Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R03T0157

MAIN-TRACK DERAILMENT

CANADIAN NATIONAL
TRAIN NUMBER A-450-31-21
MILE 68.9, BALA SUBDIVISION
GAMEBRIDGE, ONTARIO
21 MAY 2003

Canada

Railway Investigation Report

Main-Track Derailment

Canadian National
Train Number A-450-31-21
Mile 68.9, Bala Subdivision
Gamebridge, Ontario
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Summary

At 1144 eastern daylight time on 21 May 2003, Canadian National (CN) train A-450-31-21, travelling southward from North Bay, Ontario, destined for Toronto, Ontario, derailed 49 rail cars south of the Highway 12 public crossing in the village of Gamebridge, Ontario, Mile 68.9 of the CN Bala Subdivision. The derailed equipment included 21 tank cars loaded with sulphuric acid, 2 empty box cars, and 26 box cars loaded with paper.

Approximately 250 tons of sulphuric acid was released from three tank cars. An underground fibre-optic cable on the west side of the track was severed, disrupting service for 16 hours. Highway 12 was closed in the vicinity of the derailment area until the morning of 26 May 2003. Some 50 people were evacuated due to the toxic nature of the released product and to ease clean-up operations. Two firefighters suffered minor fume inhalation, and a local citizen suffered minor acid burns to his feet.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 21 May 2003, Canadian National (CN) freight train A-450-31-21 left North Bay, Ontario, proceeding southward on the Bala Subdivision, destined for Toronto, Ontario. The weather was 20°C, sunny and clear, with a slight northeast wind.

At about 1144 eastern daylight time,[1] while travelling at 59 mph with the throttle in the No. 5 position, an undesired emergency brake application (UDE) occurred. After conducting the necessary emergency procedures, the crew inspected the train and found that 49 cars, the 47th to the 95th behind the locomotives, had derailed and were piled up, immediately south of the Highway 12 crossing at Mile 68.9, in the village of Gamebridge, Ontario (see Photo 1). Some 1700 feet of track was destroyed, beginning at the south end of the Highway 12 crossing and extending southward through the crossing at Concession Road A.

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

The derailed cars included 21 Class 111A tank cars loaded with sulphuric acid (UN 1830),[2] 2 empty box cars, and 26 box cars loaded with paper. Approximately 250 tons of acid was released. Emergency responders contained the leaking product and extinguished a small fire.

Double-shelf couplers had kept most of the derailed tank cars together, but a separation did occur between the 49th car (PROX 16159) and the 50th car (UTLX 12779). The 47th, 48th, and 49th cars were then dragged south to Mile 68.3, where car PROX 16159 became detached from the train and rolled onto its side on the west side of the track. The front of the train continued southward for an additional 400 feet, stopping near Mile 68.2.

The 47th car (PROX 16125) was upright with the wheels of the trailing truck derailed to the gauge side of the west rail. The 48th car (GATX 6565) was upright with all eight wheels derailed. The three cars had spread the rails, damaging ties, plates, anchors, and spikes, and rolled the west rail over for an additional 2000 feet of track beyond the main derailment area.

A review of the locomotive event recorder (LER) determined that the last engine whistle occurred at 1143:32, with the train travelling at 59 mph near the Concession Road A crossing at Mile 68.84. *Canadian Rail Operating Rules* (CROR) Rule 14 (l) requires that the train whistle be sounded at least one-quarter mile from every public crossing until the engine fully occupies the crossing.

The loss of brake pipe pressure occurred at 1144:07. Some 94 seconds before, the train had accelerated from 57 mph to 59 mph. No train or dynamic braking had been applied in the two minutes before the UDE.

Over the 35-second period from the end of the engine whistle to the start of the UDE, the train travelled a distance of about 3030 feet. The Concession Road A crossing is approximately 460 feet south of the Highway 12 crossing. When the UDE occurred, the rail cars near the Highway 12 crossing were approximately 3490 feet behind the head end. On train A-450-31-21, two empty box cars, the 68th and 69th cars in the consist, were some 3400 feet from the head end.

The train weighed about 11 800 tons and was 5889 feet long. It was hauling 103 loaded cars, 8 empty cars, and 1 residue car. The train was marshalled with 3 locomotives followed by:

- 1 empty tank car;
- 1 residue tank car;
- 2 loaded box cars;
- 4 empty box cars;
- 17 loaded box cars;
- 1 empty hopper car;
- 41 loaded tank cars;
- 2 empty box cars; and
- 43 loaded box cars.

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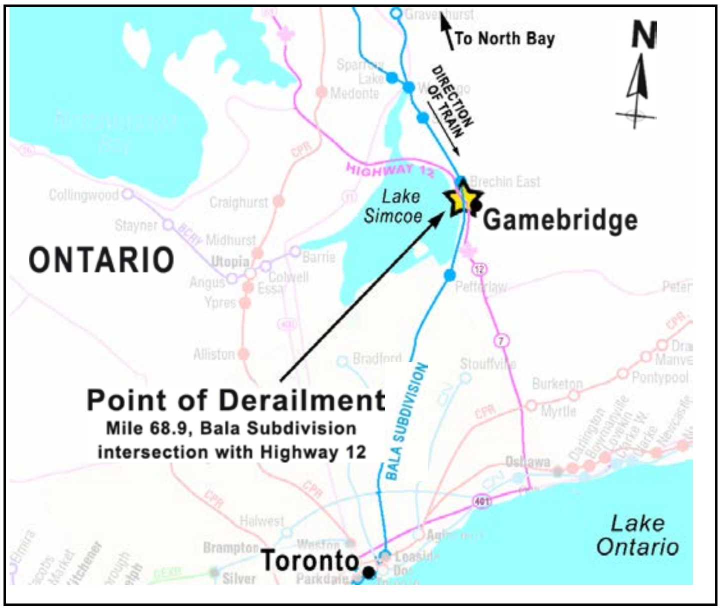
[2] United Nations dangerous goods identification number

Trains with empty cars mixed with loaded cars are known to be subject to increased buff forces during emergency brake applications.[3] The Board has investigated similar derailments when an emergency brake application occurred on long trains that had an empties-ahead/loads-behind configuration (R00Q0023, R01T0006, and R01M0061).

The Bala Subdivision is part of CN's transcontinental mainline and extends northward from Toronto, Mile 0.0, to Capreol, Ontario, Mile 276.1 (see Figure 1). In 2002, rail traffic over this subdivision was 34.2 million gross tons (MGT). The subdivision is controlled by a rail traffic controller (RTC) in Toronto. The method of train control is Centralized Traffic Control System (CTC), authorized by the CROR.



The operating crew consisted of a locomotive engineer and a conductor, both of whom were qualified for their respective positions, and met the required fitness and rest standards.

Particulars of the Track

The Bala Subdivision is designated as Class 4 track,[4] and the maximum allowable operating speed is 60 mph for freight trains and 80 mph for passenger trains. The tangent track in the derailment area was built on a six-foot fill with a southward descending grade of 0.28 per cent. The ballast consisted of crushed stone and slag.

The rail was 136-pound continuous welded rail (CWR) manufactured by Sydney Steel in 1996. The rail was laid in 1999 on 14-inch double-shouldered tie plates, secured to the ties with two spikes per plate, and box-anchored every second tie. The ties and fasteners were in fair condition, except for several ties north of the

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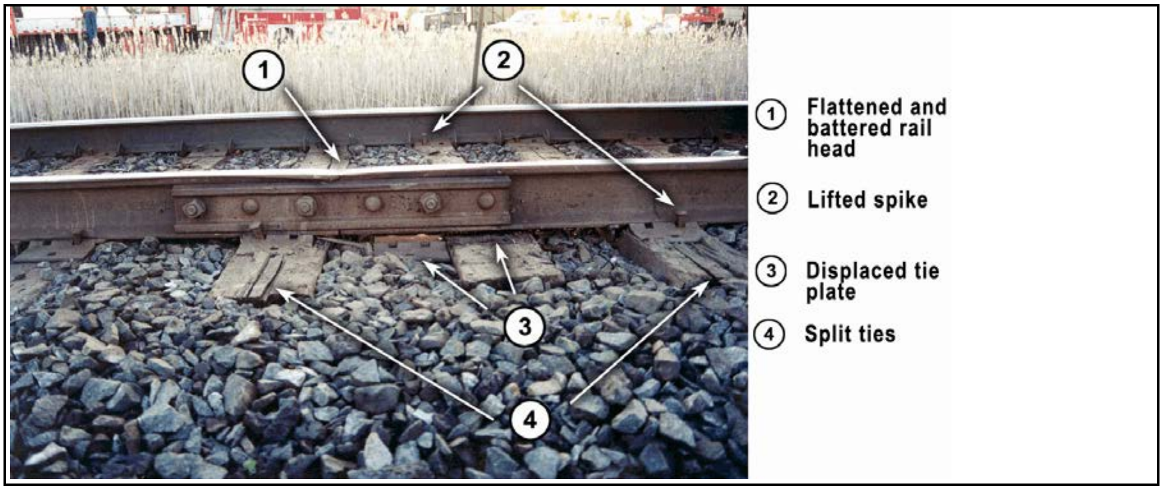
3 DOT/FRA/ORD-84-16, *Freight Train Brake System Safety Study* (November 1984); Association of American Railroads, *Track Train Dynamics to Improve Freight Train Performance*, AAR R-185, "TTD Guidelines for Optimum Train Handling, Train Makeup, and Track Considerations" (November 1979).

4 Transport Canada, *Railway Track Safety Rules*, Part II, A. Classes of Track: Operating Speed Limits.

crossing, which were either crushed, split or missing spikes. The track was generally in good condition south of the Highway 12 crossing.

There were several joints on both rails just north of the crossing. One joint on the west rail was shimmed. An 18-foot rail plug was fully bolted in place on the east rail and both of the joints were battered. One joint was supported on two ties with only one tie plate (see Photo 2); the other had worked itself off the tie. A set of splice bars had also been applied to the east rail where the rail head was flattened and battered. Four bolts in the outer holes held the splice bars in place. There was also evidence of mud pumping and poor drainage, particularly at the joints north of the crossing (see Photo 3). An examination of several other road crossings within 10 miles of the derailment site revealed similar conditions.



The Highway 12 crossing had an asphalt surface with rubber mud rails, and was protected with flashing lights, bell, and gates. It had been scheduled to be re-paved in June 2003. An examination shortly after the derailment indicated that there were no wheel or flange marks on the road surface in the crossing area. During the

post-accident assessment, track surface and gauge measurements were taken under a loaded rail car in the area north of the crossing. There were five near urgent (i.e. at least 70 per cent of the urgent limit) cross-level tangent defects, two near urgent warp62 defects, and two locations where the warp62 track geometry parameter was 1 7/16 inches, which exceeds the urgent limit of 1 1/4 inches prescribed for track surface in Part II, C.

Track Geometry, VI. Track Surface, of the *Railway Track Safety Rules* (TSR). Warp62 is the difference in cross-level between any two points less than 62 feet apart on tangents and curves.

Inspection and Maintenance

Track inspection programs help plan maintenance by identifying unsafe track conditions that may prevent trains from operating at the authorized speed. The standards and guidelines for inspecting track are contained in CN's Standard Practice Circular (SPC) 3100. CN's track inspection requirements are in compliance with Part I, Section 6 of the TSR,[5] which calls on the railway company to bring the line of track into compliance immediately or halt operations.

Ensuring safe operations involves an inspection and maintenance strategy for the track. Part I, Section 13.1, of the TSR outlines track inspection frequency and method to ensure that the track is safe. Part II, subpart F, of the TSR describes the minimal requirements to detect deviations from the standards prescribed in Part II.

The Bala Subdivision is divided into maintenance and inspection territories that are under the responsibility of a track supervisor, who reports to the general supervisor of Engineering. Until recently, the primary focus of the permanent maintenance workforce had been routine maintenance and inspection. In the past, major work programs were conducted by additional gangs moving through the territory on a programmed basis. Although the size of the permanent workforce on the south end of the Bala Subdivision has remained relatively stable in recent years, a greater proportion of project work is now assigned to line maintenance crews.

Prior to 2002, four assistant track supervisors (ATSs) shared the track inspection duties on the south end of the Bala Subdivision between Mile 22 and Mile 94 and the Newmarket Subdivision between Washago, Ontario, and North Bay. At the time of the derailment, there were only two ATSs on the territory: one on the Bala Subdivision and one on the Newmarket Subdivision. The ATS in the derailment area must inspect 72 miles of main track twice per week, along with other inspection and maintenance duties on sidings and back tracks.

With approximately 22 trains per day on the Bala Subdivision near the derailment, the track time available to the ATS is usually not enough to complete an inspection in one day. Therefore, inspections are conducted over two days, unless other qualified maintenance-of-way personnel help.
During these inspections, the track inspector must be attentive to many items, including ties, rail condition, fastenings, drainage, and crossing protection. The ATS inspection checklist involves the assessment of 23 track-related items, as required by CN's SPC 3100 (see Appendix A).

[5] Although the *Railway Track Safety Rules* were approved by the Minister of Transport, they were written and submitted by the industry and, as such, belong to the railways.

According to SPC 3100, the ATS must prepare and sign a record for each inspection on the day it is conducted. The track inspection reports must be retained for at least one year after the date of inspection.[6] Any defects that deviate from the TSR or SPC standards are noted on these forms. Additional information, such as the location of emerging defects, is not listed in this report. It is normally documented using personal logbooks.

Before the derailment, the ATS inspected the track on 19 May 2003 using a Hi-rail vehicle. No significant problems were noted near the Highway 12 crossing.

Besides visual inspections, CN uses a track evaluation system (TEST) car[7] at least five times per year on the Bala Subdivision. CN's SPC 3101 specifies the allowable deviations for a variety of track geometry parameters, including gauge, alignment, superelevation, surface, warp, and cross-level. If any of these values are exceeded, remedial action is required. Any deviation exceeding the TSR for track geometry is defined as an urgent defect.

The TEST car inspected this portion of track on 07 April 2003 and 21 April 2003. During the last test, two geometry defects were recorded just north of the Highway 12 crossing: a near urgent cross-level tangent defect of 1 1/8 inches and an urgent warp62 defect of 1 3/8 inches. According to the TSR, for Class 4 track, the urgent threshold value for these parameters is 1 1/4 inches.

CN's SPC 3101 3. (b) states that near urgent defects must be inspected within 72 hours and remedial action must be taken within 30 days. SPC 3101 3. (d) (ii) (3) states that combinations of priority defects (i.e. defects within 100 feet of each other) close to changes in track moduli (e.g. near bridges, crossings, and turnouts) must be addressed.

Despite reaching and surpassing the urgent threshold level, no slow orders were placed at this location after the TEST run and before the derailment. It was determined that the TEST car had been set up and calibrated to U.S. Federal Railroad Administration (FRA) standards. The car had been testing track in the United States before the April 21 run. The calibration settings had not yet been reset back to TSR settings. The FRA standard for a warp62 track surface deviation is not as restrictive, so the urgent threshold level had been set to 1 3/4 inches for Class 4 track.

The report of April 21 between Mile 16 and Mile 92 of the Bala Subdivision recorded 11 urgent defects, 27 near urgent defects (i.e. within 90 per cent of the urgent value) and 289 priority defects. Forty-six per cent of the defects involved wide gauge. As this was one of the first tests after the winter months, the number of track geometry defects was not unusual. Although the high number of priority defects may appear problematic, the TEST car identified track deviations regardless of the length of the defect. Many recorded defects were only a few feet in length. When an urgent defect is addressed, nearby priority defects are usually corrected at the same time.

Urgent defects must be repaired immediately or a temporary slow order (TSO) must be placed to restrict trains to a maximum speed based on track class and severity of the defects. If these safety measures are not

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6 SPC 3100, p. 2, Item 14, January 2003.

7 A track evaluation car electronically locates and identifies irregularities in track geometry, providing a real-time report of overall track condition relative to track roughness standards for the class of track.

implemented, train operation over this track must be halted. The ability to perform maintenance work and remove TSOs depends largely on crews having enough timely access to the track. Once a slow order is in place, there is significant effort to rectify the deficiencies quickly to minimize traffic delays. CN track inspectors do not feel pressured to avoid imposing TSOs when TSR deviations are detected, but crews have experienced significant problems securing adequate track time to perform maintenance work.

Near urgent defects must be inspected within 72 hours and corrected within 30 days. Once the urgent and near urgent defects are addressed, employees deal with combinations of priority defects (i.e. within 100 feet of each other) in curves and spirals, or near bridges, crossings, and turnouts. Any remaining priority defects must be monitored until they are repaired.

There is a general perception by CN's Engineering personnel that sufficient resources are available, subject to equipment availability, and that the level of maintenance programs is adequate to ensure that track is maintained to Class 4 standards.

The high number of gauge defects identified on the Bala Subdivision since 2002 has resulted in many tie renewal programs. In 2002, 12 000 ties were installed between Mile 73 and Mile 88. CN also plans to change 18 500 ties between Mile 27.6 and Mile 76.1 in 2004. When a tie renewal program is performed, a track surfacing component is usually included. In addition to the surfacing during tie programs, approximately 30 miles of additional track per year has been surfaced over the past five years (see table below).

YEAR	TOTAL MILES SURFACED*
1998	36.96
1999	92.85
2000	93.78
2001	36.3
2002	47.09

* includes surfacing completed during a tie renewal program

The TEST car produces a track quality index (TQI) report that calculates an overall quality value for each quarter-mile of track by taking the average of the values measured for surface, cross-level, gauge and alignment. Measured values for these parameters range from 0 to 1000, with 1000 being track with no deviations.

The average TQI for the Bala Subdivision was 718 in May 2002 and 760 in October 2002, reflecting improvement in track surface conditions due to programmed maintenance work. The average for the Bala Subdivision has consistently been between 700 and 800 since 1998.

A rail flaw detection car[8] tested the rail for internal defects on 21 March 2003, finding none in the immediate vicinity of the derailment.

Transport Canada Inspection Audits

Transport Canada (TC) is responsible for the safety overview of federally regulated railways through promotion, monitoring, and enforcement. TC administers and enforces provisions of the *Railway Safety Act* (RSA) and related regulations, rules, standards, and orders, based on the underlying philosophy that long-term track maintenance, as well as routine track inspections and maintenance, is the responsibility of the railways.

TC monitors and enforces the TSR. TC monitors the railway infrastructure by auditing data records, processes, and procedures and by ensuring that the railways comply with the RSA. It also conducts inspections of selected railway trackage, focusing on the railway's safety systems and patterns of compliance to identify systemic safety problems. This approach is a departure from the previous track monitoring programs, which were almost all inspection-based.

Due to the size of some of TC's regions and limited resources, the infrastructure inspector cannot review all track in a given region each year. Therefore, a method based on stratified sampling is used. This involves dividing TC's regional network into 5 to 10 homogeneous groups, in which subdivisions or sections of subdivisions are selected. For each selected track location, detailed data records are randomly examined, including inspection records, rail defect data, track geometry car data, and turnout condition data.

The sample size for these audits is based on the amount of track in the TC region and the number of available inspectors, and weighted toward higher risk groups, such as high-speed mainline track. The goal is to obtain a 95 per cent confidence level that the track condition in the selected sample reflects the track condition of the entire group.

In 2002, the two infrastructure inspectors for TC's Ontario Region had approximately 2500 miles of track to inspect, representing 36 per cent of the 6932 miles of federally regulated track in Ontario. Infrastructure inspectors also carry out special inspections related to accidents or to locations where high defect rates are identified. Since November 1998, TC has conducted audits on some 185 miles of track on the Bala Subdivision. However, due to the sampling process, the track near the derailment had not been inspected by TC for more than five years before the accident.

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[8] A rail flaw detection car uses induction or ultrasonic technology to detect internal rail defects that normally cannot be detected visually during routine track inspections.

Emergency Response and Environmental Damage

Emergency response by fire and police services, along with the railway, shipper, and regulatory agency, was prompt, extensive, and effective. The Township of Ramara activated its emergency response plan upon notification of the accident. CN implemented its dangerous goods emergency response plan, which incorporated shippers' requirements for spilled product.

The released acid was quickly contained using a backhoe and soil to block ditches and build berms to surround the released product. The ponds of product were neutralized using soda ash and lime slurry. An underlying clay bed near the derailment helped limit ground seepage.

The derailed tank cars loaded with product had the acid initially transshipped to trucks as they were removed from the wreckage. When the track diversion was completed, the product was transshipped directly into other tank cars, which were removed from the site. Contaminated material was excavated and removed to a landfill site in Paris, Ontario. The adjacent residential and farm properties received clean topsoil to replace the excavated soil.

Six residential wells and 15 sampling wells along the track and Highway 12 were tested on a daily basis until 11 July 2003. Water quality monitoring continued on a weekly basis until 25 July 2003. Additional monitoring was conducted on a monthly basis until November 2003, followed by further planned testing every three months until July 2004. To date, the spilled acid has not had any measurable impact on the local water supply or the Talbot River, southeast of the derailment.

Analysis

Since no mechanical deficiencies were identified on the train, the analysis will focus on track condition, train marshalling practices, TEST car calibration, CN's inspection and maintenance practices, and TC's track inspection audits.

There were no wheel or flange marks on the Highway 12 road surface, indicating that the point of derailment (POD) was south of the crossing. Extensive track damage made it impossible to determine the exact POD or the first car to derail. However, immediately north of the crossing, there were track geometry problems. The April 21 TEST run recorded two geometry defects just north of the Highway 12 crossing: a near urgent cross-level tangent defect of 1 1/8 inches and an urgent warp62 defect of 1 3/8 inches.

Track measurement north of the crossing under a loaded car, during the afternoon of the derailment, identified five near urgent cross-level tangent defects, two near urgent warp62 defects, and two urgent warp62 defects. These deviations were the result of a number of low, battered joints on defective ties in mud-fouled ballast.

CN's SPC 3101 3. (b) states that near urgent defects must be inspected within 72 hours and remedial action must be taken within 30 days. SPC 3101 3. (d) (ii) (3) states that combinations of priority defects (i.e. within 100 feet of each other) close to changes in track moduli (e.g. near bridges, crossings, and turnouts) must be addressed. Both of these defects describe variations in cross-level that contribute to wheel lift and harmonic rocking action of rolling stock, which could result in derailment. When oscillations are sufficiently large, they will exceed a rail car's side bearing and spring suspension tolerance, contributing to wheel climb and wheel lift.

This derailment likely occurred due to wheel climb and/or wheel lift when the train was travelling over the cross-level variations near the Highway 12 crossing.

On train A-450-31-21, two empty box cars, the 68th and 69th cars in the consist, were approximately 3400 feet from the head end and near the crossing when the UDE occurred. It is likely that wheel climb or wheel lift initially occurred on one of these empty box cars, rather than a loaded tank car. At the time of the accident, the train was negotiating a slight descending grade and speed increased from 57 mph to 59 mph 94 seconds before loss of brake pipe pressure, indicating a slight run-in. In combination with the track deviations north of the crossing, this slight run-in would also have contributed to the wheel climb or wheel lift.

Once the UDE was initiated, a severe run-in of train slack would have occurred on the two empty box cars marshalled between 41 loaded tank cars ahead and 43 loaded box cars behind. The action of the high buff forces on the two empty box cars would have generated high compressive stresses that met little resistance, resulting in the two empty box cars jackknifing into the preceding tank cars and initiating the derailment sequence.

After the emergency brake application, the derailed tank cars continued to travel southward, rolling over the west rail, spreading gauge, and damaging ties, plates, and rail anchors south of the derailment area. Eventually, the train broke apart after the derailed tank cars rolled onto their sides in a chain reaction due to the effect of the double-shelf couplers, which had kept them from jackknifing.

The marshalling of the two empty box cars between loaded tank cars and loaded box cars did not cause the derailment, but the way the train was marshalled likely resulted in an increased level of track and equipment damage.

TEST Car Calibration

Before the accident, CN's TEST car had been set up for U.S. FRA standards, and had not yet been reset back to TSR settings. FRA standards for track surface deviations are not as restrictive as the TSR standards. Due to this setup, many track geometry deviations that exceeded the urgent defect threshold were incorrectly categorized as priority defects during the April 21 TEST run.

Since immediate corrective action is not required for a priority defect, no maintenance was performed at these locations before the derailment. If these track defects had been correctly categorized as urgent, CN would likely have repaired the track immediately or placed a slow order through this location. The incorrect identification of the severity of these track surface defects resulted in inadequate protective measures or corrective action being implemented.

Track Inspection and Maintenance Practices

Track inspections are performed twice weekly on the Bala Subdivision. A total of six inspections had been conducted between the April 21 TEST run and the occurrence. The track supervisor had the TEST report, which showed cross-level variations in the derailment area. Despite these poor geometry conditions, the inspector did not initiate further inspection or maintenance activities the month before the occurrence.

Many anomalies should have provided an indication of the need for a more detailed inspection. Since track defects were not actively monitored after the April 21 TEST run, the visual inspections before the accident could not detect this safety problem. The anomalies included:

- track joints in poor condition;
- mud pumping around the crossing;
- splice bars to repair damaged rail; and
- shims to correct low joints.

The quality of a track inspection depends on the inspector's vigilance to each of the 23 items that must be assessed and to select appropriate action when potential deficiencies are identified. With the large number of items and the complexity of these items, combined with the limited amount of track time available, an inspector may sometimes find it difficult to identify all defects. The high volume of traffic (approximately 22 trains per day) would reduce the time available for basic inspection, and may result in allowing minor defects to go unattended and grow more serious.

It is also possible that the track inspector underestimated the significance of the track defects, with the following two factors contributing to this perception:

1. *Risk desensitization*: Each successive exposure to a given risk where no adverse consequences are observed can reduce an individual's level of attention to that risk, particularly when the cues used to assess the presence of the risk change in a very gradual manner.[9] In this occurrence, cross-level variations would occur very gradually, resulting in the inspectors likely being aware of the defects at the crossing, but not gradual deterioration of the problem.

2. *Knowledge of capital work projects*: Being aware that the crossing was to be refurbished in the near future would further reduce the amount of attention being devoted to the defects in the crossing area. The inspector may have expected that the cross-level problems would be rectified when the crossing was refurbished.

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[9] G.A. Peters, "Liability prevention techniques for a world marketplace," *International Journal of Fatigue*, vol. 20, pp. 99-105 (1998).

The proximity of the track defects to the very busy Highway 12 road crossing may also have exacerbated the situation. The inspector was required to negotiate safe passage across Highway 12 on a Hi-rail vehicle without activated protection, which may have diverted the inspector's attention. These factors may have hampered the inspector's ability to perform a more detailed Hi-rail inspection of cross-level conditions.

The track defects could have been more readily detected if the inspector had checked on foot, but there is no indication that this was done. The level of attention devoted to inspections in the area was not enough to identify the gradual deterioration of track condition. Although the track inspection program included regular inspection by track forces, the inspections did not detect and correct the near urgent and combination track surface defects leading up to the POD.

The ability to perform basic inspection and maintenance to remove orders quickly is largely dependent on crews being given adequate and timely access to the track, and the resources available to do their work. Track maintenance personnel have encountered difficulties in securing adequate track time, and their workload has increased with projects once assigned to other work gangs. With the increased workload and the high volume of traffic on the Bala Subdivision, the time available for routine maintenance and inspection is reduced, increasing the risk that emerging track defects can go unattended and grow more serious.

Track Inspection Report

Item 13 of CN's SPC 3100 states, "All persons engaged in making inspections will prepare and sign a record of each inspection on the day the inspection is made in accordance with applicable Transport Canada or Federal Railroad Administration Rules." The track inspection report is used to document deficiencies that exceed the limits defined in the TSR. There is no railway or regulatory requirement to record emerging defects, although track inspectors commonly complete a personal diary or logbook with the information, which may or may not be shared with other inspectors. Therefore, the practice of recording only track deficiencies that exceed TSR standards may limit information shared with other railway personnel involved in track inspections in the territory.

Transport Canada's Inspection Audits

TC auditing for compliance with the TSR is based on data records from sample locations selected within a track group. The larger the sample size, the smaller the margin of error and the greater the confidence level for final results. Given the limited resources in 2002, TC infrastructure inspectors were only able to check 36 per cent of the track in Ontario. Even though TC's track monitoring program puts greater emphasis on high-traffic corridors, random auditing may mean that some track locations from a particular group may not be sampled for several years.

Findings as to Causes and Contributing Factors

1. The derailment likely occurred due to wheel climb and/or wheel lift when the train was travelling over the cross-level variations near the Highway 12 crossing.

2. Due to improper calibration of Canadian National's TEST car, the severity of the track defects immediately north of the Highway 12 crossing was incorrectly identified as priority defects, resulting in inadequate corrective or protection measures being taken for near urgent or urgent defects.

3. Although the track inspection program included regular inspection by track forces, the inspections did not detect and correct the near urgent and combination track surface defects leading up to the point of derailment.

Findings as to Risk

1. The current practice of not recording emerging defects on regulatory inspection reports may prevent this information from being shared with other railway personnel involved in track inspections on the territory.

2. With the increased workload for maintenance personnel and the high volume of traffic on the Bala Subdivision, the time available for routine maintenance and inspection is reduced, increasing the risk of emerging track defects going unattended and growing more serious.

3. Marshalling empty cars between blocks of loaded cars was not considered causal in this incident, but did leave the train particularly susceptible to in-train forces, especially during an emergency brake application, and increased the risk of derailment and extensive track and equipment damage.

Safety Action Taken

As a result of the potential failure to protect or repair improperly identified track geometry defects, Transport Canada issued a Notice pursuant to Section 31 of the *Railway Safety Act* to Canadian National (CN) on 18 June 2003.

On 28 July 2003, CN responded that the previously incorrectly identified defects had been protected or corrected, and that the company had initiated the following additional action:

- All defect settings on the TEST car were audited to ensure compliance with *Railway Track Safety Rules* (TSR) standards.

- A daily procedure was developed and implemented that requires TEST car operators to review and validate defect parameter settings and track class before testing operations.

- Since the derailment, two additional TEST car runs were scheduled over the Bala Subdivision. All defects identified during these tests were properly protected and corrected.

- Two additional inspections using contracted track geometry vehicles with gauge restraint technology were scheduled on the Bala Subdivision in 2003.

Transport Canada continues to follow up on the issue of train marshalling with the industry.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 13 July 2004.

Visit the Transportation Safety Board's Web site (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.

Appendix A – Canadian National's Standard Practice Circular 3100

Appendix B, Recommended Inspection Check List (Hi-Rail) (Wood Ties), of Canadian National's Standard Practice Circular 3100 give the following items to look for when conducting an inspection:

1. Rail – broken, vertical split heads, surface damage/defects, engine burns, discolouration
2. Splice Bars – broken
3. Bolts – loose, missing, bent
4. Washers – missing
5. Plates – broken, missing
6. Spikes – high, missing
7. Anchors – off, damaged, insufficient
8. Ties – broken, damaged by equipment
9. Ballast Section – cribs not full, low shoulder, narrow shoulder
10. Ballast – pumping, fouled, hanging ties
11. Line – misalignment
12. Surface – poor surface
13. Cross Level – poor cross level
14. Gauge – wide/irregularities, wheel flange marks, raised or tipped spikes, plate cutting
15. Turnouts – in addition to track items, check for misaligned, damaged, loose, worn switch points, frogs and guard rails
16. Railway Crossings – in addition to track items, check for misaligned, damaged, loose, worn castings, proper flangeways guard check/face gauge
17. Vegetation – restricting visibility and drainage, fire hazard, contacting wires, fouling ballast
18. Drainage – ditches or culverts blocked, beaver activity, high water
19. Slides – slides, rock falls
20. Fencing – damaged, open gates, livestock on right-of-way
21. Clearances – restricted clearances
22. Highway and Farm Crossings – loose, missing or high planks, obstructed flangeways, restricted sight lines, damaged or missing warning devices
23. Track Signs – defective, missing, obstructed