Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT R13W0083

CROSSING ACCIDENT

CANADIAN NATIONAL RAILWAY
FREIGHT TRAIN L50041-26
MILE 37.06, LAMPMAN SUBDIVISION
CARLYLE, SASKATCHEWAN
26 MARCH 2013

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Railway Investigation Report R13W0083

Crossing accident

Canadian National Railway
Freight train L50041-26
Mile 37.06, Lampman Subdivision
Carlyle, Saskatchewan
26 March 2013

Summary

At about 1515 Central Standard Time on 26 March 2013, Canadian National Railway freight train L50041-26 was proceeding eastward at 25 miles per hour on the Lampman Subdivision in Carlyle, Saskatchewan, when it struck a southbound school bus transporting seven elementary school children at the 4th Street East crossing. One passenger suffered minor injuries. No dangerous goods were involved.

Ce rapport est également disponible en français.

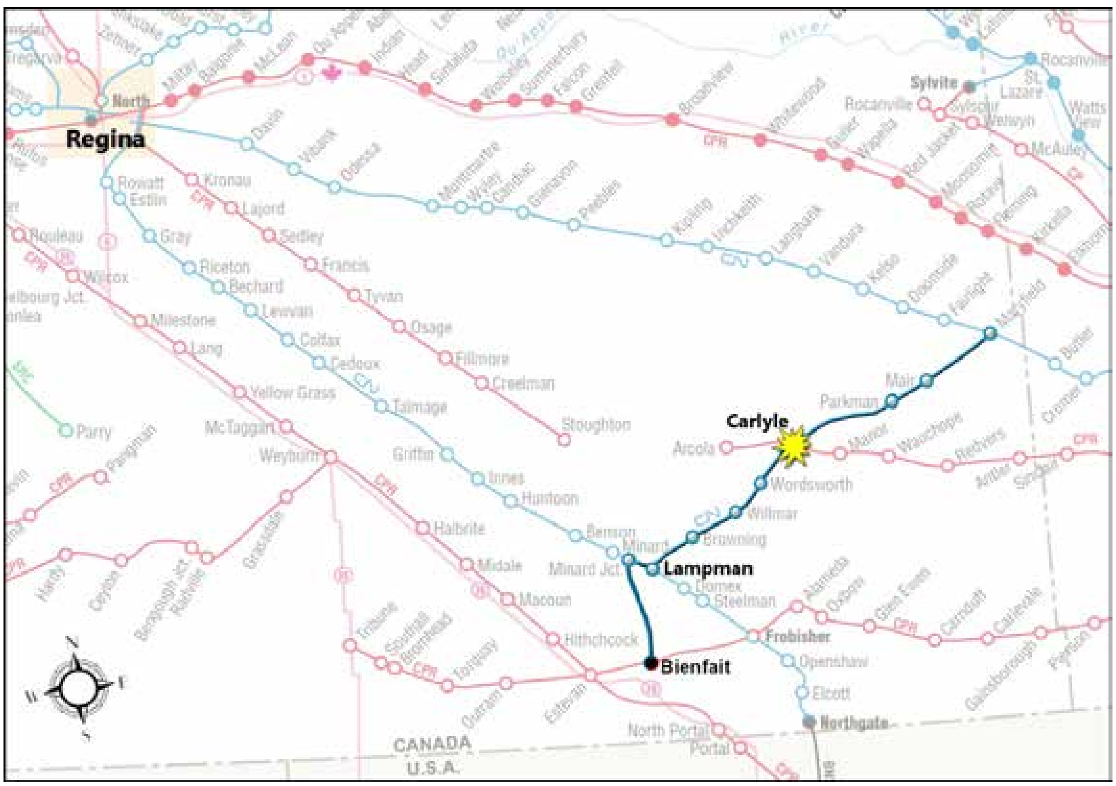
Factual information

On 26 March 2013, Canadian National Railway (CN) freight train L50041-26 (the train) departed Bienfait, Saskatchewan, travelling eastward en route to Brandon, Manitoba, on CN's Lampman Subdivision. The train consisted of two locomotives, 21 loaded freight cars, and six empty freight cars. The train weighed approximately 3000 tonnes and was about 1800 feet long. The train crew was comprised of a conductor, an assistant conductor, and a locomotive engineer. All crew members were familiar with the territory, were qualified for their respective positions, and met fitness and rest requirements.

The accident

At about 1515,[1] while travelling at 25 mph, the train approached the 4th Street East crossing (the crossing), located at Mile 37.06 of the Lampman Subdivision in Carlyle, Saskatchewan (Figure 1). The train's headlights were on full power, the ditch lights were illuminated, and the bell was activated. In accordance with *Canadian Rail Operating Rules* (CROR) Rule 14(l), the horn was sounded as the train approached and occupied the crossing.

Figure 1. Accident location (Source: Railway Association of Canada, *Canadian Railway Atlas*)



At about the same time, a school bus (the bus), operated by a licensed school bus driver (the driver), was travelling south on 4th Street East from Carlyle Elementary School, transporting seven elementary school children. The driver was not wearing sunglasses.

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[1] All times are Central Standard Time.

The bus stopped at the stop sign located at the north side of the crossing. Before proceeding, the driver looked in both directions for a train. While stopped, the driver did not open the door and did not see or hear the approaching train. The bus then proceeded into the path of the train. The lead locomotive struck the front of the bus as it entered the crossing. The front end of the bus was significantly damaged (Photo 1). One of the passengers sustained minor injuries. Police, fire and other emergency services attended the scene.

Photo 1. Accident scene looking west (Source: Canadian National Railway)

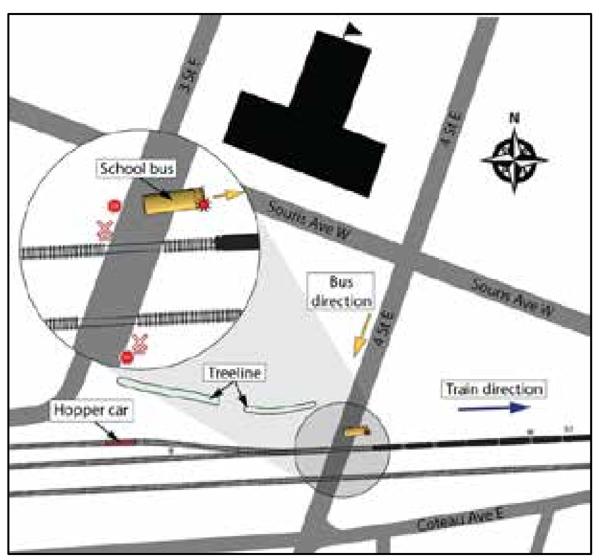
The weather at the time of the occurrence was sunny and –7ºC, and the winds were out of the north at 23 km / hr. The sun was in the western sky, approximately 34.4˚ above the horizon. Sunset occurred at 19:02 that day.

Site examination

Damage to the locomotive and the track infrastructure was minimal. The front end of the bus was torn from the frame on the passenger side of the bus. As a result of the impact, the bus came to rest across the northbound lane of 4th Street East, partially in the ditch. The train came to a stop about 1200 feet down the tracks (Figure 2).

At the time of the occurrence, a hopper car was being stored in the siding just north of the main track. The hopper car was positioned about 344 feet (105 m) west of the crossing.

Figure 2. Diagram detailing vicinity of the accident



Lampman Subdivision and track information

The Lampman Subdivision consists of a single main track, which starts at Maryfield Junction (Mile 0.0) in Manitoba and extends 86 miles west to Bienfait, Saskatchewan (Mile 86.2). The method of train control is the occupancy control system (OCS), as authorized by CROR and supervised by a CN rail traffic controller (RTC) located in Edmonton, Alberta. Maximum speed at this location is 25 mph. The horn and bell are required to be sounded in accordance with CROR and company instructions. Rail traffic density in the vicinity is low, with about one train per day.

In the vicinity of the accident, the track at the crossing was tangent, with a level grade, and consisted of 85-pound jointed rail. Track components were in good condition and met the requirements of the *Rules Respecting Track Safety* approved by Transport Canada (TC).

Crossing and road information

The roadway crossing traverses two sets of railway tracks, intersecting them at an angle of 113°. The roadway is a two-lane, asphalt-paved residential street approximately 9.3 meters wide, with a posted speed limit of 40 km / hr. There is a stop sign and a standard railway crossing sign (SRCS) on each side of the crossing. The crossing was not equipped with advanced warning signs or pavement markings. The most recent TC inspection had occurred on 16 July 2003. At that time, the average number of vehicles using this crossing was estimated to be about 100 / day.

TC's Minimum Railway / Road Crossing Sightline Requirements For Grade Crossings Without Automatic Warning Devices (G4-A), which includes level crossings equipped with stop signs, sets forth requirements for clear vehicle sightlines from a road approach to a crossing. G4-A outlines that for vehicles stopped at the crossing, the minimum sightline distance required along the rail line is 375 feet (114 m). The available sightlines for vehicle drivers stopped at the crossing met regulatory requirements and were generally clear in both directions.

The bus

The bus was a single-axle, model D220 school bus manufactured by International Bus in 2004 and equipped with an automatic transmission. It weighed 12 474 kg and had a capacity of 52 passengers. The odometer reading on the bus was about 262 000 kms. The bus was registered in the province of Saskatchewan. A provincial mechanical inspection had been performed on the bus on 26 October 2012. The inspection had included the hydraulic brake system. No exceptions were noted. The bus was equipped with side-view mirrors, which were mounted outside on the A-pillars[2] at both front corners of the bus.

The bus did not have a dedicated event data recorder. Consequently, it was not possible to determine what, if any, vehicle controls were activated just before or at the time of the accident.

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[2] A-pillars are the vertical or near-vertical supports of an automobile's front window area.

Bus company and driver information

Rilling Bus Limited (Rilling) operates the school buses in the area, and the driver had been employed by Rilling as a school bus driver since August 2008. The company requires all of its bus drivers to have a Saskatchewan driver's licence with an "S" (i.e., professional school bus) endorsement and a current medical examination. Rilling only hires qualified school bus drivers and does not provide additional training. Drivers over the age of 65 are required by the provincial insurer, Saskatchewan Government Insurance (SGI), to undergo a medical evaluation each year. The driver had recently completed the requisite medical examination in August 2012.

The driver was 68 years old and had been driving for 45 years. The driver held a valid S-endorsed Saskatchewan Class 2 licence with air brake endorsement. The licence was issued on 01 November 2012 and had an expiry date of 31 October 2017. The driver had held this type of licence in Saskatchewan since 1983 and had been driving school buses since that time. Since 1983, the driver had undergone a refresher road test every five years.

For the past four years, the driver had been driving the occurrence bus route twice each school day. This route, in addition to another route driven on alternate school days, resulted in the driver negotiating the crossing up to seven times each day. Although the driver was accustomed to the sound of a locomotive horn and was aware that the single daily train could pass through town at any time, the driver had never encountered a train at this crossing.

The driver had medical issues typically associated with aging that could potentially have an impact on driving abilities. Specifically, the bus driver had been diagnosed with diabetes (controlled with medication), obstructive sleep apnea (treated with continuous positive airway pressure, or CPAP), hypertension (controlled with medication), moderate arthritis, and chronic obstructive pulmonary disease (COPD). In addition, the driver had suffered a transient ischemic attack (mini-stroke) in late 2008. The family physician was aware of these issues and considered them all as being managed. Furthermore, the physician had reported the issues on the driver's most recent (August 2012) SGI commercial driver's licence medical report. Subsequently, the SGI Medical Review Unit (MRU) approved the driver as being medically fit to drive a school bus.

Provincial acts and regulations governing school buses

The *Saskatchewan Traffic Safety Act* defines a traffic control device as "a sign, signal, marking or device that is placed, marked or erected for the purpose of regulating, warning or guiding traffic."[3] This includes a stop sign. As such, the Province of Saskatchewan considers passive railway crossings equipped with crossbucks and a stop sign to be *controlled* railway crossings.

The *Saskatchewan School Bus Operating Regulations* (1987), Section 4 (e) states (in part):

> 4. Every driver shall:
>
> […]

[3] Government of Saskatchewan, *The Traffic Safety Act* (effective 01 July 2006 as Chapter T-18.1 of the *Statutes of Saskatchewan*, 2004), Part 1: 2(1)(ww), page 12, available at http://www.qp.gov.sk.ca/documents/PIT/Statutes/T/T18-1-2009-05-12.pdf (last accessed on 14 May 2014)

> (e) when approaching an uncontrolled railroad crossing:
>
> (iii) stop the bus not less than four and not more than 10 metres from the railroad crossing;
>
> (iv) open the front door of the bus and look in both directions;
>
> (v) proceed across the tracks when it is safe to do so and, in the case of standard transmissions, remain in first gear until the bus is completely clear of the tracks; […][4]

In the province of Manitoba, the *Public Schools Act*: *School Buses Regulation* (Section 15) requires that the driver of a school bus shall:

> (j) whether carrying passengers or not, before crossing any track or tracks of a railway, bring the school bus to a full stop not less than 5 metres or more than 15 metres from the rail nearest the front of the school bus, and fully open the service door, listen and look in both directions along the track or tracks for approaching trains [*and*] not proceed unless the action can be completed in safety […][5]

Section 4.1(c) of the Saskatchewan *School Bus Operating Regulations* requires school bus drivers to "promptly notify the school board, municipality or person who employs or has engaged the driver to drive a bus of […] any medical condition that in the opinion of the driver's physician or health care provider could have an impact on the driver's ability to safely operate a bus."[6] Reporting such conditions could result in the review of a bus driver's file and the reassessment of the driver's fitness to work.

Operation Lifesaver

Operation Lifesaver (OL) is a national public awareness program aimed at educating Canadians about the hazards surrounding rail property and trains. Its main goal is to prevent collisions between trains and motor vehicles and to prevent trespassing incidents that lead to serious injury or death. The program targets locations identified as high risk through accident history. OL responds to individual requests from schools and municipalities, and makes over 500 presentations per year to a variety of community audiences that include elementary school-aged children to high school students, and school bus operators and their drivers.

Every four years, TC conducts an evaluation of OL activities and expenditures. The 2009 evaluation stated, "Crossing accidents have steadily declined in the last decade. Extrapolating

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4 Government of Saskatchewan, *School Bus Operating Regulations* (Regina: 2003, effective 11 August 1987), Section 4(e), available at http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/H3-1R5.pdf (last accessed on 14 May 2014)

5 Government of Manitoba, *The Public Schools Act: School Buses Regulation*, 465/88 R (registered 26 November 1988), Section 15, page 10, available at http://web2.gov.mb.ca/laws/regs/current/_pdf-regs.php?reg=465/88 R (last accessed on 14 May 2014)

6 Government of Saskatchewan, *School Bus Operating Regulations* (Regina: 2003, effective 11 August 1987), Section 4.1(c), available at http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/H3-1R5.pdf (last accessed on 14 May 2014)

from research done in the U.S., it can be inferred that Operation Lifesaver in Canada has contributed to the reduction in railway crossing accidents."[7]

In 2007, the Advisory Panel for the *Railway Safety Act* Review acknowledged that an educational component was an integral part of a multi-faceted approach to rail safety. The committee stated that "more than 50% of crossing accidents occur at crossings equipped with active warning systems," and therefore, "technology by itself is obviously not sufficient to solve existing crossing safety problems, but must be coupled with robust outreach and public education programs, and an understanding of human behaviour."[8]

OL publishes tips for drivers to improve safety in the vicinity of railway crossings. A module has been developed specifically for school bus drivers. The tips for school bus drivers include advice that they turn off audio equipment and fans, silence passengers, open the driver's window and service door, and look and listen for an approaching train before deciding whether to cross railway tracks. Drivers are reminded to be especially careful at crossings without gates, flashing lights or bells. In recent years, at the start of the school year, OL has issued a media release targeted at school bus drivers. The most recent release prior to the accident was in August 2012, was titled "School bus drivers, refresh your rail safety knowledge before school starts",[9] and also contained a link to the school bus driver tips.

The bus company, the elementary school administrators, and the driver were not aware of Operation Lifesaver. None had received or sought out any targeted railway safety education.

Train visibility

A driver at a passive level crossing controlled by a stop sign needs to see both ways along the tracks. The driver must also allow sufficient time to look for trains in both directions and to decide when it is safe to accelerate and proceed across the tracks. An approaching train is most likely to be first detected by a driver when it appears within the driver's peripheral vision, because the eye is more sensitive to movement in the periphery than in central vision.[10]

Reduced visibility at level crossings can occur due to features of the road vehicle itself, such as window pillars, or rear- and side-view mirrors. This is particularly true in larger vehicles, such

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7 Transport Canada, Departmental Evaluation Services, *Evaluation of the TC Contribution to Operation Lifesaver: Final Report* (March 2009), Executive Summary, page ii, available at http://www.tc.gc.ca/media/documents/corporate-services/lifesaver-09.pdf (last accessed on 14 May 2014)

8 Transport Canada, Advisory Panel for the *Railway Safety Act* Review, *Stronger Ties: A Shared Commitment to Railway Safety: Review of the Railway Safety Act* (Ottawa: November 2007), section 7.2.3, pages 113–114, available at http://www.tc.gc.ca/media/documents/railsafety/transport_stronger_ties_report_final_e.pdf (last accessed on 14 May 2014)

9 Operation Lifesaver, School bus drivers, refresh your rail safety knowledge before school starts (15 August 2012), available at http://www.operationlifesaver.ca/general/2012/08/school-bus-drivers-refresh-rail-safety-knowledge-school-starts/ (last accessed on 14 May 2014)

10 J. Osaka, (1988), Speed estimation through restricted visual field during driving in day and night: Naso-temporal hemifield differences. In: A.G. Gale, M.H. Freeman, C.M. Haslegrave, P. Smith and S.P. Taylor (eds) *Vision in Vehicles II: Proceedings of the Second International Conference on Vision in Vehicles,* (Nottingham, UK: 14–17 September 1987), pages 45–55

as heavy trucks and school buses that are normally equipped with protruding mirrors, where the mirror occupies a significant portion of the visual field.

Glare from sunlight can also influence train visibility[11] directly or because of a sudden change in light levels due to the eyes' inability to adjust quickly.

The small relative size and dark colour of trains approaching from a distance can also lead to poor conspicuity and consequently, to poorer detection and recognition by drivers.[12]

Photo 2. Driver's view westward of approaching train during TSB re-enactment

A number of other Transportation Safety Board (TSB) investigations[13] determined that portions of the view along the rail line were obstructed by the roof pillar and side mirror on either the driver or passenger side of the cab, which hindered the ability of the driver to see the approaching train (Photo 2).

Train horn audibility

Section 11.2 of TC's *Railway Locomotive Inspection and Safety Rules* (Locomotive Safety Rules), as revised on 04 February 2010, states (in part):

> All locomotives other than in designated service operating in a controlling position shall be equipped with […]:

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11 N. Meshkati, M. Rahimi and M.J. Driver, Investigating the role of driver decision styles in highway-rail crossing accidents, *Accident Reconstruction Journal*, 16(3) (2006), pages 51–57

12 A.A. Carroll, J. Multer and S.H. Markos , *Safety of Highway-Railroad Grade Crossings: Use of Auxiliary External Alerting Devices to Improve Locomotive Conspicuity*, Report no. DOT/FRA/ORD-95/13 (United States Department of Transportation, Federal Railroad Administration, Office of Research and Development: July 1995), available at http://ntl.bts.gov/lib/42000/42600/42676/ord9513.pdf (last accessed on 16 May 2014

13 TSB rail investigations R99H0009, R99S0100, R00D0098, R04H0009 and R10W0123; TSB Occurrence R01W0149 and corresponding Rail Safety Information Letter 04-01

> (a) a horn capable of producing a minimum sound level of 96 db(A) at any location on an arc of 30 meters (100 feet) radius subtended forward of the locomotive by angles 45 degrees to the left and to the right of the centerline of the track in the direction of travel; […][14]

A Transportation Development Centre study[15] evaluating locomotive horn effectiveness determined that audible warnings should be at least 10 dB(a) above ambient noise to be recognizable as an auditory danger signal.

TSB re-enactment of crossing accident

The TSB conducted an on-site re-enactment of the crossing accident using a similar CN train and an identical school bus. The re-enactment and related field measurements determined that the measured sightlines met the TC Minimum Railway / Road Crossing Sightline Requirements For All Grade Crossings Without Automatic Warning Devices (G4-A).

Train horn sound levels were recorded using a similar locomotive equipped with an identical horn. The measured sound values for the horn met regulatory requirements. It was further determined that:

- the average ambient noise in the school bus with the engine on high idle and door closed was in excess of 70 dB(a);
- Having the door open could have increased the perceived loudness of the train horn by between 20 and 30 dB(a);[16] and
- while seated in the driver’s seat, with the bus at low idle and with windows and front door closed, the train horn cannot be heard above the ambient noise level in the bus until the train is approximately two seconds from the crossing. With a moving bus, the horn cannot be heard until the train is one second away or less.

Without fully opening the passenger side entrance door while stopped at the stop sign, the driver’s westward view along the railway tracks can be obstructed by the bus side pillar and / or side mirror, depending on the location where the bus stops.

In addition to the re-enactment, the TSB observed the crossing during an afternoon peak period. The following observations were made:

- When approaching the crossing, 15 of 52 drivers (29%) of a variety of vehicle types did not look to the sides (i.e., turn their heads) before proceeding over the crossing.
- When approaching the crossing, 10 of 52 drivers (19%) only turned their heads to look in one direction before proceeding over the crossing.
- About 95 vehicles per hour traversed the crossing (both directions).

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14 Transport Canada, TC O 0-112: *Railway Locomotive Inspection and Safety Rules* (revised 04 February 2010), Part II, section 11.2: Freight Locomotives, page 13

15 Transport Canada, Transportation Development Centre, *Locomotive horn evaluation: effectiveness at operating speeds*, TP 14163, prepared by Trans Sys Research Ltd. (June 2003)

16 Ibid.

- A school bus takes 10–18 seconds to cross both railway tracks at this crossing.
- A school bus takes 6–10 seconds to clear the first track where the accident happened.
- Not all bus drivers opened the doors of the school bus when stopped at the crossing before proceeding over the crossing.
- Pedestrians were observed trespassing by accessing railway property from the elementary school's yard and crossing the tracks at a location away from the level crossing. A worn path was also observed in the same vicinity, which suggests that trespassing was occurring more frequently at this location.

Driver expectation

Research into driver expectations has determined the following:

- When a driver becomes familiar with a particular level crossing or with a particular *type* of level crossing, and where the driver has never, or seldom, encountered an approaching train at the level crossing, the driver will tend to have a "no trains" expectation at the crossing.[17]
- Many drivers, especially in rural areas, have a negative expectancy at level crossings, whereby they come to expect the absence, rather than the presence, of trains because of the infrequency of previous train encounters.[18]
- Research shows that drivers who are familiar with a crossing, especially one associated with low train volumes, look less—and are less likely to reduce their approach speed—than drivers who are unfamiliar with a crossing.[19, 20, 21]
- Heavy-vehicle drivers, especially those who are older (i.e., more than 47 years of age), fail to look to either direction on approach to passive level crossings over 40% of the time.[22]

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17 R.E. Dewar and P.L. Olson, Railroad Grade Crossing Accidents, in: R.E. Dewar and P.L. Olson (eds.), *Human Factors in Traffic Safety* (Lawyers & Judges Publishing Co.: 2002), pages 507–523

18 R.W. Eck, A context-sensitive approach to improving safety at passive crossings, in: *Proceedings of the 7th International Conference on Railroad-Highway Grade Crossing Research and Safety: Getting Active at Passive Crossings* (Melbourne, Australia: 20–21 February 2002)

19 J.H. Sanders, Driver performance in countermeasure development at railroad-highway grade crossings, *Transportation Research Record*, 563 (BioTechnology, Inc.: 1976), pages 28–37

20 M. Yeh and J. Multer, *Driver Behavior at Highway-Railroad Grade Crossings: A Literature Review from 1990–2006*, Report no. DOT/FRA/ORD-08/03 (United States Department of Transportation, Federal Railroad Administration, Office of Research and Development: October 2008), available at http://www.fra.dot.gov/eLib/Details/L01598 (last accessed on 15 May 2014)

21 E.C. Wigglesworth, Human Factors in Level Crossing Accidents, *Accident Analysis and Prevention*, 11 (1978), pages 229–240

22 T. Ngamdung, M. daSilva, *Driver Behavior Analysis at Highway-Rail Grade Crossings Using Field Operational Test Data – Heavy Trucks*, Report no. DOT/FRA/ORD-12/22 (United States Department of Transportation, Federal Railroad Administration, Office of Research and Development: December 2012), available at http://ntl.bts.gov/lib/46000/46600/46647/DOT-VNTSC-FRA-12-01.pdf (last accessed on 15 May 2014)

Driver distraction

Driver distraction is “the diversion of attention away from activities critical for safe driving towards a competing activity.”[23] Driver distraction has been identified in several studies[24, 25] as a contributory factor to accidents at passive level crossings.

Drivers can attend to and process only one source of visual information at a time.[26] Additional visual information can distract a driver and consequently impair the detection of hazards[27] and the driver’s situational awareness.[28] In addition, the amount of visual information or visual “clutter” in the road environment can result in driver overload, which occurs when the demands of the driving task exceed a driver’s attention resources, and often results in impaired driving performance.[29]

Distractions can divert drivers’ attention during periods in which they must be making, or have made, a decision regarding the crossing.[30] Compared to younger drivers, drivers over the age of 65 are more susceptible to making driving safety errors while distracted by common secondary visual search tasks, such as identifying traffic signs and restaurants.[31]

To facilitate school bus loading after school, elementary school children who take the bus are dismissed at 1505. The children who walk to school are dismissed at 1510. The intent of the elementary school’s practice to stagger dismissal times was to keep the school buses, student pedestrians and other road traffic separated. However, with some parents picking up their children, the departure of the school buses and some child pedestrians walking, the staggered dismissal times resulted in higher than usual road and pedestrian traffic in the area of the

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[23] J.D. Lee, K.L. Young and M.A. Regan. Defining driver distraction, in: M.A. Regan, J.D. Lee and K.L. Young (eds.), *Driver Distraction: Theory, Effects and Mitigation* (CRC Press: Boca Raton, 2009), pages 31–40

[24] J.K. Caird, J.I. Creaser, C.J. Edwards and R.E. Dewar, *A human factors analysis of highway-railway grade crossing accidents in Canada*, Transport Canada report no. TP 13938E (September 2002)

[25] United States National Transportation Safety Board (NTSB*), Safety at passive grade crossings: Volume 1: Analysis,* Safety study NTSB/SS-98/02 (Washington, DC: 1998), available at http://images.spinics.net/rail/SS9802.pdf (last accessed on 16 May 2014)

[26] R.W. Eck, A context-sensitive approach to improving safety at passive crossings, in: *Proceedings of the 7th International Conference on Railroad-Highway Grade Crossing Research and Safety: Getting Active at Passive Crossings* (Melbourne, Australia: 20–21 February 2002)

[27] P.N.J. Lee and T.J. Triggs, The effects of driving demand and roadway environment on peripheral visual detections, *APRB Proceedings*, 8 (1976), pages 7–12

[28] M.R. Endsley, Toward a theory of situation awareness in dynamic systems, *Human Factors*, 37(1) (1995), pages 32–64

[29] J. Edquist, K. Stephan, E. Wigglesworth and M. Lenné, M., *A literature review of human factors safety issues at Australian level crossings*, Accident Research Centre, Monash University, Australia (2009), pages 30–45

[30] R.W. Eck, A context-sensitive approach to improving safety at passive crossings, in: *Proceedings of the 7th International Conference on Railroad-Highway Grade Crossing Research and Safety: Getting Active at Passive Crossings* (Melbourne, Australia: 20–21 February 2002)

[31] N. Aksan, J.D. Dawson, J.L. Emerson et al., Naturalistic distraction and driving safety in older drivers, *Human Factors*, 55:4 (2013), pages 841–853

crossing shortly after dismissal. As the bus approached the crossing, the driver was aware of the presence of groups of children walking along the road as well as a high level of surrounding road traffic.

Driver fitness to drive

Compared to middle-aged drivers (i.e., aged 45 to 59), on a per-kilometre-driven basis, drivers in their late 60s have a 30% greater chance of being involved in an accident. Drivers in their early 70s are 90% more likely to be involved in an accident.[32] The risk is even higher for commercial truck drivers over the age of 70. This group is over seven times more likely to be involved in a collision as compared to general drivers aged 41 to 50 years. This disparity among commercial drivers is likely due to the higher levels of driver workload than for general drivers, the increased complexity of the driving task, and the inability for commercial drivers to "self-regulate", or voluntarily reduce their exposure to risks by making fewer, or shorter, trips.[33]

Similar to commercial drivers, school bus drivers also face complex, high-workload situations when driving and are not able to self-regulate.

"There is general consensus in the scientific literature that it is not aging itself that leads to poorer driving performance, but rather it is the increased onset of medical conditions associated with aging that creates risk."[34] The increase in accident risk associated with aging led some jurisdictions in Canada to enact mandatory retirement for school bus drivers, usually at the age of 65. In recent years, however, all provinces and territories, including Saskatchewan, repealed their mandatory retirement laws due to human rights issues.[35] As of 2006, school bus drivers in Saskatchewan have not been required to retire at age 65.

In situations where a *bona fide* occupational requirement can be demonstrated (e.g., occupations that are considered to be safety critical), mandatory retirement at a given age can be required. In Ontario in 1992, mandatory retirement of school bus drivers at age 65 was upheld because expert medical evidence indicated that, as a group, those over 65 are more likely to have accidents than younger drivers, and because it is "impossible to test individually to determine who is likely to have health problems or create risks for others."[36]

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32 Eric Hildebrand, Aging school bus drivers: Is mandatory retirement appropriate? *Proceedings of the 22nd Canadian Multidisciplinary Road Safety Conference*, Banff, Alberta (10–13 June 2012)

33 Ibid.

34 Ibid.

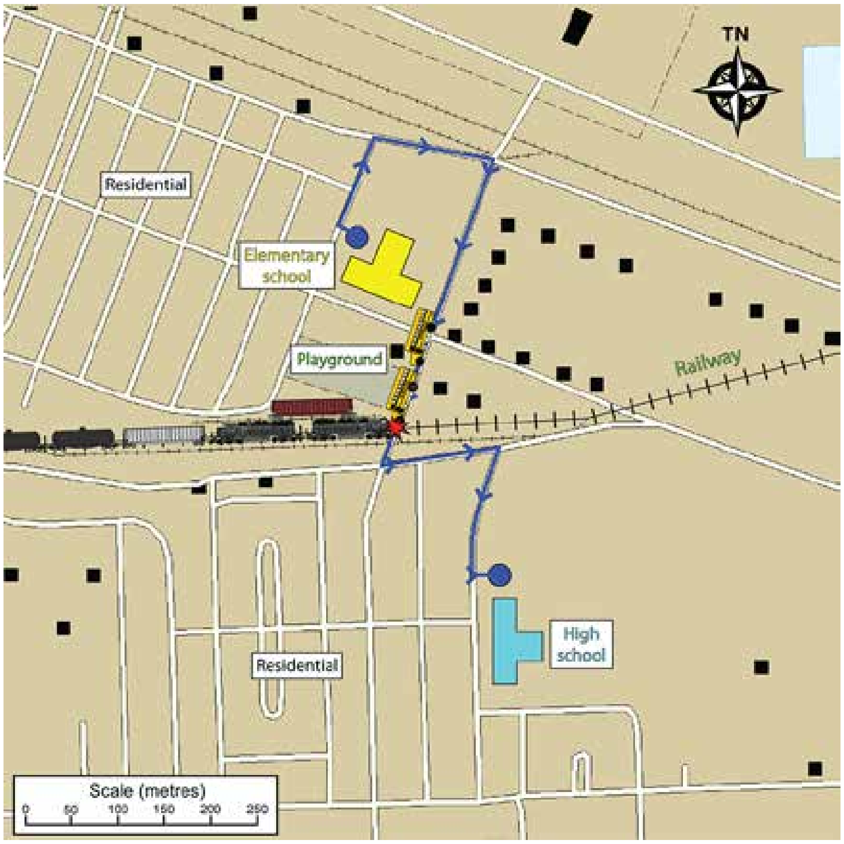
35 Standard Life Assurance Company of Canada, Elimination of mandatory retirement in Canada, in *The Article* (June 2007), available at http://www.standardlife.ca/en/pdf/group_ins/bulletin/ec152007_e.pdf

36 Ontario Human Rights Commission (OHRC), Policy and Education Branch, *Discussion paper: Discrimination and age – Human rights issues facing older persons in Ontario* (May 31, 2000), Mandatory Retirement as a Bona Fide Occupational Requirement, pages 26–28, available at www.ohrc.on.ca/en/discussion-paper-discrimination-and-age-human-rights-issues-facing-older-persons-ontario/mandatory-retirement-bona-fide-occupational-requirement (last accessed on 14 May 2014)

School bus routing in proximity of train tracks

Like many other towns across the Canadian prairies, Carlyle developed around the railway in the early 1900s. Residential neighbourhoods that lie in close proximity to the tracks have continued to develop over the years. The town's elementary school is located one block north of the train tracks, and its playground is directly adjacent to the tracks (Figure 3). There is no fence or other barrier separating the playground from the railway property that would prevent school-aged children from accessing the tracks. In general, trespass problems associated with schools in proximity to the railway right of way are common, and without adequate barriers in place, can pose an increased accident risk.[37]

Figure 3. Diagram illustrating the accident site, the surrounding area, and the bus route (blue line)



School buses in Carlyle serve both the elementary school and the nearby high school, which is located about one block south of the tracks. The occurrence bus, as well as several other school buses serving both schools, used the passive crossing once in the morning and once in the afternoon each school day. However, there are other crossings in the Carlyle area that the bus could use, which are equipped with automated warning devices (AWD) such as flashing lights, bells, and gates.

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[37] Earth Tech Canada Inc., *Final Report: Proximity Guidelines and Best Practices*, prepared for the Railway Association of Canada and the Federation of Canadian Municipalities (reprinted August 2007), available at http://www.gov.mb.ca/ia/plups/pdf/2007_guidelines.pdf (last accessed on 16 May 2014)

The elementary and high schools are members of South East Cornerstone Public School Division #209. School bus routes serving both schools are established according to the division's administration procedures, in collaboration with the school bus company. Input from the schools (e.g., on student pick-up and drop-off locations) is also considered. The occurrence bus route had been in use for many years. It is not known whether the risks related to the occurrence crossing had been identified or considered at the time that the route was chosen nor whether they had been re-evaluated in the 15 years preceding the accident.

Railway proximity issues

In 2003, the Railway Association of Canada (RAC) and the Federation of Canadian Municipalities (FCM), supported by the Canadian Association of Municipal Administrators (CAMA), signed a memorandum of understanding on proximity issues. This initiative recognized the need for better communication among various stakeholders, including railways, municipalities and developers, when planning new development.

In 2007, the RAC and FCM developed proximity guidelines.[38] Because trespass-related safety issues can result when schools and residential properties are located adjacent to the railway right of way (ROW), the guidelines recommend that increased safety measures, such as fencing, be considered at these locations.

Level crossing accident statistics

A review of TSB's Rail Occurrence Database System (RODS) for the period 2003 to 2012 determined that:

- of the 325 crossing accidents at rural, public, passive level crossings, there was only one other accident involving a school bus.
- 304 of the 325 accidents (93.5%) occurred at passive level crossings that were equipped only with SRCS.
- 21 of the 325 accidents (6.5%) occurred at passive level crossings that were equipped with both SRCS and stop signs.
- 87 of the 325 accidents (26.8%) resulted in fatalities or serious injuries.

TSB Laboratory reports

The following TSB Laboratory report was completed:

- LP057/2013 – Carlyle School Bus Accident

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38 Ibid.

Analysis

Passive level crossing accidents involving a school bus are rare, but when they do occur there is a significant risk of adverse consequence. These types of accidents are categorized as low-probability, high-risk events. Fortunately, in this occurrence, there was only a single minor injury. Train operation, track condition and equipment condition did not play a role in this accident. The analysis will focus on train conspicuity, driver performance, and school bus routing in the proximity of railway tracks.

The accident

In accordance with provincial school bus regulations, the bus stopped at the stop sign located at the north side of the crossing before attempting to cross the tracks. While stopped, the driver did not open the door and did not see the train or hear the train horn as it was sounded. The accident occurred when the driver, unaware of the approaching train, proceeded from a stop onto the crossing, where the bus was struck by the oncoming train.

Driver's ability to detect a train

At passive level crossings equipped with standard railway crossing signs (SRCS) and stop signs, the driver needs to see in both directions along the tracks from the stopped position in order to perform a visual scan for approaching trains and to decide when it is safe to proceed across the tracks. Although the available sightlines for the crossing were measured and met regulatory requirements, there were a number of obstructions that may have impeded the driver's view of the approaching train. Approaching the stop sign, the driver's view westward may have been partially obstructed by a stationary hopper car, which was stored in the siding just north of the main track. In addition, the A-support pillar on the passenger side of the bus and the side mirror may have obstructed the driver's view of the approaching train. The effect of these obstructions was dependent on where the bus stopped and when the driver looked westward along the track.

Even though sightlines met regulatory requirements, the stationary rail car, as well as the A-pillar and side mirror of the school bus, may have obstructed the driver's view westward and concealed the train at critical times during the driver's visual scan.

The driver approached the crossing from the north, and the train was approaching from the west. The driver was not wearing sunglasses at the time of the accident. While the sun's position was aligned with the direction of the approaching train, an angle of 34.4° would not likely cause significant glare. However, reduced visibility cannot be ruled out. Although the locomotive headlight was on, with the sun positioned behind the approaching locomotive, there may have been little to make the oncoming train stand out from the background environment.

The driver was familiar with this crossing and had not previously encountered a train there. Consequently, the driver had likely formed the expectation that there would not be a train at the crossing. Although the bus stopped at the crossing and the driver looked for trains in both directions, the driver's obstructed view, the expectation that no train would be present, and the lack of contrast between the approaching train and the background environment likely contributed to the driver not detecting the train when looking westward.

Train horn audibility

In accordance with *Canadian Rail Operating Rules* (CROR) Rule 14 (l), the train horn was being sounded as the train approached the crossing. The train horn sound levels were measured and met the regulatory requirements (Locomotive Safety Rules*)*, which specify that a locomotive horn must be capable of producing a minimum sound level of 96 dB(a). However, the average ambient noise in the school bus cab with the engine on high idle was in excess of 70 dB(a). The TSB re-enactment determined that with the bus at low idle, and with the windows and front door closed, the train horn could not be heard above the ambient noise level in the bus until the train was approximately two seconds from the crossing. Although the locomotive horn was sounded, the ambient noise within the bus reduced any meaningful warning that the horn was intended to provide. In contrast, had the front door been open, the sound level of the train horn could have increased by between 20 and 30 dB(a), making detection more likely. Consequently, if school bus drivers are not required to open the driver's side window and front door of the bus to look and listen for a train when stopped at a passive railway crossing, the train horn may not be audible to the bus driver, increasing the risk of a crossing accident.

Driver distraction

The intent of the elementary school's practice of dismissing children who take the bus five minutes earlier than other students was to keep the school buses, student pedestrians and other road traffic separated. The accident occurred at approximately 1515, shortly after all of the elementary school children were dismissed. The short interval between the staggered dismissal times resulted in a higher than usual volume of road and pedestrian traffic arriving at the crossing at the same time, which added to the complexity of the driver's task.

The driver was 68 years old and had over 30 years of experience driving a school bus. Through this experience, the driver knew that child pedestrians could often behave unpredictably and needed to be watched closely when they occupied the road. Since drivers process only one source of visual information at a time, additional sources of visual information can distract a driver and impair the detection of hazards. In this case, the driver had never encountered a train at the crossing, so the risk of striking a child pedestrian with the bus was perceived to be greater than the likelihood of the bus being struck by an approaching train. Therefore, it was likely that the driver's attention was primarily focused on the child pedestrians in the vicinity at the time.

Driver age compounds the effects of distraction on driving behaviour. Compared to younger drivers, drivers over the age of 65 are more susceptible to making driving safety errors while distracted by common secondary visual search tasks.[39] When driver age is also considered, the driver was likely distracted by secondary visual search tasks associated with the road traffic and pedestrian activity in the vicinity of the crossing.

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[39] N. Aksan, J.D. Dawson, J.L. Emerson et al., Naturalistic distraction and driving safety in older drivers, *Human Factors*, 55:4 (2013), pages 841–853

Driver fitness

Currently, school bus drivers in Saskatchewan do not face mandatory retirement at age 65. However, in other jurisdictions (e.g., Ontario [40]), one of the licensing limitations for school bus drivers is mandatory retirement at age 65. This approach is predicated on research that determined that, in general, drivers over the age of 65 are more likely to have accidents as compared to younger drivers. The increased prevalence of medical conditions associated with aging can lead to increases in accident involvement.

In this occurrence, the driver was 68 years old and had a number of medical issues, including some that are associated with aging and that could have increased the risk of being involved in an accident. However, the driver's physician was aware of these issues and considered them to be appropriately managed. The driver's physician had also documented the conditions on the driver's most recent medical examination report, and the provincial licensing body had approved the driver as being medically fit to drive a school bus.

It could not be determined whether the driver's medical issues played a role in this accident. However, as identified by research, school bus drivers over the age of 65, who have similar medical issues that are generally associated with aging, have an increased risk of being involved in an accident. This increase in accident risk led some jurisdictions in Canada (e.g., Ontario) to enact mandatory retirement for school bus drivers, usually at the age of 65. Therefore, if provincial jurisdictions do not employ a risk-based approach related to medical conditions associated with aging for licensing school bus drivers, there may be an increased risk of accidents involving school buses.

Provincial regulations governing school bus operation

The Province of Saskatchewan considers passive railway crossings that are equipped with crossbucks and a stop sign to be *controlled* railway crossings. At controlled railway crossings, school bus drivers are not required to open the driver's side window or the front door of the bus to look and listen for a train.

This situation is contrary to other provincial jurisdictions, which require that school buses stop not less than five metres or more than 15 metres from the nearest rail at *all* railway crossings. In addition, after stopping, the driver must:

- fully open the driver's side window and the front service door;
- look and listen in both directions along the tracks for approaching trains; and
- not proceed unless the action can be completed safely.

In this occurrence, with the bus at low idle and with the windows and the front door closed, the train horn could not be heard above the ambient noise level within in the bus until the train was

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40 Ontario Human Rights Commission (OHRC), Policy and Education Branch, *Discussion paper: Discrimination and age – Human rights issues facing older persons in Ontario* (May 31, 2000), Mandatory Retirement as a Bona Fide Occupational Requirement, pages 26–28, available at www.ohrc.on.ca/en/discussion-paper-discrimination-and-age-human-rights-issues-facing-older-persons-ontario/mandatory-retirement-bona-fide-occupational-requirement (last accessed on 14 May 2014)

about two seconds from the crossing. Therefore, if school bus drivers are not required to stop, open the driver's side window and front door of the bus to look and listen for an approaching train at all railway crossings, there is an increased risk that an oncoming train's horn will not provide adequate warning to a school bus at a crossing.

Crossing safety education

The *Railway Safety Act* Review Committee acknowledged that an educational component was an integral part of a multi-faceted approach to rail safety. The committee noted that technology alone was not sufficient to solve existing crossing safety problems, but must be coupled with robust public education programs and an understanding of human behaviour.

Operation Lifesaver (OL) is a national public awareness program aimed at preventing collisions between trains and motor vehicles and preventing trespassing incidents that can lead to serious injury or death. OL has developed a number of educational tools that detail the risks associated with level grade crossings, and OL efforts have contributed to the reduction in railway crossing accidents. The program targets high-risk locations and also responds to individual requests from schools and municipalities for targeted presentations. OL also publishes tips for drivers to improve safety in the vicinity of railway crossings and has developed a module specifically for school bus drivers.

In this occurrence, the bus company, the school bus driver, and the elementary school administrators were unaware of OL and had not received or sought out any targeted railway crossing safety education for either students or bus drivers. Without targeted railway crossing safety education for students and bus drivers, there is an increased risk for a crossing accident.

School bus routing in proximity of train tracks

The most effective countermeasure to improve level crossing safety is the separation of road and rail traffic. However, due to the high costs associated with grade separation, this is not always possible. In the absence of grade separation, the next most effective option for reducing risk at level crossings is the installation of an active warning system with protection provided by automated warning devices (AWD) such as flashing lights, bells, and gates. Without AWD, the level crossing would only have passive protection (i.e., SRCS with or without stop signs). Research[41,42,43,44] has shown that passively controlled level crossings are associated with higher accident risk and poorer driver compliance than those crossings protected by AWD.

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41 TSB Rail Investigation Report R11T0175

42 M.G. Lenné, C.M. Rudin-Brown, J. Navarro et al, Driver behaviour at rail level crossings: Responses to flashing lights, traffic signals and stop signs in simulated rural driving, *Applied Ergonomics*, 42:4 , Special issue on Transportation Safety (2011), pages 548–554

43 C.M. Rudin-Brown , M.G. Lenné, J. Edquist and J. Navarro, Effectiveness of traffic light vs. boom barrier controls at road-rail level crossings: A simulator study, *Accident Analysis and Prevention*, 45 (2012), pages 187–194

44 L-S. Tey, L. Ferreira and A. Wallace, Measuring driver responses at railway level crossings, *Accident Analysis and Prevention*, 43 (2011), pages 2134–2141

In this occurrence, the school bus route serving the elementary school and nearby high school involved using the 4th Street East passive level crossing once in the morning and once in the afternoon each school day. However, there are other crossings in the Carlyle area that are equipped with AWD protection that could be used as alternate school bus routes.

This school bus route had not been changed or reviewed by the South East Cornerstone Public School Division in at least 15 years. Had a review of this school bus route been conducted, it would have provided an opportunity to compare the risks associated with this crossing and others equipped with AWD protection. If school bus routes are not subject to periodic safety assessments, associated risks and mitigations may not be considered, increasing the risk of a crossing accident.

Proximity guidelines recommend that fencing should be considered at locations where schools and residential land are in close proximity to the railway right of way. The elementary school property is located directly adjacent to the railway right of way. With no physical barrier separating school property from the train tracks, school-aged children can access railway property more easily and be unnecessarily exposed to train traffic.

Findings

Findings as to cause and contributing factors

1. The accident occurred when the driver, unaware of the approaching train, proceeded from a stop onto the crossing, where the bus was struck by the oncoming train.

2. Even though sightlines met regulatory requirements, the stationary rail car, as well as the A-pillar and side mirror of the school bus, may have obstructed the driver's view westward and concealed the train at critical times during the driver's visual scan.

3. The driver's obstructed view, the expectation that no train would be present, and the lack of contrast between the approaching train and the background environment likely contributed to the driver not detecting the train when looking westward.

4. Although the locomotive horn was sounded, with the bus door and window closed, the ambient noise within the bus reduced any meaningful warning that the horn was intended to provide.

5. The driver was likely distracted by secondary visual search tasks associated with the road traffic and pedestrian activity in the vicinity of the crossing.

Findings as to risk

1. If provincial jurisdictions do not employ a risk-based approach related to medical conditions associated with aging for licensing school bus drivers, there may be an increased risk of accidents involving school buses.

2. If school bus drivers are not required to stop at passive railway crossings, open the driver's side window and front door of the bus to look and listen for a train, the train horn may not be audible to the bus driver, increasing the risk of a crossing accident.

3. Without targeted railway crossing safety education for students and bus drivers, there is an increased risk for a crossing accident.

4. If school bus routes are not subject to periodic safety assessments, associated risks and mitigations may not be considered, increasing the risk of a crossing accident.

Other findings

1. The school bus was not equipped with an event data recorder. Consequently, no meaningful data regarding the operation of the bus could be recovered.

2. The short interval between the staggered student dismissal times resulted in a higher than usual volume of road and pedestrian traffic arriving at the crossing at the same time, adding to the complexity of the driver's task.

3. Research has demonstrated that school bus drivers over the age of 65 with certain medical issues associated with aging have an increased risk of being involved in an accident.

4. With no physical barrier separating school property from the railway tracks, school-aged children can access railway property more easily and be unnecessarily exposed to train traffic.

Safety action

Safety action taken

The Transportation Safety Board of Canada

On 30 June 2013, the TSB issued Rail Safety Advisory Letter (RSA) - 06/13 titled "School Bus Safety at Railway Crossings." The RSA indicated that the Province of Saskatchewan considers passive railway crossings equipped with crossbucks and a stop sign to be *controlled* railway crossings and that school bus drivers are not required to open either the driver's side window or front door of the bus to look and listen for a train at these crossings. The RSA also indicated that train horns do not consistently provide adequate warning to school buses that have doors and windows closed when stopped at railway crossings. The RSA suggested that Transport Canada (TC), in conjunction with provincial authorities, may wish to review the requirements for school buses when stopping at and traversing railway crossings.

On 12 July 2013, TC responded that it has informed the provincial authorities of the issue and is following-up with them on the provincial requirements for school buses when stopping at, and traversing, railway crossings. TC has also identified this issue to the National Director of Operation Lifesaver as an area of risk to which targeted activities could be developed and conducted either nationally or provincially.

The Province of Saskatchewan

Saskatchewan will be amending Section 4(e) of the *School Bus Operating Regulations* of its *Traffic Safety Act* to require the driver of a school bus to follow these instructions when approaching a railroad crossing that is not equipped with an automatic signal device. It is anticipated that this change will come into effect by the end of June 2014.

Saskatchewan Government Insurance (SGI) will actively engage the school bus transportation industry in Saskatchewan through various programs. As part of the delivery of these programs and as part of its participation in industry events, SGI will develop and distribute information promoting school bus and rail safety, specifically targeting student transportation providers. SGI will recommend that routine assessment of school bus routes to minimize the risk of railway crossing accidents be conducted. The SGI recommendation will be directed at organizations engaged in the provision of student transportation services and at the provincial school boards responsible for administering the various student transportation agreements.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 May 2014. It was officially released on 17 June 2014.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.