

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

RAILWAY INVESTIGATION REPORT
R09V0235



MAIN-TRACK DERAILMENT

CANADIAN NATIONAL
FREIGHT TRAIN NUMBER J31753-15
MILE 7.9, YALE SUBDIVISION
KOMO, BRITISH COLUMBIA
17 NOVEMBER 2009

Canada

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

Railway Investigation Report

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Freight Train J31753-15
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Summary

At approximately 0324 Pacific standard time on 17 November 2009, Canadian Pacific coproduction freight train J31753-15 was proceeding westward from Boston Bar, British Columbia to Vancouver, British Columbia, when it struck a debris slide of rock, mud and trees that derailed the locomotive and three cars loaded with copper concentrate at Mile 7.9 of Canadian National's Yale Subdivision near Komo, British Columbia. The locomotive overturned on its side, injuring the crew. No product was lost from the derailed cars.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 17 November 2009, at 0300¹, westward Canadian Pacific Rail (CPR) coproduction² freight train J31753-15 (the train), consisting of one locomotive, 45 loaded cars and 13 empty cars, departed Boston Bar, BC on CN's Yale Subdivision³, destined for Vancouver, BC (see Figure 1). The train weighed 6394 tons and was 3519 ft long. It was marshalled with 25 hopper cars loaded with copper concentrate immediately behind the locomotive followed by a mix of loaded freight cars and empty cars.

The CN train crew, a locomotive engineer and a conductor, took control of the train in Boston Bar. They met fitness and rest standards and were familiar with the Yale Subdivision. The train proceeded westward from Boston Bar under clear signal indication without incident. The approach signal to Komo at Mile 7.7 was clear. As the train exited a 6° left hand curve at Mile 7.85 and entered a 6°30' right hand curve, the headlight revealed a debris slide of rock, mud and trees approximately 150 feet long and 10 feet deep on the track. An emergency brake application was made at 0324:26, as the train was travelling at 22.2 mph and the throttle was in the idle position. The train struck the slide, rode up and over it and came down on the other side where the locomotive rolled over onto its right hand side. The locomotive came to rest at 0324:39 and positioned about 30 feet from the edge of the embankment (see Photo 1). The first three cars behind the locomotive jackknifed and derailed upright. No product was lost but approximately 833 gallons of fuel was spilled from the locomotive.

Immediately after the accident, the conductor called the rail traffic controller (RTC) who initiated CN's incident notification process. The RTC contacted the Chief RTC and the CN Police Command Centre in Montreal who notified local emergency responders. Ambulances from Hope and Boston Bar were dispatched. The accident was also reported to the BC Provincial Emergency Program⁴ and to the federal and provincial environment agencies.

¹ All times are Pacific standard time (Coordinated Universal Time minus eight hours) unless otherwise noted.

² CN and CPR entered into a bi-directional running agreement in 1999 through the Thompson/Fraser River canyons between Kamloops and Vancouver. Under the agreement, which was fully implemented in mid-2001, loaded CN and CPR trains travel westward on CN track, taking advantage of the flatter grades while lighter, empty trains travel eastward on CPR track.

³ The Yale Subdivision is part of CN's core transcontinental route. It extends 113.8 miles westward from Boston Bar to Vancouver. It consists primarily of single main track.

⁴ The PEP is a B.C. volunteer organization that includes local (Lytton) citizens who coordinate available resources and assist in implementing local emergency plans.

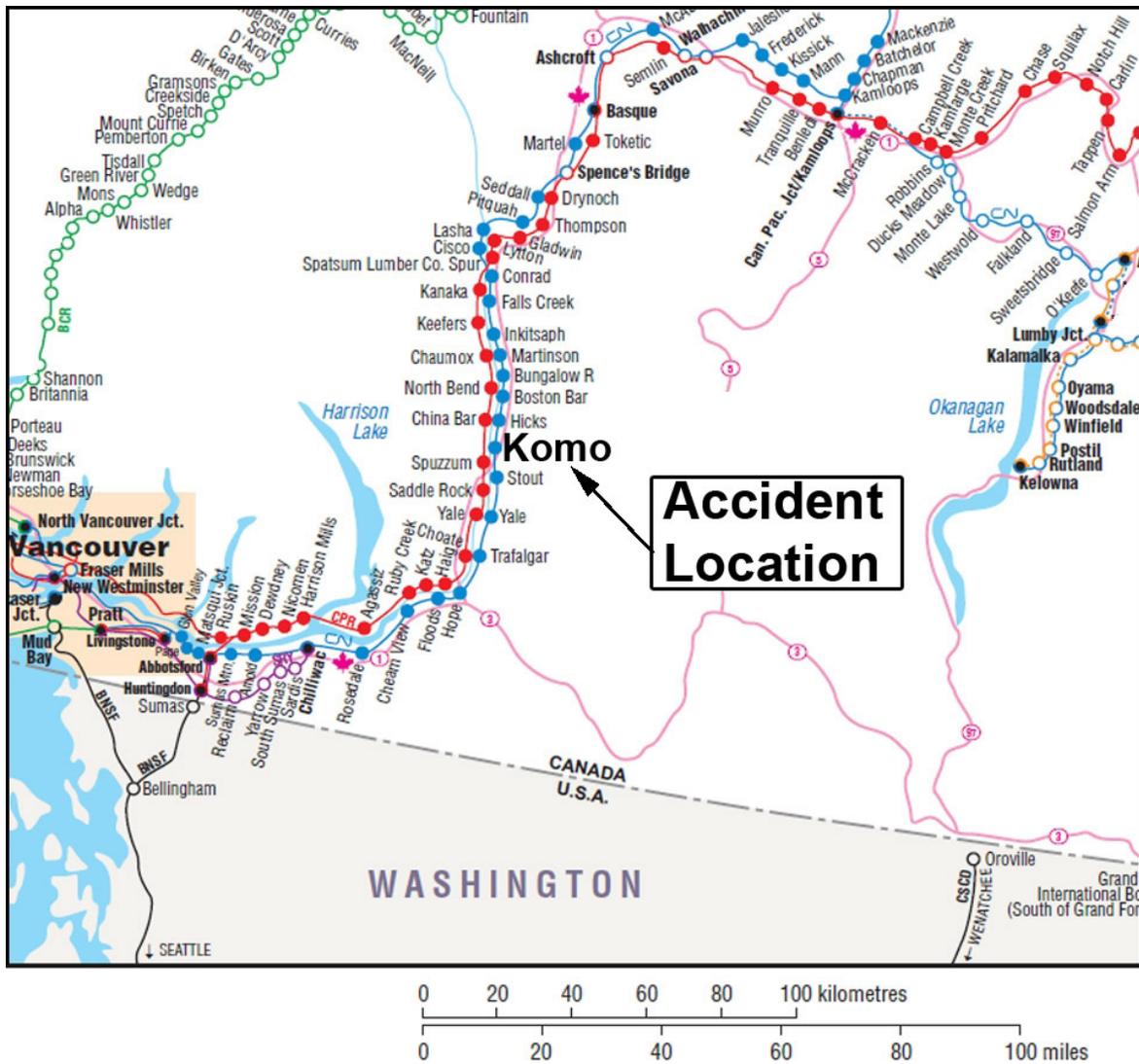


Figure 1. Location of collision and derailment.

When the locomotive overturned on its right side, the conductor landed on top of the locomotive engineer and both crew members ended up on the locomotive engineer's side window. The locomotive engineer sustained contusions and a laceration to his right leg. The conductor suffered a fractured right thumb and contusions. Both crew members tended to their injuries using first aid materials in the locomotive cab. There was no fire and it was raining heavily. Although they could have opened the nose door and exited the locomotive, the crew remained in the overturned locomotive to wait for the emergency responders because of the heavy rain. The front door of the locomotive was wedged open to allow fresh air to circulate and disperse diesel fumes in the cab.

The accident occurred 4.7 miles east of the nearest road access at Chapmans. The track supervisor at Hope, approximately 30 miles west of the accident, was called shortly after the accident. He then called a foreman and both arrived at Chapmans about an hour later where two ambulances and emergency responders had assembled. There was a hi-rail excavator at Chapmans. The foreman proceeded east to the accident site in the excavator and the track

supervisor followed in his hi-rail vehicle with paramedics on board. It was anticipated that the excavator would be needed to dig the crew out. The two vehicles arrived at the accident site shortly after 0500. The excavator bucket was used to hold the locomotive nose door open while the two crew members were extracted. The locomotive engineer was removed from the locomotive on a spine board. The two crew members, paramedics and track supervisor hi-railed back to Chapmans. The two crew members were then transported by ambulance to the hospital in Hope. Their injuries were treated, X-rays were taken and the crew was released at 1000.

There was minimal environmental impact. No copper concentrate was lost in the derailment. Absorbent pads and booms were placed around the locomotive and a vacuum truck was brought in to collect the fuel and empty the locomotive fuel tank.

Weather

At the time of the accident, it was raining and the temperature was 7°C. South- Western BC. typically receives large amounts of precipitation in the fall and winter months. From November 15 to 19, 193 mm of rain was recorded at the Environment Canada automatic weather station in Hope, BC, approximately 30 miles southwest of the derailment. The rain event that brought the heavy rainfall to the area is known as a "Pineapple Express". This weather phenomenon is characterized by a strong and persistent flow of atmospheric moisture and associated heavy rainfall carried from the Pacific Ocean.

Weather Forecasting

CN has a comprehensive weather forecasting system in place using WeatherData Inc. (WeatherData) based in Wichita, Kansas. WeatherData specializes in providing weather risk management consulting and state-of-the-art weather forecasting services to utility companies, government agencies and transportation companies in North America. This weather forecasting service provides location specific forecasts each day in 12 hour increments along with critical weather updates as required.

WeatherData issued a Storm Potential Notice to CN on November 14 at 2000 Mountain standard time (MST), forecasting very heavy rain along the BC west coast and in South Western BC. This heavy rain forecast was repeated on November 15, 16 and 17. In addition, WeatherData issued critical weather updates at 1400 MST on November 15 and 16. On November 15, CN began preparations for a heavy rain event by arranging special patrols and by getting earth moving equipment and ballast in place. In addition, CN's extreme weather response plan was triggered with a WeatherData flash flood warning alert issued at 0622 MST on November 17.

Weather Response and Other Related Protocols

WeatherData supplies weather information through the SmartRad system which has been installed in CN RTC offices for several years. The system provides Weather Alerts for imminent hazardous weather conditions for mileage specific locations. The alert notification initially appears as a flashing red icon on the RTC screen. After it is acknowledged by the RTC, the icon

changes to solid red. The colour of the tracks depicted on the RTC screen that are affected by the weather alert changes to salmon. When the weather alert expires, the icon will change to solid green. With the issuance of a Weather Alert, the RTC system will apply protection to the track to prompt the RTC when clearing signals in the area of the Weather Alert. CN protocol requires the Chief RTC to observe that the protection is in place on the display.

On the day of the occurrence, the only weather alert associated with the heavy rainfall event was a flash flood warning issued at 0622 MST, about three hours after the accident. CN protocol specifies that in the case of a flash flood warning:

- Trains in the affected area must be advised of the warning and report any unusual build up of water or unusually high and turbulent water activity adjacent to the track.
- Trains must be on the alert for any evidence of bank erosion and immediately report any rough spot associated with high water.
- Other “on track” personnel (engineering, senior manager corridor operations) must be advised of the flash flood warning and report when the advisory is no longer required.

Since no flash flood warning was issued until after the accident, no warning was given to the occurrence train.

Train crews are expected to operate trains as close as safely possible to the maximum timetable speed to maintain schedules across a territory. Crews may reduce speed at their discretion should conditions deteriorate to the point where normal speed is considered unsafe. In this occurrence, no speed reductions were made as the train approached the slide area.

Subdivision Information

The Fraser and Thompson River corridor is the main rail and highway transportation route from the BC interior to Vancouver. The terrain is mountainous and heavily forested with limited road access to the track along much of the route. Train movements are governed by the Centralized Traffic Control System supervised by the RTC located in Edmonton, Alberta. The maximum freight operating speed through the derailment area is 25 mph.

Drainage System at Accident Location

Track through the derailment area consists of a number of sharp, reversing curves on a flat grade. The single main track and adjacent highway are located on the south (east) side of the Fraser River with the highway positioned above the track and the river below (see Photo 1). Surface run-off water flows down the mountain side through a culvert under the highway and down to the track and river below.

In this occurrence, the highway culvert was not plugged as it handled the surface run-off water without damaging the highway. At the outflow channel below the highway culvert, rock had been placed to direct the surface water down the established drainage course towards the river. Water following this established drainage course is directed towards another culvert under the track. On the day of the accident, the large volume of surface run-off water partially overflowed the normal outflow channel of the highway culvert. The overflowing water then established a different drainage course down the mountain slope (see diverted outflow indicated on Photo 1).

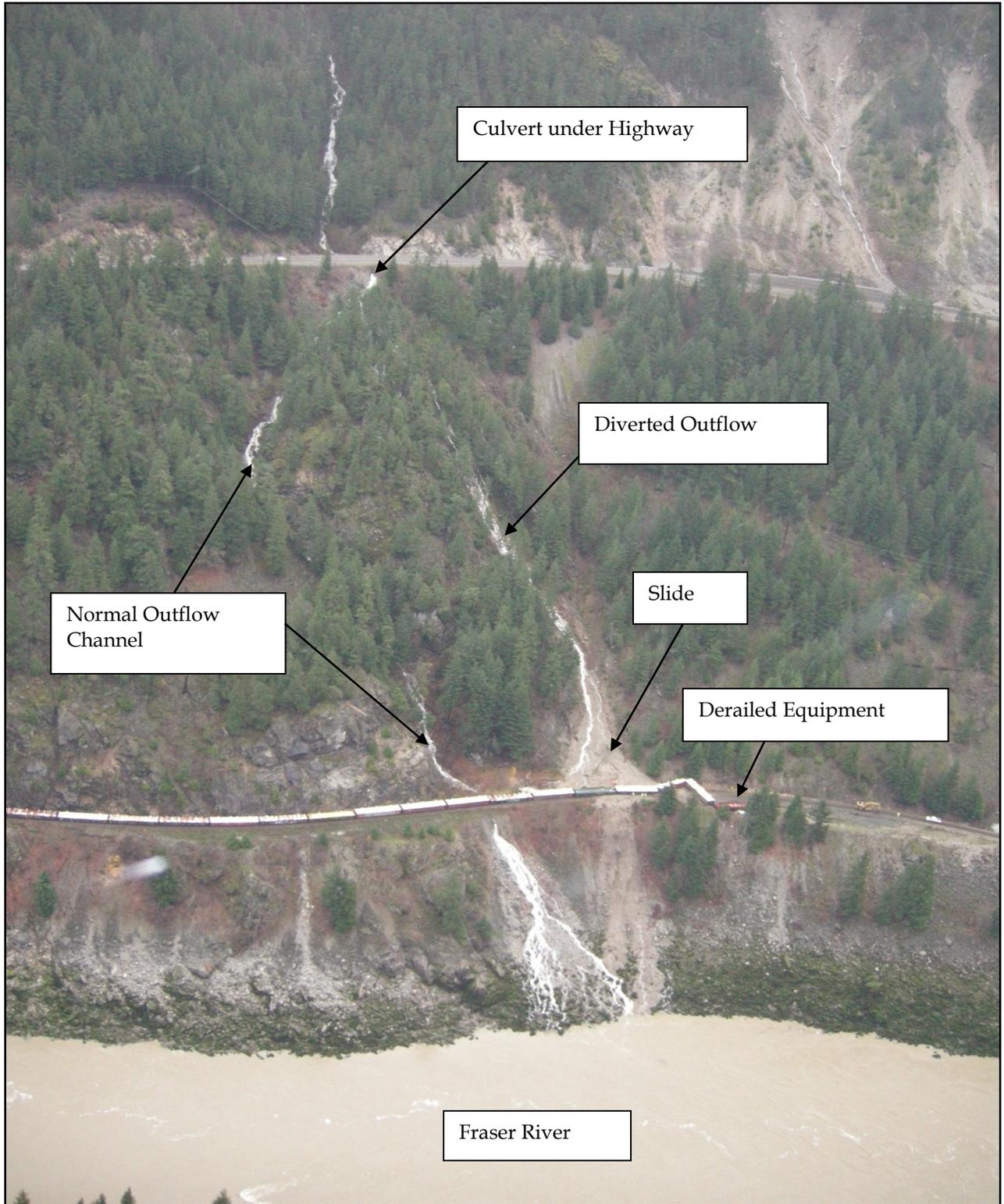


Photo 1. Slide and derailment, mile 7.9 of the Yale subdivision.

TSB Investigation R97V0063

On 26 March 1997, a CN train derailed after the track grade was washed out near Conrad, BC (Mile 106.15 of the Ashcroft Subdivision), fatally injuring both crew members. The TSB investigation (R97V0063) determined that a large volume of surface run-off was not captured and carried away as intended by the drainage system between the highway positioned above and the track below. The water infiltrated the railway grade, destabilized it and caused it to collapse.

The investigation determined that during run-off conditions the railway did not inspect or monitor drainage systems between the highway and the track to ensure that water drained away as intended. It was suggested that a comprehensive approach to track safety should include periodic inspections of any drainage system affecting the railway, particularly those shared between the railways and highway. The BC Coroner's Court Inquest into this accident recommended that railways and the MoTH (Ministry of Transport and Highways, now the BC Ministry of Transportation & Infrastructure) "develop a working relationship of sharing information related to works and issues of mutual benefit in the Fraser/Thompson Canyon corridor."

As part of the safety action taken, meetings were held between CN, Canadian Pacific Railway (CPR), MoTH, Transport Canada (TC) and the Geological Survey of Canada (GSC). Joint meetings were held twice annually. In addition, annual meetings were initiated to discuss topics of mutual concern between the railways and the MoTH.

Other Related Occurrences

Since 2004, in the Fraser/Thompson River corridor, there have been 9 occurrences (including this accident) involving trains encountering landslides on the track resulting in a derailment (see Appendix A).

Inspection and Maintenance of Highway and Track Infrastructure

A contractor based in Rosedale, BC, engaged by the BC Ministry of Transportation & Infrastructure, performs inspection, maintenance and repairs of highways and related infrastructure in the Fraser Valley Service Area 7⁵. There is currently no formal communication protocol between CN and the BC Ministry of Transportation & Infrastructure supervisors and engineers.

There is informal communication at the local level between CN personnel and local contractor highway maintenance crews in Boston Bar and Hope in emergencies. In addition, if abnormal conditions are observed during the course of normal track inspections (e.g., unusual amounts of water or debris), this information is often shared at the local level. In this occurrence, no abnormal conditions were observed during the track inspections conducted just prior to November 17.

⁵ British Columbia's highways are maintained by private contractors in 28 service areas throughout the province.

BC Ministry of Transportation & Infrastructure holds annual stakeholder meetings. These meetings provide a forum to exchange, review and communicate information on the maintenance, construction and remedial works in the Thompson/Fraser River transportation corridor. CN had not attended these meetings in recent years.

Track Inspections

Prior to the landslide and derailment in this occurrence, a minor landslide had occurred near Abrahamson, BC (Mile 93.15 of the Yale Subdivision) on November 16. The crew on the train was advised by the RTC of the Abrahamson slide.

Prior to the accident on November 17 after 0100, the track supervisor patrolled eastward along the track inspecting culverts between Chapmans (Mile 12.6) and the west switch at Komo (Mile 10.6). He then returned to Chapmans and patrolled westward. No irregularities were noted on these inspections.

Railway track inspections are carried out in compliance with both the Railway Track Safety Rules and the CN Engineering Track Standards. These inspections are focussed on track conditions. Although drainage conditions affecting the track are monitored, periodic inspection of drainage conditions above the track (e.g., mountain slope) are not specifically required.

Track inspection personnel may include the track supervisor, assistant track supervisor or a qualified person as defined in the Track Safety Rules. The Track Safety Rules stipulate that a track be inspected at such frequency and by such method as to ensure safe operation at the authorized speed. The Yale Subdivision must be inspected twice weekly, with at least two days between inspections.

CN Geotechnical Inspection and Training

As part of the Safety Action following the Conrad accident, CN and CP jointly developed a subgrade hazard education and training program. The course, Geotechnology for Railroaders, is given to maintenance of way and operating personnel to help them identify warning signs for natural ground hazards such as rock falls, slides and washouts.

A Natural Hazard Incident Report form was also developed. This form is to be completed and submitted to CN's engineering geotechnical group within 24 hours when a natural hazard is identified for further investigation. The completion and submission of this form does not replace the existing emergency RTC reporting and notification protocols.

Geotechnical inspections are generally conducted during the spring season after the snow melts, but prior to the emergence of foliage. The geotechnical inspections focus on:

- the potential for rockslides and unstable back slopes as well as hazardous drainage conditions,
- the stability of shoulders and embankments,
- the potential for roadbed subsidence (i.e., collapse), and
- the potential for beaver activities to impact track safety.

Additional geotechnical inspections may be conducted as required in response to exception or incident reports, emergent conditions or in response to requests from senior engineering officers. In this occurrence, an aerial inspection was planned for November 17 in response to the heavy rainfall.

CN Slope Protection Program

Prior to the accident, CN had carried out regular proactive programs of grade and slope stabilization. In 1999, CN developed a Grade and Slope Stabilization Engineering and Management Protocol. This slope protection program, revised in 2006, provides a process for:

- (a) identifying ground hazards,
- (b) documenting relevant information relating to ground hazards,
- (c) monitoring the status of identified ground hazard locations,
- (d) developing action plans to reduce the potential for grade and slope failure,
- (e) implementing programs of grade and slope stabilization, and
- (f) following up on stabilization programs to evaluate method effectiveness.

Using this protocol, CN's rock-fall hazard risk assessment (RHRA) and beaver activity hazard assessment (BAHA) programs were developed and implemented in the late 1990's. CN considers these hazard assessment programs an integral part of its Safety Management System.

CN Ground Hazard Warning Systems

CN's Roadbed Ground Hazard Response Guide is contained in the Western Region Chief Engineer's Bulletin. The guide provides information on assessment and actions to be taken upon discovery of a roadbed ground hazard. In this occurrence, no ground hazard was observed prior to the accident and therefore no action was taken.

As a result of the Conrad investigation, the Board recommended that:

Transport Canada, in collaboration with the Railway Association of Canada, sponsor research to develop reliable technologies for monitoring the integrity of both the track and roadbed. (Recommendation R97-02 (c))

Following this investigation, Transport Canada held meetings with the RAC, CN and CP regarding their track continuity warning systems. Existing technologies were examined and new technologies were tested. Additional research on railway ground hazard warning was being coordinated by TC's Transportation Development Centre (TDC).

CN's Root Cause Committee also recommended that: "CN continue research, on an accelerated basis, on systems and devices that will provide a warning through CTC circuitry, when track bed integrity has been compromised." CN implemented several types of wayside detection systems to warn trains of failed slopes, washouts and landslides, including:

- Slide Detector Fence,
- Emergency Slope and Washout Detection System, and
- Permanent Hazard and Washout Detection System.

Slide Detector Fence

Slide detector fences are connected to the signal system. CN System Special Instruction 5.1 (b) indicates:

Slide Detector Fences are marked in the field by a signal consisting of a white light with the letter "T" etched on its face in advance of the fence(s), (mounted either on the mast of one or more block signals, the mast of an instrument case or on a separate mast). When lighted or flashing, it indicates that the fence(s) are broken and that the main track may be impassable. Trains must approach and pass fence(s) prepared to stop and in no case exceeding 10 miles per hour until the leading end of the movement has exited the limits of the slide detector fence or the track is seen to be clear to the end of the slide detector fence limits. Trains delayed after passing signal or entering the main track between the signal and slide detector fence will be governed by the above. If main track is not impassable, speed permitted by the governing block signal may then be resumed. The signal in the rear of the signal displaying the flashing "T" light is also downgraded.

With this system, the block stays up and is less restrictive to train operations. Approximately 60 per cent of slide detector systems are of this type. The slide and derailment occurred between slide fences located at 6.95 to 7.11 and 8.11 to 8.25 on the Yale Subdivision. An alarm was recorded on November 16 for the slide detector fence further west of the derailment (Mile 10.87 - 11.36).

Emergency Slope and Washout Detection System (ESWOD)

The ESWOD system can be used with slump or washout detectors, tip-over posts or temporary slide detector fences. This is a quick, easy to install, inexpensive temporary system deployed when a slide, slump or washout hazard is identified. This system is used until a permanent stabilization measure can be taken. The system consists of a radio and power source, which when activated by mercury switches, broadcasts an emergency alarm message to trains every two minutes until reset, usually by the Signal and Communication (S&C) maintainer. This hazard detector can be connected to the CTC signal system independently of the radio talker, and when activated, will downgrade the signal indication governing the entrance to the affected block. In this situation, the RTC will receive an indication on the RTC control panel and will call the appropriate response personnel (e.g., the track and signal supervisors).

Upon hearing the emergency message broadcast, trains must advise the RTC of the message and operate through the limits prepared to stop short of a track defect, not exceeding 10 mph until the lead locomotive exits the limits or the track is seen or known to be clear. ESWOD systems are installed at locations identified by track maintenance personnel, train crews and geotechnical information as potentially unstable. Locations are noted in Tabular General Bullet Orders (TGBO).

Permanent Hazard and Washout Detector Systems

Permanent hazard and washout detector locations are noted in timetable subdivision footnotes. These warning systems, along with geotechnical mitigation efforts allowed CN to discontinue special track patrols on the BC South Line a number of years ago. These patrols were in place to detect slides, rocks on the track and other anomalies that would affect the safe operation of trains.

In this occurrence, the signal system continued to function normally and gave no advanced warning to the crew that the track ahead was blocked by a landslide. While CTC signals provide a measure of protection for train movements in the event of broken rails and occupied track, no protection is afforded by CTC if the track circuits remain intact following a mudslide, slump or washout. The slope in the vicinity of Mile 7.9 Yale Subdivision is not known as an unstable area and had no prior history of landslides or water problems. No special slope protection systems were in place prior to the slide and derailment.

Research for Landslide Hazard Risk Mitigation

The Transportation Development Centre (TDC) is Transport Canada's central research and development branch that manages a multimodal R&D program aimed at improving the safety, security, energy efficiency and accessibility of the Canadian transportation system and protecting the environment. TDC's Railway Ground Hazard Research Program is a collaborative effort of Canadian railways, federal agencies, universities and other stakeholders to improve safety and reduce losses from ground hazard incidents on Canadian railways.

One of TDC's research projects, Landslide Hazard Risk Mitigation, developed a risk-based methodology and analytical tools for landslide hazard management on rail and highway routes in the mountainous areas of British Columbia. As part of these initiatives, CN and TC have actively researched and developed slide and washout risk control strategies in many locations through the Fraser/Thompson River canyon corridor between Lytton and Hope.

Analysis

The train was operated in compliance with company and regulatory rules and instructions and there were no identified equipment deficiencies that could be considered causal. The analysis will focus on the factors leading to the landslide, the inspection of shared drainage systems and the working relationship between railway and highway maintenance personnel in the Fraser River Canyon.

The Accident

The train derailed when it struck a slide of rock, mud and trees covering the track. The slide occurred during a period of heavy rain when a large volume of surface water run-off flowed through a highway culvert above the track, breaching the normal outflow channel and partly diverting into a new channel. This diversion resulted in rock debris, mud and trees being carried down slope to the track below. Rock placed along the outflow channel below the

highway culvert was insufficient to ensure all of the water was directed down the established drainage course toward the track. The highway culvert functioned as intended. It was not plugged and handled the run-off flow without damaging the highway.

Regular geotechnical inspections and training for engineering and operations personnel, and proactive programs for grade and slope stabilization are part of CN's Grade and Slope Stabilization Engineering and Management Protocol. CN has developed and installed an extensive network of ground hazard warning systems along critical sections of its line through the Fraser/Thompson River canyon. The landslide occurred between two nearby slide detector fence installations. Because the landslide location was not known as an area of instability (i.e., no history of landslides or water problems), no special slope protection systems were in place prior to the slide and derailment.

If the track circuits remain intact when a slide, roadbed slump or washout occurs at a location unprotected by a ground hazard warning system, the CTC signal system continues to function normally and no warning is given to approaching trains which increases the risk of derailment.

Landslide Hazard Risk Mitigation

TDC's Landslide Hazard Risk Mitigation project and Railway Ground Hazard Research Program are collaborative efforts of Canadian railways, federal agencies, universities and other stakeholders to improve safety and reduce losses from ground hazard incidents on Canadian railways. Both CN and TC have taken an active role in research and development of slide and washout risk control strategies through the Fraser/Thompson River canyon corridor between Lytton and Hope.

Coordination Between Railway and Highway Maintenance Personnel

Routine track inspection processes continue to be conducted with little reference to the drainage systems on the adjacent highway, although at Komo and other places through the Fraser River canyon, drainage systems are shared. When drainage features of a highway affect railway infrastructure, railway practices should include periodic inspections of the drainage course and source of flow above the track. Subsequent to the Conrad accident in 1997 both the TSB investigation (R97V0063) and the BC Coroner's Inquest, called for a closer working relationship between stakeholders in the Fraser River transportation corridor. Stakeholder meetings have been held annually but CN has not attended in recent years, missing an opportunity to develop this closer relationship which could lead to the identification of risks and potential failures in the shared drainage systems. Without taking full advantage of formal communication and coordination between railway and highway maintenance personnel at locations where there are shared drainage systems, there is an increased risk that information regarding abnormal ground and drainage conditions will not be shared in a timely manner, especially during periods of extreme weather.

Slope and Drainage Conditions Above the Track in Mountain Territory

Track inspections were carried out in compliance with both the Railway Track Safety Rules and the CN Engineering Track Standards. These inspections focussed on track conditions. Although

drainage conditions affecting the track are monitored, periodic inspection of drainage courses and sources of flow above the track (e.g., mountain slope) are not specifically required. Without conducting periodic inspections of slope and drainage conditions above the track in mountain territory, there is an increased risk that unstable slope areas will not be identified in a timely manner, leading to derailments due to landslides and washouts during extreme weather events.

Extreme Weather Event Protocol

Extreme weather is often the main cause of a slide or washout event. CN's weather forecasting service issued weather alert notices and provided critical weather updates prior to and during the heavy rainfall event. As a result of these weather alerts, CN began implementing its extreme weather response plan, including the use of special track patrols. Extreme weather response protocols were properly followed and implemented.

A flash flood warning was issued approximately three hours after the derailment, so no advisory of potential high water adjacent to the track or bank erosion was issued to the occurrence train. Even if a warning had been issued, the train would not have been able to stop before encountering the slide because of limited visibility on the sharp curve territory due to short, tight sight lines, heavy rain and darkness.

Findings as to Causes and Contributing Factors

1. The train derailed when it struck a slide of rock, mud and trees on the track.
2. The slide occurred during a period of heavy rain when a large volume of surface water run-off flowed through a highway culvert above the track, breaching the normal outflow channel and partly diverting into a new channel.
3. No special slope protection systems were in place at the landslide location because it was not known as an area of instability and had no history of slides or water problems prior to the event.

Findings as to Risk

1. If the track circuits remain intact when a slide, roadbed slump or washout occurs at a location unprotected by a ground hazard warning system, the CTC signal system continues to function normally and no warning is given to approaching trains which increases the risk of derailment.
2. Without taking full advantage of formal communication and coordination between railway and highway maintenance personnel at locations where there are shared drainage systems, there is an increased risk that information regarding ground and drainage conditions will not be shared in a timely manner, especially during periods of extreme weather.
3. Without conducting periodic inspections of slope and drainage conditions above the track in mountain territory, there is an increased risk that unstable slope areas will not be identified in a timely manner, leading to derailments due to landslides and washouts during extreme weather events.

Other Findings

1. Even if a high water advisory had been issued prior to the occurrence, the train would not have been able to stop before encountering the slide because of limited visibility on the sharp curve territory due to short, tight sight lines, heavy rain and darkness.
2. Both CN and TC have taken an active role in research and development of slide and washout risk control strategies through the Fraser/Thompson River canyon corridor between Lytton and Hope.
3. Extreme weather response protocols were properly followed and implemented.

Safety Action Taken

TSB issued Rail Safety Advisory (RSA) 11/09 to Transport Canada (TC) on 17 December 2009. The RSA stated that, given the extreme mountain operating environment through the Fraser River Canyon and its vulnerability to landslides, Transport Canada may wish to evaluate CN's and CP's ground hazard assessment programs to ensure that they are adequate for safe train operations through this transportation corridor.

TC responded to the RSA indicating that:

- CN and the Canadian Pacific Railway (CPR) actively monitor the Fraser Canyon corridor and regularly inspect it with qualified geotechnical engineers/geoscientists.
- Both CN and the CPR are engaged in research projects to improve the detection of rock falls and slides.
- CN plans to deploy a new Seismic Rock Fall Monitoring System once testing and verification are completed.
- Transport Canada's (TC) Pacific Surface Region has an inspector dedicated to natural hazards who is currently assessing CN and the CPR's ground hazard assessment programs for all of the Pacific Region, with the Fraser Canyon as a priority. The inspector is a member of the Railway Ground Hazard Research Program.

CN installed an Emergency Slope Washout and Detection System (ESWOD) at Mile 7.9 shortly after the slide.

The highway maintenance contractor has implemented a protocol for local supervisors to contact the CN and CP representatives during rain events, periods of extraordinary runoff, and other potentially damaging weather systems. If a specific problem (i.e. diverted outflow) is identified they will immediately notify the local railway contacts.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 05 August 2010.

Visit the Transportation Safety Board's website (www.bst-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 - Main-Track Derailments since 2004 due to Landslides in the Fraser/Thompson River Rail Corridor

R04V0188 (Ruby Creek, BC, Mile 50.07 Cascade Subdivision, 27 November 2004). While proceeding eastward, CN train crew on train G-894-51-27 reported hitting a rock slide. Upon inspection it was revealed that 1 locomotive and 7 empty grain cars had derailed. The fuel tank on the locomotive ruptured and fuel oil leaked into the Fraser River.

R04V0196 (Glen Valley, BC, Mile 92.5 Yale Subdivision, 11 December 2004). While proceeding eastward, CN train crew on-train 202-51-11 reported train in emergency. Upon investigation, the crew discovered that the train had been struck by a mudslide and 8 cars had derailed.

R05V0151 (Lasha, BC, Mile 93.56 Ashcroft Subdivision, 17 August 2005). While proceeding westward, CN train crew on train E-201-31-13 reported a landslide had struck their train. Upon inspection, CN crew reported a total of 9 cars had derailed.

R05V0188 (Yale, BC, Mile 28 Cascade Subdivision, 11 October 2005). While proceeding eastward, CN freight train A-416-51-11 reported hitting a landslide. CN reported 2 locomotive and the first 7 empty flat cars had derailed. Some of the equipment came to rest down the embankment. The lead locomotive leaked fuel oil beside the Fraser River. One crew member sustained injuries and was taken to hospital.

R06V0013 (Albion, BC, Mile 99.5 Cascade Subdivision, 23 January 2006). While proceeding westward on south track, CP crew reported that a landslide had caused both locomotives (CP 8711 and 9820) to derail upright. The landslide also blocked the north track.

R07V0005 (Lasha, BC, Mile 97.5 Ashcroft Subdivision, 04 January 2007). While proceeding westward, CN train M35551-02 struck a landslide and derailed 2 locomotives and the first car of the train. The lead locomotive slid approximately 150 feet down the embankment to the edge of the river. The trailing locomotive came to rest on the edge of the embankment. The lead car derailed all wheels but remained upright.

R07V0006 (Inkitsaph, BC, Mile 118.5 Ashcroft Subdivision, 05 January 2007). The crew of train X30151 03 reported striking a landslide and derailling the lead truck of lead locomotive CN 2517.

R08V0151 (Lasha, BC, Mile 94.2 Ashcroft Subdivision, 01 July 2008). CP freight train H-401-51-01 reported train going into emergency.

Upon inspection, it was determined that 4 loaded cars of ethylene glycol had derailed when the train was struck by a mud slide. Fifteen cars were in the mud but not derailed.