



Australian Government

Australian Transport Safety Bureau



ATSB TRANSPORT SAFETY REPORT
Rail Safety Issue Investigation
RI-2011-015
Interim Factual

Investigation of the safety of rail operations on the interstate rail line between Melbourne and Sydney



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the interstate rail line between
Melbourne and Sydney**

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Investigation of the safety of rail operations on the interstate rail line between Melbourne and Sydney

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Abstract

On 16 August 2011, the Hon Anthony Albanese MP, Minister for Infrastructure and Transport, requested that the Australian Transport Safety Bureau (ATSB) undertake a systemic investigation of rail operations on the interstate rail line between Melbourne and Sydney.

A key request from the Minister was for the ATSB to examine and report on the measures taken to maintain the safety of rail operations where track quality is below acceptable operational standards. This interim report provides a summary of factual information that has been obtained during the early stages of the investigation and focuses on the processes put in place to maintain the safety of rail operations.

The investigation is continuing.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes appropriate, or to raise general awareness of important safety information in the industry. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

This interim report provides a summary of factual information that has been derived from the continuing investigation of operations on the interstate rail line between Melbourne and Sydney and builds on the information presented in the preliminary report (ISBN 978-1-74251-207-5). As the investigation is ongoing, readers are cautioned that there is the possibility that new evidence may become available that alters the circumstances depicted in this report.

1.1 Background

The track between Melbourne and Sydney is managed by the Australian Rail Track Corporation (ARTC) under long term lease arrangements. The lease arrangement for the line in Victoria (Melbourne to Albury) is between the ARTC and the Victorian Rail Track Corporation (VicTrack), and commenced in 1998. In New South Wales, the lease arrangement is between the ARTC and the Country Rail Infrastructure Authority (CRIA), and commenced in 2004 for the line between Albury and Macarthur (outer metropolitan Sydney). Each State has a rail safety regulator¹ responsible for administering the requirements of State rail safety legislation and an independent investigation agency² responsible for conducting no-blame investigations of transport safety matters.

The ARTC is responsible for infrastructure maintenance, network control and managing access by train operators such as the V/Line, RailCorp (CountryLink) and Pacific National. The ARTC is also responsible for managing major investment programs. For example, after taking control of the line in Victoria, the ARTC implemented a number of infrastructure improvement strategies, aimed at increasing axle load and train speed over the Melbourne to Albury line. Strategies were also implemented in New South Wales from 2004, aimed at improving the transit times and network capacity between Albury to Sydney. In 2007, after the release of the North South Corridor Strategy, the ARTC embarked on a major investment programme to further upgrade the track between Melbourne and Sydney. The investment program was largely funded by the Commonwealth and included the replacement of the existing timber and steel sleepers in the line with new concrete sleepers.

The condition of the track on sections of the Melbourne to Sydney line has been subject to significant adverse comment, largely in relation to the existence and remediation of ‘mud-holes’. There have also been a number of recent incidents on the corridor, including the parting of an interstate passenger train near Broadmeadows, Victoria on 11 August 2011, which is currently under investigation by the ATSB (Reference RO-2011-012), and the routing of a train onto the wrong railway track near Seymour, Victoria on 25 July 2011, currently under investigation by the Chief Investigator, Transport Safety Victoria.

On 16 August 2011, the Hon Anthony Albanese MP, Minister for Infrastructure and Transport, requested that the Australian Transport Safety Bureau (ATSB) undertake a systemic investigation of rail operations on the interstate rail line between

¹ The Independent Transport Safety Regulator (New South Wales) and Public Transport Victoria

² The Office of Transport Safety Investigations (New South Wales), the Chief Investigator Transport Safety Victoria

Melbourne and Sydney. In accordance with the Minister's request the ATSB commenced a safety issue investigation which will consider:

- the condition of the interstate rail track and measures that have been put in place to maintain the safety of rail operations where track quality is below acceptable operational standards
- actions taken by the Australian Rail Track Corporation (ARTC) to remediate the track and address the safety of operations
- safeworking practices in relation to the track
- a systemic review of safety systems, including signalling and the quality assurance of work undertaken on the track
- any other matters considered relevant by the ATSB.

A key request from the Minister for Infrastructure and Transport was for the ATSB to examine and report on the measures taken to maintain the safety of rail operations where track quality is below acceptable operational standards. This interim report provides a summary of factual information that has been obtained during the early stages of the investigation and focuses on the processes put in place to maintain the safety of rail operations.

The investigation is continuing.

1.2 Sources of information

The ATSB has gathered information from key railway organisations such as the ARTC, V/Line, RailCorp (CountryLink) and Pacific National. In addition, information has been obtained from rail safety regulators and independent investigation agencies in New South Wales and Victoria.

The ATSB has conducted a number of interviews with train drivers who regularly travel the rail line between Melbourne and Sydney and have talked with representatives from railway unions. Investigators have also travelled on the track geometry car³ observing and talking to technicians while they were measuring the track geometry between Melbourne and Goulburn.

The ATSB will continue to obtain information from various sources and analyse the information in accordance with the Minister's request.

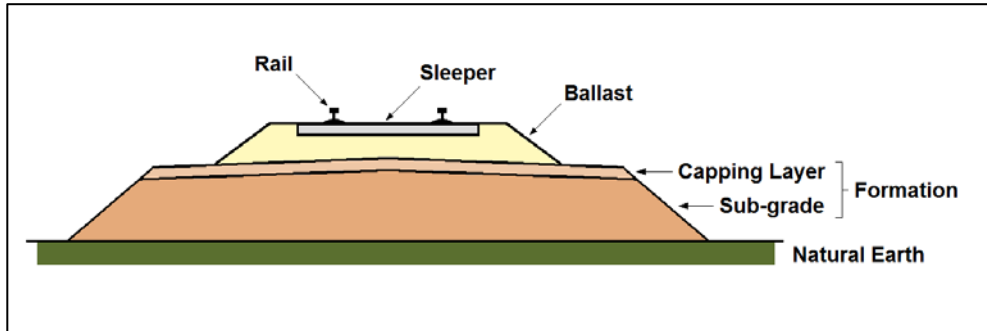
1.3 Track structure and condition

The track structure consists of a number of components, including the rail, sleepers, ballast and the formation (Figure 1). Each component is selected for its ability to perform various functions. For example, the formation is the earthworks structure upon which the ballast is laid and usually consists of the sub-grade (earth fill on top of the natural earth) and a capping layer (compacted material that provides a sealing layer to the sub-grade). The main purpose of the formation is to provide a consistent level surface at the required height above the natural ground. The ballast bed not only distributes static loads (sleepers and rail) and dynamic loads (trains) to the formation, but must also provide adequate drainage to ensure water is not retained

³ A locomotive hauled rail vehicle with electronic track recording equipment.

within the track structure. Ballast is usually obtained from quarried rock and must have suitable properties to resist crushing and breakdown.

Figure 1: Track structure



Track condition

The condition of the track on sections of the Melbourne to Sydney line had been subject to significant adverse comment. The source of adverse comment was usually related to a combination of rough riding and train delays due to speed restrictions. In many cases, the term ‘mud-holes’ has been used to describe the reason for the rough ride and subsequent speed restrictions.

A mud-hole is a generic term used to describe a condition where the sleepers appear to be surrounded by mud rather than ballast. Mud-holes occur when the ballast becomes contaminated (or fouled) with fine materials. This can be due to poor ballast (excessive fines), a breakdown of the ballast material or the formation rising up through the ballast. The fouled ballast retains water (appears like mud), prevents effective drainage and can result in poor track geometry (Figure 2).

Figure 2: Typical mud-hole due to fouled ballast

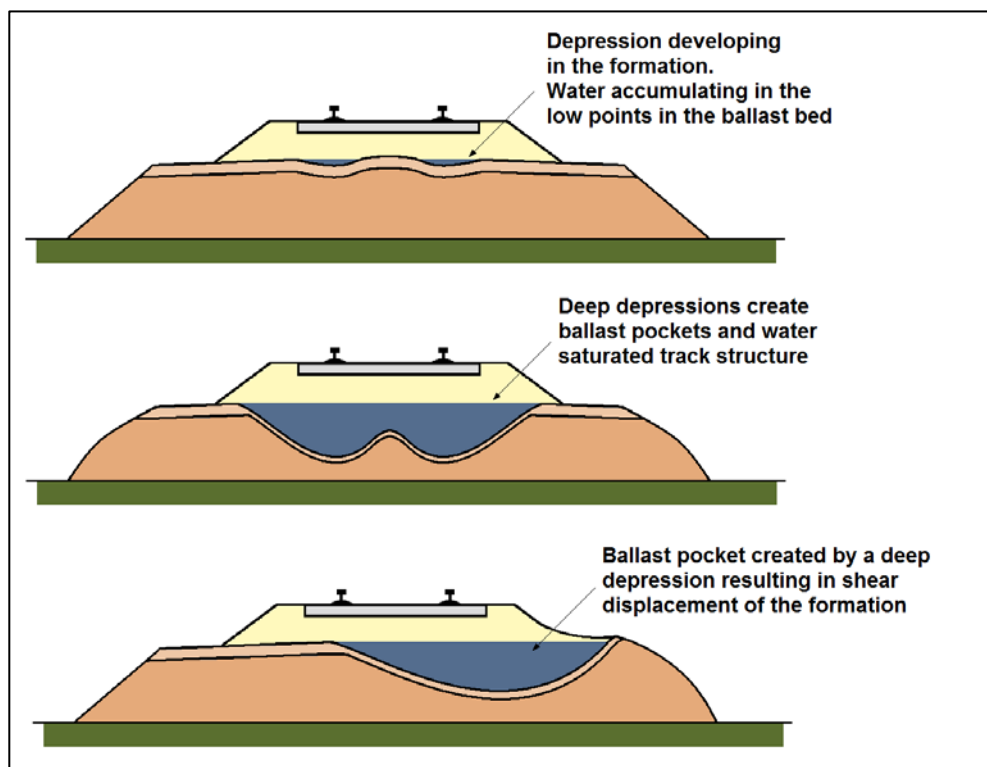


While mud-holes may develop in areas of poor track geometry, they are not a prerequisite nor are they always the cause of the problem. For cases of continued and repetitive geometry issues at the same location, the cause is often related to the formation; the term used is ‘soft formation’ or ‘soft track’.

Track defects due to soft formation generally appear due to the formation's inability to support the required train load without deformation. The defect usually begins as a depression in the formation (under one or both rails) and a corresponding dip in the track. To maintain track geometry, the track is lifted and additional ballast forced under the sleepers (a track maintenance process called tamping). However, once a depression develops, water may flow to and sit in the depression. The water will gradually soak through the formation, further weakening the formation and causing the depression to deepen, creating a ballast pocket with shear displacement causing bulging of the formation shoulders (Figure 3). Additional ballast and further tamping to maintain track geometry will usually result in a continued cycle of track dips and deepening ballast pockets. The result of extensive and continuous ballast pockets is uneven, wavy track geometry. This would probably result in a rough ride unless train speeds were reduced to a level appropriate to the severity of the track condition.

The cause of the deteriorated track condition between Melbourne and Sydney will be examined as part of the ongoing investigation. This interim report focuses on the management of deteriorated track and the methods applied to maintain the safety of rail operations until rectification works are completed.

Figure 3: Ballast pockets



1.4 Track infrastructure management

Track infrastructure is managed to ensure it is appropriate for the intended operations and that the integrity of the infrastructure is maintained to a level that is both safe and fit for purpose. Infrastructure management consists of a number of components such as design, construction, inspection and maintenance. For each component there are limits related to safety, operational requirements and economics that require consideration, all of which are inherently linked.

Track design and construction aims to create an infrastructure system that conforms to the appropriate safety standards and is compatible with functional and operational parameters. However, track and civil infrastructure is a system of components which deteriorate in condition due to a number of factors including usage and aging. It is the role of the inspection and maintenance process to ensure that the infrastructure condition stays within the designed maintenance limits. Each step has an economic cost and benefit that must be balanced to ensure the ongoing viability of operations.

Track inspection, assessment and maintenance

Track inspection, assessment and maintenance, is the process used to ensure the infrastructure condition stays within defined limits appropriate for safe operation. The process is based on a regime of inspection to detect defects, assessment to determine the required response and corrective action to repair the defect.

Up until 15 November 2011, the ARTC inspection, assessment and maintenance standards were different in New South Wales and Victoria⁴. In Victoria, the standards were drawn down from the Rail Industry Safety and Standards Board (RISSB) *Code of Practice-Volume 4, Track and Civil Infrastructure*. In New South Wales, the standards and procedures were distributed over multiple documents inherited from the Rail Infrastructure Corporation (which no longer exists as an organisation).

Since taking control of the interstate rail lines in Victoria (1998) and New South Wales (2004), the ARTC has progressively integrated the rules and procedures with the aim of developing common standards across the entire ARTC rail network; the *ARTC (Track & Civil) Code of Practice*. From 15 November 2011, common standards for inspection, assessment and maintenance were adopted for both States and documented in *Section 5, Track Geometry* of the *ARTC Engineering (Track & Civil) Code of Practice*. The revised code of practice continued to adopt an approach similar to the previous standards, but consolidated the detail into a single document^{5 & 6}. The document specifies both the standards for inspection/assessment and the appropriate action to be taken for defined defects.

⁴ The difference between States is a legacy of rail operations in Australia developing as State based organisations, each with their own rules and procedures.

⁵ This report examines the inspection, assessment and maintenance process with reference to the ARTC's consolidated code of practice. Specific aspects of the obsolete documentation will be referenced where required.

⁶ The process of developing common standards across the entire ARTC rail network is ongoing. Consequently, standards that are still specific to a particular State will be referenced as required.

Track inspection is the process by which the track condition is monitored to identify possible defects that may affect, or have the potential to affect, the capability of the infrastructure to safely perform its required function. The inspection process consists of two complementary inspection types:

- scheduled inspections
- unscheduled inspections.

As part of the process in determining track condition, a series of track geometry parameters such as vertical and horizontal alignment, cross level variation, twist and gauge are considered. Potential track defects are examined and their severity determined with reference to defined defect limits for each track geometry parameter. The defined limits are documented in the ARTC code of practice.

The track geometry car accurately measures the track and compares the results against a table of defect limits, which allows an appropriate response category to be allocated based also on rated track speed. Personnel conducting track patrols and unscheduled inspections do not normally take measurements, but assess the severity of potential defects based on their knowledge and experience. While measurements may not always be taken, an appropriate response category is still allocated with reference to the table of defect limits, but based on rated track speed and an estimate of the defect size.

Track maintenance is the process whereby action is taken to ensure the track structure is maintained to a condition appropriate for safe and continued operation of rail traffic. Where track geometry defects are identified, action is taken to rectify the problem or operational limitations applied (such as speed restrictions) to ensure safe passage of rail traffic until the defect can be repaired. Based on the assessment of track geometry defects, the action to be taken to control any risk to railway operational safety is defined by a series of response codes (Table 1).

Table 1: Definition of response codes

Response category	Inspect	Action
E1 (Emergency)	Prior to next train	Repair prior to next train see note [1]
E2 (Urgent Class 1)	Within 2 hrs or before the next train, whichever is the greatest	Repair within 24 hrs See Note [2]
P1 (Urgent Class 2)	within 24 hrs	Repair within 7 days
P2 (Priority Class 1)	within 7 days	Repair within 28 days
N	Normal inspection regime	

Note [1]

Trains may be piloted over E1 category track subject to assessment by a qualified worker.

Note [2]

Trains may travel over E2 category track at 20 km/h subject to assessment by a qualified worker.

Since response categories are based on defect size and track speed, it is possible to reduce the priority of a response by applying a speed reduction over the defective section of track. The inspection regime for the reduced category would then apply

for assessing any deterioration of the defect. If there is no change to the defect, then reinspections continue until the defect is repaired. If the defect deteriorates further, then it is again categorised and a further 'Temporary Speed Restriction' (TSR) may be applied subject to the revised category. The process continues until the defect is repaired.

1.4.1 Scheduled inspections

Scheduled inspections are the primary tool for ensuring infrastructure is maintained to a level that is both safe and appropriate for the intended purpose. The ARTC code of practice provides for the following types of scheduled inspection.

- Track patrols

Track patrols are usually conducted as a visual inspection while travelling the track in a road-rail vehicle⁷. The ARTC code of practice states that track patrols must be scheduled at intervals not exceeding seven calendar days.

- Front of train inspections

Front of train inspections are visual inspections of the track and an assessment of ride performance while travelling in the driver's cab of a train. The ARTC code of practice states that front of train inspections are to be scheduled at intervals not exceeding six months.

- Track geometry car

The track geometry car is a locomotive hauled automated track inspection vehicle used to measure several geometric track parameters without obstructing normal railroad operations. The ARTC code of practice states that track geometry car inspections are to be scheduled at intervals not exceeding four months.

The code of practice adopted by the ARTC is based on a set of standards and procedures that have been developed over many years by the rail industry as a whole. Where track has been designed and constructed in accordance with the code of practice, it is generally accepted that the documented inspection and maintenance regime is adequate. While the ATSB is still gathering and examining statistical information, limited evidence to date would suggest that the rate and extent of track deterioration between Melbourne and Sydney may have been outside the parameters normally considered by the code of practice⁸.

Based on the information obtained during the early stages of the investigation, the ARTC has acted upon the increased deterioration rate of the track between Melbourne and Sydney and implemented various strategies to ensure the safety of train operations. While an accelerated program of rectification works has been adopted, the ARTC has also increased its regime of scheduled maintenance, especially during wet weather.

For example, at times, the ARTC increased its frequency of track patrol to two patrols per week, though in the event of a 'rough ride' report or train parting, an

⁷ A road vehicle fitted with retractable rail guidance wheels. (Source: ARA Glossary for the National Codes of Practice and Dictionary of Railway Terminology)

⁸ The cause and extent of the increased deterioration rate of track between Melbourne and Sydney is part of the ongoing investigation, as is the adequacy of the code of practice.

immediate inspection was conducted. Where high concentrations of track geometry defects were detected, front of train inspections were increased to daily and then returned to weekly as rectification works were completed.

The ARTC also advised that occasionally, additional track geometry car inspections were conducted, but this was not always achievable. Consequently, the ARTC introduced the use of a KRAB trolley. The KRAB trolley (Figure 4) is a mobile trolley capable of recording track geometry and is particularly useful for recording over relatively short sections of track. The KRAB trolley is a significant improvement over manual measurement of track geometry and provides additional quantifiable track geometry data for analysis between track geometry car runs. The ARTC has also purchased a heavier version of the KRAB trolley, designed to be towed behind a road-rail vehicle, which allows measurement over longer track distances.

Figure 4: KRAB trolley



1.4.2 Unscheduled inspections

Unscheduled inspections usually occur in response to defined events. For example, extreme weather conditions can cause track damage (debris on the track or washaway of the formation), so an unscheduled inspection is usually conducted immediately after such an event and before trains travel the section.

A more common trigger for an unscheduled inspection is third-party track condition reporting. Train drivers are continuously travelling the track, so are an essential source of information regarding track conditions that may affect rail operations, such as rough ride quality. On the Melbourne to Sydney line, the ARTC has implemented procedures whereby rough riding reports and train partings require the immediate application of a 40 km/h speed limit that is to remain in place until the location has been inspected, assessed and appropriate action taken.

Train control reports

While the rules and procedures vary slightly between New South Wales and Victoria, the intent in relation to reporting and recording potential faults or irregularities is similar. In general, where drivers observe a condition that may affect the safety of train operations, they are required to advise the Network Control Officer who should make a permanent record of the reported condition and advise the appropriate personnel for action to be taken. The primary method of recording an issue reported by a train driver is the Train Control Report (TCR).

For example, where a driver experiences deteriorated track conditions that may be considered a risk to train operations, they should contact the Network Control Officer who should record the condition on a TCR. The information is then communicated to the infrastructure maintainer who is responsible for assessing the track and taking corrective action. A similar process is applied if a driver identifies confusing or non-compliant trackside signage that may also increase the risk to rail operational safety.

During the course of the investigation to date, the ATSB obtained information from various individuals and organisations. A number of concerns were expressed that Network Control Officers were (at times) reluctant to record track condition reports on a TCR, opting to make a note to maintenance personnel at a later time. While limited evidence was available to verify individual events (due to the lack of written records), the fact that concerns had been expressed from multiple and independent sources would suggest a reasonable likelihood that the concerns were valid.

The process of completing a TCR is often the initial step for actioning a potential infrastructure condition that could affect the safety of the rail network. In many cases, the driver or Network Control Officer are not best placed to assess the condition, so the TCR becomes the formal record of a potential hazard and initiates the process of inspection, assessment and maintenance. It is therefore critical that a Network Control Officer complete a TCR to ensure potential risks to rail operations are appropriately assessed and actioned.

Train partings

Track irregularities are known to be a factor that can contribute to train partings (unintended uncoupling of wagons). The ATSB is still gathering and examining statistical information related to train partings. However, some evidence to date would suggest that the track between Melbourne and Sydney has experienced an increased number of train parting occurrences. For example, Pacific National provided information that illustrated train partings involving their trains operating over the Melbourne to Sydney line had increased since mid 2009, mostly during the winter months. The extent of train partings on the Melbourne to Sydney line (all train operators) will be examined as part of the ongoing investigation. This interim report focuses on the actions taken when events occur that may indicate undesirable track conditions.

The ATSB examined the unscheduled inspection process as applied to train parting occurrences. The ATSB randomly selected a number of occurrences that had been independently recorded by train operators and examined the inspection, assessment and maintenance process associated with these events. The occurrences were selected on the basis that they occurred where evidence suggested a high concentration of track geometry issues may affect train operations. One such area was near Donnybrook, about 34 track kilometres north of Melbourne.

Train parting near Donnybrook on 2 September 2009

At about 1952 on 2 September 2009, the last wagon of freight train 4WP2 detached from the rest of the train while travelling between the 38 km and 39 km points⁹ near Donnybrook, Victoria. The train crew reported the incident to the Network Control Officer who recorded the details on a Train Control Report (TCR number 10527) and reported the issue to the relevant track maintenance personnel. Recorded voice communication indicated that (at about 2030) the Network Control Officer also warned the driver of XPT passenger train ST22 (the next train to travel the section) of potential rough track between the 38 km and 39 km points.

A short time later, a track inspector contacted the Network Control Officer and requested that a 40 km/h speed restriction be verbally applied to the section between the 38 km and 39 km points. It was apparent from the conversation that the

⁹ Distance in kilometres from a track reference point located at Spencer Street Station, Melbourne.

Network Control Officer assumed the restriction was only relevant to the XPT passenger train. Consequently, no restriction was communicated to two other trains that passed through the section about an hour later. However, neither train driver reported any problem with the track, which would suggest they did not experience any track conditions that they would have considered reportable.

Maintenance records show that track maintenance staff found a combination of geometry defects and a series of mud holes at four locations between the 41.100 km point and the 38.300 km point. At about 2230 on 2 September 2009, a track gang and a ballast tamping machine conducted rectification works to the track between the 41.100 km point and the 38.300 km point. The Train Control Report indicated that at 0302 on 3 September 2009 track works were completed and the TSR was removed, thereby returning the maximum track speed to 110 km/h for freight trains, 115 km/h for locomotive hauled passenger trains and 130 km/h for XPT passenger trains. While the track geometry had been returned to an acceptable condition, it was noted in records that further work would be required to remove mud from the track structure.

Considering the risks associated with continued track deterioration and possible train partings, the ARTC issued instructions to both maintenance personnel and Network Control Officers. Upon notification of rough riding or a train parting, a 40 km/h speed restriction was to be applied until the track had been inspected. In addition, locations that experienced a train parting were to be given higher priority for rectification works.

Train parting near Donnybrook on 9 August 2010

Due to deteriorated track condition, a speed restriction of 60 km/h (freight and passenger trains) had been applied on 7 August 2010 to the track between the 32.300 km point (near Donnybrook) and the 70.300 km point (near Kilmore East). However, on 9 August 2010 at about 2035, freight train 2SX2 parted at the 35.000 km point while travelling at the restricted speed of 60 km/h. The train crew reported the incident to the Network Control Officer who recorded the details on a Train Control Report (TCR number 9336). Records indicate that the track was inspected at 2100 and the speed restriction assessed as appropriate for the existing track condition. Records also show that track tamping was conducted on 31 August 2010, though it was noted that further work would be required to remove mud from the track structure.

Further examination of ARTC records identified that train 2SX2 had experienced another parting at the 131.000 km point (near Longwood), about 2.5 hours earlier (TCR number 9331). For this occurrence, a 40 km/h temporary speed restriction was put in place. However, upon inspection, the track was also assessed as suitable for the posted track speed.

Based on the information available, it was noted that the train had parted between the 10th and 11th wagons in each occurrence and each time it was the 10th wagon that appeared to be a fault. While it was likely that a track condition may have contributed to the parting in each case, it was equally likely that a rolling-stock issue may also have contributed. Records sourced from both the ARTC and the train operator show that the wagon in question was removed from service when it arrived in Melbourne.

For both instances of train parting associated with train 2SX2, the process of track inspection, assessment and maintenance was consistent with the documented

procedures. In addition, the process for identifying a potential rolling-stock issue was applied and the wagon removed from service.

Summary – Track infrastructure management

While the standards for inspection, assessment and maintenance (prior to 15 November 2011) varied slightly between New South Wales and Victoria, they were generally consistent with industry agreed standards and have since been consolidated under the one code of practice. Information obtained during the early stages of the investigation, suggests that the track between Melbourne and Sydney has deteriorated at an increased rate that is outside the parameters normally considered by the code of practice. While an accelerated program of rectification works has been adopted, the ARTC has also increased its regime of scheduled maintenance to a level that exceeds the requirements of the current standards.

Unscheduled inspections usually occur in response to defined events, including third-party track condition reporting. In addition, train partings can occur as a result of track irregularities and as such are triggers for unscheduled inspections. For the randomly selected occurrences, the ARTC's inspection, assessment and maintenance processes were consistently applied. Where deficiencies were identified with the application of the processes, the ARTC issued additional instructions aimed at ensuring the safety of rail operations.

The primary method of recording an issue reported by a train driver is the Train Control Report (TCR). However, information provided during the course of the investigation suggested that (at times) Network Control Officers were reluctant to record track condition reports on a TCR.

1.4.3 Application of temporary speed restrictions

The process of applying speed restrictions is an internationally accepted method for maintaining the safety of rail operations over deteriorated track. The condition of the track between Melbourne and Sydney has of recent times required the application of speed restrictions to maintain track safety. In some cases, multiple track defects in relatively rapid succession have required the application of multiple speed restrictions.

The ATSB conducted a number of interviews with train drivers who regularly travel the line between Melbourne and Sydney. The interviews identified the potential for confusion where multiple restrictions resulted in a high density of TSR signage. Considering the critical role of a TSR in managing safe rail operations, the process for applying TSR's was examined in further detail.

The rules and procedures for applying TSR's are different between New South Wales and Victoria, especially in relation to sign design. The difference between States is a legacy of rail operations in Australia developing as State based organisations, each with their own rules, procedures, signs and signals. In isolation, the rules in each state may have been considered adequate. However, as rail operations have developed into an Australia wide transportation system, train drivers have been required to operate through multiple States and retain a working knowledge of all relevant rules and procedures unique to each State. In general, training, experience and driver professionalism has reduced the safety risk associated with unique State rules and procedures. However, a risk still remains that




operating under multiple rules and procedures has the potential to create driver confusion and impact on rail safety.

While the ARTC has progressively integrated the rules and procedures of various States with the aim of developing common standards across their network, the process of gaining consensus for consolidated rules and procedures is ongoing. The concerns regarding multiple speed restrictions were predominately related to the track in New South Wales. However, it is possible that similar issues also exist in Victoria. Consequently, the scenarios presented were examined in the context of rules in both New South Wales and Victoria.

New South Wales

The ARTC document ANSG-604 *Indicators and signs* describes the types of indicators and signs used on the ARTC network in New South Wales. The signs indicating a TSR take the form of a ‘Warning’ sign, a ‘Caution’ sign and a ‘Clearance’ sign (Figure 5). ARTC document ANPR-713 *Placing temporary speed signs* describes the procedures for installing the signs that indicate a TSR.




Figure 5: Speed restriction signs (New South Wales)

		
<p>The warning sign is placed 2500 m before the affected portion of track.</p> <p>The number at the bottom of the sign indicates the speed limit that will apply in the affected portion</p>	<p>The caution sign is placed 50 m before the affected portion of track.</p> <p>The number at the top of the sign indicates the speed limit that applies in the affected portion</p>	<p>The clearance sign is placed 50 m beyond the affected portion of track.</p> <p>The sign advises that a TSR no longer applies and normal speed may be resumed</p>

The number (black text on yellow background) on the warning and caution sign is applicable to all rail traffic. However, if a restriction applies specifically to passenger trains, the number indicating the required speed is black text on a white background. Two numbers (one white, one yellow) may be displayed if a different speed is applicable to passenger and freight trains.

Where multiple speed restrictions exist and the distance between the affected areas is less than 2500 m, the sign configuration allows for a caution sign to also provide a warning to drivers as to the speed limit applicable to the next affected area (Figure 6). The position of the speed limit number (top or bottom) determines if the speed is a warning or the required speed at that location. All numbers at the bottom of the signs are warnings that indicate the speed limit that applies from the next sign. A number at the top of a caution sign indicates the speed limit that applies immediately. A clearance sign is only required after the last affected area.

Figure 6: Signs for multiple speed restrictions (New South Wales)

		
<p>The warning sign is placed 2500 m <i>before the first</i> affected portion of track.</p> <p>The number at the bottom of the sign indicates the speed limit that will apply in the affected portion</p>	<p>The caution sign is placed 50 m <i>before each</i> affected portion of track and <i>after each</i> affected portion except the last.</p> <p>The number at the <i>top</i> of the each sign indicates the speed limit that applies from the current caution sign to the next.</p> <p>The number at the <i>bottom</i> of each sign is a warning and indicates the speed limit that applies from the next caution sign.</p>	<p>The clearance sign is placed 50 m beyond the <i>last</i> affected portion of track.</p> <p>The sign advises that a TSR no longer applies and normal speed may be resumed</p>

During the course of the investigation, the ATSB was provided with examples where the speed restriction signage had not been installed in accordance with ANSG-604 and ANPR-713.

On 22 August 2011, an XPT driver reported a TSR irregularity to the ARTC network controller, which was recorded on a train control report (TCR9070). The report indicated two locations where multiple speed restrictions were not sign posted in accordance with the procedures. In each case, speed restrictions were applied to short areas of affected track that were located within the boundaries of a long speed restricted section of track.

Speed restriction records indicated that a TSR of 120 km/h (passenger trains) was applied on 14 June 2011 between the 493.900 km point¹⁰, (near Junee) and the 514.600 km point (near Wagga Wagga), a distance of just over 20 km. The normal track speed was 160 km/h for XPT passenger trains and 115 km/h for freight trains. On 4 July 2011, a second TSR of 80 km/h was applied for all trains over a short 150 m section of track between 496.850 km and 497.000 km points, which was entirely within the boundaries of the first TSR. A similar configuration was reported between the 534.900 km point, (near Uranquinty) and the 547.000 km point (near The Rock) a distance of just over 12 km. In this case, two short speed restricted areas (80 km/h and 60 km/h) were located within the boundaries of the longer speed restricted (120 km/h) section of track.

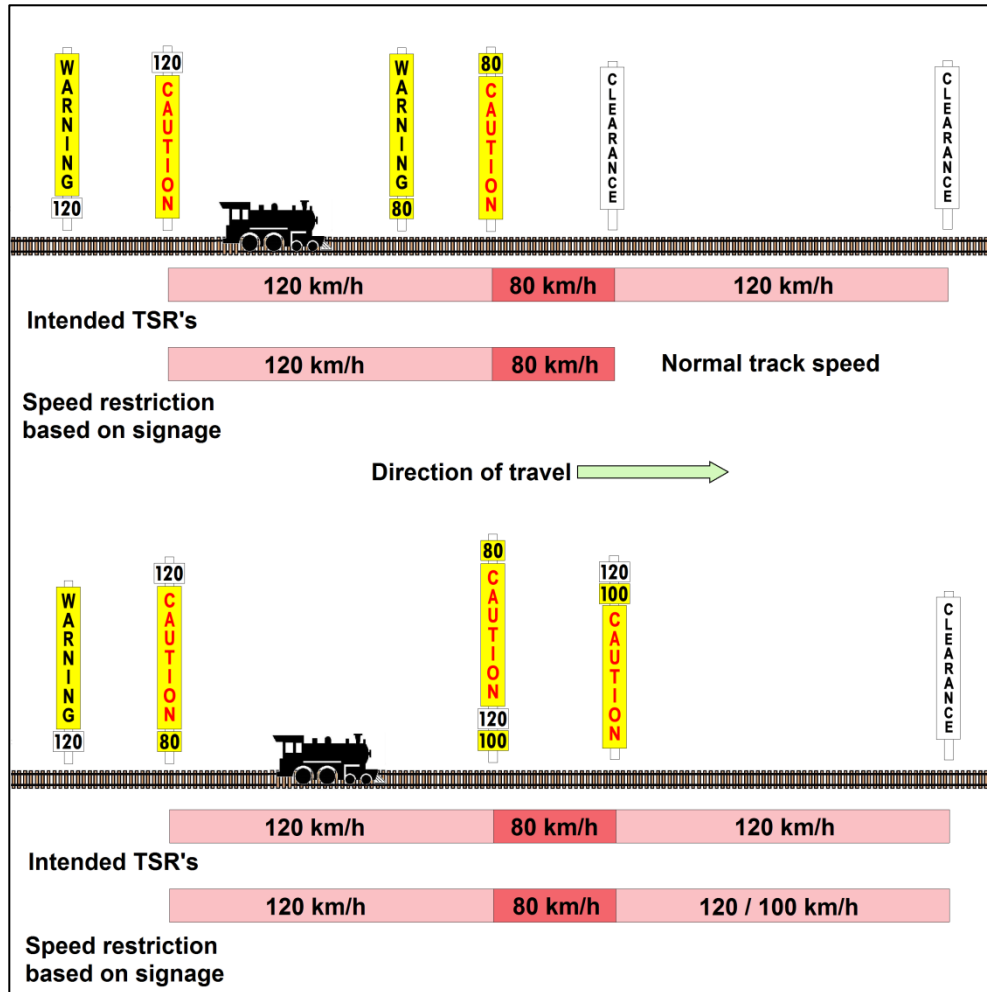
The report (TCR9070) advised that a clearance sign had been installed at the end of each TSR, including the short speed restricted sections within the longer sections. A clearance sign means a TSR no longer applies and normal track speed may be

¹⁰ Distance in kilometres from a track reference point located at Sydney Central Station.

resumed. However, in this case, the first TSR (120 km/h) was intended to apply both before and after the short sections of speed restricted track.

Figure 7 shows an example of the TSR signage as installed on 22 August 2011 (upper image) and an alternative layout that is consistent with the rules and procedures (lower image)¹¹. The figure illustrates how an additional clearance sign removes the speed restriction from a section of track that was intended to have a TSR limit of 120 km/h for passenger trains. The solution illustrated in the alternative layout returns the limit for XPT passenger trains to 120 km/h while also allowing freight trains to travel at up to 100 km/h.

Figure 7: TSR signage between 493.900km and 514.600km



While the ARTC procedure (ANPR-713) does not provide a diagram to illustrate the configuration of signs to be used where a TSR is placed within the boundaries of another TSR, it does clearly state that the clearance sign is to be located 50 m after the 'last' speed restricted area. Based on the information provided to the ATSB, it appeared as though the second (short section) TSRs were applied without knowledge or consideration of the first (long section) TSRs.

Driver interviews identified a number of other irregularities with respect to multiple TSRs. In most cases, the issue related to a series of restrictions (often less than

¹¹ Note that Figure 7 only illustrates the signage for rail traffic travelling in one direction.

2500 m apart) where a warning sign was located within the boundaries of the previous TSR. For example, Figure 7 illustrates a warning sign placed before the 80 km/h caution sign. This is not a valid configuration under the ARTC rule (ANSG-604) and procedure (ANPR-713) for TSRs.

While the signage as illustrated at Figure 7 was not a valid configuration under the rules, the placement of the 80 km/h warning sign did not present a safety risk and in fact provided additional warning for drivers of a change in speed ahead. However, the placement of the clearance sign 50 m beyond the 80 km/h restriction unintentionally released the 120 km/h restriction and therefore allowed XPT services to travel at the normal track speed of 160 km/h.

It was concluded that an additional (or intermediate) warning sign may be appropriate, especially where a second restriction is required some distance (greater than 2500 m) within the boundaries of a longer speed restricted section of track. This would provide drivers with warning of an impending additional TSR within the section.

Victoria

The rules for applying TSRs on the ARTC network in Victoria are documented in *TA20 ARTC Code of Practice for the Victorian Main Line Operations*. In this case, there are four signs indicating a TSR; a 'Warning' sign, a 'Caution' sign, a 'Normal Speed' sign and a 'Normal' sign (Figure 8). However, the rules do not provide any guidance where multiple TSRs may be required within 2500 m of each other, nor where a TSR may be required within the boundaries of another TSR.

With respect to warning signs, the rules in Victoria require a warning to be placed 2500 m before each 'Caution' sign with no reference regarding multiple TSRs. A number of drivers expressed a concern that, with a high number of TSRs existing on the Melbourne to Sydney line (in Victoria), there was increased risk of confusion where multiple TSR locations resulted in warning signs interspersed within the signage of an unrelated TSR.

Figure 8: Speed restriction signs (Victoria)

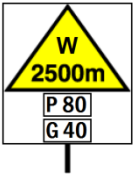
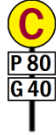

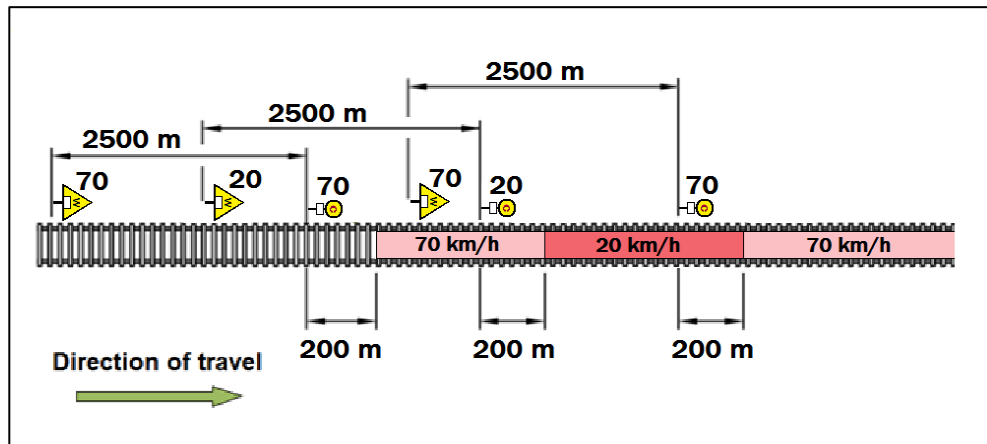
		
<p>The 'Warning' sign is placed 2500 m before the 'Caution' sign.</p> <p>The numbers¹² indicate the speed limit that will apply from the caution sign</p>	<p>The 'Caution' sign is placed 200 m before the affected portion of track.</p> <p>The numbers¹² indicate the applicable speed limit</p>	<p>The 'Normal Speed' sign and 'Normal' sign are placed 200 m and 1200 m (respectively) beyond the affected portion of track.</p> <p>Passenger trains of eight vehicles or less and light locomotives may resume normal speed at the 'NS' sign.</p> <p>Trains with distance counters may resume normal speed when the rear of the train has passed the 'NS' Sign.</p> <p>All trains may resume normal speed when the locomotive has passed the 'Normal' sign. However, trains in excess of 1200 m in length must not resume normal speed until the rear of the train has passed the 'NS' Sign.</p>

Figure 9 illustrates an example (only the warning and caution signs are illustrated) where a driver would see a 20 km/h 'Warning' sign immediately before the first 70 km/h 'Caution' sign. Similarly, a 70 km/h 'Warning' sign precedes the 20 km/h 'Caution' sign. In both cases, the warning sign preceding the caution sign is not intended for the next speed restriction immediately ahead. This configuration may present a confusing, if not misleading, indication of the impending speed restriction. Unlike the New South Wales rules, there is no provision under the rules in Victoria to use a 'Caution' sign as a warning sign for the next restricted area. Consequently, there currently appears to be no alternative in Victoria other than provide a warning sign before each TSR.

The configuration in Figure 9 does not illustrate the 'Normal Speed' sign (200 m after each TSR location) and the 'Normal' sign (1200 m after each TSR location). Without any guidance to the contrary, it is possible that signage may be applied to affected areas without consideration of adjacent or nearby TSRs. Consequently, a 'Normal Speed' and/or a 'Normal' sign may be installed at a location whereby a restriction could be unintentionally released when a TSR was intended to remain (similar to the scenario described above in New South Wales).

¹² The letters 'P' for passenger and 'G' (goods) for freight trains (followed by the permitted speed) are provided when passenger trains are permitted to travel at a higher speed than freight trains.

Figure 9: Multiple speed restrictions (Victoria)



1.5 Operator imposed speed restrictions

During interviews conducted by the ATSB, representatives from train operators and train drivers who regularly travel the line between Melbourne and Sydney raised the issue of operator imposed speed restrictions. Their statements indicated that both passenger and freight organisations and drivers were imposing additional speed restrictions due to poor track conditions and their concerns regarding the safety of train operations. Examples were provided by both Pacific National and V/Line. Pacific National periodically issued their drivers with a 'Local Safety Notice' which specified speed limits to apply for all Pacific National trains over the Melbourne to Sydney line, while V/Line periodically issued memos to their train drivers specifying speed limits to apply to all V/Line trains. These actions suggested the possibility that the TSRs imposed by the ARTC as part of the inspection, assessment and maintenance process were not considered adequate or safe by train operators.

At times during 2010 and 2011, the ARTC had multiple restrictions in place between Melbourne and Albury, mostly at 80 km/h, but with a few locations restricted to lower speeds. The rail organisations decided to impose speed restrictions over much more extensive distances than those imposed by the ARTC, though the speed limits were not much different (that is, generally 80 km/h). This would imply that in general, the limits imposed by the ARTC were considered appropriate where posted, but needed to cover more extensive areas of track.

The ATSB examined the evidence provided to better understand the reasoning behind the self-imposed speed restrictions. The information indicated that operators experienced extensive areas of rough riding over much of the track between Melbourne and Albury, though they acknowledged that TSRs had been applied to most areas. In addition, organisations found it near impossible for trains to run at posted track speeds because of the requirement to slow down for the multiple ARTC imposed TSRs.

Examination of TSR records found that multiple TSRs were often applied within 5 km of each other. Considering that many freight trains are over 1.5 km long, it is evident that after clearing one restriction, trains would almost reach the next. Consequently, there is limited opportunity for trains to increase speed, and if they did, rarely could they reach maximum track speed before needing to slow in preparation for the next restriction.

Based on the evidence available to date, the operator imposed speed restrictions appeared to have been applied for a number of reasons. Organisations acknowledged that extensive areas of rough riding increased the risk of driver/passenger injury or damage to rolling-stock/freight. However, they also noted that multiple and frequent TSRs were detrimental to operational efficiency and on-time running.

Considering the operator imposed restrictions were no slower than the ARTC imposed TSRs, it was apparent organisations considered the ARTC restrictions appropriate. However, it was also evident that organisations had experienced conditions that prompted them to conduct their own testing and/or inspections into ride quality over the Melbourne to Sydney track. As a result of these tests, organisations applied their own blanket restrictions over long sections of track which addressed both operational efficiency and improved ride quality over track not subjected to TSRs.

From the ARTC perspective, the opportunity exists to consider the practical consequences on rail operations when applying frequent TSRs.

1.6 Summary

On 16 August 2011, the Hon Anthony Albanese MP, Minister for Infrastructure and Transport, requested that the Australian Transport Safety Bureau (ATSB) undertake a systemic investigation of rail operations on the interstate rail line between Melbourne and Sydney. A key consideration, discussed within this interim report, was to examine and report on the measures taken to maintain the safety of rail operations where track quality is below acceptable operational standards. The extent and cause of the deteriorated track condition between Melbourne and Sydney will be examined as part of the ongoing investigation.

The process of ensuring track infrastructure is suitable for safe rail operations consists of multiple and complementary components of infrastructure management, such as design, construction, inspection and maintenance. Track infrastructure will deteriorate over time, so it is necessary that the process of inspection, assessment and maintenance be applied to ensure the infrastructure is maintained at a level that permits continued safe rail operations. The process is based on a regime of inspection to detect defects, assessment to determine the required response and corrective action to repair the defect.

The ATSB examined the ARTC's inspection, assessment and maintenance processes as they have been applied to the Melbourne to Sydney line. Based on the evidence available during the early stages of the investigation, the ATSB found:

- There was no evidence to suggest that any systemic issues exist that may compromise the safety of rail operations where track quality is below acceptable operational standards.
- Safety of the Melbourne to Sydney line is being maintained largely through the application of speed restrictions, although increased maintenance activities and speed restrictions have resulted in extended train running times along the corridor.

Based on evidence available to date, the ATSB has also identified a number of issues where the opportunity exists to further improve the safety of operations across the ARTC rail network:

- The rules and procedures for applying TSRs are different between New South Wales and Victoria. In general, training, experience and driver professionalism has reduced the safety risk associated with unique State based rules and procedures. However, a risk remains that operating under multiple rules and procedures has the potential to create driver confusion and as such may impact on rail safety.
- The process of applying TSRs is critical to maintaining safety of rail operations over deteriorated track. However, in some cases, TSR signage had not been installed as per the rules and procedures. In some cases the incorrect application of the TSR meant that a TSR no longer applied over a section of track where a speed restriction was intended to remain. Based on information provided to the ATSB, it appeared as though maintenance personnel had applied a second (short section) TSR without knowledge or consideration of a first (long section) TSR.
- The rules for applying TSR's on the ARTC network in Victoria (TA20) do not provide any guidance where multiple TSRs may be required within 2500 m of each other, nor where a TSR may be required within the boundaries of another TSR. Without any guidance to the contrary, it is possible that signage may be applied without consideration of adjacent or nearby TSRs, with the potential that a restriction may be released where a TSR was intended to remain.
- The use of additional (or intermediate) TSR 'Warning' signs is not specifically covered under the rules in New South Wales, but a warning sign is mandatory prior to all 'Caution' signs under the rules in Victoria. In each case, scenarios exist that may increase the risk to safe rail operations.
 - Where a second restriction is required some distance (greater than 2500 m) within the boundaries of a longer speed restricted section of track, a warning sign would be advantageous to provide drivers with warning of an impending additional TSR within the section, consistent with the warning provided at other restrictions. This is not specifically covered under the existing rules in New South Wales.
 - Where multiple TSRs are relatively close to each other, a warning sign before each TSR can result in warning signs interspersed within the signage of an unrelated TSR. This may contribute to 'sign clutter' and an increased risk of driver confusion. This TSR sign configuration is mandatory under the rules in Victoria.
- A number of multiple and independent sources expressed concern that Network Control Officers were (at times) reluctant to record track condition reports on a TCR. The TCR is often the formal initiator for action to be taken in relation to an increased risk to rail safety. It is therefore critical that a Network Control Officer complete a TCR to ensure potential risks to rail operations are appropriately assessed and actioned.
- Records showed that multiple TSRs were often applied within a relatively short distance of each other, meaning trains had limited opportunity to increase speed before slowing in preparation for the next restriction. While frequent TSRs may be adequate from a track condition point of view, a single restriction combining the requirements of multiple track defects may be more appropriate from an operational perspective. The opportunity exists for the ARTC to consider the practical consequences on rail operations when applying frequent TSRs.

1.7 Actions taken by the ARTC

The object of an ATSB safety investigation is the early identification of safety issues in the transport environment, with the intent that action will be taken to reduce the safety-related risk. Consequently, the ATSB actively communicates with organisation(s) to encourage proactive safety action that addresses safety issues.

Based on evidence available to date, the ARTC continues to apply the relevant inspection, assessment and maintenance processes to the Melbourne to Sydney line. However, during the course of the investigation, the ATSB has identified a number of issues where the opportunity exists to further improve the safety of operations across the ARTC rail network. These issues have been communicated to the ARTC, who have advised of the following actions taken or intended.

Different rules and procedures between New South Wales and Victoria

The ARTC accepts that it has a role to mitigate the safety risk of different rules applying to what effectively is a single network. However, it cannot achieve that outcome without support from other network owners, train operators and safety regulators. Whilst the rail industry and Governments publicly recognise that objective, progress has been very slow.

The ARTC remains committed to a process which will see nationally uniform and consistent safeworking rules for the rail industry which caters for different operating environments. Recognising that that process will continue to take some time, the ARTC will continue to implement its Consolidated Safeworking Rules (CSR) on the defined interstate rail network, acknowledging that it will require regulatory approval and agreement of adjoining network owners. This will be achieved by continuing to participate in the Australian National Rules and Procedures process managed by RISSB.

Incorrect application of TSR rules and procedures

The ARTC accepts that given the number of TSRs that have been imposed there is potential for incorrect application, especially when responding to reports which may require an immediate response at a site within or near an existing TSR. As the report indicates in Figure 7, incorrect application of the rule may lead to an inadvertent outcome. ARTC will again reinforce with its maintenance staff and undertake reviews of application of the following guidance:

- when deciding on the boundaries of a proposed TSR, review the location of any existing TSRs and where practical amalgamate them into a single TSR
- ensure that when a TSR is imposed adjacent to or within an existing TSR the procedures are followed in accordance with ANPR-713.

Guidance for application of TSRs under the TA20 rules and procedures in Victoria

ARTC acknowledges that the rules and procedures for applying TSRs on the ARTC network in Victoria (under TA20) do not provide guidance on signage where TSRs may be required within 2500 m of each other, or where a TSR may be required within the boundaries of another TSR, which could lead to confusion and the inadvertent cancellation of a required TSR. The ARTC will amend the document where required. As mentioned above, the ARTC will reinforce the need for its maintenance staff to consider the location of existing and adjacent TSRs and where possible amalgamate them into one TSR to avoid the issue until the rules and procedures have been amended.

Use of warning signs under the TSR rules - possible risk to safety

In order to avoid the potential confusion that may exist in Victoria because of the requirement for a mandatory warning sign for each speed restriction where TSRs are prepared adjacent to each other or within an existing TSR, the ARTC will again reinforce with its maintenance staff the need to review existing TSRs and where practical amalgamate them into a single TSR.

The ARTC will also review, as part of its Consolidated Rules project, the need to clearly outline the signage requirements for a TSR within or adjacent to an existing TSR so as to avoid potential confusion from the number and location of signs and in particular the warning sign requirement for each TSR.

Consistent use of train control reports

The ARTC has and will continue to reinforce with its Network Controllers the need to create a TCR (Train Control Report) when train drivers report issues with the track.

The ARTC understands the issues raised by stakeholders and appreciates the reports provided by train drivers. The ARTC meets regularly with train operators and will seek feedback from those meetings as to whether an individual circumstance or reports generally are not being generated when requested by drivers. The ARTC will also conduct regular monitoring to check adherence to the procedure.

ARTC is unaware of recent complaints about the lack of creation of TCRs, but also acknowledges that our priority is to remediate the track to demonstrate our commitment to fixing the issue.

Frequent speed restrictions

The ARTC acknowledges that frequent speed restrictions may give rise to confusion and may make efficient train operations difficult. The ARTC have instructed track maintenance staff to take this into account in applying TSRs and have commenced a targeted remediation program to reduce the current number of speeds on the line or by applying a blanket speed restriction across a number of specific sites.

This interim report focuses on issues associated with the safety of rail operations between Sydney and Melbourne. The ATSB continues to examine:

- the condition and management of the rail track between Melbourne and Sydney
- the track maintenance standards, procedures and practices applied to the Melbourne to Sydney corridor
- contemporary rail track maintenance standards and practice outside Australia
- a review of recent rail safety incidents and reports on the Melbourne to Sydney line
- the safe working rules, procedures and practices applicable to works on the track
- any other issues considered relevant to the investigation.

Those, and any other issues identified during the progress of the investigation will be addressed in the final report, including the extent and cause of track deterioration on the Melbourne to Sydney rail corridor.

The ATSB acknowledges the safety actions already taken, which are consistent with what has already been established through the investigation. It is nevertheless possible that further investigation may highlight additional opportunities to improve operational rail safety on the Melbourne to Sydney line.

The Australian Transport Safety Bureau plans to complete its investigation within a year of the Minister's request. Should any further safety issues emerge during that time, the ATSB will bring those issues to the attention of the relevant authorities or organisations and publish them as required.

The investigation is continuing.

Investigation of the safety of rail operations on the interstate rail line
between Melbourne and Sydney