INDEPENDENT
TRANSPORT
SAFETY
REGULATOR

RAIL INDUSTRY SAFETY REPORT

2011–12

Contents

Abbreviations

ARTC	Australian Rail Track Corporation
ATSB	Australian Transport Safety Bureau
BOCSAR	Bureau of Crime Statistics and Research (NSW)
CRN	Country Regional Network
CSB	Controlled Signal Blocking
DIRN	Defined Interstate Rail Network
LOW	Lookout Working
JHR	John Holland Rail
LPA	Local Possession Authority
MRA	Metropolitan Rail Area
NAR	No Authority Required
NCIS	National Coronial Information System
NRSR	National Rail Safety Regulator
OTSI	Office of Transport Safety Investigations
RSRP	Rail Safety Regulators' Panel
SPAD	Signal Passed at Danger (without authority)
TOA	Track Occupancy Authority
TWA	Track Work Authority

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Executive summary

This is the ninth NSW annual *Rail Industry Safety Report* prepared by the Independent Transport Safety Regulator (ITSR). It summarises safety performance on the NSW rail network in 2011–12, as well as historical incident trends over time.

The NSW rail network comprises the Metropolitan Rail Area (MRA) network, the Defined Interstate Rail Network (DIRN), the Hunter Valley Rail Network (Hunter), the Country Regional Network (CRN) and a range of smaller networks including tourist and heritage railways and private lines.

The information presented in this report is based primarily on occurrence notifications – the initial written advice of a safety occurrence that a rail transport operator must submit to ITSR in accordance with the *Rail Safety Act 2008*. The report considers three aspects of rail safety performance:

- *fatality and injury* – fatal and serious injuries as direct measures of harm to people associated with railway operations
- *rail accidents* – those safety occurrences that result in injury or damage, with a focus on accidents with potential for multiple casualties such as passenger train collisions
- *rail accident precursors* – safety occurrences which do not directly cause harm but serve as warning signs of potentially unacceptable events, for example, a broken rail.

The key findings in relation to each of these areas are summarised below.

Fatality and injury

Passengers

- Two passengers were fatally injured in separate occurrences in 2011–12. One person was crushed between a platform and departing train. The other passenger died as a result of an alleged assault.
- The annual number of passenger fatalities decreased over the 23 years of available data.
- The rate of serious passenger injury in 2011–12 (1.59 per million passenger journeys) is consistent with that for the previous two years. About 87% of serious injuries were due to falls.

Railway employees

- There were no employee fatalities in 2011–12, which is the second year in succession with no fatalities.
- The annual number of employee fatalities has not changed significantly over the 23 years of available data, remaining steady at about one per year.
- Thirty-six employees were seriously injured in 2011–12. Accidents included a collision between two track machines, a cleaner struck by a passenger train in a yard and ten employees taken to hospital for smoke inhalation following arson-related incidents.

Members of the public (other than trespassers)

- Three members of the public were fatally injured in separate occurrences in 2011–12. One person was killed in a collision between a train and road vehicle at a level crossing. The other two incidents involved fatal road vehicle accidents that obstructed rail lines.
- About 80% of rail-related public fatality in NSW over the 23 years of available data was associated with collisions between trains and road vehicles at level crossings.
- The annual number of public fatalities resulting from level crossing collisions decreased over the 23 years of available data.

Trespassers (including suspected suicide)

- Twenty-eight people were killed in trespass-related incidents in 2011–12.
- The annual number of trespass fatalities decreased over the 23 years of available data, however, the decreasing trend is not constant and appears to have levelled off in recent years.
- A separate analysis of coronial information shows that just over 75% of trespass-related fatalities on the NSW rail network since July 2000 involved acts of suicide.

Rail accidents

Train derailment

- Three running line passenger train derailments were notified in 2011–12. Each train was carrying passengers but no injuries were reported for any incident.
- Twenty-three running line freight train derailments were notified in 2011–12. Two-thirds of these were associated with low speed movements to or from yards.
- The rates of running line passenger and freight train derailment (per million train km travelled) and the number of track machine derailments have not changed significantly over the past five years.

Train collision

- Nine level crossing collisions between trains and road vehicles were notified in 2011–12. Three collisions involved passenger trains, and thereby exposed large numbers of people to potential harm. There were several serious near miss incidents involving trains and heavy road freight vehicles.
- The annual number of level crossing collisions decreased over the 23 years of available data. A contributing factor to this reduction is level crossing closures (122 since 2002) and safety upgrades (five major upgrades in 2011–12).
- Six running line collisions between trains were notified in 2011–12. Two incidents involved passenger trains but no injuries were reported for either incident. In both cases, the passenger train was struck by out of gauge equipment on a passing freight train. Four collisions involved track machines.

Fire

- Almost 90% of fires on passenger trains in 2011–12 were associated with arson on the MRA. The incident rate (per million passenger journeys) appears to have decreased over the past five years.
- The rate of rolling stock-related passenger train fire (per million train km travelled) has decreased over the past five years but appears to have steadied in recent years.
- The rate of rolling stock-related fire on freight trains (per million train km travelled) increased over the past five years.

Accident precursors

Safeworking systems

- The rate of passenger train SPADs on the MRA (per million train km travelled) decreased over the five years to 2011–12. The rate of freight train derailments across the NSW network has not changed significantly over time.
- The number of notified breaches for most forms of procedural systems has not changed significantly over time. However, the number of incidents involving workers on track with no protection in place appears to have fallen.
- There is evidence of a temporary rise in some types of breach following changes in the systems of working and responsibilities for control.

Signal and track

- No serious failures in the systems used to authorise train movements were notified in 2011–12. However, there were four occurrences involving wrong side failures in level crossing warning equipment used to control road and pedestrian traffic.
- A previously reported increase in track misalignments on the main southern corridor between Sydney and Albury appears to have stabilised. However, misalignments have increased on other segments of the network over the past five years.

Rolling stock

- The number of notified wheel and bearing failures remains low. However, accident findings indicate these types of irregularities remain significant contributors to freight train derailments.
- The rate of braking system irregularity on freight trains (per million train km travelled) has increased over time.
- At least two track machine runaways notified in 2011-12 involved braking irregularities. One of these incidents involved a near miss with a track worker.

Freight load

- The rate of most forms of load irregularity, including open door and load shift on freight trains, (per million train km travelled) decreased over the past five years.
- The rate of uneven load incidents (per million train km travelled) decreased in 2011–12, following an elevated rate the previous year. However, at least one derailment in 2011–12 was attributed to an uneven load.

Fitness for duty

- The amount of drug and alcohol testing performed by industry in 2011–12 was the highest of the past five years. Testing increased in all sectors except passenger operator alcohol testing which remained steady.
- The overall detection rate for drugs (positives per tests conducted) decreased from 1.05% in 2010–11 to 0.75% in 2011–12. The rate of detection for passenger operators and infrastructure maintainers decreased over the past five years.
- The overall detection rate for alcohol decreased from 0.05% in 2010–11 to 0.03% in 2011–12. The rate of detection for freight operators remained steady over time while rates decreased for all other sectors over the past five years.

Some aspects of the 2011–12 incident analysis point towards an improvement in rail safety. An important example is the significant decrease in the annual number of both passenger and public fatalities in NSW over the 23 year record available to ITSR. The 2011–12 year was also the second in succession without a notified employee fatality – the first time since the beginning of available records.

While rail transport operators must ensure adequate measures are in place to protect people from harm, individuals have a degree of personal control over their exposure to some hazards. This is most evident in unlawful acts such as suicide and trespass, which collectively accounted for 85% of all fatalities on the NSW rail network over the past 10 years. Responsibility for safety also extends to passenger behaviour. Fifteen of the 18 passenger fatalities since the Waterfall train accident and 85% of serious passenger injuries in the past three years involve falls, with many involving intoxication or dangerous behaviour such as rushing to catch trains.

The level of harm associated with rail system safety risk appears to have reduced over time as a result of the focus and effort to improve rail safety in NSW. It has been nine years since the last multi-fatality passenger train collision or derailment in NSW. The improvement in safety is also evident in incident statistics for some important accident precursors. The number of broken rails on the MRA decreased over the past five years. A previously reported rise in track misalignments on the main southern corridor between Sydney and Albury also appears to have steadied, following the start of remedial works. There is also evidence of improvement in some aspects of the safeworking systems used to ensure the safe movement of trains, for example, a fall in the rate of passenger train SPADs and a marginal decrease in breaches of degraded working systems – used when normal methods of safeworking have been suspended.

While this positive trend in rail safety risk is reassuring, incident data shows there remains potential for multi-fatality rail accidents on the NSW rail system. Two level crossing collisions and several near miss incidents in 2011–12 involved intercity passenger trains travelling at high speed, thereby exposing passengers and crew on these trains to potential harm. There were 23 freight train derailments in 2011–12, posing safety risks to train crew. Some of these derailments occurred on corridors shared with passenger services, introducing a collision risk when freight wagons foul adjacent lines. An issue concerning the safe operation of track machines has also emerged – in 2011–12 ITSR was notified of three incidents involving runaways of hi-rail vehicles, exposing both machine operators and track workers to harm.

The effective management of rail safety risk remains vulnerable to operators' reliance on procedural-based risk controls for safeworking systems. While there is the suggestion of a decrease in the number of incidents involving workers on track with no protection, more than 100 serious incidents involving failures in the procedural systems used to protect workers on track were notified in 2011–12. There is also some evidence of an occasional, temporary rise in the number of breaches immediately following a change in the system of working, or the transfer of responsibility for control to different organisations or control centres, suggesting safety change management practice needs further attention.

Under rail safety law, rail transport operators are responsible for assessing and managing safety risks posed by their operations. ITSR's role, as the regulator[1], is to verify the competency of rail transport operators to develop and maintain their own systems for managing safety and preventing accidents and to assist in improving the effectiveness and maturity of their risk controls. Promotion of better practice is one means by which ITSR achieves its objectives. Examples in 2011–12 included completion of a two-year study of national road crash, rail accident and level crossing survey data to form the basis for improvements to risk models and to assess safety risks at level crossings. ITSR also launched an assurance review service for the rail industry, providing a standardised review of an operator's asset management practices. At a strategic level, in 2011–12 ITSR provided specialist support to Transport for NSW in the negotiation of suitable standards for industry drug and alcohol testing and fatigue management in Rail Safety National Law.

Education and promotion is always underpinned by traditional compliance and enforcement activities as necessary. The continued high number of serious irregularities in the management of workers on track required strong regulatory focus. In 2011–12 ITSR conducted over 30 inspections of worksites, and another 70 inspections of freight and passenger operators, to verify that the risks associated with their operations were being monitored and managed. ITSR's activities also included attendance at operational meetings, site inspections and oversight of operators' accident investigations – these are particularly important in cases where risks cannot be effectively monitored through incident data, as in the case of broken axles, where precursor conditions such as subsurface axle defects are not easily detected or notified prior to catastrophic failure.

For particularly serious incidents involving harm to people or property, or where significant harm was narrowly avoided, ITSR will initiate a formal compliance investigation to determine

1 In addition to enforcing the *Rail Safety Act 2008*.

whether breaches of legislation have occurred. In 2011–12 ITSR commenced 30 such investigations. The investigations covered a range of serious incidents, including the derailment of a freight train on the MRA due to an axle failure, the runaway of a freight train on the DIRN and multiple worksite protection failures, including a collision between a train and an excavator and between a train and track machine.

ITSR's enforcement options range from facilitation, through statutory notices, up to the suspension of accreditation or prosecution in the case of serious breaches of legislation. In 2011–12 ITSR commenced prosecutions of the rail operators involved in two accidents – the track worker fatality at Kogarah in April 2010 and the track worker fatality at Newbridge in May 2010. ITSR also commenced six prosecutions of rail safety workers for offences under the drug and alcohol provisions of the NSW rail safety legislation.

ITSR's 2011–12 regulatory program and operational priorities are described fully in ITSR's *Annual Report 2011–12*[2].

2 See ITSR's website <http://www.transportregulator.nsw.gov.au>.

1. Introduction

Section 62 of the *Rail Safety Act 2008* requires ITSR to submit an annual safety report to the NSW Minister for Transport. This *Rail Industry Safety Report 2011–12* summarises key rail safety incidents on the NSW rail network for the year and also considers historical trends. Most of the statistical summaries in this report are based on the incident categorisation within the national occurrence classification guideline (OC-G1, 2008)[3].

1.1 Industry overview

For ITSR's purposes, a railway is a guided system designed to transport passengers or freight on a railway track, together with related infrastructure and rolling stock. This includes the heavy rail systems of RailCorp, the Australian Rail Track Corporation (ARTC) and John Holland Rail (JHR) as well as light rail, monorail and various tourist and heritage operations.

The heavy rail sector in NSW comprises two key segments:

- below-rail or track and infrastructure networks
- above-rail or fleet and train operations on the networks.

The sector also incorporates ancillary facilities including terminals, stations and sidings and support services such as construction and maintenance of infrastructure.

Below-rail

There are four primary below-rail networks in NSW[4] (Figure 1):

- The Metropolitan Rail Area (MRA) network is centred in Sydney and comprises about 2,000 km of track. It is under the management and control of RailCorp and is mainly used by CityRail urban and inter-urban passenger services. It also services intrastate freight transport and includes dedicated freight lines to major Sydney terminals such as Port Botany and Cooks River.
- The Defined Interstate Rail Network (DIRN) covers about 3,400 km of track. The DIRN extends beyond NSW and connects the MRA with the other mainland state capitals. It is owned by the NSW Government but is leased to, and managed by, ARTC as part of the interstate rail network. The DIRN is used primarily for freight transport and long distance passenger trains including CountryLink.
- The Hunter network is also managed by ARTC as part of the lease from the NSW Government. It is used primarily for transport of coal to the Newcastle ports but also carries intermodal freight, interurban passenger trains and CountryLink services. In July 2011 the Hunter network was extended to incorporate the line running from the Gunnedah basin collieries into the Hunter Valley coal supply chain. An extra 370 km of track from Gap to Boggabilla was transferred to the lease to bring the total track length of the network to over 1,100 km.
- The Country Regional Network (CRN) is mainly used for bulk commodities such as grain, however it also carries other freight traffic and passenger services. In July 2011 the section of the CRN from Gap to Boggabilla was transferred to ARTC's Hunter Valley lease. In January 2012 operational control and infrastructure management of the CRN was transferred from ARTC to John Holland Rail. The CRN comprises about 2,800 km of operational track and over 3,000 km of non-operational track.

Above-rail

The above-rail segment comprises rail fleets for passenger and freight tasks. A summary of change in passenger and freight movements in NSW over the past five years is shown in Figures 2 to 4.

The passenger segment is dominated by the RailCorp-owned CityRail (Table 1). This is a commuter railway with more than 1,650 carriages, 307 stations and providing one million

3 Rail Safety Regulators' Panel, *Guideline for the Top Event Classification of Notifiable Occurrences: Occurrence Classification – Guideline One (OC-G1)*, RSRP, June 2008.
4 In this report, the allocation of occurrences to networks (DIRN, MRA, etc.) is based on the occurrence location as supplied in the occurrence notification. Historical data are allocated to networks in their current configuration, for example, incidents between the Gap and Bogabillia (historically CRN) are now included in the DIRN and Hunter network.

trips, on average, per weekday. CityRail provided 304 million passenger journeys in 2011–12 (Table 1), representing more than 99% of all passenger journeys in NSW. The number of journeys in 2011–12 represents a 7% rise in the annual number of journeys compared to 2007–08.

CountryLink, also owned by RailCorp, is the principal provider of long distance passenger rail services. In 2011–12 the CountryLink fleet undertook some two million passenger journeys to regional NSW and interstate destinations including Melbourne and Brisbane.

Heritage railways also carry passengers in NSW. Some operators use their own track, while others operate on the MRA and the DIRN. The five largest operators based on number of passenger journeys are shown in Table 2.

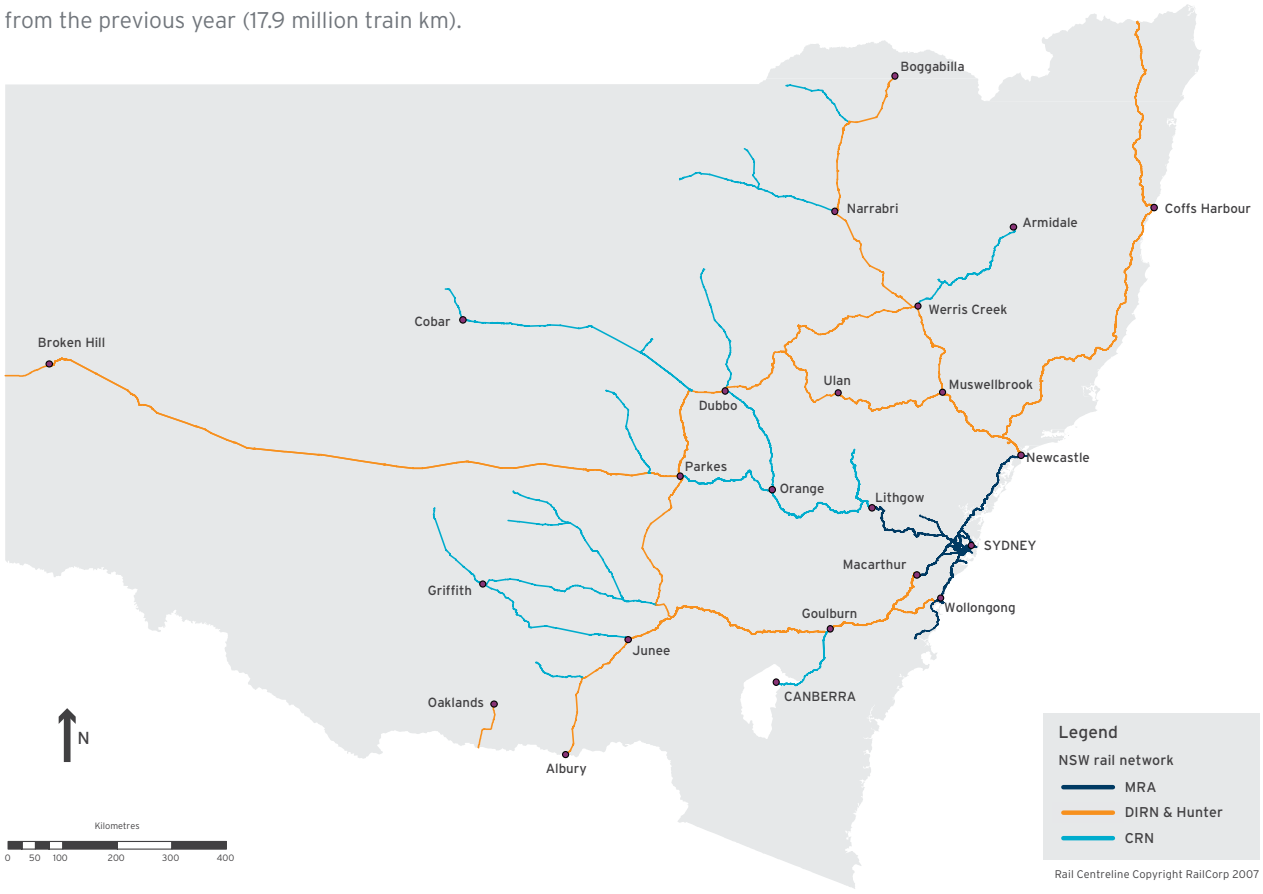
The freight task comprises two main elements – bulk freight, such as coal and grain, and intermodal freight, such as containerised goods. In NSW the largest freight task is coal haulage in the Hunter Valley. Pacific National represents almost 70% of total freight train kilometres travelled in NSW (Table 3). Freight train movements have gradually increased from early 2010 (Figure 4). The 2011–12 figure (19.2 million train km) represents a 7% increase from the previous year (17.9 million train km).

Ancillary facilities

Ancillary facilities include stations, terminals and private line connections to the networks. Nearly all operational stations in NSW are controlled by RailCorp. The light rail and monorail tracks and facilities in Sydney, including respective stations, are controlled by Veolia Transport.

Some terminals are owned by above-rail freight operators, for example, the Sydney Freight Terminal at Chullora is owned by Pacific National. Other terminals are controlled by third parties, for example Port Waratah (Newcastle) by Port Waratah Coal Services and Cooks River Yard controlled by Maritime Container Services.

Privately owned lines and sidings connected to the NSW network include balloon loops from coal mines, grain silo sidings and lines in industrial areas such as Port Kembla.



▶ Figure 1: Major rail networks in NSW, 2011–12

The rail line running between the Victorian border and Oaklands in NSW is part of the defined interstate rail network (DIRN) but leased by ARTC from the Victorian Government.

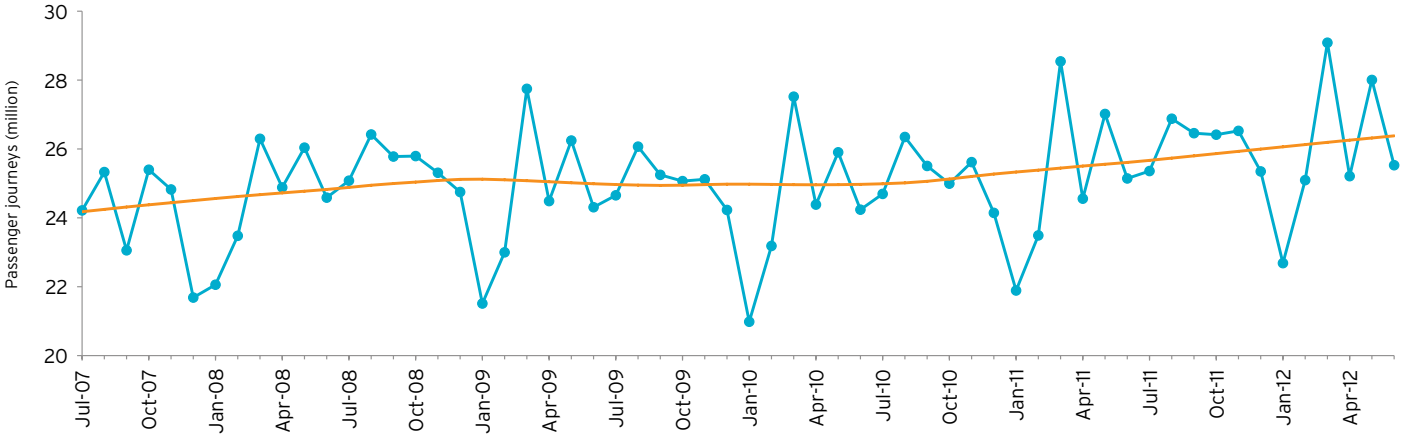


Figure 2: Passenger journeys on the NSW rail network, 2007-08 to 2011-12

Shows monthly total passenger journeys and smoothed trend. Based on data provided by NSW rail transport operators.

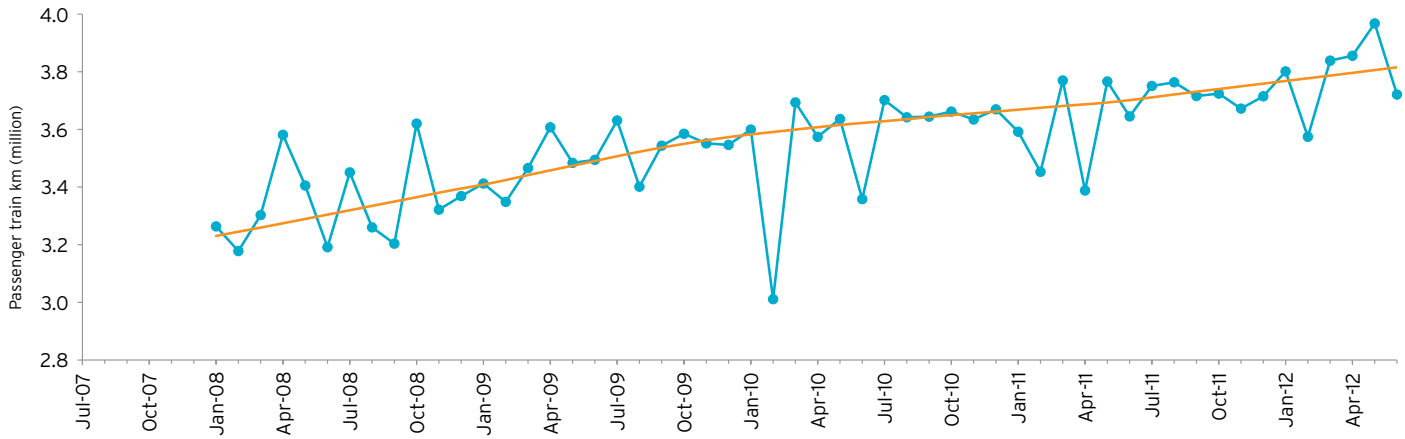


Figure 3: Passenger train km on the NSW rail network, 2007-08 to 2011-12

Shows monthly total passenger train km and smoothed trend. Based on data provided by NSW rail transport operators. Data prior to 2008 not shown due to a change in method of calculation by RailCorp which limits comparability over time.

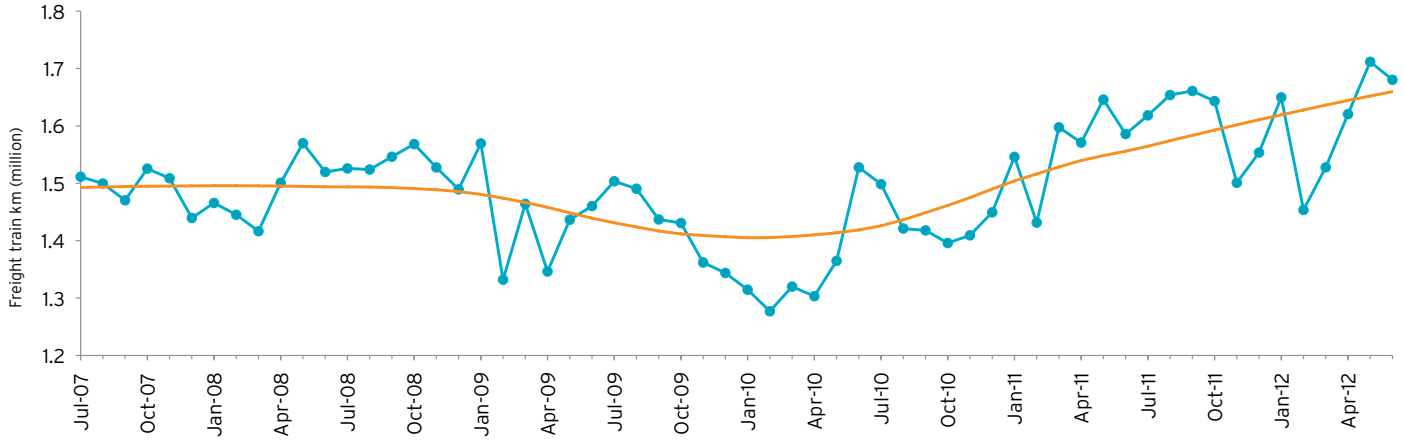


Figure 4: Freight train km on the NSW rail network, 2007-08 to 2011-12

Shows monthly total freight train km and smoothed trend. Based on data provided by NSW rail transport operators.

▶ Table 1: Top five commercial passenger rolling stock operators in NSW (by passenger journeys) 2011–12

Operator	Passenger journeys	Passenger train km
Railcorp – CityRail	303,549,541	38,990,318
Veolia Transport Pty Ltd (Light Rail)	4,389,494	491,401
Veolia Transport Pty Ltd (Monorail)	2,175,109	201,059
Railcorp – CountryLink	1,996,941	5,050,271
Perisher Blue Pty Ltd	221,332	78,937

▶ Table 2: Top five tourist and heritage rolling stock operators in NSW (by passenger journeys) 2011–12 (operating as at 30 June 2012)

Operator	Passenger journeys	Passenger train km
Zig Zag Railway Co-op Ltd	46,456	22,528
Sydney Tramway Museum	41,168	5,479
NSW Rail Transport Museum	25,795	24,703
Lachlan Valley Railway Society Co-op Ltd	21,775	14,030
Australian Railway Historical Society (ACT Div)	10,780	6,942

▶ Table 3: Top five freight rolling stock operators in NSW (by freight train km travelled) 2011–12

Operator	Freight train km
Pacific National Pty Ltd	13,413,203
QR Limited	1,451,124
Qube Logistics (Rail) Pty Ltd	1,054,374
Interail Australia Pty Ltd	891,434
Independent Railways of Australia Pty Ltd	656,062

Support services

Organisations that construct or maintain infrastructure or rolling stock also need to comply with the *Rail Safety Act 2008*. Some rail transport operators conduct a substantial amount of maintenance in-house, however for some tasks such as infrastructure maintenance, a comparatively high proportion of work is undertaken by contracting organisations.

Regulation

Rail safety law in Australia is based on a co-regulatory model. Under this model, the government determines the legislative framework after consulting with the rail industry. Rail transport operators are responsible for assessing the risks to safety associated with their railway operations and establishing an effective safety management system (SMS) to mitigate the risks, either by elimination or by implementing appropriate controls. Rail safety regulators are responsible for ensuring compliance with the law and accrediting rail transport operators. The purpose of accreditation is to verify a rail transport operator has the systems, capacity and competency to implement its SMS, effectively manage safety risks and assure the safety of its operations. Regulators also monitor the safety performance of rail transport operators through compliance and enforcement activities, including targeted inspections and compliance investigations.

1.2 Rail safety reporting

Background

Section 63 of the *Rail Safety Act 2008* requires rail transport operators to notify ITSR of safety-related incidents on the NSW rail network. Notifiable occurrences are defined in the *Rail Safety Act 2008* (Section 4) as any accident or incident associated with railway operations that has, or could have, caused significant property damage, serious injury or death or an incident of a type prescribed by the regulations to be a notifiable occurrence (summarised in Section 7).

Notifiable occurrences must be reported to ITSR within 72 hours of the rail transport operator becoming aware of the occurrence taking place. Occurrence reports are submitted using a standard form, with the information to be provided based on the national guideline for reporting notifiable occurrences (ON-S1 2008)[5].

5 Rail Safety Regulators' Panel, *Guideline for the Reporting of Notifiable Occurrences: Occurrence Notification – Standard One (ON-S1)*, RSRP, June 2008.

Notifiable occurrence statistics

For the purpose of analysis and reporting, each notifiable occurrence report received by ITSR is classified into one of the standard national occurrence categories defined in the national occurrence classification guideline (OC-G1, 2008)[6]. Classification is generally done by rail transport operators at the time of the notification based on the information available at that time. However, in some circumstances the classification of an occurrence record may change at a later date as further information comes to hand.

The unit of classification under the national occurrence classification guideline is the *top event* of an occurrence. This is defined as the event with the greatest adverse outcome, expressed in terms of injury, property damage or accident potential. A notifiable occurrence will often comprise several events, for example, a signal passed at danger (SPAD) followed by a derailment at catch-points. Under the national guideline, this occurrence would be classified (and counted) as a derailment only. For some incidents, the selection of the top event is not straightforward and involves a choice between various realised and potential outcomes. The decision on the relative importance of these factors is often subjective which leads to some inconsistencies in the classification[7].

Changes in occurrence classification

The national occurrence reporting and classification scheme was revised in June 2008 and implemented by NSW rail transport operators in January 2009. All notifiable occurrence records held by ITSR prior to January 2009 were classified to a former version of the scheme[8]. ITSR continues to reclassify historical records for important types of occurrences to the June 2008 occurrence classification guideline.

Most statistical summaries in this report are based on the national occurrence categories. This includes summaries of related attributes such as the type of person involved in an occurrence (for example, *passenger, public, employee*) and type of train (for example, *freight train, passenger train*). Where categories or related data items differ from the national occurrence reporting and classification scheme these are noted in the text.

Safety trends through time

ITSR's notifiable occurrence records extend back over 20 years. In this time there have been major changes in the legislative requirements for incident reporting, including the types of occurrences to be notified, their classification, data custodianship and associated quality standards. Consequently, some of the observed changes in occurrence rates over time, and between sectors, are artefacts of changes in the processes governing incident data capture, coding and reporting.

For this report, most historical data series are restricted to the most recent five years (that is, from 1 July 2007 to 30 June 2012). This period of data excludes most of the major changes to reporting processes in NSW. For example, on 1 January 2004, the administration and enforcement of the *Rail Safety Act 2002* was transferred to ITSR. From this time a larger number of rail transport operators undertaking a greater range of operations began notifying occurrences directly to ITSR. Also, the most recent structural changes to the rail industry in NSW occurred during 2004 and the national occurrence reporting and classification scheme was introduced in NSW at the end of that year. However, the period of data in this report is still subject to changes in the reporting process and these issues are noted in the text of relevant chapters.

Informing safety management

Analysis of notifiable occurrence data is an important part of the process to identify safety issues and emerging trends. However, notifiable occurrences are lag indicators of rail safety in that they represent failures in safety management that have already progressed to an unacceptable state such as a broken rail, or an adverse outcome such as injury or damage. Further, because of the requirement to notify in a timely manner, notifications often lack information on the underlying causal factors of incidents, which usually only come to light after investigation.

In order to prevent serious incidents such as train collisions and derailments, safety performance monitoring must also incorporate measures of the state of organisational, procedural and behavioural systems designed to prevent accidents. This ensures that safety deficiencies are identified at an early stage, before they escalate to the point of a failure or adverse outcome.

6 Rail Safety Regulators' Panel, *Guideline for the Top Event Classification of Notifiable Occurrences: Occurrence Classification – Guideline One (OC-G1)*, RSRP, June 2008.
7 There is tendency for users to default to a realised consequence as the primary determinant of top event, even if that consequence was minor relative to far greater potential harm narrowly avoided.
8 Rail Safety Regulators' Panel, *Occurrence Categories and Definitions (ON-S1)*, RSRP, August 2004.

Such measures are referred to as lead indicators of safety because they help to flag potential safety issues. Examples of lead indicators include the proportion of required training delivered and the proportion of scheduled safety audits performed.

ITSR therefore uses a variety of safety information, in addition to notifications, to measure safety performance and guide regulatory activity. These include findings from investigations of rail accidents, both within and outside NSW, to identify hazardous events and contributing factors relevant to NSW railways. Safety risk modelling also plays a critical role, particularly in relation to lower frequency, high consequence risks that may not be apparent over the decade or two that occurrence data is available. A large part of ITSR's regulatory activity comprises compliance inspections, which focus on rail transport operators' capacity and competency to identify safety risks relevant to their operations and ensure they are appropriately controlled[9].

9 ITSR's regulatory activities are described in ITSR's *Annual Report 2011–12*. See ITSR's website <http://www.transportregulator.nsw.gov.au>.

2. Rail-related fatality and injury

Threats to personal safety on railway premises arise from various hazards. Some of these hazards are unique to rail operations such as train movement, while others are experienced in everyday life such as antisocial behaviour. Exposure to such hazards will vary according to the nature of an individual's interaction with a railway.

Figure 5 provides a summary of railway fatalities in NSW over the past decade, in terms of the person's relationship with the railway at the time of the occurrence (employee, passenger, etc.) and the types of accident that led to the fatality.

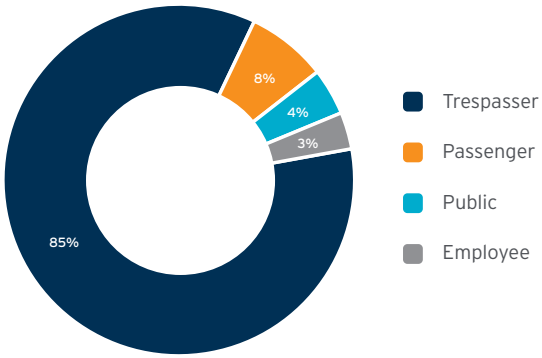
Trespass accounted for 85% of all rail fatalities in NSW over the period, most of which were associated with suicide[10]. The remaining fatalities were unintended consequences of other unlawful, but voluntary, behaviour such as skylarking, vandalism and taking shortcuts across rail property. Most of the 276 trespass fatalities were associated with hazards unique to rail (90% were due to strikes). However, the balance of responsibility for managing this risk lies with the individuals who choose to engage in dangerous behaviour. Trespass-related fatality is described in Section 2.4 of this report.

Employees and passengers collectively represent just over 10% of rail fatalities over the past 10 years. Most fatalities arose from hazards specific to rail such as derailments and train strikes.

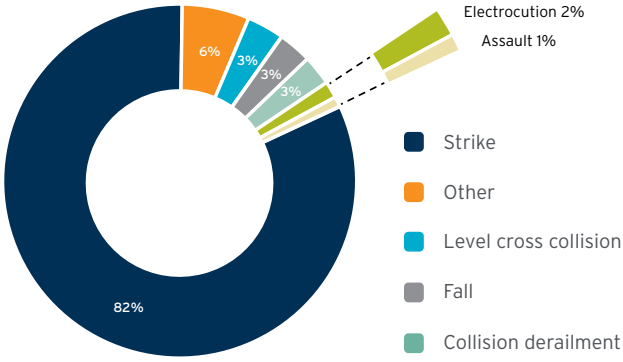
However, unlike trespass, the individuals involved had not engaged voluntarily in dangerous behaviour and the balance of responsibility for managing such risks lies with rail transport operators. Some hazards to which employees and passengers are exposed are not unique to rail and are experienced in everyday life such as falls on stairs. In these cases, individuals have a role to play in managing safety, for example, walking rather than running for a train. Much of this report is devoted to summarising threats to passenger and employee safety.

Fatalities involving members of the public (4%) were associated primarily with level crossing collisions. Level crossings pose a unique challenge for rail safety management – road users have legitimate access to the corridor via level crossings yet the collision risk posed by dangerous road user behaviour is significant. These issues are described further in Sections 2.4 and 3.2 of this report.

Involvement (Number of fatalities = 325)



Mechanism (Number of fatalities = 325)



▶ Figure 5: Fatality on the NSW rail network over the past decade, 2002-03 to 2011-12

Strike is a collision between a train and a person. *Trespasser* includes acts of suicide. Percentages have been rounded.

10 See the results of work by ITSR to verify NSW's rail fatality record against information within the National Coronial Information System (Section 2.4 of this report).

2.1 Passengers

SUMMARY

- Two passengers were fatally injured in separate incidents in 2011–12. One passenger died when crushed between a platform and a departing train. The other died as a result of alleged assault.
- The annual number of passenger fatalities decreased over the 23 years of available data.
- Falls account for 15 of the past 18 passenger fatalities since the Waterfall train accident. The remaining three fatalities involved alleged assault.

Two passengers were killed on the NSW rail network in 2011–12 (Table 4). Both incidents occurred on the MRA. One person died in a security incident (alleged assault) and the other died after falling between a platform and the departing train.

A total of 497 passengers received injuries in 2011–12 that required transport to hospital[11]. The majority of injuries occurred on the MRA and involved personal safety and security threats as opposed to rail-specific hazards. About 87% of injuries (430) involved falls, with a higher proportion occurring on weekdays during the morning and afternoon commuter peaks compared to other times. Falls on stairs, ramps, and escalators collectively accounted for almost 45% of fall-related injuries. Alleged assault accounted for 11% of injuries, and this type of incident was most common in the late evening/early morning towards the end of the week. One passenger was seriously injured as a result of being struck by a train (Table 5).

The profile of passenger injury and fatality in 2011–12 is similar to that observed in recent history (Figure 6). The rate of injury (1.59 per million passenger journeys) is consistent with the previous two years of available data (1.69). The number of passenger fatalities remains close to the historical low of recent years, having decreased over the 23-year period of record from a median of six fatalities per year in the first decade to two fatalities per year in the decade to 2011–12 (Figure 7).

Falls dominate the historic fatality record, although the nature of falls has changed over time. Falls from train were the main cause of passenger fatality in the first decade. A program of central locking in urban and interurban passenger services in the late 1990s, whereby doors remain locked whilst the train is in motion, virtually eliminated this type of occurrence[12]. Falls account for 15 of the past 18 passenger fatalities since the Waterfall train accident. In five of these cases the injury was sustained in the fall itself. Ten incidents involved a strike following a fall from a platform. Passenger behaviour is a significant factor in some of these incidents. Coronial information[13] shows elevated blood alcohol in 10 of the 15 fatal falls. At least 10% of non-fatal falls also refer to intoxication. Another contributing factor is passengers rushing on stairs and platforms. There is also evidence that older passengers are overrepresented in falls, based on available patronage figures.

Alleged assault accounted for three of past 18 fatalities in NSW and 12% of all non-fatal passenger injuries in the three years to 2011–12. Longer term data on assault-related incidents[14] is

Note on injury grading

The grades of injury severity within the national occurrence classification guideline are based on the level of medical attention required. A *serious* injury is defined as one that requires admittance to hospital. A *minor* injury is defined as one that requires medical attention but not admission to hospital.

Unfortunately, rail transport operators nationally cannot reliably determine the level of health care received by injured people after they have left railway premises, for example, determining whether or not a person transported to hospital was subsequently admitted. Consequently, other criteria are used by rail transport operators to grade injury severity, including workplace injury scales and length of time of incapacitation. The criteria vary over time and between operators which introduces inconsistency into data, limiting comparability.

Instead of using the hospital *admission* criterion to define serious injury, this report adopts a criterion of *ambulance transported*. Information to support this criterion is generally available in the occurrence narrative and provides an opportunity to delineate more significant injuries in a consistent manner. However, this criterion is far broader (more inclusive) than the hospital admittance criterion as less than half of all persons presenting at hospital will be admitted.

11 Refer to Note on injury grading (this page).
12 Independent Transport Safety and Reliability Regulator, *Train door emergency egress and access and emergency evacuation procedures*, ITSRR, November 2004.
13 Refer to Note on use of Coronial information (Section 2.4).
14 As defined in: Australian Bureau of Statistics, *Australian and New Zealand standard offence classification (ANZOC)*, cat. no. 1234.0, ABS, 2011.

compiled by the NSW Bureau of Crime Statistics and Research (BOCSAR) based on crimes reported to, or detected by, police. The rate of criminal assault on railway premises[15] (per million passenger journeys) has decreased over time, albeit at varying rates (Figure 8). A separate analysis of crime on the NSW rail network[16] concluded recorded rates of crime are generally low. It did however highlight that personal risk (that is, risk to a given individual attending a station) is greater at stations on the periphery of the MRA. In May 2012 the NSW Government implemented a Police Transport Command to more effectively target crime on the NSW rail system which may lead to further improvements in personal security.

Recent injury and fatality statistics are suitable indicators of personal accident risks associated with incidents such as falls and assaults, because these occur at sufficient frequency to monitor change. However, they do not accurately reflect the full risk profile of a railway, particularly in relation to potentially catastrophic rail accidents such as passenger train collisions and derailments which are rare and by chance may not be captured or reflected in shorter data series.

It has been more than nine years since the last multi-fatality passenger train accident in NSW (Waterfall accident, January 2003). While these types of accidents are rare they still constitute a significant risk to NSW rail operations. The three multi-passenger fatality accidents in NSW, shown in Figure 7, represent about 3% of all fatal incidents but almost 20% of all passenger fatalities. Despite the absence of a catastrophic rail accident over an extended period, the risk remains relevant. Sections 3 and 4 of this report presents summary statistics for a range of accidents and accident precursors which serve as warning signs of fatal train accidents still possible under the current risk control framework of NSW railways.

Table 4: Passenger fatality on the NSW rail network, 2011–12

Excludes fatalities associated with trespass, suspected suicide and ill-health. Network in brackets.

Date	Time	Location	Category	Description
26 August 2011	0422	Cardiff (MRA)	Alleged assault – on train	Passenger assaulted and died of injuries following day.
24 February 2012	2319	Newtown (MRA)	Train collision – running line – person	Passenger fell from platform and crushed between platform and departing train.

Table 5: Passenger injury on the NSW rail network, 2011–12

Persons injured and requiring transport to hospital as a result of railway-related accidents. Excludes *slip, trip, fall; trespass; attempted suicide; alleged assault* and occurrences not classified under the national occurrence classification guideline (for example, scalds, striking/being struck by equipment). Network in brackets.

Date	Time	Location	Category	Description
22 November 2011	0849	Wiley Park (MRA)	Train collision – running line – with person	Passenger fell from platform and was struck by train. Ambulance conveyed person to hospital.

15 NSW Bureau of Crime Statistics and Research, unpublished annual criminal incident statistics (quarterly update to end June 2012), 09 September 2012.
16 NSW Bureau of Crime Statistics and Research, *Crime on the NSW rail system*, Issue paper no. 64, August 2011, Sydney.

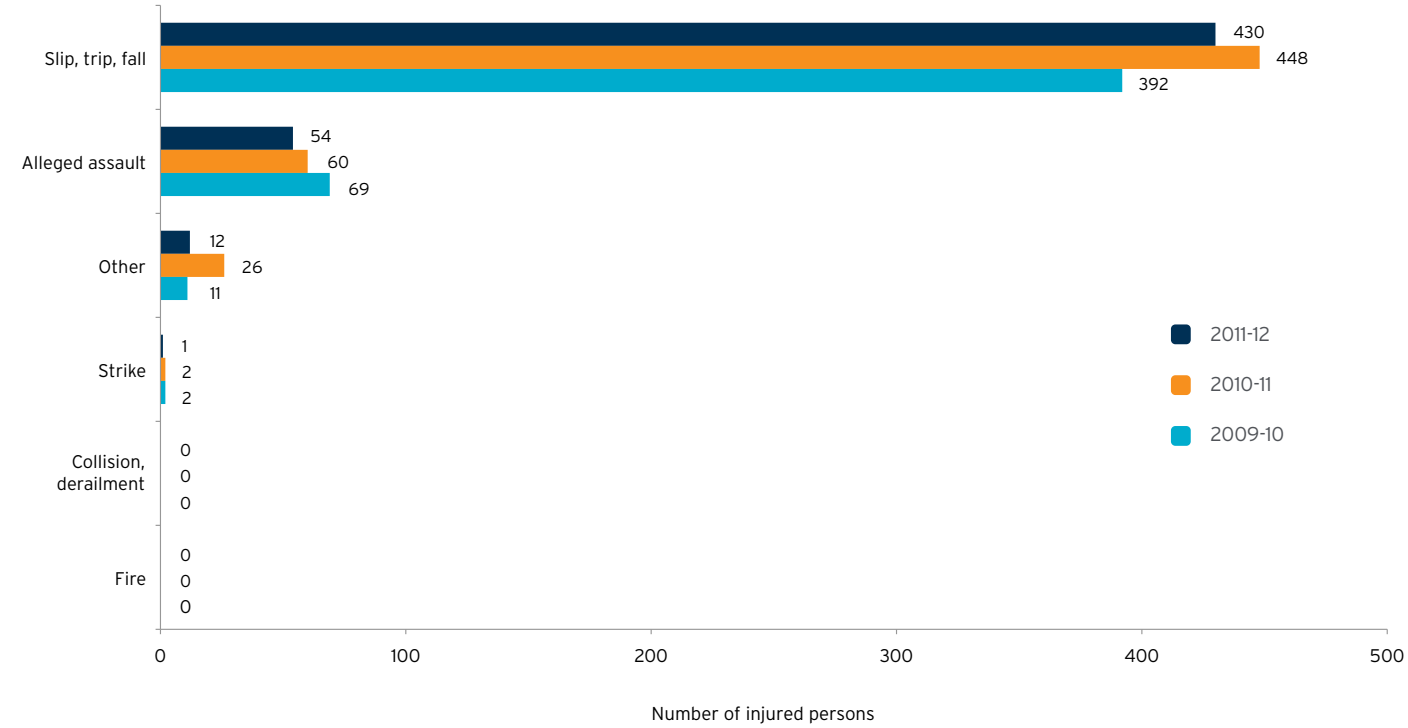


Figure 6: Passenger injury on the NSW rail network by accident type, 2009–10 to 2011–12

Injured and requiring transport to hospital – see *Note on injury grading* (page 13). Totals for earlier years may be different to previously published figures due to revisions. *Strike* is collision of train with person. Categories are *top event* based (for example, a collision between a train and a person falling from the platform is a *strike*).

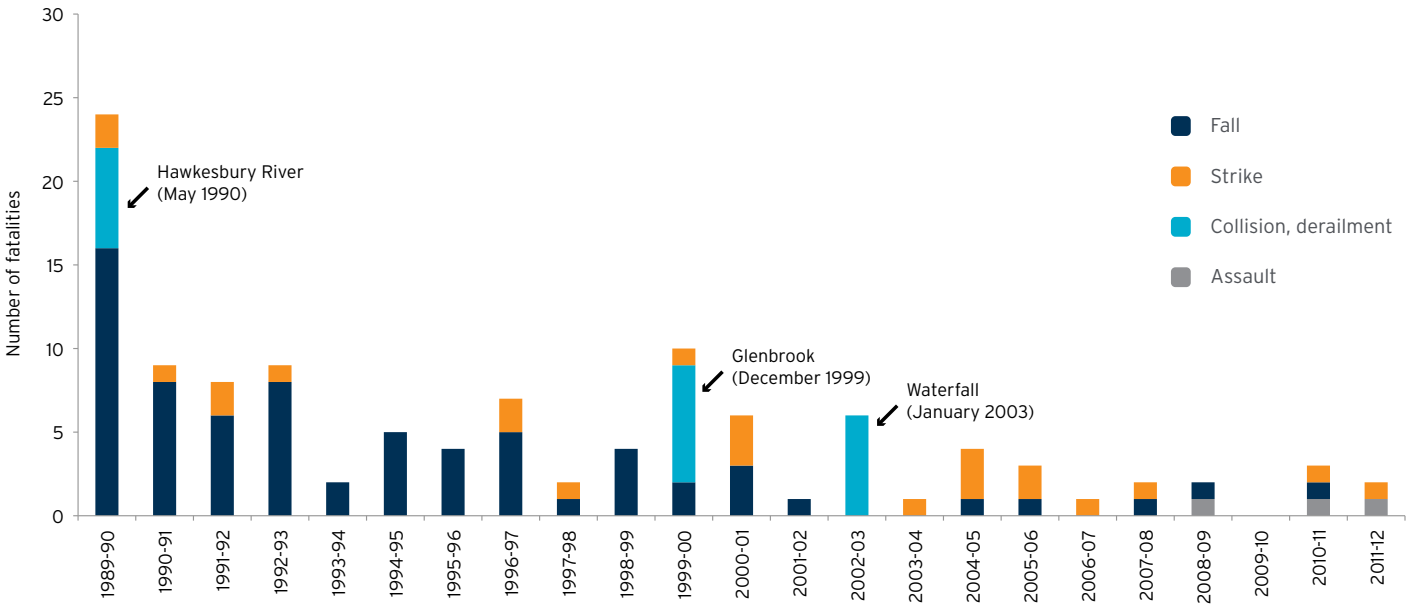
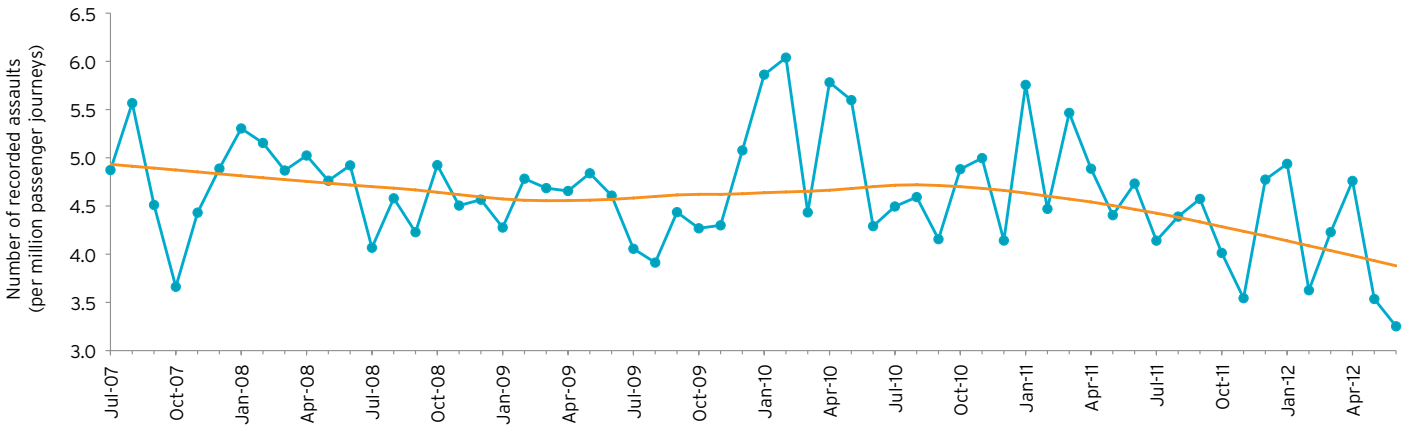


Figure 7: Passenger fatality on the NSW rail network, 1989–90 to 2011–12

Excludes fatalities associated with ill-health (for example, stroke). *Strike* is a collision between a train and person. Labelled bars for passenger fatalities indicate multi-fatality train accidents.



▶ Figure 8: Assault on rail premises in NSW, 2007–08 to 2011–12

Shows monthly total rate and smoothed trend. Based on recorded criminal incidents from BOCSAR and passenger journey data reported to ITSR by rail transport operators.

2.2 Railway employees

SUMMARY

- No employees were fatally injured in 2011–12, which is the second year in succession with no employee fatalities.
- The annual number of employee fatalities has not changed significantly over the 23 years of available data and remains steady at about one per year.
- Thirty-six employees were seriously injured in 2011-12. Accidents included a collision between two track machines, a cleaner struck by a passenger train in a yard and nine employees suffering smoke inhalation in a single arson-related train fire.

No employee was fatally injured in a railway accident on the NSW rail network in 2011–12. However, ITSR was notified[17] of 36 non-fatal injuries in 2011–12 (Figure 9). The incidents involved some hazards common to many workplaces, for example, use of power tools, manual handling (*Other* in Figure 9) and some specific to rail. A summary of the latter is provided in Table 6. The most notable incident was an arson–related train fire at Central station which resulted in nine employees being transported to hospital for smoke inhalation.

The longer term pattern of non-fatal injury is presented in Figure 9. The number of injuries in 2011–12 was similar to that observed in previous years except for those associated with fire as a result of the aforementioned train fire at Central. About 75% of non-fatal injuries over the past three years arose from general workplace, personal and security threats, rather than rail-specific hazards. The injury risk varied according to the employee's specific role. Station staff, passenger train crew and transit officers were the victims of assault whereas track maintainers, freight crew and shunters tended to dominate occupational injuries such as crush and manual handling-type injuries.

The full 23-year history of employee fatalities on the NSW rail network is shown in Figure 10. There is no evidence of trend in the average annual number of employee fatalities over the period. However, 2011–12 was the second year in succession without an employee fatality. This is a potentially significant finding given this has not been observed previously. It may also be a chance event, given the variable nature of historical counts over time and limited evidence of improvement in performance for some key risks such as track worker safety (see Section 4.2).

Almost all employee fatalities are associated with hazards unique to rail (Figure 10). About 80% of fatalities over the past 23 years were associated with movement of rolling stock in one of three main forms:

17 ITSR may not be notified of all occurrences involving injury on railway premises. The national guidance material on notifiable occurrences excludes some occurrences in repair shops not involving a train in motion and occurrences in railway offices not directly affecting the safe operation of trains.

- Worksite protection accidents: about 45% of train movement-related fatalities (including the last two) were due to trains that entered the section of track where work was taking place and striking workers (or vehicles they were in). Failures of this nature can expose multiple people to harm and two of the past three multi-fatality incidents were of this nature (Sandy Hollow and Singleton; Figure 10). This risk remains significant and is described further in Section 4.2.
- Single fatality strikes: 40% of train movement incidents comprised fatal injuries to employees on or about moving trains either via falls and / or strikes. A range of roles are involved including train crew, security staff and shunters. The last fatality of this nature was near Baan Baa in May 2006 when a member of a track ballasting crew fell from, and was struck by, a ballast train. ITSR is currently investigating an incident at Hornsby in 2011–12 in which a train cleaner was struck by an empty passenger train during shunting. A separate near miss in January 2012 involved a freight wagon being shunted while an employee was under the train.
- Train accidents: about 15% of train movement risk is associated with accidents such as collisions between trains and train derailments. The primary employee groups exposed to these types of incidents are train crew. The Waterfall train accident was the last one of this nature. However, the number of collisions and derailments each year in NSW exceeds 50 so the risk is still relevant. One employee was injured in a collision between two track machines in 2011–12 (Table 6).

Table 6: Employee injury on the NSW rail network, 2011–12

Persons injured and requiring transport to hospital as a result of railway-related accidents. Excludes *slip, trip, fall; trespass; attempted suicide; alleged assault* and occurrences not classified under the national occurrence classification guideline (for example, some workplace-type injuries such as power tool incidents). Network in brackets.

Date	Time	Location	Category	Description
10 July 2011	2108	Blacktown (MRA)	Fire – on train – passenger related	Seat on fire in passenger carriage. Ambulance requested for transit officer receiving smoke inhalation.
14 September 2011	0102	Central (MRA)	Fire – on train – passenger related	Seat on fire in passenger carriage. Nine employees transported to hospital for smoke inhalation.
13 February 2012	2332	Hornsby[1] (MRA)	Collision – yard – train and person	Cleaner struck by empty passenger train during yard shunting. Cleaner conveyed to hospital.
14 February 2012	1707	Kinalung (DIRN)	Collision – running line – between trains	Ballast regulator ran into the rear of a tamping machine. Crew member of ballast regulator sustained a broken leg.
29 March 2012	1436	Turramurra (MRA)	Electrical infrastructure irregularity – other	Contractor transported to hospital after receiving an electric shock when coming into contact with rail corridor boundary gate.
3 June 2012	1922	Central (MRA)	Rolling stock irregularity – other	Train guard transported to hospital after receiving an electric shock and burns to hand when switching on lights in carriage.

1 Subject of investigation by ITSR

The other key fatality risk based on historical data is associated with electrical hazards. There have been four fatal electrocutions in NSW over the past 23 years involving various high voltage sources including overhead power lines and 1500V overhead wiring used to power trains. It has been nine years since the last electrical-related fatality. However, ITSR has received two notifications of electrocution-related injury for each of the past two years. One incident in 2011–12 involved the lighting circuit in a carriage and the other involved an electrified boundary gate. The second incident was attended by OTSI and an investigation was undertaken by RailCorp.

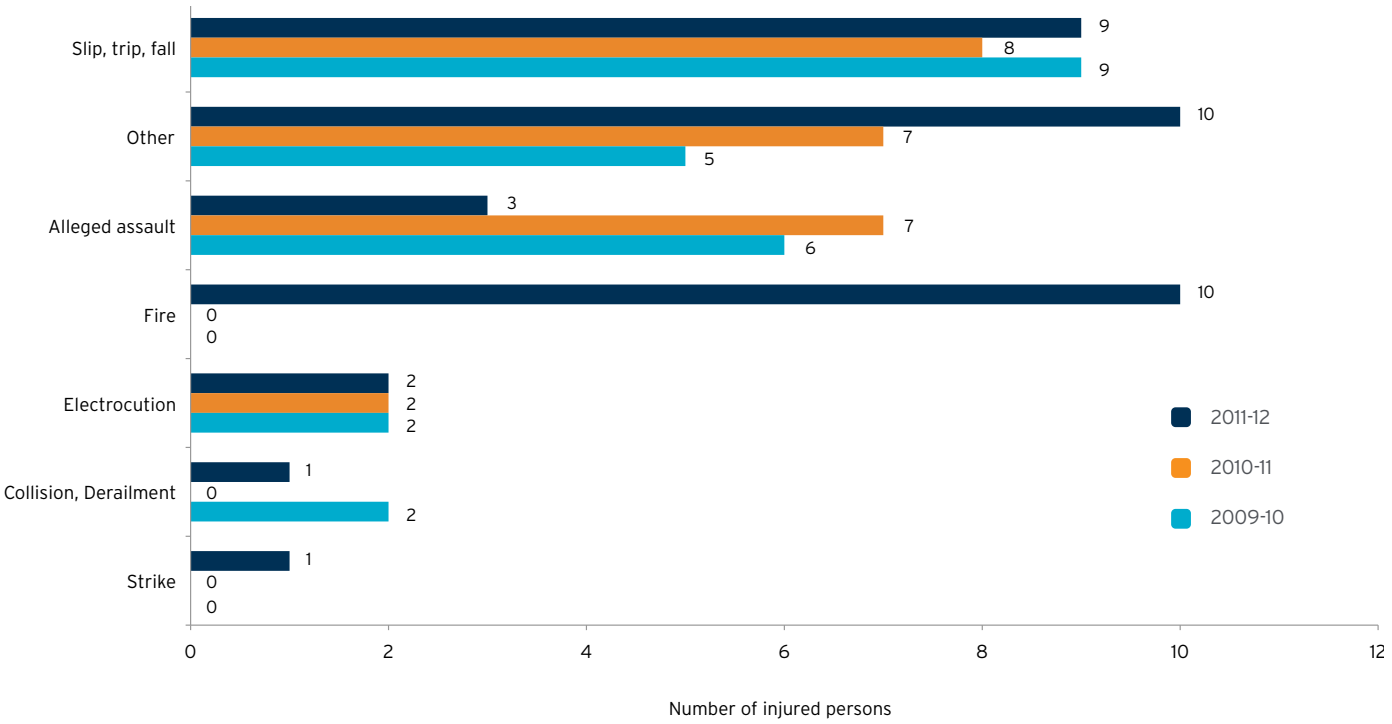


Figure 9: Employee injury on the NSW rail network by accident type, 2009-10 to 2011-12

Injured and requiring transport to hospital – see *Note on injury grading* (page 13). Totals for earlier years may be different to previously published figures due to revisions. *Strike* is collision of train with person. Categories are *top event* based (for example, a collision between a train and a person falling from the platform is a *strike*). *Employee* includes *contractor* and *volunteer*.

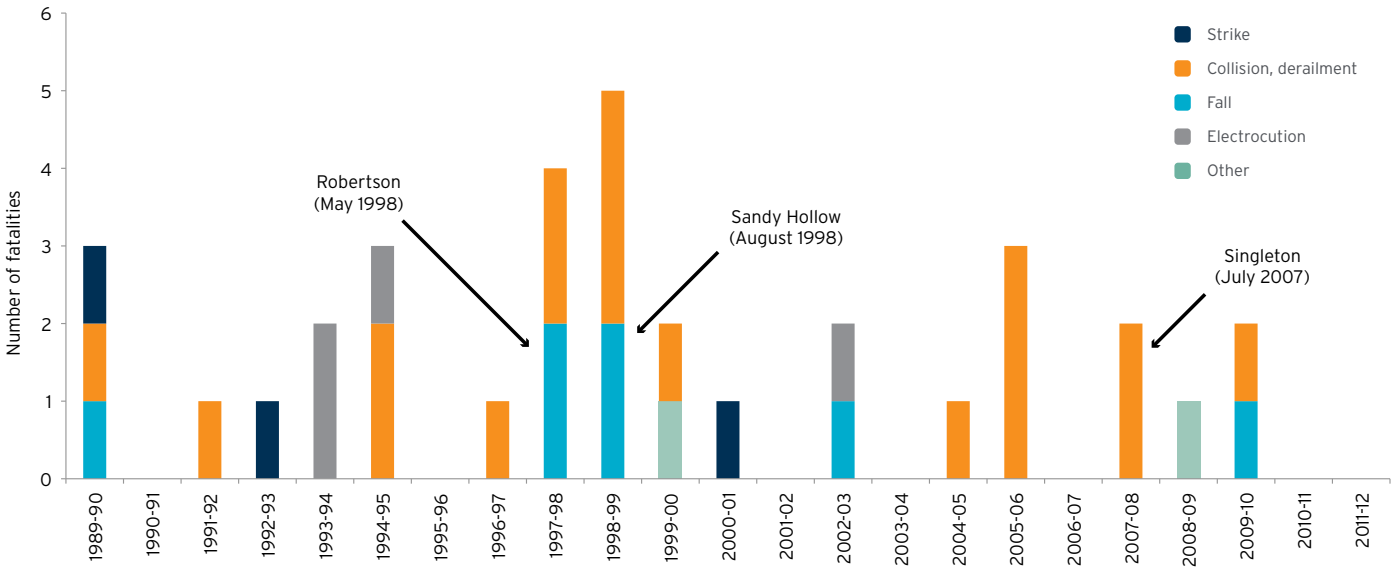


Figure 10: Employee fatality on the NSW rail network, 1989–90 to 2011–12

Excludes fatalities associated with ill-health (for example, stroke) except where employee was in a safety critical role at the time of the occurrence. *Strike* is collision of train with person. Labelled bars represent multi-fatality accidents. *Employee* includes *contractor* and *volunteer*.

2.3 Members of the public (other than trespass and suicide)

SUMMARY

- Three members of the public were fatally injured in separate occurrences in 2011–12. All were drivers of road vehicles. Only one of the accidents involved a collision between a train and road vehicle at a level crossing.
- About 80% of all rail-related public fatalities in NSW over the past 23 years were due to collisions between trains and road vehicles at level crossings.
- The annual number of fatal collisions between road vehicles and trains decreased over the 23 years of available data.

Three members of the public were fatally injured in separate occurrences in 2011–12 (Table 7). One incident involved a semi-trailer crashing onto the rail line as a CountryLink train approached. Two incidents occurred at level crossings but only one involved a collision with a train. The other was a road vehicle accident that blocked the rail line and damaged level crossing infrastructure.

Sixteen members of the public were seriously injured in 2011–12 (Figure 11). Table 8 summarises two incidents associated with railway operations – both occurred at level crossings though only one incident involved rolling stock. The second was a road traffic accident that affected the safety of railway operations.

The number of serious injuries in 2011–12 was consistent with that for the previous two years (Figure 11). However, caution must be attached to these statistics because of the generally low counts and uncertainty concerning the relevance of some of these incidents to railway operations[18]. The most common causes of public injury in 2011–12 were road vehicle accidents affecting rail property (four of the six *Other* occurrences in Figure 11) and assault. Three people were injured in two separate level crossing collisions, described further in Section 3.2.

The full 23-year history of public fatalities on the NSW rail network is shown in Figure 12. There has been a decrease in the annual number of public fatalities over the period, from a median of 5.5 fatalities per year in the first decade to 1.0 in the decade to 2011–12. This improvement reflects a decrease in the number of level crossing collisions, which is the primary means by which the public is exposed to rail-related hazards. About 80% of all rail-related public fatalities over the past 23 years were due to collisions between road vehicles and trains at level crossings.

Another relevant risk to the public in NSW is that associated with pedestrians moving about the Sydney light rail system. In 2011–12 two members of the public were injured in separate incidents when struck by a light rail vehicle. One received a minor injury and the other was transported to hospital. There have been nine such occurrences notified to ITSR in the five years to June 2012.

Table 7: Public fatality (excluding trespass and suicide) on the NSW rail network, 2011–12

Excludes fatalities associated with trespass, suspected suicide and ill-health. Network in brackets.

Date	Time	Location	Category	Description
14 September 2011	2335	Rossglen (DIRN)	Track obstruction – other object	Semi trailer crashed through bridge railing and slid down embankment onto rail line. Approaching CountryLink train was brought to a halt to avoid colliding with the truck.
28 December 2011	1155	Yenda (CRN)	Level crossing damage / interference	Four wheel drive and tractor collided at level crossing, with one vehicle fouling rail line. One person fatally injured.
4 May 2012	0911	Nundah (Hunter)	Level crossing collision – train and road vehicle	Coal train struck road vehicle at a passively controlled level crossing. The driver of the road vehicle was fatally injured.

18 For example, falls in areas accessed by both passengers and the general public.

Table 8: Public injury (excluding trespass and suicide) on the NSW rail network, 2011–12

Persons injured and requiring transport to hospital as a result of railway-related accidents. Excludes *slip, trip, fall; trespass; attempted suicide; alleged assault* and occurrences not classified under the national occurrence classification guideline. Network in brackets.

Date	Time	Location	Category	Description
16 November 2011	1552	Pymble (MRA)	Track obstruction	Road vehicle crashed down embankment and onto running line. Driver conveyed to hospital.
20 December 2011	1059	Gulgong (DIRN)	Level crossing collision – train and road vehicle	Car ran into freight train and was dragged for 250m. Driver and passenger of road vehicle transported to hospital.
26 January 2012	1240	Paddy's Market (Light Rail)	Collision running line person	Light rail struck person walking in between the up and down lines. Person taken to hospital for examination.
3 February 2012	1133	Waitara (MRA)	Track obstruction	Road vehicle crashed through boundary fence into rail corridor. Driver conveyed to hospital.
29 February 2012	0610	Capital Square (Light Rail)	Track obstruction	Road vehicle collided with overhead stanchion. Driver taken to hospital.
27 February 2012	1607	Narromine (DIRN)	Level crossing collision – train and road vehicle	Freight train collided with car that had stopped on crossing, with car coming to rest on its roof. Car driver transported to hospital.
9 April 2012	1114	Morisset (MRA)	Civil irregularity – other	Road vehicle reversed through station fence and under platform. Driver conveyed to hospital.

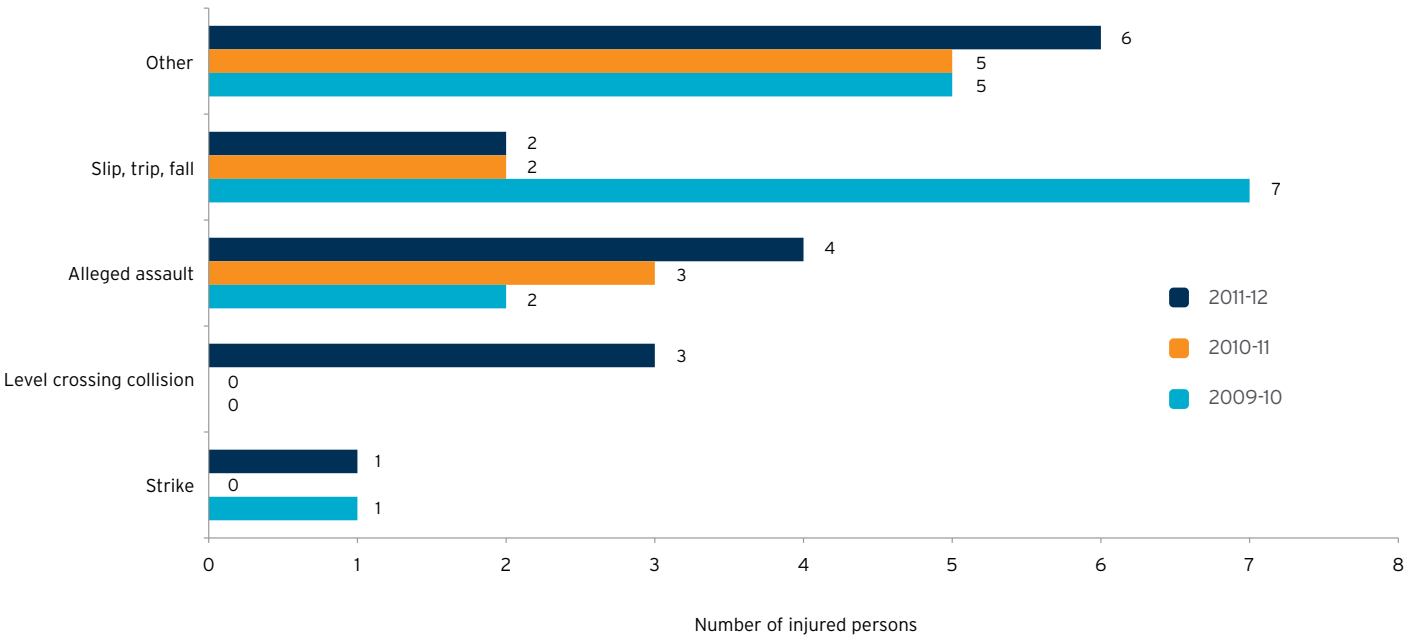
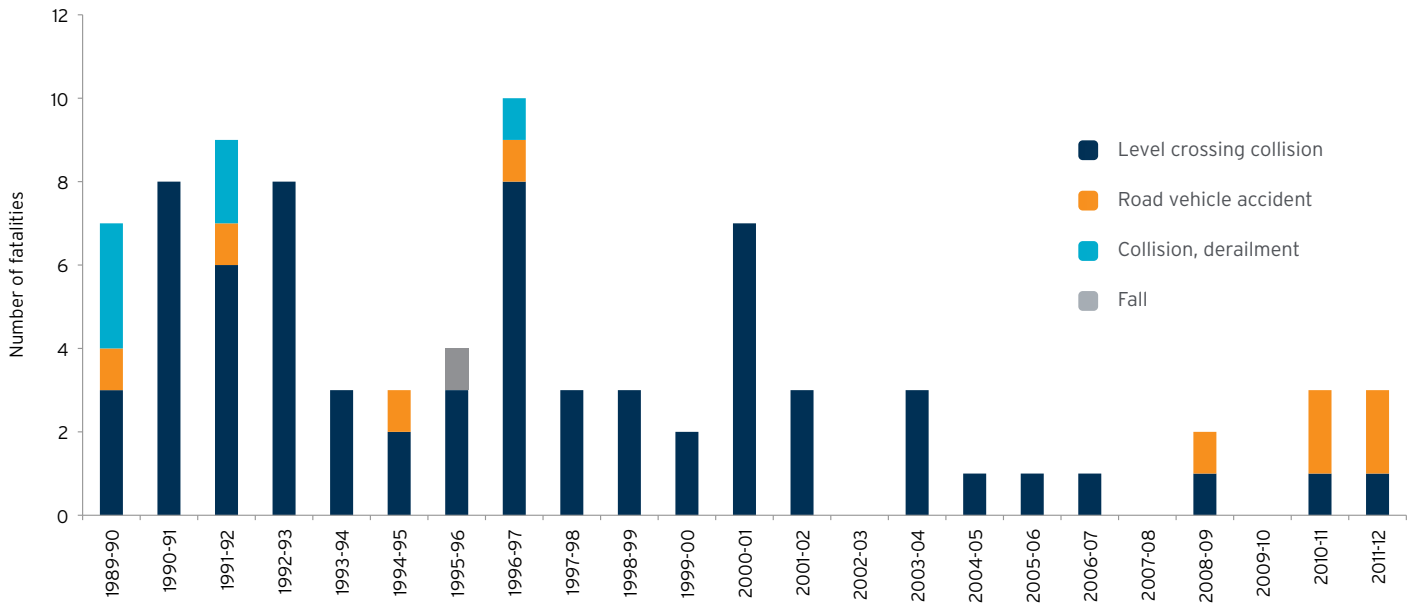


Figure 11: Public injury (excluding trespass and suicide) on the NSW rail network by accident type, 2009–10 to 2011–12

Injured and requiring transport to hospital – see *Note on injury grading* (page 13). Totals for earlier years may be different to previously published figures due to revisions. *Strike* is collision of train with person. Categories are *top event* based (for example, a collision between a train and a person falling from the platform is a *strike*).



▶ Figure 12: Public fatality (excluding trespass and suicide) on the NSW rail network, 1989–90 to 2011–12

Excludes fatalities associated with trespass and ill-health where evidence suggested in the occurrence description or definitive information. Level crossing collisions includes collision between train and person (strike) except in cases where incident description indicates trespass or suicide.

2.4 Trespassers (including suicide)

SUMMARY

- Twenty-eight fatalities in 2011–12 involved trespass on rail premises, with about 70% of these incidents suspected to be acts of suicide.
- The annual number of trespass fatalities decreased over the 23 years of available data, but appears to have steadied in recent years.

Trespass incidents are considered separately from other incidents because they are associated with deliberate, unlawful acts by the individual and therefore are beyond the direct control of railways. Trespass includes both accidental fatality (for example, an unintended consequence of vandalism or taking a short cut across tracks) as well as self harm (as in the case of suicide). These types of incidents also generate other risks, such as passenger crowding on platforms from service disruptions and trauma to employees dealing with incidents.

There were 28 trespass-related fatalities in 2011–12, with 25 incidents occurring on the MRA. Twenty-five of the fatalities involved a person being struck by a train. The remaining incidents comprised one train surfing fatality and two suspected suicides not involving a train. About 70% of all incidents are suspected to be acts of suicide based on the information available at the time of writing[19].

Twenty people required transport to hospital for trespass-related injury in 2011–12 (Figure 13). The most common causes of injury were strikes, jumping from heights and acts of self-harm (the last two fall within the category *Other* in Figure 13). The ratio of fatality to injury in 2011–12 (4:1) for trespass is markedly higher than that for other types of people involved in accidents, such as passengers and employees. This is because trespass generally involves people in places exposed to serious hazards such as moving rolling stock, high voltage electricity and unprotected heights.

19 Coronial information is necessary to determine intent with reliability and some cases were not concluded at the time of writing.

The nature of trespasser fatality in 2011–12 is similar to that observed over recent years. About three-quarters of these incidents involve suicide, based on a separate analysis of coronial information (see Note on use of coronial information). The full 23-year history of trespasser fatalities on the NSW rail network is shown in Figure 14. The annual number of trespass fatalities decreased over the 23-year period. However, the trend is not constant, with most of the reduction occurring in the decade from the late 1990's, to a historical low of 18 fatalities in 2008–09 and a steadying of annual counts in recent years.

While these types of occurrences are beyond the direct control of railways, rail transport operators seek to influence behaviour and reduce trespass by various means including surveillance, education, and maintenance of fencing along higher risk areas of the corridor. Risk to trespassers was one of the key themes of National Rail Safety Week in August 2011.

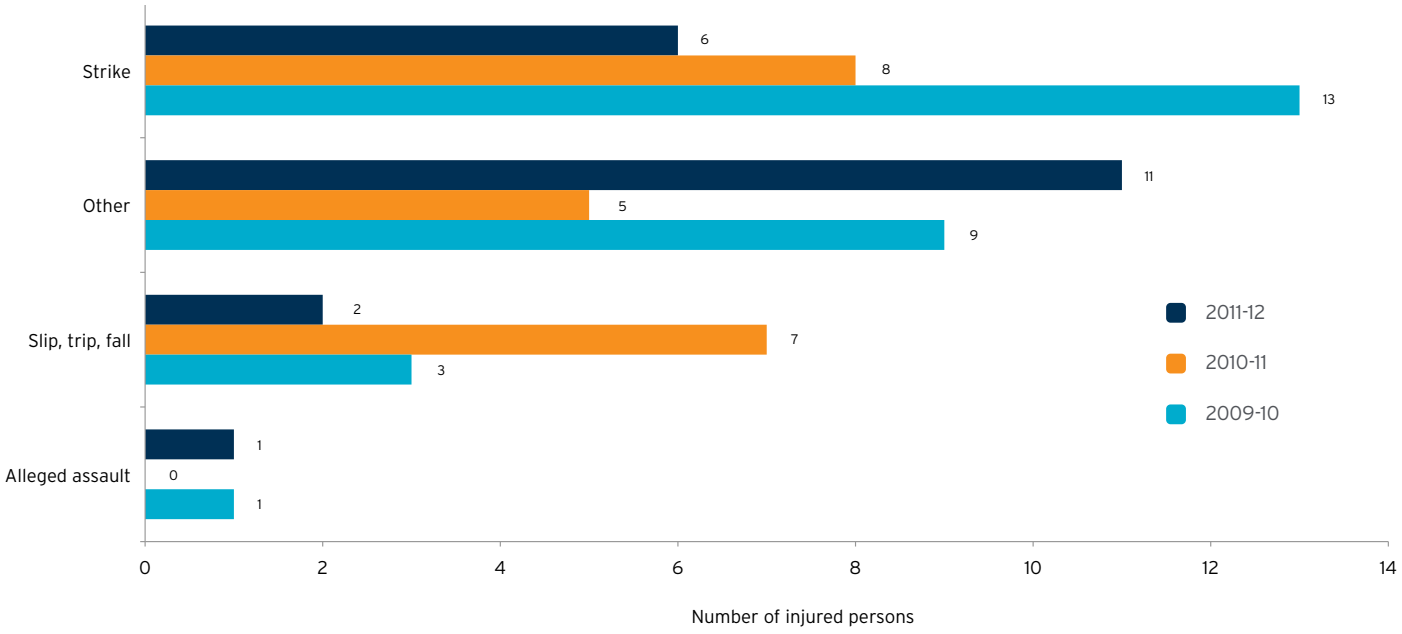


Figure 13: Trespass and attempted suicide-related injury on the NSW rail network by accident type, 2009–10 to 2011–12

Injured and requiring transport to hospital – see *Note on injury grading* (page 13). Totals for earlier years may be different to previously published figures due to revisions. *Strike* is collision of train with person. Categories are *top event* based, for example, a collision between a train and a person falling from the platform is a *strike*.

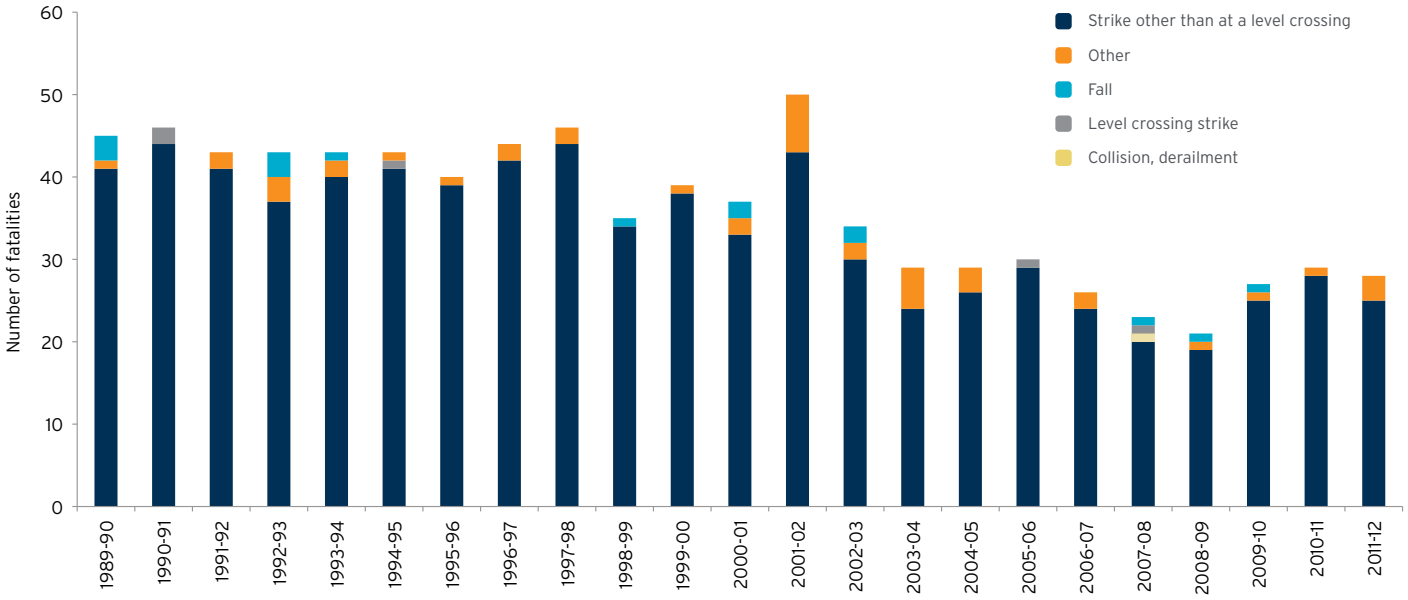


Figure 14: Trespass and suspected suicide fatality on the NSW rail network, 1989–90 to 2011–12

Strike is collision of train with person.

Note on use of coronial information to verify NSW historical fatality records

High quality data on rail-related fatality is important to the understanding and management of safety risks associated with railway operations. While initial incident reports provide sufficient detail to understand the basic mechanism of accidents and injury (for example, person struck by a train), the underlying factors and behaviours that contributed to an incident are usually not clear.

The highest safety risk on the NSW rail network is associated with trespass. These incidents involve a range of motivations and behaviours. Trespass fatality may be the result of either an accident (for example, a train striking a person on track to retrieve property or take a short cut) or a conscious act to take one's life. Understanding behaviour and motivations is particularly relevant to trespass because responsibilities for management and preventative strategies will differ according to motive.

Some of the best information available to rail safety managers on trespass-related fatality is that provided by coroners. Importantly, coroners' reports will often include a formal determination of intent[20] to conclusively distinguish between accidental death and suicide.

During 2011–12 ITSR undertook a project to verify NSW's historical fatal incident record against information within the National Coronial Information System (NCIS), managed by the Victorian Institute of Forensic Medicine[21]. Summary findings of this exercise, based on examination of 11 years of data (July 2000 to June 2011) are:

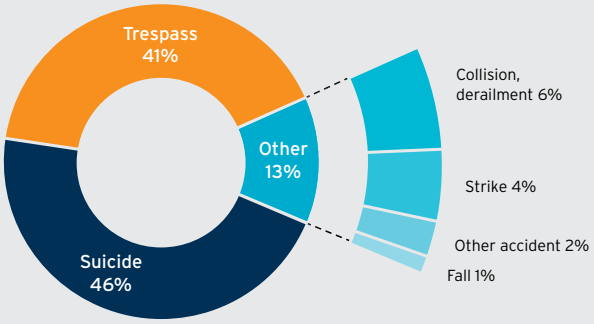
- prior to the validation exercise, ITSR had records for 366 fatalities in its incident database for the period;
- 97% of fatalities held by ITSR were matched to a corresponding case in NCIS;
- 11 extra fatalities associated with rail operations were found in NCIS (6 falls; 5 suicides);
- 20 existing records without reference to fatality were found to be fatal based on NCIS (10 suicides; 6 strikes; 4 falls);
- the total number of fatalities in NSW for the 11 year period was revised upwards to 397 (8.5% increase) (Figure 15).

20 In some cases a statement of intent may not be made by the Coroner.
21 In 2012 governance of the NCIS will be transferred from the Victorian Institute of Forensic Medicine to the Victorian Department of Justice.

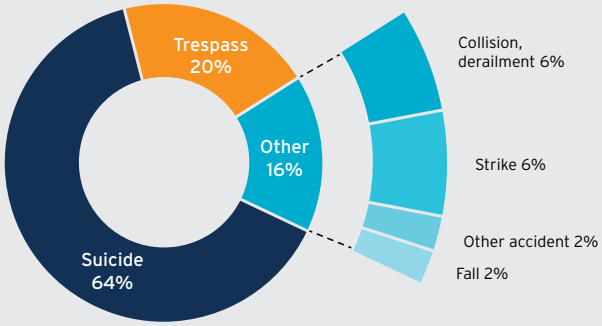
Third party information sources such as NCIS are a valuable resource for rail transport operators to ensure accuracy and completeness of records used to estimate risks. Importantly, the detailed information on circumstances and behaviour also improves understanding of contributing factors, leading to better decisions on actions to minimise harm. Examples of findings that may help inform and optimise decisions on safety risk management include:

- three-quarters of rail-related suicide involved males, the same as the national figure for suicide generally[22]
- the proportion of trespass incidents associated with suicide is higher than that originally estimated (53% to 76%)
- two-thirds of the 21 passengers fatally injured in falls and strikes recorded an elevated blood alcohol concentration.

Fatalities before NCIS validation
(Number of fatalities = 366)



Fatalities after NCIS validation
(Number of fatalities = 397)



▶ Figure 15: Changes to NSW rail fatality record following verification against the National Coronial Information System

Period of data is July 2000 to June 2011. Excludes fatalities not associated with railway operations (for example, health-related fatality).

22 <http://www.mindframe-media.info>, accessed 23 November 2012.

3. Accidents and other key rail safety occurrences

This section presents statistics for the four national occurrence categories that are most closely associated with significant accidents: *derailment, level crossing collision, train collision* and *fire*. Subsets of incidents within each of these national categories represent high risk occurrences, that is, with potential to cause multiple injuries and fatalities, sometimes in a single accident. These higher risk occurrences are the focus of this chapter.

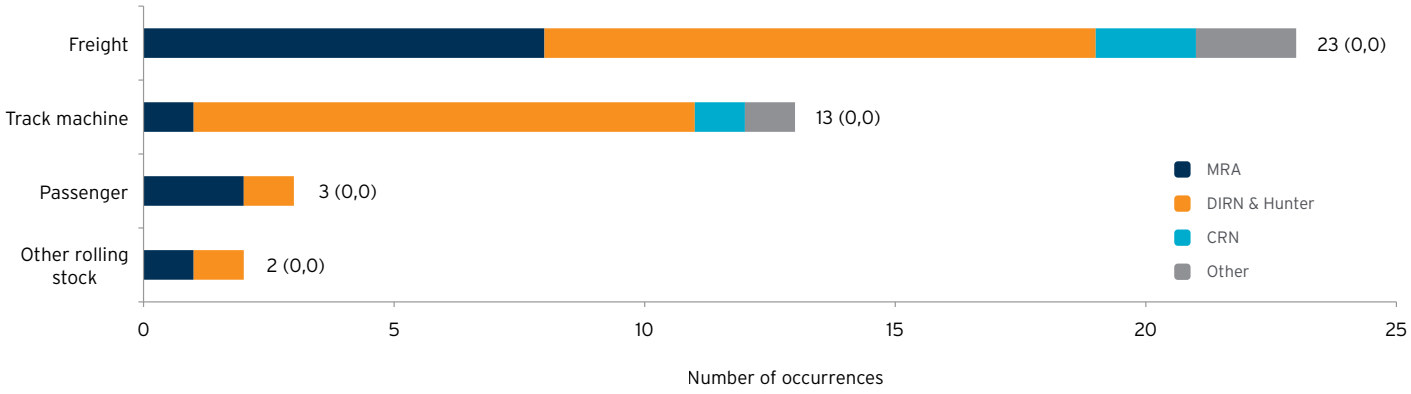
3.1 Train derailment

SUMMARY

- Three running line passenger train derailments were notified in 2011–12. Each train was carrying passengers at the time of the incident but no injuries were reported for any occurrence.
- Twenty-three running line freight train derailments were notified in 2011–12. No injuries were reported for any occurrence. Two-thirds of derailments were associated with low speed movements to or from yards.
- Thirteen running line track machine derailments were notified in 2011–12. Most incidents involved hi-rail vehicles on track inspections. No injuries were reported for any occurrence.

Derailments arise from a number of causes, including rolling stock irregularities, track irregularities and human error. A total of 41 running line and 172 yard derailments were notified to ITSR in 2011–12. Despite the comparatively high frequency of yard derailments, they are generally lower risk incidents involving low-speed movements of freight rolling stock and empty passenger sets.

Running line derailments are of primary concern because of the potentially severe consequences associated with higher track speeds, threat to adjacent lines posed by derailed rolling stock and multi-fatality potential in the case of passenger trains. A breakdown of running line derailments in 2011–12 is provided in Figure 16.



▶ Figure 16: Derailment (running line) on the NSW rail network, 2011–12

In brackets are number of fatalities and number of injured people transported to hospital, respectively.
Other rolling stock comprises light locomotives and non-powered rolling stock such as freight wagons.

Table 9: Passenger train derailments (running line) on the NSW rail network, 2011–12

Network in brackets.

Date	Time	Location	Train type	Description
6 November 2011	0418	Aylmerton (DIRN)	Passenger – interurban	Loaded passenger train collided with abandoned utility on line and derailed with one carriage coming to rest foul of adjacent line. No injuries reported. The derailed carriage and a section of track were damaged.
9 February 2012	1629	Hurstville (MRA)	Passenger – urban	Loaded passenger train derailed on catch-points after passing a signal at stop. No injuries or damage reported.
24 March 2012	1524	Hornsby (MRA)	Passenger – urban	Loaded passenger train departing platform derailed leading bogie on incorrectly set points. No injuries reported. Minor damage reported for the derailed carriage and points involved.

While the frequency of passenger derailments in 2011–12 was comparatively low, these incidents still pose the greatest derailment-related fatality risk over the longer term because they expose a large number of people (passengers and train crew) to potential harm.

There were three passenger train derailments in 2011–12, representing a rate of 0.07 per million passenger train km travelled. Each incident is summarised in Table 9. All involved in-service passenger trains, however no injuries were reported. One incident was on the DIRN and involved a train striking an abandoned car on the line. The remaining two incidents were on the MRA — an incident at Hurstville that was preceded by a SPAD and an incident at Hornsby that was the result of a points failure.

The five-year history of passenger train derailments is shown in Figure 17. Neither the count, nor rate (per million train km travelled), of passenger train derailment has changed significantly over the period. However, a small reduction occurred in 2011–12, associated with tourist and heritage passenger services on isolated railways. This sector has averaged two derailments per year over the past four years yet none were notified in 2011–12[23]. The annual number of passenger train derailments on the MRA remains stable over the five-year period at two to three per year.

The longer term fatality risk due to freight train derailment is similar to that for passenger trains, but arises in a different way. Passenger train risk is a function of infrequent, but potentially high consequence, incidents (both passengers and crew exposed to harm). In contrast, freight train derailments occur at a far higher frequency, but expose few people to harm i.e. train crew only.

There were 23 freight train derailments on or affecting running lines in 2011–12 (Figure 16). This is equivalent to a rate of 1.19 derailments per million freight train km travelled. The five-year history of freight train derailments is shown in Figure 17. Neither the count, nor rate (per million train km travelled), of passenger train derailment has changed significantly over the period.

Eleven of the 23 derailments in 2011–12 occurred on the DIRN and Hunter network. Almost half of these derailments were of lower severity because they involved low-speed movements of trains to or from yards. The more serious incidents involving trains on running lines are summarised in Table 10. The incidents arose from a range of causes including track irregularities, rolling stock defects and load-related incidents. Three of the derailments are being investigated by the ATSB and one is being investigated by OTSI.

Eight of the 23 freight train derailments in 2011–12 occurred on the MRA. This is the highest annual count for this network of the five years. Six of the eight incidents were associated with movements to or from yards. The remaining two are summarised in Table 10. One of the derailments was caused by a rolling stock failure (faulty hopper door). The other was the result of a broken axle and is the subject of an investigation by OTSI — while the point of derailment was on a section of single line, the train had travelled on multi line track and had therefore posed a potential threat to trains on adjacent lines. In response to this and several other incidents over recent years, ITSR issued

23 This may be due, at least in part, to reduced activity – the number of tourist and heritage train km in 2011–12 was the lowest of the five-year period.

a Transport Safety Alert[24] on the safety risks associated with catastrophic axle failure. The alert included a requirement for rail transport operators to reassess a range of issues, for example, the status of axle fatigue in their risk registers and the adequacy of maintenance and inspection procedures to detect fatigue and defects prior to failure.

Approximately two-thirds of all running line freight train derailments in 2011–12 were associated with low-speed movements of trains to or from yards. In some cases, the point of derailment was within a siding but the safety of a running line was compromised, for example, points damaged or rolling stock was in a position to foul a running line. While most incidents posed only a limited threat, several represented potentially serious incidents under differing circumstances. One incident at Bomaderry was due to a bearing failure and occurred as the freight train was heading into the private siding from the main line. This incident had the potential to lead to more serious consequences had the failure occurred on a running line at line speed.

In 2011–12 ITSR successfully completed a prosecution under the *Rail Safety Act 2008* for a May 2009 yard derailment in Griffith in which derailed wagons left rail property, crossed a public road and came to rest on private property.

Track machines were involved in 13 running line derailments in 2011–12 which is consistent with the annual average over the past four years. About 80% of all derailments occurred on the CRN and DIRN and Hunter, which is consistent with the longer term average. Three-quarters of these incidents involved hi-rail vehicles on track inspections. The remaining derailments involved other road / rail and rail bound track maintenance vehicles.

The remaining two running line derailments in 2011–12 involved rolling stock other than freight, passenger and track maintenance trains. Both incidents occurred within yards and involved out of control vehicles that derailed and subsequently threatened the safe operation of a running line. The first incident occurred in July 2011 at Ettamogah and involved four freight wagons running uncontrolled out of a siding and derailing on catch-points, with wagons coming to rest foul of the main line. The other incident occurred at Enfield in February 2012 and involved a shunting tractor and wagon running away in a siding and derailing at catch-points, coming to rest foul of a dedicated freight running line. This incident was the subject of a compliance investigation by ITSR.

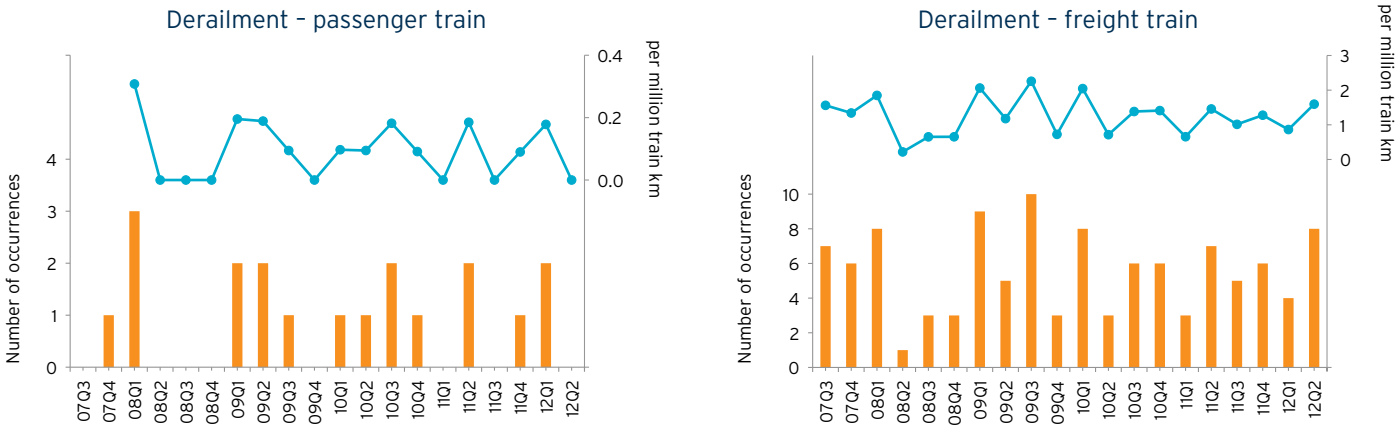


Figure 17: Passenger and freight train derailment (running line) on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (count per million train km travelled). Passenger train rate prior to 2008 excluded due to change in RailCorp's method of train km calculation.

24 Transport Safety Alert No. 40, *Catastrophic failure of freight axles in the barrel area*, ITSR, April 2012.

Table 10: Freight train derailments (running line) on the NSW rail network, 2011–12

Excludes derailments associated with entry to or from yards, shunting and track possession. Network in brackets.

Date	Time	Location	Description
16 September 2011	0324	Wolli Creek (MRA)	A freight train derailed and re-railed itself after running over a hopper door that had come loose and was dragging beneath the train. No injuries and only minor track damage reported.
23 October 2011	0545	Wirrinya[2] (DIRN)	The last six wagons of a freight train derailed causing extensive damage to rolling stock and track. No injuries reported.
23 November 2011	2358	Clifton[1] (MRA)	Eight coal wagons on a freight train derailed, with several sustaining significant damage. No injuries reported. Suspected cause was a broken axle on coal wagon.
21 December 2011	0500	Trida (DIRN)	Freight train derailed one wagon. No injuries and only minimal track and rolling stock damage reported. Cause not known.
22 February 2012	2202	Gunning (DIRN)	Freight train derailed one wagon. No injuries and only minor track damage reported. Suspected cause was a sheared axle due to wheel bearing fault.
4 March 2012	0715	Roto[2] (DIRN)	One locomotive and several wagons of a freight train derailed after travelling over a section of track washed away by flood waters. No injuries reported. However four wagons suffered minor damage as a result of the derailment.
11 April 2012	0409	Broken Hill[2] (DIRN)	A ballast train travelling to worksite derailed one wagon, causing significant track damage. No injuries reported. Suspected cause was an uneven distribution of load.
21 April 2012	1630	Burren Junction (CRN)	Freight train derailed one wagon. No injuries and only minor track damage reported. Suspected cause was a collision with supporting track infrastructure.
5 May 2012	0145	Gulgong (DIRN)	Freight train derailed one wagon after striking and running over a cow. No injuries and only minor rolling stock damage reported.

1 Subject of compliance investigation by OTSI.
2 Subject of compliance investigation by ATSB.

3.2 Level crossing collision

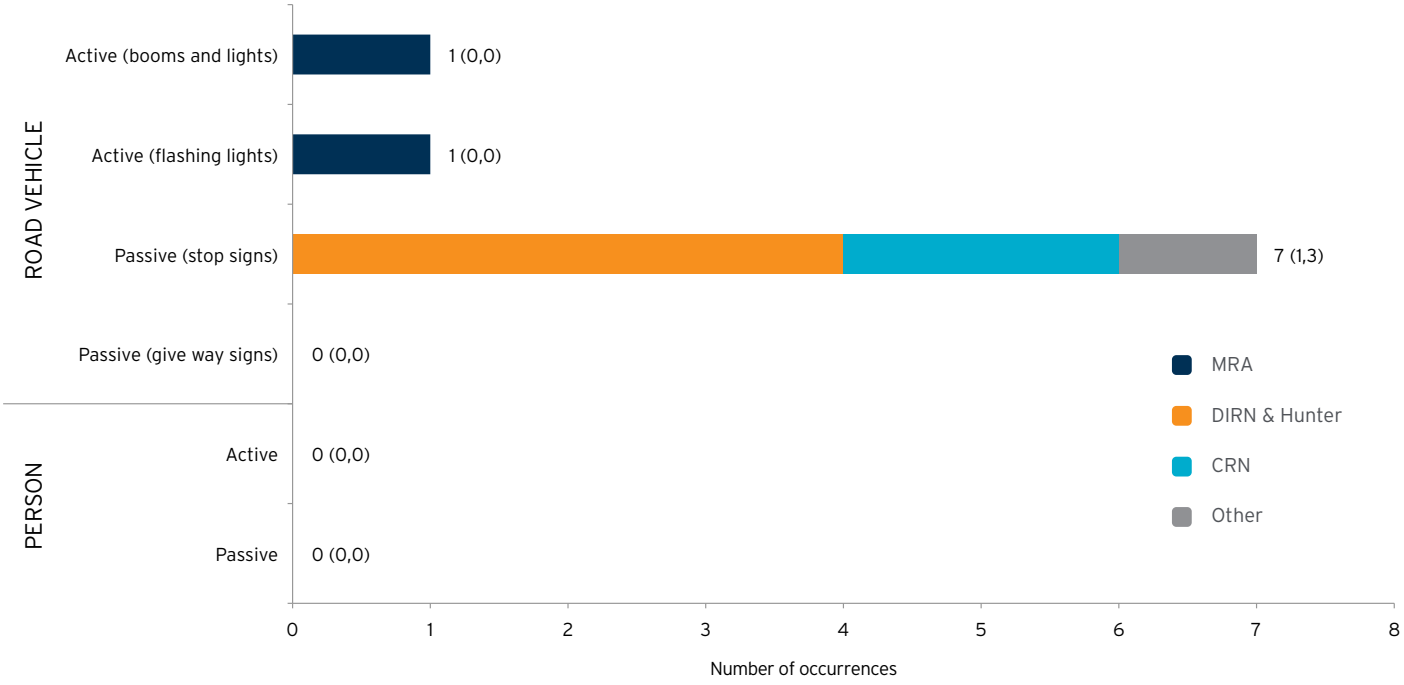
SUMMARY

- Nine level crossing collisions between trains and road vehicles were notified in 2011–12. One collision resulted in a fatality to the driver of a light passenger road vehicle.
- The annual count of collisions between trains and road vehicles at level crossings has decreased gradually over the 23 years of available data.
- There were more than 100 notifications of near misses between trains and road vehicles in 2011–12, including several involving passenger trains and heavy road freight vehicles.
- 122 level crossings have been closed in NSW since 2002. In 2011–12, upgrade works progressed on 31 level crossings, including completion of major upgrades at five crossings.

Level crossings provide the main point of interaction between rail and road traffic and therefore present a high risk for serious collisions between trains and road vehicles. Collisions between road vehicles and trains at level crossings accounted for about 30% of rail-related fatalities in Australia over the five years to the end of 2010[25].

There are more than 3,700 level crossings in NSW[26] and most are located in regional areas. Almost two thirds of all crossings in NSW are associated with private roads and/or rail yards and the majority of these are passively controlled. The remaining crossings intersect public roads and running lines of the NSW rail network. About one-quarter of these crossings are actively controlled and the remainder are passively controlled.

There were 9 collisions between trains and road vehicles at separate level crossings in 2011–12 which are summarised in Table 11 and Figure 18. A collision at a passively controlled crossing between an empty coal train and a utility vehicle resulted in the driver of the utility suffering fatal injuries and was the subject of an investigation by OTSI.



▶ Figure 18: Level crossing collision on the NSW rail network, 2011–12

In brackets are number of fatalities and number of injured people transported to hospital, respectively.

25 Excluding incidents involving suspected suicide; (Source: Independent Transport Safety Regulator. *Level crossing accidents in Australia*, ITSR, Sydney, August 2011).
26 Based on 2009 figures: Staysafe Committee, *Report on Updating Progress on Railway Level Crossing Safety*, Report No. 2/54, Parliament of NSW June 2009.

Table 11: Level crossing collisions between trains and road vehicles on the NSW rail network, 2011–12

Network in brackets.

Date	Time	Location	Crossing control	Description
8 July 2011	0934	Dapto (MRA)	Active – lights	Loaded CityRail service collided with a car at an active crossing. No injuries and only minor rolling stock and infrastructure damage reported. The level crossing equipment was found to be operating correctly at the time.
9 July 2011	0205	Neath (Other)	Passive – stop signs	Freight train struck a passenger vehicle at low-speed after sounding their horn and applying the emergency brake. No injuries and only minor infrastructure damage reported.
12 August 2011	1608	Nyngan (CRN)	Passive – stop signs	Freight train struck a car at a passive level crossing. No injuries and only minor damage to the train and car reported.
2 September 2011	1817	Woy Woy[1] (MRA)	Active – booms	CityRail service carrying 200 passengers struck and dragged an unoccupied car for 300m. No injuries reported, however the train and car suffered significant damage. The level crossing equipment was found to be operating correctly at the time.
20 December 2011	1059	Gulgong (DIRN)	Passive – stop signs	Freight train travelling at 50 km/h collided with a car at a crossing and dragged the car approximately 250m. All three occupants of the car were transported to hospital with two suffering serious injuries. Minor damage to the train reported.
27 February 2012	1607	Narromine[1] (DIRN)	Passive – stop signs	Freight train travelling at approximately 70 km/h struck a car that had stopped on the level crossing. The driver of the car was transported to hospital with serious injuries. Minor infrastructure damage reported.
11 March 2012	1025	Kootingal (CRN)	Passive – stop signs	Loaded CountryLink service collided with a motor vehicle at a passive level crossing. No injuries and only minor damage reported.
4 May 2012	0911	Nundah[1] (Hunter)	Passive – stop signs	Empty coal train travelling at 70 km/h collided with a utility. The driver of the motor vehicle sustained fatal injuries. Minor damage to the train reported.
27 June 2012	1505	Narrabri (DIRN)	Passive – stop signs	Freight train travelling at 55 km/h struck a motor vehicle at a passive crossing. No injuries or damage reported.

1 Subject of compliance investigation by OTSI

Two of the collisions in 2011–12 occurred at actively controlled crossings. Based on the circumstances described in the initial notifications, crossing equipment was certified as working correctly at the time of the incident. Seven of the nine collisions occurred at passively controlled crossings. This type of crossing accounts for about two-thirds of all collisions over the 23-year period of available record which reflects, in part, the far larger number of passive crossings in NSW compared to active crossings. However, other factors are relevant in such comparisons including the volumes of road and rail traffic and the greater safety offered by higher levels of protection, for example, boom gates over stop signs.

The distribution of collisions across NSW, based on the full 23-years of available data, is shown in Figure 19. Historically, most collisions occurred on the DIRN and Hunter networks, contributing 176 of the 390 collisions across both active (65) and passive (111) crossings. The CRN was the next highest contributor, recording 114 collisions across the 23-year period, with more than 80% of collisions occurring at passively protected crossings. There were 68 collisions on the MRA, split evenly between active and passive crossings.

The full 23-year history of level crossing collisions on the NSW rail network is shown in Figure 20. The annual number of collisions decreased at both active and passive crossings over the 23-year record, across each of the main networks. At a state level, the number of collisions at active crossings has decreased from a median of eight fatalities per year in the first decade to three in the decade to 2011–12. The number of collisions at passive crossings has fallen from 13.0 to 6.5, although the decreasing trend in annual counts appears to have levelled off in recent years. Importantly, the number of fatalities associated with level crossing collisions has also dropped markedly over this period (see Section 2.1).

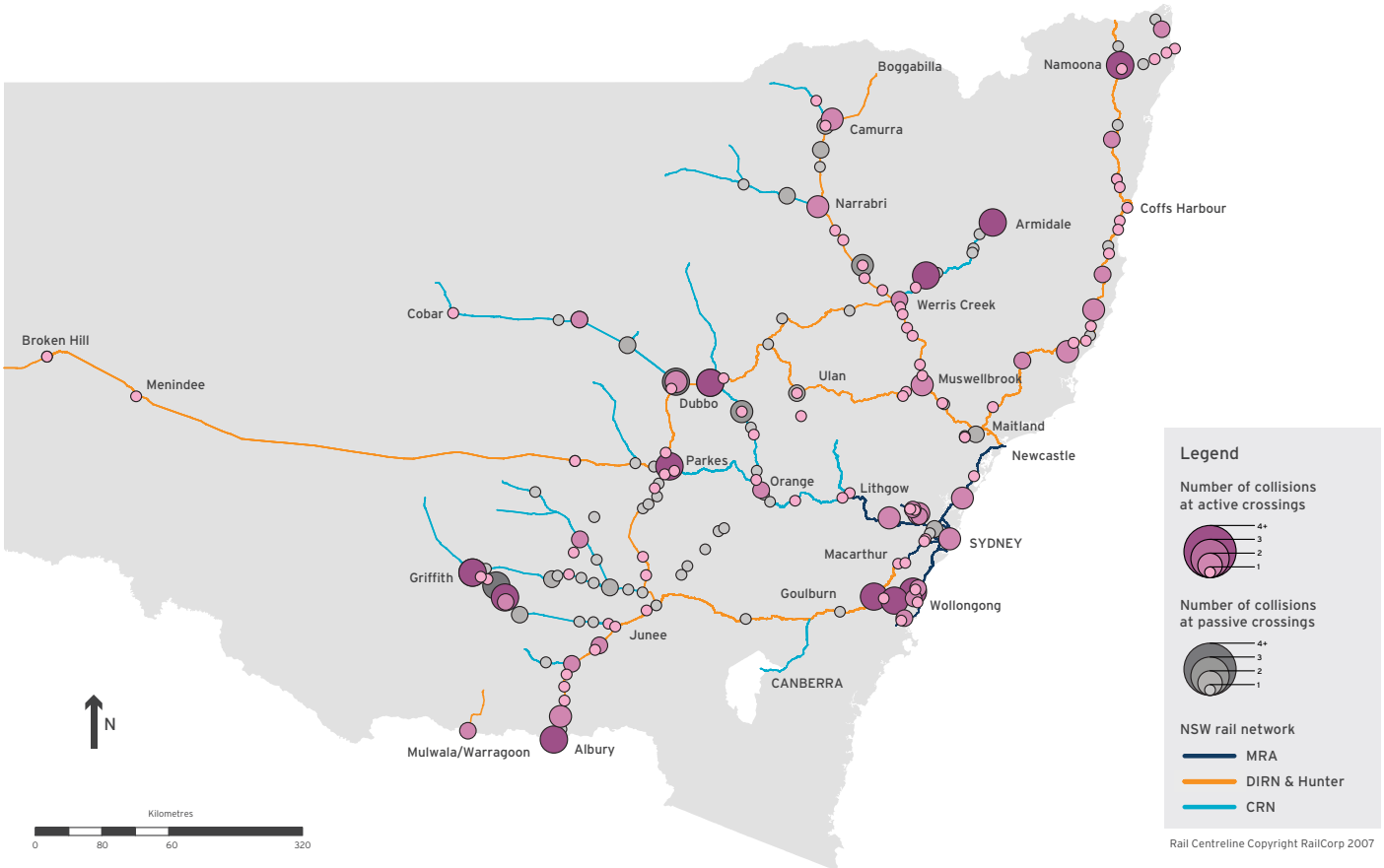


Figure 19: Level crossing train and road vehicle collision on the NSW rail network, 1989–90 to 2011–12

Mapped location is based on a place name (generally a town or locality) rather than the exact level crossing location. Hence, a given symbol may represent the sum of incidents at several crossings at a single locality. Collisions on non-operational lines shown.

Despite the observed improvement in level crossing safety over time, the risk of multi-fatality accidents remains. The most critical collisions in this regard are those involving passenger trains, with each collision exposing a large number of people (passengers and train crew) to potential harm. There were three such occurrences in 2011–12 (Table 11). No injuries were reported in any of these, however harm was only narrowly avoided in a collision at Woy Woy involving a train carrying 200 passengers and travelling at almost 100 km/h.

The risk of fatal injury to train occupants further increases when collisions involve heavy, rather than light, road vehicles. The greater mass of heavy vehicles increases the severity of damage to trains and the likelihood of derailment and fatality. A separate analysis of level crossing accidents across Australia shows the fatality rate (per incident) for collisions involving heavy vehicles (for example, articulated trucks) is double that of lighter vehicles (passenger cars and vans). While there have been no collisions between passenger trains and heavy road vehicles in NSW over the past five years, there have been many serious near misses (see Figure 21).

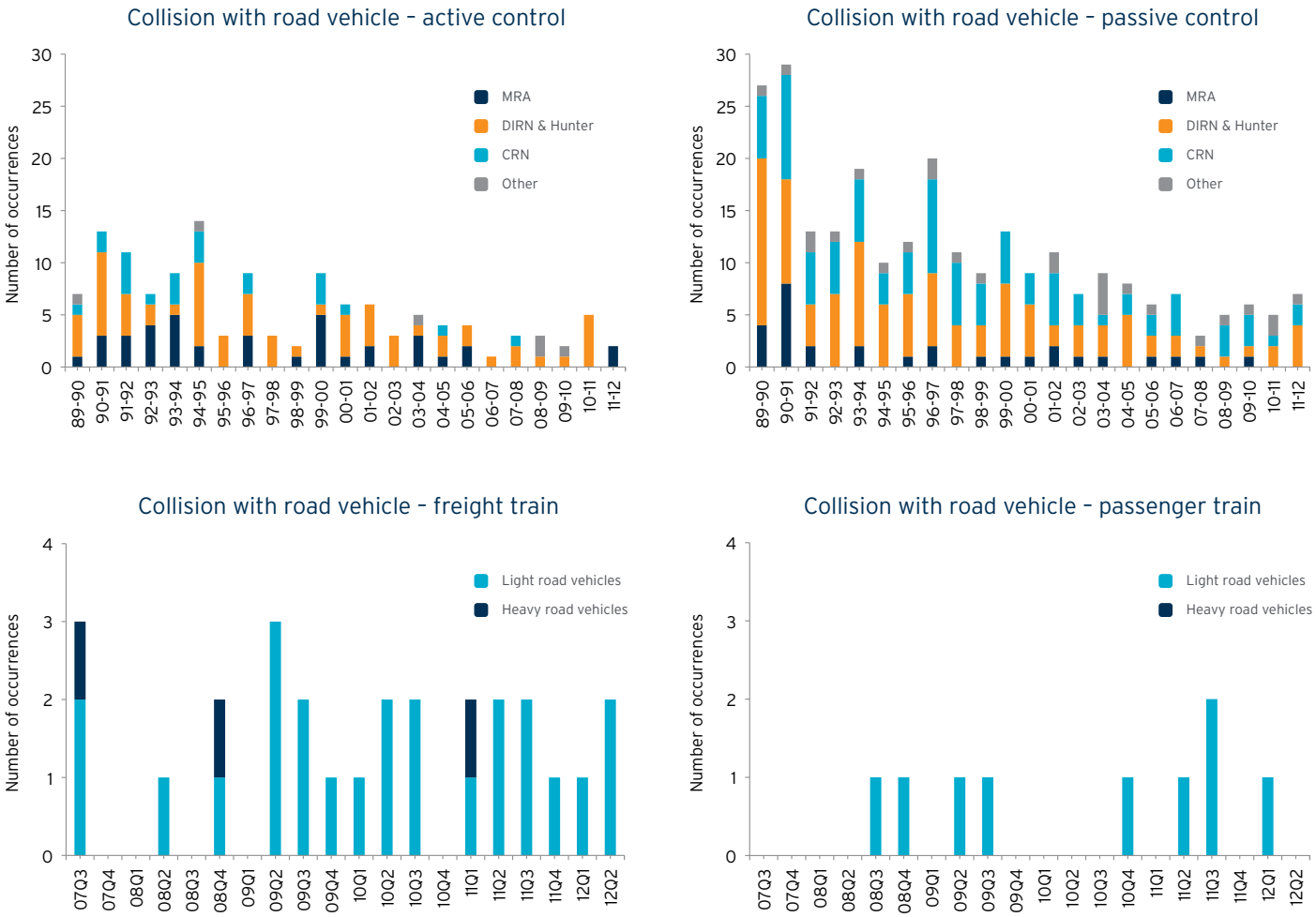


Figure 20: Level crossing train and road vehicle collision on the NSW rail network to 2011–12

Vertical bar is annual occurrence count. *Light road vehicles* includes the national occurrences categories *light passenger vehicles, buses, motorcycles* and *bicycles*. *Heavy road vehicles* includes the national occurrences categories *heavy freight vehicles, dangerous goods vehicles* and *other road vehicles*.

A number of safety initiatives have been undertaken by NSW rail and road authorities under the coordination of the NSW Level Crossing Strategy Council (LCSC)[27]. These initiatives have been a contributing factor to the improvement in level crossing safety in the state over the longer term. They include[28]:

- Level crossing closures: a total of 122 level crossings have been closed since 2002, the majority of which were on private property. One public and one private crossing were approved for closure and decommissioned in 2011–12. Both of these were in the Hunter valley.
- Level crossing safety upgrades: major safety upgrades were completed at five level crossings in 2011–12 and minor works were completed at 17 sites. In addition to works completed, concept designs were prepared for another five projects and four projects proceeded to the detailed design stage.
- Awareness and enforcement actions: the vast majority of level crossing collisions are the result of road user behaviour. Targeted awareness and enforcement actions are a critical element of managing the risk at level crossings. During 2011/12, Transport for NSW and NSW Police Force conducted three level crossing awareness and enforcement campaigns in country NSW. The campaigns in Orange, Tamworth and Dubbo were supported by NSW Roads and Maritime Services and rail agencies, and were successful in improving motorist compliance at level crossings.

One of ITSR's corporate priorities in 2011–12 was the continued reduction of risks at NSW level crossings through the adoption of better risk management practices. ITSR's work to achieve this target included:

- as part of the national Rail Level Crossing Group, ITSR completed a study of national road crash, rail accident and level crossing survey data that identified key factors influencing safety at level crossings. Study findings were used to improve the Australian Level Crossing Assessment Model (ALCAM), a mathematical model and dataset used to estimate safety risks at level crossings.
- working closely with the LCSC to help coordinate and track an action plan to advance level crossing safety. ITSR also provided regular and ad-hoc reports to the LCSC and associated agencies on level crossing safety performance to identify opportunities for safety improvement.
- under the *Rail Safety Act 2008*, rail infrastructure managers and road authorities must make agreements to manage safety risks at level crossings on public roads. In 2011–12 ITSR undertook a range of tasks to facilitate these agreements including site inspections, presentations and review of draft agreements. In cases where agreements were falling behind schedule, ITSR oversaw the development of detailed implementation plans to ensure satisfactory progress towards compliance.

Level crossing near miss

A near miss incident represents a sequence of events that has progressed to a point just short of actual harm being realised. Analysis of near miss data (for example, trends over time, differences between crossings) helps to identify emerging risks. However, the relationship between near miss incidents and collisions is not straightforward – crossings with a history of near misses are not necessarily ones where collisions occur and vice versa; more collisions occur at passive crossings whereas active crossings dominate the near miss statistics.

The five-year history of notified near miss incidents is shown in Figure 21. The number of notifications decreased over the period. This trend is associated with the MRA and occurred despite an increase in train movements on this network (Section 1.1). The decline in incidents is likely to reflect both the adoption of a more precise definition of near miss over time as well as improvements in safety through initiatives coordinated by the NSW Level Crossing Strategy Council including crossing closures, safety education and targeted enforcement activities.

There is no evidence of trend over time in the number of near miss reports for any other network. However, abrupt and temporary changes in the counts for some periods are evident. These tend to reflect issues at individual crossings or groups of crossings. Examples include the rise at active crossings for Other networks in late 2008–09, associated with several crossings in and around rail yards in the Port Kembla industrial area. A sharp rise is also evident in the most recent period for the DIRN and Hunter and Other networks. This was due, in part, to several crossings adjacent to collieries on the Hunter network.

27 See the Transport for NSW level crossing website <http://www.transport.nsw.gov.au/levelcrossings>.
28 NSW Level Crossing Strategy Council, *Yearly Report 2011/12, Level Crossing Safety Improvement Program*, LCSC, (draft).

Figure 21 also summarises near misses by categories of train and road vehicle. Freight trains account for almost two-thirds of near miss incidents over the period, with most involving light road vehicles. In such cases, the risk of injury lies primarily with road vehicle occupants because of the greater mass of freight trains compared to road vehicles. The balance of fatality risk shifts towards train crews in collisions involving heavy road freight vehicles such as semi trailers. National data shows the rate of fatality per collision involving heavy vehicles is double that of collisions involving light vehicles such as cars or vans.

The greatest risk of multi-fatality accidents at level crossings is associated with collisions between passenger trains and heavy vehicles. This is because passenger trains expose multiple people (crew and passengers) to potential harm. Just over 5% of near miss incidents were of this nature but in many cases harm appears to have been only narrowly avoided. In 2012, there were five incidents involving XPT passenger trains and trucks on the DIRN and Hunter and CRN networks. One incident on the Hunter network in May 2012 involved a CountryLink passenger service travelling at 120km/h missing a heavy grain truck on a passive level crossing by approximately three seconds.

ITSR regularly reports a range of level crossing statistics, including near miss incidents, to the NSW LCSC. This is combined with other information such as risk evaluations and site assessment to help inform strategies to improve safety at level crossings.

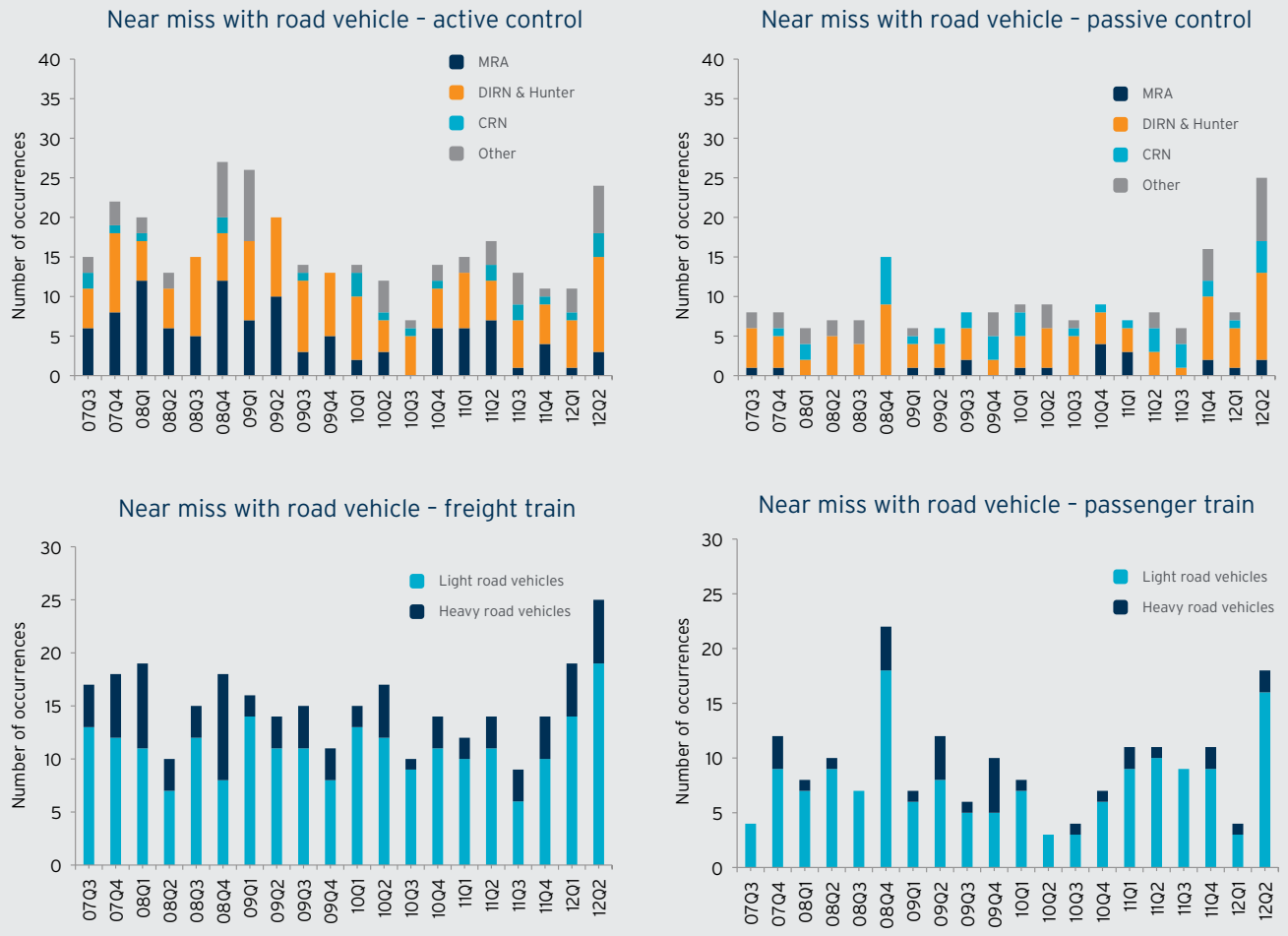


Figure 21: Level crossing train and road vehicle near miss on the NSW rail network, 2007-08 to 2011-12

Vertical bar is annual occurrence count. *Light road vehicles* comprise national occurrence category road vehicle types *light passenger vehicles, buses, motorcycles* and *bicycles. Heavy road vehicles* comprises *heavy freight vehicles, dangerous goods vehicles* and *other road vehicles*.

3.3 Collision other than at level crossing

SUMMARY

- Six running line collisions between trains were notified in 2011–12. Two of the collisions involved passenger trains. In both cases trains were struck by equipment protruding from passing freight trains.
- A collision between a track machine and freight train on the DIRN is being investigated by ITSR and the ATSB. The track machine was placed on the tracks without authority. No injuries were reported.
- Three collisions were between track machines. One incident resulted in a rail safety worker suffering serious injuries.

The national occurrence category *collision* comprises a broad range of occurrences, all of which involve a train (or rolling stock) striking, or being struck by, something. Collisions on or affecting the safety of running lines are also classified separately from those in yards. The former are typically the higher risk occurrences and are summarised in Figure 22.

Nearly 90% of occurrences in 2011–12 were trains hitting animals and smaller objects on or about the track. While these types of incidents are relatively frequent, they usually result in no injuries to passengers or train crew and little or no damage. However, there are exceptions, particularly when larger or heavier objects are involved. ITSR investigated an incident in July 2011 in which a CityRail service was struck by a tree that had been blown over in high winds. One passenger received minor injuries as a result of the collision. One freight train derailment in 2011–12 (Table 10) was the result of a collision with livestock.

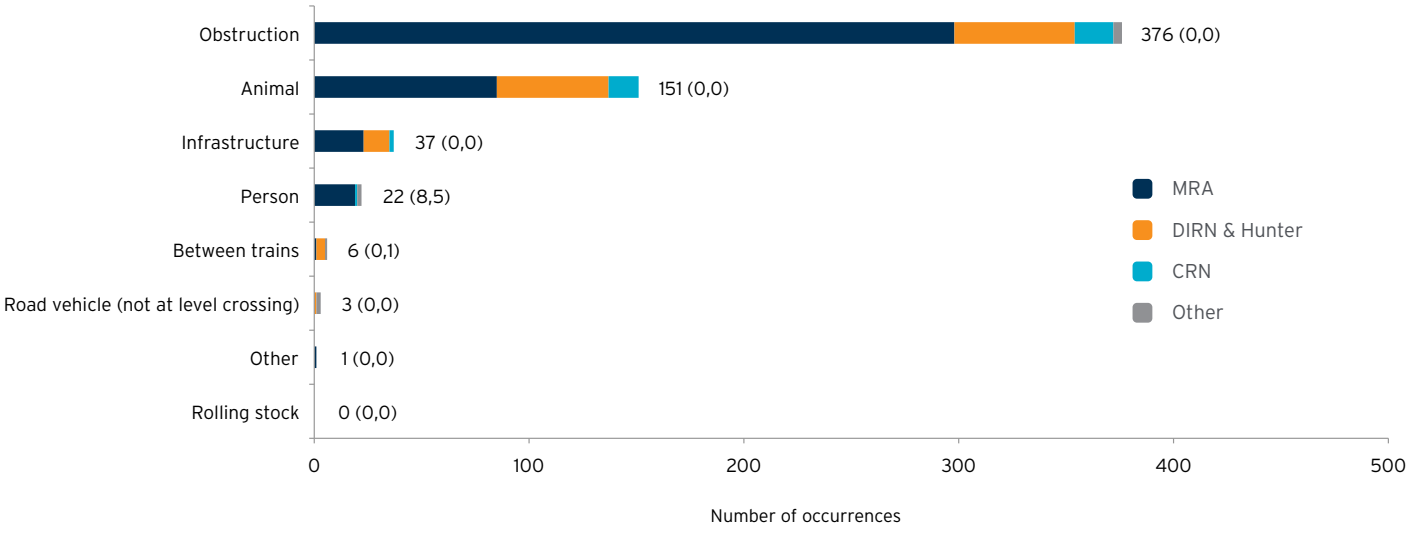


Figure 22: Running line train collision other than level crossing on the NSW rail network, 2011–12

In brackets are the number of fatalities and number of seriously injured people transported to hospital, respectively.
Excludes occurrences classified as *suspected/attempted suicide*.

The most important type of collision in terms of single fatality risk is collision with person (*strike*). There were 22 collisions with persons notified in 2011–12 (Figure 22)[29]. About 60% of incidents and 7 of the 8 fatalities involved trespassers. About 30% of incidents involved passengers, with individual behaviour a contributing factor in several incidents, for example, falls due to intoxication or rushing for a train. One of the fatalities and one of the five serious injuries in 2011–12 involved passengers struck by trains (Tables 4 and 5 respectively). Two of the incidents involved pedestrians struck by light rail trains. These types of risks were described previously in Section 2.

29 Some caution must be attached to these results because they include trespass incidents but exclude occurrences classified as suspected suicide and the distinction between the two is not reliable (see note section 2.1).

Table 12: Collision between trains (running line) on the NSW rail network, 2011–12

Network in brackets.

Date	Time	Location	Train type	Description
13 July 2011	1550	Menindee[1,2] (DIRN)	Freight – track machine	Freight train collided with and destroyed a track machine placed on track without authority. The crew of the track machine jumped clear before the collision and were uninjured.
28 July 2011	0850	Zig Zag[1](Other)	Track machine – track machine	Track machine collided with another track machine after being unable to stop due to reported ice on track. Both machines damaged, but no injuries reported.
8 September 2011	0147	Auburn (MRA)	Track machine – track machine	Collision between two track machines in transfer. No injuries reported, however both track machines received significant damage.
24 January 2012	1910	Islington Junction (Hunter)	Passenger – freight	Passing passenger train struck brake equipment protruding from a freight train locomotive. No injuries and only minor damage to both trains reported.
1 February 2012	1120	Gunning (DIRN)	Passenger – freight	Loose straps on wagon of a freight train struck passing passenger service. No injuries or damage reported.
14 February 2012	1707	Kinalung (DIRN)	Track machine – track machine	Track machine derailed after colliding with another track machine travelling in the same direction. One employee was transferred to hospital with a broken leg. Both track machines suffered significant damage.

1 Subject of compliance investigation by ITSR.
2 Subject of compliance investigation by ATSB.

Some types of collision, such as collisions between trains, pose a risk of multiple fatalities in a single accident. There were six running line collisions between trains in 2011–12 (Table 12), and there is no evidence of trend in the number of these incidents over the past five years (Figure 23). Incidents involving in-service passenger trains are of particular concern because of the exposure of multiple people to potential harm. Two collisions involved passenger trains in 2011–12 though neither involved a single line (head to head or nose to tail) collision. In both cases out of gauge material protruding from a freight train came into contact with a passenger train on an adjacent line. No injuries and only minor damage were reported. The most recent serious single line passenger train collisions in NSW include the collision of a passenger train and track machine at Newbridge in May 2010, a collision between two monorail vehicles in February 2010 and collision between an in service but empty train with a track machine at Zig Zag in April 2011.

Running line collisions involving freight trains expose train crew to harm and can lead to significant damage and disruption. There is also risk to passenger services on shared networks. There was one single line collision involving a freight train in 2011–12. This occurred at Menindee when a freight train struck a track machine placed on track without authority (Table 12). This is the subject of investigation by ITSR and ATSB. This incident arose from failures in the application of a specific set of rules designed to manage the safety of workers and work on track. Similar factors contributed to a collision between a freight train and excavator, described further below. These types of incidents are referred to as worksite blocking failures and are considered further in Section 4.2.

Three of the six collisions in 2011–12 involved track machines with one incident resulting in a serious injury. One incident on an isolated tourist and heritage line in July 2011 was the subject of a compliance inspection by ITSR, and followed on from another serious collision on the same railway some four months earlier between an in service but empty passenger train and track machine. In June 2012 ITSR imposed a restriction on this operator, preventing it from operating any passenger services until it has addressed these serious safety issues[30].

30 Due to a deterioration in underlying systems for managing the safety of its operations to a point where passengers, visitors and workers may become exposed to unacceptable levels of risk.

While much of the collision-related safety risk is associated with accidents on running lines, collisions in yards and wholly within work sites are also monitored by ITSR. ITSR and OTSI investigated an incident in May 2012 at Mangoola in the Hunter, where a ballast train collided with a track machine that had become disabled within the worksite. Whilst this incident occurred on a closed, single line section of track, several employees were on the ballast train at the time of the collision. No injuries were reported, however one of the track machines was derailed.

As well as collisions between trains, incidents involving trains colliding with other large, heavy objects also pose a significant safety risk. One derailment on the MRA in 2011–12 (Section 3.1) was caused by a collision with a car. There were three other collisions with road vehicles in 2011–12. Two were minor incidents – a freight train exiting a siding clipped a car obstructing the line, and a light rail vehicle in Sydney struck a car on the line. No injuries were reported for either of these incidents. A more serious collision occurred on the Hunter network in December 2011 when a freight train struck an excavator[31] moving across the track. The excavator was extensively damaged as a result of the collision but no injuries were reported. The incident is the subject of investigation by both the ATSB and ITSR.

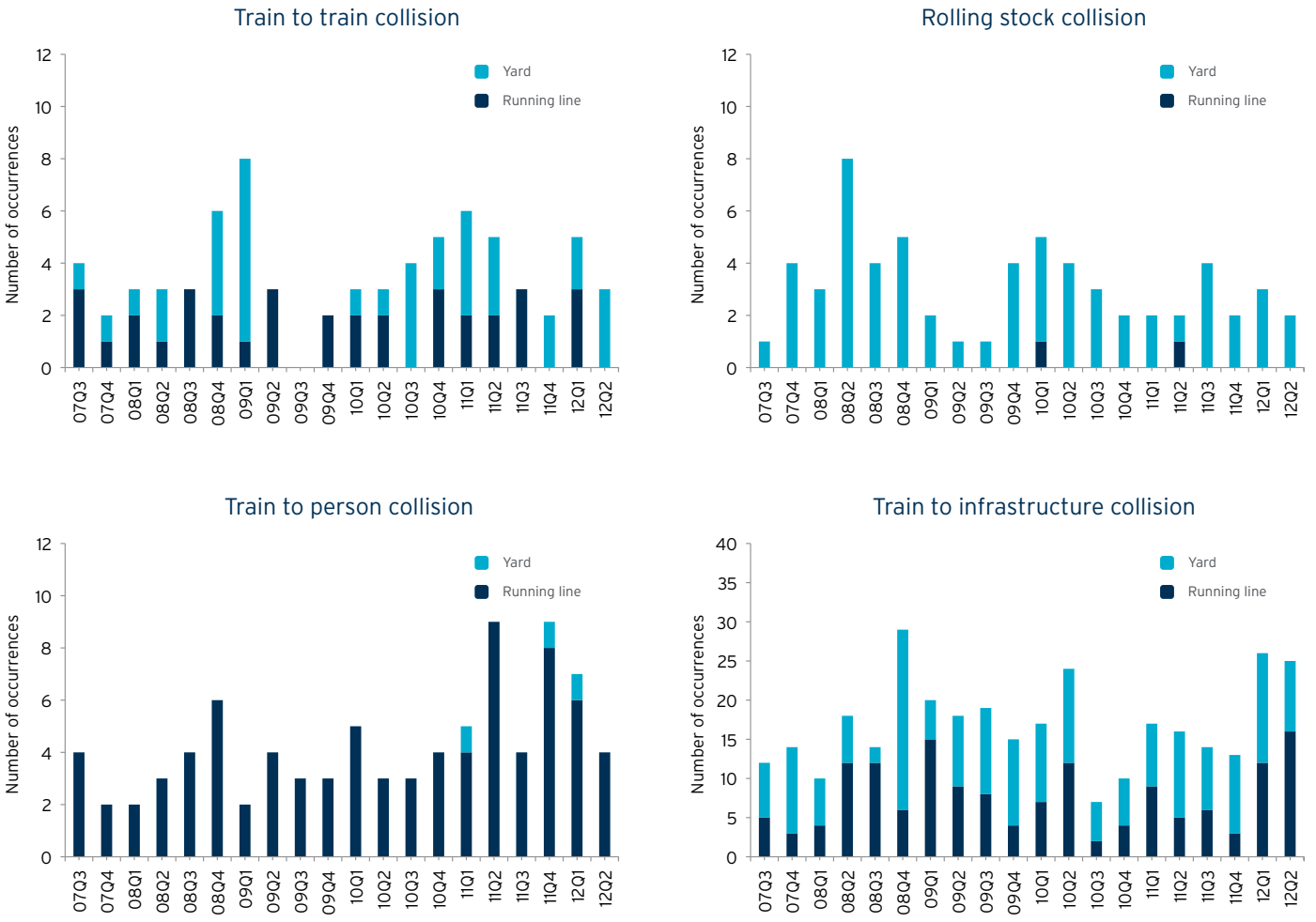


Figure 23: Train and rolling stock collisions on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. *Train to person collision* excludes occurrences classified as *suspected/attempted suicide* and occurrences at level crossings.

31 The excavator had on track capability but was not on track at the time and is therefore classified as *Road vehicle – special purpose machinery* under the national occurrence classification guidelines.

There were 37 collisions between trains and infrastructure on running lines in 2011–12. A range of infrastructure was involved including signals, platforms and buffer stops. Causes included out of gauge rolling stock, human error and infrastructure fouling the line. The number of occurrences in the first half of 2012 was markedly higher than recent historical figures but remained within the bounds of variation observed over the past five years. Most incidents were of a minor nature. However, ITSR routinely monitors such incidents and takes action in cases where more serious incidents are reported or repeat patterns are observed. In late 2011, following repeat notifications of trains scraping platforms at specific locations, ITSR undertook a review of information to determine the relevant issues including rolling stock and track condition. These were then followed up with operators to ensure corrective measures were implemented and risks were being appropriately managed.

3.4 Fire

SUMMARY

- 145 passenger train fires were notified in 2011–12. Almost 90% of occurrences were associated with arson on the MRA.
- The rate of arson-related passenger train fire (per million passenger journeys) on the MRA decreased over the past five years.
- The rate of rolling stock-related fire on passenger trains (per million train km travelled) decreased over time but steadied in recent years.
- The rate of freight train fire (per million train km travelled) increased over the past five years.

There were 350 fires notified in 2011–12 (Figure 24). Approximately 85% of incidents occurred on the MRA, which is consistent with the results of the previous four years. The strong contribution reflects the network's comparatively greater volume of rail traffic and higher station density.

Almost half of the notified fires in 2011–12 were train fires. The risk of fatality and injury associated with train fire is substantially less than that posed by other rail hazards such as collision and derailment. However, train fires still pose a direct injury risk to passengers and train crew. Fires can also lead to other hazards associated with evacuation, personnel fighting the fire and smoke in tunnels and stations.

Almost 90% of passenger train fires in 2011–12 were associated with arson on the MRA (*Other* in Figure 25). Most incidents involved the lighting of newspapers or attempted lighting of seats with more than two-thirds of incidents occurring between the hours of 6pm and 5am. Figure 26 shows the distribution of arson-related train incidents across the MRA over the past three years. These incidents were spread across the network, although a greater number of fires are suggested for the lines running to the west and south-west of the network. Two separate occurrences involving seat fires resulted in a total of ten employees being transported to hospital for smoke inhalation. Several occurrences required the evacuation of passengers from the train and/or termination of the service.

The five-year history of arson-related passenger train fires is shown in Figure 27. There was a marginally significant decrease in the rate of incidents across the MRA over the five-year period,

although most of the decrease is observed in recent years. This suggests that previously reported measures implemented by RailCorp to manage this risk have had a positive effect. These include the progressive rollout of new rolling sock with higher fire ratings and improved surveillance capability. As noted in Section 2.2, the NSW Government implemented Police Transport Command in May 2012 to coordinate security management and control of rail crime including arson.

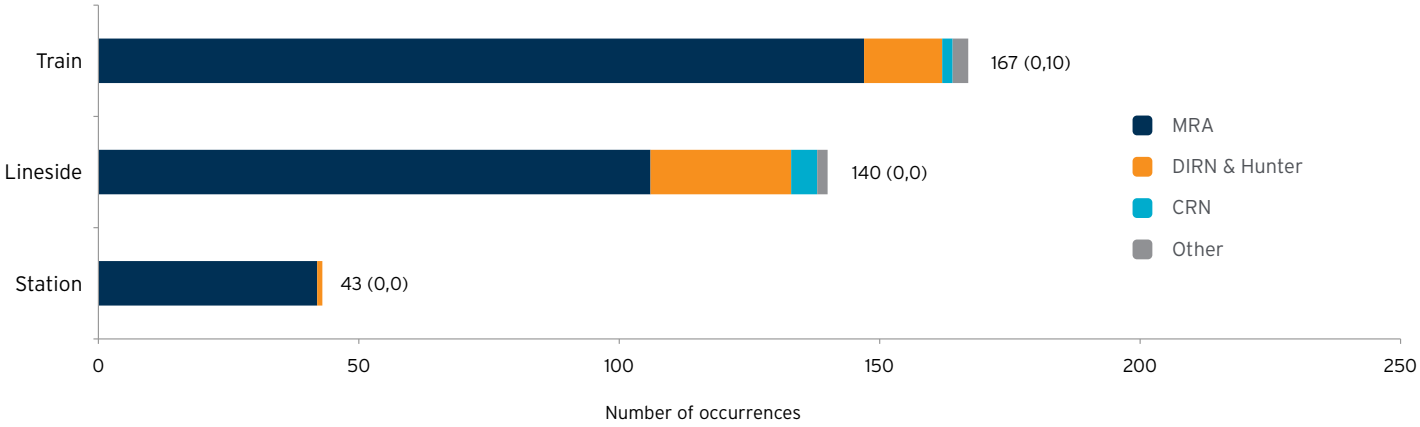


Figure 24: Fire on the NSW rail network, 2011–12

In brackets are number of fatalities and number of injured people transported to hospital, respectively.

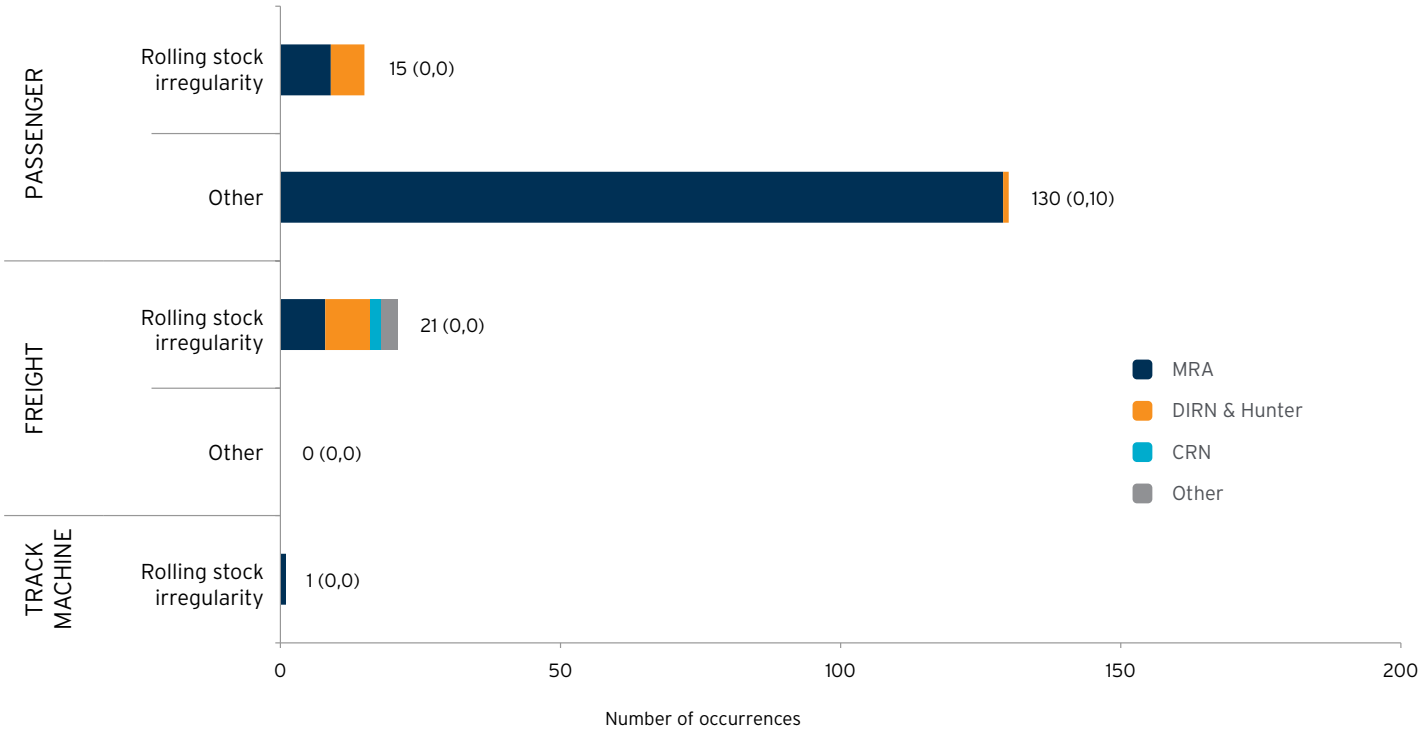


Figure 25: Train fire on the NSW rail network, 2011–12

In brackets are number of fatalities and number of injured people transported to hospital, respectively.

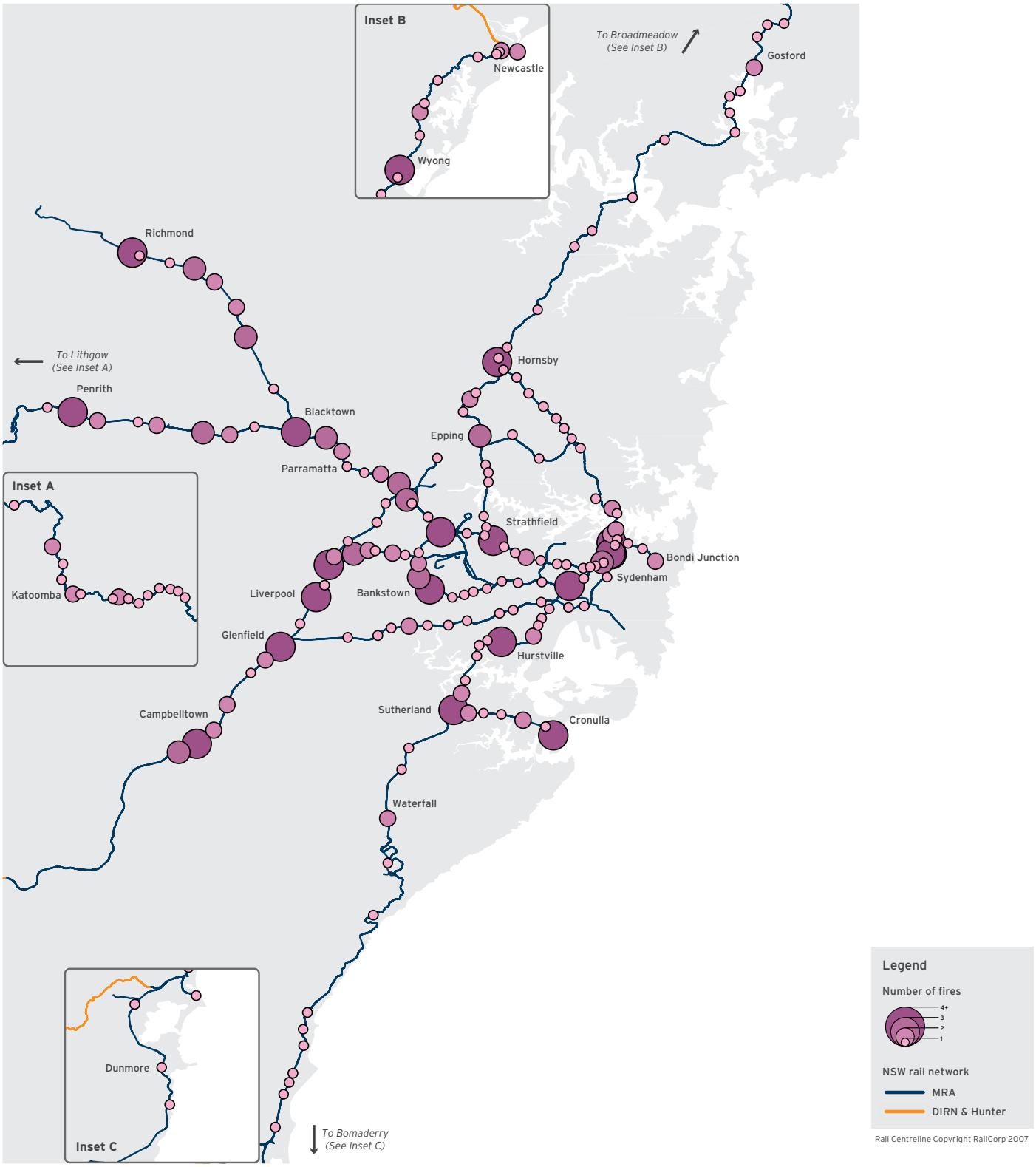


Figure 26: Passenger-related train fire across the MRA, 2009-10 to 2011-12

Mapped location is nearest reported location as notified and for some occurrences will represent the location where evidence of the fire was first detected.

A small number of passenger train fires were due to rolling stock faults. Fifteen rolling stock-related passenger train fires were notified in 2011–12. Most fires were associated with traction motors and electrical equipment. Despite a truncated record due to reporting changes, the rate of rolling stock-related passenger train fires decreased over the period of available records (Figure 28), from 0.54 per million train km travelled in 2008–09 to 0.33 in 2011–12. The majority of the trend occurred early in the period, and has steadied from 2010. Despite the improvement over time, several occurrences in 2011–12 were serious and required the evacuation of passengers from trains.

There were 21 freight train fires notified in 2011–12 which equals a rate of 1.09 incidents per million train km travelled. Nineteen incidents involved locomotives with a range of causes including engine fires, brakes and electrical components. The remaining fires were associated with sticking brakes on freight wagons. Previous reports have noted an overall increase in both the count and rate of freight train fire over the longer term. This pattern has persisted through most of 2011–12 (Figure 28). However, the count for the most recent month of the five-year period (June 2012) was the lowest of any in the past five years.

More than half of all fire occurrences notified to ITSR in 2011–12 were lineside and station fires, with most occurring on the MRA (Figure 24). About one-third of lineside fires were classified as affecting safety-related infrastructure, the majority of which involved sleepers. A significant proportion of station fires were associated with vandalism or careless acts, for example, discarded cigarettes.

The five-year history of lineside and stations fires is shown in Figure 29. The number of lineside fires on the MRA in 2011–12 (106) was less than 2010–11 (140), and continued a decrease in counts over the period. The number of station fires on the MRA also fell markedly, from 73 in 2010–11 to 42 in 2011–12 and there is a suggestion of a downward trend in these types of incidents over the five-year period.

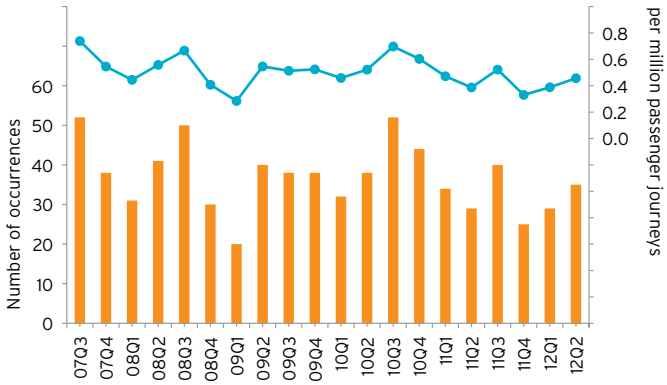


Figure 27: Arson-related passenger train fire on the MRA network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (count per million passenger journeys).

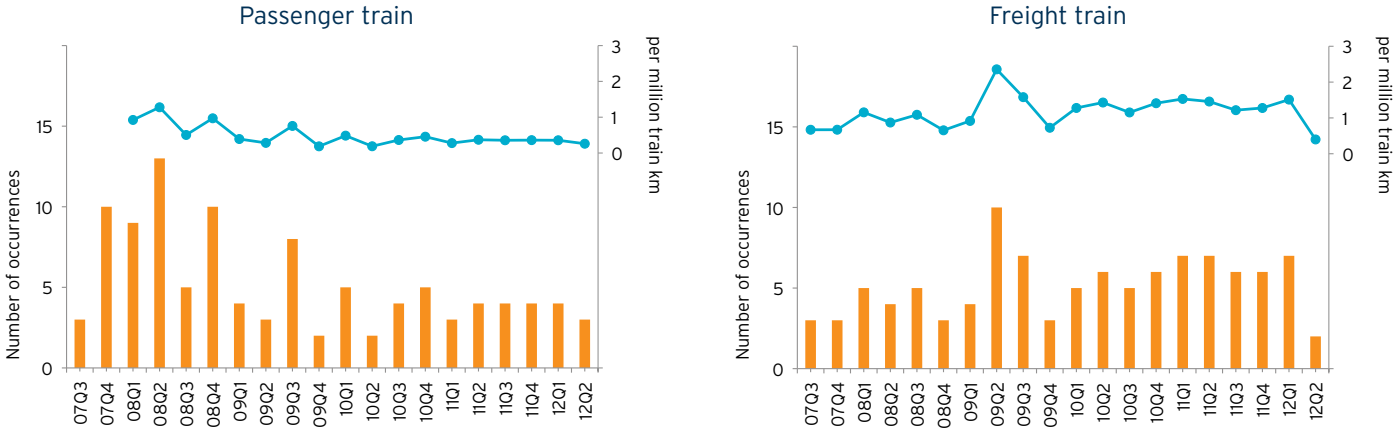
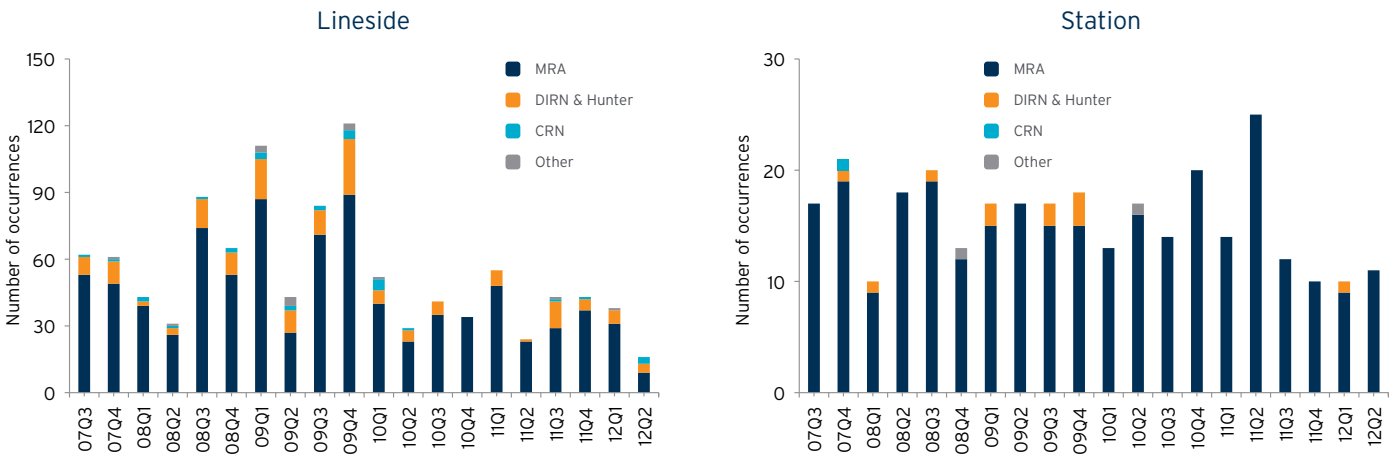


Figure 28: Rolling stock-related train fire on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (count per million train km travelled). Passenger train rate prior to 2008 excluded due to change in RailCorp's method of train km calculation.



▶ Figure 29: Lineside and station fire on the NSW rail network, 2007–08 to 2011–12

Vertical bars are quarterly occurrence counts.

4. Precursor rail safety occurrences

Most of the rail safety occurrences notified in NSW each year do not result in an adverse outcome such as injury or damage. Many of these occurrences are precursor events – incidents that could, in combination with other events, progress to accidents and actual harm. Accident precursors serve as warning signs of failures in safety risk controls employed by rail transport operators. They are particularly important in providing insight to the underlying risks of infrequent, but serious, accidents that are still relevant to a railway under its current level of risk control but have not occurred in the period of available accident data.

This section summarises five of the key groups of accident precursor defined within the national occurrence classification guideline. Assessing longer term trends in precursor incidents is complicated by changes in the legislative requirements to report them over time. In this report, the effects of reporting changes have been reduced by restricting the analysis to more recent years, after the period of many major changes. However, the period considered in this report still encompasses a significant reporting change arising from implementation of revised national notification requirements in 2009 and resultant changes to rail transport operators' incident capture and reporting processes.

4.1 Proceed authority irregularity

SUMMARY

- The number of driver error-related signal passed at danger without authority on the MRA decreased over the past five years.
- The number of incidents involving trains exceeding other limits of authorised movement has increased recently. This is associated primarily with freight trains passing stop boards in and about freight yards.
- The rate of driver error SPADs (per million train km travelled) for freight trains was almost 70% higher than that for passenger trains in recent years, despite a greater proportion of freight train movements occurring on unsignalled or less densely signalled track.

In NSW there are four principal systems used to manage the movement of rail traffic in a way that ensures adequate separation of trains and prevents conflicting movements[32]. An integral part of each of these systems is a means to authorise the movement of a train from one section of track to another.

For double-track and multiple-track territory and most heavily utilised single lines, the authority for a train to proceed is given by a signal indication. This form of authority applies to most of the MRA, a significant proportion of the DIRN and Hunter and the CRN between Lithgow and Orange. For single lines subject to lighter rail traffic, which includes most of the CRN and the north-western portion of the DIRN, an authority to proceed is given via the train driver's possession of a token (a metal rod called a "staff"), and/or the issue of a written or verbal authority.

Figure 30 summarises occurrences in 2011–12 that involved a train exceeding the limit of its authorised movement, either by passing a signal or other form of limit.

32 There is another series of systems to authorise train movements at times when the normal systems of safeworking are not available (see Section 4.2).

Signal passed at danger (without authority)

SPADs are important precursors to train collisions and derailments. Section 3.1 described a passenger train derailment on the MRA in February 2012 that was preceded by the train passing a signal at danger without authority. There have been four similar derailments on the MRA over the past few years.

A note on signals passed at danger (without authority)

The number of SPADs alone does not provide a complete picture of the risk posed by occurrences of this type. This is because the actual risk of collision following a SPAD depends on many factors, including whether the signal is equipped with engineering defences, which automatically stop a train once it has passed a red signal, how far the train travelled into another section and whether that section was occupied.

SPADs can rarely be attributed to a single cause such as driver error and are better understood by looking at the full range of contributing factors which may make human error more likely.

The most significant types of SPAD in terms of accident risk are those due to driver error. These types of SPADs are referred to here as *non-technical* SPADs. In the national occurrence classification guideline most non-technical SPADs fall within one of two subcategories, *driver misjudged* and *completely missed*. However, the information provided in an occurrence notification is usually insufficient to distinguish between the two. For this reason, data for these two categories (together with *starting against signal*) are combined and presented as SPAD (non-technical) in Figures 30 to 32.

There were 209 non-technical SPADs in 2011–12 (Figure 30). Nearly two-thirds of these occurred on the MRA, reflecting its greater volume of rail traffic and higher signal density compared to other networks. The number of incidents on the MRA in 2011–12 (133) was slightly higher than the previous year (122) but the nature of change varied between the different train operations. CityRail trains were involved in 94 SPADs on the MRA in 2011–12. Both the number and rate of CityRail SPADs on the MRA has decreased over the five-year period, the latter from 3.2 per million train km travelled the first 12 months of available data to 2.4 in 2011–12. RailCorp has a range of programs underway to reduce the number of SPADs on its network[33] including driver guidance, an awareness and communications campaign, and local workshops for drivers to discuss SPADs.

The remaining SPADs on the MRA in 2011–12 involved either freight trains or other train types (principally light locomotives and track machines). The number of freight train SPADs on the MRA fluctuates considerably over time but has increased for two consecutive years from a low of 12 in 2009–10. This may reflect, in part, a marked rise in freight train km travelled across all networks in the same period[34].

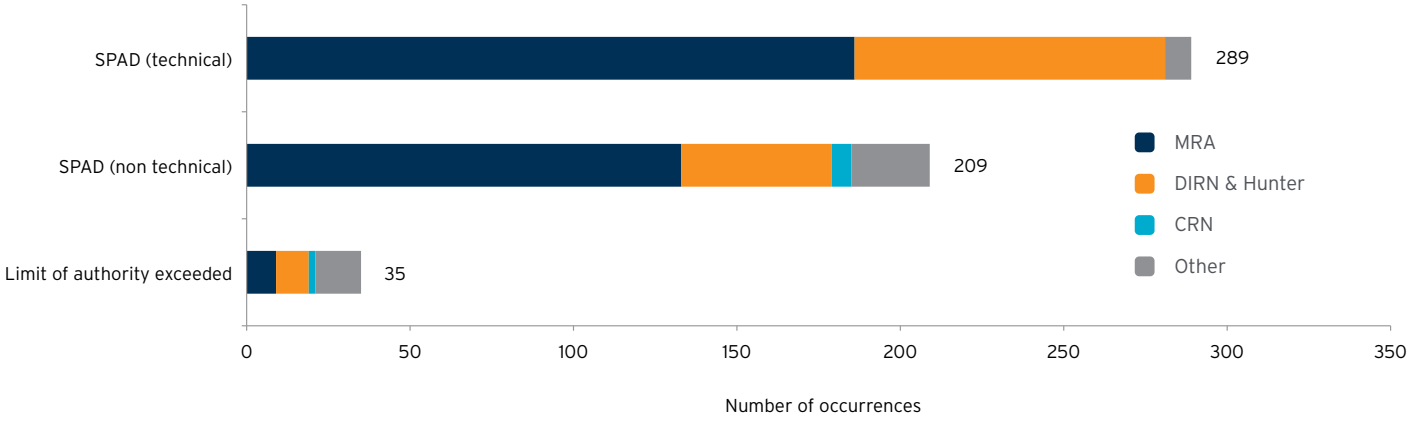


Figure 30: Limit of authority exceedance on the NSW rail network, 2011–12

Signal passed at danger (non-technical) comprises national categories *driver misjudged*, *completely missed* and *starting against signal*. Excludes occurrences classified as *signal passed at danger other.*

33 Independent Transport Safety Regulator, *Transport safety bulletin, Focus on signals passed at danger*, ITSR, June 2011. This bulletin and associated information on better practice in SPAD management and tools for investigating SPADs are available for download from ITSR's website <http://www.transportregulator.nsw.gov.au>.
34 Freight train kilometres are not reported on a network basis so rates of change on the MRA cannot be calculated.

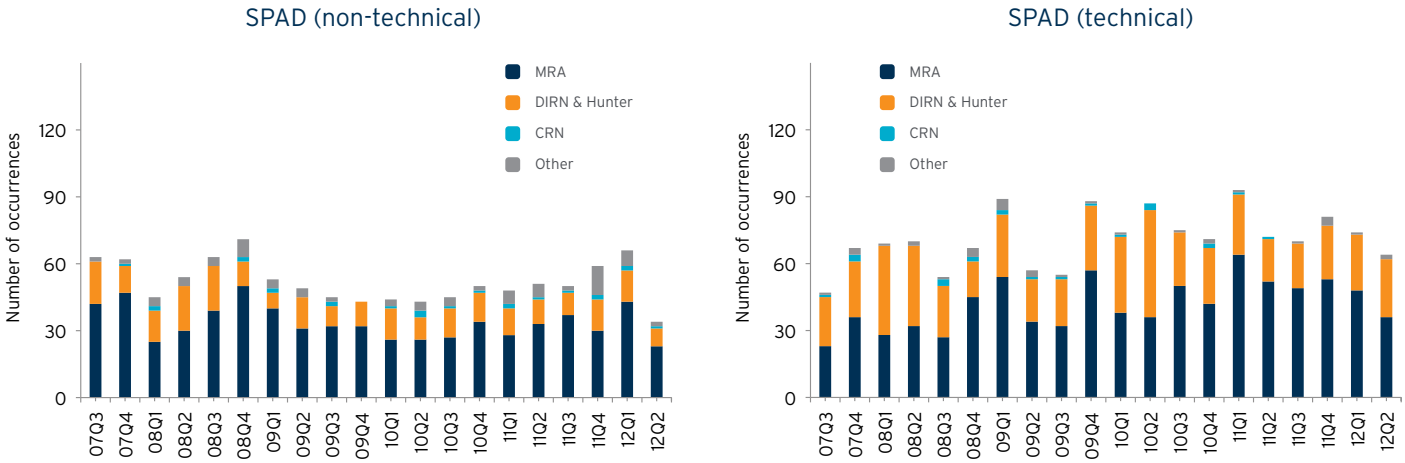


Figure 31: Signal passed at danger on the NSW rail network, 2007–08 to 2011–12

Signal passed at danger (non-technical) comprises national categories *driver misjudged, completely missed* and *starting against signal*. Excludes occurrences classified as *signal passed at danger other*. Vertical bar is quarterly occurrence count.

Forty-six of the 209 non-technical SPADs occurred on the DIRN and Hunter network. Most (76%) involved freight trains which represent most of the rail traffic on this network. Passenger trains accounted for a further 15% of the non-technical SPADs on this network. The number of SPADs has not changed significantly over the five-year period for this network. OTSI investigated a serious SPAD at Gunnedah Coal Junction in March 2012, when a freight train passed a signal at stop by 870 metres and led to a potential collision as it came to a stand about 715m short of another freight train heading in the opposing direction.

Figure 32 shows non-technical SPADs for passenger and freight trains over the entire NSW network. The SPAD rate for freight trains over the most recent two years of data (3.9 per million train km travelled) was about two-thirds greater than that for passenger trains (2.3), despite freight trains undertaking a greater proportion of their movements on track with lower signal densities and unsignalled track.

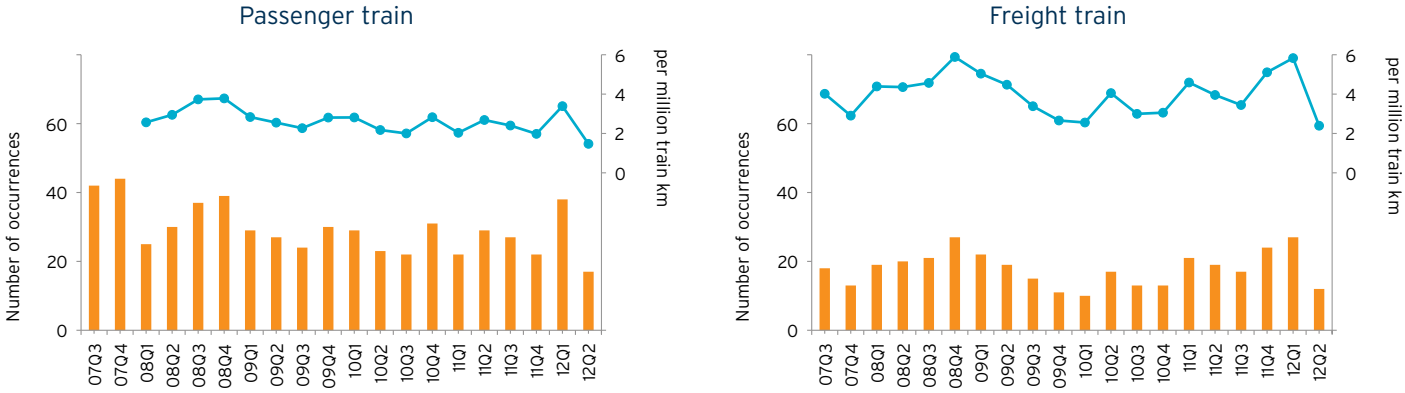


Figure 32: Signal passed at danger (non-technical) on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (count per million train km travelled). Passenger train rate prior to 2008 excluded due to change in RailCorp's method of train km calculation.

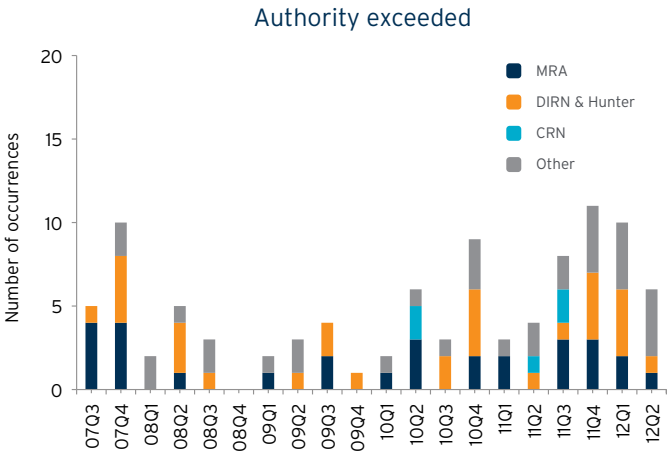
Technical SPADs

The most frequent type of SPAD notified to ITSR is a *technical SPAD*. In the national occurrence classification guideline these incidents are categorised as *signal restored as train approached*. They involve a signal indication changing from proceed to stop as a train approaches, with insufficient time given to the driver to stop the train. They are associated with a variety of causes including power failures, signaller error and track circuit failures. These SPADs do not pose a collision risk as the route ahead of the signal is clear for the train. However, they still pose a safety hazard because rapid deceleration associated with emergency braking may cause load shifts on freight trains and falls on passenger trains.

There were 289 such occurrences in 2011–12 (Figure 30). The five-year history of this type of incident is shown in Figure 31. There is an increasing trend in incidents over the five-year period however counts appear to have steadied in 2011–12. Again, the pattern of change varies between sections of the network. The DIRN and Hunter did not exhibit significant change over the five years and the MRA steadied following four consecutive years of increase. ITSR routinely reviews such occurrences to understand the nature of these incidents. Based on a review of data for the past two years, the cause of the incident could not be determined in about 25% of cases. The two leading causes of the remainder were power supply interruptions and surges (19%) and signal controller/maintainer actions (19%). The analysis suggests many of these incidents could have been avoided and ITSR communicates these findings back to track managers to verify that all reasonably practicable measures are being taken to reduce these occurrences.

Proceed authority exceeded

There were 35 notifications of trains exceeding the limit of their authorised movement under non-signalled systems of authorisation in 2011–12. The five-year history of this type of incident is shown in Figure 33. There is the suggestion of an increasing trend in counts over the period, the nature of which varies over time and between networks. The rise is most evident in late 2011 and is associated primarily with freight trains passing stop boards during movements within and about freight terminals (*Other* networks). These are lower risk occurrences due to the low speeds involved and isolated nature of incidents with regard to passenger train operations. However, ITSR initiated action in response to several incidents to ensure requirements for the safe movement of trains to and from yards are observed, especially in cases where responsibility for control of such movements is transferred between controllers across an operational interface, for example, the interface between mainline network control and yard control.



▶ Figure 33: Authority exceeded on the NSW rail network, 2007–08 to 2011–12

Most of the remaining incidents involved trains exceeding the limit of their authority on running lines. These are potentially serious incidents as they increase the risk of conflicting movements and collisions. ITSR and the ATSB investigated an incident at Bogan Gate (DIRN) in August 2011 in which a track machine (ballast cleaner) being transferred to Broken Hill under a track occupancy authority travelled beyond the limit of its authorised movement. These types of incidents are considered in more detail in Section 4.2.

As well as trains exceeding the limit of authority, ITSR is occasionally notified of other forms of irregular movement such as movements undertaken without any authority at all. In May 2012 a CityRail train was driven in the wrong running direction without authority at Homebush on the MRA. This was the third incident of this nature in the past three years and ITSR has commenced a compliance investigation of this incident.

4.2 Safeworking irregularity

SUMMARY

- More than 200 notified occurrences in 2011–12 involved significant failures in the systems governing the safe operations of trains and protection of workers on track.
- The number of notified breaches for most forms of procedural systems has not changed significantly over time. However, the number of incidents involving workers on track with no protection in place appears to have fallen.
- There is evidence of a temporary rise in some types of breach following changes in the systems of working and responsibilities for control.

Safeworking systems comprise the procedures and technologies governing the safe operation of trains and protection of people on or about the track. Section 4.1 of this report described a specific subset of irregularities associated with safeworking systems – those where a train exceeded the limit of its authorised movement. However there are other important elements of safeworking systems in which irregularities and threats to safety occur and these are considered below.

In mid-2006 ITSR began a broad and detailed review of serious irregularities in various safeworking systems. This section of the report is based on the data collected as part of this review. The statistical summaries presented are not based on the national occurrence categorisation, which only introduced a coarse level categorisation of these types of safety occurrences in 2008–09.

Procedural safeworking

Procedural safeworking explained

On rail vehicle detection track in NSW, the authorisation for a train to proceed is provided by fixed signals. The signal indications are determined largely by the status of interlockings and the location of trains as determined by track circuits and axle counters. As such, the integrity of the authority communication system does not rely on verbal communications or manual procedures.

On non-rail vehicle detection track, or when signalled track develops a fault, manual safeworking methods are used (albeit supported by hardware and/or software in some cases) and involve communications by telephone, train radio or other verbal forms. These manual methods of safeworking are referred to as procedural safeworking.

In such cases, a breakdown in procedure or a miscommunication of information can lead to situations where the "blocking" required to keep trains separated has, in effect, been compromised. This increases the potential for accidents such as derailments or collisions.

Procedural safeworking irregularities in 2011–12 are summarised in Figure 34.

The most common form of irregularity in 2011–12 (18 incidents) was associated with degraded working. This type of working is used at the time when the normal method of safeworking has been suspended, for example, due to signal fault. Errors may then occur in the alternative procedural-based system for managing train movements such as hand signalling.

About 90% of degraded working irregularities in 2011–12 occurred on the MRA. The relatively high number of incidents for this network reflects, in part, several factors which exist most intensively on this network. The MRA consists almost entirely of signalled track and multiple lines. The failure modes in such areas, and the specific methods of degraded working employed to manage such failures, are generally more liable to procedural errors. Moreover, the number of opportunities for failures to occur is higher, for instance, a greater number of signals will potentially result in a greater number of signal failures. These characteristics, when coupled with higher rail traffic densities and relatively complex track configurations, create greater opportunity for irregularities to occur. Also, individual railway staff are required to work to procedural methods only occasionally, and will have less experience and familiarity with the system compared to the normal signalled

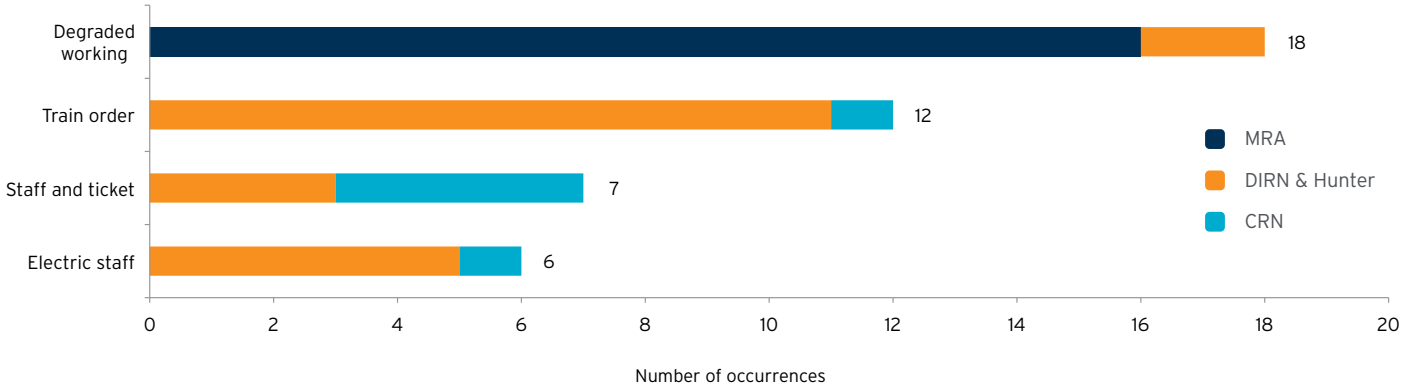


Figure 34: Procedural safeworking irregularity on the NSW rail network, 2011–12

Irregularities are a subset of notified occurrences (those with potential for collision or derailment) notified to ITSR.

system of safeworking. This increases the likelihood that something will be missed or overlooked.

The five-year history of degraded working incidents is shown in Figure 35. Data for the two most recent quarters is elevated and associated with the MRA. However, consideration of changes over the longer term shows evidence of a marginally significant decreasing trend over the full five year period.

The remaining two degraded working irregularities in 2011–12 occurred on the DIRN and Hunter network. One of these incidents was the subject of compliance activity by ITSR – an incident at Rappville in February 2012 in which a network controller issued two Special Proceed Authorities for the one section of track, allowing a potential conflicting movement (collision) between a freight and passenger train.

The remaining procedural irregularities in 2011–12 were associated with forms of working specific to the DIRN and CRN (Figure 34). Twelve of the failures involved train order working and the number of incidents has increased in the second-half of the period (Figure 35).

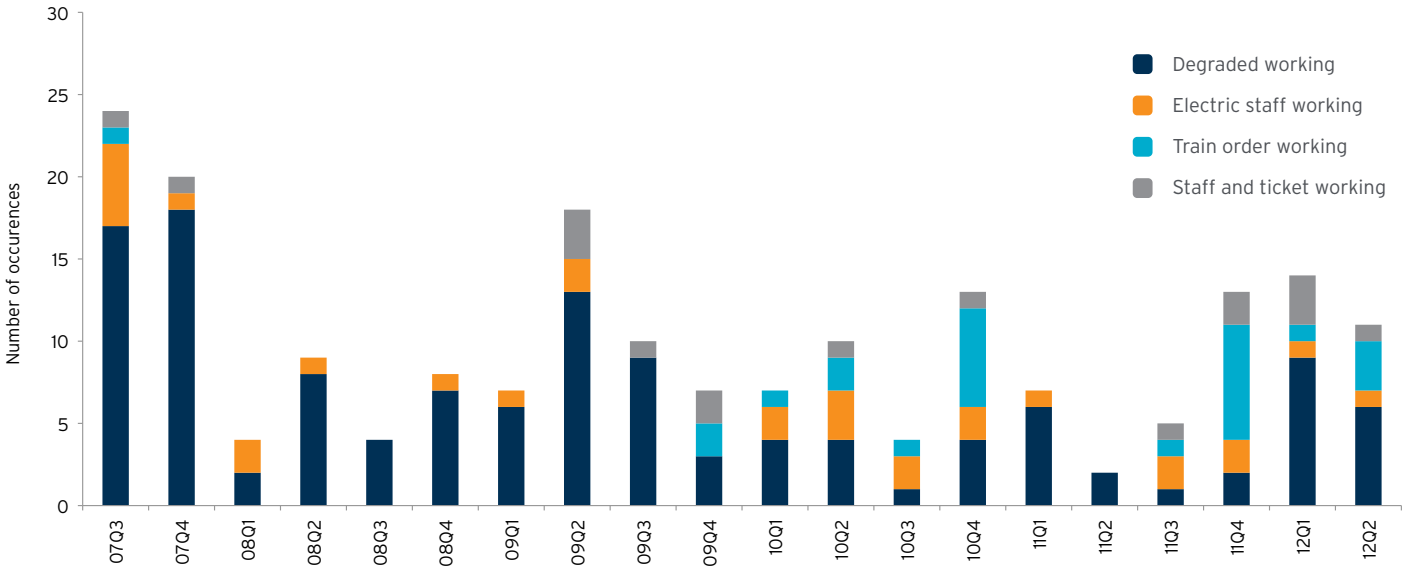


Figure 35: Procedural safeworking irregularity on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Shown is a subset of procedural safeworking irregularities notified to ITSR (those with potential for collision or derailment) notified to ITSR.

A potential contributor to this rise is an expansion of this form of working on the NSW rail network. Examples include implementation of train order working on about 175km of track between Stockinbingal and Parkes in September 2010 and on more than 800 km of track north of Werris Creek in November the same year. There have also been several marked, but temporary, increases arising from implementation issues – a rise in late 2010 was associated with the aforementioned implementation north of Werris Creek; a spike in late 2011 occurred on a part of the DIRN at a time where control was transferred from one control centre to another.

The number of incidents associated with the two remaining forms of working had not changed significantly from that observed over the past four years. ITSR is investigating one incident in October 2011 at Weetaliba on the DIRN in which a freight train ran through incorrectly set points. The points were left in the incorrect position by the crew of a track machine which had been moved into the adjacent siding. ITSR also noted a temporary rise in staff and ticket and electric staff failures in early 2012 at the time of JHR's takeover of train control on the CRN. Several incidents involved confusion amongst various parties regarding systems and responsibilities, particularly at interfaces between the CRN and other networks.

Worksite protection

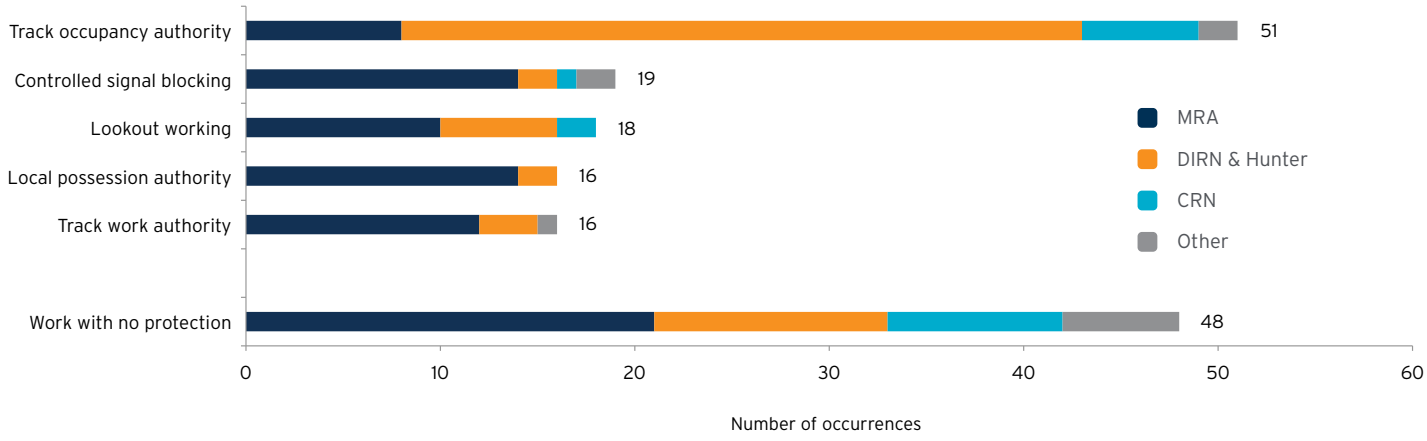
Worksite protection explained

Worksite protection refers to a specific set of safeworking rules and procedures designed to manage the safety of worksites and workers on track.

In NSW there are five different methods of worksite protection prescribed in the network rules. These range from low levels of protection (for example, where lookouts warn workers of approaching trains), through to exclusive 'possessions' where the protection arrangements are advertised in advance and no trains (other than work trains) are permitted to enter the worksite.

Serious irregularities for each of the five methods of worksite protection in 2011–12 are summarised in Figure 36. The data of Figure 36 represent a subset of more serious occurrences within the broader set of notified worksite-related incidents. They are incidents that represent a situation where the separation between trains and worksite(s) was not adequately ensured[35].

Fortunately there were no track worker fatalities associated with worksite protection in 2011–12 and it has been two years since the last track worker fatality. However, the risk of fatality remains significant with 120 serious irregularities notified



▶ Figure 36: Worksite protection irregularity on the NSW rail network, 2011–12

The category *Work with no protection* represents work performed without any approved work on track protection method being applied. The other five categories represent failures in the use of the approved method of protection. Excludes records lacking sufficient information for categorisation.

35 In 2010–11 ITSR revised its classification of serious worksite protection incidents to accommodate changes in safeworking rules and provide a more meaningful representation of certain types of failures. Part of this revision involved identification and classification of occurrences where work on track took place without any protection.

in 2011–12, including several near miss incidents. There were another 48 irregularities where work appeared to have been undertaken without any approved work on track protection method being applied.

The nature of worksite protection irregularities varied between networks. The most problematic method of protection on the DIRN and Hunter network was track occupancy authority (TOA), consistent with it being the most frequently used method of protection on this network. For the MRA, all five forms of protection had a significant proportion of irregularities recorded, reflecting the use of a wider variety of protection methods used on this network compared to others. The MRA also recorded a comparatively large number of occurrences that involved workers on track without any approved method of protection in place at all[36].

Changes in the number of serious worksite protection incidents over time for each of the main networks are presented in Figure 37. There is no evidence of an overall increasing or decreasing trend in the number of occurrences over the five-year period.

An exception is the CRN which exhibited a marginally significant rise over time. This appears to be a function of a very low number of notified occurrences early in the period, together with a recent issue involving third parties accessing the rail corridor without obtaining the necessary authority.

One of the most significant changes to worksite protection rules in recent years was a change to rules governing the lowest form of protection, no authority required (NAR). This rule was revised in December 2010 to "Lookout Working" (LOW) based on the Coroner's report into the Singleton double rail fatality of 2007[37], which identified that improvements to the NAR rule were needed. There is no evidence of a change in the number of NAR/LOW failures over the period of the rule change, based on ITSR's review of notifiable data. However, there is suggestion of a decrease in incidents involving work undertaken without any approved work on track protection, based on data extending back to the start of records (July 2006)[38].

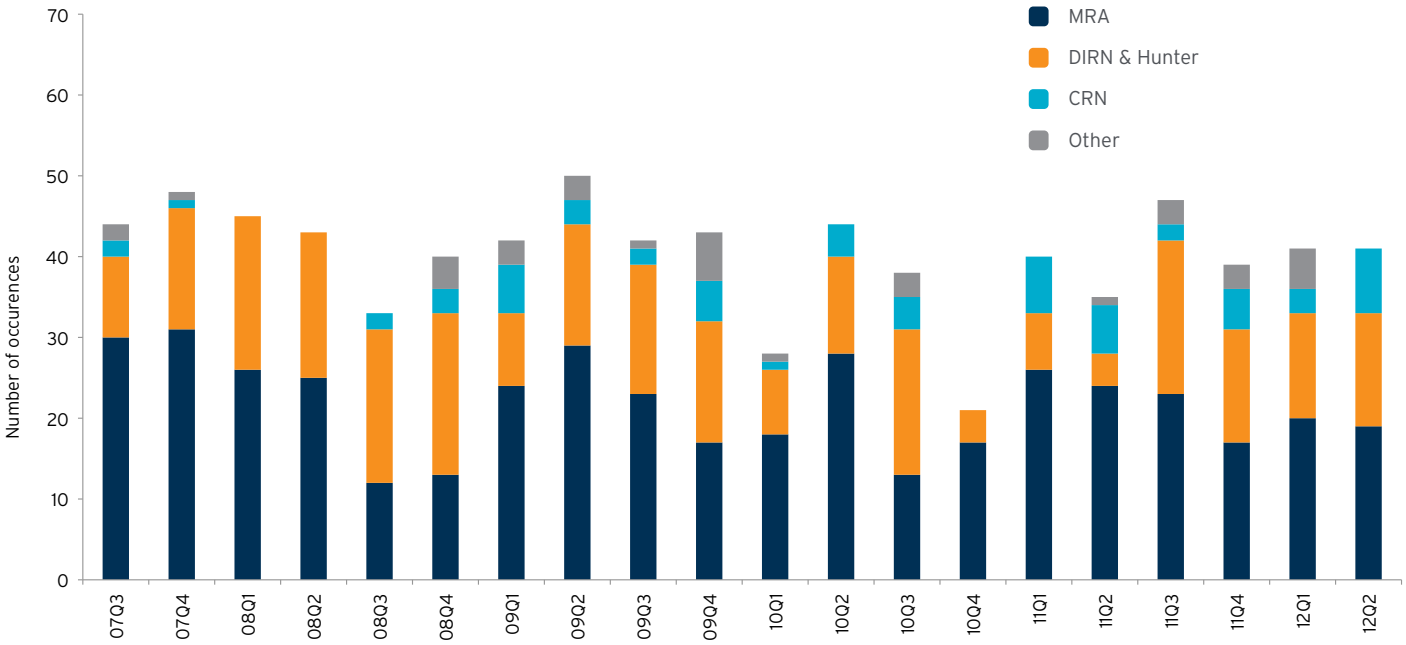


Figure 37: Worksite protection irregularity on the NSW rail network, 2007–08 to 2011–12

Excludes records lacking sufficient information for coding. Includes work performed without any approved work on track protection method being applied.

36 This data may not represent all risks associated with the different methods of worksite protection. For example, misjudgements by lookouts or other instances where no protection method was actually established may never be formally reported unless an accident or near miss occurs.
37 A copy of the Coroner's recommendations is available at ITSR's website <http://www.transportregulator.nsw.gov.au>.
38 Individual operators have noted reductions in certain types of higher severity worksite protection incidents based on their own richer, more detailed investigation findings and data.

Failures in individual methods of worksite protection

Notified irregularities in the safe use of the five approved methods of worksite protection are routinely subcategorised by ITSR into specific failure types. This helps determine the specific weaknesses of each method that may require attention. A summary of findings based on five years of data for the three main networks is presented in Figure 38 to Figure 42.

LOW[39] is the lowest form of worksite protection. It does not exclude trains from a worksite and instead requires workers to move to a safe place on the approach of a train. Figure 38 summarises the types of failures specific to LOW. The single most common type of failure (35% of all LOW failures) was use of LOW when a higher form of protection was warranted. LOW is restricted to the use of light, non-powered hand tools but findings from a previous ITSR compliance program highlighted the tendency of workers to perform heavier work than permitted because the lowest form of protection is easier and quicker to implement, and requires fewer resources. About 45% of failures for LOW over the five-year period were associated with lookouts, for example, work undertaken without a lookout or the lookout positioned in an unsuitable location. Lookouts are a critical element of this system of protection because they are responsible for watching for approaching trains and warning workers to move away from the track in sufficient time.

Controlled signal blocking (CSB)[40] uses signals set at stop to exclude rail traffic from a worksite. Figure 39 shows the majority of failures occur on the MRA which is dominated by signalled track suitable for this type of protection. CSB is used on a far smaller proportion of the other networks. The dominant type of failure on the MRA was work conducted without CSB protection actually being in place (23% of incidents). The next most common type of failure, relevant to both the MRA and DIRN, was work conducted outside the area actually protected by CSB, and trains not identified between the blocking signal and worksite. The latter

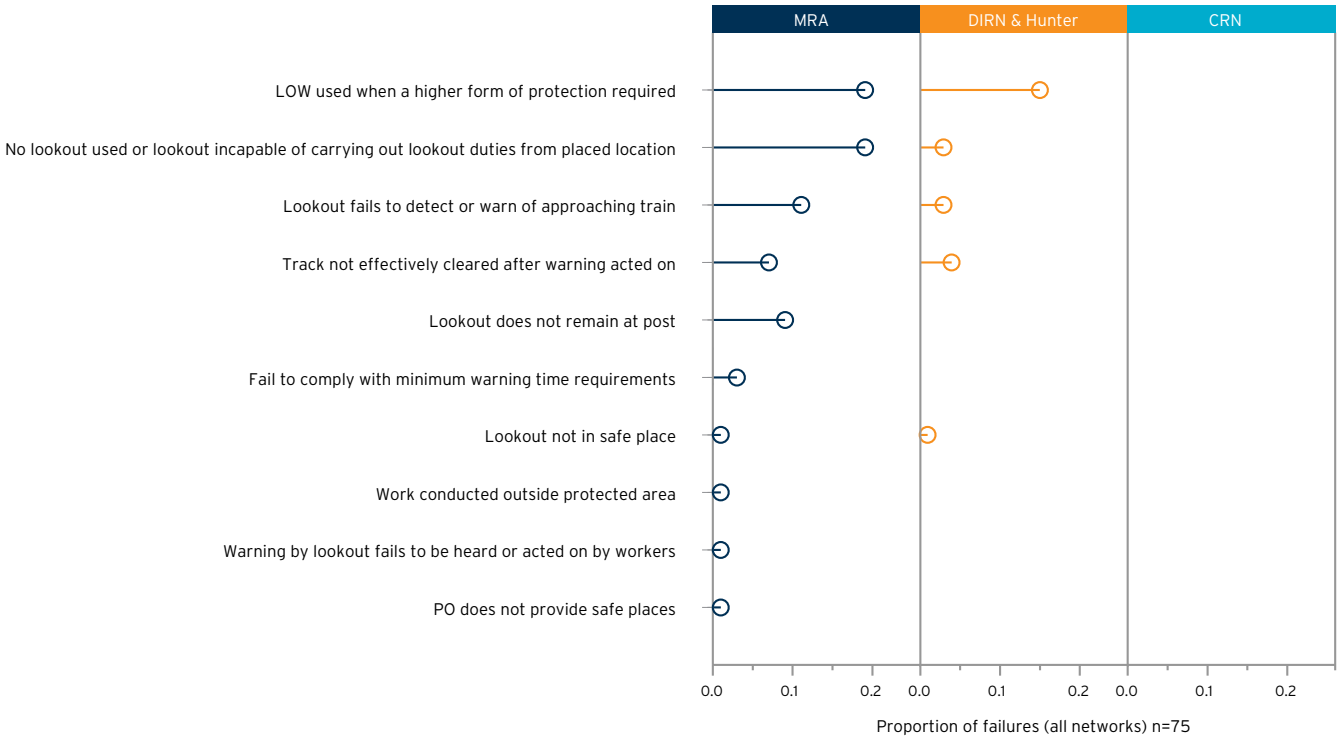


Figure 38: Lookout working failure on the NSW rail network, 2007–08 to 2011–12

PO = protection officer. 82 failures over period but 7 failures excluded because of insufficient information to determine failure type.

39 For this report, statistics for LOW are combined with a former version (NAR).
40 In 2012–13 the network rule and procedure for controlled signal blocking will be revised and renamed to absolute signal blocking (ASB) .

Figure 39: Controlled signal blocking failure on the NSW rail network, 2007–08 to 2011–12

PO = protection officer. 65 failures over period but 3 failures excluded because of insufficient information to determine failure type.

was a relevant factor in the death of a track worker at Kogarah on the MRA in April 2010[41] and also a collision between a freight train and excavator on the Hunter network in December 2012[42] (summarised in Section 3.3).

Track work authority (TWA) is a formal work on track authority. However, rather than give exclusive occupancy to track workers, it allows occupation of track by workers between rail traffic movements. Rail traffic is controlled by signallers and hand signallers. Apparent differences between the various failure types of Figure 40 are less reliable due to the small number of failures distributed across a large number of categories. However, the two most common types of failure both involved hand signallers. Similar to LOW, hand signallers have a crucial role in the protection of workers under TWA in managing a train's approach towards, and passage through, a worksite in a safe manner.

Figure 41 summarises failures in the use of track occupancy authorities (TOA). TOA is one of two 'possession' types of protection that completely exclude trains from the work area. However, higher forms of protection still pose significant risk – the last track worker fatality in NSW (Newbridge, May 2010) involved a passenger train colliding with a track machine working under a TOA.

TOA irregularities account for just over 40% of all blocking failures in NSW. About 70% of failures were on the DIRN and Hunter, where TOAs are the primary form of protection. About 22% of failures were associated with a specific application of TOA – to authorise movement of track machines between work locations or for hi-rail track inspections. In these instances, the vehicles have exceeded the limit of their authorised movement under the TOA. Section 4.1 describes one incident of this type on the DIRN that was investigated by ITSR and the ATSB. Three other TOA-related incidents on the DIRN in 2011–12 are also the subject of investigation.

41 In 2011–12 ITSR commenced prosecution of the rail operator involved in this accident.
42 Subject of investigations by both ITSR and OTSI.

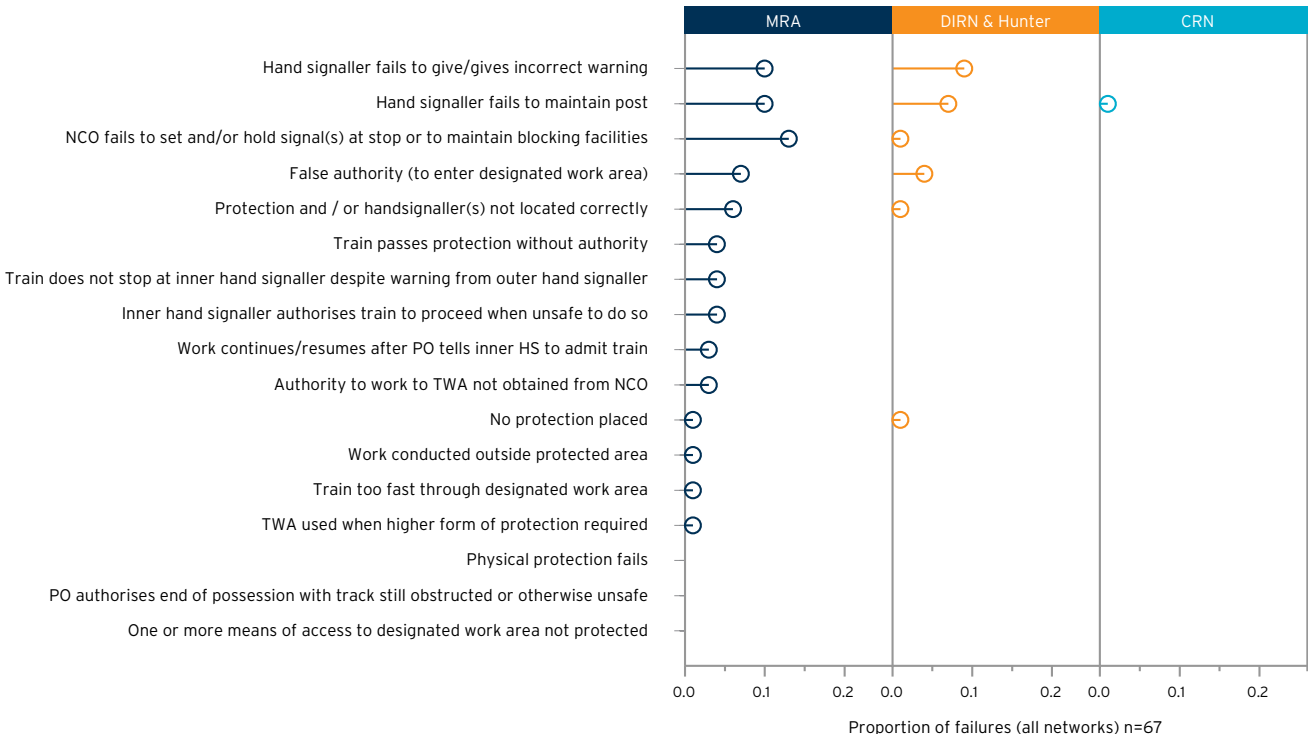


Figure 40: Track work authority failure on the NSW rail network, 2007–08 to 2011–12

NCO = network control officer. PO = protection officer. 73 failures over period but 6 failures excluded because of insufficient information to determine failure type.

Figure 41: Track occupancy authority failure on the NSW rail network, 2007–08 to 2011–12

NCO = network control officer. PO = protection officer. 244 failures in period but 8 failures excluded because of insufficient information to determine failure type.

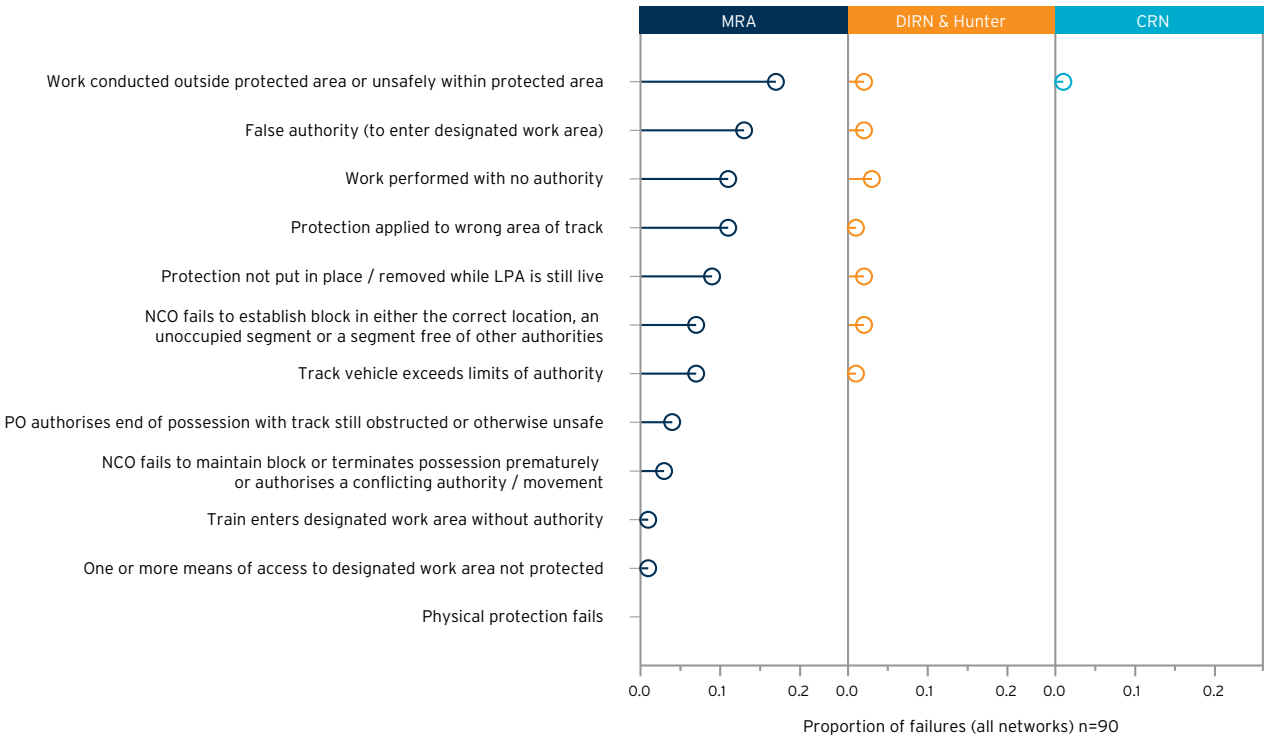


Figure 42: Local possession authority failure on the NSW rail network, 2007–08 to 2011–12

NCO = network control officer. PO = protection officer. 93 failures over period but 3 failures excluded because of insufficient information to determine failure type.

Figure 42 summarises failures for the other 'possession' type of track work – local possession authority (LPA). LPA is the highest form of protection and represents about 15% of all failures over the five-year period. Almost 85% of incidents occurred on the MRA. LPA irregularities are uncommon on the other networks where TOAs are the preferred form of possession. Failures on the MRA were distributed across many categories, with the most common form of failure being work conducted outside the protected area or unsafely within the area. This form of failure was associated with a near miss on the Hunter network in November 2012 between a track worker and maintenance train travelling on an adjacent line.

The types of failures revealed by this form of analysis help ITSR in its planning of strategic and operational activities to encourage improved management of track worker safety. In 2011–12 ITSR undertook 32 worksite inspections to monitor the adequacy of protection and compliance with network rules. It also undertook six compliance investigations of serious incidents.

In 2011–12 ITSR also continued its strategic engagement with NSW rail transport operators to improve practices for management of track worker safety. This included working with RailCorp on the use of fault trees[43] developed by ITSR in 2010–11 to strengthen rules and systems for worksite protection. ITSR also held a workshop with rail transport operators to discuss approaches and seek assurance that rail transport operators are collecting and analysing information in a way that allows effective identification and management of issues.

43 Fault trees utilise a graphical technique to identify the chain of events leading to a specific fault or failure.

4.3 Signal and track irregularity

SUMMARY

- There were no serious communication, token or signal-based system irregularities notified in 2011–12. Four actual or potential wrong side failures in the level crossing equipment used to control road and pedestrian traffic were notified.
- The number of notified broken rails has not changed significantly over the past five years for the networks as a whole, however, there are marked differences between sections.
- A previously reported increase in track misalignments on the main southern rail corridor between Sydney and Albury appears to have stabilised, however misalignments have increased on other segments of the network over the past five years.

Signal and other authority system irregularity

The national occurrence category *Signalling and other proceed authority systems irregularity* comprises irregularities in the systems, components and equipment used to authorise train movements in a safe manner. Irregularities in the three systems used in NSW to authorise movements of trains are shown in Figure 43, together with irregularities in level crossing equipment used to control the movement of road and pedestrian traffic. Each of the categories in Figure 43 is defined quite narrowly, being essentially limited to the most serious irregularities, such as wrong side failures.

There were no serious irregularities in 2011–12 for the communication, token or signal-based systems used in NSW. This is the first time over the five-year period with no irregularities notified[44].

Four occurrences notified in 2011–12 described actual or potential wrong side failures in the level crossing equipment (Figure 43). One failure was due to damaged electrical cabling critical to the activation of controls. A second incident involved an apparent failure of the track circuit to detect the approaching train. The cause was not described in the two remaining cases. Due to the serious nature of the failures summarised in Figure 43, each incident was reviewed by ITSR's specialist support team. Depending on circumstances, this may include communication with relevant infrastructure managers and site inspection to understand the nature of the failure and to verify incidents were investigated and associated risks were appropriately managed.

In addition to the wrong side failures, ITSR identified another 118 other safety critical failures in level crossing control equipment in 2011–12. Approximately 50% of these involved red battery alarms. These indicate loss of mains power has occurred and back up power has dropped to a point where it may be insufficient to activate the crossing controls. Another 40% of safety critical failures involved some aspect of active controls not working, such as boom gates not descending correctly or no audible warnings. Both wrong side and safety critical failures are regularly reported to the NSW LCSC which coordinates level crossing safety between agencies (see Section 3.2).

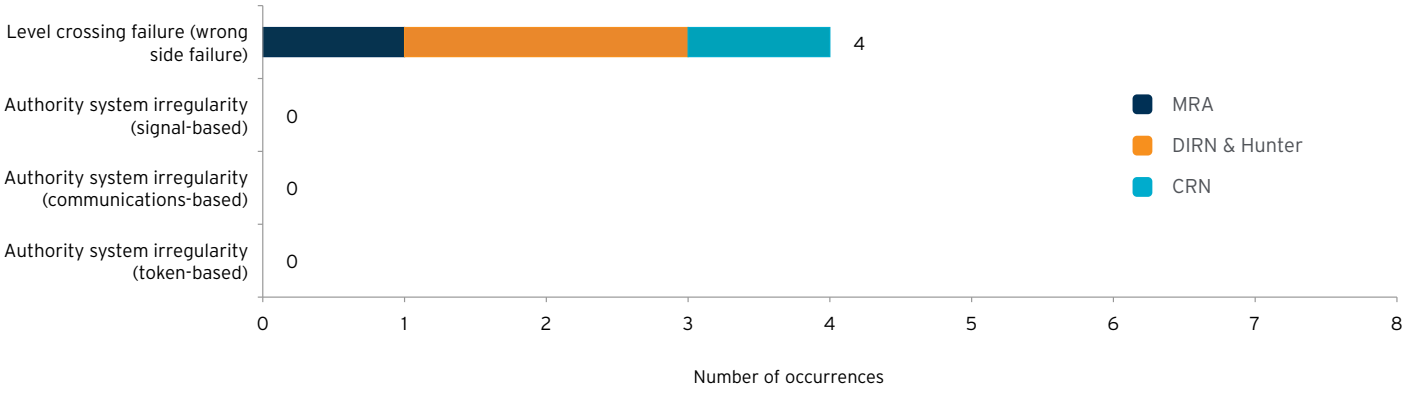


Figure 43: Signal and other proceed authority system irregularity on the NSW rail network, 2011–12

44 Due to the low frequency of incidents and a recent change to coding conventions for level crossing failures five-year time series are not available for the categories in Figure 43.

Track irregularity

Figure 44 provides a summary of the primary categories of track irregularity within the national occurrence classification guideline.

The most common type of track irregularity notified to ITSR is track obstruction, with 754 occurrences notified in 2011–12. This type of incident is defined broadly in the national occurrence classification guideline and incidents therefore vary markedly in terms of their nature, cause and risk posed. Most track obstructions involve small or low mass objects such as tree branches, rubbish and animals that pose little or no risk to the safety of train operations. Some obstructions involved rail-related material such as high ballast, sleepers, train seats and maintenance equipment.

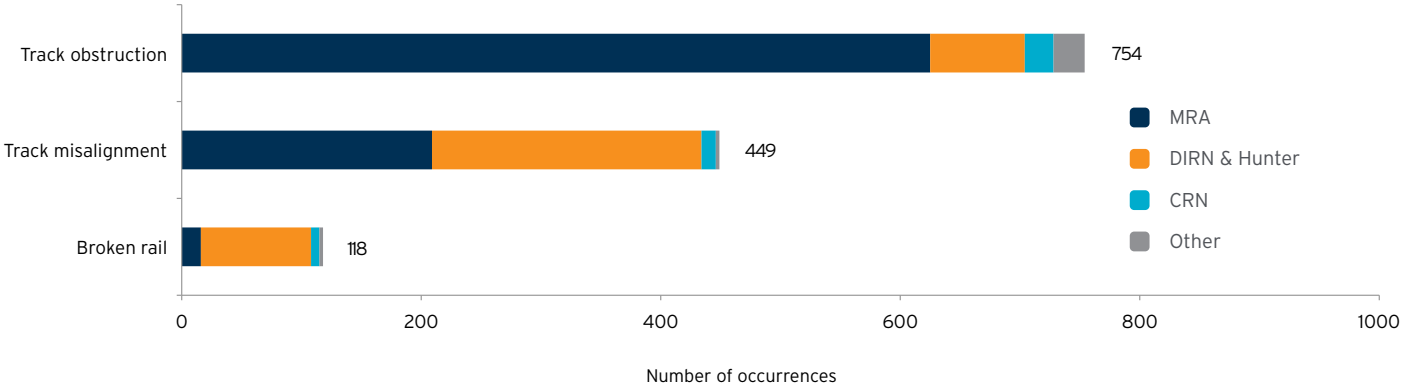
A small proportion of occurrences in 2011–12 involved larger, heavier objects which present a significant safety risk. For example, there were more than 20 incidents of road vehicles obstructing the rail corridor[45] notified in 2011–12. These incidents arose from various causes – road traffic accidents which led to cars entering the corridor, railway-related road vehicles left foul of running lines as well as several trespass incidents in which cars become stuck on a track. One of three passenger train derailments in 2011–12 was the result of a collision with an abandoned road vehicle on the track (Table 9, Section 3.1). In September 2011 a potentially serious near miss incident occurred when a semi trailer crashed off a road bridge onto a rail line. An approaching CountryLink train was bought to a stand before the truck (Table 7, Section 2.3).

Broken rails and misaligned track are the two key indicators of track condition and associated safety of the rail network. Analysis of these notified track defects provides a valuable measure of the way the asset is being maintained, in addition to their role as precursors for more serious incidents. At least two freight train derailments in 2011–12 were the result of a track irregularity (see Section 3.1).

A note on the definition of broken rail and misaligned track

The definition of *broken rail* and *misaligned track* in the national occurrence classification guideline is different from the engineering standards used by industry for track inspection, maintenance and reporting. *Broken rail* (occurrence category 11.1) includes, but is not restricted to, complete breaks through the entire cross section of the rail. It may also include fractures and broken joints. *Misaligned track* (occurrence category 11.2) encompasses misalignment in both the horizontal and vertical planes as well as failures in the formation – the ground upon which the track is laid. *Misaligned track* in particular, therefore, comprises a diverse range of incident types that vary markedly in terms of their causes, consequences and safety risks posed.

There were 118 broken rails notified in 2011–12 (Figure 44). More than 80% of these occurred during the cooler months of the year, specifically April to September. This seasonal pattern was also a feature of the longer term record (Figure 45) and reflects a seasonal increase in stresses associated with rail contraction during very cold weather. At such times, rail is more likely to break under load from rolling stock.



▶ Figure 44: Track-related irregularity (running line) on the NSW rail network, 2011–12

Spread track is not shown (usually associated with another top event such as derailment).

45 Excluding level crossings.

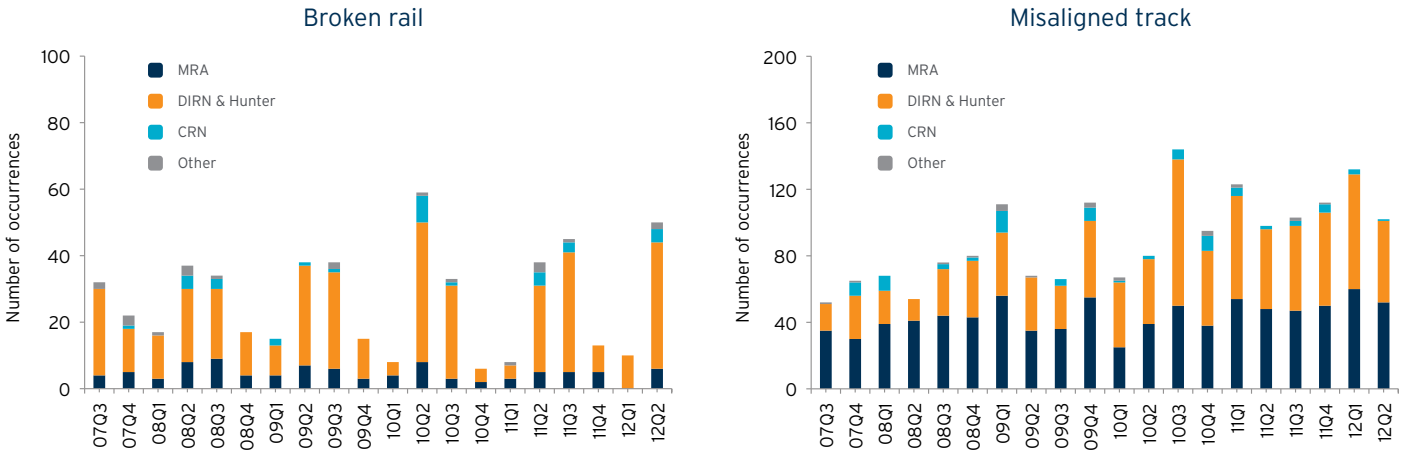


Figure 45: Track irregularity (running line) on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count.

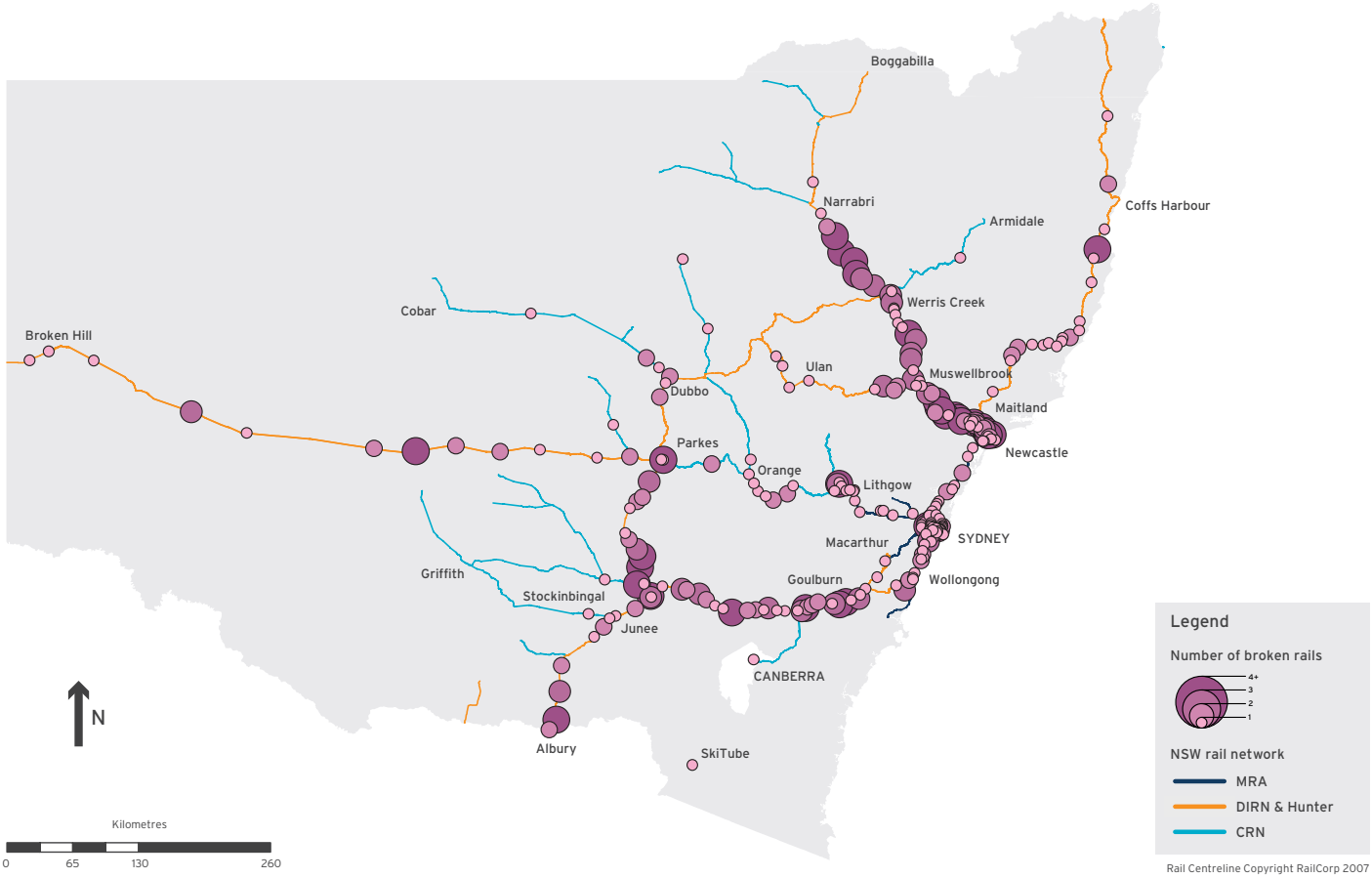


Figure 46: Broken rail (running line) across the NSW rail network, 2007–08 to 2011–12

Mapped location is based on nearest reported location as notified by rail transport operators.

There were 16 notified broken rails on the MRA in 2011–12. While they represent a small proportion of broken rails in NSW (14%) they represent a disproportionately high contribution to safety risk because of the derailment threat posed to passenger services which dominate the rail traffic on this network. Previous reports have noted a decreasing trend in the number of broken rails on the MRA. The five-year history of broken rails on the NSW network is shown in Figure 45. The low frequency of incidents makes it difficult to evaluate trend. The number of notified breaks in 2011–12 was slightly higher than the previous year (13) but remains close to historical lows for the past five years.

There were 92 broken rails notified for the DIRN and Hunter network in 2011–12, representing approximately three-quarters of notified breaks for NSW. Whilst the number of notified breaks has not changed significantly over the past five years, patterns of change vary markedly between different sections of the network.

The variation in broken rails across sections of the DIRN and Hunter network over the past five years is shown in Figure 46. The greatest concentration of notified breaks was in the Hunter, with a rate of 43 per 1,000 track km in 2011–12, compared to between 3 and 12 per 1,000 track km for all other networks. Most of the breaks were in the lower Hunter, between Maitland and Muswellbrook, which carries the highest volumes of coal traffic. However, a large number of breaks also occurred on the track north of Werris Creek, towards the upper reaches of the current Hunter Valley coal supply chain. This part of the Hunter network has exhibited increasing volumes of coal traffic in recent years and demand is forecast to continue to increase rapidly with four new mines proposed.

Broken rails on the DIRN were concentrated on the main southern corridor, between Goulburn and Junee, and the section of line between Stockinbingal to Parkes. The number of breaks on these sections of the network has not changed significantly over time, although a recent rise is suggested for the latter. On the CRN, the highest counts are evident on the line running west of Lithgow.

Misaligned track, as defined under the national occurrence classification guideline, encompasses a particularly diverse range of defects (see note on the definition of track irregularities). It includes defects in horizontal geometry — often described as *buckles or kicks* — that occur more often in the warmer months when higher temperatures expand rail and increase its chance of buckling. The category also includes vertical irregularities, some of which are associated with defects in the ballast and underlying formation. While the seasonality of vertical irregularities is less pronounced, some such as bog holes and mud holes are more frequent in the months when rainfall and drainage issues become relevant.

Almost 50% of all misalignments in 2011–12 occurred on the MRA. Most notifications comprised train driver reports of track conditions such as "rough riding" and "dips", but lacked sufficient information to verify whether the conditions, as described, met the minimum severity threshold of the national occurrence classification guideline[46]. The five-year history of misalignments on the MRA is shown in Figure 45. The number of incidents has increased over the period though the nature of trend varies over time and between sections of the network. Specific locations with large numbers of repeat notifications have also influenced the trend. Despite the quality issues with this data, ITSR monitors incident reports on a daily basis and analyses patterns of incidents by location and segments of the network to identify issues for inclusion in the scoping of regulatory programs.

There were 225 notifications of track misalignment on the DIRN and Hunter networks in 2011–12. This was less than the count for 2010–11 (243) and represented the first year of reduction following several consecutive years of increase. Again, however, the pattern of change over time varied between different segments of the network.

Figure 47 (a-e) shows the change in the distribution of misalignment across the NSW network over each of the past five years. Almost 40% of misalignments in 2011–12 (Figure 47e) occurred on the Hunter network, primarily between Maitland and Muswellbrook and west to the last of the coal mines at Ulan. This network has exhibited an increase in misalignment over the five-year period. The increase is gradual, rather than abrupt, and is likely to be due, at least in part, to the increase in coal freight traffic on this part of the network as described above.

The other main concentration of misalignments in 2011-12 was on the DIRN between Goulburn and Junee. Previous reports have described the role of a major ARTC re-sleepering program, completed in 2008–09, on the increase in misalignments. The specific method of re-sleepering employed on this corridor led to disturbance of the track base, drainage problems and the formation of mud holes. The trend in misalignments on this part of the DIRN is evident in comparison of yearly maps from 2007–08 to 2010–11. During 2011–12 ARTC commenced a ballast rehabilitation project to resolve this issue and the number of reported misalignments appears to have decreased between 2010-11 (96) and 2011–12 (62). Similar re-sleepering programs were also carried out between Stockinbingal and Parkes (late 2009) and Parkes to Broken Hill (early 2011). The former has exhibited a subsequent rise in misalignments between 2009-10 and 2010-11 (Figure 47d). A small and localised rise appears to have commenced in 2011–12 on the section of line immediately

46 For example, whether or not a speed restriction was imposed.

west of Parkes (Figure 47e). However, an extreme weather event in early 2012 was a contributing factor to this increase.

As noted in previous reports, speed restrictions have been imposed by ARTC in the various corridors to ensure the safety of train operations is maintained. However, this has led to a marked increase in transit times – the average annual transit time delay for both the Hunter and main southern corridors has increased over the three years to 2011–12[47]. While safety is maintained[48] longer travel times can, in turn, lead to other safety concerns such as driver fatigue.

ITSR's regulatory activity in relation to track issues such as broken rails and mud holes included monitoring rail infrastructure managers' adherence to applicable engineering standards and verifying that the standards themselves provided the necessary margin of safety. In 2011–12 ITSR closely monitored progress on the ballast rehabilitation project on the main southern corridor and undertook approximately 40 inspections of rail infrastructure managers. These inspections ensure track managers' systems for identifying and managing track-related risks were adequate and maintenance and inspection programs are sufficient to identify potential safety-related issues at an early stage, well before they escalate to the point of failure or harm.

ITSR also progressed its asset management program to promote improved lifecycle management of physical rail assets such as track from planning through to disposal. In April 2012, ITSR hosted a workshop on asset management, attended by senior business and technical personnel from NSW rail operators. The workshop included presentations from several non-rail industries on the business and safety benefits of asset management and successfully engaged participants on ways to improve and strengthen asset management practice in the rail industry[49].

Figure 47a: Misaligned track (running line) across the NSW rail network, 2007-08

Misaligned track comprises vertical and horizontal misalignments as well as formation failures.
Mapped location is based on nearest reported location as notified by rail transport operators.

47 For example, monthly average time delays on the southern corridor for 2011-12 ranged between 18 and 47 minutes for the XPT and 40 and 106 minutes for superfreighters, Australian Rail Track Corporation, *2011-12 NSW Lease Annual Condition Report*, ARTC, South Australia, July 2012.
48 At the time of writing the ATSB was nearing completion of an investigation of the interstate rail line between Sydney and Melbourne including the condition of the track and measures put in place to maintain the safety of rail operations. The Interim Factual report from this investigation <http://www.atsb.gov.au> states safety of the line is being maintained through application of speed restrictions where track is below acceptable operational standards.
49 ITSR's asset management program is described fully in ITSR's Annual Report 2011–12, see ITSR's website <http://www.transportregulator.nsw.gov.au>.

Figure 47b: Misaligned track (running line) across the NSW rail network, 2008-09

Misaligned track comprises vertical and horizontal misalignments as well as formation failures.
Mapped location is based on nearest reported location as notified by rail transport operators.

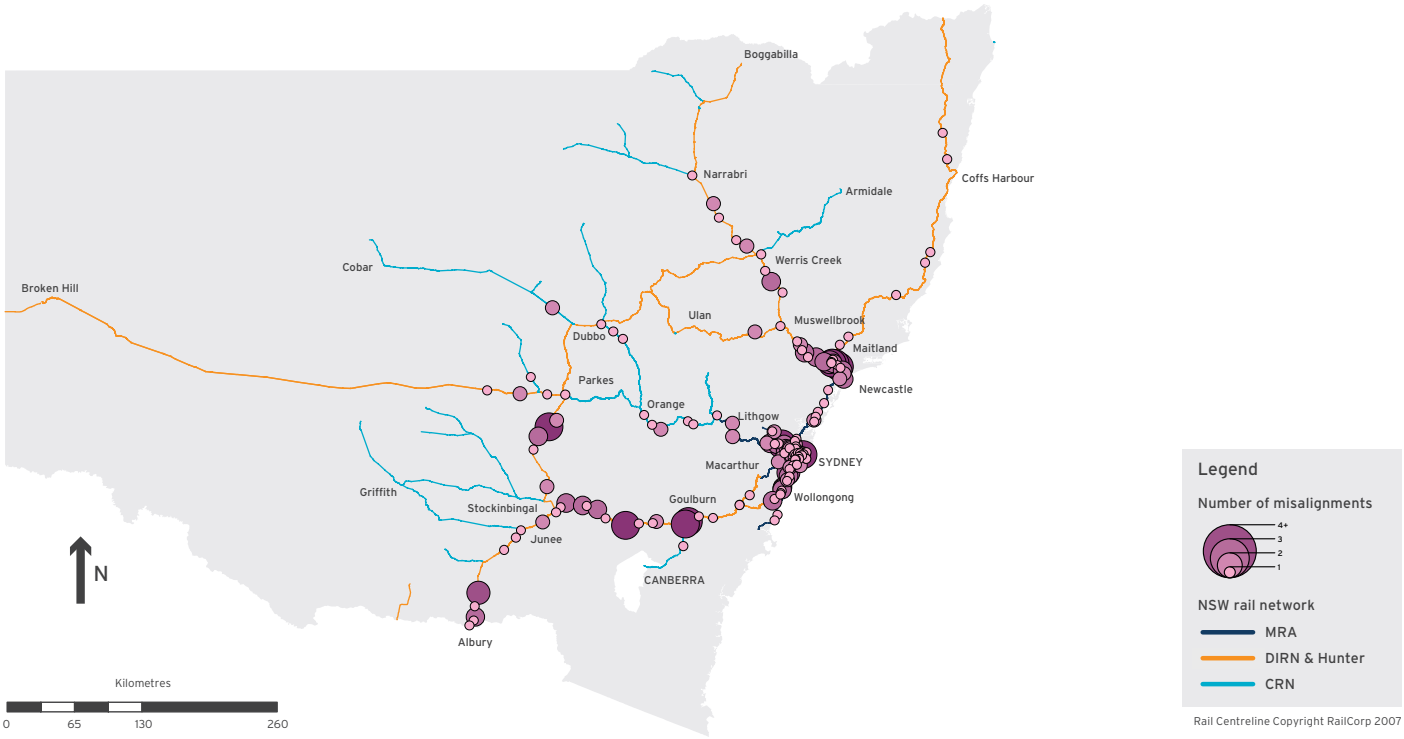


Figure 47c: Misaligned track (running line) across the NSW rail network, 2009-10

Misaligned track comprises vertical and horizontal misalignments as well as formation failures.
Mapped location is based on nearest reported location as notified by rail transport operators.

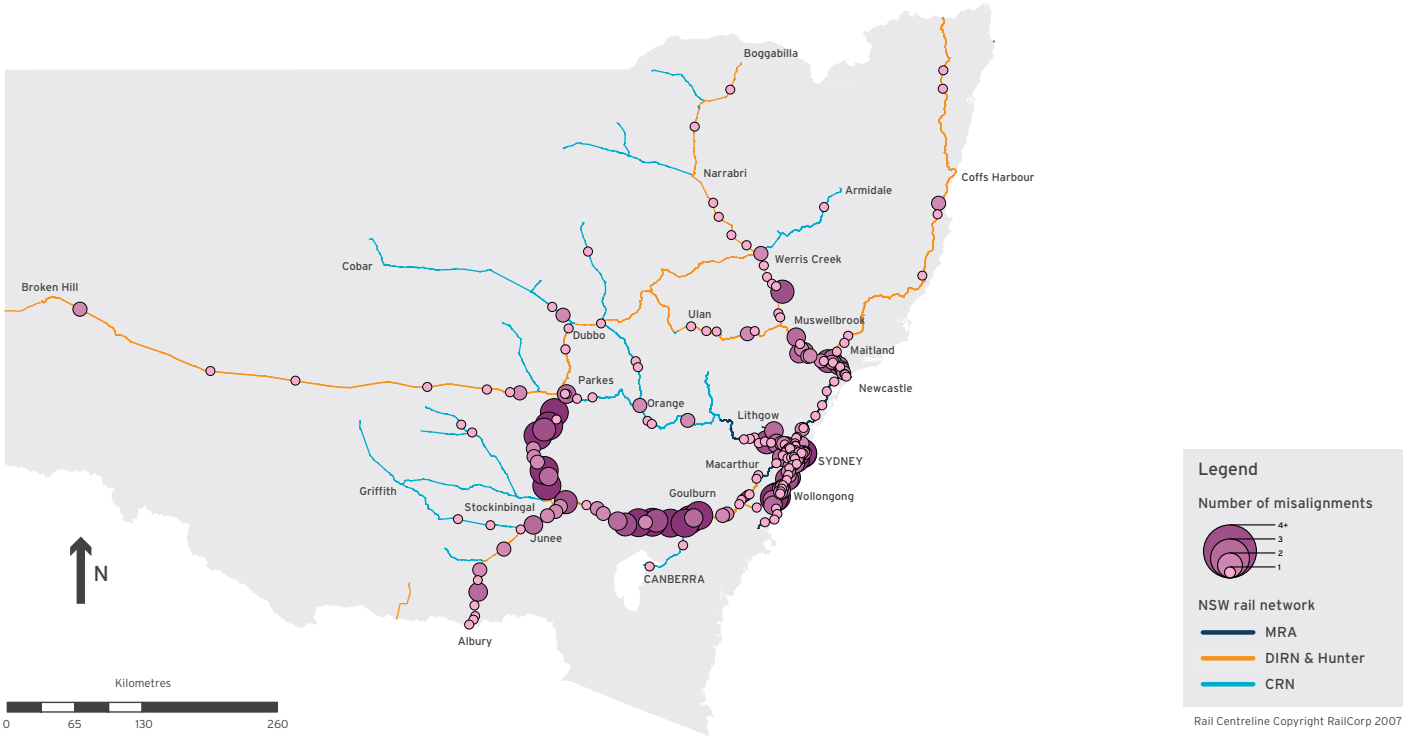


Figure 47d: Misaligned track (running line) across the NSW rail network, 2010-11

Misaligned track comprises vertical and horizontal misalignments as well as formation failures.
Mapped location is based on nearest reported location as notified by rail transport operators.

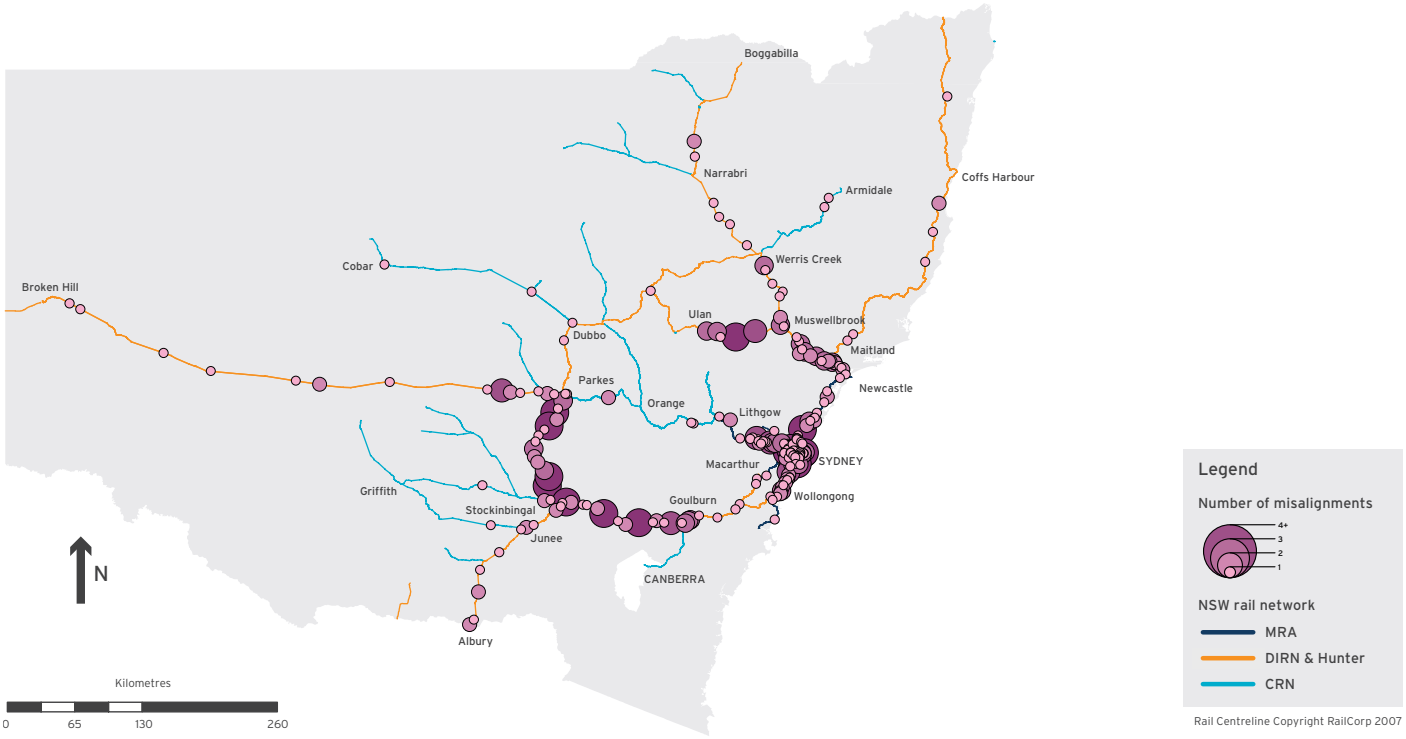


Figure 47e: Misaligned track (running line) across the NSW rail network, 2011-12

Misaligned track comprises vertical and horizontal misalignments as well as formation failures.
Mapped location is based on nearest reported location as notified by rail transport operators.

4.4 Rolling stock irregularity

SUMMARY

- Five passenger train and five freight train bearing failures were notified in 2011–12. In several cases the failure was severe enough to prevent the train from travelling any further.
- Broken axles have caused several freight train derailments in recent years. In 2011–12 ITSR issued a safety alert instructing freight operators to reassess their management of this risk.
- The rate of braking system irregularity on freight trains (per million train km travelled) increased over the past five years.
- ITSR was notified of several incidents involving the runaway of hi-rail vehicles due to braking irregularities. In 2011–12 ITSR issued a safety alert instructing rail transport operators to reassess a range of issues concerning hi-rail safety including braking performance.

Some types of rolling stock irregularity defined within the national occurrence classification guideline are important contributors to train accidents. Both wheel/axle failure and defective bearing are the most significant in this regard with incident data showing the later as a significant contributor to freight train derailments (see Table 10, Section 3.1, for more information). Rolling stock irregularities for 2011–12 are summarised in Figure 48 by train type.

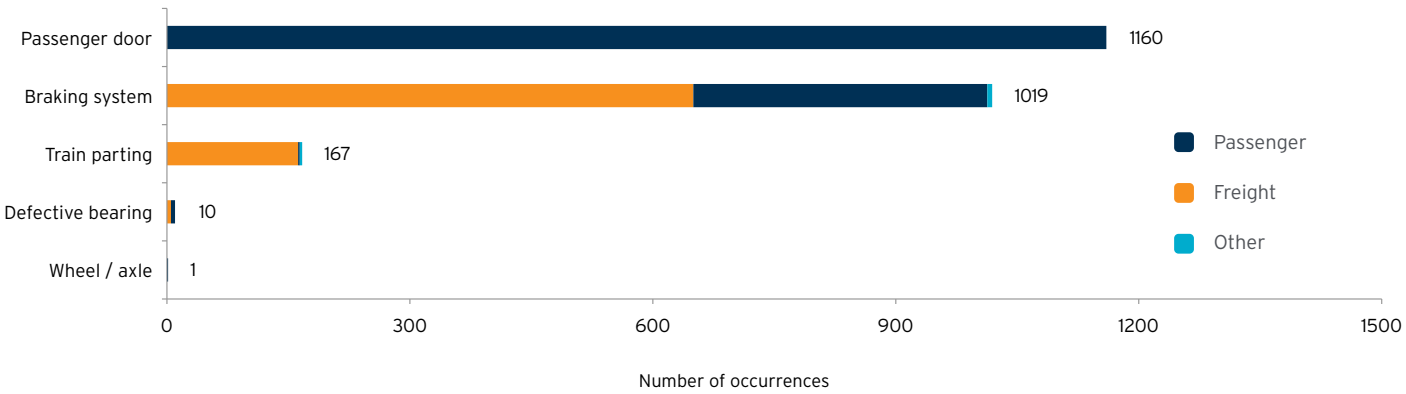
Passenger trains

No wheel irregularities were notified in 2011–12, consistent with the generally low frequency of these occurrences over the previous four years. Five bearing-related irregularities were notified in 2011–12, also consistent with that observed over the past few years (Figure 49). Two bearing incidents were reported for each of CityRail and CountryLink passenger trains. One bearing irregularity was notified for a tourist and heritage service. In several of these cases the severity of failure was such that trains could no longer travel.

More than 90% of brake-related irregularities on passenger trains were associated with CityRail passenger trains, which provide the vast majority of the state's passenger train services. Both the number and rate of brake-related incidents has fallen over the five-year period (Figure 49). The rate of irregularity fell from 16.5 occurrences per million train km travelled in 2008–09 to 8.0 in 2011–12.

Faulty passenger train doors are of lower significance in terms of safety risk. However, they are a major contributor to fleet-related delays on the MRA. Past reports have described a range of measures undertaken by RailCorp to address the rate of door failures. Both the number and rate (per million train km travelled) of incidents decreased over the period for which comparable data is available. The rate of passenger door-related irregularity has fallen from 34.5 in 2008–09 to 25.7 in 2011–12, although the rate appears to have steadied in 2011–12.

In 2011–12 ITSR undertook over 40 compliance inspections of mainline and tourist and heritage passenger rolling stock operators to verify systems for identifying and managing risks are adequate. ITSR's activities also extend to attendance at operational meetings concerning rolling stock maintenance and site inspections to observe operator



▶ Figure 48: Rolling stock irregularity on the NSW rail network, 2011–12

Braking system includes occurrences with a top event of wheel scale or wheel flat (which are classified as *rolling stock other* under the national occurrence classification guideline).

incident investigations in practice. These types of activities are particularly important in managing a variety of rolling stock risks that are not reliably detected or captured in the suite of precursor notification categories of the national notification scheme, for example, failures in some engineering defences on rolling stock; subsurface axle defects.

Freight trains

Recent history shows that many freight train accidents in NSW such as derailments and fires are caused by rolling stock irregularities. While associated risks are generally lower than that for passenger trains, due to reduced passenger exposure, more than 20% of the 817 freight train irregularities listed in Figure 48 occurred on the MRA, posing potential risks to passenger trains on adjacent lines.

There were no notifications of axle-related irregularities in 2011–12. However, as noted previously (Section 3.1), there were several derailments resulting from axle breaks. The reason for few (if any) notified precursors to this type of failure is that the precursor condition is typically a surface or subsurface defect normally detected during maintenance and inspection[50]. Visual inspection of axles is a critical defence against such derailments and in April 2012 ITSR issued a safety alert instructing rolling stock operators and maintainers to reassess the adequacy of maintenance and inspection procedures to detect such failures (see Section 3.1).

There were five notifications of axle bearing-related irregularities on freight trains in 2011–12. Four of the five incidents were detected by trackside monitoring equipment. This equipment plays a critical role in the detection of bearing faults and prevention of derailments, although false alarms are sometimes notified. The rate of bearing-related occurrences in 2011–12 (0.3 per million train km travelled) remained at historical lows. However, axle bearing failures remain a significant risk and appeared to be the cause of two running line freight train derailments in 2011–12 (see Table 10 for more information). A further six notifications had insufficient information to accurately determine if they met the threshold of a bearing-related incident under the OCG1 classification scheme.

A total of 650 braking system irregularities were notified in 2011–12. Both the number and rate of freight train brake irregularities increased over the five year period (Figure 49). The rate has risen from 20.3 per million train km travelled in 2007–08 to 33.7 in 2011–12. While the vast majority of irregularities were associated with rolling stock defects, for example, sticking brakes, they did include crew-related incidents such as failure to release handbrakes. The consequence of incidents was generally limited to rail traffic delays while brakes were repaired or isolated. However several incidents in 2011–12 escalated to a potentially more serious outcome. In July 2011 a freight train ran away at Unanderra on a section of the MRA and subsequently passed a signal at stop. In this case the loss of control was associated with a brake pipe irregularity. In May 2012 at Demondrille, a freight train ran away with the brakes having no effect. The train travelled at 100km/hour as opposed to the recommended speed limit of 70km/hour, with the uncontrolled movement presenting a serious risk of derailment. The incidents were the subject of a compliance inspection and compliance investigation by ITSR.

An issue to emerge in 2011–12 was faults in the electronically controlled braking systems on some types of freight rolling stock, primarily coal trains on the Hunter network. In these incidents, electrical interference between locomotives passing one another on adjacent lines led to emergency brake applications. The number of incidents has increased sharply in recent times, from 10 incidents in 2010-11 to over 50 in the first half of 2012. While this is primarily an operational issue, it does generate secondary risks associated with crews and maintainers sometimes having to attend to the train on track in high rail traffic areas. In such cases these employees are reliant on procedural systems such as those described in 4.2 to ensure their protection from other rail traffic in the area.

Train partings comprise the unintentional separation of rolling stock and are generally caused by coupler faults or track irregularities. They are lower risk occurrences because brakes automatically apply in such situations, preventing runaways. However, they result in delays and require train crew to leave the train (to inspect and re-couple trains) which, in turn, gives rise to secondary risks such as those described above for brake irregularities. There were 162 train partings notified in 2011–12, with more than three-quarters occurring on the DIRN and Hunter network. Both the number and rate of partings increased over

50 Under the national occurrence reporting and classification scheme rolling stock irregularities detected and corrected during a normal maintenance program are excluded from notification.

the five year period (Figure 49). The rate increased from 4.8 per million train km travelled in 2007–08 to 8.4 in 2011–12. The rate of increase appears to have steadied in 2011–12, although patterns vary markedly between different sections of the network. Previous reports have noted the role of track misalignments in train partings on the main southern interstate rail line between Sydney and the Victorian border. The number of parting incidents on the main southern corridor decreased in 2011–12, coinciding with the decrease in the number of misalignments on this section in 2011–12 (Section 4.3). Conversely, the number of train partings between Stockinbingal and Parkes in 2011–12 was the highest of the past five years, coinciding with the previously described increase in track misalignments on this section of track in recent years (Section 4.3).

Safety risks associated with freight rolling stock irregularities are a key focus of ITSR's various compliance and safety improvement programs. ITSR uses information from notifications as well as its knowledge of the nature and scale of operations to target higher risk freight operators. These include operators with comparatively poor performance, larger operations and/or running on networks shared with passenger services. In addition to a number of investigations, in 2011–12 ITSR undertook more than 20 compliance inspections of specific freight operators to ensure safety risks associated with rolling stock irregularities were being appropriately managed and rolling stock complied with relevant engineering standards. In several cases ITSR undertook joint audits with rail regulators from other states for operators with multi-jurisdictional accreditation.

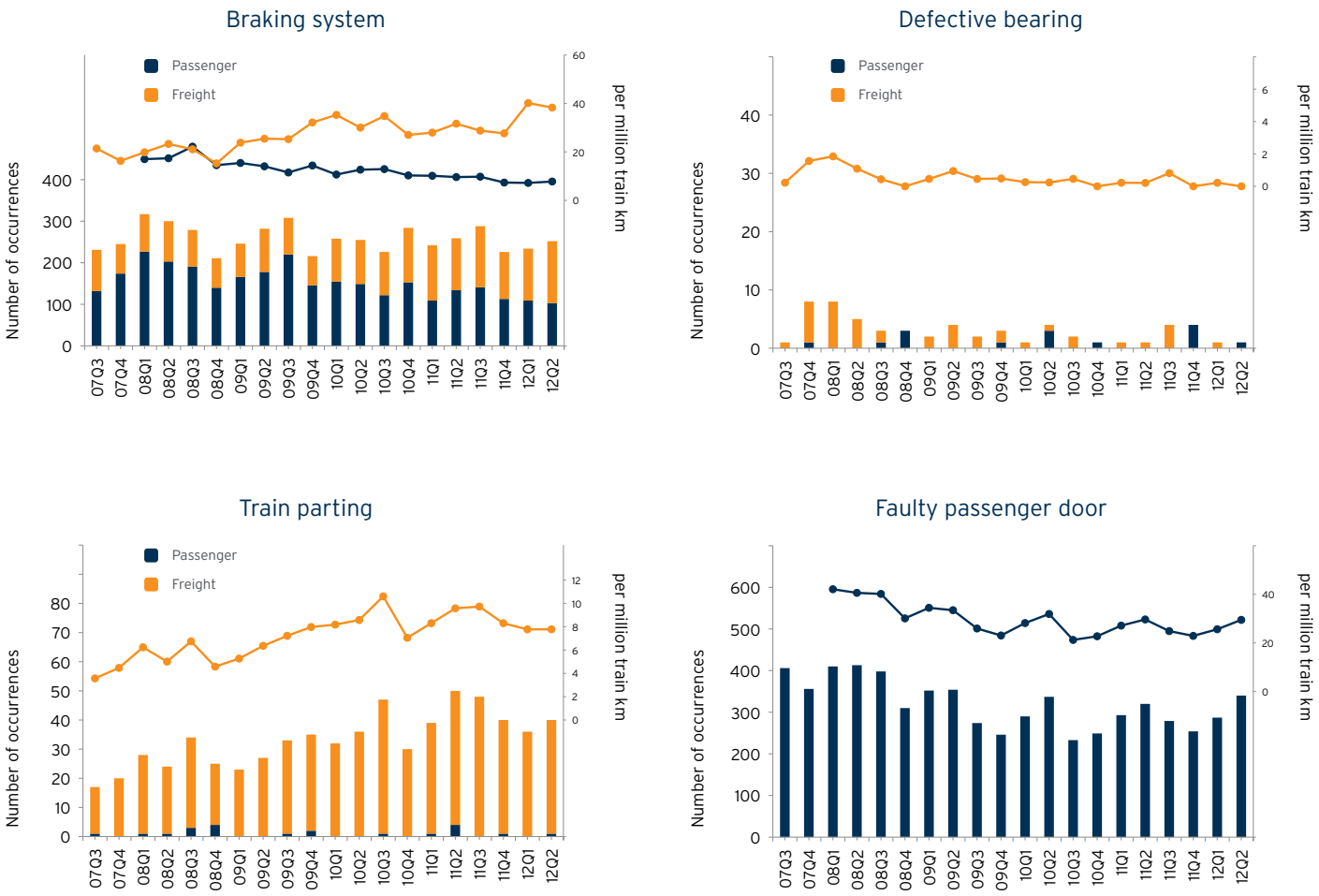


Figure 49: Rolling stock irregularity on the NSW rail network, 2007–08 to 2011–12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (per million train km travelled). *Braking system* includes occurrences with a top event of wheel scale or wheel flat (which are classified as *rolling stock other* under the national occurrence classification guideline). Passenger train rate for brake and door prior to 2008 excluded due to change in RailCorp's method of train km calculation. Passenger train rates for *defective bearing* and *train parting* not shown due to low counts.

Other trains

Just ten of the rolling stock irregularities in Figure 48 were associated with trains other than passenger and freight. Most were minor incidents, such as train partings and brake-related irregularities on light engines and trains hauling track maintenance vehicles. However, within this group there were incidents with potential for significantly greater harm. The single notification of wheel failure in Figure 48 involved a track maintenance train – in May 2012 at Thirroul, a sleeper laying machine sustained a broken axle while being hauled as part of a track maintenance train. Unusually, the failure did not result in derailment. However, it did occur on dual track and would have posed a collision risk to passing trains had it derailed. ITSR is currently investigating this incident as part of a broader investigation into axle failure across various types of rolling stock.

ITSR also received a number of notifications in 2011–12 relating to rolling stock irregularities on various types of hi-rail vehicles. Some of these incidents were minor, for example, one incident comprised a hi-rail's brakes locking on, preventing movement. Others were serious – in October 2011 at Schofields on the MRA a hi-rail ran uncontrolled for 100 metres, narrowly missing an employee on track; in November 2011 at Boronia on the MRA a hi-rail track machine ran uncontrolled for 2.7 km due to brake failure with a machine operator onboard. As a result of these types of incidents ITSR issued a Transport Safety Alert[51] on the safety risks associated with hi-rail operation. This included a requirement for rail transport operators to reassess a range of issues in relation to hi-rail safety, including effective braking performance and adequacy of systems to ensure control when switching between road and rail based modes of travel.

51 Transport Safety Alert No. 39, *Effective operation and management of hi-rail equipment*, ITSR, March 2012.

4.5 Load irregularity

SUMMARY

- 170 load irregularities were notified in 2011–12. The incident rate of most types of load irregularity (per million freight train km travelled) has fallen over the past five years.
- The rate of uneven distribution of load occurrences (per million freight train km travelled) dropped in 2011–12 following a sharp rise the previous year, but was a contributing factor in at least one freight train derailment in 2011–12.

Load irregularities are associated with freight trains and are precursors to a range of rail accidents. A load that shifts beyond the train envelope poses a collision hazard to other trains and railway infrastructure such as signals. The loss of materials from trains such as coal can obstruct tracks and derail trains.

A total of 170 load irregularities were notified for the period 2011–12 (Figure 50). More than half of the load irregularities occurred on the DIRN and Hunter network, which carries most of the state's freight traffic. Almost 15% of incidents occurred on the MRA, where they present a risk to passengers on platforms and in trains.

The five-year history of load irregularities is shown in Figure 51. Both the count and rate of incidents has changed significantly over the period for several categories.

There were 63 open doors (including hatches and gates) reported in 2011–12, remaining unchanged from 2010–11. However there was a longer term decreasing trend in the rate of open door incidents over the past five years. The rate fell from 4.2 per million freight train km travelled in 2007–08 to 3.3 in 2011–12. Open freight container doors have been the subject of past compliance and inspection activity by ITSR due to the collision risk they pose, with freight operators taking steps to reduce these occurrences, for example, wagon and door modifications.

Load shifts and out of gauge loads are classified separately from one another under the national occurrence classification guideline. However, there is often insufficient information provided in a notification to distinguish between them so counts for the two are combined. There were 49 occurrences classified as either *load shift* or *out of gauge* in 2011–12, which is consistent with that for 2010–11 (48). Both the number and rate of these types of incidents have decreased over the five-year period. The rate has fallen from 4.9 per million freight train km travelled in 2007–08 to 2.5 in 2011–12.

The category *uneven distribution of load* encompasses two main types of incident – load unevenly distributed within an individual wagon (which can cause a wagon to lean), and an uneven distribution of load between wagons within a train. These incidents are comparatively low in frequency but are a significant contributor to accidents, responsible for at least five running line freight derailments in the past three years, including one in 2011–12, described previously in Section 3.1 (Table 10). There were 12 notifications of uneven load distribution in 2011–12, a decrease from the spike observed in 2010–11 but higher than the pattern observed over the five-year period (Figure 51). The higher results in the past two years followed ITSR issuing a rail industry safety notice in

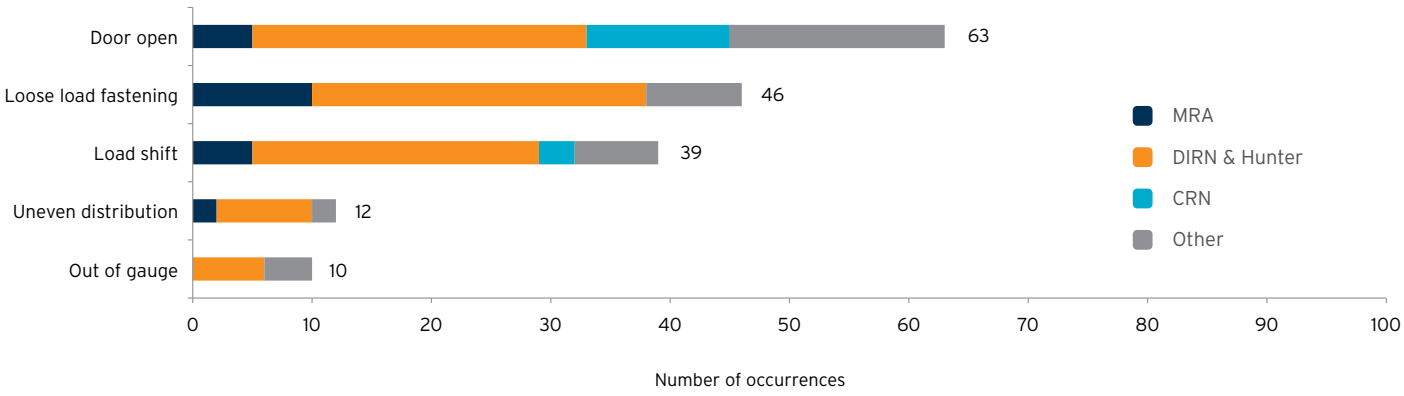


Figure 50: Load irregularity on the NSW rail network, 2011–12

Door open includes incidents where load is lost from a freight train via an open door. Such incidents are classified as top event *load shift* under the national occurrence classification guideline.

June 2010[52] highlighting the derailment risk associated with unevenly loaded wagons. The rise is therefore likely to be due, at least in part, to heightened awareness of this issue and a resultant increase in monitoring and reporting.

Load fastening irregularities are one of the most frequent, but lowest risk types of load irregularity. They include dragging chains, loose ropes and flapping tarpaulins. While the risk associated with these types of occurrences are generally minor, they pose a threat of minor damage to passing trains – in February 2012 a loose strap on a wagon struck a passing passenger train (see Table 12). There were 46 occurrences reported in 2011-12 at a rate of 2.4 occurrences per million freight train km travelled. Both the number and rate of these types of incidents have decreased over the five-year period (Figure 51) from 82 and 4.6 occurrences per million freight train km travelled in 2007-08.

Figure 51: Load irregularity on the NSW rail network, 2007-08 to 2011-12

Vertical bar is quarterly occurrence count. Solid line is quarterly occurrence rate (count per million freight train km travelled).

52 Independent Transport Safety and Reliability Regulator, *Operation of less than safely loaded wagons*, ITSRR, Sydney, June 2010.

5. Fitness for duty

Human involvement in rail safety accidents may be immediate and direct, for example, an error such as setting points in the wrong direction leading to a derailment. In other cases, the human contribution may be remote, for example, an error or omission in an inspection or maintenance task that led to a rolling stock irregularity at a later time.

The importance of human performance in operational safety is recognised in the national guideline on safety management systems for rail transport operators[53]. Effective safety management systems must consider the range of factors that influence worker behaviour, from organisational factors such as safety culture through to local workplace conditions and personal factors such as physical health.

NSW's rail safety legislation is consistent with the national guideline requirements for safety management systems. However, it specifies additional requirements in three key areas of safety management concerning rail safety worker performance – drug and alcohol management, human fatigue and health and fitness.

5.1 Drug and alcohol management

SUMMARY

- More than 20,100 drug and 165,700 alcohol tests were conducted by rail transport operators in 2011–12. The amount of testing in 2011–12 was the highest on record.
- The rate of detection (per tests conducted) decreased over the past five years for most sectors of the industry.
- ITSR initiated six prosecutions in 2011–12 against rail safety workers for offences under the drug and alcohol provisions of the NSW rail safety legislation.

The requirement for rail transport operators to conduct drug and alcohol testing of rail safety workers was introduced in the *Rail Safety Act 2002* and further developed under the *Rail Safety (Drug and Alcohol Testing) Regulation 2003* and the *Rail Safety (Drug and Alcohol Testing) Regulation 2008*.

The *Rail Safety Act 2008* requires all rail transport operators to have formal drug and alcohol programs in place that comply with the Regulation. Since 2006 it has been mandatory for every operator (excluding heritage operators) to have a random testing program that tests 25% or more of its rail safety workers every year[54]. In addition, testing may also include targeted and post-incident testing.

All operators are required to notify ITSR of positive test results as well as any instance where an employee refuses to undergo testing. Commercial rail transport operators are also required to submit quarterly summaries of testing activity to ITSR. These extra reporting requirements do not apply to heritage operators.

Program activity

At the time of writing, about 97% of quarterly testing summaries expected for 2011–12 had been submitted to ITSR. Based on these summaries, more than 20,100 drug and 165,700 alcohol tests of rail safety workers were conducted during 2011–12. The number of drug tests in 2011–12 was 11% higher than the final figures for 2010–11 (18,132). The number of alcohol tests in 2011–12 increased by more than 25% from that of the

53 National Transport Commission, *National Rail Safety Guideline, Preparation of a rail safety management system*, NTC Canberra, 2008.
54 Under the National Law passed in the South Australian parliament in April 2012, NSW drug and alcohol testing provisions, as currently applied in NSW legislation, will be retained.

previous year (130,966). However, these results are influenced by individual operators. One operator in particular, representing about 10% of rail safety workers in NSW, increased its testing more than ten-fold in 2011–12 to account for 45% of all alcohol tests conducted.

There was marked variation in the volume and nature of testing activity between rail transport operators and sectors of the industry generally. The mid-ranked operator in terms of program activity tested at a rate of 2.2 tests per worker per year for alcohol and 0.7 tests per worker per year for drugs. However, the top 10% of rail transport operators undertook drug and alcohol testing at a far higher rate, of at least 12 and 2.9 tests per worker each year respectively. Importantly, the analysis of random testing activity shows every accredited operator in NSW exceeded the minimum amount of testing required under the regulation (a minimum of 25% of an operator's rail safety workers subjected to random testing each year).

As well as industry-led testing, ITSR also undertook drug and alcohol testing of rail safety workers on several occasions in 2011–12. This resulted in seven random drug and 92 random alcohol tests. The testing focused on a range of small and large rail transport operators.

Program results

Table 13 presents a summary of testing results for 2011–12 based on all forms of testing. Drug testing covers a range of drug classes including amphetamines (for example, 'speed'), opiates (for example, heroin) and cannabinoids (derived from cannabis). The overall detection rate for drugs in 2011–12 (0.75%), fell markedly from 2010–11 (1.05%) and represents the lowest detection rate over the period of record. As in previous years, cannabis was the most common drug associated with positive drug tests.

Like summary statistics on testing activity, the overall detection rate is sensitive to the influence of larger operators (who conduct the majority of tests) and operators reporting anomalous testing activity or results. The overall detection rate for alcohol in 2011–12 (0.03%) was influenced by the unusual testing activity of one operator, as noted previously. Exclusion of this operator's results from the analysis yielded an alcohol detection rate in 2011–12 of 0.05% (as opposed to 0.03%). Importantly, this rate was still well below that for a similarly adjusted figure of 0.09% observed in 2010–11[55]. An indication of the variance in overall detection between operators is also provided in Table 13. It shows just over 55% of rail transport operators testing for drugs and 68% of operators testing for alcohol did not return a positive result in 2011–12.

Table 13: NSW rail industry drug and alcohol testing results (all forms of testing), 2011–12

Statistics are based on rail transport operators that were accredited and required to submit quarterly returns for at least part of 2011–12. Excludes refusal to be tested (n=13). Includes all testing reasons, namely, for-cause, random, post-incident and 'other'. Excludes the heritage sector which has different testing and reporting requirements.

Description	Drug	Alcohol
Number of rail transport operators testing	42	47
Approximate random component (% of all tests)	93.8	98.9
Overall detection rate (% of all tests)[1]	0.75	0.03
Median rail transport operator detection rate (% of all tests)[2]	0.00	0.00
Number of rail transport operators reporting no positive results	24	32
Number of rail transport operators reporting exactly one positive result	6	9
Number of rail transport operators reporting more than one positive result	12	6

1 Total positive tests (all rail transport operators) divided by total tests (all rail transport operators) multiplied by 100 (excludes refusal to be tested).
2 Rail transport operator detection rate is rail transport operator's total positive tests divided by rail transport operator's total tests multiplied by 100 (excludes refusal to be tested). Median is the middle ranked value of all rail transport operator detection rates.

55 These operators represented 1% of the total 2010–11 and 10% of the 2011–12 workforces, and undertook about 45% of all alcohol tests with no or very few positives recorded .

Another limitation of the overall detection rate is that it is influenced by the results of non-random testing. Non-random testing comprises a range of test types that may yield rates of detection that are unrepresentative (higher or lower) of the general railway safety worker population. For example, it includes for-cause testing – testing that targets individuals because there is reason to believe they could be affected by drugs or alcohol.

A breakdown of random testing activity and test results by industry sector over five years is shown in Figure 52. All sectors have reported increased testing rates over the five-year period, with the exception of the passenger sector. Despite a small decrease in 2011–12 for this sector compared to the previous year, drug testing rates in the passenger sector have generally increased over the five years while alcohol testing rates have remained steady.

Rates of drug and alcohol detection varied between sectors. Passenger train operators have exhibited a gradual decrease in detection rates over the five year period. Rates of drug detection have fallen from 1.4% of tests conducted in 2007–08 to 0.8% in 2011–12. Rates of alcohol detection have fallen from 0.14% to 0.05% over the same period.

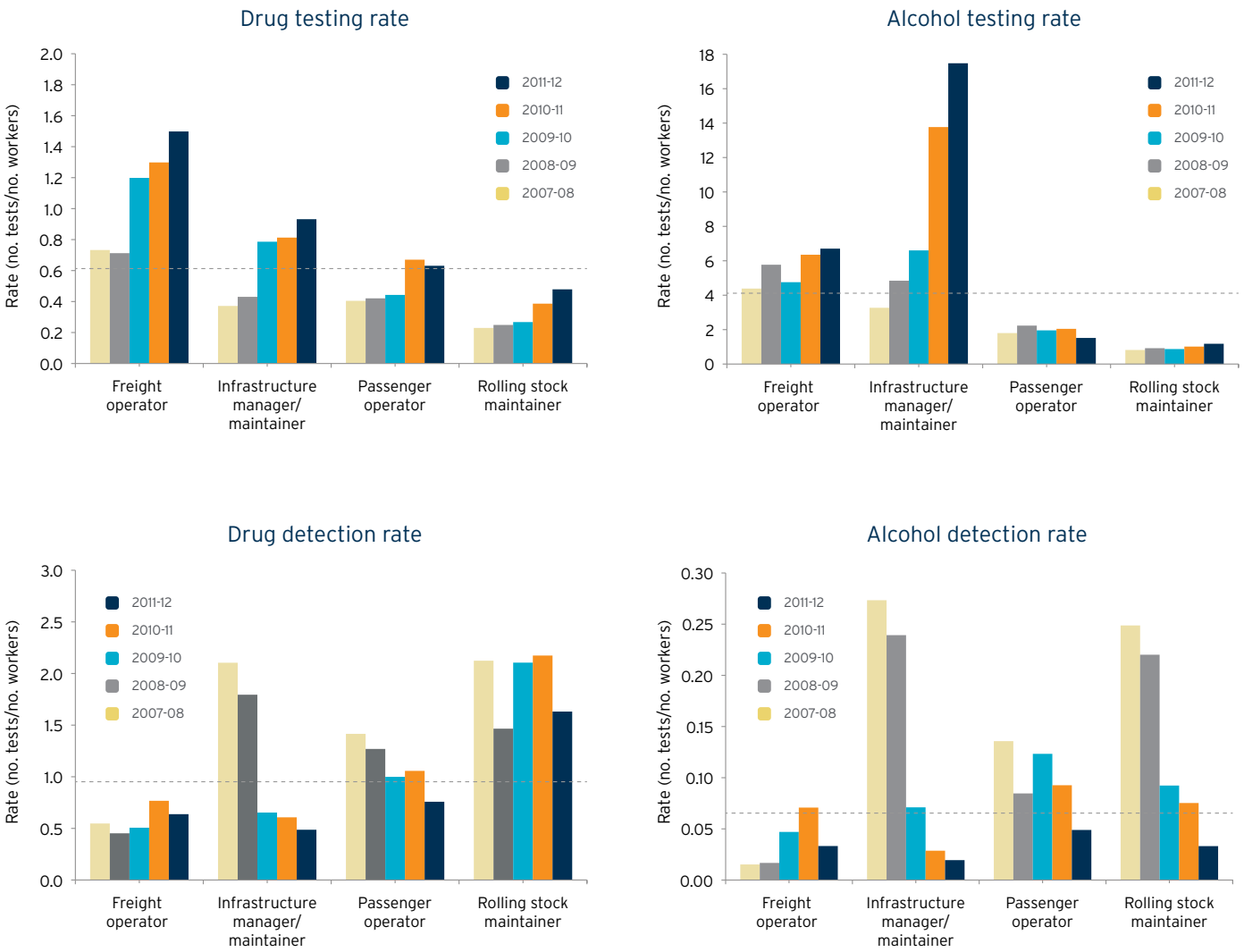


Figure 52: NSW rail industry random drug and alcohol testing activity by sector, 2007–08 to 2011–12

Dotted line is industry average over five years 2007–08 to 2011–12. Excludes refusals to be tested. Excludes the heritage sector which has different testing and reporting requirements. All rates are averages for the sector as a whole, whereby an individual rail transport operator's contribution to a sector rate is proportional to the operator's size.

Freight operator detection rates for both drugs and alcohol decreased slightly in 2011–12, following several consecutive years of increase. Both drug (0.64%) and alcohol (0.03%) detection rates remain well below the respective industry wide averages over the five-year period.

Rolling stock maintainers have historically recorded comparatively high rates of detection for both drugs and alcohol. The rate of drug detection in recent years remains high compared to all other sectors (1.6%). However, alcohol detection rates appear to have fallen over the five year period (0.03% in 2011–12) although the comparatively low testing rate means estimates of detection are less reliable and subject to considerable volatility between years.

Infrastructure maintainers have also recorded comparatively high rates of drug and alcohol detection in the past compared to other sectors. A marked drop in the rate of both drug and alcohol detection for this sector was first noted in 2009–10. The rate of detection for both drugs and alcohol over the past three years was at least half of that observed over the first two years of testing. As previously mentioned, the alcohol testing rates have been heavily influenced in the last two years by unusually high testing rates of several operators which may not be representative of this sector as a whole. As such, caution must be used when comparing alcohol detection rates for this sector over the period.

Throughout 2011–12 ITSR continued to monitor testing activity of rail transport operators and investigate incidents of concern and breaches of legislation. Thirteen compliance investigations were undertaken in 2011–12 for drug and alcohol breaches. ITSR also commenced six prosecutions of rail safety workers for offences under the *Rail Safety (Drug and Alcohol Testing) Regulation 2008*. Two matters involved instances of exceeding the prescribed concentration of alcohol (PCA), one instance for being under the influence of a drug and three matters related to the failure to supply a sample including the supply of a synthetic sample. With the exception of the two PCA matters, all occurred on separate occasions at various locations across NSW. ITSR also worked closely with Transport for NSW in the provision of specialist advice to ensure the current standard of safety offered by NSW's current drug and alcohol testing provisions were retained in the implementation of the National Rail Safety Regulator and application of the Rail Safety National Law in NSW[56].

56 This is described further in ITSR's *Annual Report 2011–12*, see ITSR's website <http: //www.transportregulator.nsw.gov.au>.

5.2 Other fitness for duty programs

Fatigue management

Fatigue is a state of reduced mental or physical capacity caused by a combination of sleep loss, disrupted circadian phase and workload. These factors are inherent to shiftwork in continuously operating transport industries such as rail. Fatigue impairs a worker's reasoning and concentration and this can lead to errors. As such, fatigue is recognised as a causal factor in accidents and incidents on railway systems.

The national guideline for preparation of safety management systems states rail transport operators must develop and implement a program for the management of fatigue amongst rail safety workers. Such programs should be developed in accordance with separate national guidance on fatigue management[57].

The current fatigue management requirements for rail transport operators in NSW are consistent with those specified in the national guidance. The *Rail Safety Act 2008* and *Rail Safety (General) Regulation 2008* require rail transport operators to have a fatigue management program, which is part of their safety management system. However, the Act and Regulation also list a number of specific requirements for rail transport operators in their management of fatigue including:

- minimum standards for certain rail safety workers, for example, maximum shift length for freight train drivers
- specific matters to be considered in preparing a fatigue management program, for example, the need for education and training of rail safety workers to identify and manage fatigue
- specific matters which must be addressed or included in a fatigue management program, for example, provide for safe hours of work and periods of time between shifts.

A key issue for NSW in the establishment of the National Rail Safety Regulator and associated National Law was to ensure that current standards of safety achieved in NSW through regulation were not diminished. Under the National Law, passed in the South Australian parliament in April 2012, NSW fatigue management provisions, as currently applied in NSW legislation, will be retained[58].

Health and fitness management

Rail safety workers must be of sufficient good health and fitness to perform their duties. The national guideline for preparation of safety management systems states rail transport operators must put in place a health and fitness program to ensure that worker ill-health does not jeopardise rail safety.

A separate national standard[59] has been developed to help guide rail transport operators in their development of a health and fitness program. The standard describes the elements of an effective program including management systems and responsibilities, assessment procedures and medical criteria to ensure rail safety workers maintain an appropriate level of health.

The NSW legislation is consistent with the national guidance in requiring rail transport operators to have in place health and fitness management programs. However, whereas national guidance indicates operators' health and fitness programs must comply with the national standard so far as is reasonably practicable, the NSW legislation specifies that program's compliance with the national standard must be absolute[60].

57 National Transport Commission, *National Rail Safety Guideline, Management of Fatigue in Rail Safety Workers*, NTC, Canberra, 2008.
58 This is described further in ITSR's *Annual Report 2011–12*, see ITSR's website <http: //www.transportregulator.nsw.gov.au>.
59 National Transport Commission, *National Standard for Health Assessment of Rail Safety Workers*, NTC, Canberra, 2004.
60 Compliance with the National Health Assessment standards is a provision of the national model law passed in the SA Parliament in May 2012.

6. Glossary of rail-related terms

Source of definitions

Most definitions have been sourced from the national occurrence classification guideline and the *Glossary for the National Codes of Practice* (Australasian Railway Association <http://www.ara.net.au>). Level crossing definitions are from the NSW Staysafe Committee[61]. Some descriptions may differ from definitions contained in the legislation – for compliance purposes readers should refer to Section 4 (Interpretation) of the *Rail Safety Act 2008*.

Accreditation requirements are outlined in the *Rail Safety Act 2008*. NSW rail transport operators must be accredited by ITSR or exempt from the requirement to be accredited under the Act. The granting of accreditation indicates that a rail transport operator has demonstrated it has the competence and capacity to manage the risks to safety associated with the railway operations for which it is accredited.

Ballast refers to material, usually stone, that surrounds the sleepers to hold them in place.

Balloon loop is track forming a loop usually at the end of a railway line where empty wagons are loaded from overhead bins, or full wagons are emptied through hopper doors in to under-track grates, all while the train is moving at low speed. The loop enables the train to effectively do a 'U' turn.

Buffer stop is a structure erected across and at the end of a track at main line terminals or dead end sidings which is intended to stop rolling stock.

Electric staff is a system of safeworking involving the use of a staff as authority to occupy a section, with electrical equipment ensuring that only one staff is available for that section at any one time.

Foul is where an object is in a position to obstruct rail traffic on an adjacent line.

Freight trains are designed and used for carrying goods such as coal and minerals, grain, fuel, livestock and containers.

Hi-rail see road rail vehicle.

Infrastructure generally includes the track and its components, for example, rails, sleepers, bridges, ballast, and signalling equipment. Generally the term does not include stations or terminals.

Interlocking is an arrangement of signal equipment that prevents conflicting movements of trains through junctions or crossings. It is designed so that it is impossible to give clear signals to trains unless the route to be used is proved to be safe.

Level crossing is any crossing of a railway at grade, providing for both vehicular traffic and other road users including pedestrians. The control of railway crossings is classified as either active or passive according to the following criteria:

- **active control** – control for the movement of vehicular or pedestrian traffic across a railway crossing by devices such as flashing signals, gates or barriers, or a combination of these, where the device is activated prior to and during the passage of a train through the crossing
- **passive control** – control for the movement of vehicular or pedestrian traffic across a railway crossing by signs and devices, none of which are activated during the approach or passage of a train and which rely on the road user, including pedestrians, detecting the approach or presence of a train by direct observation.

In addition to actively and passively controlled crossings there are also *occupational* or *accommodation* crossings between private property and public roads, maintenance crossings and illegal crossings.

Light locomotive(s) means one or more locomotives coupled together without any other rolling stock attached.

Near miss is any occurrence where the driver of a moving train takes emergency action, or would have if there was sufficient time, to avoid impact with a person, vehicle or other obstruction and no collision occurred. Emergency action includes continuous audible warning and/or brake application.

Network rules are rules issued to mandate the requirements for safe operation on a rail network.

Passenger journey is a measure of passenger transport, based on point to point journeys. In urban areas a point to point journey refers to the total trip irrespective of the number of vehicles or modes used. In non-urban areas, each change of vehicle or mode along the route is counted as a separate passenger journey.

Passenger trains are trains designed and used for carrying passengers.

61 NSW Staysafe Committee, *Report on updating progress on railway level crossing safety*, rep. no. 254/09, Staysafe Committee, Parliament of NSW, June 2009.

Rail infrastructure manager is the person who has effective management and control of rail infrastructure of a railway, whether or not the person owns the rail infrastructure or has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it.

Rail safety worker is a person who has carried out, is carrying out or is about to carry out rail safety work. Classes of rail safety work are defined under Section 7 of the *Rail Safety Act 2008*.

Rail transport operator is a rail infrastructure manager, a rolling stock operator, or both.

Rail vehicle detection track is a portion of track formed into an electric circuit where current is carried through the rails and used to detect the presence of trains. Track circuits are used in the operation and control of points and signalling equipment.

Risk is the likelihood that a harmful event might occur. A safety risk is expressed as the combination of the likelihood of an adverse event occurring and its associated harmful consequences.

Road rail vehicle is a vehicle that is capable of running on both road and rail. Often these are standard road vehicles that have a pair of flanged rail wheels on the front and rear.

Rolling stock means any vehicle that operates on or uses railway track.

Rolling stock operator is a person who has effective management and control of the operation or movement of rolling stock on rail infrastructure for a particular railway, but does not include a person merely because the person drives the rolling stock or controls the network or the network signals.

Running line is railway track used primarily for the through movement of trains.

Safeworking system is an integrated system of operating procedures and technology for the safe operation of trains and the protection of people and property on or in the vicinity of the railway.

Shunt is to move trains or vehicles on lines for purposes other than through movement.

Siding is a portion of railway track, connected by points to a running line or another siding, on which rolling stock can be placed clear of the running line.

Staff is a metal rod which represents the authority for rail traffic to occupy a section.

Staff and ticket is a system of safeworking involving the use of a staff or the issue of a written authority to occupy a section after the driver has seen the staff for the section.

Superfreighter is a high-priority intermodal freight train.

Terminals are places where freight is loaded onto or unloaded from trains. A passenger terminal is a place where passenger trains commence or terminate for passengers to board or alight.

Track maintenance vehicle is a specialised type of rail-bound rolling stock used to maintain infrastructure.

Train kilometre is a measure of train activity, based on the distance travelled by a train.

Train order is a system of safe working involving the use of an instruction, on a prescribed form, issued by a train controller to direct the movement of traffic.

Wheel flat is the loss of roundness of the tread of a wheel caused by wheel slip or wheel slide.

Wheel scale is the build up of metallic material on a wheel tread's surface.

Wrong side failure refers to a failure in the signalling system which results in the signal displaying a less restrictive aspect than required, for example, showing a proceed indication when the correct indication should be stop.

Yard is a network of railway tracks and sidings for marshalling, storage, and/or maintenance of locomotives, engines or wagons.

7. List of notifiable occurrences

Under the *Rail Safety Act 2008* (Section 63), rail transport operators are required to report to ITSR, or another authority specified by ITSR, all notifiable occurrences that happen on, or in relation to, the operator's railway premises or railway operations.

Notifiable occurrences are defined in the *Rail Safety Act 2008* (Section 4) as any accident or incident associated with railway operations that has, or could have, caused significant property damage, serious injury or death or an incident of a type prescribed by the regulations to be a notifiable occurrence.

The *Rail Safety (General) Regulation (clause 27)* defines a specific set of notifiable occurrences as follows:

Category A[62]

(a) an accident or incident that has caused death, serious injury or significant property damage

(b) a running line derailment

(c) a running line collision between rolling stock

(d) a collision at a road or pedestrian level crossing between rolling stock and either a motor vehicle or a person

(e) a fire or explosion on or in rail infrastructure or rolling stock that affects the safety of railway operations or that endangers one or more people

(f) a suspected terrorist attack

(g) any accident or incident involving a significant failure of a safety management system that could have caused death, serious injury or significant property damage

(h) the theft of or from rolling stock or railway premises of a rail transport operator of security sensitive dangerous goods (within the meaning of the *Australian Dangerous Goods Code* prepared by the National Transport Commission as in force on the commencement of this regulation) or the tampering with any such goods on rolling stock or railway premises of a rail transport operator

(i) any other accident or incident that is likely to generate intense public interest or concern.

Category B

(a) a derailment, other than a running line derailment

(b) a collision involving rolling stock

(c) any accident or incident at a road or pedestrian level crossing arising from a failure of rail infrastructure or that caused a risk to safety or damage to a person or property

(d) the passing of a stop signal, or a signal with no indication, by rolling stock without authority

(e) any accident or incident where rolling stock exceeds the limits of authorised movement given in a proceed authority

(f) any failure of a signalling or communications system that endangers, or that has the potential to endanger, the safe operation of trains or the safety of people, or that causes or could cause damage to adjoining property

(g) any slip, trip or fall by a person on, to or from a train, railway track, railway bridge, station, platform, escalator, lift or stairs, or any person being caught in the door of any rolling stock

(h) any situation where a load affects, or could affect, the safe passage of trains or the safety of people, or causes or could cause damage to adjoining property

(i) any accident or incident involving dangerous goods that affects, or could affect, the safety of railway operations or the safety of people, or that causes or could cause damage to adjoining property

(j) any breach of a safe working system or procedure, or the detection of any irregularity or deficiency in such a system or procedure

(k) any irregularity in any rail infrastructure (including electrical infrastructure and any obstruction on a running line) that could affect the safety of railway operations or the safety of people

(l) any irregularity in any rolling stock that could affect the safe operation of the train or the safety of people, or cause damage to the rolling stock

(m) any fire or explosion that causes damage to rail infrastructure or rolling stock, or both, or that causes the disruption or closure of a railway (even if the closure is only a precautionary measure)

(n) any accident or incident on railway premises where a person inflicts, or is alleged to have inflicted, an injury on another person

(o) a suspected attempt to suicide

(p) if a rail safety worker employed by a rail transport operator has returned a result to a test designed to determine the concentration of alcohol or other drugs in a sample of blood or urine that suggests that the worker was in breach of a relevant safety requirement concerning the use of alcohol or other drugs at a relevant time

(q) the infliction of any wilful or unlawful damage to, or the defacement of, any rail infrastructure or rolling stock that could affect the safety of railway operations or the safety of people

(r) any accident or incident in a rail corridor that indicates that the security of the corridor is compromised and that affects, or may affect, the safety of railway operations.

62 Category A occurrences are more serious than Category B occurrences and therefore must also be notified to OTSI as soon as practicable after the operator becomes aware of the occurrence.

Photographs

Paul Foley – Lightmoods Photography
Dean Golji – Courtesy of RailCorp

Business and service hours

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Reception is open from 8.30am to 5pm. After hours contact (for emergencies only) (02) 8263 7211

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