 25 years old to have at least 25% of the skin panels removed so that the underlying structure can be assessed and certified as sound by an approved engineer.
[74] Average fleet age 12 years over life of contract.
[75] Average age of the 1600 dedicated school buses is 9.6 years. About 100 replacements are authorised per year.
[76] Age limit can be 10-25 years, depending on size and usage of bus. 5 year extension possible for large buses following major upgrade.
[77] Permitted on bench seats not equipped with belts if child under 12 years.
[78] Students may stand on DETE operated and contracted school buses subject to the following safety conditions, viz the number of standing passengers does not exceed the number of rows of seats and the seats have appropriate hand holds, the time of travel as a standing passenger does not exceed 20 minutes, and students in their early years of schooling are to have priority in the allocations of seats.
[79] While there is no regulatory ban on standing passengers, policy is to avoid the necessity for passengers to stand on contract school buses in speed zones over 80 km/h.
[80] Standing permitted for maximum 20 km if bus designed for it (not open category). Trial of extra buses to eliminate standing conducted in a selected mountainous area; results of trial currently being considered.
[81] Improved door safety systems ensure that the doors open automatically if a hand or limb is caught. These systems also interlock with the brakes to prevent the bus from moving.
[82] Toyota Coaster models from 1994 onwards have an interlock that will not allow the throttle to be pressed if the door is open.
[83] Sensors and brake interlocks are fitted to rear doors only. Considering extending to front doors as well.
[84] Sensors and brake interlocks are fitted to rear doors. Some drivers have been found to use the interlock as a substitute for the handbrake.

Table 5.6: Environmental Programs and Initiatives - Dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Guidelines for:								
- Bus stop location	Yes[90]	Yes	Yes	Yes[91]	Yes	Yes[92]	Yes	Yes
- Selection of school bus routes	Yes[93]	Yes	Yes	Yes[94]	Yes	Yes	Yes	Yes
Indented bus bays	Yes	Some	Considered	Some	Yes	Yes	Yes	Yes
Pedestrian fences at bus stops	-	No	No	Some[95]	No	Some	No	Some
School Bus route audits	No	Yes	Considered	Yes	Yes	Some	No	Yes
School Bus speed limits	Yes[96]	Some[97]	Yes	No	No	No	No	No
Reduce speed limits around school buses	Yes[98]	Yes[99]	No	No	No	Yes[101]	No	No
School Zone speed limits	Yes	Yes	Yes	Some[102]	Yes[103]	Yes	Yes	Yes[104]
Marked bus waiting area	-	No	Yes	Some[105]	No	Some[106]	Yes	Some[107]
Interactive hazard warnings at each end of bus zone	No	No	No	No	Yes[108]	No	No	No

[85] Buses manufactured after August 1997 are equipped with an internal 'fish eye' mirror to enable driver to monitor rear door.
[86] Some operators choose to close off the rear door and install additional seating.
[87] One bus with a rear door recently slipped through. It is expected this bus will be required to be fitted with door sensors and interlocks.
[88] Rear doors are opened only at schools and at Canberra's four bus interchanges. ACTION supervisors are usually present at the interchanges.
[89] Government buses are equipped with rear doors, private school buses are not.
[90] There is limited consultation made in relation to bus stop location however no specific guidelines exist. As far as possible, school bus stops are relocated, in consultation with the Department of Transport, away from higher speed multi-lane roads.
[91] School bus guidelines are sent to school principals, who are responsible for allocation of bus stops.
[92] Many school bus stops are inside schools.
[93] There are guidelines for the selection, however these refer to non-commercial runs only.
[94] School bus routes are allocated by the Dept of Infrastructure based on requests from schools.
[95] Where appropriate as part of rural bus safety interchange program.
[96] 100 km/h speed limits applies to buses travelling in urban and rural areas, with further restriction to 80km whilst children are standing on the bus.
[97] The speed limit for buses with a gross vehicle mass of over 5 tonnes is 100 km/h, even if the speed limit on a section of road is over 100 km/h.
[98] NSW has a 40 km/h 'when lights flash' initiative to reduce speed limit for vehicles travelling around school buses.
[99] South Australia has a 25 km/h speed limit for vehicles from either direction passing a school bus stopped for the purpose of children boarding or alighting. New (25 km/h) warning/reminder sign are being fitted on rear of all DETE school buses, which comply to some extent with Rule 117 (2) of Div.18. New sign developed and trialed by DETE/Transport SA.
[100] Victoria is currently trialing the use of 40 km/h speed limits around buses on high-speed roads in three rural shires.
[101] Tasmania has a 40kmh 'when lights flash' initiative to reduce speed limit for vehicles travelling around school buses.
[102] Victoria already has around ninety 40 km/h school speed zones.
[103] Typically 40 km/h on a road zoned elsewhere for 60 km/h, 60 km/h on 70 km/h or 80 km/h roads, 80 km/h on 100 km/h roads.
[104] 40 km/h.
[105] Part of the rural bus safety interchange program.
[106] Bus only areas outside some metro schools. Signed but no pavement markings.
[107] Included in planning for new schools.
[108] Currently being trialed at one bus stop. Flashing lights are activated by transmitter on bus.

Table 5.7: Road User Programs and Initiatives – Non-dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Educational programs/training for[109]								
- School children	Yes	Yes[5]	Yes[110]	Yes	Yes	Yes	Yes	Yes
- Bus drivers	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
- Parents[111]	Yes	Yes	Yes[110]	Yes	Yes	Yes	No	Yes
- Motorists	Yes	No	Yes	Yes	Yes	Yes	No	Yes
- Teachers	Yes	Yes	Yes[110]	Yes	Yes	No	Yes	Yes
- Pre-schoolers	Yes	Yes	Yes[110]	Yes	No	Yes	Yes	No
Parent behaviour:								
- Require vehicles to slow or stop near school bus	Yes	Yes	No	No	No	Yes	Yes	No
- Require parents to pick-up on same side as bus	No	No	Considered	No	No	No	No	No
- Encourage parents to pick-up on same side as bus	Yes	Yes	Considered	Yes	Yes	Yes	No	Yes
Supervision of students by adults:								
- At bus stops at school	Some	Yes	Yes	Yes	Some	Yes	Yes	Yes
- Bus stops away from school	No	No	No	No	No	No	Yes	No
- On buses	No	No	No	No	No	Yes	Yes	No
Supervision by student bus monitors								
- At bus stops at school	No	No	No	-	No	No	No	-
- Bus stops away from school	No	No	No	No	No	No	No	No
- On buses	No	No	No	No	No	No	No	No
Code of Conduct publications for:								
- Students, parents, guardians	Yes	Yes	Yes	No	Yes	Yes	No	Considered
- Drivers	No	Yes	Yes	No	Yes	Yes	Yes	Considered

[109] These educational programs are provided through a variety of approaches. For example, workshops, videos, school newsletters, school curriculum, licensing methods, etc.
[110] *Safe Routes to Schools.* Also some education of children carried out by TransPerth and other bus operators.
[111] These may differ from the measures listed under 'Parent Behaviour'.

Table 5.8: Vehicle-Related Programs and Initiatives – Non-dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
School bus signs on vehicle	Yes[112]	No	No	Some[113]	Some[114]	No	No	No
Flashing lights	Yes[115]	No	No	Considered[116]	Considered	No	No	Yes
Hazard warning light	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Other lighting	No	No	No	No	No	No	No	Yes[117]
Additional cross-view mirrors	Yes	No	Yes	Yes	No	No	No	No
External speakers	No	No	No	No	No	No	No	No
Seat belts in front seats	No	Yes	No	Yes[118]	No	No	Yes [119]	No
Seat belts for other seats:								
- Lap belts	Some	Yes[120]	No	Yes[121]	Yes[120]	No	No	No
- Lap-sash belts	-	Yes[120]	No	Yes[121]	Yes[120]	No	No	No
Emergency exits	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Roll over protection	No	Yes[120]	No	Yes	Yes	Yes	No	Yes[117]
Dual circuit braking	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Radio communication	-	Yes	Yes	-	No	Some	Yes	Yes
Pedestrian / Electronic sensors[122]	-	No	Yes	No	No	No	Yes	No
Mechanical sensors	-	No	No	-	No	No	Yes	No
Stop signal arms	No	No	No	No	No	No	No	No
Mechanical arms/barriers	No	No	No	No	No	No	No	No
Reflective markers	No	No	Yes	-	No	No	Yes	No
Side impact padding/bags	No	No	No	No	No	No	No	No
High back seats	No	Yes[123]	No	No	Yes[124]	No	No	Some
Compulsory bus inspection:								
- Yearly	No	Yes	Yes	Yes	No	No	Yes	Yes
- Six monthly	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- Random	Yes	Yes	Yes	Yes	Yes	No	No	Yes

[112] Signs are fitted to public buses that carry school children. These are displayed all day.
[113] 'School Specials' carry school bus signs, other route service buses do not.
[114] School bus signs are required on government buses. Urban fleets are permitted but not required to use these signs..
[115] Flashing lights are fitted to public buses that carry school children. These are only activated during school travel times.
[116] Being considered for rural route buses
[117] New buses
[118] Applicable in coaches
[119] Driver seat belt only.
[120] Depending on size of bus, as per ADRs.
[121] Applicable in coaches used for school excursions only.
[122] Electronic devises installed on the vehicle to detect the presence of a child near a school bus.
[123] Coach type vehicle only.
[124] On open category buses

Table 5.8 (con't): Vehicle-Related Programs and Initiatives – Non-dedicated Bus Services (contd)

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Specialised inspection equipment (roll-over brake testers)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Mandatory maintenance by operators	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Frame and chassis inspections:								
- Periodic or age	No	Yes	Yes	Yes[73]	Yes	No	Yes	No
- Random	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Rejection procedure:								
- List of defects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
- Issue of defect notice	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Maximum age limit of bus	No	Yes[125]	No	No	Yes	No	Yes	Yes
3 for 2 seating rule:								
- scheduled runs	Yes	Yes	Some	Yes	Yes	Yes	No	Yes
- excursions	Yes	Yes	Some	No[126]	Yes	No	No	Yes
'No standing' regulation	No	No	No	No	Some[127]	No	No	No

Table 5.9: School Bus Safety – Environmental Programs and Initiatives – Non-dedicated Bus Services

PROGRAM / INITIATIVE	NSW	SA	WA	VIC	QLD	TAS	ACT	NT
Guidelines for:								
- Bus stop location	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indented bus bays	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pedestrian fences at bus stops	Yes[128]	Yes[129]	No	-	No	Some	No	Yes[130]
School Zone speed limits	Yes	Yes	Yes	Some	Yes	Yes	Yes	Yes
Marked bus waiting area (painted area to wait)	-	Yes[131]	Yes	-	No	No	Yes	Some
Interactive hazard warnings at each end of bus zone	-	-	No	-	Yes	No	No	No

[125] 25 year limit subject to frame inspection.
[126] Indication that some schools are willing to pay additional costs to ensure single seating, seat belt fitting arrangements for excursions.
[127] On certain mountainous roads
[128] Only at a few schools.
[129] Only at a few schools.
[130] At some bus stops.
[131] Metropolitan Adelaide area only.

5.3. Review of March 2001 Action Plan

The National School Bus Safety Action Plan proposed in *AP-R186* and *AP-R186A* (Austroads, 2001) has been revised in light of the outcomes of the updated crash analysis, research findings and understanding of the initiatives in place in Australian jurisdictions. A copy of this School Bus Safety Action Plan is provided in **Appendix C.**

5.3.1. Review Process

5.3.1.1. Refining the action items

The actions in the School Bus Safety Action Plan have been refined in light of best practice research findings and understanding of initiatives in place. The ARRB TR project team made these refinements in consultation with the Expert Working Group.

In reviewing the Action Plan it was noted that a number of items have already been completed. These are discussed in Section 5.3.2. Further to this, on a number of occasions, two or more of items have been combined into a single action or a single item has been separated into two or more items for further consideration. These refined items are presented in Section 5.3.3. Each action item was examined and where necessary the item has been amended or reworded to align with current research and to provide succinct, measurable action items for implementation.

5.3.1.2. Prioritising Action Items

Each revised action item was rated in terms of its priority and effectiveness in addressing common causes of fatalities and injuries associated with school bus travel, and in terms of the resources and ease of implementation associated with undertaking the action.

The rating method applied was developed in consultation with Expert Working Group. This method required each action item to be rated across four categories (priority, effectiveness, resources and implementation) using the following rating levels:

Category	Rating	Rationale for rating
Priority	A	*Action that addresses the most common cause of school bus related fatalities (based on available fatality data)*
	B	*Action that may address potential cause of fatalities (where available data is less conclusive)*
Effectiveness	1	*Proven and effective action*
	2	*Unproven action offering promising results / some merit*
	3	*Unproven action, though unlikely to be effective*
	4	*Action proven to be unsuccessful*
Resources	*High*	*High level of resources required to undertake action*
	Medium	*Medium level of resources required to undertake action*
	Low	*Low level of resources required to undertake action*
Implementation	*Difficult*	*Difficult action to implement*
	Complex	*Complex yet achievable action to implement*
	Easy	*Easy action to implement*

Where an action does not specifically address common or potential causes of school bus related fatal crashes, but relates to data management or injury management practices, an 'N/a' priority rating has been applied.

Additionally, where actions call for a feasibility study to investigate the effectiveness of a given initiative, an 'N/a' effectiveness rating may have been applied.

Justifications for the ratings applied were drafted for each revised action item. These justifications are drawn on the available crash data, research findings and consultation reported in this and previous progress reports for this project. Therefore, ratings and justifications for each action item are presented in Section 5.3.5.

5.3.2. Action items already completed

Vehicle Safety: Mechanical/Operational Safety

The March 2001 School Bus Safety Action Plan proposed that a scheme be developed to ensure that all buses had mechanical safety inspections carried out every 6 months.

> Develop a scheme to ensure that all buses, used for the transportation of children during school travel times have mechanical safety inspections at least once every 6 months, where a mandatory maintenance scheme is not in place.

However, based on the description of safety initiatives currently in place across Australia, as depicted in Section 3, mechanical safety inspections are already being carried out at 6 monthly intervals or more frequently in all jurisdictions. Therefore, this action has been removed from the Revised Action Plan (Section 5.4).

Future Research: Policy / Data

The March 2001 School Bus Safety Action Plan contained an action item pertaining to the development of national guidelines to facilitate a consistent approach to the implementation of future school bus safety initiatives. This item was refined to read:

> Where feasible, ensure that a consistent approach to the implementation of future school bus safety initiatives is adopted across jurisdictions and encourage ongoing communication between jurisdictions.

The impetus for this action item stemmed from the recommendation proposed in the *School Bus Safety in Australia – AP-R186 (Austroads, 2001)* that a "School Bus Safety Advisory Group be established to, amongst other things, monitor the implementation of school bus safety initiatives and identify new developments in school bus safety". However, this School Bus Safety Advisory Group has since been established and is therefore this action has been removed from the Revised Action Plan (Section 5.4).

Future Research:

The March 2001 School Bus Safety Action Plan contained an item relating to the need to develop and prioritise a research program pertaining to benefits associated with various school bus safety initiatives.

> Develop and prioritise a research program that seeks to evaluate / quantify the benefits associated with school bus safety initiatives for which little or no objective information is available. Propose to include, though not limited to, evaluating the speed of traffic travelling around buses, the use of speed restrictions and warning light. Also include evaluating the effectiveness of campaigns related to improving student behaviour and encouraging parents to pick up and drop off students on the same side of the road as the bus.

As the current project has sought to highlight and prioritise the actions required to evaluate and quantify the benefits of a range of initiatives, this action item is no longer required and has been removed from the Revised Action Plan (Section 5.4).

5.3.3. Combining or separating actions items

The March 2001 School Bus Safety Action Plan was reviewed in consultation with jurisdictions. Those action items with a similar focus were combined. For example, the March 2001 action item of developing a surface improvement program around bus stops and another item of providing indented bus bays have been combined (see RES 3, p 84). Other March 2001 measures have been separated into different action items for clarity of analysis. For example, the March 2001 action item referring to both the parking regulations around school bus areas and speeding in speed limited zones is now two separate action items (RUS 11 and 12, p 64 and 65).

5.3.4. Additional action item

Data Collection

Following discussion of action items in the March 2001 School Bus Safety Action Plan, an additional action item for *data collection* was drafted. This action item relates to the need for consistency in methods of collecting fatality and injury data where school buses are involved:

> *Data Collection*: Identify and develop nationally consistent methods for collecting data relating to fatal and injury crashes involving school children travelling in and around school buses.

Justifications and ratings regarding priority, effectiveness, resources required and ease of implementation for each of this revised action item is discussed in Section 5.3.5.

5.3.5. Consideration / discussion of refined action items

This section presents each refined action item together with an indication of the extent to which the item has been applied across jurisdictions, and priority and feasibility ratings for each item. A detailed justification for the rating that has been applied, based on crash data, research evidence and current practice findings, is presented for each action item.

5.3.5.1. Road User Safety: Pre-school Children (RUS 1)

Action: Where not currently implemented, introduce a resource that targets children and parents on school bus safety issues that relate to safe behaviour on and around buses.

Status: Three out of eight Australian states currently implement some form of education program for children attending pre-school.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification: Research suggests that young children lack the perceptual and cognitive functions necessary to make safe decisions in different traffic environments (Connelly *et al*., 1998). The Queensland School Transport Safety Taskforce highlighted this, suggesting that parents and carers can assist children to make safe pedestrian decisions by training positive behaviour. For example, parents and carers can be trained to undertake 'commentary walking' with children where they talk through and explain their actions while modeling safe pedestrian behaviour (Queensland School Transport Safety Taskforce, 2001). Such training may also be successful for pre-schoolers to encourage positive behaviour in and around school buses.

It is important to understand what information is being provided and what resources are being used across Australia at the pre-school level. Ensuring that all pre-school children receive a grounding in bus safety at an early age is expected to have long term results on increasing child safety and awareness of parents and carers. However, given the lack of research evidence pertaining to this action item, it is difficult to comment on the size of the safety benefits that may be achieved.

While this action seeks to prevent injuries associated with school bus travel, has a relatively low resource cost and is easy to implement given pre-existing communication networks, it may be outweighed by actions more closely aligned with addressing common causes of school bus related fatal crashes involving school aged children. Crash reductions as a result of this action are expected to be very difficult to assess and likely be achieved over the long term, once children enter formal schooling.

5.3.5.2. Road User Safety: School Children (RUS 2)

Action: Identify 'gaps' in current road safety programs within the curriculum that are applied to school children at each year level, commencing from primary school to the end of secondary school. The specific focus should be on the identification of school bus safety related messages.

Once 'gaps' are highlighted efforts should be made to develop and implement resources and activities to address these.

Status: Every jurisdiction is currently implementing road safety education programs at the primary school level encompassing school bus safety. Some jurisdictions have no materials or programs for secondary students.

Rating:

– **Priority** A

– **Effectiveness** 2

– **Resources** Medium

– **Implementation** Easy

Justification: Research completed by the Transportation Research Board (TRB, 1989) indicated that pupil education programs offer considerable safety improvements for children travelling in and around school buses when compared to the safety gains offered by occupant protection measures such as the installation of seat belts.

This action is perceived to address the most common causes of school bus related fatalities with the potential to reduce fatalities and injuries in both the short term and the long term. It is acknowledged that an investigation of traffic safety education programs operating at both primary and secondary school level in Australia is currently underway.[132].

While this study is not specifically focussed on school bus safety and associated messages, it is anticipated that as part of the investigation, programs offering education relating to safe travel, including school bus travel, will be identified. Therefore, it will offer a starting point for identifying road safety based educational programs operating and the 'gaps' in relation to school bus safety. With additional resources this could be extended to include a specific focus on school bus related safety messages.

It is anticipated that the resources required to identify the gap in education are small, given work has already commenced. However, where gaps are identified, the development and implementation of new resources and activities will require higher costs.

[132] ARRB Transport Research has been engaged by Austroads to undertake an investigation of school based traffic safety education programs operating at both primary and secondary schools in Australia. The intention of the project is to ensure that all school-based road safety education programs are developed and delivered using sound road safety and educational principles and policies. This project is RS.SS.N.014. The investigation will look both at programs operating and their content, and the style of delivery and assess pedagogic soundness and culminate in a 'content' and 'process' checklist for school based educational programs.

5.3.5.3. Road User Safety: School Children (RUS 3)

Action: Investigate current *Codes of Conduct* (or Behaviour) for children travelling on school buses that are applied across Australia. Where *Codes of Conduct* are not currently operating, consideration should be given to the development and implementation of such codes.

It is further recommended that material relevant to behaviour management techniques for bus drivers be incorporated into these *Codes of Conduct* (further detailed in RUS 8).

Status: The review of current practices in Australia suggests that *Code of Conduct* publications for children and drivers for dedicated bus services are in place or under development in all jurisdictions, with a less common application for non-dedicated bus services.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification: Given that many jurisdictions have already developed and implemented *Codes of Conduct* for various audiences, including school children, parents and drivers, it is feasible that remaining jurisdictions could also develop and implement such publications to promote appropriate, safe behaviour on school buses, for relatively small cost.

It is recommended that new *Codes of Conduct* should be consistent with existing codes, yet be developed to cater for individual jurisdictional requirements and operating practices.

Further, it is noted that there is a lack of research documenting the success of *Codes of Conduct* in reducing fatalities and injuries and this may suggest a long term action item of evaluating the success of these codes in increasing the safety of children travelling in school buses.

Given the potential outcomes on the behaviour of children and the management of behaviour by bus drivers, the development and implementation of *Code of Conduct* publications in each jurisdiction is viewed as an action that can address potential causes of fatalities and injuries associated with travel in school buses.

5.3.5.4. Road User Safety: Parents and carers (RUS 4)

Action: Investigate the possibility of parents and carers taking on a 'supervisory role' at bus stops that are located away from schools.

Status: Investigation of current practice indicates that no jurisdictions implement widespread formal regimes to ensure that children are supervised by adults at bus stops located away from school grounds or while on-board buses. The Australian Capital Territory is the only jurisdiction that indicates it offers such supervision for both dedicated and non-dedicated bus services.

Rating:

– **Priority** A

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Difficult

Justification The need for adult supervision of children beyond school bus stops is recognised as a high priority. The analysis of crash data presented in Section 3 of this report indicates that in Australia the majority of school bus related crashes during school travel times are associated with children disembarking from buses in the afternoon on their way home from school, while unaccompanied by an adult. Due to absence of national data detailing the involvement of school bus related injury crashes, the precise magnitude of this problem may be under-represented.

While there is an absence of evidence evaluating the role of parental supervision associated with school bus travel, it is recognised that appropriate supervision of children, especially when disembarking from the bus, has the potential to reduce children fatalities and injuries which result when children darting out in front of a bus and subsequently struck by a passing motorist. Therefore, this action is expected to address the most common cause of school bus related fatal crashes.

However, it is noted that there are considerable difficulties restricting the ability to successfully implement this action. Issues associated with legal liability and child protection may limit the ability or desire of parents and carers taking responsibility for other children in these situations. It is also appreciated that many children may not be receptive to other parents and carers taking on authoritarian roles.

Further to this, there are a vast number of bus stops beyond the school setting that would require supervision. It may be feasible for communities in metropolitan areas to consider using a parent or carer in a supervisory role at high risk bus stops in the local area or at stops where a considerable number of children disembark. However in rural areas, where bus stops are more spread out with fewer children disembarking at each stop, the task of providing a parent or carer to supervise alighting and boarding practices becomes much more difficult.

5.3.5.5. Road User Safety: Teachers (RUS 5)

Action: Investigate the possibility of teachers taking on a 'supervisory role' at bus stops that are located near schools or within school boundaries.

Status: Adult supervision at school-based bus stops is provided in five jurisdictions. In New South Wales and Queensland teachers supervise students at bus stops at private schools but generally not at government schools. In Victoria, the supervisor may be a teacher, a parent or a student 'bus captain'.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low/medium

– **Implementation** Complex

Justification: The crash data presented in Section 3 of this report indicated that the majority of school bus related fatalities during school travel time occur when children are disembarking a bus on their journey home in the afternoon. Injuries sustained in crashes that occur as children disembark the bus in the morning or while alighting the bus in the afternoon are less common.

Many schools already employ the practice of teachers or staff monitoring the boarding and alighting practices of children on buses at school based bus stops or interchanges. Additionally, when children are disembarking a bus at school, they are generally heading in the same direction (i.e. towards the school or classroom) rather than disembarking in many different directions and attempting to cross the road as is often the case on the journey home. Therefore, this action is expected to address potential cause of fatalities rather than the most common causes.

The consistent management of children when boarding and alighting school buses at school-based stops may provide an opportunity to reinforce the need for caution around school buses and to promote the importance of appropriate student behaviour while on board the vehicle.

While the resources associated with investigating the possibility of teachers taking on a supervisory role at bus stops located near schools or within school boundaries are low, the implementation of the action is expected to be much more complex due to the demand on teachers and associated union issues

5.3.5.6. Road User Safety: Motorists (RUS 6)

Action: Revise current learner driver manuals and identify gaps in relation to safe driving behaviour around buses, particularly school buses.

Develop recommendations, where they are not already in place, regarding safe travel around buses for inclusion in licence manuals.

Status: Based on preliminary investigations, the learner driver handbooks in New South Wales and Tasmania incorporate safety messages relating to the need for caution when driving around school buses. Queensland and South Australia are considering the inclusion of school bus safety messages in learner driver manuals. The extent to which other jurisdictions incorporate such messages in current driver learner manuals needs to be further examined. Victoria's new Hazard Perception Test includes a test item relating to school bus safety, but not all test candidates see this particular item.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification: The crash data presented in Section 3 of this report indicated that drivers involved in the school bus related fatalities, for the five years investigated, were aged between 18 and 72 years, with the average driver age being 38 years. Given the small number of fatalities, trends relating to driver age were not evident.

However, ensuring that driver handbooks and manuals provide sufficient information relating to rules governing traffic behaviour around school buses and the dangers associated with children as pedestrians moving around school bus early in drivers educational experiences has the potential to increase driver awareness and reduce school bus related crashes. Inclusion of such information is suitable means of ensuring motorists are aware of relevant legislation and traffic laws operating in each jurisdictions pertaining to safe travel around school buses. Oversees research has also recommended that extending driver education and pubic information to the pre-licence stage may lead to greater understanding, increased awareness and voluntary compliance of traffic regulations pertaining to school buses from the onset of the driving experience (CUTR, 2000).

Reviewing current manuals and developing recommendations regarding safe travel around buses for inclusion in licence manuals is an action that may address the cause of potential fatalities in the long term. It is a low cost action that is easy to implement, although it is noted that it is difficult to assess the safety benefits directly relating to this action.

5.3.5.7. Road User Safety: Bus Owners/Operators/Drivers (RUS 7)

Action: Conduct a review of current 'road trauma related' first aid training requirements for bus drivers.

Status: The Bus Association of Victoria reported that some operators may provide first aid training to drivers. First aid training for drivers has not been considered by Queensland Transport. Provision of first aid training to bus drivers in other jurisdictions is unknown.

Rating:

– **Priority** N/a

– **Effectiveness** 3

– **Resources** Medium

– **Implementation** Difficult

Justification: There is a lack of evidence indicating that training bus drivers in first aid will reduce the injuries sustained by children in school bus related crashes in Australia. Further to this, based on available data, there is no evidence of a relationship between the level of injuries sustained in a bus crash and the ability of a bus driver to provide first aid.

This action will not address common causes or potential causes of school bus related fatal crashes, but rather presents an opportunity to improve the management of injuries in the event of a crash. Therefore an 'N/a' priority rating has been applied.

Some research highlights that providing basic early life-saving intervention may lead to a reduction in the number of roadside deaths, although the magnitude/extent of success is unknown. The potential merits of providing first aid training for all school bus drivers may be outweighed by the perceived legal implications of providing assistance that worsens injuries or leads to death. As the driver's first responsibility is to the passengers, leaving the bus to attend to an injured person outside of the bus may prejudice the safety of child bus passengers.

In a recent review of pertinent issues relating to the provision of first aid at the scene of a crash, Mabbott (2000) reported that "…there has been considerable debate concerning litigation against those who perform actions that worsen or lead to death of a victim. A considerable amount of time and resources have been directed at legislation aimed to protect 'Good Samaritans' who act in good faith" (2000, p401). Mabbott concluded that while there are logical reasons to introduce first aid training and other means of assistance, there are also reasonable arguments against legislating it as compulsory. For these reasons it is expected that recommending first aid training for all bus drivers may be opposed by the bus industry and government agencies alike. While the management of injuries is important, this action will not have an immediate effect on preventing school bus related crashes.

5.3.5.8. Road User Safety: Bus Owners/Operators/Drivers (RUS 8)

Action: In conjunction with school bus service providers, develop a *Code of Conduct* (or Behaviour) for bus drivers operating school buses for application across Australia.

Status: The review of current practices in Australia found that *Code of Conduct* publications for drivers of dedicated school bus services have been implemented or are under development in all jurisdictions, with a less common application for non-dedicated bus services.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification: This action item was originally associated with the development of an accreditation program for bus operators. However, given the complexities associated with the employment conditions of the bus industry (i.e. split shift operation), the needs for and requirements of an accreditation program are perceived to be larger than the scope of the present project.

The bus industry is crucial to the provision of transport of children to and from school in each state and therefore, bus drivers play a key role in maintaining the safe travel of children on school buses. However, research suggests that some bus drivers find behavioural problems among students difficult to manage, with some operators suggesting that disruptive behaviour can be distracting enough to prevent bus drivers from fully attending to the driving task (Henderson, Roberts & Sara, 1995). To combat this, it is recommended bus drivers receive appropriate training to assist bus operators and drivers in managing student behaviour on buses. In line with the recommendation of the Queensland School Transport Safety Taskforce, it is further recommended that the *Code of Conduct* publications provide a framework for a behaviour management program (2001, p21).

Note: This action is reliant on action item RUS 3, which refers to the development and introduction of *Codes of Conduct* publications for children and bus drivers in each jurisdiction.

This action may address the potential cause of fatalities and serious injuries associated with travel in school buses. The development of a *Code of Conduct* to incorporate bus operators / drivers needs is perceived to require low resource input, given it is linked with RUS 3, and is easy to implement. However, it is further noted that the training of each driver in a behaviour management program based on the *Code of Conduct* will require additional resources and may be met by some industry resistance.

5.3.5.9. Road User Safety: Public Education / Communication (RUS 9)

Action: Develop and implement a 'Communication Strategy' to advocate the need for safety around school buses and promote the safety associated with travel on a school bus.

The strategy should focus on publicising consistent safety messages pertaining to safe school bus travel through a range of mediums (local papers, community radio, pamphlets, advertising, etc) to a range of different road users (pedestrians, bus passengers, motorists, motorcyclists, cyclists).

To account for the variations in traffic regulations pertaining to school buses these strategies may differ for each jurisdiction, though consistency should be maintained where possible.

Status: Based on current practice, each jurisdiction implements a range of programs focussed at educating the general public on road safety related issues, including school bus safety. However the extent to which coordinated communication strategies / public education campaigns are operating is less clear.

Rating:

– **Priority** A

– **Effectiveness** 1

– **Resources** High

– **Implementation** Complex

Justification: To ensure that programs at a state and local level received the best possible chance to be successful, consistent and effective strategy for communication is essential.

Most jurisdictions report running statewide and local public education campaigns when a given school bus safety initiative is being implemented or in action. Such communication is delivered through a range of mediums to different road users, depending on the intended audience. Further to this it is recognised in the research that mobilising local resource mediums, such as local newspapers and community radio, creates informed communities and compliments current enforcement practices (Cairney, 2001).

The analysis of crash data presented in Section 3 of this report indicates that school bus related crashes generally involve a number of typical characteristics, with the majority of fatalities occurring when children are disembarking a bus on their journey home in the afternoon and are struck by a passing motorist. The concerns raised by the community in relation to school bus travel are also similar across Australia and initiatives focussed towards safer school bus travel have been developed with the same goals in mind.

Therefore, it is recommended that a national communication strategy be developed and implemented to ensure that consistent safety messages are portrayed to a variety of road users across Australia. Such a strategy would provide a mechanism to deliver consistent messages, reinforce school bus safety actions implemented in each area and address change in traffic laws and legislation, thus complimenting and enhancing current practices. It is noted that variations pertaining to the operation of school buses in each jurisdiction would need to be taken into account in the implementation of the strategy.

While the costs involved in identifying current strategies implemented across Australia and difficulties associated with developing and implementing a consistent strategy at a national level are noted, the delivery of consistent school bus related messages to a range of road users using a variety of local mediums is expected to increase understanding, lead to greater awareness and result in long terms reductions in school bus related crashes.

5.3.5.10. Road User Safety: Public Education / Communication (RUS 10)

Action: Examine the wearing and use of conspicuous clothing or apparel by children when travelling in and around buses.

Status: Encouraging children to wear conspicuous clothing when travelling by bus was not mentioned by respondents from any state or territory. It is not known whether this has been encouraged anywhere in Australia.

Rating:

– **Priority** B

– **Effectiveness** 3

– **Resources** High

– **Implementation** Difficult

Justification: While the wearing and use of conspicuous clothing may increase ability to see children, the unexpected movement of children in and around buses is of greater concern. The research documents that due to their size and the speed and uncertainty with which they move around stopped or stationary buses, children are at greatest risk of being hit by a passing vehicle once alighting from the bus. The evidence also suggests that primary school aged children are at greater risk as pedestrians because they have under-developed peripheral vision, have difficulty determining the direction of sounds and cannot accurately judge speed or distance of moving vehicles (Connelly *et al*, 1998, New York State Governor Traffic Safety Committee, 1999). The wearing of vibrant, conspicuous clothing will not alter these characteristics of young children and therefore expected to have little impact on their behaviour around school buses.

In the absence of solid evidence as to the effect of children wearing conspicuous clothing while travelling around school buses, it is suspected that the use of conspicuous clothing or apparel alone will not have a marked impact on reducing school bus related crashes. This action may address the potential cause of fatalities however, the effectiveness of the action is questionable. It is noted that it will be difficult to implement. Further to this, given that a significant proportion of school children are compelled to wear a school uniform, the introduction of a separate piece of apparel is likely to be both high in cost and difficult to implement and enforce for unknown safety benefits.

5.3.5.11. Road User Safety: Enforcement (RUS 11)

Action: Examine the level and effectiveness of enforcement practices employed to prevent illegal parking by general motorists at or around school-based bus stops.

Status: The extent to which this action is applied is unknown.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Medium

– **Implementation** Complex

Justification: The movement of traffic around school zones and bus stops during school commuting hours is associated with high risk of injury. Increases in the volume and type of traffic, the needs of a variety of road users (i.e. pedestrians, cyclist, motorists) and variations in the on-road experience of children contribute to the potential for conflicts during these periods.

When parents, carers and bus drivers park illegally in effort to pick up and set down children near school based bus stops, the risk of injury increases.

Therefore, in an effort to determine and implement most effective approaches to reducing illegal parking around school based bus stops, it is recommended that the level and effectiveness of enforcement is examined. If the practice of illegal parking can be minimised at school based bus stops, this may address a potential cause of school bus related crashes. It is further anticipated that improving the parking behaviour around school based bus stops may have a flow on effect, thus leading to improved parking practices when parents and carers are picking up and setting down children at bus stops beyond the school environment.

There are significant costs involved in the process of examining current enforcement practices and the effectiveness of these. Given the number of school based bus stops this action is also complex to implement. Should the examination find the needs for increased enforcement or altered practices, resourcing implications are probable.

5.3.5.12. Road User Safety: Enforcement (RUS 12)

Action: Examine the level and effectiveness of enforcement practices employed to prevent motorists speeding in speed limited areas around stopped school buses.

Status: School zone speed limits are widespread in all jurisdictions except Victoria, where only about 90 school zones have been implemented. In addition, three states have reduced speed limits for vehicles passing a school bus while passengers are boarding or alighting. New South Wales and Tasmania operate a '40 km/h when lights flash' speed restriction around stopped school buses, while South Australia requires motorists to slow to 25 km/h when passing a stopped school bus. Victoria is also considering adopting a 40 km/h speed restriction around stopped buses.

Rating:

– **Priority** A

– **Effectiveness** 2

– **Resources** Medium

– **Implementation** Complex

Justification: In the United States and Canada, drivers in either direction must stop when a school bus stops to set down or pick up children. In Australia, a number of jurisdictions impose speed limits around school zones and stopped school buses to reduce the risk of injury and fatality among bus pedestrians. A number impose restricted speed limits around stopped school buses in conjunction with other warning devises, such as flashing light systems.

Recent research suggests that reducing vehicle speed, even by a small amount, can have significant benefits in reducing the incidents and severity of pedestrian / vehicle crashes and casualty crashes in general. An investigation of 4,214 pedestrian crashes involving a car or similar vehicle in Western Australia between 1987 and 1996 indicated that the speed of the colliding vehicle was a dominant factor associated with the severity of injuries sustained (Legge, 2000). Similarly, an investigation of pedestrian accidents on arterial roads in Adelaide found that small differences in travelling speed can have a significant effect on the impact speed of pedestrian/vehicle collisions; with researchers concluding that reducing urban speed limits to 50 km/h has the potential to reduce pedestrian fatalities on arterial roads by 30% (McLean *et al.*, 1996).

Further to this, recent research also suggests that small reductions in speed can reduce involvement in casualty crashes in general. Kloeden *et al.* (2001) reported the results of two case control studies conducted in South Australia to explore the relationship between free travelling speed and the risk of involvement in a casualty crash. One was conducted in 60 km/h urban areas and the second in rural areas with speed limits of 80 km/h or greater.

The results demonstrated an exponential increase in crash risk associated with high free travelling speed, leading the authors to conclude that significant reductions in casualty crashes could be achieved from small reductions in speeds on both arterial and rural roads (Kloeden *et al.,* 2001).

This action is similar to the earlier action item pertaining to combating illegal parking behaviour around school bus stops. The impetus for the item comes from the need for reduced traffic speed around stopped school buses to allow children greater opportunity to safely cross the road to board or after alighting the school bus. Given the crash data presented in Progress Report 2 indicates the greatest risk to children is crossing the road after alighting, it is recommended that the level and effectiveness of police enforcement of vehicles exceeding specified speed limits is examined. This action addresses the most common cause of school bus related fatalities.

There are considerable costs and complexities associated with examining current enforcement practices and the effectiveness of these. However the safety benefits resulting from improved enforcement of vehicles exceeding the limit around stopped school buses is expected to have a positive impact on the number of school bus related crashes where children are killed or seriously injured as a result of being struck by a passing motorist.

5.3.5.13. Vehicle Safety: Conspicuity (VS 1)

Action: Evaluate the effectiveness of flashing lights on buses when the bus has stopped to drop-off and pick-up children during school travel times.

Status: Based on understanding of current practice, six jurisdictions require dedicated school buses to be fitted with and operate flashing light systems, with only two jurisdictions requiring the same practices for non-dedicated bus services.

Rating:

– **Priority** A

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification: Research in Australia and overseas has identified that children are at greatest risk of injury as a pedestrian boarding or alighting a school bus. Injuries are typically sustained when a child is struck by a passing motorist after alighting the bus.

All Australian states, except WA, require buses used for school services to be fitted with warning signs and flashing lights which must be activated when the bus stops to set down and pick up school children to alert motorists to the presence of school children.

Other states also impose speed restrictions that apply when these lights flash. For example, New South Wales has introduced a 40 km/h speed restriction to traffic travelling in the same direction. When the flashing lights are activated, approaching drivers must slow to this speed.

Further evaluations as to the effectiveness of flashing lights, comparing jurisdictions where specific speed restrictions have also been introduced to those where they have not, are required to determine the success of these countermeasures in alerting motorists to the presence of school children. This action is expected to address common causes of school bus related fatalities. Given that some evaluations have already been carried out, the resources required to undertake further evaluations are relatively low and relatively easy to implement.

5.3.5.14. Vehicle Safety: Conspicuity (VS 2)

Action: Identify effectiveness of buses using high visibility strips in reducing bus-related crashes. If proven to be effective, introduce the application and retrofitting of high visibility strips on school buses.

Status: High visibility strips, other than text and graphical 'School Bus' signs, are not commonly used.

Rating:

– **Priority** B

– **Effectiveness** 3

– **Resources** Medium

– **Implementation** Complex

Justification: To increase the conspicuity of school buses in the United Sates and Canada a number of initiatives have been introduced. These initiatives include fitting vehicles with retro-reflective markings, painting the buses 'national School Bus yellow', installing strobe lights and using daytime running lights.

Queensland Transport developed and implemented a high visibility fluorescent orange and yellow strip to draw drivers' attention to the presence of a school bus. A trial of the strip was subsequently conducted to determine whether bus drivers, parents and school teachers noticed any behavioural changes. Interviews and focus group discussions found support for the colour scheme and the strips, with many reporting that the strips were effective in making drivers slow down. However, many of those interviewed also reported that they already slow down when approaching a school bus, regardless of whether the bus has been fitted with a high visibility strip. In the absence of speed observations, the trial indicated that the implementation of high visibility strips, as implemented in Queensland, has a limited potential to raise awareness of the presence of school buses (King, 1999).

In comparison to flashing light systems that operate as the bus stops to set down or pick up children, high visibility strips simply increase the conspicuity of school buses. Therefore this action may not directly address the most common cause of school bus related fatalities. This action aims to increase a driver's awareness as to the presence of a school bus, with the expectation that increasing visibility will encourage drivers to travel at slower speeds.

Based on the evidence available, this is not considered to be a high priority action. Additionally, though the action is achievable for relatively small costs, it is not expected to result in significant reductions in school bus related crashes.

5.3.5.15. Vehicle Safety: Occupant Protection (VS 3)

Action: Investigate the need for and a cost effective method of fitting auxiliary mirrors outside buses to improve a driver's view of potential risks. Review vehicle design standards should retrofitting of auxiliary mirrors be required

Status: Non-standard mirrors that have been employed on school buses include convex mirrors inside the bust to provide the driver with a view of the rear door area, convex external mirrors to provide the driver with a view of the outside of the left side of the bus while simultaneously providing a view of passing traffic, and external mirrors mounted in front of the driver to provide a view of child pedestrians crossing in front of the bus.

Rating:

– **Priority** B

– **Effectiveness** 3

– **Resources** Medium

– **Implementation** Easy

Justification: Research in Australia, the United States and Canada indicates that children are at greater risk of injury when moving around the bus as a pedestrian compared to travelling as a passenger in a moving bus. Further to this, statistics suggest that in the United States and Canada a significant proportion of school bus related child fatalities are a result of children being struck by the school bus itself. This occurrence has been linked to the long-nose design of school buses in the latter jurisdictions (Hildebrand, 2001). To combat this occurrence, many states and provinces in the United States and Canada require buses to be fitted with a range of countermeasures to increase the bus drivers view of children when they are moving outside the vehicle, including comprehensive mirror arrangements inside and outside the vehicle (Transport Canada, 1998).

However, in Australia the incidence of children being struck by the bus itself is rare. As reported in Progress Report 2, the majority of children fatally injured in school bus related crashes in Australia result from children being struck by a passing motorist after alighting the bus. Therefore, the installation of auxiliary mirrors to the outside of buses, while beneficial in improving the bus driver's view of children outside the bus, does little to improve the visibility of children to passing motorists.

Though it is relatively simple to assess the need for and cost effective method of fitting auxiliary mirrors to school buses for relatively low cost, the costs associated with reviewing vehicle design standards should retro fitting be required would be higher. Given that few children are injured or killed as a result of being struck by the bus itself, safety benefits resulting from this action are expected to be relatively low.

5.3.5.16. Vehicle Safety: Occupant Protection (VS 4)

Action: Identify the feasibility and related cost of school buses being limited to carrying one child to each single seat compared to current three-for-two policy.

Status: With the exception of the ACT, all jurisdictions permit the three-for-two seating policy for all scheduled runs (and some special runs) in dedicated school bus services, with lesser application of the policy in non-dedicated bus services.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** High

– **Implementation** Difficult

Justification: As reported in Section 3 of this report, the perception of risk to children while travelling on and around school buses is high, even though available evidence indicates very low incidence of bus related crashes. The debate between perceived risk and crash incidence is fundamentally related to the high value placed on a child's life by the community.

Further to this, members of the community have reported the widespread application of the three-for-two seating rule as a prime issue of concern. This rule allows three children to occupy the seating compartments allocated for two adults. However, there is a lack of research evidence to suggest that retaining the three-for-two seating rule compromises the safety level of passengers.

The three-for-two seating practice is common in almost all jurisdictions in Australia and therefore consideration to abolish or amend the practice would have significant ramifications on the carrying capacity of current bus services. Australian research has suggested that the abolition of this policy would lead to an increase in bus travel costs of 16% per year (Johnson, 1993) as more buses would be required to transport the same number of children. Abolition of this policy is also likely to require a ban on standee bus passengers, further increasing the demand on bus travel and associated costs.

The examination of the costs associated with providing a single seat to each child occupant involves the identification of current practice, the extent to which the current policy is taken-up, the capacity and cost implications associated with additional carrying requirements and so forth.

Given the small number of fatalities occurring to children as bus passengers, and the lack of research evidencing that the three-for-two seating policy increases risk of injury to children, the reduction in injuries that amendments to this policy may provide is unknown. Further to this, the cost of abolishing this policy is not expected to provide a safety gain as large as that perceived by the community. In comparison, greater safety benefits are expected by undertaking a number of other safety countermeasures that include improvements to the road environment and the behaviour and awareness of road users.

5.3.5.17. Vehicle Safety: Occupant Protection (VS 5)

Action: Identify the feasibility and related cost of school buses ensuring that all children are seated while the bus is moving.

Status: All Australian jurisdictions currently permit carriage of passengers who have to stand on normal route service buses (with some exceptions for non-dedicated service buses). Queensland Transport recently conducted a trial with increased provision of buses in non-urban areas to reduce the need for standing; the results of the trial are presently under consideration. Furthermore, the number of standees permitted on each bus journey is calculated in a number of different ways across Australia.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** High

– **Implementation** Difficult

Justification: As reported in Section 3 of this report, the perception of risk to children while travelling on and around school buses is high, even though available evidence indicates very low incidence of bus related crashes. The debate between perceived risk and crash incidence is fundamentally related to the high value placed on a child's life by the community.

Members of the community have reported significant concerns with the carriage of children as standees on moving buses and the general overcrowding of buses. This practice is common on normal route service buses where specially designed standing areas are provided.

There is a lack of evidence depicting whether standees are at greater risk of injury than seated occupants, as the number of serious crashes involving school buses is low. The only Australian research into the safety of standees concluded that, based on the low incidence and low risk of injury to bus passengers in general, the additional risk posed by a child standing during a journey is reported to be very small (Henderson, 1996). Others have argued that in the event of a crash, standees are at greater risk of injury to self and others they collide with than seated occupants are. Children traveling as standees are not offered the same protection as they would be through compartmentalisation, if seated. Additionally, some suspect that minor injuries may be sustained though often not recorded suggesting that the danger to standing bus occupants may be under represented. It may be appropriate to examine improvement to principles and practices of permitting standees on route service buses.

Following an examination of crashes between 1989 and 1992, Henderson concluded that the annual cost (including medical, rehabilitation and loss of work costs) to the community of injury to children received as a result of standing in a moving bus was around $50,000 to $60,000 per year. Further, Henderson concluded that the elimination of the risk via the banning of standees would cost the community thousands more than the value of the injuries saved. That said, range of improvements to regulation of standees may be more cost effective and viable approach.

This action may require investigation into a range of measures focussed on improving safety to standees. For example, it is recommended that consideration be given to:

- Developing a consistent method of calculating the number of standees permitted to travel on each trip be developed, with consideration to restricting the number permitted on any journey.
- Restricting standees on routes with high-speed roads and steep descents, on rural roads and on routes with other high-risk characteristics.
- Investigating countermeasures to increase the safely of standees which could be adopted at minimal costs such as ‘handholds’ (Henderson, 1996).

5.3.5.18. Vehicle Safety: Occupant Protection (VS 6)

Action: Identify the feasibility, effectiveness and cost of installing 3-point (lap-sash) seat belts in school buses in Australia.

Status: Lap-sash belts are not widely available on school buses in any jurisdiction except on certain coach-style vehicles that are required by ADRs to be fitted with belts. A few operators in Victoria are known to have fitted belts to cater for schools that require them for excursions; such buses cost considerably more to hire. WA Transport recently commissioned ARRB Transport Research to advise on the feasibility of conducting a trial of seat belts on school buses; the results of the study are currently under consideration.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** High

– **Implementation** Difficult

Justification As reported in Section 3 of this report, the perception of risk to children while travelling on and around school buses is high, even though available evidence indicates very low incidence of bus related crashes. The debate between perceived risk and crash incidence is fundamentally related to the high value placed on a child's life by the community.

Despite the low frequency of injuries to children as a bus passengers, the most common concern raised by parents and the community at large is the need to ensure children are protected in seat belt position while travelling on board a school bus. Further to this, there is a significant amount of research examining the effectiveness of seat belts as a means of protecting children from serious injury or death while travelling as a on school bus passenger. However, despite testing and research, the debate as to whether seat belts offer improved occupant protection has continued.

The research referenced in Section 3 of this report documents that:

> "…a wide range of studies examining the safety of compartmentalisation compared with the level of occupant protection offered by seat belts. Compartmentalisation appears to offer adequate protection for occupants in frontal impact collisions, with some concerns as to it effectiveness in collision involving high lateral forces and cases of bus rollover. Further, there is difficulty in determining whether the addition of appropriate occupant restraint systems such as seat belts will achieve the same level of occupant protection as that which could be achieved through a number of other cost effective and practical measures".

Specifically focusing on fitment, effectiveness and cost of mandating seat belts on school buses in NSW, Henderson and Paine (1994) reported mixed opinions regarding their effectiveness in reducing death or injury to school children. They noted that the effectiveness of seat belts depends on the style of the belt, and a number of other vehicle design features including the type of seat fitted, seat height, seat padding, appropriate anchorage and so forth. Additionally, effectiveness is dependent on the extent to which all passengers use belts and adhere to vehicle policies. Further to this, there is some evidence to suggest that lap-belt use alone, in absence of high set backs and adequate seat padding can have the potential to increase risk of injury in frontal impact and can increase belt-induced internal injuries (National Transportation Safety Board, 1987).

A number of jurisdictions in Australia have undertaken preliminary investigations as to the cost of fitting and retrofitting seat belts and other seating requirements, the impacts on carrying capacity and the expected safety benefits. However, the extent of reduced injury risk to passengers travelling on route service buses fitted with seat belts is largely unknown due to lack of data on bus crashes and their low occurrence. Based on the Australian situation and international research, Henderson and Paine (1994) concluded that the reduction in injury risk is "unlikely to exceed 20% if seat belts were worn consistently and compared to 50% injury reduction achieved when worn in cars" (cited in Queensland School Transport Safety Taskforce, 2001, p27).

Preliminary investigations into the costs of installing seat belts on school buses in Queensland, South Australia and Western Australia are summarised below:

Queensland

The Final Report of the Queensland School Transport Safety Taskforce (2001) reported on the importance of considering the installation of seat belts in school buses in conjunction with a range of other safety features including rollover strength and the strength of seats and seat anchorage. The Taskforce included the costs associated with improving these safety features, as well as the additional costs posed by abolishing standees, in developing cost estimates for installing seat belts on school buses operating in non-urban routes (environment 2) and those operating in steep and mountainous areas (environment 3). Based on full replacement of buses to upgrade the fleet the Taskforce reported broad estimates between $450-500 million over 15 years to ensure all passengers on buses operating in environments 2 and 3 have belted positions. Subsequent to the release of this report, Queensland Transport (2002) have revised these estimates, reporting that the fitment of seat belts to these buses would be around $720 million over then next 15 years. These revised estimates include operating costs which were not included in the original Taskforce estimates (personal communication).

South Australia

Preliminary estimates as to the costs of fitting seat belts to DETE (Department of Education, Training and Employment) operated and contracted buses that serve country areas and, to a lesser extent, outer areas of Adelaide, were prepared in April 2001. A conservative estimate of $13 million was proposed to retrofit 3-point lap sash seat belts to 570 small, medium and large DETE contracted and operating buses. Additional costs associated with reduced seating capacity (around $10 million), costs of running extra services or larger buses (around $2-3 million) and of moving drivers and buses ($ 0.5 million) bring this total to $26 million .

A number of other issues associated with the fitment of seat belts on DETE operated and contracted school buses in South Australia were also noted. For example, fitting seat belts would require additional policing to ensure correct usage of seat belts by school aged children at all times during the journey. Impacts on ineligible students and preschool children, on other initiatives to improve student comfort (eg, air-conditioning) and on other programs under the National Action Plan, which target areas of greatest risk for school bus students would require consideration. Further to this, assessments regarding the structural integrity of each school bus would be required before seat belt installation commences and the amount of time required to carry out an extensive program of retrofitting seat belts to school buses located throughout the State would also need to be considered (DETE, personal communication, March 2002).

Western Australia

One component of the feasibility study of trialing seat belts in contract school buses in Western Australia involved determining the costs associated with seat belt fitment (ARRB TR, 2001). This feasibility study is currently being considered by the Road Safety Council of Western Australia, therefore the cost estimates can not be released.

Given the low number of injuries sustained by school bus passengers, the life saving potential offered by seat belts is questionable. Due to costs and complexities involved in the fitment of seat belts and associated vehicle requirements (i.e. seat strength, height, anchorage and padding), the cost per life expected to be saved is very high in comparison to the benefits that may be obtained by implementing countermeasures that include improvements to the road environment and the behaviour and awareness of road users.

5.3.5.19. Vehicle Safety: Occupant Protection (VS 7)

Action Investigate the feasibility, safety benefits and costs of fitting school buses with higher seat backs.

Status High back seats are not generally provided on school buses except when coach-style vehicles are used for school services.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** High

– **Implementation** Difficult

Justification As reported in Section 3 of this report, the perception of risk to children while travelling on and around school buses is high, even though available evidence indicates a very low incidence of bus related crashes. The debate between perceived risk and crash incidence is fundamentally related to the high value placed on a child's life by the community.

The height of seat backs is an important component in improving occupant safety benefits through compartmentalisation. Compartmentalisation offers a passive design approach to protect occupants by providing a "protective envelope consisting of strong, well padded, well anchored, closely spaced seats that have energy absorbing seat backs" (McCray, 2001). The height of seat backs is also an important issue for consideration should there be a move towards the fitment of seat belts in school buses.

At present, buses must comply with a number of Australian Design Rules (ADRs) pertaining to occupant protection and the application of seat belts in buses. However there are no provisions that apply specifically to school buses used in the transportation of children to and from school. One of the ADRs, ADR 68/00, pertains to the provision of occupant protection in buses, with reference to appropriate seat height. This ADR:

> "applies to all omnibuses over 3.5 tonnes which seat more than 17 passengers and in which all seats have a reference height (seat back height) greater than 1.0 metre.
>
> …For lap-sash seat belts to be fitted to school buses…the buses must first be modified to incorporate high-back seats….
>
> ADR 68/00 specifies that in these vehicles (with seat backs greater than 1.0 metres), all front and rear seating positions be equipped with seat belts. The ADR indicates that route services buses are exempt from the requirements prescribed.
>
> The ADR specifies the requirements for seat belts in buses including the strength of seats, seat anchorages, seat belt anchorages, children restraints anchorages and the provisions for protection occupants from impact with seat backs and accessories on seats and arm rests". *(ARRB TR, 2001, p6)*

However, very few buses used in the transportation of children to and from school are effected by the improved occupant protection measures offered under ADR 68/00 and related ADRs. Consequently, amendments to legislation pertaining to school buses or indeed changes to the structure or design of school buses themselves (for example, the height of seat backs) would be required in order to seat belts to be fitted in buses.

Research suggests that the provision of higher seat backs may offer increased safety through compartmentalisation and offer greater returns on investment compared to other vehicle based safety countermeasures (such as seat belts). For example, a study into the effectiveness, injury reduction and life-saving potential of nine different safety measures conducted by the Transportation Research Board (1989) reported that the provision of high backs seats (24 inches) offered greater potential to reduce injuries to passengers on dedicated school buses, per dollar invested, compared to other vehicle based countermeasures (Transport Research Board, 1989).

This action item requires an investigation into the costs and associated safety benefits of fitting high back seats to buses used in the transportation of children to and from school.

5.3.5.20. Vehicle Safety: Mechanical/Operational Safety (VS 8)

Action Investigate the feasibility, effectiveness, legal implications and costs installing external loud speakers, which will allow drivers to communicate with pedestrians.

Status No jurisdictions have external loud speakers fitted to buses used in the transportation of school children to and from school.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** Medium

– **Implementation** Complex

Justification This action was recommended based on research in the United States relating to the use of external speakers for bus drivers to use to control the behaviour of children outside the vehicle.

Given the typical crash scenario in Australia, where children are typically struck by a passing motorist after walking out in front of the school bus, it is expected that loud speakers may have some benefit in reducing this type of crash. If successful, this action may lead to a reduction in the number of children who walk out in front of the bus after alighting and reduce child fatalities and injuries. In the absence of further evidence, this action has been rated as medium priority, with limited potential safety gains.

Due to the lack of evidence on the use and success of these external loud speakers, a trial could be conducted to observe the behaviour of students travelling on buses where external loud speakers are installed.

5.3.5.21. Vehicle Safety: Mechanical/Operational Safety (VS 9)

Action Initiate, as part of the Australian Design Rules (ADRs), a critical review of bus design standards.

Status N/A

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** Medium

– **Implementation** Easy

Justification It is well documented that occupant protection is an issue of concern frequently mentioned by members of the community in relation to safe bus travel of school children to and from school. While fatal crashes involving school children as bus passengers is relatively small in Australia, the potential of injury is of great concern.

A number of ADRs are relevant to the provision of occupant protection in buses, including, but not limited to ADR 68/00: Occupant protection in buses; ADR 66/00: Seat strength, seat anchorage strength and padding in omnibuses; and ADR 4/03 Seat belts.

Consideration should be given to a review of these ADRs with a focus on the provision of child safety in and around school buses. The ability to implement this action is perceived to be relatively easy though the resources required would depend on the review approach taken. For example, if a retrospective review is undertaken, the costs associated with this are expected be low. However, if the review is scoped to include crash testing then it may prove to require considerable resources.

5.3.5.22. Vehicle Safety: Mechanical/Operational Safety (VS 10)

Action Investigate the feasibility, effectiveness and cost of motion sensors that are able to interact with the braking performance of a bus and alert the driver as to when a child is in front of the bus.

Status Motion sensors are used to detect the presence of children in front of the bus only in New South Wales and the Australian Capital Territory.

Rating:

– **Priority** B

– **Effectiveness** 3

– **Resources** Medium

– **Implementation** Complex

Justification Research in Australia, the United States and Canada indicates that children are at greater risk of injury when moving around the bus as a pedestrian compared to travelling as a passenger in a moving bus passenger. Research further suggests that in the United States and Canada a significant proportion of school-bus related child fatalities are a result of children being struck by the school bus itself. Motion sensors that detect the presence of a pedestrian outside the school bus have been used in these jurisdictions in an effort to reduce the incidence of bus drivers impacting with child pedestrians.

Given the typical crash scenario is different in Australia, it is expected that the application of motion sensors on school buses would have limited success in reducing potential school bus related fatalities and injuries. If the use of motion sensors was combined with the operation of external loud speakers (as detailed in VS 9), this may improve the effectiveness in reducing potential crashes. This would allow the driver to determine the presence of children around the buses and consequently use the load speaker to alert children to potential danger.

However, it is noted in the absence of evidence as to the effectiveness of these sensors and the significant costs associated with their implementation and testing, this action item is considered to be difficult to implement.

5.3.5.23. Vehicle Safety: Communication (VS 11)

Action Review the adequacy, need and costs of communication facilities operating in buses in Australia, with particular reference to rural buses (two way radios, mobile phones, etc).

Status The installation of voice communication equipment in buses is widespread in Victoria, Northern Territory and the Australian Capital Territory and patchy in other jurisdictions.

Rating:

– **Priority** N/a

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification A review of the adequacy, needs and costs of communication facilities operating in buses may increase the efficiency with which emergency assistance is provided in the event of a school-bus related crash.

However, the current investigation has not unearthed any evidence to suggest that children are dying or sustaining long term injuries as a result of delays in the provision of emergency assistance. It is recommended that if this action is implemented, coronial data files could be investigated to provide further evidence. Therefore, this action will not address common causes or potential causes of school bus related fatal crashes. Rather it presents an opportunity to improve the management of injuries in the event of a crash. Therefore an 'N/a' priority rating has been applied.

Based on the low occurrence of these school bus related crashes, it is not expected that a review of communication facilities operating at present will result in significant reduction in the number of children fatally or seriously injured as a result of a school bus related crashes.

5.3.5.24. Road Environment Safety: Bus Stops / Bus Routes (RES 1)

Action: Identify effective new technologies that alert motorists that a school bus is present and the need to exercise caution, as children may be alighting/boarding the bus (i.e. flashing lights in high risk school bus stop zones).

In the long term, develop a pilot to determine the effectiveness of new technologies that may reduce crash risk of school students around buses.

Status Bus-activated flashing lights have been installed at a small number of school bus stops in Queensland.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** Medium

– **Implementation** Easy

Justification Flashing lights in high-risk school bus stop zones are applied in hilly, mountainous regions and areas of high-fog risk in Queensland. The intention is to improve visibility of bus presence for specific locations where a bus stop can not realistically be relocated.

The use of this approach has potential application to other high-risk bus stops in Australia. Further, such technologies may also be used to activate dynamically, that is to lower speed limits during times when school buses are in operation.

While the effectiveness of this initiative has not yet been determined, it is expected to result in a reduction in traffic conflicts and potential crashes. This action is recommended as a feasible initiative for trialing in other high-risk bus stop locations.

5.3.5.25. Road Environment Safety: Bus Stops / Bus Routes (RES 2)

Action: Develop a consistent system for auditing bus routes in each state. The audit process will seek to:

- Identify road design features that fail to meet current standards.
- Identify road characteristics that may contribute to crash occurrence and severity.

Status: All jurisdictions in Australia reported that guidelines exist for the development of bus stop locations and selection of school bus routes. Most jurisdictions also report conducting audit of school buses though the detail and frequency of such audits varies across jurisdictions.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Easy

Justification Safety audits adopt a pro-active approach to crash risk reduction by identifying road features that may potentially contribute to a crash and its severity and allow application of corrective measures to be implemented. Therefore, this action seeks to address potential causes of school bus related crashes.

Given the work carried out to date in drafting guidelines for bus stop locations and the selection of routes, the development of consistent system for auditing bus routes is expected to require relatively low resources and be easy to implement.

5.3.5.26. Road Environment Safety: Bus Stops / Bus Routes (RES 3)

Action Ensure that indented bus bays and appropriate road surfacing are provided at high-risk bus stops.

Status Most jurisdictions provide indented bus bays at some locations. The status of road surface improvements at school bus stops is not known.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** High

– **Implementation** Complex

Justification Improvements in bus stop and road design, and bus stop placement may potentially reduce crash risk and severity markedly. For example, bus stops designed to improve driver awareness of child pedestrians will provide positive safety benefits.

Further safety measures employed at bus stops may include localised improvements in the skid resistance of road surfaces. Improving the skid resistance of road surfaces has demonstrated itself to improving road safety.

It is noted that the development of a bus stop improvement program will be more complex for those jurisdictions that do not have comprehensive bus stop auditing processes in place.

5.3.5.27. Road Environment Safety: Bus Stops / Bus Routes (RES 4)

Action Investigate the feasibility of dedicated waiting bays for the pick up and drop off of school students only.

Children would be expected to remain at dedicated locations when waiting to be picked up by the bus or by parent and carers.

Status Five jurisdictions have dedicated school bus waiting areas at some locations.

Rating:

– **Priority** B

– **Effectiveness** N/a

– **Resources** High

– **Implementation** Difficult

Justification This action item seeks to provide a safe place for children to wait to be picked up by either the bus or by parents and carers. However, it is recognised that for a range of reasons it is difficult to provide a dedicated area for children to wait.

There are physical constraints associated with providing dedicated waiting areas in both school-based environment and beyond. There are also difficulties associated with managing children while in they wait in these bays. Further, unless supervision could be arranged, there is no way to ensure such designated waiting bays are used by children. Additionally, there may be considerable safety issues associated with the development and use of waiting areas located beyond school environment.

While the effectiveness of such waiting bays have not be proven, given the difficulties associated the provision of bays and enforcement of their use it is unlikely that this action will have significant impact on the prevention of school bus related fatalities and casualties. Further to this, the resources associated with determining whether dedicated waiting locations are a feasible means of increasing safety of children while waiting picked up and dropped off are expected to be considerable.

5.3.5.28. Road Environment Safety: Bus Stops / Bus Routes (RES 5)

Action Investigate extending the planning and design of new schools to ensure that the traffic environment around schools is conducive to safety.

Status The extent that jurisdictions currently consider the interaction of school buses in the traffic environment when planning and designing new schools is unknown.

Rating:

– **Priority** B

– **Effectiveness** 2

– **Resources** Low

– **Implementation** Complex

Justification Planning and designing new schools to ensure that the traffic environment around schools is conducive to safety would enable bus stops and school layout to be integrated in a manner that would facilitate safe boarding and alighting practices by school children.

The implementation of this action provides the opportunity to reduce child exposure to crashes by minimising unsafe crossing practices, increasing the conspicuity and visibility of children and employing traffic safety measures. It is further noted that this action may have greater application in minimising minor injuries and near misses associated with boarding and alighting buses on and around school grounds than in reducing the number of child fatalities associated with school bus travel, as the majority of these occur after the child has alighted the bus in the afternoon and presumably outside school areas.

An investigation of the extent to which jurisdictions currently consider the interaction of school buses in the traffic environment when planning and designing new schools needs to be undertaken. At a policy and government level this is very useful action and is expected to have long term benefits in maintaining the safety of children travelling in and around buses within the school environment. If considerations are made at a traffic management / planning stage then the resources would be relatively low, although it is noted that the implementation of this action may be complex.

5.3.5.29. Data Collection (DC 1)

Action Identify and develop nationally consistent methods for collecting data relating to fatal and injury crashes involving school children travelling in and around school buses.

Consideration should be given to the use of new technologies to assist in the collection and collation of more detailed databases pertaining to crashes involving school buses.

Status N/A

Rating:

– **Priority** N/a

– **Effectiveness** 2

– **Resources** Medium

– **Implementation** Complex

Justification The *School Bus Safety in Australia* study AP-R186 (Austroads, 2001) documented that there is insufficient information contained in current crash databases to make definitive conclusion about fatal and serious injury crashes involving children and school buses during school commuting hours. AP-R186 suggested that data pertaining to the intention of pedestrian movements, the origin or destination of pedestrian trips and secondary vehicles involved in impact is required. It further recommended that additional information pertaining to the safety measures implemented within the vicinity of the crash (eg. flashing lights, implementation of speed zones, proximity of bus stop to pedestrian crossing, etc) would be beneficial. Specific concerns were also noted regarding the lack of detailed data on hospital or serious injury crashes available at a national level.

At a state level, there is variation in the detail of data collected and methods of data collection employed. There is great variation in the fields of data collected by different jurisdictions. Additionally, some states report difficulties in differentiating school buses from general passenger buses within the crash data collected. Other jurisdictions reported difficulties identifying whether a given incident involved a school child or general service passenger.

The development of a consistent data collection procedure and increasing the amount of information collected for both fatal and serious injury crashes is of high priority. However, as this action does not specifically address common causes of fatalities associated with school bus travel, an N/A priority rating has been applied.

The costs involved in examining and amending data collection practices at a national level are expected to be significant. However, access to detailed crash data will assist in better targeting safety initiatives focused around school buses therefore leading to potential for long term reductions in the risk of injury to children travelling in and around school buses.

In the future, consideration could be given to the use of new technologies (i.e. hand held computers such as 'palm pilots') to assist in the direct entry of data at the crash scene. The use of this approach may allow a greater volume of data to be collected, require fewer police resources and provide opportunity for data contained in crash databases to be linked to other related databases such as registration and licensing.

5.4. Revised Action Plan

This section provides a summary of the action items contained in the Revised Action Plan.

Each revised action item is listed below, rated in terms of its priority and effectiveness in addressing school bus related fatalities, and in terms of the resources and ease of implementation associated with undertaking the action.

For ease of presentation and comprehension, the revised action items have been separated into three categories based on the priority rating applied. Action items are then represented in order of the perceived or proven effectiveness, the resources associated with the action and the ease with which actions may be implemented.

5.4.1. Priority A: Addresses most common cause of fatalities

The following action items address the most common causes of school bus related fatalities.

Effectiveness	Resource	Implementation	No.	Action Item
1	High	Complex	RUS 9	Develop and implement a Communication Strategy to advocate the need for safety around school buses and promote the safety associated with travel on a school bus. The strategy should focus on promoting consistent safety messages pertaining to safe school bus travel through a range of mediums (local papers, community radio, pamphlets, advertising, etc) to a range of different road users (pedestrians, bus passengers, motorists, motorcyclists, cyclists).
2	Low	Easy	VS 1	Evaluate the effectiveness of flashing lights on buses when the bus has stopped to drop-off and pick-up children during school travel times.
2	Low	Difficult	RUS 4	Investigate the possibility of parents and carers taking on a 'supervisory role' at bus stops that are located away from schools.
2	Medium	Easy	RUS 2	Identify 'gaps' in current road safety programs within the curriculum that are applied to school children at each year level, commencing from primary school to the end of secondary school. The specific focus should be on the identification of school bus safety related messages. Once 'gaps' are highlighted efforts should be made to develop and implement resources and activities to address these.
2	Medium	Complex	RUS 12	Examine the level and effectiveness of enforcement practices employed to prevent motorists speeding in speed limited areas around stopped school buses.

5.4.2. Priority B: May address potential cause of fatalities

The following action items may address potential causes address of school bus related fatalities.

Effectiveness	Resource	Implementation	No.	Action Item
2	Low	Easy	RUS 1	Where not currently implemented, introduce a resource that targets children and parents on school bus safety issues that relate to safe behaviour [of pre-schoolers] on and around buses.
2	Low	Easy	RUS 3	Investigate current *Codes of Conduct* (or Behaviour) for children travelling on school buses that are applied across Australia. Where *Codes of Conduct* are not currently operating, consideration should be given to the development and implementation of such codes. It is further recommended that material relevant to behaviour management techniques for bus drivers be incorporated into these *Codes of Conduct* (further detailed in RUS 8).
2	Low	Easy	RUS 6	Revise current learner driver manuals and identify gaps in relation to safe driving behaviour around buses, particularly school buses. Develop recommendations, where they are not already in place, regarding safe travel around buses for inclusion in licence manuals.
2	Low	Easy	RUS 8	In conjunction with school bus service providers, develop a *Code of Conduct* (or Behaviour) for bus drivers operating school buses for application across Australia.
2	Low	Easy	RES 2	Develop a consistent system for auditing bus routes in each state. The audit process will seek to: – Identify road design features that fail to meet current standards – Identify road characteristics that may contribute to crash occurrence and severity
2	Low	Complex	RUS 5	Investigate the possibility of teachers taking on a 'supervisory role' at bus stops that are located near schools or within school boundaries
2	Low	Complex	RES 5	Investigate extending the planning and design of new schools to ensure that the traffic environment around schools is conducive to safety.
2	Medium	Complex	RUS 11	Examine the level and effectiveness of enforcement practices employed to prevent illegal parking by general motorists at or around school-based bus stops.
2	High	Complex	RES 3	Develop a bus stop improvement program to ensure that indented bus bays and appropriate road surfacing are provided at high-risk bus stops.
2	High	Difficult	VS 6	Identify the feasibility, effectiveness and cost of installing 3-point (lap-sash) seat belts in school buses in Australia.
3	Low	Difficult	RUS 10	Examine the wearing and use of conspicuous clothing or apparel by children when travelling in and around buses.
3	Medium	Easy	VS 3	Investigate the need for and a cost effective method for fitting auxiliary mirrors outside buses to improve a driver's view of potential risks, and review vehicle design standards for retro-fitting
3	Medium	Complex	VS 10	Investigate the feasibility, effectiveness and cost of motion sensors that are able to interact with the braking performance of a bus and alert the driver as to when a child is in front of the bus.

Effectiveness	Resource	Implementation	No.	Action Item
3	Medium	Complex	VS 2	Identify effectiveness of buses using high visibility strips in reducing bus-related crashes. If proven to be effective, introduce the application and retro-fitting of high visibility strips on school buses.
N/a	Medium	Easy	RES 1	Identify effective new technologies that alert motorists that a school bus is present and the need to exercise caution, as children may be alighting/boarding the bus (i.e. flashing lights in high risk school bus stop zones). In the long term, develop a pilot to determine the effectiveness of new technologies that may reduce crash risk of school students around buses.
N/a	Medium	Easy	VS 9	Initiate, as part of the Australian Design Rules (ADRs), a critical review of bus design standards.
N/a	Medium	Complex	VS 8	Investigate the feasibility, effectiveness, legal implications and costs installing external loud speakers, which will allow drivers to communicate with pedestrians.
N/a	High	Difficult	VS 4	Identify the feasibility and related cost of school buses being limited to carrying one child to each single seat compared to current three-for-two policy.
N/a	High	Difficult	VS 5	Identify the feasibility and related cost of school buses ensuring that all children are seated while the bus is moving.
N/a	High	Difficult	VS 7	Investigate the feasibility, safety benefits and costs of fitting school buses with higher seat backs.
N/a	High	Difficult	RES 4	Investigate the feasibility of dedicated waiting bays for the pick up and drop off of school students only. Children would be expected to remain at dedicated locations when waiting to be picked up by the bus or by parent and carers.

5.4.3. Action items with an 'N/A' priority rating.

The following action items do not specifically address common or potential causes of school bus related fatal crashes, but relate to data management or injury management practices. Therefore an 'N/a' priority rating has been applied.

Effectiveness	Resource	Implementation	No.	Action Item
2	Low	Easy	VS 11	Review the adequacy, need and costs of communication facilities operating in buses in Australia, with particular reference to rural buses (two way radios, mobile phones, etc).
2	Medium	Complex	DC 1	Identify and develop nationally consistent methods for collecting data relating to fatal and injury crashes involving school children travelling in and around school buses. Consideration should be given to the use of new technologies to assist in the collection and collation of more detailed databases pertaining to crashes involving school buses.
3	Medium	Difficult	RUS 7	Conduct a review of current 'road trauma related' first aid training requirements for bus drivers and implement a program of 'road trauma related' first aid training where such programs are not already operating

6. SUMMARY

6.1. Analysis of Crash Data

The review of recent crash data undertaken in this study has confirmed the summary and conclusions drawn in the original analysis of data as reported in *AP-R186A School Bus Safety in Australia – Technical Report (Austroads, 2001)*.

The update of crash data has revealed that:

(iv) While the number of pedestrian fatalities has steadily fallen since 1995, total child pedestrians fatalities and child pedestrian fatalities during school commuting hours have plateaued.

(v) The number of child pedestrian fatalities associated with school bus travel has continued to fall (this conclusion should be treated with caution, as the numbers involved are small).

(vi) The typical characteristics associated with child fatalities and school bus travel have not changed.

As identified in the earlier report (AP-R186 and AP-R186A), the typical crash scenario appears to be that the child is on his or her way home from school and is unaccompanied by an adult. After getting off the bus they are hit by another vehicle in attempting to cross a 2-way undivided road (mid-block and with no pedestrian crossing in the vicinity).

It appears that in most cases the child has attempted to cross the road without looking for oncoming traffic. This is occurring in both urban and rural areas, but in general on roads with speed limits of 60 km/h or more. Neither speeding nor alcohol intoxication was associated with any of the school bus related crashes identified in the database. Although it is difficult to determine the timing of the sequence of events from the crash records, it appears that in most cases the collision is occurring immediately after the child has alighted from the bus and presumably while the bus is still in the vicinity.

Further to this, this analysis highlights that the crash databases maintained by jurisdictions do not contain sufficiently detailed information for the evaluation of school bus safety. Auxiliary information is required to identify school children injured while using buses to commute to and from school. In particular there is a need for the following in both the fatal and hospitalisations crash databases:

- The intention of pedestrian movements (ie. the pedestrian was crossing the road to board a bus when the crash occurred).
- The origin and destination of pedestrian trips (ie. travelling home from school, travelling for extra curricula activities, etc.).
- Data on secondary vehicles not directly involved in the pedestrian impacts (eg presence of a bus, other vehicles).

6.2. Review of Relevant Literature

As exemplified by fatality and injury data, research evidence also indicates that bus travel is a relatively safe mode of transport. Research evidence also suggests that the risk of injury to occupants while travelling as a passenger of a bus is low. The greatest risk to children traveling to or from school is as a pedestrian moving around school buses.

Despite the evidence that children as bus passengers are relatively safe, there remains a strong perception in the community, by parents in particular, that buses pose a greater risk than travel in the family car.

Debates over the safety of school buses, the benefits of compartmentalisation, the cost of installing seatbelts and other countermeasures relative to the safety gains that are likely to result are well-documented. The debate is discussed in detail in this report, indicating that research is mixed and the evidence is largely inconclusive due to the low crash risk associated with vehicles.

Overall, the research indicated that initiatives aimed at increasing driver and pedestrian behaviour, improved vehicle maintenance and roadside environments may offer greater potential for increasing the safety of children travelling in and around buses, as compared to the mandation of seatbelts, the abolishment of standees and the removal of 'three for two' seating in Australia.

6.3. Review of Current Practice in Australia

Risks associated with travel by school bus

This report illustrates that a number of actions, programs and initiatives have been undertaken in Australian states and territories to improve school bus safety. However, all of these actions are designed to address a comparatively small number of actual and perceived risks associated with travel to and from school by bus.

This crash data presented in Section 3 illustrates that the risk of children being struck by passing traffic when crossing the road before boarding or after alighting from the bus is by far the greatest risk associated with travel by school bus. The data also indicates that the next greatest risk of fatal crashes, though less frequent, is associated with traveling as a bus passengers when children become trapped in bus doors when they close and are subsequently dragged by the bus, or when children are injured within the bus when the bus is involved in a collision with another vehicle.

A number of other perceived risks associated with travel to and from school by bus were identified in the literature and through consultation, however the low number of crashes and the absence of injury data at a national level preclude the actual risk of injury from being determined. These perceived risks include:

- Children injured by passing traffic while waiting for bus.
- School bus colliding with children before boarding or after alighting.
- Passengers injured by impacts inside the bus (as a result of collision with another vehicle).
- Other vehicles crashing into the school bus.
- Passengers distracting or interfering with bus driver.
- Collisions caused by mechanical fault or failure in bus.
- Sub-optimal management of passenger injuries after a crash.

Implementation of countermeasures

The actions and programs that have been implemented or considered in Australia to address risks as pedestrians moving around school buses and to address risks as bus passengers traveling in school buses are summarised in this report.

In addition, a summary of the state-by-state implementation of each countermeasure for dedicated and non-dedicated services (i.e. for school students travelling by scheduled route bus services) is presented in tabular format.

These tables intend to provide an indication of the type of programs and initiatives operating to some degree across Australia to maximise the safe travel of school children in and around school buses.

6.4. Reviewing the School Bus Safety Action Plan

The National School Bus Safety Action Plan proposed in *AP-R186* and *AP-R186A* (Austroads, 2001) was revised in light of the outcomes of the updated crash analysis, research findings and understanding of the initiatives in place in Australian jurisdictions.

Therefore, in consultation with the Expert Working Group the action items listed in School Bus Safety Action Plan were refined. Following refinement, each revised action item was rated in terms of its priority and effectiveness in addressing school bus related fatalities associated with school bus travel, and in terms of the resources and ease of implementation associated with undertaking the action. Justifications for the ratings applied were drawn from available crash data, research findings, consultation with key stakeholders and from advice of members of the Expert Working Group.

It is anticipated that the Revised Action Plan will be beneficial in assisting jurisdictions to give priority to those measures which address the most common cause of fatalities where the greatest gains can be made in school bus safety for children.

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APPENDIX A — DATA TABLES

Table A.1: Number of child pedestrians aged 5-17 years killed in road crashes in the morning and afternoon on school days by State/Territory, Australia 1990-2000

	State/Territory								Australia
Time	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	
Morning (8-10am)									
1990	0	0	2	2	1	0	0	0	5
1991	0	0	2	1	1	0	0	0	4
1992	1	2	0	1	0	0	0	0	4
1993	2	0	0	1	1	0	0	0	4
1994	1	0	0	0	0	0	0	0	1
1995	0	1	0	0	0	0	0	0	1
1996	1	1	1	1	0	0	0	0	4
1997	0	0	0	0	1	0	0	0	1
1998	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0
2000	4	1	0	0	0	0	0	0	5
1990-2000	9	5	5	6	4	0	0	0	29
Afternoon (3-5pm)									
1990	11	5	5	0	0	1	0	0	22
1991	5	6	3	0	0	0	0	0	14
1992	5	3	4	1	0	0	0	0	13
1993	5	2	4	0	0	0	0	0	11
1994	3	1	4	2	3	0	0	0	13
1995	5	0	3	1	1	0	0	0	10
1996	3	0	0	0	0	0	0	0	3
1997	0	1	1	0	1	0	0	0	3
1998	1	4	1	1	0	0	1	0	8
1999	1	1	1	1	1	1	0	0	6
2000	0	1	1	0	1	1	0	0	4
1990-2000	39	24	27	6	7	3	1	0	107
Total (morning + afternoon)									
1990	11	5	7	2	1	1	0	0	27
1991	5	6	5	1	1	0	0	0	18
1992	6	5	4	2	0	0	0	0	17
1993	7	2	4	1	1	0	0	0	15
1994	4	1	4	2	3	0	0	0	14
1995	5	1	3	1	1	0	0	0	11
1996	4	1	1	1	0	0	0	0	7
1997	0	1	1	0	2	0	0	0	4
1998	1	4	1	1	0	0	1	0	8
1999	1	1	1	1	1	1	0	0	6
2000	4	2	1	0	1	1	0	0	9
1990-2000	48	29	32	12	11	3	1	0	136

Source: ATSB Monthly Crash Database 1990-2000

Table A.2: Number of child pedestrians aged 5-17 years hospitalised as a result of road crashes in the morning and afternoon on weekdays by State/Territory, Australia 1990-1997

	State/Territory								Australia
Time	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	
Morning (8-10am)									
1990	29	21	16	8	7	1	1	0	83
1991	21	21	10	3	6	4	0	0	65
1992	18	23	10	3	6	1	0	2	63
1993	16	23	8	4	6	0	0	0	57
1994	25	23	6	3	4	3	1	1	66
1995	11	21	7	4	5	1	1	2	52
1996	26	17	8	2	6	4	0	1	64
1997	20*	18	7	2	4	1	1	3	56
1990-97	166	167	72	29	44	15	4	9	506
Afternoon (3-5pm)									
1990	103	76	36	28	23	7	2	2	277
1991	81	51	37	23	24	10	1	3	230
1992	96	40	40	13	24	10	1	2	226
1993	76	41	36	13	19	5	1	1	192
1994	73	48	45	6	21	4	2	2	201
1995	74	47	38	12	13	5	0	3	192
1996	50	54	28	14	17	3	1	3	170
1997	60*	39	24	7	19	3	3	2	157
1990-97	613	396	284	116	160	47	11	18	1645
Total (morning + afternoon)									
1990	132	97	52	36	30	8	3	2	360
1991	102	72	47	26	30	14	1	3	295
1992	114	63	50	16	30	11	1	4	289
1993	92	64	44	17	25	5	1	1	249
1994	98	71	51	9	25	7	3	3	267
1995	85	68	45	16	18	6	1	5	244
1996	76	71	36	16	23	7	1	4	234
1997	80*	57	31	9	23	4	4	5	213
1990-97	779	563	356	145	204	62	15	27	2151

Source: ATSB Casualty Crash Database 1990-1997

Table A.3: Listing of characteristics of 25 fatal crashes where a child (aged 5-17 years) was killed alighting from a bus, or crossing a road before boarding or after alighting a bus before or after school, Australia 1992, 1994, 1996, 1997 and 1998

State	Year	To / From bus	DCA	Time	U/R	Limit	Mid block	Road config	Road Surface	Weather	Age in years	Sex
NSW	1996	From	Emerge	Am	Urban	?	Yes	Div	Sealed	Fine	5-12	M
NSW	1992	From	Emerge	Pm	Urban	60	Yes	Div	Sealed	Fine	5-12	M
NSW	1994	From	Near	Pm	Urban	60	Yes	2way	Sealed	Fine	5-12	F
NSW	1996	From	Emerge	Pm	Urban	60	Yes	2way	Sealed	Fine	5-12	F
NSW	1996	From	Far	Pm	Urban	60	Yes	2way	Sealed	Fine	5-12	M
NSW	1996	From	Far	Pm	Urban	70	Yes	2way	Sealed	Fine	13-17	M
NSW	1992	From	Far	Pm	Urban	100	Yes	2way	Sealed	Fine	5-12	M
NSW	1992	From	Far	Pm	Rural	100	Yes	2way	Sealed	Fine	5-12	M
NSW	1994	From	Far	Pm	Rural	100	Yes	2way	Sealed	Fine	5-12	F
NSW	1994	From	Alight	Am	Urban	40	Yes	2way	Sealed	Fine	5-12	F
NSW	1994	From	Alight	Pm	Urban	60	Yes	2way	Sealed	Fine	5-12	F
NSW	1992	From	Alight[a]	Pm	Rural	100	No	Int.	Sealed	Fine	5-12	F
Vic	1992	To	Near	Am	Urban	60	Yes	2way	Sealed	Rain	5-12	M
Vic	1997	From	Emerge	Am	Rural	100	Yes	2way	Sealed	Fine	5-12	F
Vic	1997	From	Far	Pm	Rural	?	Yes	2way	Sealed	Fine	13-17	F
Qld	1992	From	Emerge	Pm	Urban	60	Yes	2way	Sealed	Fine	5-12	M
Qld	1994	From	Emerge	Am	Rural	80	Yes	2way	Sealed	Fine	13-17	F
Qld	1992	From	Far	Pm	Rural	100	Yes	2way	Unsealed	Fine	5-12	F
Qld	1994	From	Far	Pm	Rural	100	No	2way	Sealed	Fine	13-17	M
Qld	1994	From	Far	Pm	Rural	100	Yes	2way	Sealed	Fine	5-12	F
SA	1994	From	Near	Pm	Rural	80	No	Int.	Sealed	Fine	5-12	M
WA	1994	From	Emerge	Pm	Rural	80	Yes	2way	Sealed	Fine	13-17	M
WA	1994	From	Far	Pm	Rural	90	Yes	2way	Sealed	Rain	13-17	M
WA	1994	From	Near	Pm	Rural	110	Yes	2way	Sealed	Fine	5-12	M
NT	1998	From	Emerge	Pm	Urban	80	Yes	Unk	Sealed	Unk	5-12	M

Source: ATSB Fatality Crash Database 1992, 1994, 1996, 1997 and 1998

Note: am=7-9am
pm=3-5pm

Road configuration -Div = divided road
2way = 2 way undivided road
Int. = intersection.

APPENDIX B – CONTACT DETAILS

Contact details for people and agencies that supplied information about the implementation of school bus safety measures in each state and territory are listed below. The contact person marked with an asterisk (*) was the primary contact person for their state or territory. These were the people who provided the responses to the October 2001 e-mail enquiry.

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APPENDIX C — MARCH 2001 NATIONAL SCHOOL BUS SAFETY ACTION PLAN

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Road User Safety	Pre-school children	• Where not currently implemented, introduce a resource that targets children and parents on school bus safety issues that relate to safe behaviour on and around buses. • Refer to Public Education / Communication section.	• Maintain and continue program.	• Ongoing program.	• Measure degree to which pre-school centres use the resources/programs targeting school bus safety. • Measure incidence and severity of crashes associated with school buses involving pre-school aged children.	• **Department of School Education (DSE),** State Road Authority (SRA), School Council / Parents Association
Road User Safety	School children	• Identify 'gaps' in the current road safety programs within the curriculum applied to school children at each year, commencing from primary school to the end of secondary school. • Develop a Code of Conduct (or Behaviour) for children travelling in and around school buses for application across Australia. This may require a review of Codes of Conduct that are currently operating in some jurisdictions. • Refer to Public Education/ Communication section.	• Identify programs delivered, from commencement of primary school to the end of secondary school, containing school bus safety messages. For example, educational videos, games and pre-excursion bus safety lessons for primary school children. • Develop appropriately targeted countermeasures to promote the delivery of safety practices for each age group. • Undertake an investigation of high priority research initiatives into school bus safety, identified during the Short-Term strategy period. Implement safety initiative for areas where research initiatives demonstrate a considerable safety benefit. • Implement a Code of Conduct (or Behaviour) for children travelling in and around school buses for application across Australia, where one does not already operate.	• Continue School Education resources delivered to school network. • Ongoing implementation. • Evaluate other initiatives not given priority in the previous period of the strategy. • Continue Code of Conduct (Behaviour) program.	• Level of implementation of educational resources that incorporate school bus safety messages. • Monitor and evaluate the effectiveness of safety initiatives to determine levels of crash risk reduction for children associated with buses. • Incidence and severity of child pedestrian crashes at varying age groups.	• **SRA**, DSE, School Council / Parents Association

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Road User Safety	Parents/ Carers and Teachers	• Develop media campaigns to improve practices that will reduce child exposure to crash risk. For example, promoting that children are picked-up and dropped-off on the same side of the road as the bus. • Encourage the use of school newsletters or bulletins as a source of constant reminder of the risks and behaviours of pedestrians around school buses. Existing school newsletters or bulletins may focus on different safety themes throughout the year. For example, advocating the value of parental supervision whilst children are boarding and alighting a school bus, or the value in parents and carers picking-up and dropping-off children on the same side of the road as the bus. • Investigate the possibility of teachers, parents and carers taking on a "supervisory role" at bus stops that are located near schools. This role would resemble the role of a crossing supervisor, with the supervisor to assist primary school children, who are unaccompanied by an adult, to cross the road in a safer manner. OHS implications will need to be addressed. • Refer to Public Education/ Communication section.	• Increase awareness of important issues associated with the safety of school travel and the responsibility of parents through community radio campaigns, local papers and pamphlets. • Implement "supervisory role" for primary school students, where adults in the community assist children, in the vicinity of school bus stops, to cross the road safely (eg. Refer to Detailed Report; Section 4). OHS implications will need to be addressed.	• Ongoing. • Ongoing.	• Measure level of participation of programs. • Measure the proportion of high-risk behaviours of students around school bus stops, at participating schools. For example, number crossing to board or alight while unaccompanied by an adult.	• DSE, School Council / Parents Association
Road User Safety	Motorists	• Revise current learner driver manuals and identify gaps in relation to safe driving behaviour around buses. • Refer to Public Education/ Communication section.	• Develop recommendations, where they are not already in place, regarding safe travel around buses for inclusion in "L" and "P" plate licence curricula.	• Ongoing.	• Measure degree to which Learner assessment tests reflect positive recall of the recommend curriculum items.	• SRA, Police

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Road User Safety	Bus Owners/ Operators/ Drivers	• Conduct a review of current 'road trauma related' first aid training requirements for bus drivers. • Ensure that as part of an accreditation program, drivers and operators of school buses are required to attend workshops dealing with school bus safety – as endorsed by Authorities responsible for school bus safety in each jurisdiction. • In conjunction with school bus service providers, develop a Code of Conduct (or Behaviour) for bus drivers operating school buses for application across Australia. This may require a review of Codes of Conduct that are currently operating in some jurisdictions.	• Implement a program of 'road trauma related' first aid training for bus drivers and operators, where such programs are not already operating. • Implement a Code of Conduct (or Behaviour) for bus drivers operating school buses for application across Australia, where this is not already occurring.	• Ongoing. • Continue Code of Conduct (Behaviour) program.	• Proportion of bus drivers trained in first aid. • Level of participation in workshops.	• **Responsible Public Transport Agency (TA)**, Bus Operators
Road User Safety	Public Education / Communication	• Ensure local media support messages are operating advocating the safe travel of motorists and children around school buses, ie. local papers, community radio, pamphlets, advertising, etc. • Identify public education campaigns focussing on different road users: including students, parents, pedestrians, cyclists, motorists, bus drivers, teachers and carers. • Promote the wearing / use of, conspicuous clothing / apparel amongst children in and around buses. • Develop Communication Strategy. This may include the identification of current bus safety communication messages operating in each jurisdiction over a range of programs. For example, New South Wales "wait until the bus has moved away, then find a safe place to cross", in Western Australia: "9-3" look for me", and Northern Territory, "The Five B's."	• Implement a range of public education programs relating to school bus safety, focusing on different road users. • Implement a Communication Strategy.	• Ongoing.	• Attitudinal surveys to measure the level of public awareness of school bus safety.	• **SRA**, DSE, TA, Bus Operators, Local Council

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Road User Safety	Enforcement	• Identify current levels of enforcement relating to parking and traffic regulations around school buses (including illegal parking at bus stops, high-risk traffic behaviour around buses, speeding in speed limited areas etc).	• Develop a program to ensure that traffic regulations relating to motorist behaviour around school buses is appropriately enforced.	• Ongoing.	• Rate of traffic infringement notices issued.	• **Local Council**, DSE, Police, Parents and Teachers Association
Vehicle Safety	Conspicuity	• Evaluate the effectiveness of Flashing Lights on buses when dropping-off and picking-up children in the vicinity of a school bus, during school travel times. • Ref: to environmental safety improvements in respect to speed zones around school buses. • Identify effectiveness of buses using high visibility strips in reducing bus related crashes.	• Review the operation of flashing lights on school buses, when the bus is slowing down to drop-off and pick-up children, following the evaluation of their effectiveness. • If proven to be effective, introduce the application and retro-fitting of high visibility strips on school buses.	• Ongoing. • Continue implementation.	• Proportion of buses with flashing lights. • Proportion of buses with high visibility strips.	• **SRA**, TA, Bus Operators
Vehicle Safety	Occupant Protection	• Investigate the feasibility and most cost effective method for fitting auxiliary mirrors inside and outside buses to improve a driver's view of potential risks within and outside the vehicle, and review vehicle design standards for retrofitting. • Identify the feasibility and related costs of school buses being limited to carrying one person to each single seat and ensuring that all children are seated while the bus is moving. • Identify the feasibility, effectiveness and cost of installing 3-point seat belts in school buses in Australia. • Investigate the feasibility, safety benefits and costs of fitting school buses with higher seat backs.	• Commence program on retrofitting school buses with auxiliary mirrors. • Act on results of feasibility of restricting one person per seat on a school bus and to and all children standing whilst the bus is moving. • Act on results of the feasibility, effectiveness and cost of installing 3-point seat belts in school buses in Australia. • Act on results of the safety benefits of fitting school buses with higher seat backs.	• Continue implementation.	• Proportion of buses fitted with auxiliary mirrors.	• **SRA**, TA, Bus Operators

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Vehicle Safety	Mechanical/ Operational safety	• Develop a scheme to ensure that all buses, used for the transportation of children, during school travel times, have mechanical safety inspections at least once every 6 months, where a mandatory maintenance scheme is not in place. • Investigate the feasibility, effectiveness, legal implications and costs installing external loud speakers, which will allow drivers to communicate with pedestrians. • Initiate, as part of the Australian Design Rules (ADRs), a critical review of bus design standards • Investigate the feasibility, effectiveness and cost of motion sensors that are able to interact with the braking performance of a bus and alert the driver as to when a child is in front of the bus.	• Implement a scheme for ensuring that mechanical safety inspections of school buses occur every six months. • Act on the results of the investigation into the installing loud speakers in school buses.	• Continue program. • Continue program. • Develop guidelines, where they do not already exist, for identifying appropriate maximum age limits for buses.	• Proportion of school buses complying with six monthly mechanical safety inspections. • Proportion of school buses fitted with external loud speakers.	• SRA, TA, Bus Operators
Vehicle Safety	Communication	• Review the adequacy, need and costs of communication facilities operating in buses in Australia, with particular reference to rural buses (two way radios, mobile phones, etc). Consult with emergency services in each jurisdiction.	• Act on the review to ensure that all school buses have appropriate means of communication for their designated area of travel.	• Ongoing	• Number of buses with communication facilities (eg. two-radio, mobile phones etc.).	• TA, Bus Operators

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Road Environment Safety	Bus Stops/ Bus Routes	• Identify effective new technologies that alert motorists that a school bus is present and the need to exercise caution, as children may be alighting/boarding the bus. • Develop a nationally consistent system for auditing bus routes. • Compile an inventory of bus stops located in hazardous locations and identify the types of hazards that are present. • Develop surface improvement program for road surfacing around school bus stops. • Develop a program for providing intended bus bays at high risk bus stops. • Investigate the feasibility of having bus routes that do not require children to cross particularly hazardous road • Investigate the feasibility of designating a particular section of road or school environment for the pick up and drop off of school students only. Such areas could be highlighted by pavement markings and associated signage to advise parents of safe places to pick up and drop off children. • Investigate the feasibility and cost of extending the planning and design of new schools to ensure that the traffic environment around schools are conducive to safety.	• Develop a pilot to determine the effectiveness of new technologies that may reduce crash risk of school students around buses and commence implementation of these new technologies. • Commence work emanating from school bus route audits to enhance the safety of the road environment for the bus. • Undertake school bus route audits to identify particular routes that have high crash risks during school travel times. • Act on inappropriate locations by redeveloping or relocating bus stops. • Apply surface improvements (such as skid resistant pavement) in vicinity of school bus stops to increase vehicle ability to stop quickly and safely. • Commence program providing indented bus bays and associated pedestrian fencing. • Develop a program where schools designate areas as 'pick up and drop-off points', with these areas being accompanied by pavement markings and associated signage.	• Continue implementation. • Undertake road safety audits of school bus routes and continue corrective work emanating from road safety audits. • Develop national uniform standards and procedures to be followed when designing and locating bus stops. • Continue implementation of surface improvements. • Continue program. • Continue implementation.	• Number of new technologies operating around school bus stop areas. • Number of school bus audits undertaken and the degree to which corrective work has been undertaken. • Number of improvements made to the road environment at selected bus stops over period of time. • Proportion of bus stops with skid resistant pavement. • Proportion of bus stops with intended bus bays. • Proportion of schools/bus stops with a marked and signed "pick-up" and "drop-off" point/section.	• SRA, Local Government, TA, Police, Parents and Teachers Association

Program Element	Target Area	Short Term (0-12 months)	Medium Term (12-36 months)	Long Term (36+ months)	Performance Measures	Responsibility (Bold indicates key responsibility
Future Research		• Develop and prioritise a research program that seeks to evaluate / quantify the benefits associated with school bus safety initiatives for which little or no objective information is available. Proposed to include, though not limited to evaluating the speed of traffic travelling around buses, the use of speed restrictions and warning lights. Also include evaluating the effectiveness of campaigns related to improving student behaviour and encouraging parents to pick up and drop off students on the same side of the road as the bus stop. • Investigate the feasibility of developing national guidelines or criteria to facilitate a consistent approach to the implementation of future school bus safety initiatives	• Commence research program that will seek to identify and measure benefits associated with selected school bus safety initiatives. In addition to evaluating initiatives, may include, examining the application of interactive initiatives which detect the presence of school children in or around buses, the use of ITS as a means of informing traffic that a school bus is in the vicinity and auditing school bus routes for jurisdictions where they have not yet been undertaken.	• Continue program.	• The degree to which the benefits associated with school bus safety initiatives is known.	• **SRA**, Research Organisations, DSE, TA, Police, Parents and Teachers Associations.

INFORMATION RETRIEVAL

Austroads (2002), **Review of the School Bus Safety Action Plan — Final Report**, Sydney, A4, 121pp, AP-R207/02

KEYWORDS:

Buses – safety; buses – schools; buses – children.

ABSTRACT:

At the request of the Australian Transport Council, ARRB Transport Research was commissioned by Austroads in 1999 to undertake a review of school bus safety in Australia. This study reviewed current practice and research in relation to school bus safety and identified new or proven safety measures that may be used as part of a national approach to school bus safety. The key outcome of the study was the development of a draft National School Bus Safety Action Plan, which sought to provide a set of short, medium and long term measures designed to reduce the incidence and severity of crashes involving school children that were associated with bus travel.

The current study reviewed the draft National School Bus Safety Action Plan based on an assessment of updated crash analyses, research findings and initiatives in place across Australian jurisdictions. The crash analysis confirmed the findings of the original report and highlighted that children are at greatest risk of injury or death when attempting to cross the road after alighting the bus. The study reported on initiatives being implemented by jurisdictions to improve the safety of school bus travel. Further, the study included a review of actions in the Action Plan with the aim of identifying succinct, measurable actions that address those areas most likely to yield safety benefits. A system for prioritising these actions, based on the extent to which they address key contributing crash factors, their effectiveness, resource needs and ease of implementation, was developed. Based on this ranking system, the current report presents a Revised Action Plan which aims to assist jurisdictions to give priority to those measures which address the most common cause of fatalities where the greatest gains can be made in school bus safety for children.

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