Australian Government
Australian Transport Safety Bureau

Level crossing collision between freight train 2C74 and road-train truck

Yarri Road, Parkeston, Western Australia, on 22 February 2021

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Addendum

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Safety summary

What happened

At about 1701 on 22 February 2021, a road-train truck drove into the path of a freight train at the Yarri Road level crossing in Parkeston, Western Australia. The train collided with the truck, resulting in the derailment of the train's locomotive. The level crossing was fitted with active control devices encompassing railway crossing flashing signal assemblies, which were operational prior to the collision.

The locomotive and truck were substantially damaged in the collision, and the 2 drivers on board the train were seriously injured.

What the ATSB found

The ATSB found that the road-train truck driver engaged in tasks related to setting up the truck cabin while approaching the level crossing. This distracted their attention away from the road ahead and probably contributed to them not identifying the flashing lights (indicating the presence of a train) until it was too late to stop.

The level crossing design was consistent with the applicable Australian standard and provided sufficient opportunity for attentive drivers to identify the flashing light level crossing controls and stop. Due to the curved geometry of Yarri Road approaching the level crossing, drivers needed to look ahead and across the curve to see the crossing lights. Because of the effects of distraction, the truck driver was probably only looking at the section of road directly ahead of their vehicle and did not look at the crossing lights.

What has been done as a result

As a result of this accident, the road-train truck company (MLG Oz) implemented an awareness campaign and supporting processes prohibiting the presence of mobile phones and mobile phone cradles with the cabin of its vehicles. Additionally, in coordination with the rolling stock operator, Aurizon, MLG Oz has undertaken a joint exercise to understand the constraints both truck drivers and locomotive drivers face utilising level crossings on a daily basis.

The road owner, City of Kalgoorlie-Boulder has removed vegetation to improve sighting at the level crossing. Main Roads Western Australia are currently reviewing the speed zones along Yarri Road, with discussions held with the City of Kalgoorlie-Boulder to consider extending the 60 km/h zone to incorporate the level crossing. Additionally, a feasibility study is planned to determine if active advance warning assemblies can be installed on the approaches to the level crossing.

Associated with the number of recent collisions and their potential consequences, the ATSB has commenced a safety study into level crossing collisions involving trains and heavy road vehicles in Australia.

Safety message

This incident highlights, for truck drivers (and other road users), the importance of completing preparatory set up of their cab prior to moving their road vehicle, or stopping their vehicle to undertake and complete these tasks. Distraction can significantly impair driving safety. Even though it may be possible to occasionally glance at the road ahead while engaged in another task, critical information from the broader road environment may not be effectively perceived and comprehended, particularly on curved road approaches to level crossings.

The investigation

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope investigation was conducted in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

On 22 February 2021, train 2C74 departed Parkeston, Western Australia, for a shuttle service to West Kalgoorlie. The freight train, operated by Aurizon, consisted of one locomotive (Q4002) and 12 wagons. The crew comprised a driver and a tutor driver.

At about 1700,[1] 2C74 (travelling west) rounded a left curve, which led onto a 500 m straight section of track approaching the Yarri Road level crossing. At the same time, a road-train truck with 3 trailers, designated fleet number TK070 and operated by MLG Oz, was travelling north on Yarri Road (Figure 1).

The northbound road approach to the Yarri Road level crossing consisted of a sweeping right curve leading up to the crossing (Figure 1). Two passive level crossing advanced warning signs provided advice to approaching road traffic of a crossing ahead, one located at the beginning of the curve and the other about half distance through the curve. At about the location of the second sign were 'Rail X' road markings.

Figure 1: Aerial view of the level crossing approach and road alignment

The road-train truck was travelling north along a sweeping right curve on Yarri Road before approaching the railway crossing. The train was travelling west.
Source: Google Earth, annotated by ATSB

The active controls at the level crossing began operating (flashing) when the train was about 440 m away and travelling at about 35 km/h.[2] A few seconds later, the train driver sounded the

[1] All time references in this report are in local time (Western Standard Time).
[2] The posted track speed limit was 50 km/h.

locomotive horn.[3] At this time, the truck was about 800 m from the crossing and travelling about 50 km/h,[4] though gradually accelerating. The truck driver reported that, at about this time, a mobile phone cradle that they had previously fixed to the truck windscreen, via its suction cup, dropped off of the windscreen. The truck driver then set about cleaning and reattaching the mobile phone cradle, before inserting their mobile phone.

When the train was about 200 m from the crossing, the truck was just passing the first warning sign, about 350 m from the crossing. The train driver sounded the locomotive horn a second time when about 175 m from the crossing. About 6 seconds later and about 120 m from the crossing, the train driver sounded the horn a third time. At about the same time, the truck driver, still engaged with setting up their mobile phone in the cradle, was passing the second warning sign, about 160 m from the crossing. During this period, the train was travelling at about 37 km/h and the truck about 70 km/h, and neither driver had noticed the other vehicle approaching the crossing.

About 5 seconds after passing the second warning sign, the truck driver noticed the level crossing flashing lights and then, shortly after, the train approaching from the right. The truck driver reacted by applying the brakes, causing the trailer brakes to lock up and introduce wheel skid. At almost the same time, the train's tutor driver, participating in a crossing check of the level crossing with the train driver, observed the truck approaching the crossing from their left and gave warning to the train driver. The train driver reacted by placing the locomotive brake handle in the emergency position. The train at this point was about 40 m from the crossing.

Neither vehicle could stop in time to avoid a collision. At about 1701, the truck drove into the path of the freight train, and the train collided with the truck's first trailer. The force of collision resulted in the derailment of the locomotive, which came to a stop about 40 m after the crossing (Figure 2). Both train drivers were seriously injured and required hospital treatment.

Figure 2: Locomotive, post-collision

Image taken towards the east of the locomotive post-collision. Also visible are the rear 2 trailers of the road-train truck TK070.
Source: Aurizon, annotated by the ATSB

The truck's prime mover uncoupled from its trailers, left the road and came to a stop about 50 m after the crossing. The truck's first trailer came to rest between the prime mover and locomotive on

[3] The sounding of the locomotive's horn on approach to the level crossing was a requirement of the ARTC network safeworking rules and procedures.

[4] The posted road speed limit for Yarri Road was 80 km/h. Main Roads Western Australia imposed a further 10 km/h reduction on posted speed zones for restricted access vehicles. As such, the speed limit for the road-train truck in this accident was 70 km/h.

the northern side of the track, and the truck's second and third trailers stopped on the southern side of the level crossing. The truck driver was shaken but otherwise unhurt.

Context

Level crossing information

Kalgoorlie is a regional city located about 595 km east-north-east of Perth, Western Australia. Parkeston is a suburb of Kalgoorlie, located about 3 km north-east of Kalgoorlie city centre (Figure 3).

Figure 3: Location of Parkeston, Western Australia

Source: NatMap, Geoscience Australia, annotated by the ATSB

The rail line through Kalgoorlie is part of the interstate rail network between Adelaide and Perth and provides passenger and freight services. The Yarri Road level crossing is near the interface between the Australian Rail Track Corporation (ARTC) network to the east, and the Arc Infrastructure rail network to the west. The ARTC was the designated rail infrastructure manager for the level crossing, and the City of Kalgoorlie-Boulder was the road manager.

The level crossing comprised a single standard gauge track that intersected the roadway at an angle of about 35/145°.

Yarri Road is a sealed road carrying traffic between Kalgoorlie and locations to the north-east of the town, including some mine sites. The road runs in a north-south orientation before curving right immediately prior to the level crossing, for traffic approaching from the south. The speed limit was 80 km/h for the section of road approaching the level crossing from the south. The speed limit increased to 100 km/h a short distance to the north of the level crossing. Yarri Road was part of the approved route[5] for MLG Oz for its regular road-train operations.

The land adjacent to Yarri Road on the approach to the level crossing was sparsely vegetated with low-lying scrub and a few trees. There was a slight gradient, with the road being higher than the train line around the vicinity of the rail approach to the east of the level crossing, reducing to level as the train line approached the level crossing.

[5] Main Roads WA Accredited Mass Management Scheme. Tri-drive concessional level 3.

The Australian Level Crossing Assessment Model (ALCAM) is an assessment tool used to identify hazards and risks at level crossings, and to assist the prioritisation of level crossing upgrades. The most recent calculation of ALCAM ratings for the Yarri road crossing was conducted in October 2018. This assessment noted an average annual daily road usage of 200 vehicles per day and an average train volume of 20 trains per day, and it determined a medium high risk of collision at the crossing, with a predicted 125 years between collisions.

The level crossing featured active[6] traffic control devices (flashing light level crossing controls and bells) and passive[7] road surface markings and roadside signage for both road approaches. Further information about the traffic control devices is provided in *Traffic control devices at Yarri Road level crossing*.

Environmental conditions

Conditions on the day of the accident included clear weather, with a temperature of 31.4 °C recorded at 1500 at the Kalgoorlie-Boulder airport weather station. There had been no significant rainfall recorded for 2 days prior to the accident. Camera footage from the road-train truck showed that there were no environmental factors affecting visibility along the road ahead at the time of the accident (see also Figure 7).

At 1700, the sun was at an altitude of 19.61° from the horizon, with an azimuth of 269.75°. As the road-train approached the level crossing, the sun was to the truck driver's left, moving further behind the driver as they rounded the curve. With the flashing light level crossing controls aligned to the road centreline at about 220°, sunlight would have shone on the lights from an angle of about 70°. Given the relatively obtuse angle of the sun on the level crossing, and because the warning assembly comprised light-emitting diode (LED) type lights with hooded housings including a black supplementary target board to enhance visibility, the position of the sun was unlikely to have affected the truck driver's ability to see the flashing light level crossing controls.

Train and train crew

Train 2C74 was 249.7 m in length, with a total weight of 335.6 t. No evidence was identified to indicate there were problems with the train's braking performance or other train systems that were potentially relevant to the accident.

The rail crew consisted of 2 drivers; a driver in the left driver's seat and a tutor driver, who had just stood up out of the observer's seat at the time of the collision. The driver was a qualified driver receiving practical route tuition for the West Kalgoorlie to Parkeston route on the day of the accident.

The train crew reported that, proceeding towards the level crossing, they conducted a crossing check, with each driver checking the road approach to their side of the train, and each calling 'all clear'. A few seconds after hearing the 'all clear' from the driver, the tutor driver cross-checked for left-side traffic. They saw the approaching truck TK070 and identified it was not going to stop. Shortly after, the driver applied emergency braking. The ATSB determined that, at the point the train crew conducted the initial crossing check, it was unlikely they could have taken any action to prevent the collision.

The resulting forces of impact to the locomotive (Q4002) of train 2C74 did not compromise the survivable space available to the train crew. The train crew injuries were as a result of being thrown around within the locomotive cabin due to the rapid deacceleration triggered by the impact.

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[6] Active control: control of 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.

[7] Passive control: control of 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.

The actions of the train crew prior to the collision were consistent with Aurizon's emergency response training. As such, the train handling, train speed and train driver actions were not considered factors in this collision.

Road-train truck driver

The road-train truck driver had been employed by MLG Oz since 2018 and held the appropriate driver's licence for operating the type of vehicle used on the day of the accident. The truck driver said they were very familiar with the level crossing at Yarri Road and had never seen a train there before.

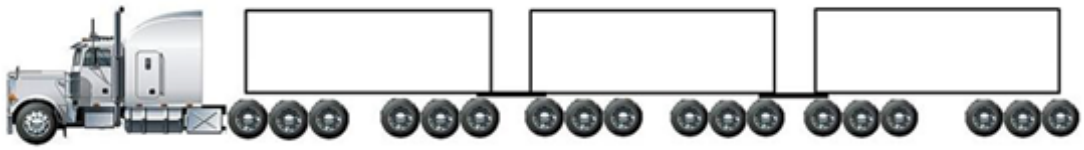
Prior to commencing duty at 1630 on the afternoon of the accident, the truck driver undertook an MLG Oz test for blood alcohol concentration at about 1617, with no alcohol detected. Following the accident, the Western Australia Police Force conducted tests for the presence of an illicit drug and alcohol, which provided a negative result (that is, no alcohol or drugs were detected).

The truck driver was rostered on day shifts from 14–18 February and on night shifts for 19–22 February. The night shifts commenced at 1630 and ended at 0500, with a 1-hour break. The driver reported that they were not feeling tired on the afternoon of the accident, having slept well for about 7 hours before starting work. Overall, there was insufficient evidence to conclude that fatigue or non-work-related factors were affecting the driver's performance in the period leading up to the accident.

Road-train truck information

Road-train truck TK070 consisted of a Mack Titan Tri Drive prime mover and 3 side-tipping trailers in A-Triple configuration (Figure 4). The road-train was loaded with 97.5 t of ore and had a combined mass of about 148 t.

Figure 4: Tri-Drive road-train combination in A-Triple configuration



The image shows a Tri-Drive prime mover with trailer combination in A-Triple configuration.
Source: MLG Oz

Post-accident inspection by the Western Australia Police Force found that the overall braking performance of the prime mover and first trailer met the requirements prescribed by regulations.[8]

Road-train onboard monitoring system

The prime mover was equipped with an in-cab driver monitoring system, comprising a driver-facing camera as well as other sensors and hardware. This system was configured to provide in-cab and back-to-base alerts and data if it detected signs of driver fatigue or distraction. The prime mover was also equipped with forward-facing and side-facing cameras.

The driver started their journey about 3 minutes before the collision. Footage from the driver-facing camera showed the period leading up to the collision. From about 1 minute before the collision, the footage showed the driver engaged in several activities related to configuring the cab for the journey. This included using a spray bottle to clean the suction cup of a mobile phone cradle, manipulating the mobile phone cradle, and placing the mobile phone into the cradle in front

[8] Accident damage prevented a complete assessment of the braking performance of the second and third trailers. The testing that was conducted did not identify any pre-accident defects.

of the driver. There was no evidence of any incoming or outgoing SMS[9] messages or voice calls during this period.

When interviewed by the ATSB after the accident, the driver identified that manipulating the mobile phone cradle and the phone probably distracted them. However, the driver also said that manipulating the phone cradle was a simple task that could be conducted in a couple of seconds. The driver thought this was about as long as it took to fix the cradle and they had completed interacting with the phone before rounding the curve on the approach to the level crossing. This recollection was not consistent with the in-cab video, which showed it took about 30 seconds from when the driver picked up the phone cradle to when they appeared to have their hands free from this task. The footage also showed that the driver's eyes appeared to remain focussed on objects in the cab and on the dash after the truck entered the straight section prior to the level crossing.

When compared with footage from the forward-facing camera, the driver-facing footage showed that the driver's eyesight appeared mainly focussed on activities within the cab throughout the approach to the level crossing. When the truck was at the position of the second warning sign (about 170 m prior to the level crossing), the forward-facing footage showed the train visible and slightly right of straight-ahead. The driver did not appear to look at or notice the flashing light level crossing controls or the train until about 5 seconds before the level crossing.

The ATSB obtained a report produced by the manufacturer of the in-cab monitoring technology, which stated that the monitoring system did not detect any 'distraction events' during the journey before the accident. The manufacturer advised that the system was configured to detect distraction by tracking head movements. Distraction events were identified when a driver's head moved outside a specified range of movement for a specified length of time. In this instance, the driver did not need to make large head movements to manipulate the mobile phone cradle, and the glances away from the target field of view were less than the threshold time. Although it was evident the driver's attention was directed in part towards cab configuration activities rather than focussed on the driving task, there was no suggestion the in-cab monitoring technology was deficient within its operational specifications.

Traffic control devices at Yarri Road level crossing

Background information

Given the size and weight of most trains, it is not possible for them to brake at anywhere near the rate of a road vehicle. In most circumstances, by the time a train driver can sight an approaching motor vehicle and decide whether it will stop, the train is already close to the railway crossing. In such circumstances a train driver is unable to take any effective action to avoid the collision other than sound the locomotive horn to warn the motorist, and (if time permits) make an emergency brake application.

By comparison, a road vehicle can stop relatively quickly. It is for this reason that, regardless of the type of crossing control (passive or active), the onus to take appropriate action to avoid a collision rests almost entirely with the road vehicle user.

The critical requirement at crossings with active controls is the road vehicle user's ability to sight the flashing lights, recognise their intended message and react in accordance with the road rules. Consequently, it is important that active controls are effective at alerting the road user that they are approaching a railway crossing, with sufficient time for them to stop safely before entering the crossing.

There are 2 standards relevant to railway level crossings in Australia:

- Australian Standard (AS) 7658:2020 *Level crossings – rail industry requirements.* AS 7658 was prepared by the Rail Industry Safety and Standards Board (RISSB) with input from various railway organisations. The standard specified minimum operational and engineering

[9] SMS: Short Message Service, also known as text message.

requirements for the life cycle of a level crossing. The requirements were intended to supplement details prescribed in AS 1742.7 (following).

- Australian Standard (AS) 1742.7:2016 *Manual of uniform traffic control devices Part 7: Railway crossings.* AS 1742.7 specified the traffic control devices to be used to control and warn road traffic at and in advance of railway level crossings.

Flashing signals – minimum warning time

Both AS 7658 and AS 1742.7 stipulated that, where flashing light level crossing controls are installed, a minimum warning time of 20 seconds[10] be provided between the activation of the flashing lights and the arrival of the train. This was intended to allow road vehicles:

- to stop before entering the crossing, or
- if unable to stop, to traverse and clear the crossing before a train arrives.

The ATSB established that the flashing lights had been operating for about 45 seconds before the arrival of train 2C74 at the Yarri Road level crossing. Therefore, from a timing perspective, the crossing exceeded the timing requirements of both AS 7658 and AS 1742.7.

Level crossing configuration

AS 1742.7 illustrated the requirements for several crossing configurations, such as straight road approaches, sharp curves immediately prior to a crossing, and a crossing near road junctions. The standard did not specify any control treatment variations for sweeping road approaches such as existed at the Yarri Road level crossing. The only curved approach referenced was in relation to the orientation of signage and flashing lights. The standard advised that level crossing signage should be oriented towards the approaching traffic rather than the road edge, with flashing lights oriented to be visible from any point along the stopping sight distance[11] sight line.

Consequently, the ATSB examined the Yarri Road approach with respect to the straight road approach treatment specified in the standard. Figure 5 (left) shows the minimum treatment as specified in AS 1742.7. An examination of road markings and signage at the Yarri Road level crossing identified slight variations from the requirements specified in the standard. Figure 5 (right) shows the configuration installed at the Yarri Road level crossing on 22 February 2021.

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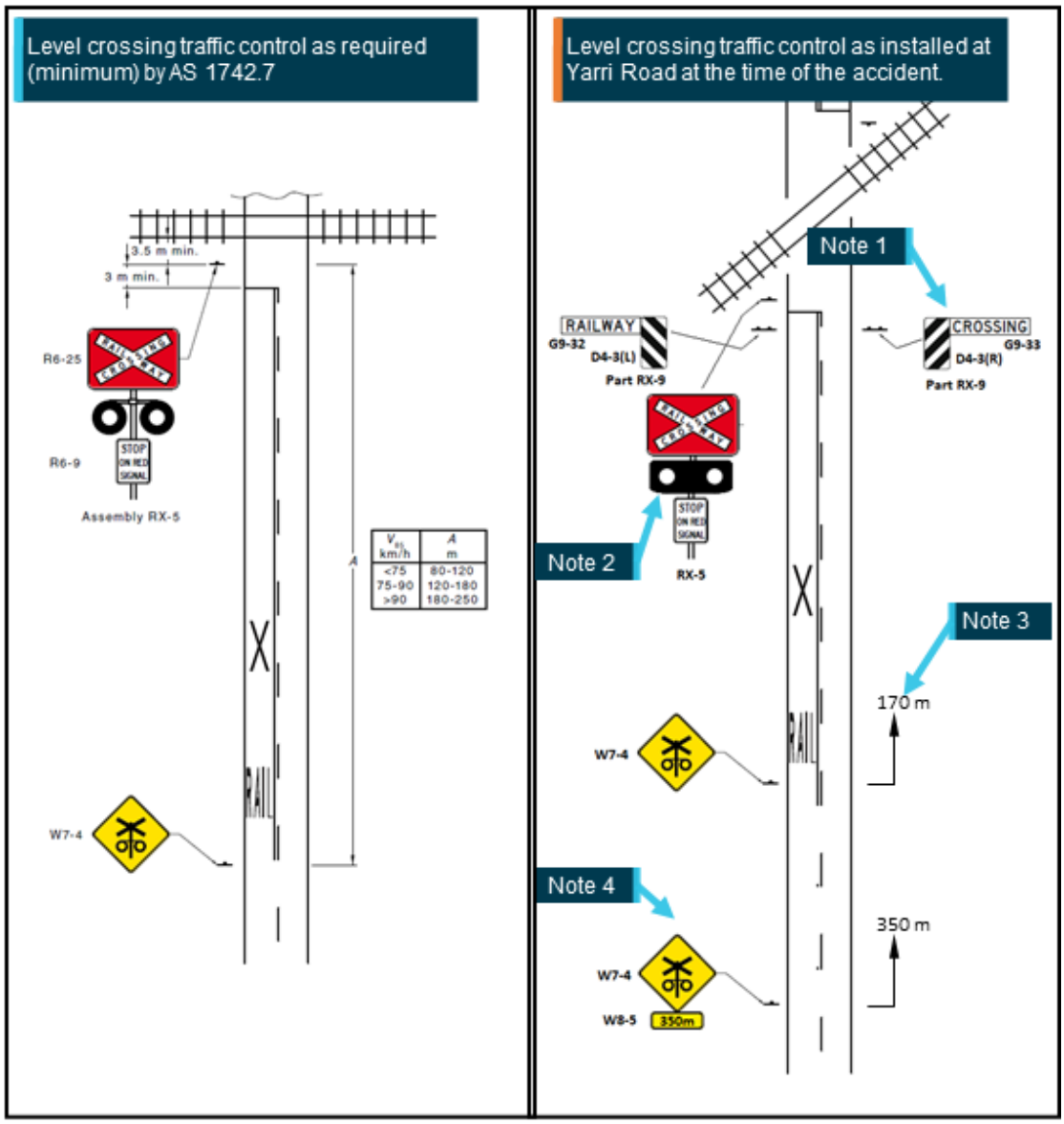
[10] The ARTC, the rail infrastructure manager for Yarri Road, specified a minimum 25-second warning time for level crossings within its network.

[11] Stopping sight distance: minimum distance of an approaching road vehicle from the nearest rail when the road driver must be able to see an approaching train in time to stop if necessary, before reaching the crossing.

Figure 5: Comparison of traffic control required by AS 1742.7 (left) with the controls installed at Yarri Road level crossing on 22 February 2021 (right)



Note that the illustration shows the road for a straight road approach, whereas the Yarri Road approach consisted of a sweeping right curve.
Source: AS 1742.7-2016 Figure 4.6, with right comparison image annotated by the ATSB

The points of note are:

- The optional 'Railway crossing width marker assembly' (RX-9) had been installed at the Yarri Road level crossing (Figure 5, Note 1). The standard stated that this assembly should be used '…where the conspicuity of the crossing needs to be enhanced, typically on high-speed rural road approaches.'
- The flashing signal assembly (RX-5) installed at the Yarri Road level crossing included a large black supplementary target board (Figure 5, Note 2). The standard suggested that a black supplementary target board of suitable size may be used to enhance the visibility of a flashing signal.
- A 'Railway crossing flashing signal ahead' sign (W7-4) was positioned approximately 170 m before the flashing light assembly (Figure 5, Note 3). This was consistent with a level crossing approach design based on 85% of road vehicles travelling between 75–90 km/h (V_{85}), noting the road speed limit was 80 km/h.

- A second (optional) 'Railway crossing flashing signal ahead' sign (W7-4), with distance plate (W8-5), was positioned 350 m before the flashing light assembly (Figure 5, Note 4). This was positioned on the straight section of road before the curved approach.

Overall, the level crossing configuration was generally consistent with AS 1742.7.

Stopping sight distance

Main Roads Western Australia (MRWA) manages and regulates the movement of heavy vehicles over pre-approved routes in Western Australia, known as Restricted Access Vehicle (RAV) networks. Yarri Road was approved for RAVs up to AAB-Quad configuration. Although truck TK070 in A-Triple configuration had the same maximum vehicle length as the AAB-Quad configuration, the A-Triple configuration had a lower maximum combined vehicle mass.

AS 1742.7 provided guidance for calculating the stopping sight distance for various vehicles (AAB-Quad presenting the worst-case scenario). This guidance included the general case assumption of 2.5 seconds perception reaction time while travelling at the speed limit.

Using the guidance documented in AS 1742.7, the stopping sight distance for a road-train in AAB-Quad configuration, traveling at the road speed limit of 80 km/h, was calculated as 199 m. For RAVs travelling roads in Western Australia with speed limits above 60 km/h, MRWA applied additional speed limits of 10 km/h less than the posted speed limit. At a road speed of 70 km/h, the calculated stopping sight distance for an AAB-Quad would reduce to 165 m.

Sighting surveys conducted by MRWA prior to the accident recorded an observed sighting distance of 220 m[12] for northbound vehicles approaching Yarri Road level crossing. For a vehicle travelling at 80 km/h, this would provide about 9.9 seconds continuous sighting of the level crossing warning lights. At 70 km/h, this would extend to about 11.3 seconds, providing 2.8 seconds more than the minimum (2.5 seconds) perception reaction time.

In this case, the flashing lights at the Yarri Road level crossing were operating for about 45 seconds. Consequently, the lights were flashing for the entire time while truck TK070 was within sighting distance of the crossing. Similarly, the available sight distance exceeded the required stopping distance, so there was sufficient time for the driver to observe the flashing lights, react and stop before the level crossing.

Flashing light conspicuity

The ARTC advised that the flashing lights at the Yarri Road level crossing comprised 10 high intensity LED lamp units in a combination of main lights and back lights, focussed at each road approach. Examination of data recorded by the railway crossing event logger supported that all LED lamps were functioning at the time of the collision.

LED lamp units provide high intensity illumination over a wide viewing angle and provide good performance (warning), from a road user perspective, compared to traditional incandescent lamps. LED lights are also less susceptible to the effects of sun glare and reflection. According to the manufacturer's specifications, the LED lamp units in use at Yarri Road had a range of about 700 m and a light beam spread of 30°.

AS 7658 specified that site-specific focussing diagrams should be prepared to optimise the visibility of flashing light installations at level crossings. The engineering plans for the Yarri Road level crossing specified that the warning lights for the direction that the road-train truck approached be focussed towards the centre of the road at about 120 m from the lights (near the 'Rail X' road markings). Given this focus and the beam spread of the lights, they would have been visible from a northbound vehicle for all of the 220 m sighting distance (Figure 6).

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[12] The sighting distance was to the flashing lights. Prior to 220 m, the sighting was limited by trees and/or vegetation. Following the accident, a MRWA site survey undertaken on Yarri Road level crossing in April 2021 measured a sighting distance of 260 m.

Figure 6: LED light beam spread and vegetation affecting sighting distance on northbound approach to Yarri Road level crossing

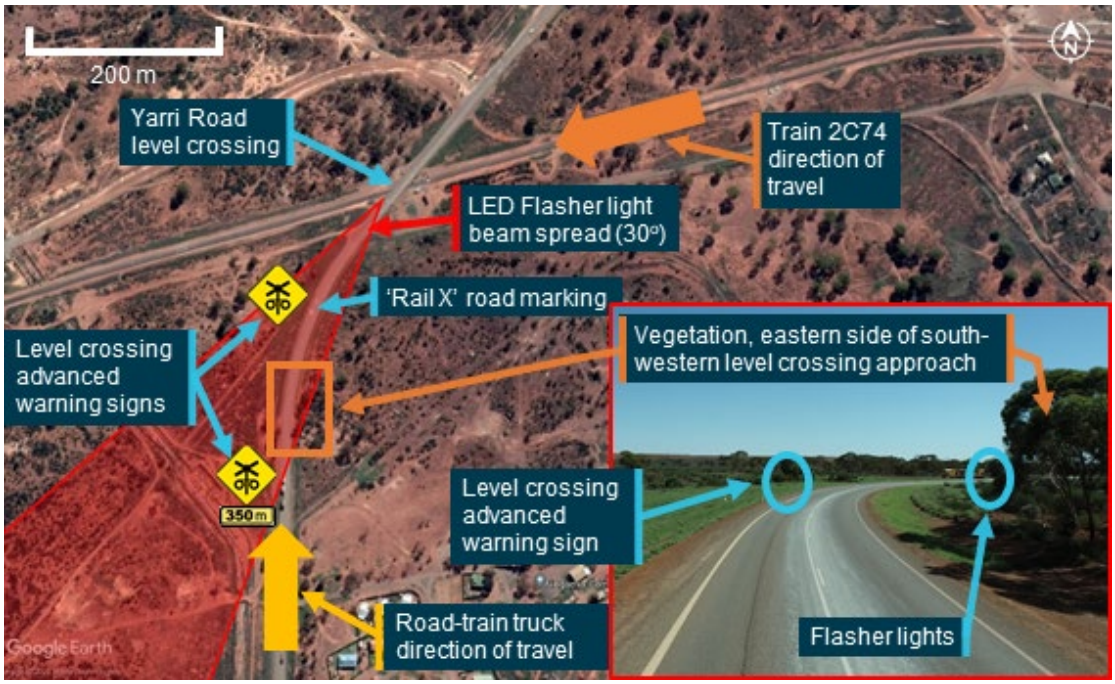

Image shows the LED light beam spread for the northbound approach to Yarri Road level crossing, as well as the vegetation on the eastern side of the road. Note that the light spread encompasses the entire area from when the warning lights come into view after passing vegetation on the eastern side of road.
Source: Google Earth and WA Police Service, annotated by the ATSB

Curved level crossing road approach

The southern (northbound) approach to Yarri Road level crossing consisted of a sweeping right curve, before straightening about 70 m prior to the crossing. For this approach configuration, a road vehicle driver's line of sight would need to look through the curve, across vegetation on the inside of the curve, to be capable of sighting the flashing lights (Figure 7). It is not until the vehicle is much closer to the crossing that a driver's vision along the road would also coincide with line of sight to the crossing. By this time, it would be unlikely that a large multi-trailer truck, travelling at the speed limit, would be able to stop before the level crossing. It is for this reason that a driver must continuously scan the road ahead, so action can be taken to avoid hazards. In this case, scanning includes looking through the curve, identifying the flashing lights and bringing the vehicle to a stop in a controlled manner.

Figure 7: Curved road approach to the level crossing

Note that the 2 images show the curved road approach from about 180 m from the level crossing. The top image shows the approach overhead with an indication of the road-train truck driver's line of sight. The bottom image shows a screen capture from the forward-facing video camera on road-train truck TK070 with the driver's sight lines to the road and the level crossing ahead.
Source: MLG Oz and Google Earth, annotated by the ATSB

Notifiable occurrences

A search of the Office of the National Rail Safety Regulator (ONRSR) notifiable occurrence[13] data was conducted for similar events at the Yarri Road level crossing. The search was limited to level crossing near misses and collisions from the date[14] that ONRSR commenced rail safety regulation in Western Australia until the date of this accident. The search returned only one related record, details of which included:

- A near miss with a B-Double fuel tanker at 1213 on 24 July 2017. The report noted that the B-Double tanker was able to stop in a safe location after taking evasive action, with the train crew reporting that they did not have enough time to apply emergency brake. The report did not state the direction that the B-Double fuel tanker had approached the Yarri Road level crossing.

Safety analysis

Road-train truck TK070 proceeded through the level crossing at Yarri Road while the flashing light level crossing controls were activated, and into the path of freight train 2C74. The truck driver had not noticed the flashing lights, and only noticed train 2C74 at a time when it was too late to prevent the collision. When the train crew of 2C74 saw the truck and identified that it was not going to stop for the crossing, it was too late for them to stop their train or reduce the severity of the impact.

This accident demonstrates that the safety of road and rail traffic at level crossings is dependent on road users attending to and responding to the level crossing controls. This is particularly the case for heavy vehicle road traffic, whose greater mass poses a greater hazard to rail traffic in the event of a collision.

The level crossing configuration was generally consistent with AS 1742.7. The flashing light level crossing controls were activated for the entire time truck TK070 was within sighting distance of the crossing. Although there was a sweeping curve on approach to the crossing, there was sufficient sighting for a driver scanning for hazards along the road ahead to react and stop before the level crossing. Overall, the ATSB concluded that the operation, design and maintenance of the level crossing was unlikely to have been contributory to the development of this accident.

Distraction occurs when a driver's attention (meaning where the driver is looking, what they are manipulating/touching, and what they are thinking about) is diverted from activities critical for safe driving towards a competing activity (Parnell and others 2016). Research has shown that distracted drivers:

- spend more time looking at objects in front of their vehicle and less on objects in the periphery
- make fewer 'anticipatory glances' towards potential hazards
- notice fewer objects in the driving scene, being more vulnerable to 'look but failed to see' errors (Strayer and Fisher 2016).

The effects of distraction can be insidious, since drivers can often be unaware of the extent to which their performance has been impaired. Performance can be impaired for up to 20 seconds after attention is redirected back to the primary driving task following a distraction (Bowden and others 2019). As such, even when a driver presumably believes that they are no longer distracted due to re-focussing on the road ahead, their performance may still be impaired.

Mobile phones can be a significant source of distraction for road vehicle drivers. Drivers who use their mobile phones while driving take longer to respond to hazards and other objects, have reduced sampling of information such as mirrors and speedometers, and are less able to maintain the position of their vehicle on the road (Caird and others 2014; Caird and others 2018). This is partly because of the interference caused by looking at and manipulating a phone or other

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[13] A legislative requirement for rail transport operators to report notifiable occurrences as prescribed within Regulation 57 of the Rail Safety National Law (WA) Regulations 2015.

[14] ONRSR commenced operations in Western Australia on 2 November 2015.

technology, and partly because of the cognitive distraction caused by thinking about activities like holding a conversation (Young and others 2003). Research has also demonstrated that driving performance is similarly impaired by other in-vehicle technology such as navigation and entertainment systems (Ranney and others 2011).

Shortly after commencing the journey along Yarri Road, the road-train truck driver engaged in activities primarily related to configuring the cab, including setting up a dash-mounted mobile phone cradle and placing a mobile phone in the cradle. Although the driver was not using their mobile phone to dial or text, the interaction with the phone distracted the driver from the task of driving the truck, causing them to divide their attention between driving and manipulating the phone and its cradle, and to look away from the road ahead. The driver's visual attention was diverted from the road ahead for significant periods during the 1 minute prior to approaching the level crossing, including during the critical period of the approach to the level crossing where the flashing light level crossing controls were visible and there was sufficient distance to stop.

The truck driver had never seen a train on previous journeys across the Yarri Road level crossing, and it is possible that a low expectancy of encountering a train contributed to the truck driver allocating a low level of attention to the crossing. Studies have found that drivers who are familiar with a level crossing are more likely to be involved in a crossing incident than drivers unfamiliar with the crossing, partly because they do not expect to encounter a train (Yeh and Multzer, 2015).

Due to the curved geometry of the road approaching the level crossing, the flashing light level crossing controls were located away from the driver's straight-ahead line of sight. This continued until the truck approached the crossing straight-on, about 70 m before the crossing. Consequently, the driver needed to look through the curve of the road to see the flashing warning lights at the crossing in time to stop for the train. Due to distraction, the driver only made occasional glances ahead of the truck, probably only attending to objects immediately in front, and ensuring the truck remained on the road. The driver was probably not effectively scanning further ahead of the truck and through the curve to the crossing lights.

The driver of the road train thought they could safely re-attach the mobile phone cradle and conduct other activities while still operating their vehicle, believing this would only take a short time and take a small amount of effort.[15] This accident shows that even the simplest of tasks can distract attention away from the road ahead, sometimes at critical times when attention is required to detect signals, hazards or other road users. Wherever possible, it is safest to perform secondary tasks before commencing the journey or after pulling over and stopping the vehicle.

A small proportion of level crossing collisions tragically result in fatalities and/or serious injuries to those on board road vehicles. In addition, some level crossing collisions that involve heavy road vehicles can result in serious adverse consequences to those on board trains. The ATSB also noted that there were 11 collisions between heavy road vehicles and trains at level crossings in Australia between July 2020 and June 2021 (and 23 such collisions over the previous 5 years).

Accordingly, in 2021, the ATSB commenced a safety study into level crossing collisions involving trains and heavy road vehicles in Australia.[16] The study includes a review of previous collisions to determine their characteristics and circumstances, and also determine if there are any unidentified systemic safety issues or learning opportunities that could enhance the safety of future transport operations.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not

[15] Research shows that drivers underestimate time periods when they are experiencing elevated workload or conducting multiple tasks at the same time (Baldouf and others 2009).

[16] RS-2021-001 *Review of level crossing collisions involving trains and heavy road vehicles in Australia*

meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the collision between a road-train truck and a freight train at the Yarri Road level crossing near Parkeston, Western Australia, on 22 February 2021.

Contributing factors

- While approaching the level crossing, the road-train truck driver engaged in several tasks related to setting up the truck cabin, taking attention away from the road ahead. As a result, the driver was distracted during the critical period when it was possible to notice the flashing light level crossing controls in time to stop for the train.

Other findings

- The Yarri Road level crossing configuration provided sufficient sighting and stopping distance for an attentive road vehicle driver to notice the flashing light level crossing controls and bring the vehicle to a controlled stop before the level crossing.

Safety actions

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. All of the directly involved parties are invited to provide submissions to this draft report. As part of that process, each organisation is asked to communicate what safety actions, if any, they have carried out to reduce the risk associated with this type of occurrences in the future. The ATSB has so far been advised of the following proactive safety action in response to this occurrence.

Safety action by Aurizon

Aurizon advised it had completed the following proactive safety actions:

- Aurizon engaged with Main Roads WA, ARTC, and ARC Infrastructure to understand the current Yarri Road ALCAM assessment, existing controls and potential for additional controls (such as active advanced warning assemblies). Main Roads WA has confirmed to Aurizon that the ALCAM assessment had been reviewed and updated. Main Roads WA advised Aurizon that it does not believe any changes to the level crossing are required based on a review of the accident. Aurizon will continue to work with Main Roads WA on strategies to reduce driver distraction.
- Aurizon engaged with the road manager for Yarri Road, the City of Kalgoorlie-Boulder, to ensure there is a commitment to maintaining vegetation to a suitable level to ensure clear sighting distances at Yarri Road level crossing are maintained.
- Aurizon has conducted a learning team with MLG Oz and QUBE to understand the constraints both truck drivers and locomotive drivers face utilising level crossings on a daily basis. A number of occurrences were also discussed, including this accident.
- Aurizon conducted an emergency management risk review in September 2021.
- Aurizon scripted and developed an awareness video, which will be distributed to staff as part of a level crossing reporting awareness program that is under development.

Aurizon stated it was also continuing to progress with the following proactive safety actions:

- Occurrence and engineering data is being analysed to determine a location of safety in the locomotive cab (including raising discussions regarding seat belts/air bags for locomotives with the Rail Industry Safety and Standards Board as an industry-wide issue).
- A locomotive familiarisation session is being conducted with the Department of Fire and Emergency Services (planned for April 2022).
- Engineering data associated with crash pulse and energy management is being reviewed, using data gained from this accident. This review is being conducted in 2 phases:
  - short-term – a high-level analysis to provide clear options to drivers about positions of safety in the locomotive.
  - long-term – in conjunction with relevant industry working groups, complete detailed analysis on crash pulse and energy management in locomotives to define a position of safety and any design needs for locomotives.
- A potential automated emergency warning notification device has been identified and is expected to be trialled in early 2022.
- Options are being investigated to install an emergency tap (emergency brake) for the second driver to activate while seated in a Q class locomotive.

In addition, Aurizon advised that it continues to work with rail infrastructure managers and road managers on targeted intervention at high-risk level crossings. A working group is being stood-up to provide additional coordination to activities across multiple interfaces.

Safety action by Australian Rail Track Corporation

The Australian Rail Track Corporation made contact with the road manager for Yarri Road (City of Kalgoorlie-Boulder) and suggested that it consider the benefits of installing active advance warning assemblies.

Safety action by MLG Oz

MLG Oz advised that it had completed the following proactive safety actions:

- reviewed its documentation and training that related to the use of mobile phones
- delivered a use of mobile phones re-awareness campaign throughout the business, which was supported by the in-cabin footage from this accident
- prohibited the use of mobile phone cradles within the cabin and reinforced that mobile phones were to remain out of reach in the driver's crib/shift bag
- added MLG Oz safety team to the in-cab monitoring system so that they will be notified of and could view distraction events, which will be reported on following monthly site visits
- reviewed and updated the MLG Oz Trafficable Route risk assessment
- produced an awareness video from the in-cabin footage obtained from this accident was used to outline how quickly a distraction event can result in a serious incident
- reviewed MLG Oz's Commercial Drivers Fatigue Management Plan and conducted a self-audit to ensure compliance with the Act
- took part in a learning day with Aurizon to understand the constraints both truck drivers and locomotive drivers face utilising level crossings.

Safety action by City of Kalgoorlie-Boulder

The City of Kalgoorlie-Boulder advised that it had completed vegetation removal on the eastern side of Yarri Road to improve sighting towards the flashing light level crossing controls from the southern approach to the level crossing.

Safety action by Main Roads Western Australia

Main Roads Western Australia advised that it was currently reviewing the speed zones along Yarri Road. As part of this review, temporary traffic counters were being deployed along Yarri Road; these traffic counters will be used to determine the vehicle volumes, vehicle types and vehicle speeds along the road.

Discussions have been held with the City of Kalgoorlie-Boulder to consider extending the 60 km/h zone such that it incorporates the level crossing. A feasibility study is also being undertaken to determine if active advance warning assemblies can be installed on the approaches to the level crossing.

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the drivers of train 2C74
- the driver of road train truck TK070
- Aurizon
- MLG Oz
- Main Roads Western Australia
- Western Australia Police Force
- Australian Rail Track Corporation (ARTC)
- Arc Infrastructure
- City of Kalgoorlie-Boulder
- Nine News
- Telstra.

References

ARTC Annotated Code of Practice for the Defined Interstate Rail Network, Issue 3.0 - Volume 3, Operations and Safeworking Part1: Rules.

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Ranney TA, Baldwin GH, Parmer E, Martin J and Mazzae EN (2011) *Distraction effects of manual number and text entry while driving*, Report No. DOT HS 811 510, National Highway Traffic Safety Administration: Washington DC.

Strayer DL and Fisher DL (2016) 'SPIDER: A framework for understanding driver distraction', *Human Factors*, 58:5–12.

Yeh M and Multzer J (2008) *Driver behaviour at highway-railroad grade crossings: A literature review from 1990–2006,* Report No. DOT/FRA/ORD-08/03, Federal Railroad Administration: Washington DC.

Young K, Regan M and Hammer M (2003) *Driver distraction: A review of the literature*, Report No. 206, Monash University Accident Research Centre.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- the drivers of train 2C74
- the driver of road-train truck TK070
- Aurizon
- MLG Oz
- Main Roads Western Australia
- City of Kalgoorlie-Boulder
- Australian Rail Track Corporation (ARTC)
- The Office of the National Rail Safety Regulator (ONRSR).

Submissions were received from:

- the drivers of train 2C74
- Aurizon
- MLG Oz
- Main Roads Western Australia
- ARTC
- ONRSR.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

General details

Occurrence details

Date and time:	22 February 2021 – 1701 WST	
Occurrence category:	Accident	
Primary occurrence type:	Level crossing collision	
Location:	Parkeston, Western Australia	
	Latitude: 30º 43.672' S	Longitude: 121º 29.433' E

Train details

Track operator:	ARTC	
Train operator:	Aurizon	
Train number:	2C74	
Type of operation:	Freight	
Departure:	Parkeston, Western Australia	
Destination:	Kalgoorlie, Western Australia	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 2	Passengers – 0
Damage:	Substantial	