Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R10E0056

CROSSING COLLISION

VIA RAIL CANADA INC.
PASSENGER TRAIN NUMBER 1
MILE 10.76, EDSON SUBDIVISION
WINTERBURN, ALBERTA
04 MAY 2010

Canada

Railway Investigation Report

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Summary

On 04 May 2010, at 0832 Mountain Daylight Time, westbound VIA Rail Canada Inc. passenger train No. 1 struck a 4-door pick-up truck at the Winterburn Road level crossing, Mile 10.76 of the Edson Subdivision. As a result of the collision, the 3 occupants of the truck sustained fatal injuries. The crew and passengers on the train were uninjured.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 04 May 2010, at approximately 0811, [1] westbound VIA Rail Canada Inc. (VIA) passenger train No. 1 (the train) departed the station in Edmonton, Alberta and entered the CN Edson Subdivision at West Junction destined for Vancouver, British Columbia (see Figure 1). VIA Train No. 1 originates in Toronto and normally departs Edmonton at 0737 after a 1-hour servicing stop, but due to its late arrival from the east at 0655, its actual departure time was 0811. VIA reported on-time departure times for approximately 90% of train No. 1 departures from Edmonton.

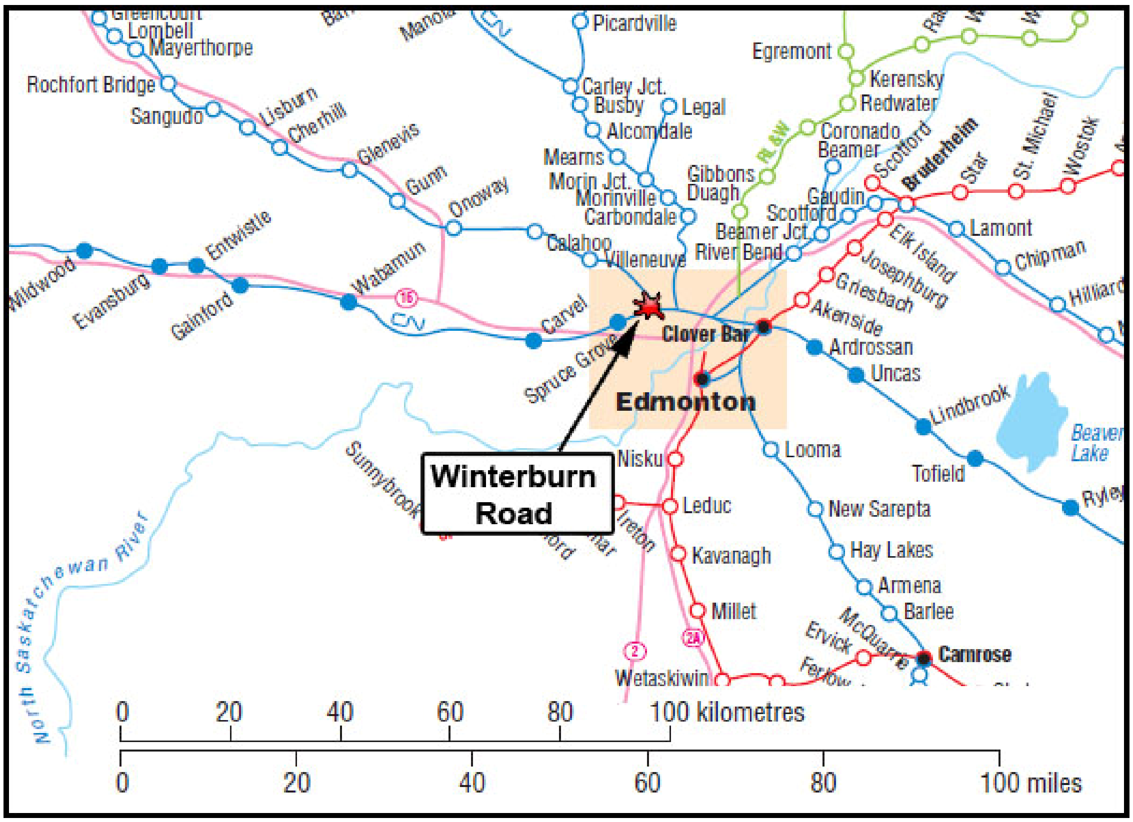

Figure 1. Accident Location (Source: Railway Association of Canada, *Canadian Railway Atlas*)

At approximately 0832, as the train reached Winterburn Road crossing at Mile 10.76, it struck a southbound truck that had entered the crossing. The force of the collision propelled the truck westward for approximately 150 feet where it came to rest in the ditch northwest of the crossing. The train brakes were placed in emergency just after impact and the train came to rest approximately 40 seconds later, 700 feet west of the crossing. The truck was destroyed and the 3 occupants, the driver and 2 children, were fatally injured. The VIA crew members, onboard staff and passengers on the train were uninjured. The head-end locomotive (VIA 6407) sustained minor damage.

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[1] All times are Mountain Daylight Time (Coordinated Universal Time minus 6 hours).

The crossing was protected by incandescent flashing lights, a bell and gates. Just prior to the accident, the crossing signals were working and northbound traffic on Winterburn Road was stopped at the crossing. The southbound truck arrived at the crossing and entered it at the same time as the train was entering it. At the time of the accident, the truck was the only southbound vehicle at the crossing.

During post-accident examination, scratch marks were visible on the pavement south of the north gate on the west side of the road. Inspection of the crossing signal equipment, including the north crossing gate for southbound traffic, revealed no visible damage. The northward-facing crossbucks and signal lights on the masts and the north faces of the crossing gates were covered by snow (see Photos 1, 2 and 3). The photos, taken within 2 hours of the accident, depict the aftermath of the storm but do not depict the near whiteout conditions at the time of the accident.

Photo 1. North signal, northward-facing lights

Photo 2. South signal, northward-facing lights

Photo 3. Northward-facing signals and gate

Weather

At the time of the accident, the temperature was just below freezing with high winds from the north to northwest at approximately 40 km/h, gusting up to 68 km/h with blowing and falling snow. It had rained throughout the night, turning into freezing rain and then snow in the early morning. Driving conditions and visibility were poor; the road surface was wet, slippery, and covered in fresh snow (see Photo 4). The crew reported that the north-facing right side window of the locomotive was iced up and covered with snow, and that the wipers had little effect in clearing the front window. Poor visibility prevented a clear view of the north side of the crossing.

Photo 4. Winterburn Road crossing, looking north

Train Crew and Train Information

The train crew consisted of 2 locomotive engineers, with 1 acting as conductor; both were qualified for their positions, met current fitness and rest standards, and were familiar with the territory. The train consisted of 3 locomotives and 20 cars. There were 26 onboard staff and 219 passengers.

The braking system on the train was a 26LU-L air brake system that worked in conjunction with disc brakes attached to each wheel. The last "C" mechanical inspection was conducted on VIA locomotive 6407 on 27 April 2010. Repair records indicate that VIA locomotive 6407 was in serviceable condition. The schedule "B" air brake test had been performed as required at the beginning of the trip in Toronto on 01 May 2010. Prior to the train departure from Edmonton on the day of the accident, the operating crew was changed and the required continuity brake test was performed.

Recorded Information

The locomotive event recorder (LER) download was reviewed. Because anti-whistling was in effect at this crossing, [2] the locomotive horn was not sounded as the train approached Winterburn Road crossing. The engine bell was activated several times from 0826:49 up to the time of impact at 0832:35. At the time of the accident, the train was travelling at 69 mph in throttle position 6. The train brakes were placed in emergency one second later. The headlight and ditch lights on VIA 6407 were continuously displayed on full power. Although cameras were being installed on VIA Rail's locomotive fleet, this particular locomotive (6407) had yet to receive one.

Edson Subdivision

The Edson Subdivision is part of CN's core transcontinental route. It extends from Edmonton to Jasper, Alberta (Mile 235.7). Train movements on the Edson Subdivision are governed by the Centralized Traffic Control System (CTC), authorized by the *Canadian Rail Operating Rules* (CROR) and supervised by a Rail Traffic Controller located in Edmonton. The maximum authorized speed through the accident location is 70 mph[3] for passenger trains and 60 mph for freight trains. There are approximately twenty six freight trains per day in both directions. Passenger service on the Edson Subdivision is provided by VIA with three trains in each direction per week.

The track is classified as Class 4 according to the *Railway Track Safety Rules* (TSR). The track consists of tangent double main track. Approaching the accident location from the east, the track is on a slight, ascending grade that varies between 0.10% and 0.40%.

Crossing Information

Winterburn Road is a north-south, undivided two-lane arterial road that crosses the tracks at approximately 70-degrees on level grade (see Photo 5).

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2 An exemption to *Uniform Code of Operating Rules* Rule 14(l) requiring whistling at public crossings at grade was approved by Transport Canada in 1989 for crossings at miles 8.58, 9.67, 10.76 and 11.81.

3 70 mph speed zone begins at Mile 7.0.

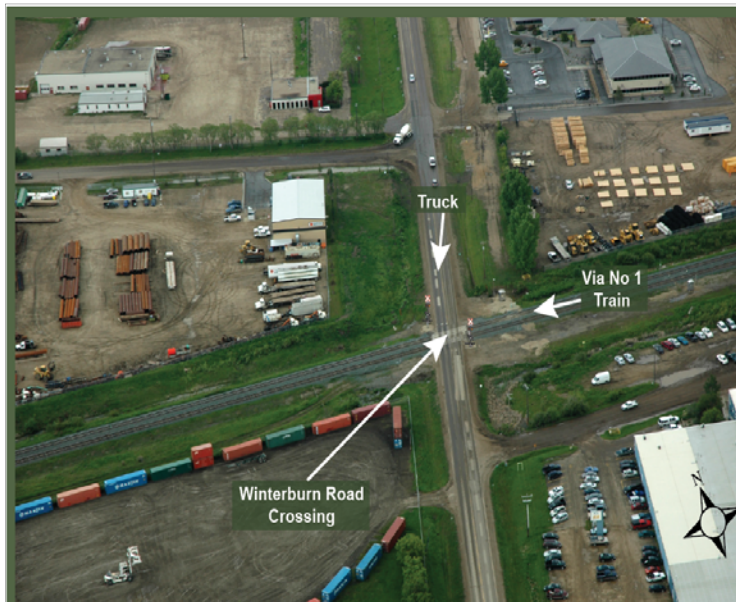

Photo 5. Winterburn Road crossing

The road provides direct access between Highway 16 to the north and Highway 16A (Stony Plain Road) to the south. Sight-lines for southbound traffic approaching the crossing are severely restricted in the northeast quadrant by trees, brush and an industrial compound and in the northwest quadrant by a building and a compound. Sight-lines for northbound traffic are severely restricted in the southwest quadrant by an industrial compound and containers and in the southeast quadrant by brush and buildings. Average daily traffic counts on Winterburn Road in 2008 were 10 629 vehicles. The maximum permissible speed is 60 km/h.

The accident crossing is located approximately 3 miles west of CN's Bissell Yard. A hand throw switch for a spur track is located off the south track approximately 2100 feet east of the crossing.

Crossing Sight-lines and Warning Distance Requirements

The primary sight-line requirement for drivers approaching a crossing is a clear view of the grade crossing warning system. There is no regulatory requirement to provide drivers with sightlines of approaching trains when there is a grade crossing warning system with gates.

Based on Transport Canada (TC)'s draft RTD 10 guidelines, Stopping Sight Distance (SSD) is the sum of the distance travelled during the perception and reaction time and the distance it takes to bring the vehicle to a stop once the brakes have been applied. [4] SSD represents the minimum distance from the stop line to the location at which a vehicle driver approaching a crossing at the maximum permissible speed is able to perceive the grade crossing warning signal without obstruction. For the crossing at Winterburn Road, SSD is 85 meters. [5]

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4 Transport Canada draft RTD 10 Road/Railway Grade Crossings Technical Standards and Inspection, Testing and Maintenance Requirements, Section 4.4, dated 24 October 2002.

5 85 meters is obtained with a perception and reaction time distance of 42 meters and braking distance of 43 meters. In the calculations, the perception and reaction time is 2.5 seconds and the coefficient of friction is 0.33.

With respect to minimum warning time for vehicle drivers approaching an actively-protected grade crossing, the RTD 10 guideline is in accordance with the American Railway Engineering and Maintenance of Way Association (AREMA) – Communications and Signals Manual of Recommended Practice. [6] AREMA standards specify a minimum of 20 seconds of warning time, but no maximum warning time is specified. [7] In comparison, RTD 10 recommends a minimum approach warning time of 20 seconds; a maximum of 35 seconds for grade crossing warning systems without gates; and a maximum of 55 seconds for grade crossing warning systems with gates. [8]

At the Winterburn Road crossing, at the maximum train speed of 70 mph, the crossing warning system in place at the time of the accident was designed to activate 23 seconds (i.e., 20 seconds RTD 10 minimum time + 2 seconds relay reaction time + 1 second clearance time) before the train occupied the crossing. A vehicle approaching the crossing at a constant speed of 60 km/h would be approximately 1200 feet (365 m) from the crossing when the warning system is activated.

Based on TSB reportable occurrences, there have been 2 prior accidents at this crossing. They occurred in 1986 (no injuries) and 2001 (one fatality).

Crossing Protection at Winterburn Road

The crossing signal system at Winterburn Road consisted of 2 signal standards equipped with flashing signal lights, a bell mounted on the northwest signal mast and 3 lights on the gates. The tip light is steady-lit and the other 2 flash alternately in unison with the mast mounted flashing lights. At the time of the accident, the crossing protection system had parallel direct current (DC) relay type track circuits. The single track system was originally installed in 1970 and the second system was added when the second track was constructed in 1978. At the time of installation, the crossing protection equipment was of appropriate design and technology. Each signal standard had 2 sets of incandescent signal lights and a set of standard railway crossing signs (i.e., crossbucks). Passive advance crossing warning signs were located 633 feet north of the crossing and 471 feet south of the crossing.

The crossing protection system was designed for a train speed of 70 mph to provide a minimum warning time of 23 seconds and a gate delay [9] of 4 seconds. The crossing signals are activated when an approaching train or railway vehicle occupies the circuit. At Winterburn Road, the crossing signals were activated when trains were approximately 2434 feet west of the crossing or 2427 feet east of the crossing, regardless of train speed. There were wide variances in train speeds in the vicinity of the crossing as a result of the different types of trains, the approach gradients in the vicinity of the crossing, the length and weight of trains, the proximity of Bissell

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6 TC Railway signal and traffic control systems standards, TC E-17, revised 04 June 2007.

7 AREMA Volume 1 Part 3.3.10.

8 RTD 10, Section 20.4 (c), Technical Standards and Inspection, Testing and Maintenance Requirements, 24 October 2002.

9 Gate descent is delayed following signal activation to allow traffic to clear the crossing without damaging the gates. Gate delay time is determined by road speed and type of traffic. Trucks require a longer gate delay to clear the crossing before the gates descend.

Yard, and the switching operations for the spur track east of the crossing. Slower, heavier freight trains (e.g., westbound freight trains on the ascending grade) resulted in a signal activation for longer periods of time as compared to the faster passenger trains.

The spur track, which was located approximately 2100 feet east of the crossing, was within the crossing circuit. Switching activities at this spur track (about 3 times per week) would often result in signal activation at Winterburn Road crossing, whether or not there was an approaching train. The crossing signals would deactivate after 150 seconds (2.5 minutes) if a train or equipment was stopped within the crossing circuit or was proceeding at less than 10 mph. An additional circuit was present at this crossing to reactivate the warning system to provide the minimum warning time when a train is proceeding at less than 10 mph. Special instructions in the timetable specify that trains on the south track proceeding at less than 10 mph must not exceed 10 mph approaching within 2400 feet until the crossing is fully occupied to ensure the minimum warning times were provided.

Nuisance Operations at Winterburn Road Crossing

Following the accident, there were numerous media, witness and anecdotal reports about nuisance operation [10] of the automatic warning devices and inconsistent warning times resulting in extensive delays to motorists at Winterburn Road crossing. There were reports that vehicles were driving around the gates at this crossing, even shortly after the accident.

CN has an inspection and repair system whereby service tickets are created to record service requirements at crossings. CN records indicate that 16 service tickets were created for this crossing in 2009, the highest number for any crossing on the Edson Subdivision. Eleven of these tickets were related to the crossing gates. Between 2006 and 2009, 70% of the service tickets issued for this crossing were related to bent or broken gates. [11] The number of broken gates at the crossing was not considered by CN or Transport Canada (TC) to be unusual. However, spring-loaded gates had been installed to reduce the number of gates being damaged and requiring replacement.

Since 2008, there had been 3 public complaints to CN's 1-800 Call Desk [12] about this crossing. Transport Canada (TC) has no records of actual delays at this crossing, but according to CN trouble ticket data, there were 18 trouble tickets for the crossing in 2009. The number of trouble tickets, combined with the average daily traffic of 10 629 vehicles (based on the 2008 survey), indicates that significant delays have occurred at this crossing.

CN has a process for maintainers and supervisors to review each complaint that results in a service ticket. Additional notification is provided when a particular crossing receives 3 or more service tickets in 30 days. However, there was no indication that complaints at this crossing had

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10 Operation of the crossing protection system that is not followed by the approach of a train to the crossing within the anticipated timeframe. This can be a result of railway switching activity within the limits of the warning system.

11 Gates at this crossing were powered down to 35 degrees from vertical before falling to horizontal with gravity.

12 Planned maintenance work requiring the presence of an S&C maintainer will also generate a service ticket if the maintainer's presence is not anticipated.

been reviewed as CN Signals and Communications (S&C) maintainers and supervisors did not file any defect or exception reports for this crossing.

To reduce nuisance operation of the warning system and associated unsafe driver behaviour, a constant warning crossing protection system with LED lights to improve signal conspicuity can be installed to replace an existing DC crossing protection system. The constant warning system, also known as a Grade Crossing Predictor (GCP) 4000 system, detects the presence of trains when the approach circuit is occupied and determines the speed of the train before activating the warning system to provide the minimum warning time. Using this approach, the system provides a constant warning time regardless of train speed. However, there can be variances when a train is accelerating or decelerating as it approaches the crossing. Accelerating trains will reduce the warning times and decelerating trains will increase the warning times. If a train stops on the approach circuits, or if equipment is left standing on the approach circuit, the system will deactivate after a short period of time, generally 30 to 45 seconds. If a train starts moving towards the crossing again, the system will reactivate. If a train moves away from the crossing, it will not reactivate the system. The GCP 4000 system provides a minimum warning time of 27 seconds with a gate delay of 11 seconds to prevent longer trucks from striking and damaging the gates.

Crossing Improvement Process

There are approximately 43 000 federally and provincially regulated public and private railway grade crossings in communities across Canada and their safety is a significant issue for railway companies, the federal government, provinces, municipalities, the general public and others. In Canada, as in the U.S., crossing and trespassing accidents are by far the largest source of railway fatalities and serious injuries, comprising 87% of these in 2006. With new urban development, the growing number of vehicles and drivers, and the increasing length, frequency and tonnage of trains, the potential for grade crossing accidents is substantial. The TSB issued its Watchlist in March 2010 identifying the 9 safety issues that pose the greatest risk to Canadians. One of these safety issues concerns the high risk of passenger trains colliding with vehicles in busy corridors.

Transport Canada's Grade Crossing Improvement Program (GCIP) is an important contributor to safety at existing crossings. Through this program, more than $100 million has been invested in crossing safety improvements over the past 15 years. Under section 12 of the *Railway Safety Act*, the GCIP provides contributions for up to 80% of the cost of improvements at public crossings in Canada. The remaining cost is usually split 12.5% to the road authority and 7.5% to the railway.

More than 50% of crossing accidents occur at crossings equipped with active warning systems. [13] Projects to modernize and improve crossing protection systems are eligible for funding under the GCIP. However, crossing upgrades can be costly, and most provinces have projects awaiting approval. Either the railway or road authority can initiate and pay for an upgrade project. Crossings are a shared responsibility. The railway typically makes application to Transport Canada for authority and a grant under the GCIP where the work involves

13 *2007 Railway Safety Act Review*, Chapter 7, “Proximity Issues”.

warning systems. The road authority will typically make application for changes to roadway approaches or interconnecting traffic signals.

The Winterburn Road crossing was originally located on the outskirts of Edmonton but, over the years, road traffic has increased with urbanization. Rail traffic has also increased and trains have become longer and heavier. In addition to the crossing upgrades conducted with the road authorities and TC, CN identifies 2 crossings to upgrade each year at its own cost based on road and rail traffic, accident history, and maintenance. In 2010, this crossing was neither on CN's crossing upgrade list nor on TC's priority list.

Post-Accident Examination of Crossing Protection System

The functionality of the crossing protection system at Winterburn Road was investigated by CN and TSB shortly after the accident. During this examination:

- The crossing bungalow was enclosed in a tent to protect equipment from the weather.
- Relay positions were recorded and no exceptions were noted.
- The test switch in the signal bungalow was opened and the crossing lights were activated and gates fully descended normally on both sides of the crossing.
- It was noted that the bell sound was muffled due to the presence of ice and snow.
- For northbound vehicles, southward-facing warning lights and reflectorized materials were visible.
- For southbound vehicles, the presence of ice and snow was noted on the northward-facing warning lights, gate lights, and reflectorized materials. With the crossing protection operating, it was difficult to see light emitted from the northward-facing signals. [14]
- An inspection of the north gate did not show any indication of recent damage or contact with a vehicle.
- Upon completion of the activated crossing inspection, the test switch was closed and the remaining operational tests were conducted in accordance with company maintenance procedures (i.e., S&C GI-301(Q), SCP-701 and Western Canada S&C Operational Test Procedures).
- Tests on the crossing event recorder were conducted according to company maintenance procedures (i.e., GI-307, Inspecting and Testing Recording Devices). Data was downloaded and the time stamp reset.
- CN operating tests found no technical faults and determined all equipment was within specification.

Crossing Event Recorder

Although of older design and technology, relay-based DC crossing protection systems comply with AREMA standards and are considered by Transport Canada to provide adequate protection and an acceptable level of safety. They operate in the fail-safe mode in that any

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[14] Subsequent to the derailment of a VIA train on CN's Montmagny Subdivision (R10Q0011), a Rail Safety Advisory (RSA 02-10) highlighting the risks of snow obscuring a CTC signal was issued.

failure of the train detection device will result in the system activating. In the event of a power failure, a back-up battery will power the system for several hours depending on the number of trains.

For the crossing protection system at Winterburn Road, a 3-year record of operational tests required under CN General Instruction (GI)-310 was reviewed. No exceptions were noted.

The crossing had a prototype event recorder[15] installed as a test in 2006. There are no regulatory requirements for event recorders, and because it had not been inventoried in CN's Signal Equipment Tracking System (SETS), it was not being regularly monitored, inspected, tested nor downloaded under GI-307. Shortly after the accident, the event recorder information was downloaded and the time stamp was reset. Given that there was no useable time stamp for the downloaded information, it was not possible to identify the signal event activities for the morning of the accident.

A 10-day sample of the useable crossing event recorder data prior to the accident was reviewed. Records of the signal event activities for over 200 trains were examined. For this 10-day sample, 63% of the westbound trains generated warning times of more than 1 minute at the Winterburn Road crossing. In comparison, less than 13% of eastbound trains generated warning times of more than 1 minute.

The crossing event recorder was reset after the accident, and subsequent records from 04 May to 18 May 2010 were also reviewed. Based on approximately 370 trains, it was determined that 61% of the westbound trains generated warning times of more than 1 minute, while 10% of the eastbound trains generated warning times of more than 1 minute.

Credibility of Crossing Protection System

A crossing protection system warns drivers that a train or equipment is coming so that they stop their vehicles clear of the tracks. An indicator of the credibility of a crossing protection system is the extent to which it is trusted by drivers. Inconsistent warning times and nuisance alarms will affect the system credibility, particularly for frequent travellers at a given crossing. Recent studies on warning times for vehicle drivers determined the following:

- "Drivers begin to lose confidence in the traffic control system if the warning time exceeds approximately 40 seconds at crossings with flashing light signals and 60 seconds at gated crossings." [16]
- "The most significant device credibility problem results from excessive warning times which are experienced at many crossings with active traffic control due to the type of

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15 Crossing event recorders are considered non-vital equipment not essential for safe train operations.

16 S.H. Richards and K.W. Heathington, *Assessment of warning time needs at railroad-highway grade crossing with active traffic control*, Transportation Research Board Record 1254, Washington DC, 1990, pp 72-84.

train detection equipment and the presence of variable speed trains…excessive warning times are one of the main reasons for lack of compliance with active warning systems."[17]

- "…changes from fixed-distances to constant warning time (CWT) systems yielded a 26% increase in system effectiveness…impatient drivers are tempted to drive through active devices when warning times are high…for CWT systems, effectiveness increased with increase in train speed variation." [18]

Driver and Vehicle Information

The vehicle was a 4-wheel drive truck with ABS brakes and original factory all season tires with 7 to 8 mm tread depth and even wear. Examination of the front brake pads and rear shoes indicated approximately 10% to 20% wear and no contamination. The truck was considered to be in good mechanical condition. [19]

The driver held a valid Alberta licence for the class of vehicle he was driving. The driver was an experienced driver who did not wear glasses. In the night prior to the accident, the driver went to bed at approximately 0030. During the night, the driver's sleep was interrupted and on at least one occasion, the driver got up for an unknown period of time. The driver woke up at approximately 0730, which was later than usual. Consequently, the driver and the 2 children left their home later than normal that morning. At approximately 0831, they turned southbound onto Winterburn Road, 1 km north of the crossing, destined for Winterburn School where the 2 children attended school. The school is located approximately 2.6 km south of the crossing and classes started at 0840.

The driver was a frequent traveller through this crossing. On school days, the driver travelled through the crossing on the way to and from Winterburn School (i.e., twice in the morning and twice in the afternoon). The driver also travelled through the crossing at other times of the day.

The driver had surgery on 20 April 2010. One of the objectives of the surgery was to confirm the diagnosis of a brain abscess. After surgery, the patient (driver) was treated with antibiotics. During a neurological examination on 23 April 2010, the patient showed significant improvement and had no signs of neurological impairment. The driver was discharged from the hospital on 27 April 2010. No driving restrictions were considered necessary.

The medical examiner's report into this accident determined the following:

- Despite the absence of significant blood infiltration into the injured tissues, on the balance of probabilities, the cause of death was attributed to multiple blunt injuries.
- Tests performed on the pleural fluid, vitreous humor and urine indicate alcohol present at levels between 0.03 g/l, 0.06 g/l and 0.06 g/l respectively.

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17 S.H. Richards, R.A. Margiotta and G.A. Evans, *Warning time requirements at railroad-highway grade crossing with active traffic control*, Report FHWA-SA-91-007, Transportation Center, Tennessee University, February 1991, pp. 4-18.

18 Ibid.

19 As determined by the City of Edmonton Police investigation.

- The brain abscess could have played a role in the collision by causing seizure activity. Alcohol consumption the night before the accident and a short, interrupted sleep would favour such an event.

Toxicological interpretation by the medical examiner's office of the alcohol present in the tissue samples indicate a blood alcohol content (BAC) of 0.03% to 0.05% at the time of the accident. The legal limit for motorists in the province of Alberta is a BAC of 0.08%.

Anti-Whistling

A common noise-related complaint for communities in the vicinity of railway tracks is the issue of trains whistling as they approach a crossing. Train-whistling requirements are set out in *Canadian Rail Operating Rules* (CROR), Rule 14, Engine Whistle Signals. Subsection (l) requires the sounding of 2 long sounds, 1 short sound, 1 long sound. Clause (i) of that rule requires (in part):

> At public crossings at grade: Trains exceeding 44 mph must sound whistle signal ¼ mile before the crossing, to be prolonged or repeated, until the crossing is fully occupied.

Under the *Railway Safety Act*, municipalities may pass a resolution or bylaw prohibiting train whistling in certain areas within their boundaries, provided that the crossings in question meet regulatory safety requirements. Before passing such a resolution, the municipality must consult the railway and obtain its concurrence, notify each relevant association or organization, and give public notice of its intentions. A locomotive whistle will still be used in an emergency if required under railway operating rules, or if ordered by a Transport Canada safety inspector.

On the Edson Subdivision, there are 4 crossings between Miles 8.58 and 11.81 (i.e., a distance of 3.23 miles). The City of Edmonton passed an anti-whistling bylaw for these 4 crossings and made application to Transport Canada for an anti-whistling order which was granted in 1989.

TSB Laboratory Report

The TSB Laboratory analyzed [20] the data captured by the truck's airbag sensing and diagnostics module (SDM). The SDM determines whether the vehicle's airbags should be deployed during a crash and also functions as an event recorder. However, the SDM only records 2.5 seconds of data into a re-circulating random access memory (RAM) buffer.

Although the data recorder did not have a date stamp or time stamp, analysis confirmed that the recovered data was recorded during the 2.5 seconds leading up to the accident. The SDM recorded the following information in 0.5 second intervals:

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[20] Transport Canada's Collision Investigations group was contacted and supplied most of the required information. Other sources were the document "Recording Automotive Crash Event Data" that was supplied by Transport Canada and the Bosch crash data retrieval tool version 3.4.

Parameter	**-2.5 sec**	**-2.0 sec**	**-1.5 sec**	**-1.0 sec**	**-0.5 sec**
Accelerator Pedal Position (%)	0	0	0	0	0
Vehicle Speed* (MPH)	36	30	30	28	28
Engine Speed (RPM)	1216	1024	960	896	832
Percent Throttle	15	15	14	12	10
Brake Switch Status**	ON	ON	ON	ON	OFF
Engine Torque (ft-lb)	-	-	-	18.07	12.54

* "Vehicle Speed" is the wheel speed, not necessarily the speed of the vehicle.
** "Brake Switch Status" indicates the status of the brake lights only.

Based on the data, the following facts were established:

- The accident vehicle event recorder indicates that the driver and front seat passenger's safety belts were unbuckled at the time of the accident.
- Air bags did not deploy.
- The data indicates the accelerator position was at 0% for up to 2.5 seconds prior to impact, meaning the operator did not have his foot on the gas pedal during this time.
- The "Vehicle Speed" (wheel speed) parameter shows the wheels slowing from 36 mph at 2.5 seconds before the impact to 28 mph 0.5 seconds before impact. This suggests that the vehicle was slowing when it impacted the train.
- The "Engine Speed" parameter shows the engine rpm dropping from 1216 rpm at 2.5 seconds prior to impact to 832 rpm at 0.5 seconds prior to impact. This indicates that the vehicle's engine was idling.
- The "Percent Throttle" parameter shows the vehicle's throttle at 15% at 2.5 seconds before impact, dropping to 10% at 0.5 seconds before impact. This also indicates that the vehicle's engine was idling.
- The "Brake Switch Circuit Status" shows that the brake switch was ON from 2.5 to 1 second prior to impact and OFF at 0.5 seconds prior to impact. This data suggests that the brakes were being applied from 2.5 seconds to 1 second prior to impact.

The available parameters could not be used to determine the extent of braking (i.e. the force being applied to the brake pedal) prior to the impact.

The following TSB Laboratory report was completed:

- LP122/2010 – Recorder Download Analysis

Analysis

Neither track conditions nor the mechanical condition of the train were found to be contributory to the accident. There was no indication that the mechanical condition of the vehicle contributed to the accident. The analysis will focus on functionality of the crossing warning system, weather, and driver behaviour.

The Accident

The collision occurred when the southbound vehicle proceeded onto the crossing immediately in front of approaching VIA Train No. 1.

Weather conditions were very poor during the morning of the accident. It was snowing heavily, visibility was limited and the north face of most objects and features of the landscape in the vicinity of the accident site were covered with snow. Heavy, wet snow had accumulated on the north face of the crossing warning signal lenses as well as on the gate, its lights and reflectors. The snow-covered, north-facing crossing system components blended in with the white surroundings. During daylight conditions, lights are less visible than in darkness and a layer of snow scattering the light beam made their indication even less apparent. The truck's windshield wipers were likely operating and the windshield and windows of the vehicle would likely have had snow or water droplets on them. Visibility of the active crossing protection system was greatly reduced and road conditions were made slippery by the severe weather conditions.

The driver frequently used the crossing at or near the same time of day. His regular use of the route would have left him familiar with the crossing and the frequency of train activity. He left home later than usual that morning and may have been in a hurry to avoid his children being late for the start of classes. The combination of brake lights "on", the decreasing wheel speed, and the reduction in engine RPM from the vehicle data recorder indicates that the driver was applying the brakes in the seconds before the accident. The driver likely did not perceive the active crossing protection system and the position of the crossing gate until the vehicle was too close to stop due to the vehicle speed and road conditions.

Driver Physiology

The medical examiner concluded that, on the balance of probabilities, the cause of death was attributed to multiple blunt injuries consistent with the collision.

It could not be determined to what extent, if at all, the driver's brain abscess contributed to the collision. The driver's cerebral abscess could potentially have played a role by causing seizure activity, supported by the presence of alcohol in the driver and his short, interrupted sleep the night before.

The presence of alcohol in the blood of the driver at the time of the accident indicates alcohol consumption during the previous evening or early morning. The amount of time that elapsed between 0030 (i.e., when the driver retired for the evening) and 0832 (i.e., the time of the accident) is about 8 hours. Given that at least 8 hours had elapsed, it is likely that he had a BAC higher than 0.03% to 0.05% when he went to bed.

An interrupted night's sleep, as well as the presence of alcohol can result in acute sleep disruption. These are recognized fatigue risk factors. Fatigue, combined with low levels of alcohol in the body, can negatively affect driving performance and risk perception [21] to an extent comparable to a legally impaired driver. [22]

Crossing Warning System

The crossing signal system consisted of incandescent flashing lights, a bell and gates. Newer crossing signal installations make use of LED (light emitting diode) light technology, which provides improved conspicuity of active signal lights. Incandescent bulbs generate more heat than LED lights. Both LED and incandescent bulb technologies continue to be acceptable for use in railway crossing protection systems.

The southbound truck had entered the crossing, but the gate on the north side of the crossing was undamaged. This fact, along with the history of nuisance signal activation at the crossing, initially led to doubts about the functionality of the signal system. During post-accident testing, the system functioned properly and no electrical or mechanical faults were found. Review of downloaded historical operational data indicated that the relay-based DC crossing protection system had functioned as designed in the past. Testing performed immediately after the accident, a review of historical operational data, and observations of the crossing protection system immediately prior to the accident indicated that the system was functioning as designed the morning of the accident.

Most of the protected crossings in Canada have relay-based DC crossing protection systems. Although of older design and technology, they are a simple, robust system that provides an acceptable level of protection. However, their use at crossings when there are varying train speeds may not be appropriate as road and rail traffic density and patterns change. The review of the event recorder data confirmed that westbound trains produced longer warning times as compared to eastbound trains. Inconsistent warning times and nuisance operations of the crossing protection system at Winterburn Road may have desensitized some local motorists to the signals.

Vehicle Sensing and Diagnostics Module (SDM)

New vehicles are increasingly being equipped with event recorders. In this occurrence, the truck's sensing and diagnostics module functioned as an event recorder. However, the SDM only recorded the events for 2.5 seconds (approximately 33 meters) before impact. Despite the

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[21] S. Banks, P. Catcheside, L. Lack, R.R. Grunstein and R.D. McEvoy, "Low Levels of Alcohol Impair Driving Simulator Performance and Reduce Perception of Crash Risk in Partially Sleep Deprived Subjects", *Sleep*, Vol. 27, No. 6, 2004, pp. 1063-1067.

[22] M.E. Howard, M.L. Jackson, G.A. Kennedy, P. Swann, M. Barnes and R.J. Pierce, "The Interactive Effects of Extended Wakefulness and Low-dose Alcohol on Simulated Driving and Vigilance", *Sleep*, Vol. 30, No. 10, 2007, pp. 1334-1340.

short recording time, the downloaded data revealed that the accelerator was not applied (i.e., the vehicle was idling during this time), the vehicle was braking up to one second prior to impact and wheel speed was slowing, likely indicating that the driver was attempting to slow the vehicle and stop before hitting the gate and fouling the crossing. Due to the snowy, slippery road, the driver likely manoeuvered into the northbound lane, cleared the gate but fouled the crossing and was hit by the train.

It could not be determined when braking was initiated or how much braking was applied. In addition, the speed of the truck before the 2.5 second time period and the evasive manoeuvers performed by the driver (if any) could not be confirmed. In order to obtain a more complete accident reconstruction, a longer recording time on the vehicle event recorder would be required, as well as a higher sampling rate and additional recorded parameters.

Anti-Whistling Orders at Crossings

Train horns provide auditory warnings to motorists, but anti-whistling was in effect at this crossing. While anti-whistling orders decrease annoying noise levels, especially in urban areas with multiple crossings, the orders remove an auditory warning to indicate the impending arrival of the train, increasing the risk of collision when other defences fail.

Crossing Performance Monitoring

The high incidence of gate replacement at this crossing was not seen by the railway as a possible crossing protection system deficiency, but solely as a driver behavioural issue. Replacing broken gates had become such a routine maintenance task that they were being replaced with spring-loaded mechanisms at some locations to prevent gates from being broken. Service tickets and maintenance for crossing protection systems were rarely discussed amongst maintainers or elevated to supervisors for discussion and resolution. In addition, by not maintaining the crossing event recorder, one of the key tools for investigating accidents and public complaints of nuisance operations and the monitoring of crossing performance was unavailable.

Both TSB’s Watchlist and TC’s draft RTD 10 call for safety assessments to identify high-risk crossings along busy passenger train routes and to make the necessary safety improvements. A safety assessment could include developing a process to review crossing maintenance and service tickets, along with regular review of crossing event recorder data and traffic patterns with road authorities. No such crossing safety assessment had been conducted at Winterburn Road crossing. In the absence of a routine crossing safety assessment prior to the accident, an opportunity to identify latent safety issues associated with the relay-based DC crossing protection system at Winterburn Road was missed.

Findings as to Causes and Contributing Factors

1. The collision occurred when the southbound vehicle proceeded onto the crossing immediately in front of approaching VIA Train No. 1.
2. Visibility of the active crossing protection system was greatly reduced and road conditions were made slippery by the severe weather conditions at the time of the accident.
3. The driver likely did not perceive the active crossing protection system and the position of the crossing gate until the vehicle was too close to stop due to the vehicle speed and road conditions.
4. The vehicle was braking up to 1 second prior to impact and wheel speed was slowing, indicating that the driver was attempting to slow the vehicle and stop before hitting the gate and fouling the crossing. Due to the snowy, slippery road, the driver likely manoeuvered into the northbound lane, cleared the gate but fouled the crossing and was hit by the train.

Findings as to Risk

1. Relay-based direct current (DC) crossing protection systems at crossings with varying train speeds result in inconsistent warning times and nuisance warnings that can desensitize motorists to the crossing signals, increasing the risk of unsafe driving behaviour.
2. Anti-whistling orders remove an auditory warning to indicate the impending arrival of a train, increasing the risk of collision when other defences fail.
3. In the absence of a routine crossing safety assessment prior to the accident, an opportunity to identify latent safety issues associated with the relay-based DC crossing protection system at Winterburn Road was missed.
4. Fatigue, combined with low levels of alcohol in the body, can negatively affect driving performance and risk perception to an extent comparable to a legally impaired driver.

Other Findings

1. Testing performed immediately after the accident, a review of historical operational data, and observations of the crossing protection system immediately prior to the accident indicated that the system was functioning as designed the morning of the accident.
2. In order to obtain a more complete accident reconstruction, vehicle event recorders must provide a longer recording time, a higher sampling rate and additional recorded parameters.
3. By not maintaining the crossing event recorder, one of the key tools for investigating accidents and public complaints related to nuisance operations and the monitoring of crossing protection system performance was unavailable.

4. Inconsistent warning times and nuisance operations of the crossing protection system at Winterburn Road may have desensitized some local motorists to the signals.
5. The medical examiner determined that the driver died from multiple blunt injuries sustained in the accident. It could not be determined to what extent, if at all, the driver's brain abscess contributed to the collision.

Safety Action Taken

Following the accident, instructions were issued by CN to ensure an accurate inventory of crossing event recorders into the SETS database, to verify correct time stamps, and to inspect and download crossing event recorders according to GI-307.

On 12 May 2010, Transport Canada and CN conducted a joint inspection of the Winterburn Road crossing. Following this inspection, application was made by CN to TC for a grant under Section 12(1)(a) of the *Railway Safety Act*, R.S.C. 1985, c.32 (4^{th} Supplement) to upgrade the crossing protection system. After discussions with TC and CN, the City of Edmonton also agreed to support the proposed crossing improvements.

On 18 May 2010, CN replaced the DC crossing protection system at Winterburn Road with a constant warning system with LED lights. Data from the new crossing protection system was examined. It was determined that nuisance operations at this crossing were significantly reduced as no warning times greater than 1 minute were recorded over a 2-week period. In comparison, approximately 36% of the warning times were greater than 1 minute prior to the installation of the new system

During the installation of the new crossing protection system, the signal masts were relocated to accommodate road shoulder widening.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 09 August 2011.