Safety of school bus journeys

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An important note for the reader

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Abbreviations and acronyms

ACC	Accident Compensation Commission
ADDW	advanced driver distraction warning
ADR	Australian Design Rule
AEB	autonomous (or automated) emergency braking
AIS	alcohol interlock systems
CAS	Crash Analysis System
CCTV	closed-circuit television
CMVSS	Canadian Motor Vehicle Safety Standard
CO	carbon monoxide
CSA	Canadian Standards Association
DDAW	driver drowsiness and attention warning
DSI	death and serious injury
ESC	Electronic Stability Control
FMVSS	Federal Motor Vehicle Safety Standard
GVM	gross vehicle mass
ISA	intelligent speed assist/adaptation
LED	light emitting diode
LDW	lane departure warning
LKA	lane keep assist
NO_2	nitrogen dioxide
NZQA	New Zealand Qualification Authority
NZTA	NZ Transport Agency Waka Kotahi
PCBU	person conducting a business or undertaking
PM	particulate matter
PSV	passenger service vehicle
PSV Rule	Land Transport Rule: Passenger Service Vehicles 1999
PUDO	pick-up (and/or) drop-off
RCW	rear collision warning
RUB	*Requirements for Urban Buses in New Zealand*
UNECE	United Nations Economic Commission for Europe
VKT	vehicle kilometres travelled
VRU	Vulnerable Road User

Contents

Executive summary

School buses are the safest form of transport for children to get to and from school. However, travelling on school buses is not entirely without risk.

The safety of school buses in New Zealand was last examined in 2010 in NZ Transport Agency research report 408: *School bus safety*. Since 2010, there has been renewed interest in school bus safety, including a call for seatbelts on school buses and changes to the requirements for standing and seating on school buses. As such, there is a desire to undertake a fresh review of school bus safety in New Zealand, considering current evidence and broader safety interventions being implemented under Road to Zero: New Zealand’s Road Safety Strategy 2020–2030.

NZ Transport Agency Waka Kotahi (NZTA) contracted Abley Limited to review the current state of school bus safety in New Zealand and to identify a suite of interventions that will enhance the safety of students and bus drivers in and around school buses. The research objectives were to:

- understand current best practice both nationally and internationally, including interventions that have been tried
- undertake an assessment of the operating conditions for school buses and the vehicle fleet used for delivering school bus services (where data are available)
- review current legislation, guidance, policy and practices that impact on the safety of school bus travel
- make recommendations on measures to improve the safety of those travelling on school buses.

The scope of this research includes school bus services contracted or funded by the Ministry of Education Te Tāhuhu o te Mātauranga as well as dedicated school bus services contracted by councils as part of public transport contracts. It does not include school bus services provided as part of the Ministry of Education’s Specialised School Transport Assistance.

The research was undertaken during 2022 and involved:

- undertaking a literature review to examine school bus safety guidance, research and practices in New Zealand and internationally
- engaging with relevant stakeholders to better understand current practices, challenges and safety concerns regarding school bus travel in New Zealand
- undertaking technical analysis to quantify and qualify the safety of school buses, and to identify the types of road environment that present a greater risk of a serious or fatal school bus crash.

Approximately 10% of students travel to school on a school bus. Daily school bus travel is delivered and funded under one of the following models:

- **Daily Bus** services, which are contracted and funded by the Ministry of Education directly
- **Direct Resourcing** or **Māori Medium Schools**, where bulk funding is provided to schools or kura to contract school bus services directly or provide the services themselves
- dedicated school bus services delivered by councils as part of their urban transport network.

Students are eligible for travel assistance funded by the Ministry of Education if they live more than a set distance from their nearest school and there is no other suitable public transport available. The eligibility distance varies depending on the year level of the student, ranging from 3.2 to 4.8 km from the school. The Ministry also funds and contracts ‘Technology Bus’ services for Year 7 and 8 students who need to travel to other schools for technology classes.

Approximately 83% of daily school bus services are funded or contracted by the Ministry of Education. However, this represents approximately 92% of the passenger kilometres travelled overall, as, on average, these services travel much longer distances compared to services provided by councils. It was also found that approximately 84% of Daily Bus services (by length) operate on rural roads, compared to regional council networks in Auckland and Wellington, which are approximately 88% urban by length.

The crash risk (for all road users) of different types of school bus operating environments was assessed. It was found that run-off and head-on road crash rates are higher on rural roads compared to urban roads. The crash rate is highest on undivided roads with extreme operating conditions: roads with a 'high' infrastructure risk rating, tortuous alignment or in higher elevations where adverse weather and road conditions are more likely to be encountered.

A detailed review of crashes involving school buses and injury events reported to the Ministry of Education between 2010 and 2021 was undertaken. Over this period, it was found that bus drivers and passengers were most likely to be injured while travelling on the bus (24.7 injuries per year), with approximately 38% of these injuries resulting from non-collision events such as harsh braking. However, the highest rate of death and serious injury (DSI) to road users occurred around pick-up and drop-off (PUDO), with a rate of 3.0 DSIs per year. Most (75%) of these DSIs were pedestrians crossing the road to or from the bus.

Several limitations in how school bus related injuries are reported are also discussed, including a cautionary note on using historical crash data to predict the likelihood of future fatal or serious injury crashes.

An extensive review of guidance, policy, legislation and practice was undertaken covering:

- Road to Zero and how initiatives under this strategy could affect the safety of school bus users
- school bus route design
- PUDO site selection, assessment and auditing
- school bus signage, visibility, and speed limits around buses
- fleet profile, vehicle selection and vehicle technologies
- occupant protection, including compartmentalisation, seatbelts and standing on buses
- driver management
- education and behaviour management
- crash and incident reporting
- Ministry of Education auditing processes.

Finally, the findings across all stages of the research were collated and critically reviewed. Potential interventions were then identified to address apparent issues and gaps under the following focus areas:

1. School bus route design
2. Speed and infrastructure (on roads where school buses operate)
3. Selection, design, visibility and operation of PUDO sites
4. Conspicuity of school buses, visibility of school bus routes and speeds around stationary buses
5. School bus vehicle safety technologies
6. Bus occupant protection
7. Bus driver management
8. Education and behaviour management
9. Eligibility for school bus transport from a safety perspective
10. Data collection, reporting and sharing.

The interventions identified under these focus areas represent high-level actions to improve school bus safety. It was not possible, within the scope of this project, to undertake detailed assessment for each intervention. For this reason, it is recommended that a multi-agency school bus safety working group be formed to progress the investigation and implementation of these interventions.

Abstract

Every school day approximately 10% of school-aged children in New Zealand travel to school on a school bus. Buses are the safest form of transport for children to get to and from school; however, travelling on a school bus is not entirely without risk. There has been renewed interest in school bus safety recently, and a desire to take a fresh look at school bus safety in New Zealand.

The purpose of this research was to review the current state of school bus safety in New Zealand and to identify interventions that will enhance the safety of students and bus drivers in and around school buses. The scope included school bus services contracted or funded by the Ministry of Education Te Tāhuhu o te Mātauranga, and dedicated school bus services contracted by councils as part of urban public transport contracts.

The research was undertaken during 2022 and involved reviewing New Zealand and international literature, engaging with stakeholders from relevant New Zealand organisations, and undertaking technical analyses to better understand the risks associated with school bus travel.

An extensive review of guidance, policy, legislation and practice was undertaken considering all facets of school bus safety, including road infrastructure, speed management, vehicle safety, driver management, student education and bus occupant protection. Considering the findings across all stages of the research project, the report then identifies several interventions (actions) to address identified issues and gaps.

1 Introduction

School buses are widely regarded as the safest form of transport to school; however, travelling on school buses is not entirely without risk.

The safety of school buses in New Zealand was last examined in 2010 in NZ Transport Agency research report 408 – *School bus safety* (Baas et al., 2010). Since 2010, there has been a renewed interest in school bus safety, including a call for seatbelts to be required on school buses, as well as interest in changes to requirements for standing and seating on school buses. As such, there is a desire to revisit the 2010 research report, to review these prior findings against current evidence and considering broader safety interventions being implemented under Road to Zero: New Zealand's Road Safety Strategy 2020–2030 (Te Manatū Waka Ministry of Transport, 2019).

In 2022, NZTA contracted Abley Limited to review the current state of school bus safety in New Zealand and to identify a suite of interventions that will enhance the safety of students and bus drivers in and around school buses. The research objectives were to:

- understand current best practice both nationally and internationally, including interventions that have been tried
- undertake an assessment of the operating conditions for school buses and the vehicle fleet used for delivering school bus services (where data are available)
- review current legislation, guidance, policy and practices that impact on the safety of school bus travel
- make recommendations on measures to improve the safety of those travelling on school buses.

1.1 Scope

This research project covers school bus services contracted or funded by the Ministry of Education Te Tāhuhu o te Mātauranga (excluding services provided through Specialised School Transport Assistance), and dedicated school bus services contracted through councils as part of public transport contracts.

1.2 Methodology

This research project was undertaken during 2022 and involved three stages:

1. literature review
2. stakeholder engagement
3. technical analysis.

Together, the three research stages addressed the project objectives by ensuring relevant information from both reported sources and current practices is captured.

1.2.1 Literature review

The literature review examined school bus safety guidance, research and practices in New Zealand and internationally. The review included a combination of published literature and reports, and focused on:

- regulations and guidance around school bus safety
- safety outcomes of wearing seatbelts on school buses, including secondary outcomes
- latest developments in bus vehicle technology and corresponding safety assessments

- interventions and trials to improve safety on and around school buses, including entering, exiting and when crossing the road near school buses.

1.2.2 Stakeholder engagement

Engagement with relevant stakeholders was undertaken to better understand current practices, challenges and safety concerns regarding school bus travel in New Zealand. This occurred in two stages.

The first stage involved wide engagement with a range of government ministries, advocacy groups and bus operators, including representatives from the following government agencies and industry groups:

- Ministry of Education Te Tāhuhu o te Mātauranga
- Ministry of Transport Te Manatū Waka
- NZ Transport Agency Waka Kotahi
- New Zealand Police Ngā Pirihimana o Aotearoa
- Environment Canterbury
- Bus and Coach Association
- Rural Women New Zealand
- Safe and Sustainable Transport Association.

Thirteen meetings were undertaken with stakeholder groups or individuals between 31 May 2022 and 30 June 2022. The purpose of this stage was to:

- fill gaps in the literature review in terms of understanding the current regulations, policies and contractual requirements of school bus operations
- identify relevant and available data sources
- anecdotally understand the challenges and safety concerns of bus users
- understand participants' impressions of current school bus operations.

The purpose of the second stage of engagement was to undertake a more targeted review of systems and processes, focusing on:

- fleet safety and maintenance
- fleet selection
- driver management and training
- pick-up and drop-off (PUDO) site selection
- route planning
- incident reporting
- student/parent education and behaviour management.

This involved undertaking eight interviews between 20 July 2022 and 3 August 2022 with the following organisations and individuals:

- selected bus operator fleet managers and health and safety managers
- Ministry of Education Regional Transport Advisors and Transport Contract Managers
- directly resourced school network managers.

1.2.3 Technical analysis

The purpose of the technical analysis was to quantify and qualify the safety of school buses, and to identify the types of road environment that present a greater risk of a serious or fatal school bus crash.[1] The extent of the technical analysis was confirmed with the project steering group, with the scope limited by data currently available. The technical analysis included:

1. quantifying the type and split of school bus services across New Zealand, including the number of trips and equivalent kilometres travelled on council services and each type of Ministry of Education funded service (the findings from this analysis are presented in section 2.3)
2. examining crash reports from the New Zealand Crash Analysis System (CAS) and incident reports collated by the Ministry of Education to quantify and explore patterns in the number and severity of injuries involving school buses in the 12-year period from 2010 to 2021 (the findings from this assessment are presented in chapter 4). A retrospective analysis of data from the years 2008 and 2009, not initially included (see section 4.2.7) did not affect these findings.
3. assessing bus route operating conditions and the relative risk of a sample of school bus routes in different road environments. This included estimating the length of school bus route by risk category and service type and quantifying the relative crash risk of each type of school bus route. (The findings from this assessment are presented in chapter 5.)

1.3 Report structure

The findings across all stages of the research were collated and reported against topic-specific chapter headings as follows:

- Chapter 2 provides the context for school bus travel in New Zealand, including the types of school bus services that operate in New Zealand, eligibility for services, and key statistics by service type.
- Chapter 3 summarises prior research into school bus safety in New Zealand, including research into the relative risk of different modes of transport.
- Chapter 4 describes the methodology and findings from the crash and incident analysis.
- Chapter 5 describes the methodology and findings from the assessment of school bus route operating conditions.
- Chapter 6 describes current guidance, policy, legislation and practices regarding school bus safety, including relevant literature and international comparisons.
- Chapter 7 collates the findings from this research and identifies interventions for addressing identified issues and gaps. These interventions are grouped into 10 focus areas.
- Chapter 8 outlines the conclusions from the research.

[1] The focus on both fatal and serious crash risk in the technical analysis reflects the vision set in *Road to Zero: New Zealand's Road Safety Strategy 2020–2030* of 'a New Zealand where no one is killed or seriously injured in road crashes' (Te Manatū Waka, 2019, p. 6). The definition of 'serious' in this context is taken from the definition used in the Crash Analysis System; that is, 'where any of the parties required medical attention and was taken to hospital' (Waka Kotahi, 2023).

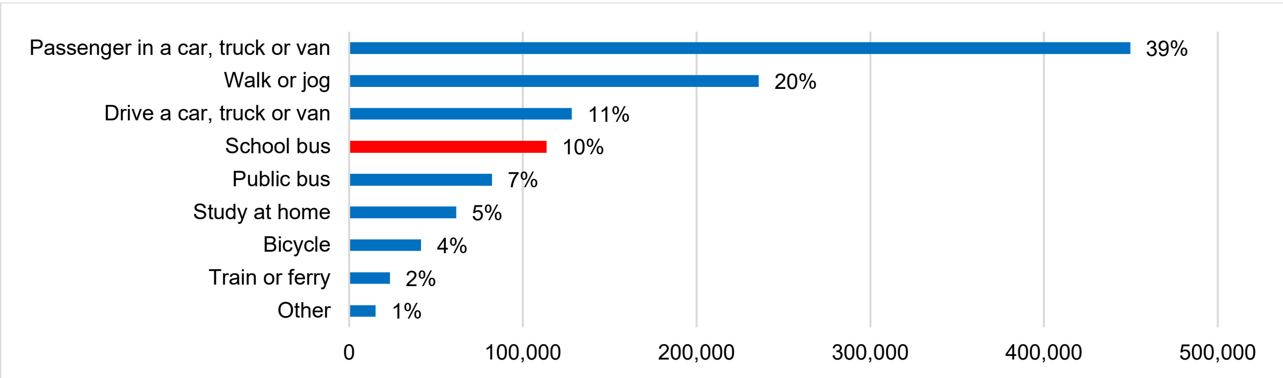
2 School bus travel in New Zealand

This chapter provides the context for school bus travel in New Zealand, including the types of school bus services that operate in New Zealand, eligibility for services, and key statistics by service type.

2.1 School travel in New Zealand

Census 2018 was the first census in New Zealand where people were asked about how they travelled to education, specifically asking 'What is the one main way you usually travel to your place of education – that is, the one you use for the greatest distance?' In 2018, approximately 113,400 people aged 5–19 recorded 'school bus' as their primary mode of travel to education, representing 10% of all travel to education in this age group (Figure 2.1).

Figure 2.1 Percentage of travel to education by mode for people aged 5–19 (Stats NZ, 2018)



Auckland had the most people travelling by school bus (27,264 people) followed by the other large cities and regions (Northland, Waikato, Bay of Plenty, Wellington and Canterbury) (Table 2.1). The regions with the greatest proportion of school bus travel were Northland (26%), the West Coast (21%), and Southland (18%). Despite having the highest absolute number of students travelling by school bus, Auckland had the least mode share (proportion) doing so. This indicates there is a need to consider both numbers of rides and mode share when thinking about school bus transport.

Table 2.1 Travel to education by school bus, by region and mode share – peopled aged 5–19 (Stats NZ, 2018)

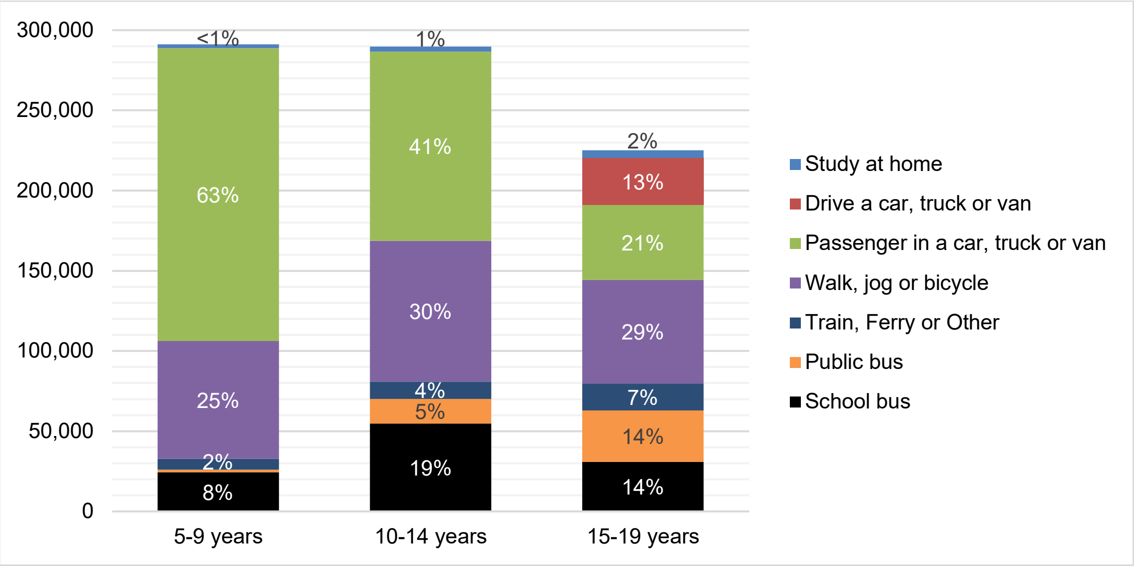
Region	Number of people	Mode share (percent)
Northland	10,083	26%
Auckland	27,264	7%
Waikato	13,323	12%
Bay of Plenty	10,524	15%
Gisborne	1,869	16%
Hawke's Bay	4,569	12%
Taranaki	3,627	14%

Region	Number of people	Mode share (percent)
Manawatū-Whanganui	5,829	10%
Wellington	9,675	8%
Tasman, Nelson, Marlborough	4,155	13%
West Coast	1,257	21%
Canterbury	11,562	8%
Otago	5,238	9%
Southland	4,122	18%
Area outside region	39	< 1%
Total	**113,136[a]**	

[a] This total figure varies slightly from the national total in Figure 2.1. This is due to fixed random rounding to base 3 in the Census data, in accordance with the confidentiality rules for the 2018 Census (Stats NZ, 2020).

Children aged 10–14 are most likely to travel by school bus, representing almost half of all school bus travel for people aged 5–19 (49.8%, as shown in Figure 2.2). Children in this age band often travel further to reach intermediate and secondary schools compared to younger children, whose primary schools are usually closer to home. Older children (aged 15–19) are more likely to drive or take a public bus, noting that the Census data for this age range also capture recent school leavers travelling to tertiary education providers. It is also noted that the total number of children aged 5–19 in Figure 2.2 is approximately 3,100 fewer than the total number of people that reported a journey to education by school bus. This suggests there are children under the age of 5 and/or adults over the age of 19 who were also recorded in the Census as travelling to education on a 'school bus'.

Figure 2.2 Journey to education by mode and five-year age band (Stats NZ, 2018)



2.2 Types of school bus service

School bus services are primarily funded by the Ministry of Education or funded and provided by councils as part of their urban public transport services.

2.2.1 Services provided by the Ministry of Education

The Ministry of Education provides school transport assistance to help children get to school where distance and/or accessibility is a barrier to attending school.

2.2.1.1 Eligibility

To be eligible for travel assistance, students must meet the following criteria:

- They are enrolled at the closest state or state-integrated school they are eligible to attend.
- They live more than a certain distance from school, depending on their year level:
  - Years 1–8 (primary and intermediate school): at least 3.2 km from the school
  - Years 9–13 (secondary school): at least 4.8 km from the school
- There is no other suitable public transport option available.

2.2.1.2 Funding and delivery of school bus services

The Ministry of Education directly funds and delivers school transport assistance through:

- **Daily Bus** services, which are school bus services operating between schools and designated bus stops within a designated proximity to students' homes
- **Technology Bus** services, which enable Year 7 and 8 students to travel to other schools where technology classes are provided.

The Ministry of Education also delivers transport assistance through:

- **Direct Resourcing**, where bulk funding is provided directly to schools to provide school bus services
- **Māori Medium Schools**, where bulk funding is provided directly to kura, kura kaupapa Māori and designated character wharekura to provide school bus services
- **Specialised School Transport Assistance**, where transport assistance is provided for children with safety and/or mobility needs that prevent them from travelling independently to and from the nearest appropriate schools. This type of travel is outside the scope of this research project.

Transport service providers (bus operators) run these services under a contract with either the Ministry of Education, or with the school directly (for Direct Resourcing and Māori Medium Schools).

In addition to school bus services, a conveyance allowance is available for caregivers to assist with transport costs for eligible students where school bus services are impractical or unavailable.

2.2.1.3 Ineligible students

Transport service providers may carry students who are ineligible for school transport assistance, provided there is a seat available for them and they don't deviate from the defined bus route. Charging a fee for this service is at the discretion of the transport service provider.

2.2.1.4 Roles and responsibilities

The Ministry of Education outlines the roles and responsibilities of the different parties involved in Daily Bus and Technology Bus services and Conveyance Allowances in the *School Transport Roles and Responsibilities Guide* (Ministry of Education, 2021). The responsibilities in this guide are summarised in Table 2.2. Roles and responsibilities for directly resourced schools are similar; however, schools are responsible for service design (within the level of funding provided), contracting, safe siting of bus stops, and auditing and monitoring supplier performance.

At the Ministry of Education, the following roles are responsible for managing Daily Bus and Technology Bus services:

- Regional Transport Advisors design routes for the Daily Bus services, and review school bus routes as required.
- Transport Contract Managers ensure transport service providers comply with their legal and contractual requirements. They conduct audits and coordinate incident management (when required).

Table 2.2 Responsibilities of parties involved in school transport (adapted from Ministry of Education, 2021, p. 6)

Responsibility	Ministry of Education	Transport service provider	Schools	Caregivers
Policy	✓			
Communication with caregivers and students			✓	
Addressing student behaviour			✓	✓
Health and safety	✓	✓	✓	✓
Eligibility assessment and advice	✓		✓	
Route design, validation, and review	✓			
Ensuring students get safely to and from the bus stop or pick-up point				✓
Service delivery and operations		✓		
Safe siting of bus stops		✓	✓ (outside schools only)	
Contracts for service and contract variations	✓	✓		
Auditing and monitoring supplier performance	✓			
Emergency and incident management	✓	✓	✓	

2.2.2 Council services

Dedicated school bus services can be delivered by regional councils to supplement their urban transport network. Regional councils deliver these services under the Public Transport Operating Model, which is the same contract model used to deliver urban public transport services. This responsibility may be delegated to a city or district council; for example, Invercargill City Council has delegated authority from Environment Southland for their urban routes, including a small number of school bus services. Under the Public Transport Operating Model, these services will comply with the *Requirements for Urban Buses in New Zealand* (the ‘RUB’), which is a national standard for usability, accessibility and safety of urban buses (Waka Kotahi, 2021b).

2.2.3 Other services

Other types of school bus transport include:

- daily services operated by private schools, funded by parents through the school

- buses chartered by schools to transport children to cultural and sporting activities; for example, field trips, attending interschool competitions and travelling to swimming lessons
- services operated by Out of School Care and Recreation providers transporting children to and from after-school care, or for school holiday programmes
- urban public transport services that carry children to and from school but are not dedicated school bus services.

These services are considered outside the scope of this research project.

2.3 Key statistics by service type and funding model

This section presents key statistics for each type of bus service funded by the Ministry of Education and by councils. These statistics are:

- *service count* – the total number of daily inbound and outbound services each school day
- *passenger trips per day* – the total number of passengers trips per school day (inbound and outbound), based on either patronage data or the number of eligible students
- *bus kilometres travelled* – the total distance travelled by school buses daily in kilometres, in both directions (inbound and outbound); note that this statistic is based on actual or estimated average route lengths and does not consider any part of a bus route that is completed twice in one journey, known as 'runbacks'
- *equivalent passenger kilometres travelled* – the number of passengers multiplied by the trip length. Where detailed data on patronage and route length are available, this was calculated on a route-by-route basis. If detailed data are not available, this is estimated by multiplying the total average daily patronage by the average route length across the bus network.

The measure '*equivalent passenger kilometres travelled*' allows for a comparison of exposure to risk for different types of school bus services. Note that this measure should not be used to compare between daily school bus routes and technology routes, or to compare school bus travel with travel to school by other modes. On daily school bus routes, children are picked up and dropped off along the routes, whereas Technology Buses typically carry all students from the start of the route (the home school) to the end of the route (the technology centre). Therefore, actual passenger kilometres travelled for daily services will be much lower than the calculated equivalent passenger kilometres travelled. Daily school bus routes run every day, whereas the Technology Bus runs only on days when a technology class is scheduled.

Each statistic was sourced from each organisation directly, extracted from organisational websites or public datasets, or estimated using base rates for similar services. Estimated figures are denoted with an asterisk (*) where relevant. All data sources are listed in Appendix A.

2.3.1 Daily school bus services

Daily school bus services provide transport to children travelling to and from school every school day. These include Ministry of Education funded services (Daily Bus, Direct Resourcing and Māori-Medium Schools) and council-funded services.

2.3.1.1 Ministry of Education funded services

Table 2.3 sets out total number of services, passenger trips, kilometres travelled, and equivalent passenger kilometres travelled for daily services funded by the Ministry of Education. Where data were not available for

Direct Resourcing and Māori Medium Schools services, these were estimated using the same base rates as the Daily Bus, on the assumption that these services operate in a similar manner to Daily Bus services with:

- an average number of 35.3 students per service
- an average trip length (inbound or outbound) of 26.5 km.

Table 2.3 Ministry of Education daily school bus travel statistics

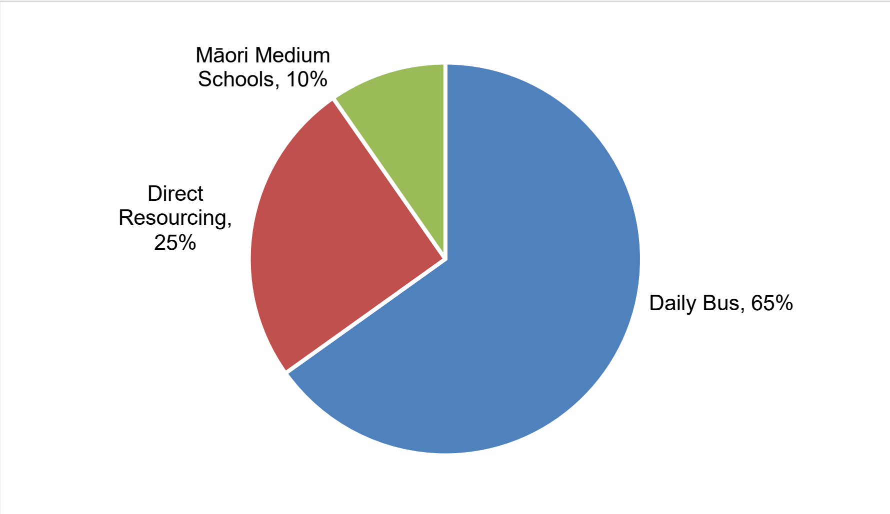
Service or funding model	Services per day (inbound + outbound)	Bus km travelled per day	Passenger trips per day[a]	Equivalent passenger km
Daily Bus	2,890	76,651	102,036	2,761,413
Direct Resourcing	1,118	29,650*	39,480*	1,047,000*
Māori Medium Schools	430*	11,405*	15,214	403,520*
Total	**4,438**	**117,709**	**156,723**	**4,211,933**

[a] This value is based on a single eligible student making two trips each school day: from home to school in the morning, then from school to home in the afternoon.

* Estimated using base rates for similar services.

Figure 2.3 shows the split in services per day across Daily Bus, Direct Resourcing and Māori Medium Schools. This shows that approximately two-thirds of Ministry of Education funded services are delivered as Daily Bus services.

Figure 2.3 Percentage of Ministry of Education funded daily school bus services per day, by service/funding model



2.3.1.2 Services funded by councils

The statistics for council services are shown in Table 2.4 and graphed in Figure 2.4. These figures do not include school-specific services operated by Otago Regional Council (Dunedin), Invercargill City Council, and Horizons Regional Council (Whanganui), as these councils currently operate fewer than six services each.

Where some metrics for some councils were not available or sourced directly, these were estimated using the following average rates based on school bus services delivered in Auckland, Greater Wellington, and Canterbury:

- an average number of 32.5 students per service
- an average trip length (inbound or outbound) of 12.1 km.

Figure 2.4 shows that Auckland Transport operates over half (55%) of all council services for which data were gathered. Together, Auckland Transport and Greater Wellington Regional Council operate approximately 78% of all council-funded services. The statistics for Taranaki, Bay of Plenty and Gisborne should be interpreted with care as these are based on estimated base rates for similar services.

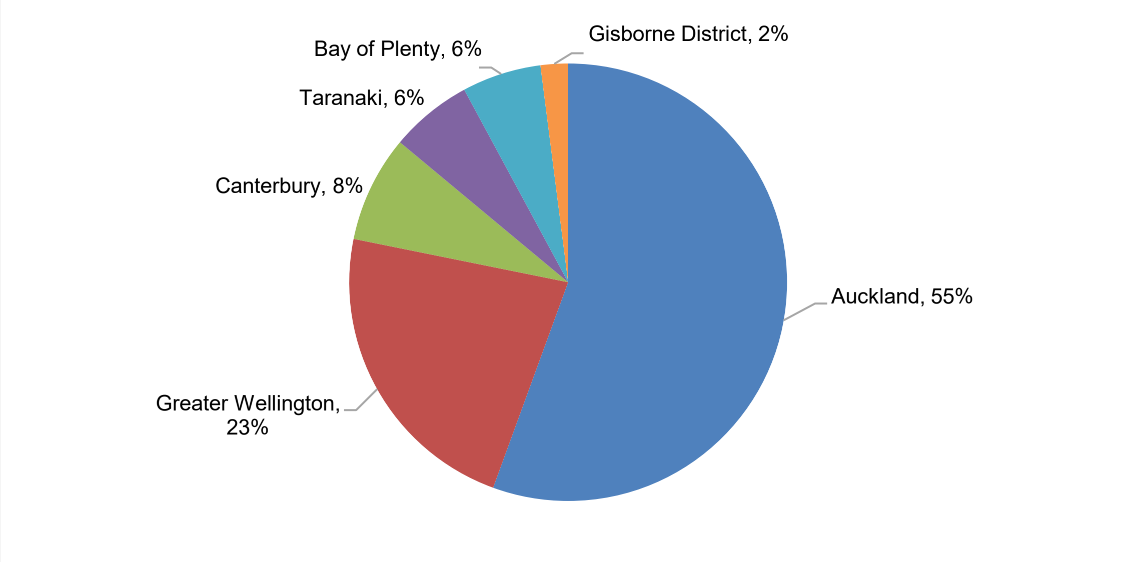
Table 2.4 Regional and local council school bus service statistics

Regional or local authority	Services per day (inbound + outbound)	Total km bus travel per day	Passenger trips per day	Equivalent passenger km
Auckland Transport	494	5,388	15,345	184,140
Greater Wellington Regional Council (Metlink)	201[2]	2,518	7,494	93,675
Environment Canterbury (Metro)	70	847*	2,051	24,817*
Taranaki Regional Council (Citylink)	54	653*	1,757*	21,259*
Bay of Plenty Regional Council (Baybus)	52	629*	1,692*	20,472*
Gisborne District Council (Waka Kura)	18	218*	586*	7,086*
Total	**889**	**10,253**	**28,925**	**351,449**

* Estimated using base rates for similar services.

[2] The odd number of inbound plus outbound services is due to some councils providing a different number of services in the morning, compared to the afternoon.

Figure 2.4 Percentage of council-funded daily school bus services per day, by region/district



2.3.1.3 Comparison of daily school bus services

Figure 2.5 shows the split in services delivered by different organisations/funding models. The Ministry of Education delivers or funds approximately 83% of school bus services in New Zealand through Daily Bus, Direct Resourcing and Māori Medium Schools, with approximately 17% of services delivered by regional or local councils.

Figure 2.5 Percentage of daily school bus services, by service type

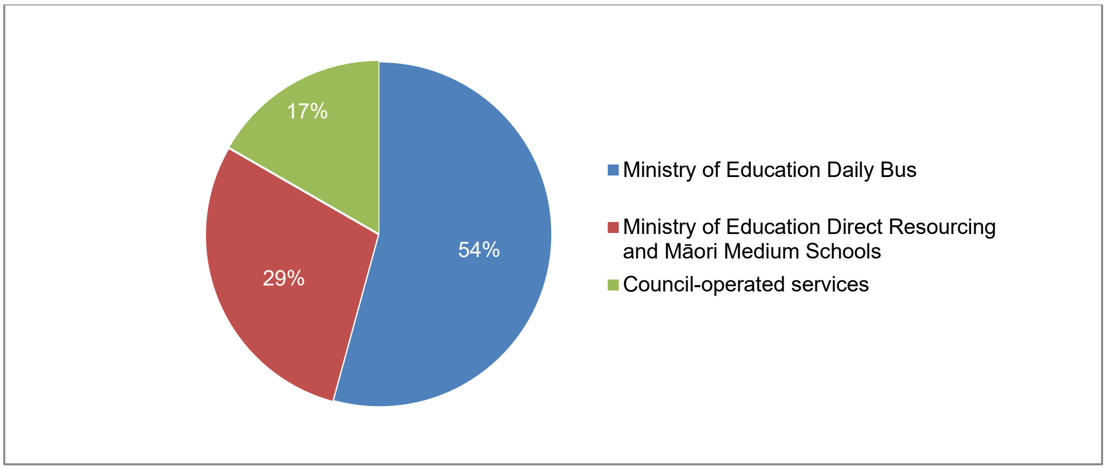
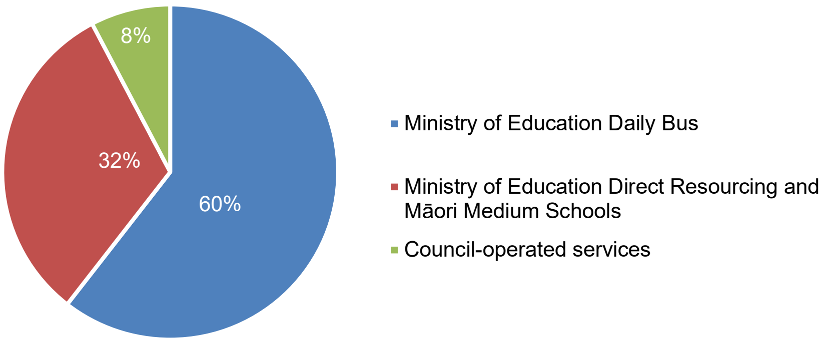


Table 2.5 shows the average patronage and average bus route length for each type of service where data were available. This demonstrates that while patronage across these services is relatively similar, Ministry of Education daily routes are at least twice as long (by distance) as those operated by Auckland Transport and Greater Wellington Regional Council. This results in much higher equivalent passenger kilometres travelled across Ministry of Education services compared to services operated by local and regional councils (Figure 2.6).

Table 2.5 Average patronage and average length of bus route by service type

Service type	Average patronage per service	Average length of bus route (one-way)
Ministry of Education Daily Bus	35.3 students	26.5 km
Auckland Transport school bus services	31.1 students	12.0 km
Greater Wellington Regional Council school bus services	37.3 students	12.5 km

Figure 2.6 Percentage equivalent passenger kilometres travelled, by service type



2.3.2 Technology Bus

The key statistics for Technology Bus services are provided in Table 2.6, showing service count (return trip), total kilometres of bus travel (return trip), number of eligible students and equivalent passenger kilometres. Note that the statistics for Technology Bus services in this table are not directly comparable to daily school bus services for the following reasons:

- They do not run daily, therefore the number of services and equivalent passenger kilometres travelled are spread over a week or a fortnight, rather than being a 'daily' figure.
- Technology buses operate with 'full' patronage for the length of the route because all the passengers are picked up from the source school at the start of the route and dropped off at the technology centre (and vice versa on the return leg). The only exception is for technology services that pick up and drop off students from more than one school along the route.

Table 2.6 Ministry of Education Technology Bus travel: key statistics

Service count (return trip)	Total km bus travel (return trip)	Eligible students	Equivalent passenger km
644	16.940*	30,593	804,650

* Estimated using base rates for similar services.

For these reasons, the equivalent passenger kilometres travelled for Technology Buses is more reflective of actual passenger kilometres travelled compared to the equivalent passenger kilometres travelled calculated for daily school bus services.

2.3.3 Other school bus services

The contribution of other school bus activity towards total school bus passenger kilometres is unknown. This includes school buses operated by private schools, and buses chartered directly by schools for off-site activities. Charter services, for example, may be comparable to technology services as the number of passengers per bus would be relatively high. While further discussion of these services is outside the scope of this research, some consideration should be given to them when introducing interventions to improve bus passenger safety.

3 Prior research and recommendations regarding school bus safety in New Zealand

This chapter summarises previous research, statistics, and recommendations regarding school bus travel in New Zealand, including the relative risk of bus travel to other modes of travel to school.

3.1 Risk of travel by different modes, including school bus

There have been few studies into the risk of travel by school bus in New Zealand. Only three prior studies were found that investigated this area. Two of these are now relatively old, relying on data prior to 2007. The findings from all three of these studies, including limitations, are discussed below.

3.1.1 Risk associated with different modes of travel (2010–2014)

In 2015 The Ministry of Transport Te Manatū Waka released a series of factsheets titled *Risk on the Road*, which quantified the road safety risks associated with different modes of travel: driving a light four-wheeled vehicle, being a passenger in a light four-wheeled vehicle, motorcycling, cycling, walking, and travelling by bus (Te Manatū Waka, 2015). These factsheets used data from the New Zealand Household Travel Survey from July 2010 to June 2014 to estimate hours spent travelling by different mode, and data from CAS to quantify deaths and injuries by mode.

The outcomes of the analysis found that travelling as a bus passenger is the safest mode overall, with 0.7 deaths and injuries per million hours spent travelling as a bus passenger (Figure 3.1), and 3.0 deaths and injuries to bus passengers for every 100 million km travelled (Figure 3.2).

Figure 3.1 Deaths and injuries in motor vehicle crashes per million hours spent travelling (reprinted from Te Manatū Waka, 2015, p. 6)

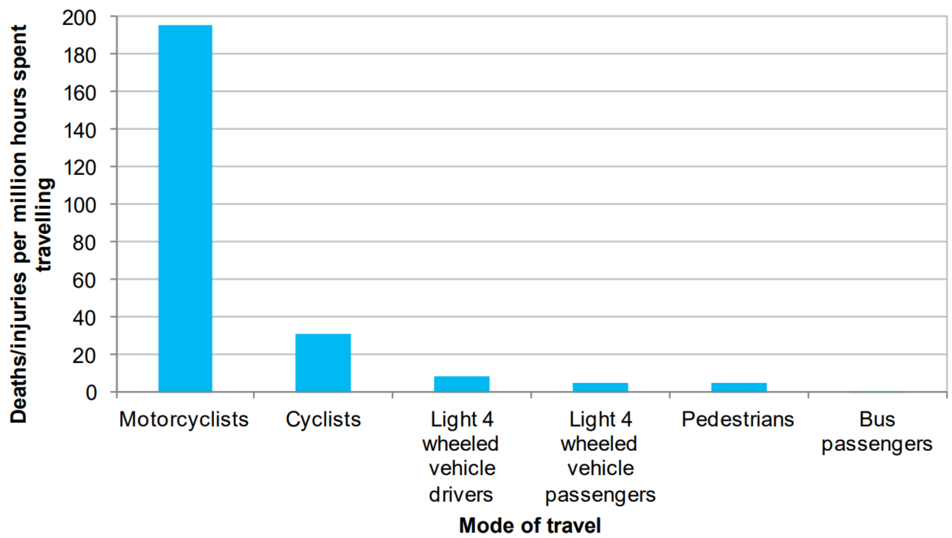
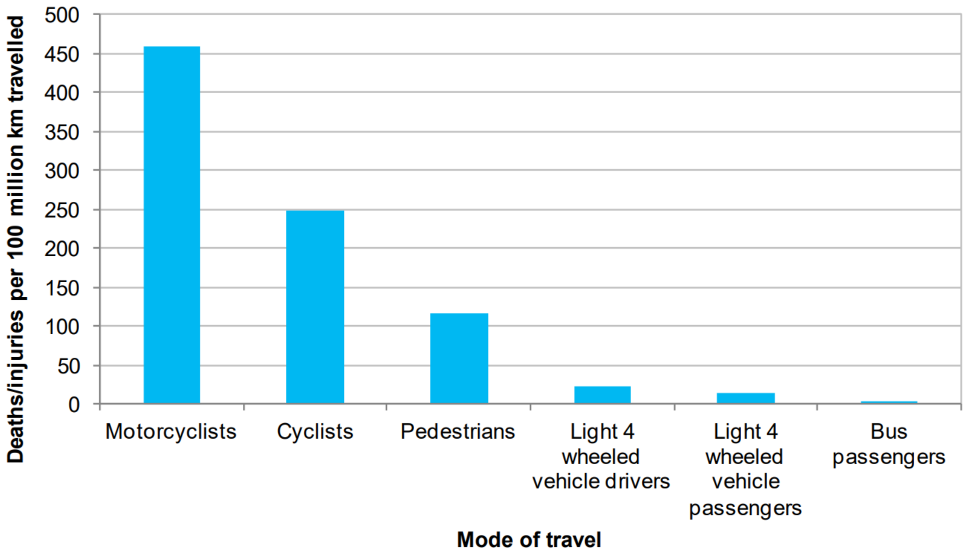


Figure 3.2 Deaths and injuries in motor vehicle crashes per 100 million km travelled per year (reprinted from Te Manatū Waka, 2015, p. 7)



Note that this study did not distinguish between the reason for travel – for example, travel to work versus travel to education – nor did it investigate relative risk by age group. Additionally, the mode for 'bus passengers' includes travel on all types of buses, including scheduled urban services, coach travel, inter-regional bus, and school bus services. Despite these limitations, this study provides a high-level baseline of the relative risk of different modes of travel in New Zealand.

3.1.2 CAS analysis of school bus deaths and injuries (1987–2007)

A research report into school bus safety in New Zealand was published by the NZ Transport Agency in 2010 (research report 408 – Baas et al., 2010). The research project was initiated by the Bus Safety Technical Advisory Committee with the Ministry of Education as the lead organisation. The research focused on two areas of school bus safety:

- the safety of children crossing the road to or from a school bus
- the safety of children while travelling on a school bus.

For each area of school bus safety, Baas et al. (2010) used CAS data to identify the number and rate of deaths, serious injuries and minor injuries to children for the 21-year period from 1987 to 2007 (Table 3.1).

Table 3.1 Deaths, serious injuries and minor injuries to children using school buses in New Zealand, 1987–2007 (data from Baas et al., 2010)

Area of school bus safety	Injuries reported in CAS 1987–2007			Deaths and serious injuries per year
	Fatal	Serious	Minor	
Children crossing the road to or from a school bus	22	45	91	3.2
Children while travelling on a school bus	6	35	112	2.0

This analysis shows that children are more likely to be killed or seriously injured when crossing the road to or from a school bus compared to when travelling on a school bus. However, a limitation of this study is it relied solely on crash data and does not consider injuries that resulted from non-collision events – for example, harsh braking events, or slips and falls when embarking or disembarking the bus.

3.1.3 ACC travel-to-school injury analysis (2003–2005)

Schofield et al. (2008) combined injury data collected by the Accident Compensation Commission (ACC) for the period 1 July 2003 to 30 June 2005 with travel data from a Census at School survey to determine the absolute and relative risks of school-related travel in New Zealand. The injury data collected by ACC include any injury where a claim was made to ACC. These data do not distinguish between the severity of injury, which could range from a single visit to a doctor to injuries that require extended hospitalisation and ongoing treatment.

The findings from the analysis showed that private motor vehicle was the most dominant form of travel. It was found that cycling was the riskiest activity, followed by walking and motor vehicle travel, and lastly, bus and train travel in terms of trips and exposure risks (Schofield et al., 2008). When comparing the cost of the injuries, the most severe (and costly) injuries were due to motor vehicle travel, followed by walking, cycling and bus travel.

Bus injuries had a prevalence of 2.6 injuries per million trips, and 4.0 injuries per million hours, noting that this includes all types of bus travel to school (including urban buses not specifically designated as ‘school buses’). The estimate of 4.0 injuries per million hours is much higher than the 0.7 deaths and injuries per million hours of travel by all bus passengers estimated by Te Manatū Waka (2015). Although the two studies are not directly comparable due to differences in the date periods covered, this suggests that many injuries on buses are under-reported or not reported in CAS (eg, injuries resulting from non-collision events such as heavy braking).

Detailed analysis of injuries while travelling to and from school by bus was reported in an unpublished presentation by Gianotti and Drader (2007) using the same data as the Schofield et al. (2008) study. The authors reviewed each injury and classified them by when and how the injury occurred. Of the 521 bus-related travel injuries reported over two years, it was found that:

- 18% of injuries occurred during pre-bus travel
- 76% of injuries occurred ‘on bus’
- 6% of injuries occurred during post-bus travel.

While the raw data are not provided in this presentation, inferences from the graphs provided suggest that approximately:

- 26% of injuries were attributed to ‘stopping/braking’
- 20% of injuries resulted from the bus colliding with another vehicle or external object
- 19% of injuries occurred during entry or exit to the bus, with most of these (76%) occurring while passengers were getting off the bus
- 14% of injuries resulted from an interaction with the interior of the bus (ie handrail/pole, seat, sharp edge)
- 13% of injuries were attributed to assault
- 6% of injuries occurred ‘post-bus’, where a pedestrian was struck by the bus or other vehicle.

It is noted that the data used in this study are relatively old, and care must be taken in considering whether these findings represent current travel and injury risk. However, this research takes a broader view of injury and risk beyond crashes, highlighting the range of injuries that can occur during school bus travel, including assault, during stopping/braking and while getting on and off the bus.

3.2 Improving school bus safety – recommendations and trials

There were several reports issued and recommendations made for improving school bus safety since 2010. These are summarised below.

3.2.1 NZ Transport Agency research report 408

A range of options to reduce deaths and injuries were reviewed in research report 408, with the authors recommending a package of measures to improve the safety of children using school buses (Baas et al., 2010).

The authors recommended the following measures to improve the safety of children who have to cross the road to and from school buses:

- Minimise the need for students to cross the road:
  - Encourage caregivers to meet their children at the bus stop.
  - Rearrange bus routes to reduce the number of children who have to cross the road.
  - Improve bus stops.
- Prevent children from running heedlessly across the road:
  - School community-based initiatives.
  - Road safety education in schools.
- Minimise the consequences by slowing down the traffic when children are crossing:
  - Amend the Land Transport Road User Rule to enable effective enforcement, including reviewing the speed limit when passing a stationary school bus and applying the speed limit whenever approved school bus active warning lights are activated.
  - Install active speed signs on school buses that display the speed limit when activated.
  - Review driver awareness campaigns.

Baas et al. (2010) also recommended the following measures to reduce the risk of injury to children while travelling on school buses:

- school bus management standards
- occupant protection.

Specific commentary and recommendations from this research are described throughout this report.

3.2.2 Seatbelts on school buses

Seatbelts on school buses were also investigated in the Baas et al. (2010) report. This included a literature review, international comparison, and cost–benefit analysis. A more detailed review of the costs of implementing seatbelts and seating requirements (ie, no students standing) was undertaken by Deloitte in 2019 for the Ministry of Education. The implications of these findings are discussed in section 6.6.4 of this report.

A petition to have school buses fitted with seatbelts was presented to Parliament in May 2021 with a request to require seatbelts in all school buses within five years (House of Representatives, 2022). The petition raised concerns regarding the fact that young children are required to be in a five-point harness or a seatbelt while in a vehicle travelling to a school bus stop, but the school bus has no similar requirements. This petitioner highlighted additional concerns due to high speeds on rural roads, as well as hazards such as black ice, snow, and winding terrain.

The Petitions Committee sought commentary from the Ministry of Education, NZTA and The Ministry of Transport Te Manatū Waka when responding to the petitioner. The Committee accepted assurances from these organisations that bus travel is generally very safe but noted there is a lack of information on the dangers of school buses travelling on rural roads, compared to urban roads. The Committee also noted the complexity, cost and regulatory consequences of requiring seatbelts on school buses, yet urged the Government to investigate the potential safety benefits of seatbelts on rural school buses and to find cost-effective mechanisms to address this issue.

3.2.3 School bus sign trials and evaluation

Trials of school bus signs lit with light-emitting diodes (known as LED signs) were undertaken in 2010 (Baas et al., 2010; Transport Engineering Research New Zealand, 2011), in 2013–14 (Mackie Research, n.d.) and again in 2016 (as described in New Zealand Coroners Court, 2022). The outcomes from these trials are discussed in more detail in section 6.4.3 of this report.

3.2.4 Recommendations of the New Zealand Coroner Court

There were five school bus deaths investigated by the New Zealand Coroners Court since 2007 which resulted in recommendations to improve school bus safety. The related Coroners' reports, with recommendations can be retrieved from the website of Coronial Services of New Zealand[3]. All the cases involved children who were killed after being struck by a vehicle when crossing the road after exiting a school bus. Each successive report makes similar recommendations, primarily around making school buses more identifiable to other road users, the rules around stopping or slowing around school buses, and education programmes.

The most recent inquiry (New Zealand Coroners Court, 2022) was highly critical of current practice. The Coroner summarised prior recommendations and included extensive commentary on the use of flashing lights on school buses, full stop laws/pneumatic barrier arms, education campaigns and the adequacy of the 20 km/h speed limit that applies while passing a stationary school bus. Specific references are made to the 2022 Coroner Court's recommendations, where relevant, throughout this report.

[3] By searching the term "school bus" on Findings of public interest | Coronial Services of New Zealand (justice.govt.nz). Note, this search may also return some records that are not related to this research project.

4 Crash and incident analysis 2010–2021

A review of injury crashes and reported injury incidents between 2010 and 2021 (inclusive) was undertaken to better quantify the safety of school buses, based on historical data. The extent of this analysis was confirmed with the project steering group, with the scope limited by the data that are currently available. The analysis was supplemented by a retrospective analysis of data from the years 2008 and 2009, not covered by Baas et al. (2010) nor initially included in this research (see section 4.2.7).

The crash and incident analysis involved three parts:

1. a query of CAS to determine the number of injury crashes involving ‘school buses’, including the severity of crash and injury outcomes for different road users
2. a detailed review of injury crashes in CAS and incidents reported to the Ministry of Education that occurred at or near PUDO locations, including injuries to children travelling to and from these locations
3. a detailed review of injuries to bus drivers and passengers caused by ‘on bus’ crashes and incidents reported to the Ministry of Education.

4.1 Crashes involving school buses

The number and severity of crashes and injuries involving collisions with school buses was queried in CAS using the following parameters:

- years: 2010–2021 (inclusive)
- vehicle usage: school bus
- injury severity: fatal, serious, or minor.

The high-level results of this analysis are presented in Tables 4.1 to 4.3.

Table 4.1 Injury crashes involving a school bus, by severity (2010–2021)

Crash severity	Number of crashes
Fatal crashes	10
Serious crashes	22
Minor crashes	92
Total	**124**

Table 4.2 Road users injured in crashes involving a school bus, by severity (2010–2021)

Road user type	Fatal injuries	Serious injuries	Minor injuries
Bus driver	2	4	26
Bus passenger	0	13	79
Other vehicle – driver	7	11	49
Other vehicle – passenger	0	10	9
Pedestrian	1	6	20
Cyclist	0	2	3

Road user type	Fatal injuries	Serious injuries	Minor injuries
Total	**10**	**46**	**186**

Table 4.3 Deaths and serious injuries (DSIs) for crashes involving school buses, by road user type (2010–2021)

Road user type	DSIs only	All injuries
Bus occupants	19 (34%)	124 (51%)
Other vehicle occupants	28 (50%)	86 (36%)
Pedestrians/cyclists	9 (16%)	32 (13%)
Total	**56**	**242**

The analysis showed there were 32 fatal or serious injury crashes involving school buses recorded in CAS between 2010 and 2021, which resulted in 10 fatalities and 46 serious injuries. The driver(s) in the other vehicle(s) were most likely to be fatally or seriously injured (18 DSIs), although bus passengers received the highest number of injuries overall. These findings are unsurprising given school buses carry more passengers than other types of vehicles, resulting in more injuries, but the mass difference between buses and other vehicles results in the drivers and passengers in those other vehicles being most seriously injured.

4.1.1 Limitations

The results presented above must be interpreted with caution due to the following limitations of the crash data in CAS:

- ‘School buses’ are sometimes coded only as ‘buses’, despite the description and crash diagram clearly identifying the bus as a ‘school bus’. This means some crashes involving school buses are not reported as ‘school bus’ crashes.
- Where a child was struck by a vehicle after disembarking the school bus and the bus had already moved off, the bus is not captured as a party involved in the crash.
- Minor injuries to bus passengers are under-reported (see section 4.2.3 for more detail).
- The query includes crashes where a non-operational school bus (ie, a bus parked up overnight) was struck when another driver lost control and crashed into it.
- In some crashes, the vehicle was incorrectly coded as a school bus (see section 4.2.2 for more detail).

Additionally, non-collision events that result in injuries to bus passengers (eg, heavy braking) are not captured in the crash data.

4.2 Detailed crash and incident analysis

More detailed analysis of the crash data was coupled with incident data provided by the Ministry of Education to get a more accurate estimate of injuries related to school bus travel, focusing on the following areas:

1. injuries due to assault
2. crashes and incidents that occurred immediately before, after or during the pick-up or drop-off of students
3. crashes and incidents resulting in injuries to bus drivers and bus passengers while travelling ‘on the bus’.

These analyses involved a wider range of CAS queries, a review of individual crash descriptions, and a review of incidents reported to the Ministry of Education. Where possible, crash reports were enriched with details from Ministry of Education incident reports for the same event, to improve the reporting of the number of passengers involved and the number and severity of injuries.

Note that the crash reports in CAS do not distinguish between the type of school bus service involved, and therefore also include crashes involving school buses that were chartered or operated directly by schools. The Ministry of Education incident reports only report on incidents involving Ministry of Education funded or contracted services, although some incidents involving chartered school buses were also reported by transport service providers in this dataset.

4.2.1 Injuries due to assault or dangerous passenger behaviour

In the Ministry of Education dataset, 26 incidents were identified where injury occurred due to assault or student behaviour, resulting in at least five potentially serious injuries and at least 22 minor injuries. Examples included a student assaulting another student, a student assaulting a bus driver, and dangerous behaviours such as jumping from a moving bus. These injuries are not included in the sections that follow.

4.2.2 Injuries to students and other road users during pick-up and drop-off

This analysis involved reviewing Ministry of Education incident reports and undertaking several queries in the CAS to identify events where a child or other road user was injured during school bus pick-up or drop-off (PUDO) activities. More detail on these queries is provided in Appendix B.

The review of crash and incident reports uncovered 96 PUDO-related injury events between 2010 and 2021, consisting of 80 crashes and 16 non-collision events.

Each injury event was reviewed to determine the number and severity of injuries, and to identify commonalities (Table 4.4). In all, there were 104 injuries reported, including 36 DSIs. This translates to the following injury rates for PUDO-related activities:

- 8.7 injuries per year
- 3.0 DSIs per year.

Table 4.4 Reported PUDO-related injuries, by movement or activity type (2010–2021)

Incident type	Movement or activity	Injuries to pedestrians			Injuries to other road users			Total DSIs
		Fatal	Serious	Minor	Fatal	Serious	Minor	
Collision	Pedestrian(s) struck by vehicle when crossing the road after disembarking	2	22	35	–	–	2	**24**
	Pedestrian(s) struck by vehicle when crossing the road towards the PUDO location or bus	–	3	2	–	–	–	**3**
	Pedestrian(s) struck by vehicle while travelling along the road towards a PUDO location or bus	–	1	3	–	–	–	**1**
	Pedestrian(s) or vehicle struck by bus manoeuvring at PUDO location	–	1	6	–	–	1	**1**

Incident type	Movement or activity	Injuries to pedestrians			Injuries to other road users			Total DSIs
	Pedestrian(s) struck by other vehicle at PUDO location (not crossing road)	–	1	4	–	–	–	**1**
	Vehicle struck bus while bus was stationary at PUDO	–	–	–	1	–	3	**–**
	Vehicle struck another vehicle while passing stationary bus at PUDO	–	–	–	1	1	–	**–**
Non-collision	Slip, trip or fall while entering/exiting the bus	–	3	4	–	–	–	**3**
	Caught in door while entering/existing the bus	–	–	8	–	–	–	**–**
	Total	**2**	**31**	**62**	**2**	**1**	**6**	**36**

Most PUDO-related injuries were suffered by pedestrians who were struck by another vehicle while crossing the road to or from the bus: 64 injuries, including 27 DSIs). This represents 75% of all DSIs for PUDO-related activities.

Additionally:

- A bus driver was killed when a vehicle struck a stationary bus that had stopped to pick up children.
- Another fatality and a serious injury occurred when two vehicles collided head-on while passing a stationary school bus.
- Three serious injuries involving slipping, tripping or falling while entering/exiting were reported by the Ministry of Education. All three injuries occurred while a passenger was exiting the bus.

4.2.2.1 Injuries to children crossing the road around PUDO locations

Commonalities among crashes involving pedestrians crossing the road around PUDO locations were further analysed (Tables 4.5 to 4.9). Note that not all attributes were documented for each injury, hence the total number of injuries in some tables is fewer than the 64 injuries shown in Table 4.4.

The key findings were as follows.

- Most injuries (83%) occurred in the afternoon drop-off period, between 2.30 pm and 5 pm.
- Most injuries (55%) occurred on urban roads with a posted speed limit of 70 km/or below; however, most DSIs occurred on rural roads with higher speed limits (56% of DSIs).
- Most injuries (69%) occurred when the pedestrian was described by witnesses as ‘running across’ the road, as opposed to ‘walking across’ or ‘stepping out’.
- There were a similar number of injuries that resulted due to the pedestrian crossing in front of the bus (40%), compared to the back of the bus (44%).
- Males (60%) were more likely to be injured than females (40%).
- The age group most likely to be injured was 10–14 years (54%). This is similar to the proportion of children aged 10-14 years who reported using a school bus to travel to education in the 2018 Census (49.8%, as shown in Figure 2.2).

- Higher vehicle speeds at the time of the collision increased the severity outcome for the pedestrian(s). Where the suspected speed at the time of the crash was 20–39 km/h, 28% of injuries were DSIs. This increased to 77% for crashes where the suspected speed was more than 60 km/h.
- Of the 55 injury crashes where both the state of the bus (i.e. stationary or moving off) and the suspected speed of the other vehicle were reported in CAS:
  - 69% of vehicles that struck the pedestrian while the school bus was stationary were suspected of travelling faster than 20 km/h
  - 90% of vehicles that struck the pedestrian while the bus was moving away or not present at the time of the crash were travelling faster than 20 km/h.

Table 4.5 Reported PUDO-related injuries to pedestrians crossing the road, by time of day (where documented) (2010–2021)

Time of day	Injury count
AM (0700–0900)	9 (15%)
PM (1430–1700)	53 (84%)
Total	**62**

Table 4.6 Reported PUDO-related injuries, by description of pedestrian movement when crossing road (where documented) (2010–2021)

Police/witness description	Injury count
Running across/ran out	38 (69%)
Walking across/stepped out	17 (31%)
Total	**55**

Table 4.7 Reported PUDO-related injuries to pedestrians crossing the road after disembarking, by crossing location relative to the school bus (where documented) (2010–2021)

Crossing location relative to school bus when disembarking	Injury count
Front of bus	23 (40%)
Rear of bus	25 (44%)
Other/unknown	9 (16%)
Total	**57**

Table 4.8 Reported PUDO-related injuries to pedestrians crossing the road, by age (where documented) (2010–2021)

Age band	Injury count
5–9 years	14 (25%)
10–14 years	31 (54%)
> 15 years	12 (21%)
Total	**57**

Table 4.9 Reported PUDO-related injuries to pedestrians crossing the road (by gender) (2010–2021)

Gender	Injury count
Female	23 (40%)
Male	35 (60%)
Total	**58**

Table 4.10 Reported PUDO-related injuries to pedestrians crossing the road, by severity and speed environment (where documented) (2010–2021)

Speed and traffic environment	Fatal injuries	Serious injuries	Minor injuries	Total injuries	Total DSIs
Urban (< 80 km/h speed limit)	1	11	20	32 (55%)	12 (44%)
Rural (≥ 80 km/h speed limit)	1	14	11	26 (45%)	15 (56%)
Total	**2**	**25**	**31**	**58**	**27**

Table 4.11 Reported PUDO-related crashes involving pedestrians crossing the road: injury outcome, by suspected speed at time of crash

Suspected speed at time of crash (other vehicle)	Fatal or serious injuries only	All injuries (fatal, serious, minor)	DSIs as a proportion of all injuries
0–19 km/h	0	3	0.00
20–39 km/h	5	18	0.28
40–59 km/h	11	19	0.58
60+ km/h	10	13	0.77
Unknown or not recorded	1	11	*n/a*
Total	**27**	**64**	**0.42**

Table 4.12 Reported PUDO-related crashes involving pedestrians crossing the road: injury crashes, by bus state and suspected speed of the other vehicle (where recorded in CAS)

School bus state at time of crash	Suspected speed of the other vehicle at time of crash		Percentage of injury crashes where suspected speed at time of crash was > 20 km/h
	≤ 20 km/h	> 20 km/h	
Stationary – including ‘stopped’, ‘parked’ or ‘stationary’	11	24	69%
Not stationary – including ‘approaching’, ‘moving off’, or ‘the bus had left’’	2	18	90%
Total (combined)	**13**	**42**	**76%**

4.2.3 Injuries to drivers and passengers ‘on bus’

This analysis involved reviewing Ministry of Education incident reports and undertaking several queries in the CAS to identify incidents where a bus driver or bus passengers were injured while the bus was travelling along the road. A description of the analysis methodology is provided in Appendix B.

The analysis found there were 296 injuries reported over the 12-year period (Table 4.13). This included 10 fatal or serious injury crashes, resulting in 21 DSIs (Table 4.14). This translates to the following injury and crash rates for school bus drivers and passengers travelling 'on bus':

- 24.7 injuries per year
- 1.8 DSIs per year
- 0.8 fatal or serious injury crashes per year.

A breakdown of crashes by event type is provided in Table 4.13. Most reported injuries are the result of a collision (62%), with non-collision events accounting for 38% of injuries. However, none of the non-collision events reported by the Ministry of Education apparently resulted in fatal or serious injuries to drivers or passengers (based on the description of the injury provided in the incident report).

Table 4.13 Reported incidents and crashes where a bus driver or passenger was injured while 'on bus', by classification, injury count and severity (2010–2021)

Incident type	Classification	Incident Count	Injuries to bus drivers			Injuries to bus passengers			Total DSIs
			Fatal	Serious	Minor	Fatal	Serious	Minor	
Collision	Multi-vehicle, intersection	24	–	–	12	–	3	51	**3**
	Multi-vehicle, mid-block	19	–	1	11	–	12	66	**13**
	Single vehicle, run-off road	27	1	3	12	–	1	66	**5**
Non-collision	Heavy braking/other harsh movement	37	–	–	–	–	–	51	**0**
	Other (falls, interior etc)	6	–	–	–	–	–	6	**0**
Total		**113**	**1**	**4**	**35**	**0**	**16**	**240**	**21**

4.2.3.1 Fatal and serious 'on bus' crashes – detailed review

Table 4.14 provides more detail on reported crashes where a driver or passenger(s) was killed or seriously injured, between 2010 and 2021. Of these, the worst crash involved 40 students who were injured, including 11 who were seriously injured. This crash alone accounted for 52% (over half) of the total 'on bus' DSIs for bus drivers and passengers between 2010 and 2021, demonstrating that a single, high-severity crash can have a significant impact on DSI counts for any period under review. For this reason, most of the tables that follow focus on *crash severity* (the most severe injury outcome from the crash), rather than comparing injury counts between different crash types and commonalities.

Table 4.14 Details of 'on bus' crashes resulting in fatal or serious injuries to the bus driver and/or passengers (2010–2021)

Crash type and movement	Time of day (AM/PM)	Number of passengers	Restraint use	Injuries to bus occupants
Single vehicle - bus ran off road to the right	PM	Not recorded	Driver: none available	Driver: serious injury
Single vehicle - bus ran off road to the left	PM	None	Driver: restrained	Driver: serious injury
Multi vehicle - bus hit by vehicle that failed to give way at an intersection.	PM	37	Driver: none available Passengers: uncertain	Passengers: • 2 serious injuries • 10 minor injuries
Multi vehicle - bus rear-ended by another vehicle	PM	48	Driver: uncertain Passengers: uncertain	Driver: minor injury Passengers: • 11 serious injuries • 29 minor injuries
Multi vehicle - bus hit other vehicle while existing the school driveway	PM	Unknown	Unknown	Driver: minor injuries Passengers: • 1 serious injury • 10 minor injuries
Single vehicle - bus ran off road to the left	PM	39	Driver: restrained Passengers: no details provided	Driver: minor injury Passengers: • 1 serious injury • 12 minor injuries
Multi vehicle - bus hit head-on by another vehicle	PM	25	Driver: restrained Passengers: uncertain	Passengers: • 1 serious injury • 3 minor injuries
Single vehicle - bus ran off road to the left	PM	None	Driver: uncertain	The driver died.
Multi vehicle - bus rear-ended by another vehicle	AM	3	Driver: restrained Passengers: none available	Driver: seriously injured Passengers: • 1 minor injury
Single vehicle - bus ran off road to the left	PM	None	Driver: uncertain	Driver: seriously injured

4.2.3.2 Commonalities among crashes

Common factors among the crashes were examined in detail (Tables 4.15 to 4.18). Key findings were as follows.

- Slightly more collisions occurred in the afternoon (n = 32) compared to the morning (n = 28). However, there were twice as many harsh braking/harsh movement events recorded in the afternoon (n = 22) compared to the morning (n = 11). Children may be more likely to be injured during the afternoon because they are more likely to be moving about the bus or seated incorrectly when the harsh braking occurs. This is supported by evidence that children are rowdier on afternoon rides (see section 6.8.2).
- Fourteen percent of incidents occurred outside of typical school PUDO hours. It is likely these incidents occurred on Technology Buses, or on school buses chartered for other purposes.

- Most (64%) 'on bus' injury crashes occurred on rural roads with posted speed limits 80 km/h or higher.
- In 20% of injury crashes there were no passengers on the bus at the time of the crash, with only the driver being injured. Most of these crashes are single vehicle crashes (71%).
- There were five crashes where a bus overturned, resulting in one death and one serious injury. In most of these crashes there were no or few passengers on board at the time.
- In crashes where both the damage severity and number of passengers are recorded (*n* = 56), the damage to the bus was reported as 'minor or moderate' (*n* = 31). However, most injuries to bus occupants were reported in crashes that resulted in 'overturn' or 'extensive' damage (68% of all injuries). There were no DSIs recorded in crashes where the bus received 'minor or moderate' damage.

Table 4.15 Reported incidents where a bus driver or passenger was injured while 'on bus', by time of day (2010–2021)

Incident type	Classification	AM (0630–0900)	PM (1430–1700)	Other/unknown
Collision	Multi-vehicle, intersection	11	11	2
	Multi-vehicle, mid-block	5	11	3
	Single vehicle, run-off road	12	10	5
Non-collision	Heavy braking/other harsh movement	11	22	4
	Other (falls, interior etc)	4	–	2
	Total	**43**	**54**	**16**

Table 4.16 Reported crashes where a bus driver or passenger was injured while 'on bus', by speed environment and crash severity (2010–2021)

Speed and traffic environment	Fatal	Serious	Minor	Total
Urban (< 80 km/h speed limit)	–	2	23	25 (36%)
Rural (≥ 80 km/h speed limit)	1	7	37	45 (64%)

Table 4.17 Reported crashes where a bus driver or passenger was injured while 'on bus', by crash type and loading (2010–2021)

Crash type	With passengers on board		No passengers on board	
	Number of crashes	% of crashes	Number of crashes	% of crashes
Multi-vehicle, intersection	21	38%	3	21%
Multi-vehicle, mid-block	18	32%	1	7%
Single vehicle, run-off road	17	30%	10	71%
Total	**56**	**100%**	**14**	**100%**

Table 4.18 Reported crashes where a bus occupant was injured while 'on bus', by severity of damage to the bus and total occupant count, where recorded (2010–2021)

Damage severity	Crash count	Total bus occupant count	Injuries by severity			% of occupants injured
			Fatal	Serious	Minor	
Overturn	5	13	1	1	5	54%
Extensive	20	335	0	13	113	39%
Minor or moderate	31	546	0	0	64	12%
Total	**56**	**838**	**1**	**19**	**182**	**23%**

Note: Only includes collisions where the number of passengers and severity of damage were both recorded in CAS (*n* = 56).

Cause factors

Each crash was reviewed for commonalities regarding weather and road conditions, driver factors (fatigue, illness and impairment), or vehicle factors. Of the 70 injury crashes reported:

- Adverse weather or road conditions, such as ice, high winds, or a slippery road, were cause factors in nine crashes.
- The bus driver suffering a sudden illness or medical illness (not sudden) was a cause factor in six crashes.
- Fatigue due to lack of sleep was a cause factor in two crashes. In both crashes the driver was the only occupant of the bus, with one driver killed and the other seriously injured.
- A vehicle fault or maintenance issue was identified as a cause factor in three crashes.
- There were no reports of bus drivers being impaired by alcohol or drugs.

Restraint use

Table 4.19 shows restraint use among bus drivers, as recorded in CAS. Restraint use among passengers was recorded only for passengers who were injured, and in all but seven crashes this was either not completed or recorded as 'uncertain'.

Table 4.19 Reported crashes where a bus driver or passenger was injured while 'on bus', injuries to bus drivers by severity and restraint use (2010–2021)

Restraint use	Fatal injury	Serious injury	Minor injury	No injury
Yes (available and worn)	–	2	14	7
No (available and not worn)	–	–	5	3
None available	–	1	6	4
Uncertain/not reported	1	1	8	17

Restraint use is poorly captured for injured passengers, and not recorded for uninjured passengers. Therefore it is impossible to draw conclusions from these data on how restraint use may affect crash outcomes.

4.2.4 Summary of incidents and injuries 2010–2021

Table 4.20 shows the total number of injury events and injuries by severity across all the stages of bus travel analysed. This shows 'on bus' travel having the highest rate of injury at 24.7 injuries/year; however, PUDO-related activities have the highest DSI rate (3.0 DSIs/year).

Table 4.20 School bus travel: reported injury counts and rates, by severity

Activity	Road user	All injury incidents		DSI incidents only		All injuries		DSIs only	
		Total	Per year	Total	Per year	Total	Per year	Total	Per year
PUDO-related	All road users	96	8.0	35	2.9	104	8.7	36	3.0
'On bus' travel	Bus occupants	113	9.4	10	0.8	296	24.7	21	1.8
Assault/student behaviour	Bus occupants	26	2.2	5	0.4	27	2.3	5	0.4
	Total	**235**	**19.6**	**50**	**4.2**	**427**	**35.6**	**62**	**5.2**

4.2.4.1 Interpretation

'On bus' crashes resulting in several fatal or serious injuries are relatively rare, with only one major incident in the 12-year period from 2010 to 2021. Whilst rare, if there had been another similar crash in the past 12 years, this would have considerably increased the DSI rate for 'on bus' travel. For example, several fatalities could have occurred had one of these previous crashes resulted in a rollover event with a large number of unrestrained passengers on board. For this reason, caution should be used in applying the DSI rate to predict the likelihood of future deaths and serious injuries to bus drivers and passengers for this type of crash.

In their review of bus crashes in New South Wales in 2012, the New South Wales School Bus Safety Community Advisory Committee also noted that statistics comparing the safety performance of different types of transport require careful interpretation (Transport for New South Wales, 2022b). Two reasons were given for this. Firstly, while the number of crashes resulting in fatalities for bus occupants had been very few, one multiple fatality crash has the potential to significantly vary the statistical results. Secondly, such a conclusion can lead to a complacent view that there is no room for improvement to safety in this mode.

4.2.5 Gaps in injury and incident reporting

Several limitations in how 'school bus' crashes are recorded in CAS were previously described in section 4.1.1 above. Additionally, the following gaps in the crash record were discovered when comparing the Ministry of Education incident reports to the crash reports in CAS:

- There were eight incidents involving a child who was struck and injured by a passing vehicle that were not recorded in CAS.
- There were many near-miss incidents involving children crossing the road reported by the Ministry of Education that are not captured in CAS because a collision did not occur.
- After reviewing the Ministry of Education incident reports, a further 23 injury crashes were matched and extracted from CAS. In these instances, the bus involved was either not identified as a 'school bus' in the

crash report, or the crash was classified as ‘non-injury’ despite injuries to passengers being documented in the Ministry of Education incident report.

- Some CAS reports incorrectly recorded ‘nil’ passengers on the bus, despite the matching Ministry of Education report stating several students were on board at the time.
- Nine collision events involving a school bus were reported by the Ministry of Education but could not be matched to a CAS record. Most were non-injury or minor injury crashes, although one crash resulted in 12 injuries to the driver and passengers, including at least one potentially serious injury.
- ‘Journey Purpose’ was recently added to crash reports in CAS, and this was investigated as another method for identifying crashes involving school bus travel. However, ‘Journey Purpose’ is only recorded for drivers, not passengers. For example, the bus passengers could be ‘travelling to education’ but the driver would likely report this as a ‘work-related trip’. Journey Purpose is also not collected for pedestrians, so cannot be used to identify children who were injured while walking to school.

These gaps indicate that transport service providers are not reporting all injury crashes to NZ Police, particularly where children were injured by a passing vehicle. This suggests there is a gap in procedure in how collisions are reported (the research found that some transport service providers did not fully understand the crash reporting process and how this information is used).

4.2.6 Additional harms to children travelling on school buses

Some transport service providers interviewed in the engagement stage noted that children are exposed to vehicle emissions when walking around school buses. Small children walking around the back of the bus while it moves away from the stop are exposed to some of the highest doses of exhaust emissions.

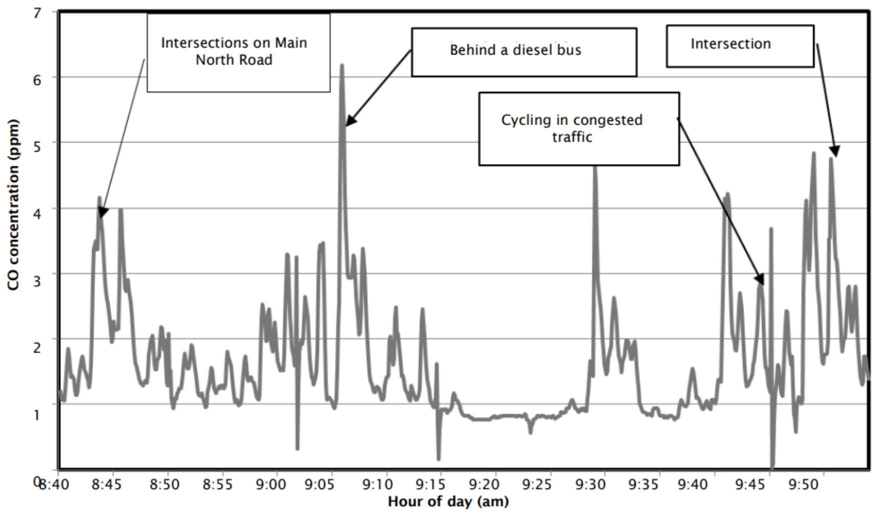
Kingham et al. (2011) conducted a study in Auckland and Christchurch to determine personal exposure to traffic pollution while travelling by different transport modes. Their literature review concludes that buses have the highest concentration of nitrogen dioxide (NO_2) levels compared to other modes due to the self-pollution from diesel engines. NO_2 has been linked to childhood asthma and increased rates of respiratory illnesses (Kingham et al., 2011).

Particulate matter (PM) was also found to be the highest in buses, with bus passengers exposed to 20% higher levels of PM_{10} than car passengers.[4] Bus passengers had the highest mean exposure to $PM_{2.5}$, PM_1 and ultrafine particles compared to car drivers, and on-road and off-road cyclists. Smaller fractions of PM have higher toxicity as they contain more organic matter and can penetrate deeper into the lungs.

Finally, Kingham et al. (2011) found that the concentration of pollutants experienced by an on-road cyclist spiked while behind a diesel bus (Figure 4.1). This finding is indicative of the spikes of emissions children may be exposed to while walking around the back of an idling bus. Additionally, children are generally more susceptible to the adverse effects of exposure than adults (Dirks et al., 2018).

[4] Particulate matter is a traffic-related pollutant that is categorised by particle size – for example, PM_{10} means particles with a diameter less than 10 microns.

Figure 4.1 Localised spikes of carbon monoxide (CO) observed during a cycling journey (reprinted from Kingham et al., 2011, p. 63)



Most (97%) of the heavy buses in New Zealand are diesel fuelled (Te Manatū Waka, 2022b). The Ministry of Education currently encourages the adoption of lower emission school buses through the tendering process by including an emission standard based on the age of vehicles used as school buses (Ministry of Education, 2020).

4.2.7 Data for years 2008 and 2009

Previous research, referred to above (Schofield et al. 2008; Gianotti, S. & Drader, F. 2007; Baas et al. 2010), incorporated data up until the year 2007, whereas the specification for the research reported on in this document (RR 710) focused on the years 2010 – 2021. This oversight in the original specification therefore left a gap of two years (2008 and 2009). A subsequent review of crash data for school buses in those years found no significant variation from other years in crashes involving school buses.

However, there were two fatalities with the cause code 729 (pedestrian to/from a school bus), one each in 2008 and 2009, The two fatalities in 2008-2009 is the same number of fatalities reported for the entire 12-year period that followed.

There were also a further four serious injuries in 2008-09, so six DSIs in total for those two years, or three DSI/year. This is consistent with findings for 2010-2021 (also averaging three DSI/year). Consequently, it was concluded that the analysis of data for 2008-09 should not affect the overall findings and conclusions contained in this report.

5 School bus route operating conditions and risk assessment

School buses in New Zealand operate over a range of road environments – from predominantly urban roads with lower speed limits and high numbers of vulnerable road users, to rural roads with varying traffic volumes and operating speeds and more challenging environmental conditions.

This chapter presents a risk assessment framework for assessing the relative risk of different road environments. This framework was applied to a representative sample of bus routes to:

- estimate the length of school bus route by risk category and service type
- quantify the relative crash risk of each type of route.

These assessments provide a baseline for understanding the relative risk of death or serious injury to school bus occupants and other road users.

5.1 Risk assessment framework

The *Australian Guidelines for the Risk Assessment of School Bus Routes* (Australian Transport Council, n.d., as cited in School Bus Safety Community Advisory Committee, 2012) provides a framework for assessing the relative risk of school bus routes. These guidelines were adapted to enable the assessment of New Zealand school bus routes, considering available datasets (Table 5.1).

Table 5.1 Adapted risk assessment framework for school bus routes

Description	Criteria	Comments
Urban	All roads with an urban land use.	Urban roads have generally lower speed limits and vehicle speeds. They also have more vulnerable road users present, such as cyclists and pedestrians.
Rural undivided – high volume	Undivided rural roads with: • high traffic volumes (≥ 3,000 vehicles per day), or • high heavy vehicle traffic volumes (≥ 500 heavy vehicles per day).	Rural roads generally have higher speed limits and operating speeds, which increase the severity of crashes. The likelihood of a crash increases with traffic volumes, resulting in more crashes occurring on high-volume roads compared to low-volume roads. These crashes are more likely to be head-on, rear-end or intersection crashes. Roads with high volumes of heavy vehicle traffic could increase the severity of crashes involving buses as the additional weight of the other vehicle (eg, a truck) negates the benefit of mass that buses usually have in a collision.
Rural undivided – extreme environment	Undivided rural roads where any of the following criteria are met: • Infrastructure Risk Rating band = 'High', or • tortuous alignment, or • prone to extreme weather conditions, particularly snow/ice. This was assessed using regional elevation thresholds as a proxy: – > 200 m in Otago/Southland	These rural roads also have higher speed limits, but operating speeds may be lower due to the road environment (eg, winding or tortuous alignment, narrow or unsealed roads). Roads with a high Infrastructure Risk Rating are less forgiving, increasing the likelihood of run-off road crashes. When a crash occurs, the severity is often higher due to the presence of roadside hazards such as cliffs and drop-offs. These roads are usually more remote and have lower traffic volumes. As such, overall crash rates (crashes/km) are low, but the number of crashes per vehicle kilometre travelled is relatively high.

Description	Criteria	Comments
	– > 300 m in Canterbury – > 400 m elsewhere.	
Rural other	All other rural roads	This includes all rural undivided or divided roads not captured in the categories above.

5.2 Assessment methodology

The following school bus services were selected for assessment:

- Ministry of Education Daily Bus
- Ministry of Education Technology Bus
- school bus services operated by Auckland Transport and Greater Wellington Regional Council.

These services were selected based on the availability of data, but also because they are a representative sample of school bus services in New Zealand.

5.2.1 Categorising school bus routes by risk category

A geospatial methodology was developed to segment and assess sections of the school bus network against the criteria in Table 5.1. This involved splitting and matching sections of school bus routes using the following existing road attribute datasets:

- road and roadside attributes from the National Infrastructure Risk Rating centreline dataset developed for MegaMaps Edition III (Waka Kotahi, 2020)
- heavy vehicle volumes from the National Road Centreline dataset (Waka Kotahi, 2021a)
- mean elevation (height above sea level) extracted from a national digital elevation model (University of Otago National School of Surveying, 2011).

The output from this analysis was used to estimate the length of the school bus network by service type and risk category.

5.2.2 Assessing relative crash risk for each risk category

A further assessment was undertaken to determine crash densities and crash rates for each school bus route risk category. This involved attaching 10 years of injury crash data from CAS (2012–2021) for all road users to each segment of bus route. This assessment was performed for the Ministry of Education Daily Bus routes only, using the methodology described in Appendix C.

Note that this assessment used crash data for all road users as there were insufficient school bus crashes in the crash record to draw meaningful conclusions regarding the actual relative risk of different types of school bus route. Additionally, for each school bus crash, it is not possible to determine what type of service this occurred on (eg, Daily Bus, Technology Bus, or charter bus), and therefore it is not possible to compare the historical crash risk across different types of service.

The following additional measures were calculated for each risk category:

- total vehicle kilometres travelled (VKT) per year
- total number of fatal and serious crashes per year
- number of fatal and serious crashes by movement category (head-on, run-off road, intersection/turning, pedestrian, or other)

- personal risk (fatal and serious crashes per 100 million VKT)
- collective risk (fatal and serious crashes per kilometre, per year).

5.3 Results

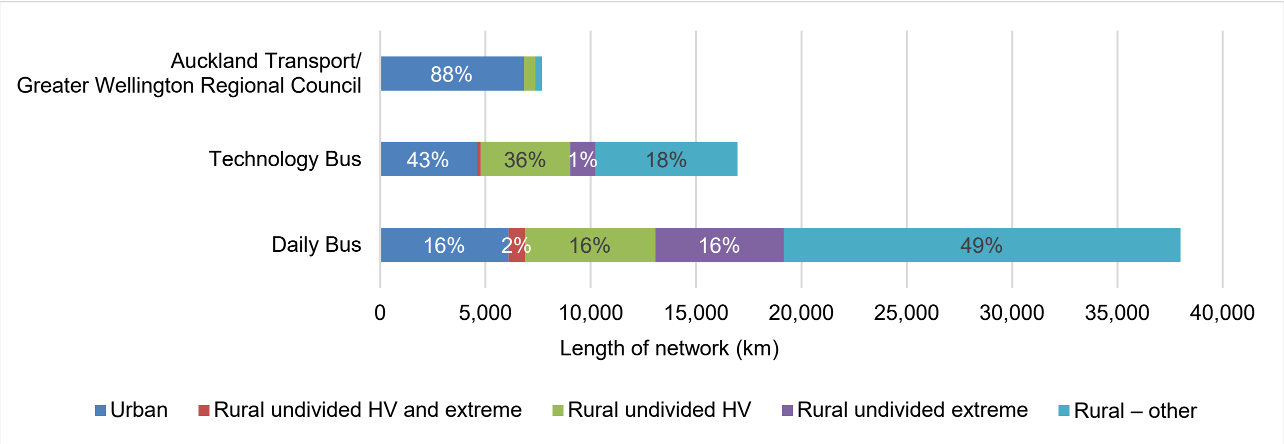
5.3.1 Classification of school bus route by service type and risk category

The length of school bus route by service type and risk category is presented in Table 5.2, and graphed in Figure 5.1. Mapped examples are provided in Figures 5.2 to 5.4. These figures include Technology Bus services; however, care must be taken in comparing these services to Daily Bus services as they do not run on a daily basis.

Table 5.2 School bus route assessment: length of school bus network, by service type and risk category

Service type	Urban	Rural undivided – high volume and extreme	Rural undivided – high volume	Rural undivided – extreme	Rural – other
Ministry of Education Daily Bus	6,105 km (16%)	773 km (2%)	6,179 km (16%)	6,110 km (16%)	18,838 km (49%)
Ministry of Education Technology Bus	4,603 km (43%)	184 km (1%)	4,237 km (36%)	1,205 km (1%)	6,735 km (18%)
Auckland Transport school bus service	4,687 km (88%)	6 km (< 1%)	309 km (6%)	25 km (< 1%)	228 km (4%)
Greater Wellington Regional Council school bus service	2,145 km (88%)	–	220 km (9%)	–	55 km (2%)

Figure 5.1 School bus route assessment: length of school bus network, by service type and risk category



Note: HV = heavy volume.

The results show that for the Ministry of Education Daily Bus services:

- These services predominantly operate on rural roads (84%).
- Approximately one-third of the roads these services operate on are classified as high-risk rural road environments, with either high traffic volumes (16%), an ‘extreme’ road environment (16%) or both (2%).

Figure 5.2 Ministry of Education Daily Bus routes in the Wellington Region, by risk classification

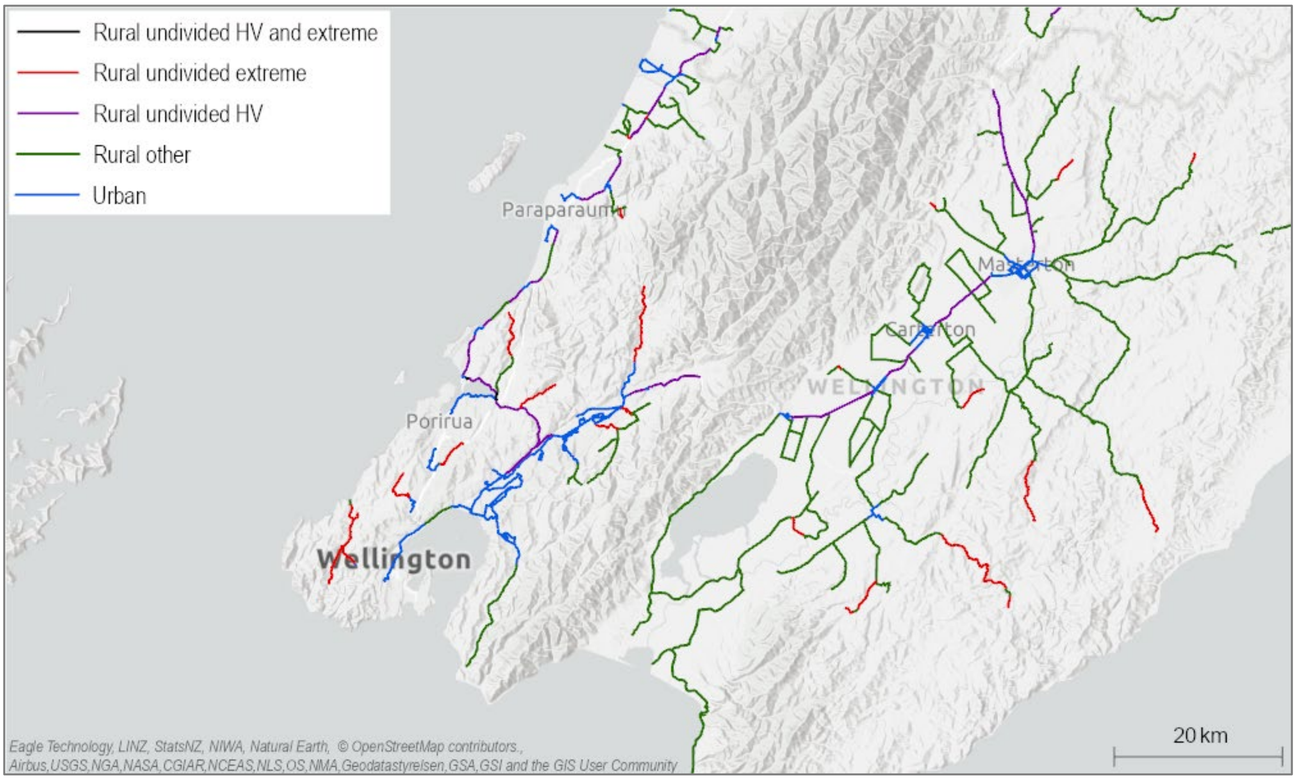


Figure 5.3 Ministry of Education Technology Bus routes in the Wellington Region, by risk classification

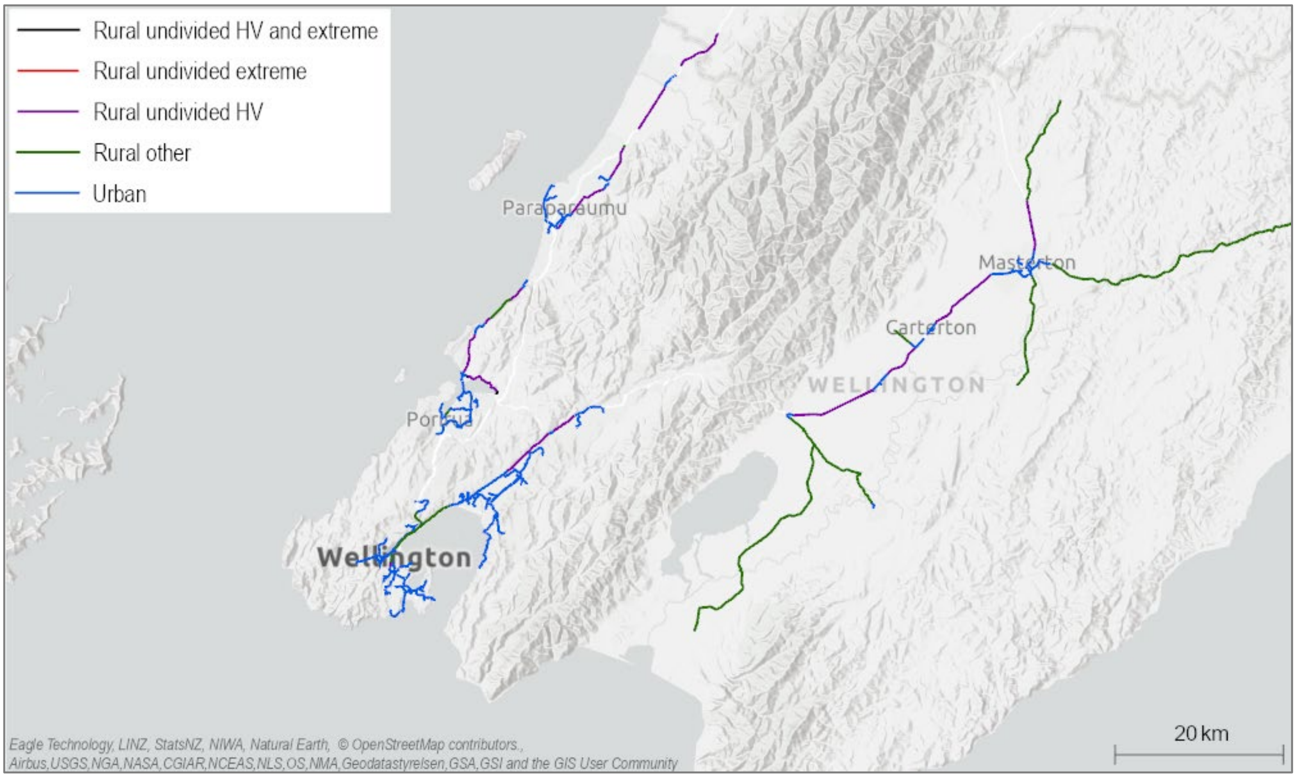


Figure 5.4 Regional council school bus routes in the Wellington Region, by risk classification

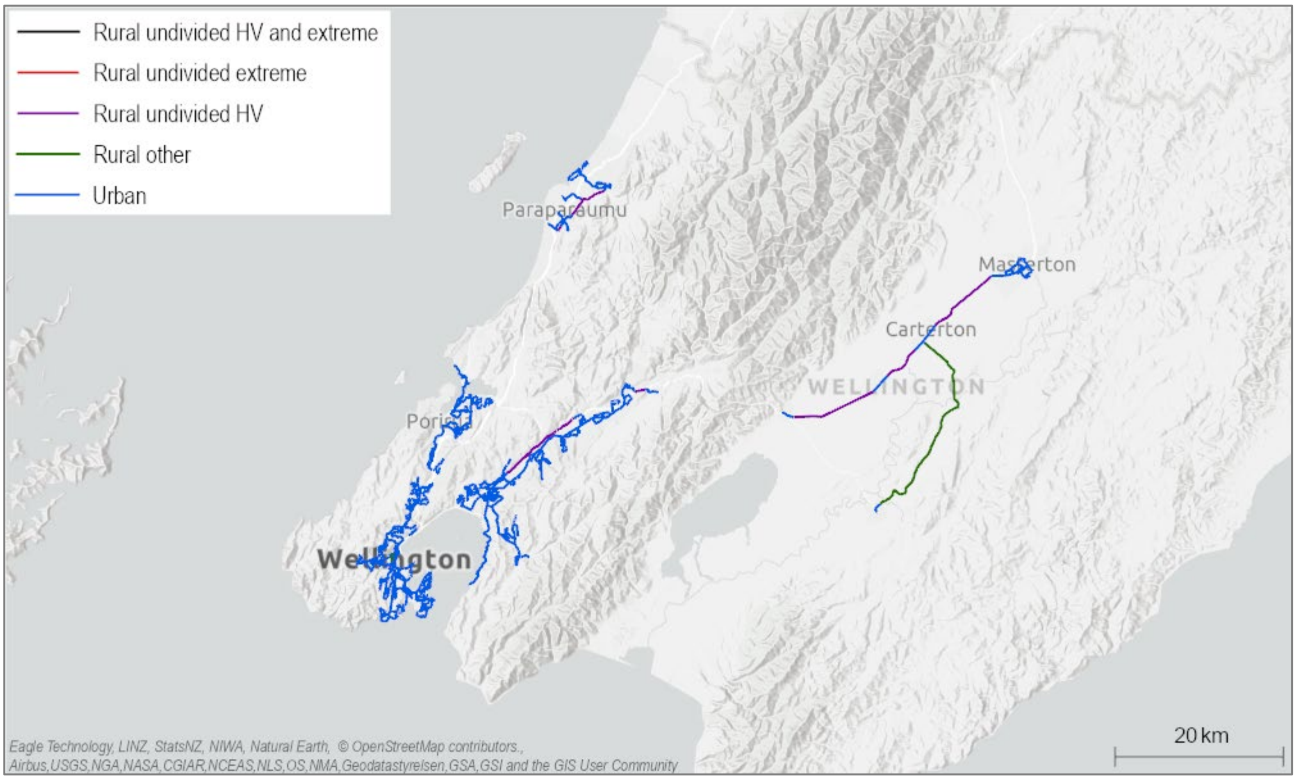


Figure 5.1 shows that Technology Buses operate in a more mixed range of road environments, although a larger proportion of routes operate on urban roads or rural undivided high-volume roads compared to Daily Bus services. This reflects the routing of these services along major arterials and highways between towns, or within urban areas.

The regional council networks (Auckland and Greater Wellington) were both classified as 88% urban by length. Services on these networks are also much shorter overall compared to Daily Bus routes, as also discussed in section 2.3.1.3. However, in both regions there are a small number of routes operating in high-risk rural environments – for example, along SH2 between Featherston and Masterton in the Greater Wellington region, and on East Coast Road and Dairy Flat Highway in Auckland.

5.3.2 Crash risk by school bus route classification

Table 5.3 shows collective and personal risk by aggregated road risk category for Ministry of Education Daily Bus routes.

Collective risk is a measure of crash density, expressed as the number of DSI crashes per kilometre, per year. This risk metric is highly correlated with traffic volumes, as the number of crashes generally increases as the number of vehicles and other road user activity increases. This is apparent in the results, with both rural undivided high-volume roads and urban roads assessed as ‘medium-high’ collective risk.

Personal risk is a measure of crash rate, expressed as the number of DSI crashes per 100 million VKT. This metric takes traffic volume into account and reflects the level of risk at an ‘individual’ level, and therefore is more useful in understanding the likelihood of an individual vehicle or road user being involved in a DSI crash. Rural undivided extreme environments were rated as ‘High’ personal risk, followed by ‘rural other’ with a ‘Medium High’ personal risk rating.

Table 5.3 Aggregate collective and personal risk for all road users on Ministry of Education Daily Bus routes, by road risk category

Category	Total length (km)	Total VKT (100 million VKT/year)	DSI crashes/ year	Personal risk		Collective risk	
				DSI crashes/ 100 million VKT	Risk band	DSI crashes/ km/year	Risk band
Rural undivided high volume[a]	6,952	168.72	977	5.80	Medium	0.141	Medium High
Rural undivided extreme environment	6,110	9.43	88.8	9.41	High	0.015	Low
Rural other	18,838	65.22	539.9	8.28	Medium High	0.029	Low
Urban	6,105	141.69	879.7	6.21	Medium	0.144	Medium High

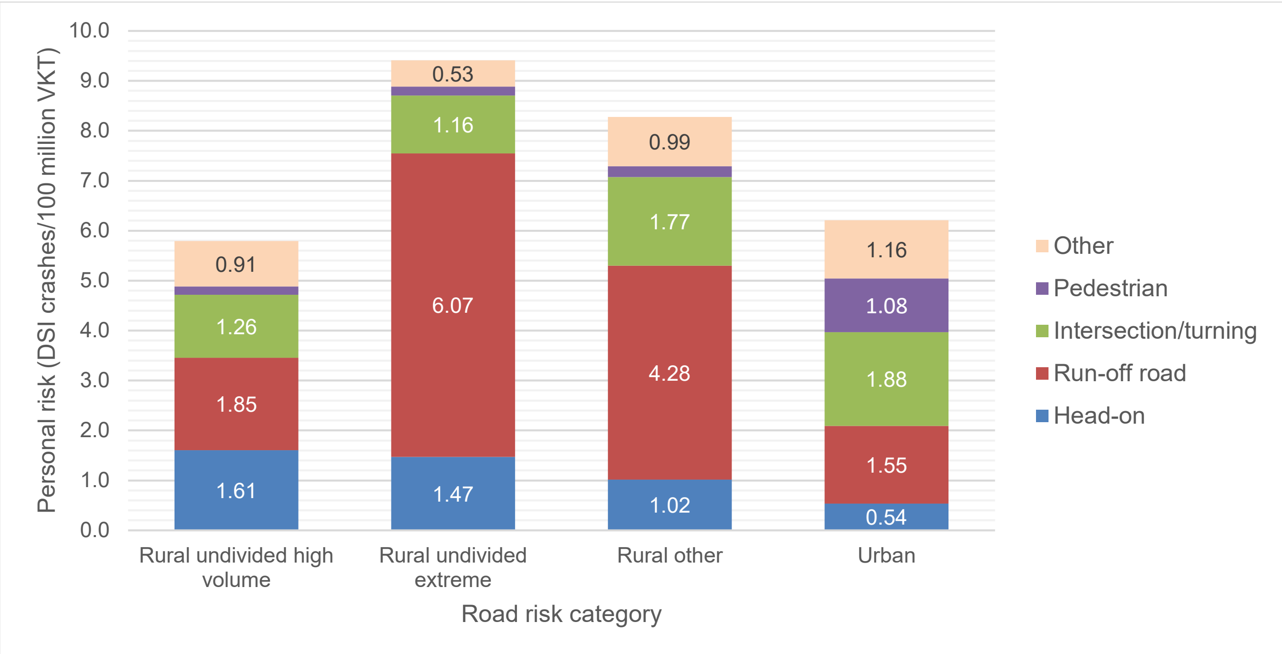
[a] This category includes roads classified as both ‘rural undivided – high volume’ and ‘rural undivided – extreme’.

Personal risk is a better metric for comparing the likelihood of an individual vehicle, such as a school bus, being involved in a DSI crash. However, it should be noted that these metrics reflect the level of risk to all road users, not just school bus occupants or children crossing roads. For this reason, the risk metrics presented in Table 5.3 should be used for comparative purposes only.

Figure 5.5 shows personal risk by road risk category and crash type. This figure demonstrates that:

- run-off road crashes have the highest crash rate on rural roads (the proportion of run-off road crashes is highest on roads classified as ‘rural undivided extreme’ and ‘rural other’)
- intersection/turning crashes have the highest crash rate on urban roads
- rural undivided high-volume roads have the highest rate for head-on crashes.

Figure 5.5 Ministry of Education Daily Bus routes: personal risk, by road risk category and crash type



6 Review of guidance, policy, legislation and practice

This chapter describes the current guidance, policy, legislation and practices that impact school bus safety. This includes a review of *Road to Zero: New Zealand's Road Safety Strategy 2020–2030* (Te Manatū Waka, 2019) to identify what actions are underway, or planned, that could impact school bus safety. The findings presented in this chapter were primarily informed by the literature review and stakeholder engagement, and international comparisons are provided where relevant.

6.1 Road to Zero: New Zealand's Road Safety Strategy

Road to Zero: New Zealand's Road Safety Strategy 2020–2030 sets a vision of 'a New Zealand where no one is killed or seriously injured in road crashes' (Te Manatū Waka, 2019, p. 6). It recognises that:

- no loss of life is acceptable in the transport system
- deaths and serious injuries on our roads are preventable
- we all make mistakes, but these mistakes should not cost us our lives.

The strategy sets a target of 40% reduction in road DSIs by 2030 (Te Manatū Waka, 2019). This will be achieved by in the following five focus areas:

1. infrastructure improvements and speed management
2. vehicle safety
3. work-related road safety
4. road user choices
5. system management.

The *Road to Zero Action Plan 2020–2022* (Te Manatū Waka, 2021) identifies specific actions under each focus area, including interventions and investments that will improve safety for all road users, including school bus users, as described below.

6.1.1 Speed and Infrastructure Programme

Improving the safety performance of roads and roadsides will reduce DSIs for all road users. This is achieved through infrastructure improvements and setting speed limits that are appropriate for the road environment. Significant government investment in safety infrastructure and speed management is planned this decade. Approximately half (600–650 DSIs) of the 40% reduction target set in *Road to Zero* is expected to be achieved through infrastructure and speed management (Waka Kotahi, 2021c).

6.1.1.1 Infrastructure improvements

The Road to Zero Speed and Infrastructure Programme is a whole-of-network approach to improving road infrastructure and setting and enforcing safe and appropriate speed limits. This 10-year, $5 billion investment programme is led by NZTA, in partnership with local authorities. This investment includes a mix of interventions for higher-risk corridors and intersections, from transformational treatments such as central wire rope median barriers and upgrading rural intersections to roundabouts, to lower-cost supporting treatments such as carriageway widening and rural intersection safety treatments.

6.1.1.2 Speed management

Setting appropriate vehicle speeds is a critical part of the Speed and Infrastructure Programme. Table 6.1 describes the survivable impact speeds for different collision scenarios. These speeds are well evidenced and becoming widely adopted globally (Waka Kotahi, 2022f). Children walking (including travelling to and from a school bus) are present outside vehicles, and therefore the desirable Safe System speed for vehicles travelling past these children should be no more than 30 km/h.

Table 6.1 Safe impact speeds for different collision scenarios (adapted from International Transport Forum, 2016, p. 88)

Road users combined with road and section type	Safe System speed
Roads and sections with people present outside and inside vehicles	No more than 30 km/h
Roads with intersections with potential for side-on conflicts between vehicles	No more than 50 km/h
Roads with potential for head-on conflicts between vehicles	No more than 70 km/h
Roads with no potential for head-on or side-on conflicts between vehicles and no people present outside vehicles	No more than 100 km/h

The *Speed Management Guide: Road to Zero Edition* (Waka Kotahi, 2022f) supports road controlling authorities to develop speed management plans that deliver safe and appropriate speed limits in line with the Road to Zero strategy (Te Manatū Waka, 2019) and the Land Transport Rule: Setting of Speed Limits 2022.[5] The *Speed Management Guide: Road to Zero Edition* states that approximately 85% of speed limits in New Zealand are above the safe and appropriate speed limit, and that reducing speed limits to align with safe and appropriate speeds will be a significant challenge. Hence, speed limit changes across the network are being prioritised and phased, focusing on:

1. corridors where lowering speed limits to safe and appropriate speed limits will save the largest number of people from DSIs
2. all streets surrounding schools, including streets outside school frontages and within 100 m of a school boundary
3. areas where the highest concentrations of active road users are expected.

Speed limits outside schools

On point (2) above, the Land Transport Rule: Setting of Speed Limits 2022 sets targets for road controlling authorities to lower speed limits outside schools. Children are vulnerable road users, making it particularly important to reduce speeds around schools where children are likely to be present. The rule introduces two categories of schools for setting speed limits on roads outside a school:

- Category 1 schools (permanent or variable speed limit of 30 km/h)
- Category 2 schools (permanent or variable speed limit of 60 km/h or less).

Schools should be classified as Category 1 (30 km/h) unless road controlling authorities can justify that a speed limit of 40–60 km/h is safe and appropriate for the road environment – for example, there is no pedestrian activity along the frontage of the school.

[5] See https://www.nzta.govt.nz/resources/rules/setting-of-speed-limits-2022/ for further information.

Speed limits at 'stopping places'

Additionally, the 2022 *Speed Management Guide: Road to Zero Edition* allows road controlling authorities to set speed limits of 40–80 km/h on rural roads classified as 'Stopping Places' under the One Network Framework. These areas are described as sections of road where people gather in a rural setting, and where people might be expected to walk across the road. Some rural PUDO sites may meet the criteria for a 'stopping place' – for example, PUDOs co-located near rural halls or visitor destinations (Figure 6.1).

Figure 6.1 Example of a 'stopping place' located on a Daily Bus route: Wilsons Bay Reserve, Queenstown (image source: Google Streetview, 2019)

Speed limits that apply to school buses

The Land Transport (Road User) Rule 2004 requires that a driver of a school bus that has a gross vehicle mass (GVM) over 2,000 kg (ie, most school buses) must not exceed 80 km/h.

6.1.1.3 Relevance for school bus safety

The Speed and Infrastructure Programme will improve the underlying safety on some school bus routes, particularly those currently running on corridors or travelling through intersections that are identified as having higher risk of fatal and serious crashes. However, some of these infrastructure projects could have other impacts on the operation of existing bus routes – for example, installing median barriers could prevent buses turning into driveways or pull-over areas.

The proposed speed limit reductions around schools and on rural corridors will also improve school bus safety in several ways:

- Reducing vehicle speeds around schools lowers the likelihood and severity of injuries to children crossing roads to and from schools. This is particularly relevant for urban schools with on-street bus stops – for example, those used by council school bus services.
- Reducing vehicle speeds around rural schools lowers the likelihood and severity of collisions involving school buses turning into and out of school PUDO locations.
- Reducing speed limits on rural roads from 100 km/h to 60–80 km/h will:
  - reduce the likelihood and severity of crashes around stationary school buses at PUDOs (this also reduces the amount of deceleration required for drivers to achieve 20 km/h when passing stationary school buses)

- reduce the speed difference between the existing speed limit for school buses (80 km/h) and the speed limit that applies to other road users (currently 100 km/h on most rural roads).

Any new requirement to develop local or regional speed management plans will require road controlling authorities to consider, among other things, road use activity and local knowledge of the road network. Likewise, when designing and implementing road safety projects, it is essential that designers are aware of PUDO sites and turning requirements of school buses so that these activities can be safely accommodated within infrastructure designs.

6.1.2 Other safety initiatives

Other focus areas and actions in Road to Zero that could impact school bus safety are:

- *Work-related road safety*: strengthening commercial transport regulation, including reviewing logbook and work-time requirements
- *Road-user choices*: prioritising road policing and enhanced drug-driver testing
- *System management*: development of in-depth crash investigations for fatal and serious crashes, and improving post-crash response.

There are no specific actions targeting heavy vehicles under the ‘vehicle safety’ focus area.

6.2 School bus route design

6.2.1 Current practice and guidance

Regional Transport Advisors at the Ministry of Education are responsible for designing routes for Ministry of Education Daily Bus services. These routes are modelled based on where school children reside, considering key design principles including the need to transport as many eligible students as efficiently as possible. These routes are mapped by the Ministry of Education and can be viewed on the Ministry of Education website. For Technology Buses, the transport service provider determines which route to take between the school(s) and the technology centre. Both Daily Bus and Technology Bus routes are reviewed annually.

The Ministry of Education also models routes for directly resourced schools in a similar manner to the Daily Bus services, but for funding purposes only. Directly resourced schools (or school clusters) are ultimately responsible for designing their school bus routes based on the funding provided to them by the Ministry of Education.

The locations of PUDO sites along bus routes are considered by the Ministry of Education as part of the route design and amendment process, although the transport service provider is responsible for determining these once the route is set. It is the responsibility of parents or caregivers to provide safe transport to and from the PUDO location. If the distance they need to travel to the PUDO location is more than 2.4 km, they may be eligible for a conveyance allowance (Ministry of Education, 2022a).

Route design guidelines are currently being reviewed internally by the Ministry of Education to provide more clarity to newer staff and to ensure routes are designed consistently across New Zealand. This document is not currently available externally, and therefore the degree to which safety factors are incorporated into these guidelines is unknown. However, during the stakeholder engagement, Regional Transport Advisors emphasised that safety comes first in route design, and no route is approved until the transport service provider has also approved it from a safety perspective. If the transport service provider raises a safety issue, Regional Transport Advisors will review the route, and Transport Contract Managers may also get involved. The Ministry of Education may review routes where there are changes in land use or road condition – for example, a road is temporarily or permanently unsuitable for bus travel. Other examples include a bridge closure that requires a detour or a change in road layout, such as a new expressway opening, which affects the local roading network.

6.2.2 Australasian guidance and prior research

There is little research or guidance on how school bus routes can be designed to improve safety for bus users.

Baas et al. (2010) explored options for improving safety through route design in New Zealand, such that the need for children to cross the road is eliminated. This includes rearranging bus routes to enable more children to be dropped off on the side of the road where they live. This could include strengthening Ministry of Education policy and procedures by making specific reference to the aim of eliminating (where possible) the need for students to cross the road.

The *Australian Guidelines for the Risk Assessment of School Bus Routes* (Australian Transport Council, n.d., as cited in School Bus Safety Community Advisory Committee, 2012) provides a framework for assessing the relative risk of school bus routes. The Advisory Committee recommended that these guidelines are used to 'facilitate risk-based allocation of resources to improve bus safety' – for example, by requiring that buses running on the highest risk be compliant with Australian Design Rule (ADR) 68/00[6] (School Bus Safety Community Advisory Committee, 2012, p. 14). The guidelines are being used in New South Wales to identify improvements to road and bus stop infrastructure.

The Austroads (2022) *Vehicles as a Workplace* guide identifies the attributes of roads that present higher risks to employees who are required to drive for work purposes. Austroads (2022, p. 25) describes the following characteristics of safer roads:

- *separation of opposing traffic*
- *separation of local traffic from through traffic*
- *elimination of or protection from roadside obstacles*
- *wide, sealed shoulders or emergency stopping lanes*
- *safe provision for pedestrians and cyclists*
- *speed limits aligned to the safety of the infrastructure*
- *well-maintained road surface*
- *roundabouts instead of traffic lights*
- *clear line markings.*

Many of these characteristics are captured in the road's Infrastructure Risk Rating and Safe and Appropriate Speed, both of which are mapped for all roads in New Zealand as part of the MegaMaps platform (Waka Kotahi, 2022a, 2022b).

[6] ADR 66/80 – *Occupant Protection in Buses* requires retracting three-point seatbelts on all passenger seats in heavy buses over 3,500 kg. This design rule is discussed in detail in section 6.6.4.

This guidance is provided to help managers determine the safest routes for their employees to travel on, but it also provides an indication of the risks posed on different types of school bus routes. This is also relevant for bus drivers transporting empty buses to the start of the run, and back to the depot at the end of the run.

In considering whether it is practicable to avoid certain roads, Austroads (2022) notes that higher-standard roads might also result in reductions in vehicle operating costs, but conversely a longer route may also increase time on the road.

6.2.3 Feedback from stakeholders

Rural organisations expressed concern about the safety of children travelling to and from PUDO locations, and the equity issues associated with this. The eligibility distance places a significant burden on families – particularly those in the agriculture sector. The lack of footpaths, and in some cases road shoulders, on high-speed rural roads with blind corners means that often the only safe form of transport to PUDO locations is for caregivers to drive children to and from them. Examples were given where children could not attend school as getting children to the school bus was too difficult given the work responsibilities on the farm. The stakeholders interviewed also noted (anecdotally) that this disproportionately affects women, who are often the primary caregiver and must balance work obligations with childcare. This concern was also voiced by the bus and coach industry, with one interview participant commenting that among migrant farm worker families, the mother may not have a driver licence and is therefore unable to drive her child to the PUDO location.

Transport service providers are aware that rural families want children to be picked up close to their homes. However, these locations may be unsafe locations for buses to stop at – for example, due to a lack of adequate site distance or shoulder width. Bus routes are also dictated by the availability of safe turning points, vehicle size, and which side of the road children are dropped off at school, which can make the siting of PUDO areas a complex decision. Transport service providers are also mindful that if a parent or caregiver cannot drive a child to a PUDO location, the child will have to walk, which is also a safety concern. This is a trade-off that some bus operators struggle to resolve.

During engagement with transport service providers, there seemed to be a misunderstanding of school bus route funding among providers, and how this translates to the actual bus route. Under current Ministry of Education school bus service contracts, routes are funded per kilometre based on the distance between the school and the start of the route. Some transport service providers thought this meant that the bus route only 'officially' starts at the furthest point, and that they are not allowed to pick up students on the way to this point (and vice versa for the afternoon drop-off). The Ministry of Education has clarified that it does not prohibit the transport service provider picking up eligible students if the outbound route passes the student.

6.2.4 Bus route signage

Road controlling authorities can install warning signs on bus routes to alert drivers of school buses operating on roads. This is the W16-6 school bus symbol, with additional 'SCHOOL BUS ROUTE' or 'SCHOOL BUS TURNS' supplementary plate, as defined in the Traffic Control Devices 2004 Rule[7] (Table 6.2).

[7] See https://www.nzta.govt.nz/resources/rules/traffic-control-devices-2004/ for further information.

Table 6.2 Current school bus route warning signs

Sign code and description	Sign
W16-6 School bus symbol	
W16-6.1 School bus route supplementary	
W16-6.2 School bus turns supplementary	

Current guidance for road controlling authorities on the use of these signs is provided on the NZTA website (Waka Kotahi, 2022e):

> *W16-6, W16-6.1 and W16-6.2 signs may be warranted on roads in rural areas where in the opinion of the road controlling authority, roadway conditions and the presence of school buses could create a hazard, in particular where the road is narrow and winding and the buses stop to allow children to board and alight. Signs should be installed at each end of a section of a school bus route where signing is warranted and may be installed near important intersections within that length. The sign should be located where approaching drivers have an uninterrupted view of it over a distance of at least 120m.*
>
> *The signs should not be installed in urban areas.*
>
> *The W16-6 and W16-6.2 School bus turns combination should be installed at the terminal points of a school bus route.*

Figure 6.2 shows a W16-6 sign with W16-6.2 supplementary plate, in situ on a school bus route.

Figure 6.2 School bus route warning sign

Installing school bus route signage is at the discretion of road controlling authorities. It is unknown how widely this signage is used in New Zealand. Given road controlling authorities do not know where all the bus routes and PUDO locations are, bus route signage has likely been added on an ad hoc basis when requested from transport service providers and rural communities. This was corroborated by one of the stakeholders interviewed, who mentioned they were aware of these signs being on roads that are not currently being used as school bus routes.

6.3 PUDO site selection, assessment and auditing

6.3.1 Current guidance

The New Zealand guidance for identifying and assessing PUDO locations for school buses is the *Guidelines for the Safe Siting of School Bus Stops* (Waka Kotahi, 2018). The guidelines only apply to bus stops where students are picked up and dropped off by dedicated school bus services and do not apply to permanent bus stops.

These guidelines were developed in 2004 by the (then) Land Transport Safety Authority to improve student safety when getting on and off buses. The guidance itself is relatively short, consisting of two pages of general guidance and single-page checklists for single bus stops, and school bus routes. For school bus stops, this includes:

- assessing the visibility of oncoming traffic for drivers and children required to cross the road, with minimum sight distances provided
- determining whether an adequate pull-in area is provided for the bus to pull off the road (eg, a wide shoulder) – where this is not possible, adequate visibility of the bus stop is essential
- identifying hazards near the school bus stop (eg, inadequate shoulder widths, one-lane bridges)
- identifying whether there is a waiting area set back from the road that students can use
- identifying whether there are likely to be winter issues with the stop (eg, the pull-in area becoming muddy)
- assessing whether there is adequate space for parents or caregivers to park their vehicle at the stop.

The guidelines do not identify who is responsible for siting school bus stops but indicate that advice may be needed from road controlling authorities for bus stops of significant concern with no practical alternative options. Additionally, the guidelines suggest that school bus operators and drivers should be consulted when auditing school bus stops but do not specify who should undertake an audit and how frequently stops should be audited.

There is no requirement to sign or mark a school bus stop location, except if the location is an urban area and is formalised as an urban bus stop or school bus stop.

6.3.1.1 Public transport design guidance

Waka Kotahi (2022c) recently published public transport design guidance online in draft form to support regional and local councils to deliver high-quality, user-centric public transport. This guidance covers all urban public transport services, including urban school bus services. It includes guidance on bus stop planning and design, and on how to consider first and last mile connections (how people travel to and from bus stops).

Some specific guidance on school bus stops is provided in the public transport design guidance, covering similar considerations as those covered in the *Guidelines for the Safe Siting of School Bus Stops* (Waka

Kotahi, 2018). However, the public transport design guidance also includes design principles for school stops, and guidance on when to provide bus shelters.

6.3.2 PUDO site selection in practice

For Daily Bus services, the Ministry of Education places the responsibility for identifying PUDO locations on transport service providers. This includes identifying potential PUDO locations and assessing these against the *Guidelines for the Safe Siting of School Bus Stops* (Waka Kotahi, 2018). Each transport service provider keeps a record of their PUDO sites, but this is not shared with the Ministry of Education except for the purpose of auditing them.

There are a variety of types of PUDO sites in New Zealand. They may be simple pull-over areas, larger areas with space for caregivers to park, or transfer areas where children move between buses. In rural areas PUDOs are unmarked and may be on high-speed roads with:

- no footpath
- an inadequate road shoulder
- high volumes of heavy vehicles.

As routes or PUDO locations may change in rural areas when families move away, or children change schools, there is usually little or no infrastructure associated with school bus PUDOs. Several stakeholders confirmed that these changes generally occur at the start of the year or term, and most PUDO sites are effectively permanent.

6.3.2.1 Reviewing and auditing PUDO locations

A sample of PUDO locations are audited by the Ministry of Education's Transport Contract Manager during their routine audits of transport service providers. The Ministry of Education currently aims to audit around 300 PUDO locations per year, which equates to approximately 2% of all PUDO locations in New Zealand. This is a new policy that started when the new school bus contracts commenced in 2022.

Transport Contract Managers sometimes assess PUDOs by following a bus on its route and observing where and how it pulls over for children to access or egress the bus. This also allows them to identify unofficial PUDO sites that would not otherwise be assessed (ie not identified by a transport service provider as a PUDO but the bus driver stops to pick up or drop off children). Transport Contract Managers also assess PUDO areas at schools as they are the terminus for bus services. They have also been involved with new schools where buses could not get into allocated bus stops. Due to the lack of compliance with the 20 km/h speed limit for vehicles passing a stationary school bus (as discussed in more detail in section 6.4.2), Transport Contract Managers generally work on the assumption that no drivers slow down to 20 km/h when auditing PUDO sites, particularly in relation to their visibility.

Disputes regarding PUDO locations are managed by the Ministry of Education, and the NZ Police Commercial Vehicle Safety Team may get involved if disputes are escalated.

6.3.3 Feedback from stakeholders on current practice

PUDO site selection was a topical point among transport service providers, with some being surprised that the onus of selecting and assessing them was placed with them under the new contracts. Most transport service providers said they would like more support or more effective coordination from the Ministry of Education, with many noting that they are not road safety specialists.

Several stakeholders noted that the NZTA *Guidelines for the Safe Siting of School Bus Stops* do not provide sufficient detail for selecting or auditing PUDO locations. Some transport service providers have developed their own resources to help with PUDO site selection, including one provider who developed a separate, enhanced risk rating spreadsheet tool. One provider mentioned that they try to put senior drivers on more rural runs to assess the safety of PUDO sites, bearing in mind that the providers do not have road safety engineers to assess the safety of PUDO locations. Some transport service providers have also considered additional requirements when siting their PUDO locations, such as the walking distance to students' homes and whether they need to cross the road.

Transport service providers have taken different approaches to address the safety issues around PUDO locations. As the distance children must travel to a PUDO site is not considered in the route design, one provider attempts to site PUDO areas such that children do not have to walk more than 200 m to their home and do not have to cross the road. It is difficult to ensure that these requirements are met, in which case this transport service provider explained that caregivers are generally happy to travel a little further for a safer PUDO location.

Generally, transport service providers comply with what is required by the Ministry of Education and make bespoke changes to PUDO locations where safety is a significant concern. If there is an issue with a PUDO site, they are complex to change. If issues are raised by the community and NZ Police becomes involved, there have been situations when NZ Police, Transport Contract Managers and road controlling authorities could not agree on a resolution, leaving transport service providers 'stuck in the middle'. One provider mentioned that they have had drivers resign due to conflicts in their community over PUDO locations, which is a concern due to the nationwide driver retention problem (see section 6.7.2).

The Ministry of Education Regional Transport Advisors mentioned that the NZTA guidance should be updated as road environments have changed over time as well. Additionally, the existing guidance does not differentiate between the different types of PUDO sites that are likely to require different safety considerations. The Ministry of Education is currently writing guidance on 'transfer' bus stops.

PUDO locations are sited on or alongside roads managed by road controlling authorities; however, these authorities are not systematically informed of PUDO locations, except where an issue is raised by a transport service provider, a caregiver, or a community member. This makes it difficult for road controlling authorities to consider school bus activities in their road infrastructure and maintenance planning. An example was provided by a district council of a roadside location being used as a storage area as part of a temporary traffic management plan, but they were unaware the site was also used for a daily school service PUDO. Transport service providers also reported some maintenance issues with PUDO areas such as trees blocking sight lines. The responsiveness of councils to these concerns can vary from council to council.

6.3.4 Comparison with Australia (New South Wales)

The existing guidance on school bus stops in New Zealand was compared with guidance provided in New South Wales. There are thousands of rural informal school bus stops on rural school bus routes in New South Wales. These bus stops are not signposted, like in New Zealand, and their locations are generally arranged between bus operators and parents. The guidance available in New South Wales – *Advice for Choosing Locations of Informal School Bus Stops* (New South Wales Centre for Road Safety, 2016) – is the most comprehensive PUDO guidance in Australia, and therefore useful for comparison with practices in New Zealand.

The New Zealand and New South Wales guidance documents are compared in Table 6.3. The comparison in this table identifies some crucial safety considerations that the New Zealand guidance does not consider, including factors to consider when assessing sight distances; the location of bus stops relative to intersections, crests and curves and other bus stops; and more detailed guidance on setbacks for waiting areas.

Table 6.3 Comparing New Zealand and New South Wales school bus stop siting guidance documents

Factor	New Zealand guidance[a]	New South Wales guidance[b]
Sight distance	• School bus stops should be sited where they are clearly visible to motorists. (A table with recommended sight distances, by speed limit, is provided.)	• All school bus stops should be sited so that they are clearly visible to motorists. (Separate sightline guidance is provided for vehicles approaching from the front and behind the bus.) • Site distance calculations are adjusted considering obstructions from curves, crests, roadside vegetation, gradients, sealed and unsealed roads, and heavy vehicle volumes.
Adequate pull-in area	• Adequate pull-in shoulder or lane width is needed. Where this is unavailable, visibility is crucial.	• Buses should stop clear of traffic lane on road shoulder or verge. • Buses should not stop near crests or curves. • The condition of the shoulder should be considered.
Waiting area for students/ Hazards getting to the school bus stop	• Firm, dry waiting areas away from the road are needed. • Suitable road shoulder to walk on is needed. • Bus stops should not require pedestrian access via non-signalised level crossings or bridges/ without pathways.	• Cleared, firm, all-weather areas are needed. • Areas should be preferably 8 m away from traffic lanes, and a minimum of 4 m away. • Avoid waiting areas on outside of curves and ends of overtaking lanes. • Bus stops should not require pedestrian access via narrow bridges, culverts, roads with no shoulder, or non-signalised railway level crossings.
Location relative to intersections	• Not addressed	• Bus stops should be located on the departure from intersections (preferably 50 m from intersection)
Location relative to other bus stops	• Not addressed	• Bus stops on both sides of the road should be staggered so pedestrians can cross between backs of buses that stop around the same time. • Bus stops close together on the same side of the road should be consolidated to the safer site if access is adequate.
Weather conditions	• If a hard shoulder could not be provided for buses to pull into, the bus stop may need to be moved in winter.	• Bus stop location should be located where wet weather will not affect pedestrian access, waiting areas, parking areas, and bus pull-off areas.
Parking for parents/caregivers	• Approaching drivers need good visibility of vehicles pulling out. • May need to limit the number of students using these bus stops to avoid congestion. • Busy stops should be moved to safer locations.	• Bus stop location should have sufficient space for carers to drop off and pick up children. • Parking should be on the same side of the road as the bus stop. This should be separate to the area where children wait for the bus. • There should be clear and safe access from parking areas to where children wait for the bus.

[a] *Guidelines for the Safe Siting of School Bus Stops* (Waka Kotahi, 2018).
[b] *Advice for Choosing Locations of Informal School Bus Stops* (New South Wales Centre for Road Safety, 2016).

In addition to *Advice for Choosing Locations of Informal School Bus Stops*, the New South Wales Government (2019) developed a *Guide to Appointed School Bus Stops* for local councils. These two guidance documents were developed following recommendations from the School Bus Safety Community Advisory Committee (2012) to develop a standard methodology for fixed rural bus stop locations and design with 'best practice' examples. The *Guide to Appointed School Bus Stops* provides guidance on determining appropriate locations, layouts and features for 'formal' school bus stops in rural and urban areas under a Safe System approach. This involves considering:

- removing conflicts and risks
- behaviour of children and other pedestrians
- behaviour of motorists
- speed management
- other vehicle movements around bus stops.

These bus stops are chosen by bus operators or Transport for New South Wales and are approved by the road authority.

6.3.5 Prior research and recommendations into safety at PUDO locations

Baas et al. (2010) explored options for improving safety around PUDO locations, including improving school bus stops in rural areas. This includes providing parking for caregivers at afternoon bus stops to avoid the children having to cross the road (to parking areas on the other side). The seal could also be widened to enable buses to pull off the road, and improvements could be made where children must walk to the PUDO location. Baas et al. suggest that local authorities should focus on improving stops on high-speed, high-volume roads that are used in the afternoon by several children and that are likely to be used on a permanent basis.

As part of their research project, Baas et al. (2010) also prepared an extensive draft guide to improve safety at PUDO sites as an appendix to their research report. The aim of this guidance was to provide more comprehensive information about the principles and technical and safety considerations involved in the location and design of school bus stops and turning points on rural and urban roads and at schools. The draft guidance addresses many of the shortcomings of the guidance available in 2010 (and still in use), including many of the factors covered in New South Wales guidance. A hierarchy of potential treatments for PUDO locations is provided, including several examples of designs for roadside bus stops and bus stops at schools. The authors anticipated that this draft guidance would be finalised, approved and adopted as a formal guide or code of practice, but this was not progressed.

Successive Coroner recommendations since 2008 have also discussed safety around PUDO locations. Coroner Ho considered whether interactive LED signs or flashing lights positioned a calculated distance from rural bus stops would improve drivers' awareness of PUDO locations (New Zealand Coroners Court, 2022). Coroner Ho also suggested a risk matrix could be developed to assess likely school bus stop locations that are more dangerous than others, where the installation of such signs would be appropriate.

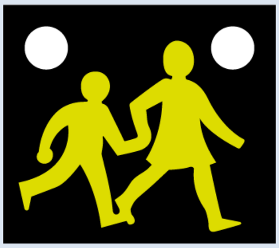
6.4 School bus signage, visibility and speed limits around buses

School buses running daily school bus routes, in both urban and rural environments, need to be clearly identifiable to other road users. Drivers need to be aware of potential hazards around school buses and understand how to drive safely around them. This includes slowing to the legal speed limit while passing a stationary school bus.

6.4.1 School bus signage and conspicuity

Vehicles operating as school buses must display a vehicle-mounted sign, as described in Schedule 1 of the Traffic Control Devices 2004 Rule and shown in Table 6.4. Further guidance on the use of these signs is provided on the NZTA website (Waka Kotahi, 2022f), including where the sign should be mounted on a vehicle, and that signs must not be installed on the inside of bus windscreens.

Table 6.4 Current school bus signage

Sign code and description	Sign
W17-1.1 School bus – 'school bus'	
W17-1.2 School bus – 'school'	
W17-1.3 School bus – 'children sign' plus flashing lights The flashing lights operate when doors open to load or unload children.	

The Ministry of Education does not specify which 'school bus' sign transport service providers should use, nor does the Ministry specify that buses have any additional signage or features to improve visibility. The static 'SCHOOL' or 'SCHOOL BUS' signs are the preferred signs in use by the transport service providers interviewed, as these are much cheaper and easier to source than the 'children sign' with flashing lights. When inspecting buses, Transport Contract Managers check that the correct signs are being used.

As an alternative approach to improving the visibility of their buses, some transport service providers have installed cheaper, alternative flashing lights, or have encouraged their drivers to use their hazard lights when loading and unloading students. Feedback from stakeholders suggests that flashing lights are most likely to be installed on buses that travel on high-risk roads.

Where there is advertising or other signage on the back of urban school buses, this can 'camouflage' the legal school bus signage – for example, as observed in Figure 6.3.

Figure 6.3 Example of advertising on the back of a school bus unintentionally camouflaging the 'SCHOOL' sign

6.4.2 Speed limits around buses

The Land Transport (Road User) Rule 2014[8] requires drivers to slow to at least 20 km/h when passing a stationary school bus stopped to drop off or pick up children. This rule applies for drivers travelling on both sides of the road past the bus.

6.4.2.1 Enforcement and compliance

Enforcement of speed limits around stationary school buses is challenging, given the bus itself is a 'moving' speed limit. To be enforceable, it must be proven that the 'SCHOOL BUS' sign was visible to motorists, that the bus was stationary, and that the vehicle passing the bus (in either direction) was exceeding 20 km/h. In the past, some NZ Police districts had attempted to enforce the speed limit by having an officer on the bus estimate the speed of passing vehicles. This required a high degree of judgement, which was problematic, and the resulting infringement could be contested.

Infringements data provided by NZ Police show that very few infringements are issued for exceeding 20 km/h passing a stationary school bus (Table 6.5). Several districts have issued less than five infringements over six years.

Table 6.5 Infringements for exceeding 20 km/h passing a stationary school bus, 2017–2021 (data from NZ Police)

Police district	2017	2018	2019	2020	2021	Total
Northland	0	0	1	0	0	1
Waitemata	0	0	0	0	0	0
Auckland	0	0	0	0	0	0
Counties Manukau	0	0	2	1	1	4
Waikato	10	3	0	1	2	16
Bay of Plenty	0	0	0	0	0	0

[8] See https://www.legislation.govt.nz/regulation/public/2004/0427/latest/whole.html for further information.

Police district	2017	2018	2019	2020	2021	Total
Eastern	6	5	3	0	2	16
Central	3	0	0	0	0	3
Wellington	0	1	0	0	2	3
Tasman	5	4	0	0	7	16
Canterbury	4	2	7	7	9	29
Southern	12	6	26	5	7	56
Total	**40**	**21**	**39**	**14**	**30**	**144**

6.4.2.2 Feedback from stakeholders

Transport service providers who were interviewed, including representatives who were also school bus drivers, expressed concerns about the 'terrifying' speed of some vehicles that pass them while dropping off or picking up children. This is particularly problematic for rural students who are exposed to higher-speed environments (Mackie, 2009). Transport service providers also reported poor compliance with the 20 km/h speed limit past school buses running as part of council-operated public transport networks, as these buses usually look identical to other urban buses except for displaying the 'school bus' sign.

Stakeholders mentioned it can be difficult to determine whether a school bus is stopped on rural high-speed roads. It was suggested that using the vehicles hazard lights or installing flashing lights may help draw drivers' attention to a stationary school bus. Some transport service providers have added stickers on their bus to remind motorists of the 20 km/h limit – for example, as shown in Figure 6.4.

Figure 6.4 Sign observed on a school bus reminding drivers to slow to 20 km/h when passing a stationary school bus

Stakeholders also mentioned previous awareness campaigns such as the 'Either way it's 20 k!' campaign. The importance of education around the speed limit was highlighted by several stakeholders who felt there was low awareness among drivers of the 20 km/h speed limit. The benefits of using media campaigns to promote giving school buses space (similar to giving cyclists space on the road) were also discussed. Further evidence on the efficacy of education campaigns is discussed in the section below.

6.4.3 School bus signage trials

In 2011, Transport Engineering Research New Zealand trialled different configurations of LED 20 km/h roundel signs, flashing beacons, and the existing standard static signs to evaluate their effectiveness in reducing vehicle speeds around stationary school buses. The authors recommended that LED speed limit school bus signs, as shown in Figure 6.5, be mandated as soon as possible, supporting a prior recommendation made by Baas et al. (2010).

Figure 6.5 Flashing LED '20' roundel sign on a school bus, as part of the 2011 trial (reprinted from Transport Engineering Research New Zealand, 2011, p. 13)

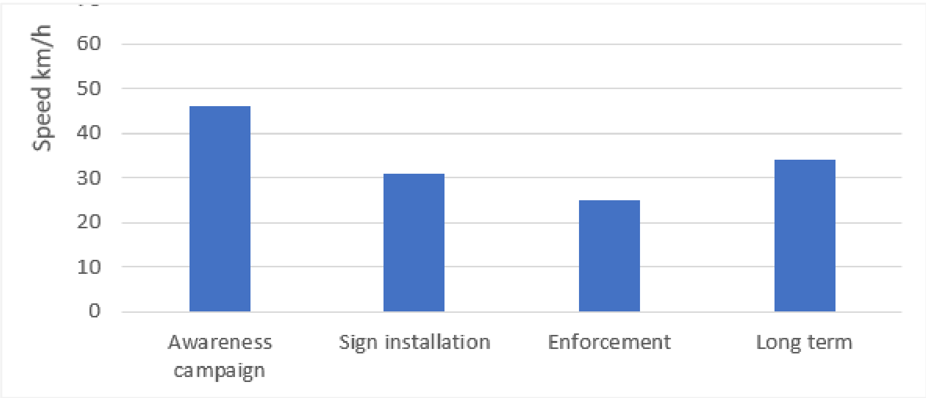
NZTA commissioned an extended trial in Ashburton during 2013 and 2014. The trial aimed to improve driver knowledge of the 20 km/h speed limit past stationary school buses and involved three stages delivered cumulatively:

1. a driver awareness campaign focusing on the 20 km/hr speed limit
2. LED signs on 30 buses that served Ashburton schools
3. targeted Police enforcement of the 20 km/h speed limit.

The LED signs used in this trial were designed to activate 20 seconds before the bus stopped and remained active until 20 seconds after the bus started moving again.

Figure 6.6 shows the model speeds after each stage of the trial on a road with a posted speed limit of 100 km/h. Note that the bars on this graph show the cumulative impact of each intervention as it was introduced and do not reflect the impact of each intervention in isolation. This shows that the flashing signs, when supported with an awareness campaign and enforcement, was most effective in reducing speeds past stationary school buses.

Figure 6.6 Modal speeds from Ashburton school bus sign trial on a road with a 100 km/h posted speed limit, showing the impact of cumulative interventions over time (adapted from Mackie Research, n.d.)



Stakeholders viewed the signage trials as an important step towards controlling speeds around stationary school buses. The signs appeared to be progressing towards implementation on the school bus fleet. However, this was stalled due to the cost of retrofitting the signs. The Traffic Control Devices 2004 Rule (Schedule 3)[9] also needs to be amended to make these signs legally enforceable. To date, they have not been implemented outside of the trials.

A NZTA funded research project is currently underway trialling interventions to improve school bus safety on SH60. This trial includes testing new signage on buses and the delineation of rural school bus stops. The types of signs being trialled include active signs with flashing lights, as well as signs reminding drivers of the 20 km/h speed limit past stationary school buses.

6.4.4 International comparison

Many comparable countries require drivers to slow down or come to a full stop while school buses are picking up or dropping off students.

6.4.4.1 Australia

Speed limits around school buses vary across Australia. South Australia requires drivers to reduce their speed to 25 km/h around stationary school buses (Government of South Australia, 2000). New South Wales and Queensland require drivers to slow down to 40 km/h around buses in ‘school bus stop zones’. Drivers in New South Wales and Tasmania must also slow to 40 km/h when travelling in the same direction as buses with ’40 when lights flash’ signs when they have their ‘wig wag’ lights flashing, as seen in Figure 6.7 (New South Wales Government, 2022b; Tasmanian Government, 2021).

[9] See https://www.nzta.govt.nz/resources/rules/traffic-control-devices-schedules#schedule1 for further information.

Figure 6.7 Flashing ‘wig wag’ lights and signage on a New South Wales school bus (reprinted from New South Wales Government, 2022b)

Victoria, Queensland and Western Australia currently do not have any speed limit requirements around school buses (Government of Western Australia Department of Transport, 2022; Queensland Government, 2022; VicRoads, 2021).

The visibility of school buses was reviewed extensively as part of an inquiry into school bus safety in rural and regional New South Wales (School Bus Safety Community Advisory Committee, 2012). The inquiry committee made several recommendations for improving the visibility of school buses, including improvements to the visibility and effectiveness of flashing warning lights, limiting the nature and extent of advertising on the rear of buses, and the use of fluorescent reflective tape on the rear and side of school buses. The combination of reflective tape and flashing signage would improve visibility of buses after dark and in fog-prone regions. It is not known if these recommendations were adopted.

6.4.4.2 United Kingdom

In the United Kingdom, drivers are encouraged to drive slowly around stationary school buses but are not required by law to do so. The Road Vehicles Lighting [Amendment] Regulations 2017 allow school buses fitted with retro-reflective school bus signs to have their hazard lights on when students are boarding or alighting.

6.4.4.3 North America

In all states in the USA and across the Canadian provinces, motorists travelling in both directions on streets with no raised medians are required to come to a full stop when a stationary school bus has extended its stop arm and has flashing lights on, as seen in Figure 6.8 (Hawkins et al., 2012; National Highway Traffic Safety Administration, 2012; Transport Canada, 2020). On streets with raised medians, stop-arm laws vary from state to state. Some states only require vehicles travelling in the same direction as the school bus to stop.

Figure 6.8 School bus in Buffalo, New York, with flashing red lights and extended stop arm (reprinted from Hawkins et al., 2012, p. 9)

Similar to the difficulties in enforcing the 20 km/h speed limit in New Zealand, stop-arm violations (passing a school bus with an extended stop arm) are also poorly enforced in the USA. A 2019 survey conducted across 39 states with over 130,000 bus drivers recorded 95,319 stop-arm violations (Katz, Kissner, et al., 2021). At least 22 states in the USA passed legislation allowing ‘stop-arm cameras’ on buses for the enforcement of stop-arm violation laws. Many of these states have been successful at increasing enforcement. Muscogee County, Georgia, reported that the number of violations decreased by 50% from 2011 to 2012 after implementing 50 cameras on their school buses (Katz, Kissner, et al., 2021). A stop-arm camera provider, American Traffic Solutions, reports that in the 2013/14 school year, 99% of drivers who were cited for stop-arm violations did not receive a second violation (American Traffic Solutions, 2014). This may be an indication of the effectiveness of enforcement.

6.4.5 Prior research and recommendations

Poor compliance with the 20 km/h speed limit passing a stationary bus was discussed in Baas et al. (2010). In addition to recommendations regarding flashing signage discussed above, the authors recommended that the Land Transport (Road User) Rule 2004 be amended as follows to enable more effective enforcement.

- The 20 km/h speed limit and its application should be reviewed. The limit around school buses should be the same as that in other high-risk areas such as outside the school gate, in shared main street spaces and near road works. This uniformity is likely to increase driver awareness and the level of compliance.
- The speed limit should apply whenever approved warning lights are activated, including when the bus is moving to or away from a bus stop.
- The sign should only be activated when students are very likely to cross the road.

Baas et al. (2010) also noted there are advantages in having the speed limit and signage around schools the same as that around school buses. At the time this research was undertaken, 40 km/h speed zones were permitted around schools; however, under the new Land Transport Rule: Setting of Speed Limits 2022, most schools in New Zealand will have 30 km/h speed limits by 2027.

In 2022, concerns regarding speeds passing school buses were also raised by Coroner Ho (New Zealand Coroners Court, 2022). However, in this case the bus wasn’t stationary and the driver who struck the student didn’t see the bus because his view was obstructed by another vehicle. In her recommendations, Coroner Ho:

- supported prior coronial findings regarding flashing lights on buses and safety awareness campaigns, but also suggested more permanent, fixed flashing roadside signage should be considered to warn oncoming vehicles to expect a school bus operating on the route ahead
- commented on the appropriateness of ‘full stop’ laws and stop arms on school buses in the New Zealand context – considering New Zealand’s typical winding road topography and the sight distance required for vehicles to stop in time, barrier arms on rural school buses were deemed impractical and possibly dangerous
- noted with concern that the 20 km/h rule does not apply when school buses are moving off from a PUDO, yet children are still vulnerable during this time
- recommended that a nationwide campaign educating motorists on the rules around passing school buses be developed and implemented.

6.5 Fleet profile, vehicle selection and vehicle technologies

The age and size of a vehicle used as a school bus, combined with the vehicle safety technologies installed on the vehicle, affect both the likelihood of a crash occurring and the severity outcomes for bus occupants and other road users should a collision occur.

Note that this section focuses on vehicle standards, vehicle technologies and the school bus fleet. Specific rules and standards regarding seating, seatbelts and seatbelt anchorages (where fitted) are discussed in more detail in section 6.6 regarding bus occupant protection.

6.5.1 Vehicle standards and contractual requirements

School buses are classified as passenger service vehicles (PSVs) and are subject to the relevant rules and standards for PSVs set by The Ministry of Transport Te Manatū Waka, primarily the Land Transport Rule: Passenger Service Vehicles 1999[10] (the PSV Rule). The PSV Rule sets minimum standards for passenger service vehicles including for seating, exits and entrances, aisles, stability, and structural strength. These standards are checked regularly through certificate of fitness inspections.

6.5.1.1 Contractual requirements

The Ministry of Education sets additional vehicle standards for school buses through their contracts with transport service providers, primarily through average and maximum fleet age requirements. The maximum age of any vehicle used as a school bus is 26 years for large PSVs or 15 years for small PSVs. This requirement is set as an emission standard as part of the tendering process to reduce carbon emissions from the school bus fleet. Transport service providers are also required to install and use an approved telematics system on their school buses. Directly resourced schools can choose additional safety standards through their contracts with transport service providers. Compliance with contractual requirements is regularly checked through the Ministry of Education auditing process, as described in section 6.10.

Urban bus services contracted by a council adhere to standards under the *Requirements for Urban Buses in New Zealand* (the ‘RUB’), which includes additional standards covering safety, accessibility, and emissions. This includes a maximum vehicle age of 20 years, and buses must have closed-circuit television (CCTV) and telematic systems installed.

[10] See https://www.nzta.govt.nz/resources/rules/passenger-service-vehicles-1999-index/ for further information.

6.5.1.2 International comparison

A list of all the relevant bus safety standards that apply in Australia (the Australian Design Rules), Canada, Europe and USA is provided in Appendix D.

The USA and Canada have specific vehicle standards for school buses, with both countries having dedicated school bus fleets. In the USA, the specific standards for school buses are Federal Motor Vehicle Safety Standard (FMVSS) 217 for emergency exits and window retention and release, and FMVSS 221, which specifies requirements for the strength of the body panel joints in school buses. Canada has specific standards for school buses, including Canadian Motor Vehicle Safety Standards (CMVSS) 217, 220, 221, and 301, and Canadian Standards Association (CSA) D250-22. CSA D250-22 is a specific standard for school buses developed by the Canada Standards Association Committee on School Bus Construction Standards.

Australia (Australian Design Rules) and Europe (United Nations Economic Commission for Europe (UNECE) Regulations) include provisions for bus safety within their general standards and have also developed new standards to accommodate new technologies. For example, UNECE Regulation No. 46 *Devices for Indirect Vision* includes provisions for reversing and blind spot cameras. UNECE Regulation No. 107 *Uniform Provisions Concerning the Approval of M2 or M3 Buses* was developed especially for light and heavy buses.

6.5.2 Fleet profile

The New Zealand school bus fleet is diverse. Transport service providers often use a mix of vehicle types on their school bus routes, including vans, truck buses, formerly urban buses, and coaches. This includes vehicles manufactured locally as well as imported from other countries such as Australia and Japan.

Table 6.6 presents the top five vehicle makes and models used for Ministry of Education Daily Bus services, based on data sourced by the Ministry of Education from transport service providers as part of the tendering process for Daily Bus routes in late 2021.

Table 6.6 Most frequent makes and models of school buses used for Daily Bus services, as provided to Ministry of Education in 2021

Make	Model(s)	Number in fleet
Mitsubishi	Rosa, Fuso, Canter	491
MAN	TGL, TGM	470
Isuzu	F and M Series	146
Ford	Transit	116
Nissan	Civilian, Scorpion	69

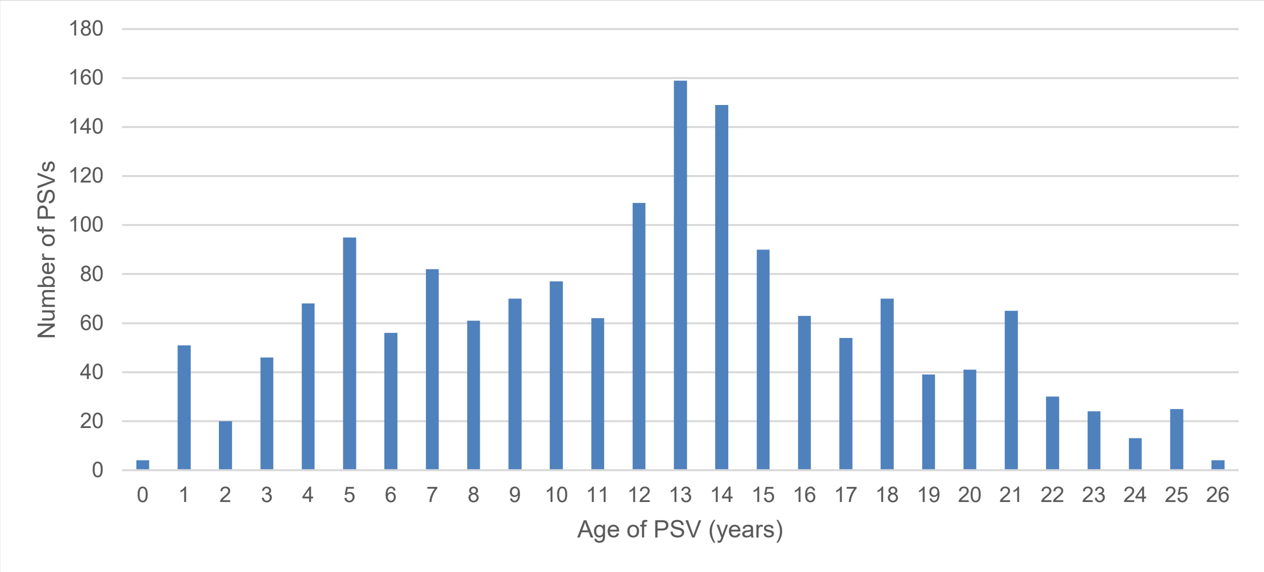
Vehicles operating as school buses are classified as PSVs and further classified as either:

- small PSVs with 12 seats or less, including the driver
- large PSVs with more than 12 seating positions.

The data provided by Ministry of Education indicate approximately 5–7% of the fleet are small PSVs, with the most common makes and models of small PSVs being the Toyota HiAce and Ford Transit.

The same dataset was analysed to determine the age profile of school buses, as shown in Figure 6.9. This figure shows vehicles used for Daily Bus services range from 0 to 26 years old, with a peak around 12–14 years.

Figure 6.9 Ministry of Education Daily Bus services: vehicle age, as provided to the Ministry of Education in 2021



The variation in age, size, country of manufacture and vehicle type means that a wide range of combinations of safety features are possible across the school bus fleet. School buses range from 26-year-old truck buses with minimal safety features to new buses designed to Australian standards that include a range of safety features and occupant restraint systems.

6.5.2.1 Feedback from transport service providers

Transport service providers do not tend to have dedicated school bus fleets, with the vehicles in their fleet often used for different purposes.

The main factors that influence the type of vehicles purchased by transport service providers for use on school bus routes were price, operating costs and the Ministry of Education contractual requirements. Providers generally consider the types and ages of vehicles run on certain routes by, for example, putting newer truck buses into tougher operating environments (gravel roads, snow, and ice). This is primarily because newer buses are less likely to break down, and therefore can operate further away from workshops.

Generally, transport service providers believe newer buses are safer buses as they are more likely to have better safety features, including reversing cameras, anti-lock braking systems and cruise control. Transport service providers that also run urban buses for council public transport networks commented that once their urban buses reach the maximum age of 20 years (as required in the RUB), these are rotated into their school bus fleet.

6.5.3 Vehicle safety technologies

Vehicle technologies help ensure the safety of vehicle occupants and other road users. A list of technologies that could be present in or applied to the school bus fleet are summarised in Table 6.7.

Table 6.7 In-vehicle road safety technologies (adapted and expanded from Pyta et al., 2022, p. 13)

Vehicle technology	Description
Autonomous (or automated) emergency	Uses sensors to detect the presence of a potential hazard in front of the

Vehicle technology	Description
braking (AEB)	vehicle and, where the driver has not done so in time, to apply the brakes to avoid a collision or to mitigate its severity.
Lane departure warning/Lane keep assist (LDW/LKA)	Uses sensors to detect the position of the vehicle in its lane and warns the driver if the course of the vehicle is gradually veering out of its lane and/or provides corrective directional control, through steering action or application of brakes on one side of vehicle.
Intelligent speed assist/adaptation (ISA)	Uses digital map data and/or visual data from a camera to identify the local speed limit, warns the driver if the limit is being exceeded and, at the driver's discretion, can limit the vehicle speed accordingly.
Rear collision warning (RCW)	Camera/audio system that alerts the driver of objects that are to the rear of the vehicle. Typically designed to assist with reversing manoeuvres.
Driver monitoring systems, including: • driver drowsiness and attention warning (DDAW) • advanced driver distraction warning (ADDW)	Monitors the status of driver alertness and attention to the driving task and warns the driver if they are impaired. Systems detect status either directly (eg, by eye-monitoring sensors) or indirectly by identifying driving style behaviours that are characteristic of an impaired driver.
Fleet management telematics (telematics)	Allows the sending, receiving and storing of information relating to the vehicle via telecommunication devices (information may include location, speed, idling status, fuel consumption and driver inputs to controls such as accelerator and steering). This information can be used for fleet management purposes such as providing safer-driving feedback advice and informing maintenance schedules.
Alcohol interlock systems (AIS)	Automatic control system that is designed to prevent driving with excess alcohol by requiring the driver to blow into an in-car breathalyser before starting the ignition. The AIS can be set at different levels and limits.
Tyre pressure monitoring system	Monitors and reports tyre pressures information to the driver of the vehicle, either via a gauge, pictogram display, or a simple low-pressure warning light.
Vulnerable road user detection	Using either direct vision standards, cameras (CCTV) or vulnerable road user detection systems to reduce blind spots around buses and coaches.
Emergency stop signal	Automatically and simultaneously activating all stop and direction indication lamps when the vehicle speed is above 50 km/h and a harsh braking event occurs. A harsh braking event is defined as 4 m/s^2 for passenger buses.
Event data recorders	Records technical vehicle and occupant information for a brief period of time before, during and after a crash or near-crash event.
Electronic stability control (ESC)	Prevents wheels from locking up during braking. This improves vehicle stability while braking and generally provides shorter controlled stopping distances.

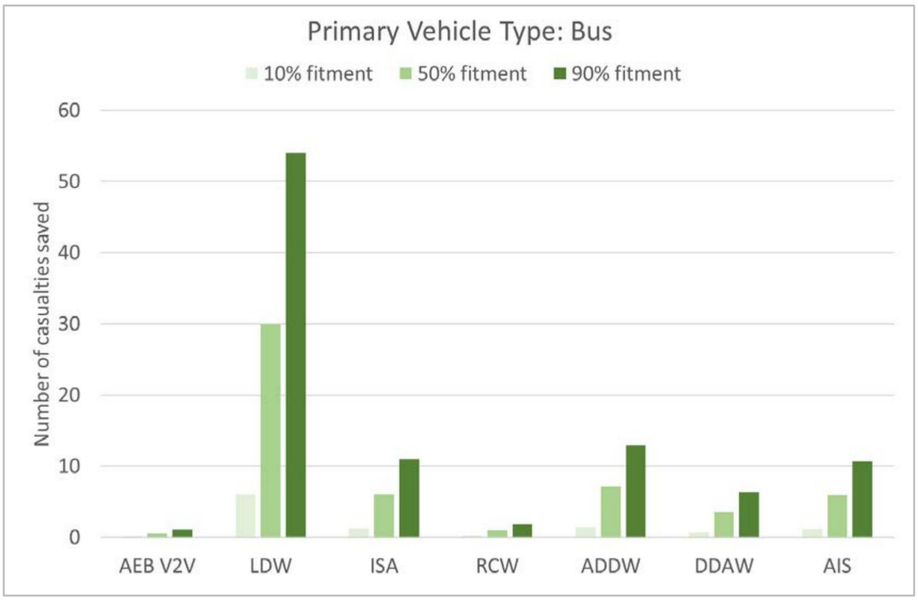
6.5.3.1 Effectiveness of vehicle technologies in New Zealand

Pyta et al. (2022) investigated the effectiveness of in-vehicle safety technologies and explored the best ways to increase the uptake of these technologies in New Zealand. The authors undertook a literature review to determine effectiveness estimates (or crash reduction factors) to avoid or mitigate injury, including where the target vehicle included buses (Table 6.8). Using crash data for 2016 to 2020 from CAS, the authors estimated the number of casualties that would have been prevented and the corresponding cost savings had vehicles been fitted with different types of vehicle technologies. This includes a breakdown by vehicle type, including buses (Figure 6.10).

Table 6.8 Vehicle technology effectiveness estimates where the target vehicle or population includes buses (adapted from Pyta et al., 2022, p. 64)

Technology	Effectiveness estimates by severity (casualty level)					Confidence
	Fatal (avoid)	Fatal (mitigate)	Serious (avoid)	Serious (mitigate)	Minor (avoid)	
Autonomous emergency braking (vehicle to vehicle only) (AEB V2V)	0%	25%	0%	25%	5%	Low
Lane departure warning (LDW)	20%	0%	20%	0%	20%	Low
Intelligent speed assist (ISA)	9%	9%	1.5%	17%	20%	High
Rear collision warning (RCW)	33%	0%	33%	0%	33%	Low
Driver drowsiness and attention warning (DDAW)	17%	0%	17%	0%	17%	Low
Advanced driver distraction warning (ADDW)	17%	0%	17%	0%	17%	Low
Alcohol interlock systems (AIS)	13%	0%	13%	0%	13%	Low

Figure 6.10 Number of casualties saved by each technology assuming varying levels of fitment in buses, 2016–2020 (reprinted from Pyta et al., 2022, p. 74)



The analysis showed that lane departure warning systems had the highest number of associated casualty savings for buses, followed by advanced driver distraction warning systems. The technologies with the greatest potential cost savings, assuming a baseline of 0% fitment moving to 100% fitment, were lane departure warning ($19 million), and intelligent speed assistance ($9 million).

6.5.3.2 Vehicle safety technology requirements in Europe (heavy vehicles and passenger vehicles)

In the European Union, the General Safety Regulation is a legislative framework designed to improve road safety (Regulation (EC) No. 661/2009). Initial requirements for heavy vehicles included electronic stability control, advanced emergency braking, and lane departure warning. These countermeasures contributed to a 28% reduction in road fatalities between 2009 and 2018. To achieve Vision Zero by 2050, the EU commissioned the Transport Research Laboratory to conduct a series of studies to identify and evaluate new technologies that could be included in future regulations (European Commission et al., 2015; European Commission et al., 2017). The General Safety Regulation was updated in 2019 and included changes that will be mandatory for all new vehicle registrations in Europe from July 2024. Vehicle technologies relevant to passenger bus safety include:

- intelligent speed assist
- emergency lane keeping system
- advanced emergency braking
- vulnerable road user detection
- reversing detection or camera
- alcohol interlock devices
- emergency stop signal.

In addition, more advanced driver distraction warning systems and event data recorders will be required by 2028 (General Safety Regulation (Regulation (EC) No. 661/2009). Buses must also currently meet the Pole Side Impact Occupant Protection Standard, a pole side impact crash test for passenger buses as per UNECE Regulation No. 135.

Transport for London (2018) developed a Bus Safety Standard as part of its Vision Zero strategy. This included an evaluation of a range of possible safety measures and resulted in the following new safety requirements for London Buses:

- advanced emergency braking
- intelligent speed assistance
- the Bus Vision Standard permitting system, which sets a minimum standard (star rating) based on an assessment of how much a driver can see through windows and mirrors and how big the resulting blind spots are – blind spots can be minimised using mirrors and camera monitor systems
- acoustic and visual conspicuity, which makes the bus more conspicuous to other road users, especially vulnerable road users, including acoustic vehicle alerting systems and additional marker lights
- impact protection for vulnerable road users, which reduces the severity of injuries for road users outside the bus in a collision through improved energy absorption and impact protection of windscreen wiper mount points.

6.5.4 Vehicle safety technologies in the New Zealand school bus fleet

The degree to which vehicle safety technologies are present within New Zealand's school bus fleet is not known, except for those that are mandated in school bus contracts, including:

- *telematics systems*, which are required by both the Ministry of Education and for urban buses funded by councils
- *CCTV systems*, which are not required by the Ministry of Education, but are required for urban buses under 'the RUB'.

6.5.4.1 Telematics

Telematics systems allow the Ministry of Education and transport service providers to monitor excess speed, harsh braking, and cornering. The Ministry of Education provides a list of approved telematic systems that transport service providers can use, and information generated from these systems can be accessed by both the provider and the Ministry of Education. As part of the auditing process, the Ministry of Education requires transport service providers to demonstrate that they are actively using their telematics systems to monitor driver behaviour.

Pyta et al. (2022) found little evidence in the literature regarding the effectiveness of 'fleet management' telematics systems in reducing crashes. The authors suggest this is due to telematics systems being primarily used to collect data from vehicles for fleet management purposes or to analyse events that occurred prior to an incident, rather than being used to monitor and respond to driver behaviour in real time. De Oliveira et al. (2019), as cited in Pyta et al. (2022), found that the improvement in driving behaviour occurred when drivers were conscious of being monitored, with the greatest improvement observed when this is coupled with appropriate feedback and training in response to undesirable behaviours.

Stakeholder feedback

Each telematics system approved by the Ministry of Education provides different end-user interfaces and functionality, and each transport service provider interviewed uses these systems to differing degrees in monitoring driver behaviour. Systems used currently include GreenRoad, EROAD, iBright and Tracker.

Some transport service providers are highly diligent in monitoring their telematics systems and use it to actively incentivise good driving behaviour and to follow up on poor driving behaviour. Reports can be pulled from the telematics system for managers to review and follow-up on. Drivers can also get alerts in real time, allowing them to rectify their driving behaviour. Some systems such as GreenRoad and EROAD have a scoring system that rates the driving of bus drivers across a company/depot. Some transport service providers have a performance pay scheme that includes incentives for safer driving, including by avoiding telematics alerts. However, this usually only applies to the urban fleet. Some transport service providers reported specific procedures for managing driver behaviour when drivers scored less than minimum requirements. Telematics have also been useful after incidents as reports can be provided to the Police to help their investigations.

There is some concern among transport service providers about the accuracy of some information generated by the telematics system. Speed readings tend to be accurate; however, measures such as sharp cornering or harsh braking may be less accurate. Some events that should have alerted the system may not do so, and sometimes the system may send an alert for a non-event.

While the Ministry of Education has access to data collected by these systems, to date this is not actively being used to monitor driver performance across transport service providers because the Ministry of Education has not yet been able to integrate and manage these data. The range of systems in use means integrating this information is complex.

6.5.4.2 CCTV

CCTV is not required on buses contracted by the Ministry of Education. This includes both internal cameras to monitor the driver and passengers and external cameras installed for blind spot monitoring.

Urban buses operated for councils must have CCTV installed, as required by the RUB. The CCTV systems on urban buses must allow drivers to view multiple views, including views of the front and rear doors, as well as three blind spot cameras (left flank, right flank and reverse cameras). There are also combined systems available combining CCTV and driver voice recording or combining CCTV with telematics.

Stakeholder feedback

Because CCTV is not required under Ministry of Education contracts, school buses will only have CCTV if transport service providers choose to have the camera system installed. As such, the use of internal CCTV on Ministry of Education funded school bus services is rare, except on truck buses where there is limited visibility of students from the cab, or on school buses that were formerly used as urban buses where CCTV was previously installed as required under the RUB.

Most transport service providers supported the use of CCTV in school buses to protect both the passengers and the driver. They encourage safe driving behaviours and support incident investigation. All the transport service providers that did have CCTV installed had observed improved student behaviour when compared to buses without CCTV.

One transport service provider who operates urban school buses with CCTV on behalf of a regional council described how they were able to extract still images from the cameras and provide these to schools as evidence of bullying or bad behaviour. The school is then able to address the issue. For serious incidents, videos are provided to the Police to investigate.

However, transport service providers are reluctant to install CCTV as it is an additional cost. One large provider explained that they have not installed CCTV on school buses because they are not a requirement and are expensive, and the footage is inaccessible on more remote routes until the bus is brought into a workshop for a service.

6.6 Bus occupant protection

Occupant protection includes the standards, devices and systems that work to minimise the severity of injury to drivers and passengers during a collision or harsh-braking event. In New Zealand, the requirements and standards for these protections are set out in Land Transport Rules, some of which reference an ADR or regulation set by UNECE. Different rules may apply to light buses and heavy buses:

- *Light buses* carry more than nine people but with a gross vehicle mass (GVM) of 3,500 kg or less. This category is split further into two categories: light buses with less than 12 seats (MD1) and light buses with more than 12 seats (MD2)
- *Heavy buses* (sometimes called omnibuses) have a GVM of more than 3,500 kg. There are three classes of heavy bus: omnibuses with a GVM of 3,500 kg to 4,500 kg (MD3), omnibuses with a GVM of 4,500 kg to 5,000 kg (MD4), and heavy omnibuses with a GVM over 5,000 kg (ME).

As most of the vehicles in the school bus fleet are classified as heavy buses, this section focuses primarily on rules and standards that apply to heavy buses, focusing on the following areas of occupant protection:

1. rollover protection
2. passenger loading (seating vs standing passengers)
3. compartmentalisation
4. seatbelts.

6.6.1 Rollover protection

The requirements for structural strength and rollover protection are set out in the PSV Rule, with heavy buses required to meet at least one of the following standards:

- one of the approval methods of UNECE Regulation No. 66 – *Uniform technical prescriptions concerning the approval of large passenger vehicles with regard to the strength of their superstructure*[11]
- one of the approval methods of ADR 59/00 – *Omnibus rollover strength*[12]
- the structural strength specifications in 7.5(3) to 7.5(14) of the PSV Rule.

ADR 59/00 is also the current design standard for buses in Australia.

6.6.2 Passenger loading (seated and standing passengers)

In the event of a crash or sudden braking incident there is a high risk of injury associated with standing on buses, including the potential for multiple fatalities and serious injuries (School Bus Safety Community Advisory Committee, 2012). Additionally, some standing students may be too small to hold a metal handrail effectively and are at higher risk of being struck by heavy school bags or thrown through the windscreen, particularly when the bus is travelling at high speed.

6.6.2.1 Regulation of seated and standing passengers

Under the PSV Rule, buses must display a Certificate of Loading, which specifies the maximum number of seated and standing passengers (excluding the driver). The number of passengers is divided into age categories: ‘adult’, ‘secondary’, ‘intermediate’ and ‘primary’. The maximum number of standing passengers is determined based on the area available within the bus for standing passengers. Standing passengers are not permitted if seatbelts are installed.

When determining the maximum number of seated passengers, the PSV Rule allows three primary or intermediate school children to sit in the same space as two adults or secondary school-aged children. This Rule is a legacy of a time when most buses had bench seats, and still applies even when individual, moulded seats are provided. This allows three children to be seated across two formed seats and enables school buses to carry more students and run more efficiently – approximately 30% fewer buses are needed for school services than would otherwise be the case (Te Manatū Waka, 2018).

6.6.2.2 Contractual requirements

The school bus contracts that commenced in 2022 required bidders to confirm that seats would be provided for each eligible student (Ministry of Education, 2020). However, transport service providers are allowed to carry standing passengers if the actual number of eligible students is greater than the number released by the Ministry of Education with the request for proposal.

Standees are permitted on urban buses on school routes funded by councils, as per the requirements in the RUB. Urban buses also have accessible seating, which reduces the seating capacity and increases the standing capacity on school runs.

6.6.2.3 Feedback from stakeholders

Transport service providers were supportive of disallowing standees for safety reasons. However, they recognised the nationwide problem of driver recruitment and retention, which could affect their ability to

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[11] See https://op.europa.eu/en/publication-detail/-/publication/69a98949-88be-4e2a-bcb7-d26d4e8778b3/language-en for further information.

[12] See https://www.legislation.gov.au/Series/F2007L04077 for further information.

provide more services to offset the reduction in bus capacity. School buses also tend to be fuller at the start of the year than at the end of the year.

On urban buses funded by councils, the bus will start to fill up as it moves through the city and gets closer to the school, and vice versa on the outbound route. The councils rely on the bus operators' observations of bus capacity to ensure that where students are required to stand, they are not standing for too long. Drivers are expected not to compromise safety by overloading the bus.

6.6.3 Compartmentalisation

Compartmentalisation is the concept of providing passive protection to bus passengers by surrounding them with closely spaced, heavily padded seats. Specific requirements for compartmentalisation include setting minimum requirements for seat back height, seat back width, padding on the rear of the seat back, and seat spacing requirements.

6.6.3.1 Effectiveness of compartmentalisation

Recent studies highlight the limitations of compartmentalisation in containing passengers in the event of a collision. Chang et al. (2021) reported on two bus crash demonstrations using full-scale anthropomorphic test devices. The demonstrations showed that compartmentalisation offered limited protection for unrestrained passengers, including when seated both properly and in common out-of-position configurations. In particular:

- The benefits of compartmentalisation are only fully realised when all passengers are seated upright, facing forward, with their backs contacting the seat. This is seldom realised when considering the normal behaviour of school children on buses.
- The interior surroundings affect the safety of passengers during an incident. The protective environment varies depending on the physical characteristics of the compartment, the size of the passenger, and the environment (whether there are other passengers behind, in front of, or across from each other).
- The type of crash determines the extent of potential harm to passengers. Compartmentalisation is most effective in forward collisions, but the protective intent of compartmentalisation is compromised in other types of collisions, particularly rollovers and side impacts.

In addition, there has been increasing evidence that compartmentalisation is not sufficient to protect passengers in all types of crashes. In its special investigation report on two school bus crashes, and its review of previous investigations it had undertaken, the National Transportation Safety Board (2018b) indicated that compartmentalisation fails to provide protection to occupants in school buses that are involved in lateral and rollover collisions. These types of collisions expose unbelted passengers to injury due to passengers:

- colliding with injury-producing components within the vehicle
- being in the intrusion zone
- being thrown out of their seating compartments, making compartmentalisation ineffective
- being ejected from the vehicle.

Due to the limitations in the compartmentalisation approach, both Chang et al. (2021) and the National Transportation Safety Board (2018b) highlight the need for seatbelt systems to further mitigate personal injury during a collision.

6.6.3.2 Vehicle standards for compartmentalisation – New Zealand and international comparison

The PSV Rule requires that if seatbelts are not installed, every forward-facing passenger seat must have either another seat, a partition or a guard rail positioned no more than 1 m in front of the seat. The Land Transport Rule: Seats and Seat Anchorages 2002[13] does not require buses to be compliant with the features necessary for effective compartmentalisation, such as high seat backs or padded seat backs.

In Australia, ADR 66/00 – *Seat strength, seat anchorage strength and padding in omnibuses*[14] specifies requirements for the strength of seats and seatbelt anchorages, and for protecting occupants through padding. This standard includes requirements for compartmentalisation/padding of seat backs.

The USA and Canada have specific vehicle standards for school buses, with both countries having dedicated school bus fleets. In the USA, FMVSS 222[15] includes requirements for compartmentalisation in school buses by setting minimum requirements for seats, including seat height, position and cushioning on contactable surfaces.

6.6.3.3 Compartmentalisation on New Zealand school buses

The degree to which compartmentalisation is provided across the current school bus fleet is unknown and likely to be varied. The type of seat and padding depends on the type of vehicle (eg, an urban bus versus a coach), where it was constructed (eg, to Australian versus New Zealand design standards), and the costs to transport service providers associated with outfitting and maintaining seats.

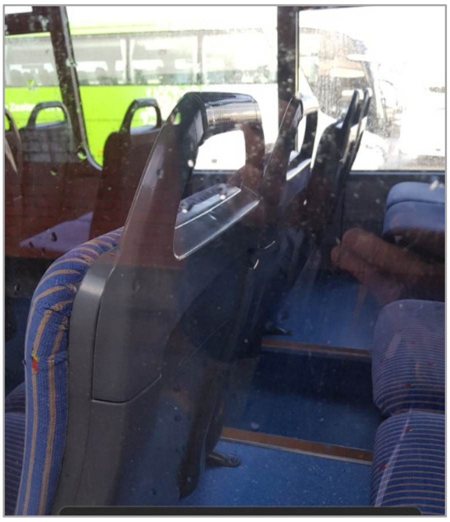
Under the RUB, seats on urban buses must consist of either a fabricated frame or moulded shell. They must also be hard-wearing and easy to clean, and therefore are usually constructed with a hard plastic shell and no cushioning on the rear of the seats. Bus builders also provide an option of building school truck-buses with hard-backed seats and no seatbelts, as shown in Figure 6.11. These types of seats offer little protection to bus passengers through compartmentalisation.

[13] See https://www.nzta.govt.nz/resources/rules/seats-and-seat-anchorages-2002/ for further information.

[14] See https://www.legislation.gov.au/Series/F2006L02312 for further information.

[15] See https://www.federalregister.gov/documents/2007/11/21/07-5758/federal-motor-vehicle-safety-standards-seating-systems-occupant-crash-protection-seat-belt-assembly for further information.

Figure 6.11 Example of hard plastic-backed seats on a New Zealand school bus (truck bus)



6.6.4 Seatbelts

The use of seatbelts and other restraints by adult and child vehicle occupants has been shown to be an effective safety measure (Austroads, 2021). Seatbelts retain passengers within the seating compartment and provide occupant protection in collisions involving high levels of deceleration such as a head-on crash, or where occupants are at risk of being ejected from the vehicle, such as in a rollover event (Baas et al., 2010).

6.6.4.1 Regulation of seatbelts in New Zealand

The Land Transport Rule: Seatbelts and Seatbelt Anchorages 2002[16] sets out the minimum requirements for seatbelts on buses:

- Light buses (class MD1/MD2) must have seatbelts in all seating positions, with the minimum requirements being lap-and-diagonal retractor seatbelts in all seats except for middle seating positions where lap seatbelts are permitted.
- Heavy buses (class MD3/MD4/ME) are not required to have seatbelts for the driver or passenger.

Where seatbelts are installed on heavy buses, these must meet all the requirements in this Rule. This means they must be operational and will be inspected through the Certificate of Fitness process.

The Land Transport (Road User) Rule 2004 clauses 7.6 to 7.11 set out the requirements for seatbelt and restraint use. Drivers and passengers are required to wear seatbelts where they are installed. However, bus drivers are not responsible for ensuring passengers are wearing seatbelts (as per the exemption given in clause 7.11[4]).

6.6.4.2 Previous research in New Zealand

NZ Transport Agency research report 408 (Baas et al., 2010) investigated the benefits and costs of installing seatbelts on school buses in New Zealand. It was found that most crashes that resulted in injuries to school bus occupants between 1987 and 2008 involved a hard braking event and/or a frontal collision with another

[16] See https://www.nzta.govt.nz/resources/rules/seatbelts-and-seatbelt-anchorages-2002-index for further information.

vehicle or stationary object. The authors suggested that had lap-sash seatbelts been worn by occupants of those crashes, some injuries might have been less severe. Considering the costs of mandatory retrofitting seatbelts into school buses, it was estimated this would return a cost–benefit ratio of 0.14. This analysis only considered social costs of injuries in collisions recorded in CAS and did not consider the benefit of preventing or reducing injury severity in non-collision events.

A further evaluation of the costs of mandating seatbelts on Ministry of Education funded services was undertaken for the Ministry in 2018 (Deloitte, 2019). At the time it was estimated that introducing seatbelts would cost in the region of $56 million to $87 million per year initially, with an ongoing cost of $19 million per year. This would be in addition to the cost of a 'no standing' policy, which is estimated to cost $14 million to $26 million per year. Several limitations and unintended consequences for these policies were identified, including impacts on ineligible students currently using school bus services, the capacity and capability of the industry in retrofitting seatbelts, and concerns regarding how seatbelt use will be enforced.

6.6.4.3 International approaches

In Australia, ADR 68/00 – *Occupant protection in buses*[17] requires retracting three-point seatbelts on all passenger seats in heavy buses weighing over 3,500 kg (categories MD3, MD4 and ME). ADR 68/00 also requires a seat anchorage strength of 20 g, which is double the requirement for seat anchorages in UNECE Regulation No. 80 (10 g). This requirement was to accommodate the potential for bus rollover crashes at higher speeds (School Bus Safety Community Advisory Committee, 2012). An exemption applies to 'Route Service Omnibuses' (omnibuses specially designed with spaces for standing passengers), omnibuses with less than 17 seats, or vehicles in which all passenger seats have a reference height of less than 1 metre.

ADR 68/00 was introduced in Australia in 1994–1995 following two bus crashes in 1989 where 55 passengers were killed and 54 were seriously injured (School Bus Safety Community Advisory Committee, 2012). Any new vehicle registered for use in Australia must comply with this design requirement. As of March 2022, all rural and regional school buses operating outside urban environments in New South Wales must be fitted with lap/sash seatbelts in accordance with ADR 68/00 following an inquiry into school bus safety in 2012 (School Bus Safety Community Advisory Committee, 2012; Transport for New South Wales, 2022a). At the same time, New South Wales adopted a policy to disallow standing passengers on unsealed roads, roads with a speed limit of 80 km/h or more, or outside urban areas. Allowances were made for when a student cannot be left in an unsafe environment and a seat with a seatbelt is unavailable. To meet this allowance, the buses must meet the applicable parts of ADR 59/00 (Rural and Regional Seatbelt Program Taskforce, 2019).

In the USA, three-point seatbelts are required for all passengers of small new school buses (less than 4,536 kilograms or 10,000 pounds). There are also performance standards for three-point seatbelts installed voluntarily on large school buses in FMVSS 222. Each state or local jurisdiction may decide whether to install seatbelts on large school buses, and many states have adopted three-point seatbelts in school buses, including Louisiana, Texas, California, Florida, New York, New Jersey, Arkansas and Nevada (Taskforce on School Bus Safety, 2020).

In Scotland, since 2001 all new coaches, minibuses and buses must be fitted with seatbelts (lap belts at a minimum) (Transport Research Laboratory, 2010). In 2017, a law was passed in Scotland that requires all school transportation vehicles to be fitted with seatbelts (Transport Scotland, 2017).

[17] See https://www.legislation.gov.au/Series/F2006L01454 for further information.

6.6.4.4 Types of seatbelts

Research into the forces exerted on coach passengers during a collision found that only the three-point safety belt system resulted in forces and injuries that were acceptable under standards set in UNECE Regulation 80 and Regulation 94 (Jamroziak et al., 2020). This study also recommended that the three-point safety belt system should be obligatory in all intercity buses. The National Transportation Safety Board (2018b) also found that lap belts only restrained the pelvis area and did not prevent the upper body from flailing. The same report recommended that because lap-and-shoulder belts provide a greater level of occupant protection than lap belts, they should be installed as standard equipment on medium-sized buses (National Transportation Safety Board, 2018a).

6.6.4.5 Supporting measures

For seatbelts to be effective, they must be worn (and worn correctly) by passengers. In Israel, where seatbelts are compulsory in all vehicles used for school transportation since 2006, seatbelt use rates by students were reported as being low (Goldman & Peleg, 2010). This observational study found low rates of seatbelt use by students, with no students using seatbelts in 42% of school buses observed, and only 23% of school buses had 100% of students using seatbelts. Seatbelt use was higher when a bus was equipped with lap-and-shoulder belts (as opposed to lap-only belts), when an adult chaperone was present, and when the pupils on the bus were primary school children. The authors conclude that without enforcement, government regulations and seatbelt availability on school buses are not sufficient to ensure seatbelt usage among pupils. Another study in the USA also found that education, training and enforcement were needed for effective implementation of seatbelts in school buses (Katz, Graham, et al., 2021).

6.6.4.6 Additional benefits of seatbelts in school buses

A study in the USA found that seatbelts on school buses contributed to calmer and less distracting environments for school bus drivers (Katz, Graham, et al., 2021). Even students who did not wear restraints were less likely to move from their seats as it would be obvious that they were not wearing a seatbelt. Sixty percent of school bus drivers reported that they observed improved behaviour from students.

6.6.4.7 Feedback from stakeholders

All the stakeholders could see the safety benefits of seatbelts, and that it was inherently a ‘good thing’. However, cost and other practicalities are significant barriers, in particular:

- Retrofitting seatbelts requires a significant amount of structural work on the buses, which incurs significant cost to operators.
- Operators are unsure about the rules regarding the responsibility of bus drivers in ensuring children are wearing seatbelts. There are different interpretations of the Land Transport (Road User) Rule 2004. It was expressed that the bus driver should have their full attention on the driving task, not monitoring children for seatbelt use.
- Children vandalise and damage the seatbelts, requiring additional maintenance. One stakeholder commented that they were aware of one operator who was proactive in installing seatbelts, but later removed them due to the high ongoing maintenance costs.
- The situation is complicated further as school bus passengers are often young children who require different types of restraints according to their age.

Most transport service providers interviewed indicated few of their school buses have seatbelts fitted. Some of these were tour buses, although some were retrofitted as trials. Tour coaches are often fitted with seatbelts as they operate on open roads and tour operators often request coaches with seatbelts.

Most transport service providers have decided not to install seatbelts due to the cost, and they are contractually not required to do so. Recently, a large provider purchased a large number of new buses from a New Zealand bus manufacturer. All were truck buses, and none were fitted with seatbelts. Another transport service provider purchased truck buses from the same manufacturer but required seatbelts to be fitted. The difference in price between truck buses fitted with seatbelts and those not fitted with seatbelts was estimated to be an additional 6–7% of the total cost of the bus.

One transport service provider mentioned that some primary schools have begun indicating that they would like seatbelts provided on their buses. For this reason, and due to the expense of retrofitting seatbelts, they have made a conscious decision to start phasing in seatbelts through all new vehicles. All their new vehicles have high seat backs and three-point seatbelts. Another transport service provider also stated that all their new buses had seatbelts because they saw it as a point of differentiation in the market. A manager of a directly resourced school network emphasised that providing seatbelts resulted in significant improvements in student behaviour, supporting the findings discussed in Katz, Graham, et al. (2021). Children are less likely to move around the bus, knowing that the driver expects them to be seated and wearing their seatbelt.

Some directly resourced schools have requested buses with seatbelts. The manager had worked with the transport service provider to install seatbelts and pay them off over time. They mentioned that their contract with the provider is longer than that of the Ministry of Education contracts, which allows the provider to pay for seatbelts over a longer time period. With shorter contracts, it would be more cost effective to phase in seatbelts with new buses.

The NZ Police Commercial Vehicle Safety Team conducted workshops with bus operators on the implementation of seatbelts on buses. This occurred following the tour bus crash in Rotorua in which there were five fatalities, where some passengers were ejected from the vehicle and others were thrown off their seats. Additional examples were provided of how harsh braking on urban buses with standees can cause injuries due to the passenger falling over or being thrown around the vehicle. The Commercial Vehicle Safety Team received resistance from bus operators due to the cost of implementation, and the liability issues around ensuring the seatbelts are worn.

The Ministry of Transport Te Manatū Waka mentioned the challenge of mandating seatbelts under the existing regulatory framework. The PSV Rule does not differentiate between buses used for different purposes. If seatbelts were mandated, they would have to be installed in all PSVs regardless of their use. It is likely a contractual approach would be a more practical approach to getting seatbelts on school buses alone.

6.7 Driver management

Comprehensive safety management systems are needed to ensure that school bus drivers are medically fit, well-trained, alert, responsive and unimpaired.

6.7.1 Current requirements

Bus drivers must hold a current passenger (P) endorsement and a current licence for the type of vehicle being driven. The P endorsement includes a check to confirm the applicant is a ‘fit and proper person’, is medically fit, and meets the minimum eyesight requirements. Under the Land Transport Rule – Work Time and Logbooks 2007,[18] school bus drivers are exempt from logbook requirements that otherwise apply to other commercial and heavy vehicle drivers.

In addition to these minimum requirements, the Ministry of Education sets additional driver standards within their contracts with transport service providers, including:

- annual medical fitness to drive
- current first aid certificate
- requirements associated with the Children's Act 2014[19] such as police vetting and safety checks
- a drug and alcohol management plan, including pre-employment, post-incident and random drug and alcohol testing
- compliance with the Work Time and Logbooks Rule, including keeping logbook records and monitoring for signs of fatigue
- the requirement to stand down any driver the Ministry of Education considers may pose a risk to the health and safety of students
- drivers adequately trained by either completing specified New Zealand Qualification Authority (NZQA) unit standards or an equivalent approved training programme
- minimum ongoing training requirements for drivers, equivalent to two half-days per annum.

Transport service providers must also have a passenger service licence, child protection policy and health and safety policy. Vehicles used as school buses must have a telematics system installed to monitor driving behaviours, as described in section 6.5.4.1. The Ministry of Education undertakes routine audits of transport service providers to confirm compliance with these driver management requirements.

6.7.2 Stakeholder feedback

There is a significant nationwide driver shortage. It is particularly difficult to recruit and retain school bus drivers as it is part-time work. Therefore, school bus drivers are generally older and semi-retired, especially in rural areas where there is little opportunity to pick up other types of bus and coach driving.

The transport service providers did not raise any concerns regarding the generally older age of school bus drivers, as drivers are required to have annual medicals and they are audited on this. Older drivers were also regarded as very experienced. The literature also indicates that older drivers (as a cohort) are involved in fewer crashes than younger drivers, and therefore do not pose an increased risk on the road (Austroads, 2016). However, some health, functional and cognitive factors associated with aging are shown to decrease driving ability and increase crash risk – for example, cardiovascular diseases, declining vision, and declining cognitive ability.

All transport service providers who were interviewed confirmed that they had zero-tolerance drug and alcohol policies. Many providers also provide counselling and support for drivers who return a positive drug or alcohol test. This is important due to the issue of driver recruitment and retention.

The NZQA driver training requirements include hazard identification and risk reduction for safe driving, first aid, rigid vehicle handling and dynamics, and fatigue management. These training modules were developed some time ago and are currently being updated by the NZQA and may require updating to include training in

[18] See https://www.nzta.govt.nz/resources/rules/work-time-and-logbooks-2007-index for further information.

[19] See https://www.legislation.govt.nz/act/public/2014/0040/latest/whole.html for further information.

the use of new technology available on buses. Some transport service providers interviewed stated that they train their bus drivers beyond what is required under the Ministry of Education contracts and provide refresher training as required. One transport service provider also mentioned that they have been struggling to provide first aid training as required by the Ministry of Education due to the unavailability of external training providers.

In engagement with the NZ Police Commercial Vehicle Safety Team, it was noted that bus drivers have the same legal alcohol limits as other motorists. In many international jurisdictions, drivers of passenger service vehicles have a reduced legal alcohol limit, usually a zero blood or breath alcohol limit. An example was provided of a driver who had consumed alcohol between the morning and afternoon school runs. This driver was under the legal limit, but it was concerning to the NZ Police as there were children on board.

6.8 Education and behaviour management

Students and caregivers (and other road users) need be aware of safe behaviours while travelling on or moving around school buses. The behaviour of students should not distract the driver from the driving task. Students must be seated and wearing seatbelts correctly (where provided) for occupant protection systems to be effective. Students and their caregivers also need to know how to keep themselves safe at PUDO locations. Similarly, other road users need to be aware of what to expect around school buses, and how to behave accordingly.

6.8.1 Current practice

No single organisation is responsible for educating children and caregivers about safety on school buses in New Zealand. The amount and frequency of education on safe bus travel that students and parents receive depends on how proactive the school, transport service provider, council, and/or NZ Police are in delivering this education.

6.8.1.1 Ministry of Education

The Ministry of Education expects schools and caregivers to educate children on appropriate and safe behaviours for school bus use. Guidance on keeping safe while using school buses is provided on the Ministry's website (Ministry of Education, 2022b).

Transport Contract Managers may investigate serious behaviour-related incidents. During engagement with these managers, it was mentioned that they try to get notices into schools to share with students and caregivers particularly about crossing the road to get to or from school buses.

School bus safety and road safety are not currently part of the New Zealand education curriculum.

6.8.1.2 NZ Transport Agency Waka Kotahi (NZTA)

NZTA provides a guide for schools, teachers and families called *School bus safety: What you need to know* on its Education Portal (Waka Kotahi, 2021d, 2022d). It identifies important points to talk to students about, including how to stay safe when waiting for the bus, safely getting on the bus, and where to wait after getting off the bus for the bus to move before crossing the road. It also provides a 'kerb drill' to teach children how to cross the road safely and provides advice for parents and other road users. The extent to which this resource is used is unclear.

6.8.1.3 Councils

City and district councils are a secondary audience for the NZTA Education Portal. One stakeholder mentioned that some local councils use these resources to conduct road safety workshops with student leaders. Some councils have been creative with these workshops – for example, one council created a puppet show on the '10 commandments of bus safety'.

In urban areas, school travel coordinators may work with schools to create school travel plans. However, as bus travel in these areas is the responsibility of the regional council, it may be omitted in these plans. Instead, schools are encouraged to work with regional councils regarding bus travel when developing school travel plans.

6.8.1.4 Transport service providers

Transport service providers are expected to ensure bus drivers understand their responsibilities in behaviour management, report incidents to the school, liaise with the school when behavioural issues arise, and work with schools to introduce a code of conduct for students (Ministry of Education, 2021).

Most transport service providers that were interviewed are active in providing safety information to their students and parents, although to varying degrees. Specific examples given from providers include:

- working with rural schools and community constables to teach children how to safely get on and off the bus
- stating an intention to be more involved in school education programmes with school bus controllers
- producing videos on school bus safety and taking 20 km/h signs to schools at the start of the year as part of an awareness campaign on the speed limit when passing stationary school buses
- developing their own training resources and conducting roadshows where they teach bus safety at school assemblies.

One transport service provider mentioned that when ineligible students receive their 'term pass' for the bus, they are provided with a 'terms and conditions' leaflet from the provider, which covers a significant amount of safety information. Nothing like this appears to be provided to eligible students by the Ministry of Education or most schools. Transport service providers also expressed that information needs to be provided to parents on how to park safely to pick up or drop off their children at the school bus stop; however, this is not currently provided.

6.8.1.5 Schools and community constables

Schools are also responsible for addressing student behaviour issues on buses, in conjunction with caregivers and the transport service provider. They are expected to clearly communicate expectations for appropriate behaviour on school transport services to caregivers and students (Ministry of Education, 2022b). This includes notifying caregivers and students of rules around PUDO, safety information and caregiver responsibilities. Schools are also responsible for the safe loading and unloading of students at the school bus bays. Each school must nominate a bus controller, usually a teacher or the school principal, who takes responsibility for these tasks.

Schools may choose to use a Code of Conduct to help reinforce safe behaviours, but this is not compulsory. The Ministry of Education provides a sample Code of Conduct that can be signed by the student, their caregiver, the school, and the transport service provider (Ministry of Education, 2022b). Some schools have student behaviour agreements that children must adhere to. However, the administration involved in getting these completed can be onerous for schools.

Community constables with the NZ Police deliver road safety training in conjunction with schools and transport service providers, which can include training and talks about safety on school buses.

Some school buses may have student bus wardens. They are usually a senior student on the route who supervises younger students and are usually on primary school buses. Schools are not required to appoint bus wardens. Student bus wardens are nominated by school staff and trained by Police School Community Officers. Their role includes ensuring orderly entry onto the bus, making the driver aware of passenger list changes, ensuring passengers are seated safely or standing in appropriate places, that students remain seated and behave appropriately, and assisting with emergency procedures after a crash or other incident (Waka Kotahi, 2021d).

6.8.2 Observations of student behaviour

In their study observing student behaviour and seatbelt use on school buses in Israel, Goldman and Peleg (2010) found that on morning bus rides from home to school, students were calmer, while rowdy behaviour and conflicts between students were more common on afternoon rides. This not only affected the overall bus environment, but also bus driver concentration.

The ACC travel-to-school injury analysis (section 3.1.2) and review of Ministry of Education incident reports (section 4.2.1) show that students assaulting other students is a concern. Assault and bullying were also raised by bus operators as a safety issue. The bus driver is the only adult on the school bus. The lack of supervision can lead to bullying and general bad behaviour among the students.

There is evidence that CCTV and seatbelts can help improve student behaviour while on the bus (refer section 6.5.4.2 and section 6.6.4, respectively, for more detail).

6.8.3 Comparison with Australia (New South Wales and Victoria)

In New South Wales, road safety education is taught in schools from kindergarten to year six. Safety Town (New South Wales Government, 2022a) is a website used for interactive learning and teaching of road safety. There are resources available for teachers and families on this website on a range of road safety topics, including safety around school buses.

In Victoria, ‘Safe Bus Travel Education Programs’ are delivered in schools by BusVic (BusVic, 2019). There are two programmes, one for primary schools and one for secondary schools. These programmes cover how to behave at the bus stop, on board the bus and leaving the bus.

6.8.4 Previous research and recommendations

Baas et al. (2010) recommended that caregivers should be encouraged to meet their children at the bus stop. It was also noted that NZ Police, the NZ Transport Agency, the Ministry of Education, schools, and community groups had been raising awareness of the need for caregivers to meet their children at the bus stop, including parking on the same side of the road as the bus. Road safety education in schools was also discussed in the 2010 report.

Several coroners have also called for improved education regarding school bus safety since 2008, including public campaigns, education programmes run at schools, and appointing bus monitors. These recommendations were made in an effort to improve safety around stationary school buses dropping off or picking up children. In 2022, Coroner Ho (New Zealand Coroners Court, 2022) considered education campaigns in depth, noting that:

- There appears to be virtually no education campaigns directed at motorists to remind them of their legal requirement to slow to 20 km/h, and that a national campaign to address this should be developed and implemented.
- It would also be beneficial to ensure that children are educated, and frequently reminded, about the importance of the role they themselves play in school bus safety. Such education campaigns should be delivered in school at the beginning of the school year, with refreshers delivered at least every six months. Posters could also be developed reminding children of key school bus safety principles.

6.9 Crash and incident reporting

Many injuries on buses may go unreported, or at least will not be captured in crash data (Elvik et al., 2009). A collision is not required to injure passengers, as demonstrated in the ACC school bus injury analysis described in section 3.1.2 and the incident analysis findings in chapter 4. There were also several gaps observed in how school bus crashes are reported, including the number and severity of injuries, as discovered and described in the crash analysis (section 4.2.5).

A study from the United Kingdom found that three-quarters of people injured while travelling on buses were not involved in an impact, with this proportion rising for seriously injured casualties (Edwards et al., 2019). This study used ‘STATS19’ data, which captures both crash data and non-collision incidents involving buses or coaches. The researchers also analysed CCTV recordings on London buses, in combination with inspections of current buses. It was found that a significant proportion of passengers are injured in non-collision events, such as harsh braking and emergency braking manoeuvres. Factors that contributed to injuries included poorly positioned handrails, lack of compartmentalisation, and objects with sharp edges and corners.

6.9.1 Incident reporting processes

For Ministry of Education funded services, transport service providers are required to report incidents to the Ministry of Education. The Ministry of Education may also receive incident reports from schools, caregivers, and members of the public. Incidents can include near misses, as well as collisions and injury events. If transport service providers have no incidents to report, they must actively tick a box confirming this when submitting their monthly reports on the electronic reporting system. The transport service provider is expected to carry out their own investigation into the incident and undertake corrective action, including notifying the school if the incident is related to student behaviour.

Transport service providers encourage their drivers to report near misses but acknowledge that not all near misses are reported. One provider mentioned that conveying the importance of reporting near misses to their drivers is difficult and that the paperwork associated with it is onerous for drivers.

Transport service providers must provide monthly reports to the Ministry of Education. However, they do not receive any reporting back from the Ministry – for example, on trends or patterns of incidents observed across providers. The Ministry of Education does not currently undertake any detailed analysis across incident reports – for example, to examine patterns over time. The transport service providers mentioned they would like more information on the types of incidents reported across the sector, and that having access to this information would encourage both them and their drivers to be more diligent in reporting incidents.

The Transport Contract Managers at the Ministry of Education found that incident reporting from transport service providers can be varied and that there is some reluctance to report incidents. For serious incidents, the Ministry of Education is generally more heavily involved in following up on these. This can include notifying schools and parents, carrying out investigations, injury follow-up, coordinating with regulatory authorities, and identifying corrective improvements. There is a formal process for this, and it may include ongoing monitoring. If the NZ Police are involved, the Ministry of Education may step back and let them lead the investigation.

6.10 Ministry of Education auditing processes

Transport Contract Managers at the Ministry of Education audit transport service providers to ensure they are complying with their contract conditions. This includes auditing compliance with vehicle safety, licensing, driver management, PUDO site selection and incident reporting requirements. There are two parts to the Ministry of Education audit process: administration and vehicle inspections.

The administration audit inspects the transport service provider's record keeping, including reviewing policies related to driver management, reviewing qualifications and competencies of drivers and workshop staff, and checking that managers' policies and procedures are complied with.

Vehicle inspections include auditing a selection of buses in the transport service providers' fleet. For a smaller provider, all the buses may be inspected, but for larger operators, 10 to 12 buses may be looked at as a representative sample. Fleet checks are carried out using a checklist. Items may get added to the checklist with learnings from incidents and experiences of the Transport Contract Manager. The vehicle inspections also include inspecting some of the equipment used (such as torque wrenches for calibration).

If a transport service provider fails part of an audit, there is a timeframe to rectify it and the Transport Contract Manager must ensure that it is rectified. The Transport Contract Managers mentioned that resolutions are generally reached as transport service providers follow their instructions. The managers also work with providers, educating them on how to improve their processes above minimum standards.

The Ministry of Education has recently doubled the number of Transport Contract Managers across New Zealand from four to eight people. This increased capacity means they are now able to visit schools to look at buses in operation during PUDO times. Schools may be advised when these visits will take place, but the transport service provider may not be notified.

Common issues Transport Contract Managers have observed in the audits include a poor understanding of hazard and risk management, poor maintenance of the Hazard and Risk Register and failing to address identified hazards and risks. Vehicle audits are scheduled with the transport service provider ahead of time, and it was suggested that it may be more appropriate for audits to be randomly conducted as opposed to scheduled. In this case providers would not have the opportunity to choose which vehicles remain at the depot for audits.

Transport service providers have generally found the auditing process to work well. However, some providers have found the process to be resource intensive. Some also expressed that they feel as though there is some inconsistency among Transport Contract Managers undertaking audits. One transport service provider felt that some parts of the audit were beyond the scope of what needed to be audited. In these situations, the providers spoke to the Ministry of Education about it and the issues were resolved.

Both the Ministry of Education and transport service providers have a primary duty of care for health and safety as they are both 'persons conducing a business or undertaking' (otherwise known as a PCBU). For Transport Contract Managers, this means that they must ensure that the Ministry of Education is meeting its obligations for the health and safety of bus drivers and passengers as the lead PCBU in the 'contracting chain' with the transport service providers. This includes ensuring that providers make necessary improvements, whilst being careful that they do not take over running a provider's business.

7 Interventions to improve school bus safety

This chapter collates and critically reviews the findings from across all stages of the research project. Potential interventions and further research are then identified to address identified issues and gaps.

7.1 Development of interventions

To assist in identifying and categorising interventions, the project team developed two 'bow tie' diagrams, replicating the approach used in New South Wales (School Bus Safety Community Advisory Committee, 2012). The two bow tie diagrams reflect the most likely risk events involving school buses in New Zealand:

1. A school bus travels into the path of another vehicle or runs off the road.
2. A bus is slowing, stationary or moving off from a PUDO location and either:
    a. a child moves into the path of an approaching or manoeuvring vehicle, or
    b. the bus obstructs the path of an oncoming vehicle.

Each diagram identifies the risk pathways leading to and from the event and identifies the interventions (or countermeasures) that eliminate, substitute, isolate or reduce the impact of the risk. These diagrams can be viewed in Appendix E. After developing the bow tie diagrams, the project team were able to identify potential interventions and areas for further research, and group these by focus area.

7.1.1 Assessment and prioritisation of interventions

When considering options for mitigating a safety risk, the first approach should be to eliminate the risk. Where this is not reasonably practicable, the risk should be minimised so far as is reasonably practicable, also known as the 'so far as is reasonably practicable' obligation.[20] To determine if something is reasonably practicable, the following factors would be assessed:

- the likelihood of the risk occurring
- the degree of harm that might result from the risk
- what is known (or should be known) about mitigating (eliminating or minimising) the risk
- the availability and suitability of the ways to mitigate the risk
- the cost associated with the ways of mitigating the risk.

The interventions presented in this chapter are high-level actions to improve school bus safety. It was not possible, within the scope of this project, to undertake a detailed assessment for each intervention. This is primarily due to the costs of many actions or interventions being uncertain. A lack of data on the baseline level of exposure or risk, or the effectiveness of some interventions, also prevented a full and complete assessment.

[20] This principle is enshrined in the Health and Safety at Work Act 2015 regarding the responsibility of PCBUs in managing health and safety risks. See https://www.legislation.govt.nz/act/public/2015/0070/latest/DLM5976660.html for further information.

7.2 Summary of interventions

Potential interventions and actions to improve school bus safety are described below, grouped by focus area.

7.2.1 Focus area 1: School bus route design

Between 2010 to 2021 there were 10 crashes resulting in death or serious injury to bus drivers or passengers. Eight of these crashes occurred on roads with speed limits 80 km/h or higher. Three of these crashes involved a school bus with no passengers onboard. In all vehicle collisions involving school buses, it is usually the occupants of the other vehicle(s) involved who are most seriously injured. Approximately 84% of Ministry of Education Daily Bus routes (by length) travel in rural road environments. These types of routes are inherently at higher risk of a fatal or serious injury crash due to the higher vehicle speeds.

To reduce the likelihood and severity of an injury crash resulting in death or serious injury to bus occupants and other road users, buses should be routed along roads with a high standard of safety available, where there is the option to do so. Characteristics of safer roads are described in section 6.2.2. Designing routes that minimise the need for children to cross the road should also be a high priority.

There are three areas where routes could potentially be designed to improve safety for bus occupants and other road users:

1. when routes are initially modelled or reviewed as part of the tendering process
2. when routes are reviewed in response to a safety concern, change in road conditions/layout, or a change in the number and location of eligible students
3. the routes used by bus drivers to reach the start of the school run, and to return from the end of the run.

Route design for Daily Bus services involves careful balancing of efficiency, safety and accessibility. School bus routes funded or contracted by the Ministry of Education are designed to transport as many eligible students as efficiently as possible, although safety is taken into consideration when finalising these routes.

The ‘safest’ road may result in eligible students having to travel further to the PUDO location on less safe modes such as walking or being driven by a caregiver. Similarly, the ‘safer’ rural route may have fewer safe PUDO locations – for example, roads with a roadside barrier and fewer pull-over locations. A ‘safer’ alternative also may be longer, and therefore more costly to run. Transport service providers report there are often no alternative routes available, especially in remote rural areas. For these reasons, it is desirable to model safer routes prior to tendering, rather than adjusting existing routes. It is noted, however, that this approach could increase the total number of routes and/or increase the length of the routes.

There may be an opportunity to optimise technology routes for safety. These routes travel between schools and technology centres, with no PUDOs. These buses are also usually full, meaning a greater number of occupants are exposed to road hazards.

Once routes are set, they should be reviewed if the road operating environment changes, either permanently or temporarily – for example, due to weather-related damage or prolonged roadworks. In considering these changes, Regional Transport Advisors at the Ministry of Education should be equipped with the best knowledge and guidance for determining the safest alternative route options.

Bus drivers travelling to and from the start or end of their route may also have alternative, safer options available to them. As demonstrated in the crash analysis, drivers appear to be at higher risk of being killed or seriously injured during this stage of the school bus journey. The Austroads (2022) *Vehicles as a Workplace*

– *Work Health and Safety Guide* provides further information on different risks posed by different types of roads, including potential controls for managing road-related risks.

Potential interventions for focus area 1 are described in Table 7.1.

Table 7.1 Interventions: School bus route design

Interventions	
1.1	Review existing route design guidelines to ensure they provide consistent, best practice guidance that considers Safe System principles.
1.2	Investigate whether existing routing algorithms (for developing school bus routes) could be improved to manage road-related risks – for example, by minimising travel on high-risk roads and avoiding high-risk manoeuvres, where practicable.
1.3	Remind transport service providers of the safety risks to drivers travelling to/from the start of the bus route and encourage them to review hazards along these routes as part of their risk management processes.

Refer also to the interventions in the following related focus areas:

- focus area 2 regarding efforts to improve the underlying safety of roads that school buses operate on
- focus area 3 regarding PUDO selection and operation.

7.2.2 Focus area 2: Speed and infrastructure (on roads that school buses operate on)

Improving the safety performance of roads and roadsides will reduce DSIs for all road users. This is achieved through infrastructure improvements and setting speed limits that are appropriate for the road environment, as described in section 6.1.1.

Road safety infrastructure projects implemented under the Speed and Infrastructure Programme will improve the underlying safety on some school bus routes, particularly those currently running on corridors or travelling through intersections that are identified as having higher risk of DSI crashes. However, some of these projects could have other impacts on the operation of existing bus routes – for example, installing median barriers could prevent buses turning into driveways or pull-over areas.

Proposed speed limit reductions around schools and on rural corridors will also improve school bus safety in several ways:

- Reducing vehicle speeds around schools lowers the likelihood and severity of injuries to children crossing roads to and from schools. This is particularly relevant for urban schools with on-street bus stops – for example, those used by council school bus services.
- Reducing vehicle speeds around rural schools lowers the likelihood and severity of collisions involving school buses turning into and out of school bus stops.
- Reducing speed limits on rural roads from 100 km/h to 60–80 km/h will lower the likelihood and severity of crashes around school buses when they are stationary on the side of the road picking up or dropping off children. This also reduces the amount of deceleration required for drivers to achieve 20 km/h when passing stationary school buses.

Any requirement to develop local or regional speed management plans will require road controlling authorities to consider, among other things, road use activity and local knowledge of the road network. Likewise, when designing and implementing road safety projects, it is essential that designers are aware of

PUDO locations and turning requirements of school buses, so these activities can be safely accommodated within infrastructure designs.

To support the speed management process, road controlling authorities need to be aware of where school buses are running, and the location of PUDO areas, therefore the primary intervention in this focus area is that this information is shared with these authorities.

A potential intervention for focus area 2 is described in Table 7.2.

Table 7.2 Intervention: Speed and infrastructure (on roads that school buses operate on)

Intervention	
2.1	Provide road controlling authorities with the location of all school bus routes and PUDO sites for consideration when planning and designing safety infrastructure projects, and to assist with developing local or regional speed management plans.

Refer also to the interventions in the following related focus areas:

- focus area 1 regarding designing school bus routes for safety
- focus area 10 regarding data collection and information sharing.

7.2.3 Focus area 3: Selection, design, visibility and operation of PUDO sites

Twenty-six children died or were seriously injured crossing the road to or from a school bus between 2010 and 2021. Concerns regarding safety of children crossing the road at PUDO sites have been raised by several coroners since 2008, and interventions to improve safety in this area were considered in some depth in research report 408 (Baas et al., 2010). Feedback from stakeholders (section 6.3.2) also highlighted several issues regarding the existing PUDO site selection guidance and the difficulty in balancing accessibility and safety when selecting appropriate PUDO locations.

Ideally, PUDO areas should be sited, and routes designed, so that children do not need to cross the road – particularly where this involves crossing a high-speed road or a road with high traffic volumes, including large volumes of heavy vehicles. However, as there is no central record of PUDO locations and their location relative to where children live, the extent of the current risk to children is unknown.

The Waka Kotahi (2018) *Guidelines for the Safe Siting of School Bus Stops* could be improved to provide more detail on site selection and to align with Safe System principles. Updated draft guidance was developed as part of research report 408 (Baas et al., 2010), which included more comprehensive information on the principles and technical and safety considerations involved in the location and design of school bus stops and turning points. However, this guidance did not progress to being finalised and adopted as a formal guide or code of practice.

The number of PUDO sites audited annually by the Ministry of Education is relatively small and could result in many higher risk PUDO locations being overlooked. It is unclear if critical safety findings from these audits are shared with other agencies – for example, road controlling authorities and NZ Police.

Because of these issues, it is recommended that updated guidance for identifying and assessing the risk of PUDO sites is developed and adopted. Both Baas et al. (2010) and the New South Wales Centre for Road Safety's (2016) guidance identify a range of interventions that could be incorporated into this updated guidance, including:

- a method or matrix for risk assessment of PUDO sites based on their use and the road context

- additional guidance on calculating sight distance/stopping distance where there are curves, crests, vegetation, gradients, sealed or unsealed roads, and high volumes of heavy vehicles
- guidance on distance the waiting area is from the traffic lane
- guidance on the location of the PUDO sites relative to intersections
- marking/signposting guidance for PUDO areas
- consideration of broader safety and accessibility impacts of PUDO locations.

A national assessment of PUDO locations could then be undertaken to identify higher-risk sites. This would enable the prioritisation of higher-risk PUDO sites for auditing and could also help road controlling authorities prioritise funding for infrastructure improvements on sites where the current level of infrastructure is inadequate – for example, high-risk sites lacking adequate separation from live traffic lanes.

PUDO locations could be documented and shared between transport service providers, the Ministry of Education, and road controlling authorities. This would allow road controlling authorities to maintain PUDO sites appropriately by upgrading infrastructure as required. It would also allow road controlling authorities to take PUDO locations into consideration when undertaking road maintenance and approving temporary traffic management plans. Noting that the effort in collating this information is potentially onerous for the agencies involved, consideration should be given to at least prioritising the mapping of PUDO sites that are highly used and unlikely to change in the future.

Signposting PUDO locations that are mostly permanent may improve other motorists' awareness of school buses or children in the area during school PUDO times. At high-risk sites, signs could be electronic and/or have flashing lights around the time the school bus runs to draw attention to it. Documenting and sharing PUDO locations will also help record which sites change over time, and which ones may need additional infrastructure to support their more permanent nature.

Potential interventions for focus area 3 are described in Table 7.3.

Table 7.3 Interventions: Selection, design, visibility and operation of PUDO locations

Interventions	
3.1	Update guidance for PUDO siting to align with Safe System principles, including improved selection and design guidance, and risk assessment methods, and considering broader safety/accessibility impacts.
3.2	Develop and formalise framework to categorise and classify PUDO sites by risk. Consider undertaking a national assessment of PUDO locations to prioritise high-risk sites for auditing and infrastructure improvements.
3.3	Investigate markings, signage, and infrastructure improvements at PUDO areas that are effectively permanent.

Refer also to the interventions in the following related focus areas:

- focus area 4 regarding conspicuity of stationary school buses (at PUDO locations)
- focus area 10 regarding the collection and sharing of data on PUDO locations and monitoring school bus safety metrics.

7.2.4 Focus area 4: Conspicuity of school buses, visibility of school bus routes, and speeds around stationary buses

Between 2010 and 2021, 26 children were killed or seriously injured crossing the road to or from a school bus, and three vehicle occupants were killed or seriously injured in collisions around stationary buses dropping off or picking up children. Over two-thirds of crashes where a child was injured crossing the road to or from a bus involved a vehicle that was suspected to be travelling over 20 km/h at the time of collision.

Most DSIs (57%) for this type of crash occurred on roads with speed limits 80 km/h or higher, although there were a higher number of injury crashes on urban roads (< 80 km/h), including 43% of DSIs.

To reduce the likelihood and severity of these types of collisions in the future, school buses running daily school bus routes should be identifiable to other road users. Drivers need to respond appropriately and drive safely around them, including by reducing vehicle speeds to safe and survivable speeds.

There is a wide range in the types of buses and vans used for school bus transport. The minimum standard of school bus signage is insufficient to alert motorists to the risks around the bus, particularly the presence of children on the roadside. Many transport service providers have sought to improve the visibility of buses by using hazard lights or by installing a mix of flashing lights, additional signage, and warning stickers. These clearly show a desire to improve the visibility of their buses; however, it has arguably resulted in an inconsistent approach to school bus signage across the country. Therefore, implementing an improved and consistent approach to school bus visibility and signage should be considered.

The current regulations are not achieving safe speeds around stationary school buses. There is poor awareness among motorists of the 20 km/h speed limit, and it is difficult to enforce. Therefore, the 20 km/h speed limit could be reviewed to expand its application to include while a bus is approaching and leaving a PUDO area. This review should also evaluate the 20 km/h speed limit against Safe System principles, considering:

- current levels of compliance and ease of enforcement
- the additional risks generated when vehicles must decelerate heavily to reach 20 km/h, particularly in rural environments
- consistency of messaging to motorists, considering the current speed management guidance and the introduction of 30 km/h speed limits around most schools.

In the USA, drivers are required to come to a complete stop when a school bus is stationary on the side of the road. However, as discussed at length by Coroner Ho in New Zealand Coroners Court (2022), this is unlikely to be practical given New Zealand’s typical winding topography and the risk of stopped traffic creating hidden queues where there is insufficient sight distance.

New approaches to enforcing speed limits could also be considered – for example, by rotating mobile speed cameras around higher-risk PUDO locations.

To address the visibility of bus routes more generally, a national risk assessment of rural school bus routes funded by the Ministry of Education could be undertaken to identify higher-risk, regularly used school bus routes where improved signage should be targeted. The outputs should be provided to road controlling authorities with guidance on how to prioritise and implement signage improvements. Innovative approaches for alerting drivers when school buses are operating should be explored – for example, the use of low-cost roadside flashing beacons or sharing bus route information with in-car navigation system providers.

Potential interventions for focus area 4 are described in Table 7.4.

Table 7.4 Interventions: Conspicuity of school buses, school bus routes and reducing speeds around stationary buses

Interventions	
4.1	Improve signage for school buses so that it communicates both the speed limit passing the bus and when the speed limit applies. Desirably, this would be the flashing LED signage tested and evaluated in research report 408 (Baas et al., 2010). The implementation of this signage should ideally align with a review of the 20 km/h speed limit passing the school bus (see intervention 4.2 below), and a national awareness and enforcement campaign that coincides with the new signs being introduced (see intervention 8.2).
4.2	Review the 20 km/h speed limit while passing a stationary school bus to consider expanding it to include the period when a bus is moving in/out of PUDO locations, and whether a 30 km/h speed limit is more appropriate.
4.3	Undertake a national risk assessment of school bus routes funded by the Ministry of Education, to prioritise bus route signage improvements. This should align with action 3.2 regarding PUDO site classification and risk assessment.
4.4	Amend the RUB to require that urban buses operating as school buses must not have advertising on the front or rear of the bus that affects the visibility of school bus signage.
4.5	Investigate options for enforcing the 20 km/h (or 30 km/h) speed limit passing stationary school buses – for example, using mobile speed cameras at PUDO locations.
4.6	Support and fund innovative projects to develop and pilot effective, low-cost solutions for improving the visibility of school buses and school bus routes.

Refer also to the interventions in the following related focus areas:

- focus area 3 regarding PUDO site classification and risk assessment
- focus area 8 on education campaigns regarding the 20 km/h speed limit rule
- focus area 10 regarding data sharing.

7.2.5 Focus area 5: School bus vehicle safety technologies

The New Zealand school bus fleet is diverse. School buses currently range from 26-year-old imported buses with minimal safety features to modern coaches designed to Australian standards with a range of vehicle technologies.

Vehicle safety technologies, including technologies and standards for buses, were extensively reviewed in section 6.5. The most promising safety technology for New Zealand buses is lane departure warning/lane keep assist, followed by advanced driver distraction warning systems (Figure 6.10) and Vulnerable Road User (VRU) detection systems (including CCTV). CCTV systems, like those used in urban buses, can also reduce blind spots for drivers outside the bus while encouraging safe behaviours with cameras inside the bus. This can also be used to monitor seatbelt use (where seatbelts are installed).

Many vehicle safety technologies, such as lane keep assist, are installed at the time of manufacture and cannot be retrofitted. Given school buses in the Ministry of Education funded fleet are aged up to 26 years old, the extent to which the school bus fleet can be modernised is challenging.

Options to mandate or incentivise the uptake of new technologies should be explored. Some technologies could also be mandated through the school bus tendering process – for example, CCTV systems, which are currently required for urban buses under the RUB. If this is not feasible, the opportunities to incentivise the uptake of vehicle technologies should be explored – for example, by adding fleet safety criteria in the quality (non-price) weighting criteria when tendering for school bus services.

Telematics systems are required on school buses; however, these systems are only effective if the driver is aware they are being monitored, and appropriate feedback and training is given in response to undesirable behaviours. There were some concerns raised by transport service providers about the adequacy and accuracy of some systems. The existing approved telematics systems should be reviewed to ensure they include interfaces that effectively provide feedback on driving behaviours to both drivers and transport service providers.

Currently there is no record of the safety standards and safety systems installed across the school bus fleet. If better records were kept, then the value of these systems could be evaluated in terms of their safety performance. This in turn would help ascertain which types of school bus are the safest for operating in New Zealand conditions.

Potential interventions for focus area 5 are described in Table 7.5.

Table 7.5 Interventions: School bus vehicle safety technologies

Interventions	
5.1	Undertake an audit of vehicle standards and vehicle technologies across the school bus fleet and require this information to be supplied by transport service providers in future school bus service tenders.
5.2	Investigate options to mandate or incentivise the uptake of vehicle technologies in the school bus fleet, focusing on VRU detection systems (including CCTV), lane departure warning/lane keep assist, and advanced driver distraction warning systems.
5.3	Review the list of telematics providers to ensure approved providers are effective in providing feedback on driving behaviours to drivers and transport service providers.

Refer also to the interventions in the following related focus areas:

- focus area 7 regarding safer bus drivers, including the use of technology to detect poor driving behaviour
- focus area 10 regarding collecting and analysing data on school bus fleets, including safety standards and safety technologies.

7.2.6 Focus area 6: Bus occupant protection

The large mass of a bus means that in a collision with a smaller vehicle, such as a passenger car, occupants in the bus are not subjected to the same degree of deceleration compared to occupants in the other vehicle. However, the mass advantage of a bus can be significantly reduced if the bus collides with another heavy vehicle or a solid object, or if the collision causes the bus to roll over.

Occupants are at higher risk of injury in the crash when the bus is travelling at higher speed. Most crashes that resulted in a school bus occupant being injured occurred on rural roads with a speed limit of 80 km/h or higher. This included 8 out of 10 crashes where a bus occupant was killed or seriously injured between 2010 and 2021.

Compartmentalisation and seatbelts reduce the likelihood and severity of injuries to bus occupants in a collision or harsh braking event. However, seatbelts are not required on heavy buses in New Zealand and there is no requirement for buses to meet a minimum standard for compartmentalisation, such as ADR 66/00

– *Seat strength, seat anchorage strength and padding in omnibuses*.[21] In the USA, all large school buses must also meet an equivalent federal standard for compartmentalisation.

Many school buses in New Zealand have low seat backs and/or hard plastic seat backs, and most lack seatbelts. Hard plastic seat backs and grab handles are common on urban buses where plastic is used for durability; however, this material offers little protection to passengers in high-speed collisions. It is common practice for transport service providers to shift urban buses with these plastic-backed seats into their school bus fleet once they reach the maximum allowable age of 20 years under the RUB. Additionally, some transport service providers are ordering new truck buses with these types of seats installed specifically for their school bus fleet.

As discussed in section 6.6.3, compartmentalisation provides limited occupant protection in rollover and side-impact crashes. The benefits of compartmentalisation are only fully realised when all passengers are seated upright in their individual seats, facing forward, with their backs contacting the seat. This is difficult to achieve considering how children behave on school buses and considering the PSV Rule, which currently allows three primary or intermediate school children to sit in the same space as two adults or secondary school-aged children.

The proportion of the school bus fleet with seatbelts installed is unknown. Based on discussions with transport service providers, only a limited number of school buses are fitted with them. These are generally lap-sash (three-point) seatbelts on padded, high-backed seats. Some transport service providers have decided to phase seatbelts into their new school buses, whilst other providers continue to purchase new buses without them. Internationally, seatbelts are increasingly becoming the preferred occupant protection in many jurisdictions, such as Scotland and in New South Wales, Australia.

There is a high risk of serious injury to children who are required to stand on buses. Current Ministry of Education contracts endeavour to reduce standing on school buses by requiring transport service providers to confirm that seats would be provided for each eligible student. However, providers can carry standing passengers if the actual number of eligible students is greater than the number initially indicated by the Ministry of Education and provided the Certificate of Loading for the school bus vehicle allows standing passengers.

To reduce risk of death or serious injury to school bus occupants, the occupant protection features of the school bus fleet should progressively be improved to:

- meet compartmentalisation standards, including minimum height and padding requirements for seatbacks as is set out in ADR 66/00 – *Seat strength, seat anchorage strength and padding in omnibuses*
- ensure lap-sash seatbelts are provided for all passengers, compliant with ADR 68/00 – *Occupant protection in buses*
- prohibit standing passengers.

Additionally, school bus interiors should be regularly inspected to ensure that potential hazards inside the passenger area are identified and removed.

Potential interventions for focus area 6 are described in Table 7.6.

[21] See https://www.legislation.gov.au/Details/F2006L02312 for further information.

Table 7.6 Interventions: Bus occupant protection

Interventions	
6.1	Progressively prioritise and adopt: • ADR 68/00 for occupant protection (three-point seatbelts for all occupants) on all heavy buses used as school buses • ADR 66/00 for seat strength, seat anchorage strength and padding on all heavy buses used as school buses.
6.2	Clarify, and educate transport service providers on, the responsibilities of bus drivers in ensuring seatbelts are worn where provided.

Refer also to the interventions in the following related focus area:

- focus area 5 regarding safer bus drivers, including the use of technology to detect poor driving behaviour.

7.2.7 Focus area 7: Bus driver management

Between 2010 and 2021, sudden illness or medical illness were factors in six (out of 70) crashes where a school bus driver and/or passenger was injured. Fatigue due to lack of sleep was a factor in a further two crashes. These crashes occurred at the end of the school run when the bus was empty, and resulted in one driver being killed and the other seriously injured. There were no reports of bus drivers involved in these crashes being impaired by alcohol or other drugs.

The Ministry of Education has comprehensive fleet safety management requirements for school bus operators to manage the safety of school bus drivers and their passengers. This includes health and safety requirements that exceed the minimum legal standard required for bus drivers, including annual medical fitness to drive, logbook requirements and drug and alcohol management plans. Telematics systems also monitor driver performance, with an onus on transport service providers to manage drivers if poor driving is detected.

Advanced driver distraction warning systems can help detect and manage impairment, distraction, illness, and poor driving behaviours. These systems can work in real time to detect and alert the driver to changes in driving behaviour. As discussed under focus area 5 (section 7.2.5 above), options to roll out these systems across the school bus fleet should be explored.

Finally, the Ministry of Education requirements set a high standard for driver management, and the legislation could be updated to reinforce these standards in law, including a zero-alcohol limit for commercial bus drivers and removing the logbook exemption for school bus drivers.

A potential intervention for focus area 7 is described in Table 7.7.

Table 7.7 Intervention: Bus driver management

Intervention	
7.1	Consider amending the Land Transport Act 1998 to align with current practice. • Introduce a zero-alcohol limit for school bus drivers. • Require school bus drivers to complete logbooks.

Refer also to the interventions in the following related focus area:

- focus area 5 regarding CCTV, telematics and advanced driver distraction warning systems.

7.2.8 Focus area 8: Education and behaviour management

Currently, no single organisation is responsible for educating children and caregivers on how to use school buses safely. Road safety education is not part of the New Zealand curriculum. Both the Ministry of Education and NZTA provide education material on school bus safety, but the delivery of this material to children is the responsibility of transport service providers, schools and parents. Local councils and NZ Police may also teach children about school bus safety as part of broader road safety training programmes. The amount and frequency of education that is delivered depends on how proactive schools, transport service providers, local councils and community constables are in delivering this information. Several Coroners have called for improvements to the delivery of school bus safety education since 2008.

Education on school bus safety should be mandatory for school bus users, delivered frequently, and provided in a range of formats. This education should focus on the main areas of risk to students, including crossing the road to and from the bus (and avoiding this where necessary) and staying seated with seatbelts on (where provided) while on the bus.

Education alone will not prevent some students from misbehaving – for example, being reckless, distracting the driver or assaulting other children. There is evidence in the literature, and from anecdotal experience, that CCTV and seatbelts are effective measures for improving student behaviour on school buses. Other measures include a mandatory code of conduct and bus wardens.

Education on safety around school buses can be extended to other motorists as there is currently poor awareness of the 20 km/h speed limit around stationary school buses. Baas et al. (2010) recommended that driver education campaigns should be continued, and Coroner Ho also recommended a national campaign be developed and implemented, noting that low-cost options for developing this should be explored if funding is a barrier (New Zealand Coroners Court, 2022). Such a campaign could be developed and run to support legislative changes to speeds around schools, and in support of enforcement activities.

Potential interventions for focus area 8 are described in Table 7.8.

Table 7.8 Interventions: Education and behaviour management

Interventions	
8.1	Develop a nationally consistent safety education programme for school bus users that is delivered regularly throughout the year, using a range of delivery channels in a range of formats. This could include a requirement that a specified quantity and frequency of targeted education is provided to school bus users each year.
8.2	Develop and deliver an education campaign targeting motorists to raise awareness of the 20 km/h speed limit passing a stationary school bus. This should be timed to support other initiatives, including enforcement activity or the introduction of new school bus signage.

Refer also to the interventions in the following related focus areas:

- focus area 4 regarding the 20 km/h speed limit
- focus area 5 regarding CCTV
- focus area 6 regarding seatbelts.

7.2.9 Focus area 9: Eligibility for school bus transport from a safety perspective

Students in Years 1–8 who live at least 3.2 km away from their nearest state or state-integrated school are eligible for transport assistance. This distance increases to 4.8 km for students in Years 9–13. The eligibility criteria also require there must not be any suitable public transport within 2.4 km of the roadside gate to their home or 2.4 km to the closest school. Therefore, students may travel up to 2.4 km to get to their nearest

PUDO location or travel up to 4.8 km to get to school before transport assistance (in the form of financial assistance) is provided by the Ministry of Education. This travel may be on a range of roads, from urban roads with good pedestrian infrastructure to winding rural roads with no pedestrian facilities and high traffic volumes.

Parents and caregivers are responsible for ensuring children travel safely to school; however, some stakeholders raised concern about the safety of children who must travel long distances along unsafe roads, especially where parents are unable or unavailable to drive them. This means some children must either walk along unsafe roads, in any weather, to get to school, or alternatively these children stay home and avoid school entirely.

Of all modes of travel to school, school buses are the safest option available. Therefore, if school bus eligibility is viewed through a safety lens, children who would otherwise be required to travel on high-risk roads should be incentivised to use school buses. This would require reducing the eligibility distance and could increase the number of school bus services.

Potential interventions for focus area 9 are described in Table 7.9.

Table 7.9 Interventions: Eligibility for school bus transport

Interventions	
9.1	Undertake further research to determine the degree to which children, who are currently ineligible for travel assistance, otherwise walk or cycle along high-risk roads to get to school.
9.2	Review eligibility for school transport through a safety perspective, with an aim of updating the eligibility criteria to reduce the distance children must travel on high-risk roads to get to school or to school bus PUDO locations.

Refer also to the interventions in the following related focus areas:

- focus area 1 regarding optimising school bus routes for safety
- focus area 3 regarding PUDO site selection and operation.

7.2.10 Focus area 10: Data collection, reporting and sharing

Information relevant to school bus safety is often lacking or difficult to source. For example, there is no single repository of school bus routes or PUDO locations. It is not known how many children cross the road to or from school buses, despite this being the riskiest stage of the school bus journey. The degree to which vehicle safety technologies and occupant protection systems are currently implemented across the school bus fleet is unknown.

The lack of information and data makes it difficult, if not impossible, to objectively assess school bus safety risks. Because this assessment of risk is lacking, it will be difficult to then evaluate potential interventions and prioritise these interventions against the relative risk of each part of the school bus system.

One step in correcting this could be to collate existing information from the Ministry of Education, transport service providers, and councils that operate school bus services. A suite of road safety metrics could then be developed to establish a baseline understanding of school bus operations. Suggested metrics include how many children are currently crossing the road to/from PUDO areas, how often children are required to stand on buses, and how many buses have seatbelts installed. The collection and reporting of data to enable these metrics could potentially be linked to contractual and auditing requirements.

Since the mid-2010s, New Zealand has moved towards more centralised and proactive road safety assessment and mapping. For example, the MegaMaps map viewer displays risk metrics and safe and appropriate speeds for all roads in New Zealand (Waka Kotahi, 2022b). This is available to all road controlling authorities to assist them with proactively prioritising speed and infrastructure improvements. This technology could potentially be leveraged to also map, assess and share school bus routes and PUDO locations. This would, for example, enable NZTA, road controlling authorities and NZ Police to see where school bus routes and stops are located, and for the Ministry of Education to better understand the underlying safety of the roads school buses are running on.

Several limitations were also identified in how crashes involving school bus travel are recorded in CAS, including instances where school buses were not coded as 'school buses', and instances where the number of passengers (and sometimes injuries to passengers) is not recorded. Additionally, several injury crashes were reported to the Ministry of Education by transport service providers, but not also recorded in CAS. Opportunities to improve reporting school bus crashes and non-collision events should be explored.

Potential interventions for focus area 10 are described in Table 7.10.

Table 7.10 Interventions: Data collection, reporting and sharing

Interventions	
10.1	Collate and map school bus routes and PUDO sites and share these data with key organisations involved in road safety, including NZ Police, road controlling authorities and NZTA.
10.2	Develop and monitor a suite of school bus safety metrics. The selection of metrics should align with key gaps in the evidence base for school bus safety; for example: • number of school bus related injuries reported to the Ministry of Education, by severity • number and proportion of school buses with seatbelts, and the features necessary for compartmentalisation • percentage of the school bus fleet with specific vehicle safety technologies installed • number of instances where a child (or children) was required to stand on a school bus, by speed environment.
10.3	Ensure transport service providers report all collisions to NZ Police, especially collisions that resulted in injuries. This could be implemented, for example, by requiring that a Police reference number is attached to every relevant transport service provider incident report submitted to the Ministry of Education.
10.4	Investigate improvements to CAS and crash reporting to improve the capture of school bus crashes and the injuries that result from these crashes.

Refer also to the interventions in the following related focus areas:

- focus area 3 regarding mapping and assessment of PUDO locations
- focus area 5 regarding an audit of vehicle standards and vehicle technologies.

7.3 Responsibilities for interventions

There are currently multiple groups and organisations that influence school bus safety in New Zealand. Contracting and funding models for school bus services include:

- Ministry of Education contracted services, which cover most school bus services in New Zealand (Daily Bus and Technology Bus)
- schools (or school networks) designing their own transport routes and tendering school bus services through the Direct Resourcing or Māori Medium Schools model, funded by the Ministry of Education
- councils delivering school bus services as part of urban public transport networks
- schools directly chartering school buses for student transport to/from school or out-of-school activities.

In addition:

- The Ministry of Transport Te Manatū Waka is responsible for the regulations for minimum safety standards for vehicles and road user activity.
- NZTA is responsible for vehicle and driver licensing, road safety infrastructure investment, and providing guidance on road design and use, including guidance on bus stops. NZTA also currently provides educational resources for school bus users.
- NZ Police is responsible for encouraging safe road use and ensuring compliance with safety regulations, particularly in commercial vehicle and driver safety. Police officers may also be involved in delivering road safety education.
- School buses travel on roads and infrastructure provided and managed by road controlling authorities.
- Transport service providers are responsible for operating school bus services, including complying with vehicle and driver safety regulations and contractual requirements, as well as being responsible for the health and safety of their employees.
- Schools are responsible for communicating with caregivers and students and addressing student behaviour issues.
- Additionally, school children, parents, caregivers, and other road users all play a role ensuring the safety of themselves and others when travelling on or around school buses.

Because there is no single organisation with oversight of all areas of school bus operation, gaps can form where responsibilities are unclear – for example, which organisation(s) are responsible for educating school bus students about bus safety. There are limited opportunities for collaboration across the sector – for example, sharing information on school bus safety trends, innovations and insights between the Ministry of Education and transport service providers, or between the Ministry of Education and councils that are operating school bus services. Finally, because school buses are the safest mode of transport to school, there is little motivation among the organisations involved to prioritise interventions that specifically improve school bus safety.

The Ministry of Education's primary responsibility is to deliver a quality education system, which includes providing transport assistance where distance and/or accessibility may be a barrier for students attending school. While safety is a consideration in the procurement of Ministry of Education school bus services, there is pressure to also deliver these services as efficiently as possible. . Additionally, the Ministry of Education does not have dedicated road safety expertise within their school bus transport advisory or contracting teams, although advice is sought from the NZ Police Commercial Vehicle Safety Team when required.

Potentially, a single government organisation could have overall responsibility for all components of school bus safety, across all pillars of the Safe System. If this is not possible, then reflection must be had on how the school bus system currently operates, the stakeholders involved, and how responsibilities can be better defined to ensure the delivery of school bus services that prioritise safety.

7.4 Recommendation

Considering the findings presented in this chapter, it is recommended that a government or industry-wide school bus safety working group be established to review the findings of this report, consider how the interventions identified in this chapter will be progressed, and assign responsibility for the investigation and delivery of them. This group should include key government agencies (NZTA, Te Manatū Waka, Ministry of Education and NZ Police) and other relevant industry stakeholders, including school bus operators and relevant community/stakeholder organisations.

There is precedent for the working group approach in New Zealand. The Bus Safety Technical Advisory Committee, a government and industry initiative led by the Ministry of Education, initiated the first report into school bus safety in 2010 (Baas et al., 2010). Similar sector-wide approaches include the working group that developed the Alpine Code of Practice (Bus & Coach Association New Zealand, 2020) and the independent Cycling Safety Panel, which developed the Cycling Safety Action Plan (Cycle Safety Panel, 2014). In New South Wales, Australia, a School Bus Safety Community Advisory Committee (Transport for New South Wales, 2022b) is responsible for the safe transportation of children in rural and regional New South Wales. This committee has an independent chair and representatives from relevant government, industry and community organisations.

8 Conclusion

The purpose of this research was to review the current state of school bus safety in New Zealand and to identify a suite of interventions that will enhance the safety of students and bus drivers in and around school buses. The research objectives were to:

- understand current best practice both nationally and internationally, including interventions that have been tried
- undertake an assessment of the operating conditions for school buses and the vehicle fleet used for delivering school bus services (where data are available)
- review current legislation, guidance, policy and practices that impact on the safety of school bus travel
- make recommendations on measures to improve the safety of those travelling on school buses.

This research project addressed these objectives by:

1. reviewing New Zealand, Australian and international literature on school bus safety, including best practice guidance, evaluations and trials of safety interventions, and vehicle safety standards
2. engaging with stakeholders from relevant New Zealand ministries and other organisations to understand current practices in school bus safety
3. analysing a range of available data to:
    a. quantify the type and split of school bus services across New Zealand
    b. quantify the type and split of crashes and injury events involving school buses
    c. assess the relative risk of school bus routes in different road environments.

The research updates prior research on school bus safety (Baas et al., 2010) by addressing gaps in current knowledge, and by considering broader safety interventions being implemented under *Road to Zero – New Zealand's Road Safety Strategy 2020–2030* (Te Manatū Waka, 2019). This report collates existing knowledge and provides a baseline understanding of school bus safety to support the prioritisation of interventions that will improve school bus safety in the future.

Findings across each stage of the research were collated in chapter 7, where potential interventions to improve school bus safety were identified. These are summarised in Table 8.1 below.

The primary recommendation of this project is that a government or industry-wide school bus safety working group be established to review the findings of this report, to consider how the interventions identified in this chapter will be progressed and assign responsibility for the investigation and delivery of them. This group should include key government agencies (NZTA, The Ministry of Transport Te Manatū Waka, Ministry of Education and NZ Police) and other relevant industry stakeholders, including school bus operators and relevant community/stakeholder organisations.

Table 8.1 Summary of potential interventions

Focus area		Intervention/action	
1	School bus route design	1.1	Review existing route design guidelines to ensure they provide consistent, best practice guidance that considers Safe System principles.
		1.2	Investigate whether existing routing algorithms (for developing school bus routes) could be improved to manage road-related risks – for example, by minimising travel on high-risk roads and avoiding high-risk manoeuvres, where practicable.
		1.3	Remind transport service providers of the safety risks to drivers travelling to/from the start of the bus route and encourage them to review hazards along these routes as part of their risk management processes.
2	Speed and infrastructure (on roads that school buses operate on)	2.1	Provide road controlling authorities with the location of all school bus routes and PUDO sites for consideration when planning and designing safety infrastructure projects, and to assist with developing local or regional speed management plans.
3	Selection, design, visibility and operation of PUDO sites	3.1	Update guidance for PUDO siting to align with Safe System principles, including improved selection and design guidance, and risk assessment methods, and considering broader safety/accessibility impacts.
		3.2	Develop and formalise framework to categorise and classify PUDO sites by risk. Consider undertaking a national assessment of PUDO locations to prioritise high-risk sites for auditing and infrastructure improvements.
		3.3	Investigate markings, signage, and infrastructure improvements at PUDO areas that are effectively permanent.
4	Conspicuity of school buses, visibility of school bus routes, and speeds around stationary buses	4.1	Improve signage for school buses so that it communicates both the speed limit passing the bus and when the speed limit applies. Desirably, this would be the flashing LED signage tested and evaluated in research report 408 (Baas et al., 2010). The implementation of this signage should ideally align with a review of the 20 km/h speed limit passing the school bus (see intervention 4.2 below), and a national awareness and enforcement campaign that coincides with the new signs being introduced (see intervention 8.2).
		4.2	Review the 20 km/h speed limit while passing a stationary school bus to consider expanding it to include the period when a bus is moving in/out of PUDO locations, and whether a 30 km/h speed limit is more appropriate.
		4.3	Undertake a national risk assessment of school bus routes funded by the Ministry of Education, to prioritise bus route signage improvements. This should align with action 3.2 regarding PUDO site classification and risk assessment.
		4.4	Amend the RUB to require that urban buses operating as school buses must not have advertising on the front or rear of the bus that affects the visibility of school bus signage.
		4.5	Investigate options for enforcing the 20 km/h (or 30 km/h) speed limit passing stationary school buses – for example, using mobile speed cameras at PUDO locations.
		4.6	Support and fund innovative projects to develop and pilot effective, low-cost solutions for improving the visibility of school buses and school bus routes.
5	School bus vehicle safety technologies	5.1	Undertake an audit of vehicle standards and vehicle technologies across the school bus fleet and require this information to be supplied by transport service providers in future school bus service tenders.

Focus area		Intervention/action	
		5.2	Investigate options to mandate or incentivise the uptake of vehicle technologies in the school bus fleet, focusing on VRU detection systems, (including CCTV), lane departure warning/lane keep assist, and advanced driver distraction warning systems.
		5.3	Review the list of telematics providers to ensure approved providers are effective in providing feedback on driving behaviours to drivers and transport service providers.
6	Bus occupant protection	6.1	Progressively prioritise and adopt: • ADR 68/00 for occupant protection (three-point seatbelts for all occupants) on all heavy buses used as school buses • ADR 66/00 for seat strength, seat anchorage strength and padding on all heavy buses used as school buses.
		6.2	Clarify, and educate transport service providers on, the responsibilities of bus drivers in ensuring seatbelts are worn where provided.
7	Bus driver management	7.1	Consider amending the Land Transport Act 1998 to align with current practice. • Introduce a zero-alcohol limit for school bus drivers. • Require school bus drivers to complete logbooks.
8	Education and behaviour management	8.1	Develop a nationally consistent safety education programme for school bus users that is delivered regularly throughout the year, using a range of delivery channels in a range of formats. This could include a requirement that a specified quantity and frequency of targeted education is provided to school bus users each year.
		8.2	Develop and deliver an education campaign targeting motorists to raise awareness of the 20 km/h speed limit passing a stationary school bus. This should be timed to support other initiatives, including enforcement activity or the introduction of new school bus signage.
9	Eligibility for school bus transport from a safety perspective	9.1	Undertake further research to determine the degree to which children, who are currently ineligible for travel assistance, otherwise walk or cycle along high-risk roads to get to school.
		9.2	Review eligibility for school transport through a safety perspective, with an aim of updating the eligibility criteria to reduce the distance children must travel on high-risk roads to get to school or to school bus PUDO locations.
10	Data collection, reporting and sharing	10.1	Collate and map school bus routes and PUDO sites and share these data with key organisations involved in road safety, including NZ Police, road controlling authorities and NZTA.
		10.2	Develop and monitor a suite of school bus safety metrics. The selection of metrics should align with key gaps in the evidence base for school bus safety; for example: • number of school bus related injuries reported to the Ministry of Education, by severity • number and proportion of school buses with seatbelts, and the features necessary for compartmentalisation • percentage of the school bus fleet with specific vehicle safety technologies installed • number of instances where a child (or children) was required to stand on a school bus, by speed environment.
		10.3	Ensure transport service providers report all collisions to NZ Police, especially collisions that resulted in injuries. This could be implemented, for example, by requiring that a Police reference number is attached to every relevant transport service provider incident report submitted to the Ministry of Education.
		10.4	Investigate improvements to CAS and crash reporting to improve the capture of school bus crashes and the injuries that result from these crashes.

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Appendix A: Data sources for school bus service statistics

Data sources for *Table 2.3: Ministry of Education daily school bus travel statistics*

Service type	Data/statistic	Source(s)
Ministry of Education Daily Bus	• Route count • Eligible students • Route length (km)	Ministry of Education Daily Bus school bus routes online GIS layer.[a] The layer is dated 'November 2021' and was extracted in May 2022.
Ministry of Education Direct Resourcing	• Route count	Ministry of Education, 18 July 2022 (pers. comm.).
	• Eligible students • Average route length (km)	Estimated based on rates generated from the Daily Bus statistics: • 35.3 passengers per service • average bus route length (one way) of 26.5 km.
Ministry of Education Māori Medium Schools	• Eligible students	Ministry of Education, 18 July 2022 (pers. comm.).
	• Route count • Average route length (km)	Estimated based on rates generated from the Daily Bus statistics: • 35.3 passengers per service • average bus route length (one way) of 26.5 km.

[a] https://www.arcgis.com/home/webmap/viewer.html?url=https://services9.arcgis.com/ygJ1AFEQ1sNGJz4H/ArcGIS/rest/services/ST_All_Bus_Routes_Nov21Update_view/FeatureServer/42

Data sources for *Table 2.4: Regional and local council school bus service statistics*

Service provider	Statistic	Source(s)
Auckland Transport	• Services per day • Total km of bus travel	Auckland Transport open GIS data: School Bus Route.[a] Downloaded 29 June 2022.
	• Patronage	Auckland Transport, 26 July 2022 (pers. comm.). Data provided: daily HOP boardings on school bus services, by route, for each school day in May 2022.
Greater Wellington Regional Council (Metlink)	• Services per day • Total km of bus travel	Metlink bus route dataset in General Transport Feed Specification (GTFS) format.[b] Downloaded 29 June 2022.
	• Patronage	Greater Wellington Regional Council, 10 August 2022 (pers. comm.). Data provided: total daily HOP boardings on school bus services for each school day in May 2022.
Environment Canterbury (Metro)	• Services per day • Patronage	Environment Canterbury, 9 June 2022 (pers. comm.). Data provided: passengers by service and school day during May 2022 (school bus services only).
	• Average route length (km)	Estimated based on the average route length across Auckland and Wellington: 12.1 km.
Taranaki Regional Council (Citylink)	• Services per day	Taranaki Regional Council website.[c] Accessed 5 August 2022. Note: The number of advertised school bus services were added up to determine total services per day.

Service provider	Statistic	Source(s)
	• Patronage • Average route length (km)	Estimated based on school bus passenger boarding rates for Auckland, Wellington and Christchurch, and average route lengths for Auckland and Wellington: • 32.5 passengers per service • average route length (one way): 12.1 km.
Bay of Plenty Regional Council (Baybus)	• Services per day	Baybus website.[d] Accessed 5 August 2022. Note: The number of advertised school bus services were added up to determine total services per day.
	• Patronage • Average route length (km)	Estimated based on school bus passenger boarding rates for Auckland, Wellington and Christchurch, and average route lengths for Auckland and Wellington: • 32.5 passengers per service • average route length (one way): 12.1 km.
Gisborne District Council (Waka Kura)	• Services per day	Gisborne District Council's Waka Kura website.[e] Accessed 5 August 2022. Note: The number of advertised school bus services were added up to determine total services per day.
	• Patronage • Average route length (km)	Estimated based on school bus passenger boarding rates for Auckland, Wellington and Christchurch, and average route lengths for Auckland and Wellington: • 32.5 passengers per service • average route length (one way): 12.1 km.

[a] https://data-atgis.opendata.arcgis.com/datasets/ATgis::school-bus-route
[b] https://www.metlink.org.nz/about/legal/general-transit-specification-feed/
[c] https://www.trc.govt.nz/buses-transport/passenger-info/citylink-information/school-buses/
[d] https://www.baybus.co.nz/tauranga-schools/school-bus-routes-2022/
[e] https://www.gdc.govt.nz/services/transport-and-parking/waka-kura-bus-service

Data sources for *Table 2.6: Ministry of Education Technology Bus travel: key statistics*

Data/statistic	Source(s)
• Route count • Eligible students	Ministry of Education, 18 July 2022 (pers. comm.).
• Route list	Ministry of Education, list of suppliers for each school bus route from 2022 (Excel spreadsheet).[a] Downloaded 22 June 2022.
• Route length	Routes were modelled using the schools listed in the route list, using GIS network analysis tools. Average route length could be extracted from the output GIS layers.

[a] https://www.education.govt.nz/school/property-and-transport/suppliers/school-bus-procurement/

Appendix B: Crash and incident analysis – detailed methodology

B.1 Injuries to students and other road users during PUDO

This analysis involved reviewing:

- injury crashes with cause codes '115 inappropriate speed past a school bus' or '729 pedestrian from or to school bus'
- injury crashes involving pedestrians aged 5–19 years, on school days between 0630–0900 and 1500–1730, on roads with a speed limit of 70 km/h or higher
- crashes involving school buses (vehicle usage = 'school bus')
- incidents reported to the Ministry of Education where an injury occurred during PUDO.

After reviewing the CAS crash records, two crashes were discarded because the vehicles involved were incorrectly coded as 'school bus'. One involved an elderly woman injured while boarding a scheduled bus service, while the other involved an 'unidentified black car' striking a child in a hit-and-run incident.

B.2 Injuries to drivers and passengers 'on bus'

This detailed analysis involved reviewing:

- crashes in CAS where all the following criteria were met:
  - the crash involved a school bus, as either a vehicle coded with the usage = 'school bus', or where the description or diagram describe the vehicle as a 'school bus'
  - the crash resulted in injuries to the bus driver and/or passenger(s)
  - the school bus was travelling along the road at the time of the crash
- incidents reported to the Ministry of Education where a driver or passenger was injured while the bus was travelling along the road, including both collision and non-collision events. Where possible, collision events were matched to the corresponding crash records in CAS.

On reviewing the 'school bus' crashes in CAS, one crash was removed where a car/wagon was incorrectly coded as 'school bus'. After reviewing the Ministry of Education incident reports, a further 23 injury crashes were matched and extracted from CAS. In these instances, the bus was either not identified as a 'school bus' in the crash report, or the crash was classified as 'non-injury' despite injuries to passengers being documented in the Ministry of Education incident report.

Additionally:

- Some CAS reports incorrectly recorded 'nil' passengers, despite the matching Ministry of Education report stating several students were onboard at the time.
- Nine collision events were reported by the Ministry of Education but could not be matched to a CAS record. Most were minor crashes, although one crash resulted in 12 injuries to the driver and passengers, including at least one serious injury.

Appendix C: Crash risk assessment methodology

The crash risk of different categories of bus route were assessed as follows:

1. Injury crashes (2012–2021) within 30 m of any section of Daily Bus route were attached to the closest section of bus route.
2. Each crash was classified by movement code category, as either head-on, run-off road, intersection/turning, pedestrian or other (see Table D.1 below).
3. Vehicle kilometres travelled per year (VKT) were calculated for each section, using the MegaMaps ADT attribute.
4. The total kilometres, VKT and number of crashes by severity and crash type were summarised for each road risk category and crash type. Given the relatively short length of rural undivided roads classified as both 'high volume' and 'extreme environment', these were reclassified as 'high volume' only.
5. Personal risk and collective risk were calculated, and risk bands determined for each road risk category at an aggregate level, using the methodology in the *High-risk rural roads guide* (Waka Kotahi, 2011).

Table D.1 Classification of crashes by movement code in CAS

Crash type	Movement code categories (from CAS)
Head-on	• Head on
Loss of control	• Lost control bend • Lost control straight road
Intersection/turning	• Crossing not turning • Crossing one turning • One turns right • Same direction turning
Pedestrian	• Pedestrian crossing road • Other pedestrian
Other	• Manoeuvring • Merging • Miscellaneous • Obstruction • Overtaking • Rear end crash

Appendix D: International vehicle safety standards that apply to school buses

Country/Continent	Safety standards	Comments
Australia Australian Design Rules	• ADR 3 Seats and seat anchorages • ADR 4 Seat belts • ADR 5 Anchorages for seat belts and child restraints • ADR 59 Omnibus rollover strength • ADR 66 Seat strength, seat anchorage and padding in omnibuses • ADR 68 Occupant protection in buses • ADR 69 Full frontal impact occupant protection	ADR standards include specific standards for buses ADR 59, 66, 68.
Canada Canadian Motor Vehicle Safety Standards and Canada Standards Association	• CMVSS111 Mirrors and rear visibility systems • CMVSS108 Lighting systems and reflective devices • CMVSS301 School pedestrian safety devices • CMVSS220 School bus rollover protection • CMVSS208 Occupant restraint systems in frontal impact • CMVSS210 Seat belt anchorages • CMVSS217 Bus window retention and emergency exits • CMVSS221 School bus body joint strength • CMVSS301 Fuel system integrity • CSA D250-22 School buses	Canada has specific standards for school buses, including CMVSS217, 220, 221, 301 and CSA D250-22.
Europe UNECE Regulations	• Regulation No. 14 Safety-belt anchorages • Regulation No. 16 Safety-belts for occupants of power-driven vehicles • Regulation No. 36 Construction of public service vehicles • Regulation No. 52 Construction of small capacity public service vehicles • Regulation No. 66 Strength of superstructure • Regulation No. 80 Strength of seats and their anchorages • Regulation No. 46 Devices for indirect vision • Regulation No. 107 General construction of M2 (light) and M3 (heavy) buses	Additional standards have been developed for new technologies, including UNECE Regulation No. 46 (2014) and UNECE Regulation No. 107 (2015).
USA Federal Motor Vehicle Standards	• FMVS 217 Bus emergency exits and window retention and release • FMVS 208 Occupant crash protection • FMVS 209 Seat belt assemblies • FMVS 210 Seat belt assembly anchorages • FMVS 221 School bus body joint strength • FMVS 222 School bus passenger seating and crash protection	Specific standards for school buses FMVS 221 and 222.

Appendix E: Bow tie diagrams

Diagram 1: A school bus travels into the path of another vehicle or runs off the road.

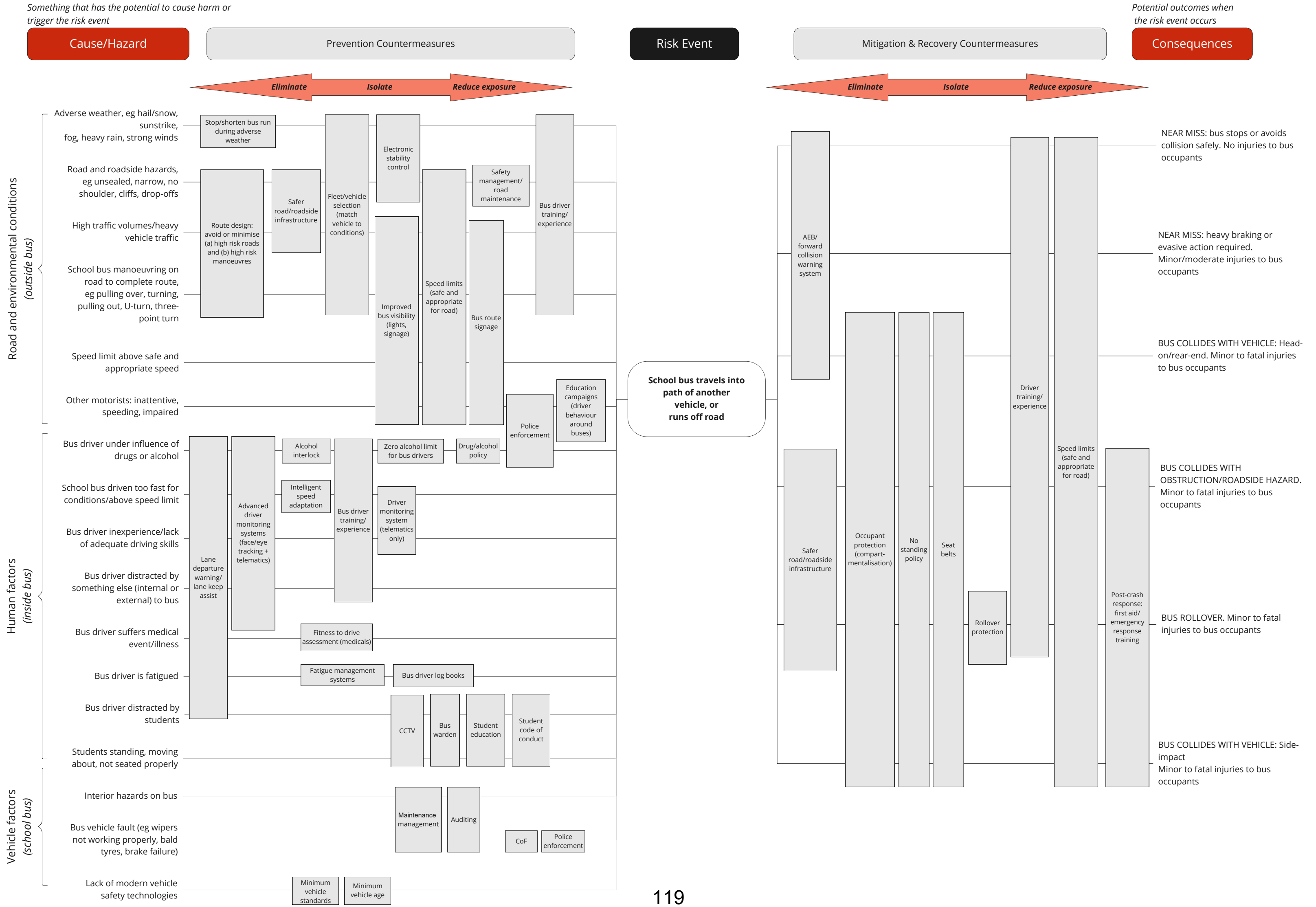

Diagram 2: Risks around pick-up drop-off activity