Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R04H0014

CROSSING COLLISION

CANADIAN PACIFIC RAILWAY
TRAIN NUMBER 120-03
MILE 51.05, OTTAWA VALLEY RAILWAY
CHALK RIVER SUBDIVISION
CASTLEFORD, ONTARIO
06 OCTOBER 2004

Canada

Railway Investigation Report

Crossing Collision

Canadian Pacific Railway
Train Number 120-03
Mile 51.05, Ottawa Valley Railway
Chalk River Subdivision
Castleford, Ontario
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Summary

At 1728 eastern daylight time on 06 October 2004, Canadian Pacific Railway freight train No. 120-03, proceeding eastward at 28 mph on the Ottawa Valley Railway, struck a northbound vehicle at the River Road public crossing (Mile 51.05, Chalk River Subdivision), near Castleford, Ontario. The train consisted of 3 locomotives and 93 cars, was 7149 feet long, and weighed 10 755 tons. The crew placed the brakes in emergency, and the train stopped approximately 1300 feet east of the crossing. The occupant of the vehicle was fatally injured.

Ce rapport est également disponible en français.

Other Factual Information

At 1433 eastern daylight time[1] on 06 October 2004, Canadian Pacific Railway (CPR) freight train No. 120-03 (the train) departed Chalk River, Ontario,[2] Mile 112 of the Ottawa Valley Railway (OVR) Chalk River Subdivision, destined for Smiths Falls. The train's ditch lights were illuminated and the headlights were on bright. At 1728, the train approached the River Road public crossing (Mile 51.05 of the Chalk River Subdivision), which was equipped with flashing lights and a bell. The conductor, looking through a narrow opening between the trees, observed a red sport utility vehicle (SUV) rapidly approaching from the south. The train entered the crossing and struck the vehicle on the far right-hand side of the right lane. The train's air brakes were placed in emergency and it came to a stop with the vehicle impacted on to the head end of the lead locomotive, CP 9133. The rail traffic controller was advised of the situation and initiated an emergency response. The driver was fatally injured, and the vehicle was destroyed. The lead locomotive received minor damage to the headlights and ditch lights.

Train Control

The method of train control on the Chalk River Subdivision is the Occupancy Control System (OCS), authorized by the *Canadian Rail Operating Rules* (CROR) and supervised by a rail traffic controller located in North Bay. The train was authorized by an OCS clearance to proceed. The maximum permissible train speed for the subdivision was 50 mph. Average daily train traffic was eight freight trains per day.

Train Crew

The train crew consisted of a locomotive engineer and a conductor. Both crew members were familiar with the territory, qualified for their positions, and met fitness and rest requirements.

Recorded Information

Information from the locomotive event recorder on the lead locomotive revealed that the train had approached the crossing travelling at 28 mph. The locomotive horn was sounded as required by CROR Rule 14(l). The train was placed in emergency braking at 1728, and 20 seconds later, it came to a stop having travelled 1288 feet since the emergency brake application.

Information from the signal event recorder indicated that the crossing signals had been active for 74 seconds before the train occupied the crossing.

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1 All times are eastern daylight time (Coordinated Universal Time minus four hours).

2 All locations in this report are in Ontario unless otherwise indicated.

Information from the analysis of the SUV's air bag control module revealed that the air bags were deployed as a result of a significant longitudinal force moment.[3]

Weather

At 1720 on 06 October 2004 at Castleford, the sky was clear, the temperature was 15°C, and visibility was unlimited.

River Road Public Crossing

River Road, in the County of Renfrew, is a two-lane, undivided rural arterial, running along the south shore of the Ottawa River. Average daily traffic was about 1000 vehicles per day. Upon leaving the village of Sand Point, heading westward towards Castleford, there was a sign posted indicating the end of a 60 km/h speed limit. When not indicated, the maximum permissible operating speed on Ontario rural roadways is 80 km/h.

For northbound traffic approaching the railway crossing at Castleford, there was a 75 cm by 75 cm, diamond-shaped advance warning sign on the right-hand side of the roadway close to edge of the gravelled shoulder, indicating a railway crossing ahead. There was also a large white X painted on the highway surface 60 m ahead of this sign. Although the advance warning sign indicated that the highway intersected the track at a perpendicular (90-degree) angle, in fact, the highway approach descends, curves, and crosses the railway tracks in a northward direction at a 65-degree angle.

For northbound traffic on River Road, the view of the crossing signal warning lights was severely restricted by trees growing next to the highway on the highway right-of-way and on adjacent property, and by a right-hand horizontal curve. Because of the horizontal curve and its downward slope, the highway approaching the crossing is difficult to navigate at speeds higher than the speed limit. The 250 m radius curve met the province of Ontario's minimum geometric design standards for a highway design speed of 80 km/h. In Ontario, roadway design speeds are typically 20 km/h higher than the posted maximum operating speed.

There were multiple black skid marks on the highway immediately before the crossing.

Crossing Signals

OVR's Signals and Communications Standard No. 12 prescribes the distance at which signal lights must be focused and aligned, and from what distance they must be visible at various highway operating speeds. It indicates that the front flashing signal lights should be focused at 720 feet from the crossing for 80 km/h roadways. The minimum focused distance (which may be necessary in some situations) is 530 feet. The standard also prescribes that the back lights, which

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[3] The longitudinal force moment is the amount of force, parallel to the longitudinal axis of the vehicle, that was detected by the air bag control module at the exact moment the air bags deployed.

are located on the left-side signal mast, on the far side of the crossing, be focused at 50 feet from the grade crossing, to be clearly visible to drivers in each lane while stopped at the grade crossing.

The standard also includes a recommended instruction from the Association of American Railroads' signal manual.

> After units have been aligned, clamps tightened and doors closed, they must be checked with lights flashing and lamps burning at recommended voltage to make certain a flashing light aspect is visible within a range of 1000 feet.

The visibility of grade-crossing warning-system light units is defined as the distance in advance of the stop line or vehicle stop position from which a set of light units must be continuously visible. Light unit focus is defined as the point at which the light beams emitted from the unit's two lenses intersect, with reasonable certainty that a person will see the warning sign quickly without having to search for it.

Coincident with the planned expansion of River Road into a two-lane highway at Castleford in 1963, an application was filed to install flashing signal lights and a bell as a crossing warning system. The application specified that the flashing signal lights to be installed be right-hand oriented as viewed from an approaching vehicle. However, the approval from the Canadian Transport Commission (CTC Board Order 114223) prescribed that the signal lights be installed left-hand oriented.

On 20 July 1976, subsequent to the investigation of an accident at this crossing, the orientation of the signal lights was questioned. The district signal engineer of the Railway Transport Committee wrote: "The relocation of the above signals due to the curvature of the northward approach and the existence of the parking lot in the northwest corner of crossing is not feasible."

On 10 August 1976, the Secretary of the Railway Transport Committee, in a letter to the road authority and the railway company, wrote that the flashing signal lights had been installed left-hand oriented "in order to improve the view of these signals from the appreciable curve on the approaches."

Part I, Section 7. (1) of CTC General Order No. E-6 (1978), prescribed the following:

> Unless otherwise authorized by the Commission, a signal of the flashing light type shall be placed on each side of the tracks and to the right of approaching highway traffic, and each signal shall have not less than four electric light units.

In 1984, the lights were changed to right-hand orientation. The TSB investigation could not find an explanation for the decision to change the signal light orientation.

Advanced Warning of Railway Crossing

The standard advance warning sign and white X painted on the pavement are intended to warn vehicle operators that there is a railway crossing ahead and that they should watch for a train or the flashing signal lights. There are several other warning systems available to alert drivers about upcoming hazards. For example, active advance warning signs, crossing illumination, rumble strips, or enhanced delineation with retro-reflective signs are helpful at appropriate sites. Research on active advance warning signs indicates that, when active yellow flashers were added to a slightly enlarged advance warning sign and were activated by an approaching train, motorist recognition and speed reduction improved significantly.[4]

Transport Canada's (TC) draft technical manual RTD 10,[5] intended to be incorporated by reference into new grade crossing regulations, specify, among other things, that:

> 14.1 A Prepare to Stop at Railway Crossing Sign as specified in the *Traffic Control Devices Manual*, shall be installed:
>
> (a) on a road approach where at least one set of front light units on a warning signal or on a cantilever at the grade crossing cannot be seen clearly within the minimum distance specified in Table 19-1.

The minimum distance specified in Table 19-1 is 165 m (530 feet) for passenger cars and light trucks, and 210 m (675 feet) for heavy trucks.

Washboard rumble strips are recognized as a traffic calming measure that warns motorists of hazards, speed zone changes, or the need for additional alertness. Rumble strips are raised or grooved patterns on, or in, the pavement that create a visible, audible, and physical alert to drivers in traffic areas where caution is necessary. Although the feasibility of using rumble strips with the present sign and white X was discussed in 2004 at TC's Sixth Annual Workshop on Highway-Railway Grade Crossing Research in Montréal, Quebec, their use has not yet been tried on Canadian level crossing approaches.

In October 2005, the Transportation Association of Canada (TAC) published a best practices guide titled *Advance Warning Flashers: Guidelines for Application and Installation*. These guidelines refer to the use of transverse rumble strips as a supplemental or alternative measure to advance warning flashers (AWFs). They list seven conditions that may prompt the use of AWFs, two of which are limited sight distance and approaches with a speed limit greater than or equal to

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4 Richard A Maher, Chairman of Committee; Fred Coleman III, Consultant, University of Illinois at Urbana-Champaign; Ronald W. Eck, West Virginia University; Eugene R. Russell, Kansas State University, *Transportation in the New Millennium, Railroad-Highway Grade Crossings A Look Forward*, 2000, published by the Transportation Research Board

5 RTD 10, *Road/Railway Grade Crossings: Technical Standards and Inspections, Testing and Maintenance Requirements*

70 km/h. According to the guidelines, while the presence of one of these conditions may justify using AWFs, the combination of two or more of these conditions is a stronger justification for using AWFs.

Examination of the Vehicle

Post-accident examination of the vehicle at the TSB Engineering Laboratory (TSB Engineering Report LP 142/2004) revealed that the SUV, a 2000 Dodge Durango, had been well maintained. Other than the crash damage, the vehicle doors and windows appeared to be tight fitting, and all the weatherstripping and other sound-insulating features were in good condition. The brake components were serviceable and in good condition. Repair records indicated that new brakes were installed in June 2004. Examination of both the left and right tail/brake light bulbs showed no stretched filaments, indicating that the bulbs were not illuminated at impact.

An examination of the speedometer, tachometer, and throttle mechanism to determine the vehicle's speed at the time of the accident was inconclusive. The SUV did not have an event recorder to store these data. (In Canada, only General Motors Corporation installs event recorders on vehicles to record these operating parameters.)

Analysis of the air bag control module revealed that the deploying longitudinal force moment was consistent with the vehicle striking the train locomotive at the speed determined by the re-enactment (TSB Engineering Report LP 142/2004). The driver was wearing his seat belt at the time of the occurrence. Examination of the crash deformation revealed a slight difference between the angle of crash and the angle of the crossing.

All vehicle windows were closed. The vehicle was equipped with a radio, CD player, and equalizer. Impact damage to the music system's wiring and speakers precluded determining if the system was being played.

Accident Reconstruction

The TSB Engineering Laboratory, in cooperation with the Ontario Provincial Police and the Ottawa Valley Railway, performed an accident reconstruction (TSB Engineering Report LP 142/2004) to evaluate the accident conditions and the driver's actions. Information obtained during the investigation was used to locate the train and the vehicle in their relative positions during the seconds before the accident. The sight-line distance, or range of visibility, of the crossing flashing signal lights was determined. The position of the locomotive, its distance from the crossing, the position of the vehicle when it could first be seen from the locomotive, the recorded information from the locomotive event recorder, and information from the post-accident examination of the vehicle were all used to establish the most likely scenario.

The distance along the rail track from the vantage point of the witness in the locomotive to the vehicle impact point at the crossing was 264.5 feet when the SUV was first observed. Given that the locomotive was travelling at a constant speed of 28 mph (41.1 feet per second), it would take 6.4 seconds for the train to traverse the 264.5 feet.

The distance along the roadway from the SUV to the crossing, when the SUV was first observed from the locomotive, was 747.75 to 818.3 feet. These represent the nearest and furthest possible distances. The average calculated vehicle speeds for these two reference positions are 128 km/h (80 mph) and 140 km/h (87 mph).

Photo 1. Crossing approach from about 300 feet

It was determined that the distance at which the front crossing signal warning lights (right side) were focused and visible to the operator of an approaching vehicle was approximately 450 feet. A driver operating at the highway speed (80 km/h) would traverse the distance between the point at which the signal lights were visible (450 feet) and the actual crossing in 6.2 seconds. It was also determined that the mast and back signal warning lights (left side) were visible, but not conspicuous, from approximately 580 feet. A flashing light aspect was not visible from a range of 1000 feet because of a forested area on the inside of the curve approaching the crossing. The distance from the crossing at which an eastward train became visible from a northbound vehicle was 295 feet.

Driver Behaviour

Studies that have examined driver reaction time indicate that it has two components: mental processing time and physical reaction time. The amount of mental processing time required depends on many factors including the magnitude of a person's current mental workload and the visibility of the signal that demands a response.[6] Larger mental workloads combined with less visible signals result in longer reaction times.

TSB investigators conducted vehicle test runs at the Castleford crossing at 80 km/h while the crossing signals were activated. Each test driver expressed similar concerns that negotiating the curve approaching the crossing demanded so much driver attention that observation of the crossing signals was compromised.

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[6] M. Green, "How long does it take to stop? Methodological analysis of driver perception - brake times," *Transportation Human Factors,* 2(3), 2000, pp. 195-216

A study of driver reaction times demonstrated that most people require 1.8 seconds to react to railroad crossing signals lights[7] if their workload is at a normal level for driving and if the signal lights are visible. The design standard allows for a driver reaction time of at least 2.5 seconds to brake at a level crossing with a visible signal and an approach void of any crest or curvature. This is based on a normal mental workload. Any deviation from this configuration requires a longer reaction time. The reaction times do not include the time required for the vehicle brake system to respond to depression of the brake pedal, nor the time required to safely stop the vehicle.

According to the TAC's 1986 *Manual of Geometric Design Standards for Canadian Roads*, the minimum stopping sight distance, reaction time plus braking distance, for a passenger car on wet pavement is 140 m (460 feet). The pavement was dry at the time of this occurrence. The manual also prescribes a decision sight distance of 230 to 310 m (750 to 1000 feet) for a design speed of 80 km/h. The manual states that decision sight distance is needed whenever there is a likelihood for error in either information reception, decision making, or control actions.

The manual suggests that it is desirable to use decision sight distances at critical locations, which include intersections, locations where unusual or unexpected manoeuvres are required, and locations of concentrated demand where sources of information compete. At critical locations where it is not feasible to provide these distances because of horizontal curvature, suitable warning devices for providing advance warning of the conditions likely to be encountered should be given special attention.

Safety Communications

Rail Safety Information Letter

On 05 November 2004, the TSB forwarded a Rail Safety Information letter to TC stating that, based on the accident re-enactment, OVR's signal visibility guidelines were not met at the River Road public crossing. Having sufficient time to view and respond to crossing signal warning lights is an important part of safety at crossings.

On 24 December 2004, TC replied, stating that it had held discussions with the railway and the municipality to correct the light alignment and to find possible opportunities for improving the signal visibility at this crossing.

Rail Safety Advisory

On 25 January 2005, the TSB forwarded a Rail Safety Advisory to TC noting that the flashing lights, originally installed in 1964, had had the front lights installed to the left of the roadway as seen by approaching northbound vehicles. The original installation had allowed for a longer sighting distance of the flashing lights along the right-hand curve, to meet the minimum visibility requirements for crossing signal lights for northbound approaching vehicles. The

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7 T. Riggs and W. Harris, "Reaction time of drivers to road stimuli," *Human Factors Report No. HER-12*, Victoria, Australia: Monas University, Department of Psychology, 1982

advisory further suggested that TC might wish to identify other crossings with road approach characteristics and signal systems similar to those at River Road, and consider action to increase the level of signal warning.

Transport Canada's Response

On 17 February 2005, TC held a site meeting at the River Road public crossing with representatives from the OVR and the County of Renfrew. Numerous measures were agreed upon to correct the problem of signal visibility at this location. For instance, it was agreed that an additional mast on the left side of the curve with 12-inch light-emitting diode (LED) light units would improve safety. In a follow-up to this meeting, the OVR stated a preference for installing an active "Prepare to Stop at Railway Crossing" sign.

In March 2005, TC replied to the TSB Rail Safety Advisory noting that the visibility of the warning signals is a key and critical factor of the effectiveness of any automatic warning system, but that the real issue was that light units must be properly aligned to attract the attention of a driver looking ahead along the road.

Various solutions to sight-line problems were described, along with standards for alignment and the need for railway signal employees knowledgeable about signal alignment. Finally, TC noted that LED light units, mounted on an additional signal mast, should be installed at the crossing. TC advised that the road authority had cut the brush on the highway right-of-way.

TC has advised that, in some instances, additional light units will be required on the main mast, on an additional mast located on the left-hand side of the road, or on a cantilevered structure, or by the use of an active "Prepare to Stop at Railway Crossing" sign.

Analysis

In the investigation into this occurrence, no deficiencies related to the operation or mechanical condition of the train were identified. No defects of track infrastructure contributed to the accident. The analysis will focus on crossing regulations relating to sight-line visibility of warning systems for highway crossings at grade, and on driver behaviour.

The Accident

While approaching the crossing, the driver did not appear to notice the train until it was too late to stop or to brake. The locomotive horn and lights were functioning, and the crossing flashing signal lights were operating. The driver attempted to clear the crossing ahead of the train. However, the attempt was unsuccessful, and the train struck the vehicle.

Accident Reconstruction

The accident reconstruction estimated the vehicle's speed to be around 128 km/h. At that rate of speed, had the signal lights been seen from a distance of 580 feet, the driver would have had only 3.1 seconds to safely stop the vehicle after reacting and depressing the brake pedal within the normal reaction time of 1.8 seconds. A vehicle travelling at 128 km/h cannot be safely stopped within 3.1 seconds. In addition, mental workload at this speed, with this highway configuration (that is, a tight right-hand curve), would have been greater, increasing the driver's required reaction time to more than 1.8 seconds, thus reducing the time available to stop the vehicle to less than 3.1 seconds.

If the driver did not see the signal lights because of the increased mental workload of negotiating the curve at a higher speed, the first visual cue would have been the train itself. The earliest that this could have occurred was at a point 295 feet from the crossing. This distance would have been traversed in 2.5 seconds at 128 km/h. However, while there was an unobstructed view of the train from 295 feet, this does not mean that the driver actually did see the approaching train. If he had, it would have only permitted enough time for him to react (less than 1.8 seconds) and then perform an evasive manoeuvre, for less than 0.7 seconds.

Crossing Signals

Based on analysis of measurements taken during the accident reconstruction, the OVR signal visibility guidelines were not met at the River Road public crossing. The growth of brush and trees on the inside of the curve approaching the crossing restricted the view of the signals, increasing the risk that they would not be seen in sufficient time to stop safely.

As noted in TC's draft technical manual RTD 10, an active "Prepare to Stop at Railway Crossing" sign may be necessary to ensure that an approaching vehicle has adequate warning time to allow the driver to stop safely. In the case of the River Road public crossing, and similar crossings without auxiliary signal systems to mitigate the consequences of poor approach visibility, there is a risk that drivers will not be able to react in time to stop safely if a train approaches or occupies the crossing. The TAC's *Advance Warning Flashers: Guidelines for Application and Installation* lists conditions that may prompt the use of AWFs. Two of these conditions (limited sight distance and approaches with a speed limit greater than or equal to 70 km/h) exist at this crossing.

In 1984, the flashing signal lights were switched to the standard right-side orientation, reducing the front light visibility below minimum requirements. This decision to change the signal light orientation did not address the rationale for the original left-hand orientation. The change from left-hand to right-hand orientation decreased the signal visibility distance for approaching northbound vehicles and increased the risk that the front lights would not be seen in sufficient time to stop before the crossing. Although the back lights were visible, back lights are designed to provide a visible indication of flashing red to motorists stopped at the crossing and are focused 50 feet in front of the crossing. They are not intended to be conspicuous from a distance. The front lights are intended to provide a visible indication of a flashing signal light to a motorist approaching from a distance, and the minimum distance that a flashing signal aspect must be visible is 1000 feet. The minimum focus distance of 530 feet applies only to the front lights. The flashing signal aspect from the front lights or back lights, right- or left-hand side, was not visible from 1000 feet.

Driver Behaviour

A driver travelling at a highway speed of 80 km/h would traverse the distance between the point at which the front signal lights were visible (450 feet) and the crossing in 6.2 seconds. Given that it would likely take 1.8 seconds for the driver to react, 4.4 seconds would be available to safely stop the vehicle, providing the driver saw the signal lights.

The driver in this accident had an increased mental workload because he was driving over the speed limit on a stretch of difficult (curved) road. This increased mental workload

- caused him to focus his attention on maintaining control of the vehicle,
- probably decreased his reaction time to the advance warning sign and the white X on the highway,
- increased the time it took him to react to the signal lights, and
- reduced the time available to stop.

As a result, the driver did not perceive either the automatic warning devices or the actual train until it was too late to stop. Because of the vehicle's age and condition, it was resistant to sound penetration and insulated from the sound of the locomotive horn.

The multiple skid marks and reports from nearby residents indicate that vehicles at this crossing approach often attempt avoidance manoeuvres, swerve into the ditch, and resort to heavy brake applications—all indications that the approach is difficult. According to the TSB test drivers, the combination of concentrating on controlling the vehicle while negotiating the curve at the posted highway speed of 80 km/h and the trees on either side of the crossing approach detracted from recognizing the crossing signals. Using the minimum geometric design standard with a highway speed of 80 km/h increases demands on the driver, thus increasing the risk that a driver will not be able to observe and comply with the crossing signals.

Minimum stopping sight distance is usually sufficient to allow reasonably competent and alert drivers to come to a hurried stop under ordinary circumstances. However, this distance is often inadequate when drivers must make complex or instantaneous decisions, when information is difficult to perceive, or when unexpected or unusual manoeuvres are required. In these circumstances, using the decision sight distance instead of the minimum stopping distance gives drivers the greater distance/time required. The decision sight distance prescribed in the *Manual of Geometric Design Standards for Canadian Roads* is similar to the OVR-required 1000-foot distance visibility for a flashing signal light aspect.

Findings as to Causes and Contributing Factors

1. The driver in this accident had an increased mental workload because he was driving over the speed limit on a stretch of difficult (curved) road. This increased mental workload

    - caused him to focus his attention on maintaining control of the vehicle,
    - probably decreased his reaction time to the advance warning sign and the white X on the highway,
    - increased the time it took him to react to the signal lights, and
    - reduced the time available to stop.

2. The change of flashing signal lights from left-hand to right-hand orientation decreased the signal visibility distance for approaching vehicles and increased the risk that the front lights would not be seen in sufficient time to stop before the crossing.

3. The growth of brush and trees on the inside of the curve approaching the crossing restricted the view of the signal lights, thus increasing the risk that they would not be seen in sufficient time to stop safely.

Findings as to Risk

1. Using the minimum geometric design standard with a highway speed of 80 km/h increases demands on a driver negotiating a curve, thus increasing the risk that a driver will not be able to observe and comply with the crossing signals.

2. When a crossing does not have an auxiliary warning system, such as an active advance warning sign, and the view of signal lights is restricted for approaching drivers, there is a risk that drivers will not be able to negotiate the crossing safely.

Other Findings

1. The Ottawa Valley Railway (OVR) signal visibility guidelines were not met at the River Road public crossing.

2. The decision sight distance prescribed in the *Manual of Geometric Design Standards for Canadian Roads* is similar to the OVR-required 1000-foot distance visibility for a flashing signal light aspect.

3. There are conditions at the northbound approach to the crossing that warrant the use of advance warning flashers.

Safety Action Taken

An additional set of long (front) lights has been installed with the back lights on the far left side of the crossing in the northwest quadrant of the crossing.

On 24 November 2004, and again in the fall of 2005, the road authority cut brush along the highway right-of-way, which was interfering with the sight-line to the crossing signals, but not on adjacent private property where there is growth that interferes with visibility of the signals. The road authority was not successful in its attempts to contact and make an official request to the owner of the private property adjacent to the highway to allow the road authority to remove trees and brush that interfere with the sight-line to the crossing signals.

The road authority has installed a 70 km/h reduced speed warning on the curve warning sign ahead of the crossing.

Transport Canada has received an application for funding to add a mast with light-emitting diode (LED) lights in the southwest quadrant and upgrade the current signal lamps to 12-inch LED lamps.

Safety Concern

In February 2005, the road authority and the railway met with Transport Canada at the site, and identified the most appropriate safety measure to be the installation of an active advance warning sign for northbound traffic approaching the crossing at Castleford. The Board is concerned that the process has resulted in no action for more than one year since the occurrence.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 15 February 2006.

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Appendix A – Glossary

AWF	advance warning flasher
cm	centimetres
CPR	Canadian Pacific Railway
CROR	*Canadian Rail Operating Rules*
CTC	Canadian Transport Commission
km/h	kilometres per hour
LED	light-emitting diode
m	metres
mph	miles per hour
SUV	sport utility vehicle
OCS	Occupancy Control System
OVR	Ottawa Valley Railway
TAC	Transportation Association of Canada
TC	Transport Canada
TSB	Transportation Safety Board of Canada
°C	degrees Celsius