



Australian Government
Australian Transport Safety Bureau

Signals Passed at Danger by train 7750

Marshall, Victoria | 2 January 2018



Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2018-001
Final – 15 January 2020

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Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

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Addendum

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Safety summary

What happened

On 2 January 2018 at about 1413, V/Line train 7750 was travelling from Waurn Ponds to Geelong as an empty car service not carrying passengers. Shortly after passing Marshall Railway Station, the train passed two signals at Danger. After passing these signals, the train entered the single line section between Marshall and South Geelong, and also the Marshalltown Road level crossing before the crossing booms had lowered. The driver applied braking as the train entered the crossing and the train came to a stop.

The 1305 V/Line Melbourne to Warrnambool passenger service, train 8865, had departed Geelong at about 1410 and was proceeding towards Marshall on the same single line section. The trains were scheduled to cross using the loop track at Marshall. The train controller in Melbourne was monitoring the progress of both trains in order to operate the points and signals at Marshall to effect the crossing. When he became aware that train 7750 was passing signals at Danger, the controller initiated a radio emergency fleet call instructing both trains to stop. When stopped, the distance between the trains was about 940 m.

What the ATSB found

The ATSB found that the driver of train 7750 did not respond to the Stop indications of signals MSL10 and MSL8 at Marshall. He subsequently made an emergency brake application, either after noticing that the Marshalltown Road level crossing booms were not lowered or possibly in a delayed recognition of signal(s) MSL10 and/or MSL8 being at Stop. The driver's performance was probably influenced by symptoms associated with nicotine withdrawal, having not applied a nicotine patch on this day.

Following this incident, the driver of train 7750 tested positive for an inactive metabolite of cannabis, with levels suggesting use within the previous 7 days. It could not be determined whether cannabis use had affected the driver's performance at the time of this incident.

V/Line's drug and medical regimes had not previously identified that this driver had been using cannabis, and the driver had not been subject to random drug testing during his employment with V/Line.

The signalling system at Marshall was not fitted with any form of positive train protection system and was reliant on driver compliance with signal indications.

What's been done as a result

V/Line has installed a train protection system at this location to stop a train that has passed a signal at Danger. The system also has several over-speed sensors to prevent a train entering the Marshalltown Road level crossing when unprotected.

V/Line continues with planning for the provision of three-position signalling for this section as part of other infrastructure projects.

Safety message

Nicotine withdrawal can affect a driver's performance. To minimise adverse impacts, attempts by safety-critical workers to stop smoking should be managed under medical supervision.

Rail operators should consider fitting authority-overrun intervention at locations (like Marshall) that present a heightened risk due to rail operations on a single, bidirectional track.

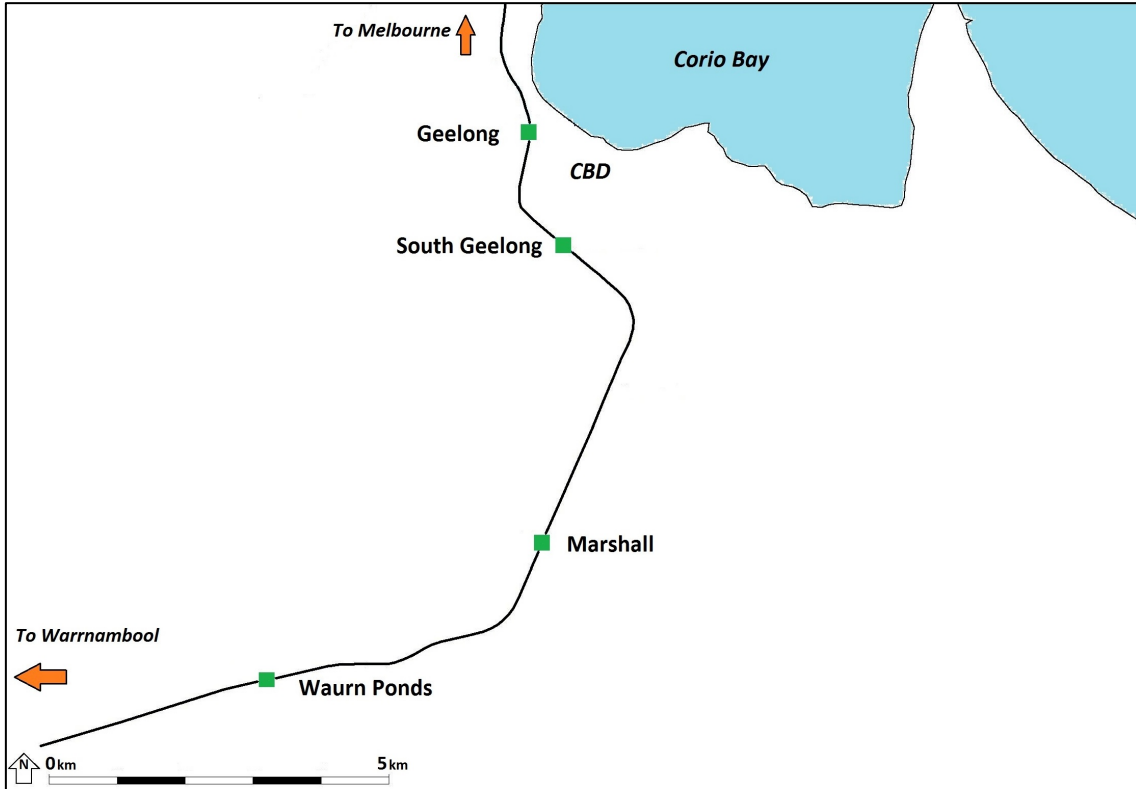
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The occurrence

On 2 January 2018, the driver was rostered to commence work at 1158. He first ran the V/Line 1250 service from Southern Cross Station to Waurn Ponds. On arrival at Waurn Ponds, the driver changed ends and train 7750 departed empty cars¹ towards Geelong. The driver was to proceed to Geelong where the train would then form the 1435 passenger service to Melbourne (Figure 1).

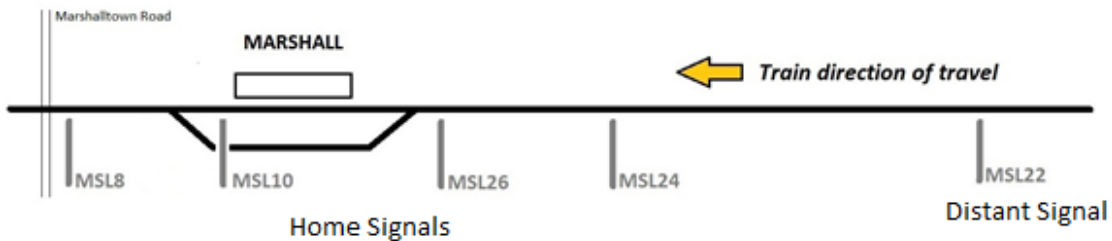
Figure 1: Marshall Railway Station location relative to Waurn Ponds and Geelong



Source: PASS Assets (Public Transport Victoria) adapted by Chief Investigator, Transport Safety (Vic)

After passing the Departure signal at Waurn Ponds, there were five signals within the Marshall location over a distance of about 5 km. Distant signal² MSL22 was followed by four Home Signals,³ MSL24, MSL26, MSL10 and MSL8 (Figure 2).

Figure 2: The sequence of signals through Marshall, travelling towards Geelong



Source: Chief Investigator, Transport Safety (Vic)

¹ The train was transferring to another location without passengers, and was not required to stop at any stations.
² In a two-position signalling system, a Distant signal is located prior to the first Home signal for a location and provides information to drivers on the indication of Home signals on the through route.
³ Signals that are 'absolute' (or Stop-and-Stay) and directly protect higher-risk locations such as infrastructure at which a potential conflict of traffic exists. When cleared (at Proceed), this signal gives the driver the authority to enter the section.

At 14:09:23⁴, the train passed Distant signal MSL22 at a speed of about 86 km/h. This signal displayed a Caution indication, meaning that at least one Home signal within the Marshall location was at Stop. Prior to MSL24, the train's speed was reduced to 57 km/h at the Surf Coast Highway level crossing, exceeding the Temporary Speed Restriction (TSR) of 40 km/h at that location.

The train speed was then increased and the train passed signal MSL24 (that was at Proceed) at a speed of about 85 km/h at 14:12:15. The train then continued at speeds of up to 94 km/h before reducing speed and passing MSL26 at about 71 km/h at 14:13:10. This reduction in speed was consistent with an approaching TSR of 70 km/h that applied just beyond signal MSL8.

The right-hand arm of signal MSL26, that was applicable for the straight-route, was at Proceed and the signal for the loop was at Stop. This indicated that the points were set for the straight (number 1) track and that train 7750 was authorised to proceed on this track.

The intention of the train controller was to hold train 7750 at MSL10 to allow the Warrnambool bound train (8865) to enter the loop (number 2) track. Train 7750 was then to proceed towards Geelong. Train 8865 would then have been required to remain in the loop at Marshall to allow a Warrnambool to Southern Cross train that was following train 7750 to also cross.

After passing MSL26, the speed of train 7750 further reduced. Home signals MSL10 and MSL8 were at Stop and the train passed both signals at a speed of about 64 km/h, at 14:13:24 and 14:13:29 respectively. The train had passed signals MSL10 and MSL8 without authority. This type of event is referred to as a Signal Passed At Danger (SPAD).

The driver reported noticing that the Marshalltown Road level crossing booms were up and making an Emergency brake application. The train entered the single line between Marshall and South Geelong and then the level crossing, before the booms had lowered.

The train controller had commenced his shift at 0700 working the 'Geelong Room' that managed rail traffic between Manor Junction⁵ and Waurn Ponds. In preparation for the cross of the two trains at Marshall, he was observing the signalling control and CCTV VDU⁶ when he saw train 7750 go through Marshall platform travelling too fast to stop at MSL10. Realising that train 7750 would not be able to stop, the train controller made a fleet radio transmission to all trains in the area to 'Red Light' (Stop). He then radioed the drivers of trains 7750 and 8865 to confirm that they had both stopped. The CCTV also allowed the train controller to confirm that train 7750 had stopped beyond the Marshalltown Road level crossing.

When both trains were stopped, the separation between train 7750 and train 8865 was about 940 m. For a single train travelling at an average speed of 85 km/h, this distance equated to about 40 seconds of travel.

Post-incident

Following the incident, the driver of train 7750 was drug and alcohol tested at Geelong at approximately 1538. Drug testing was by sampling oral fluid and returned a negative result. Testing for alcohol also returned a negative result.

V/Line subsequently requested (under its Rail Safety Worker Health Assessment processes) that the driver undertake a drug test by urine sample. This was taken at around 1000 the following morning (3 January). This testing returned a positive result for the presence of an inactive metabolite of cannabis.

⁴ Times in this detailed sequence are based on train data records and expressed as hour:minutes:seconds

⁵ Located between Little River and Werribee, on the Melbourne side of Geelong.

⁶ Visual Display Unit(s)

Context

Marshall

Marshall is located on the single line between Geelong and Warrnambool, about 80 rail-km from Melbourne. The line is part of the regional intrastate network managed by V/Line Corporation. Adjacent to Marshall Railway Station was the main line (number 1 track) and a loop (number 2 track) to facilitate trains crossing or passing. Marshall Railway Station had a single platform adjacent to the number 1 track. Except where speed restrictions applied, the line speed for this track was 115 km/h.

Safeworking and signalling

Rail traffic between Geelong and Waurn Ponds was managed under the operating rules and procedures applicable to the Track Block Safeworking System. The object of this system is to prevent trains being in the section between two adjoining locations at the same time. Interlocking prevented the train controller from being able to place a signal controlling the entrance into a single line section to the Proceed position until the section was clear.

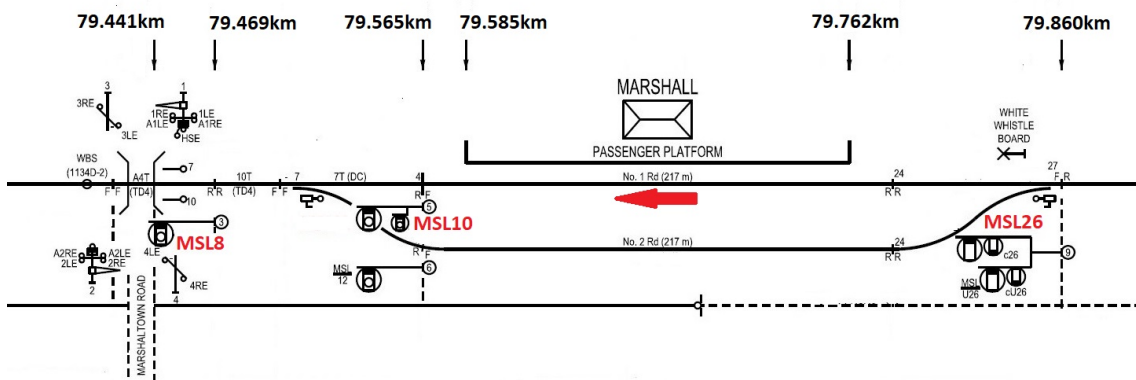
Fixed signalling through Marshall was two-position. This type of signalling is now uncommon in Victoria, having mostly been replaced with three-position signalling. Two-position signals are route signals that apply to a single route. Home signals do not provide information on the aspect of the next signal, nor specific guidance for the driver on the speed to the next signal. The driver of train 7750 indicated that he was familiar with the signalling system through Marshall.

Marshall had a signal sequence that comprised a Distant signal followed by a series of Home signals. For Geelong-bound trains, the signal sequence through Marshall was:

- MSL22 (Distant signal)
- MSL24 (Home signal)
- MSL26 (Home signal) that included separate signal heads for the mainline and the loop tracks
- MSL10 (Home Signal) and MSL12 (Home signal on the loop track)
- MSL8 (Home signal).

MSL26 was located before Marshall Railway Station, and MSL10 and MSL8 following the station and before Marshalltown Road level crossing (Figure 3).

Figure 3: Extract of signalling diagram at Marshall Railway Station



The diagram is based on the signalling diagram covering Marshall Railway Station. Key features are retained to show the location of signals MSL26, MSL 10 and MSL8 in relation to the station platform and Marshalltown Road level crossing. Source: PTV DMS, amended and annotated by Chief Investigator, Transport Safety (Vic)

The aspect displayed on Distant signals at each end of the Marshall location was governed by the status of the Home signals through Marshall and functioned automatically. For traffic coming from Waurn Ponds, if all mainline Home signals at Marshall were Clear, MSL22 would indicate Proceed (green). However, if any of MSL24, MSL26, MSL10 or MSL8 were at Stop, MSL22 would indicate Caution (yellow). A similar signalling sequence was in place for trains travelling from South Geelong to or through Marshall.

Home signals MSL10 and MSL8 were two-position, colour-light signals that displayed either a red (Stop) or green (Proceed) aspect (Figure 4).

Figure 4: Signals MSL10 and MSL8 at Marshall, pictured displaying ‘Stop’ indications



*The picture shows signal MSL10 adjacent to the Geelong-end of Marshall Railway Station. Signal MSL8 is identified in the distance, closer to the Marshalltown Road level crossing.
Source: Chief Investigator, Transport Safety (Vic)*

Signalling control for Marshall was managed from Control⁷ in Melbourne. The control workstation provided for remote control and monitoring of the signalling system. Train controllers could observe the status of all the signalling in the area and operate points and signals. The system was fitted with a SPAD alarm for this location (that would alert the controller), but in this instance the alarm volume had been turned down.

The train controller had control of all Home signals at Marshall. Home signals were operated individually, or a through-route could be set. In the through-route scenario, signals would clear when the section ahead became available without any call on the system from the train controller. However, whenever trains were to cross, the train controller was required to select and call for the desired route and clear the signals individually.

The safe application of signalling at Marshall was reliant on drivers responding correctly to signals, and did not include any additional enforcement controls to protect against a train exceeding its authority.

⁷ V/Line train control, located in Melbourne.

Marshalltown Road level crossing activation

The Marshalltown Road level crossing was track-circuit activated. However, when signal MSL10 displayed a Stop indication, the level crossing would not be activated if a train passed the signal and occupied the track circuit on the Geelong side of the signal. This configuration was to cater for a low-speed run-around movement⁸ where a calling-on signal⁹ provided authority for a locomotive to move from one end of a train to the other without activating the Marshalltown Road level crossing. Consistent with this configuration, train 7750 did not trigger the crossing protection system until it had travelled beyond signal MSL8, approximately 28 m before the level crossing.

Signalling system playback

The status of signals and the movement of trains through the section were captured on the recording of the train controller’s VDU. The colour of each track section also provided an indication of its status as follows:

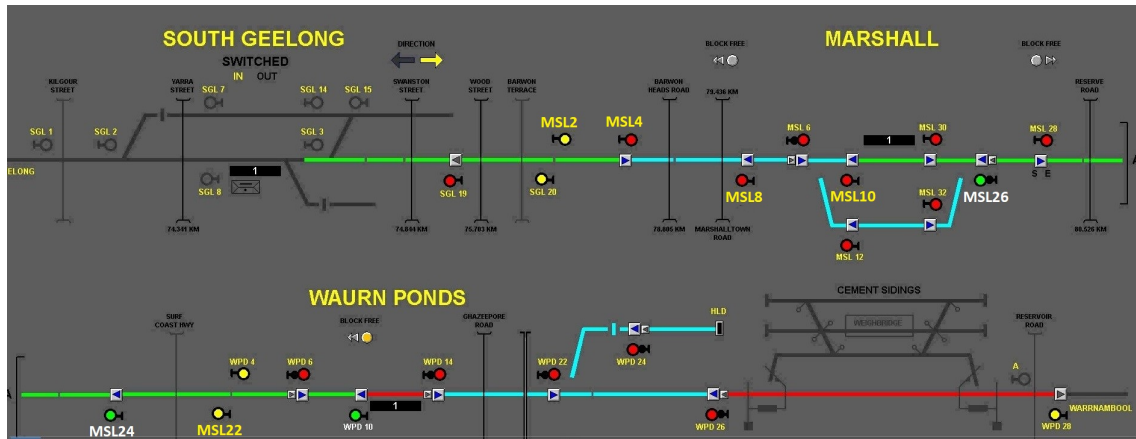
- Red indicated the presence of a train in the section
- Green indicated the track was clear and the route was set
- Blue indicated the track was clear but no route was set.

The first snapshot (Figure 5) showed the status of the network with train 7750 at the Waurn Ponds platform.

At this point, a route had been set (in green) from Waurn Ponds Railway Station to Marshall. Departure signal WPD10 was at Proceed, MSL22 at Caution (because MSL10 and MSL8 were at Stop), MSL24 and MSL26 were at Proceed, and MSL10 was at Stop to hold train 7750 at Marshall Railway Station.

Beyond MSL10, the track was clear but a route had not yet been set beyond MSL10. This route condition remained unchanged until train 7750 later occupied this single-line section of track.

Figure 5: Snapshot of VDU when train 7750 was at Waurn Ponds



A route had been set from Waurn Ponds to Marshall Railway Station. Distant signal MSL22 was at Caution (because MSL10 and MSL8 were at Stop) and signals MSL24 and MSL26 were at Proceed. Beyond MSL10, the track was clear but a route had not yet been set beyond MSL10.

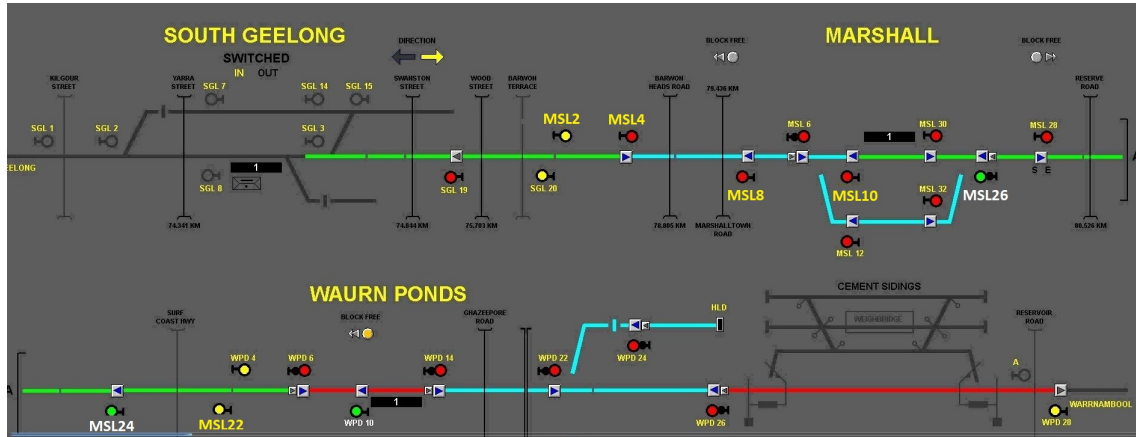
Source: V/Line, annotated by Chief Investigator, Transport Safety (Vic)

⁸ Where the locomotive is moved from one end of the train to the other.

⁹ Subsidiary signal fixed under the Home signal for the route concerned and when showing a 'Proceed' indication authorises the driver to proceed under control into a section of line which may be obstructed at any point.

The second snapshot (Figure 6) showed the status of the network as train 7750 passed WPD10. The route for train 8865 (green) was set from South Geelong through to MSL4 but the train had not yet been detected in this section. The status of signals and points at Marshall remained unchanged.

Figure 6: Snapshot of VDU after train 7750 had departed Waurn Ponds

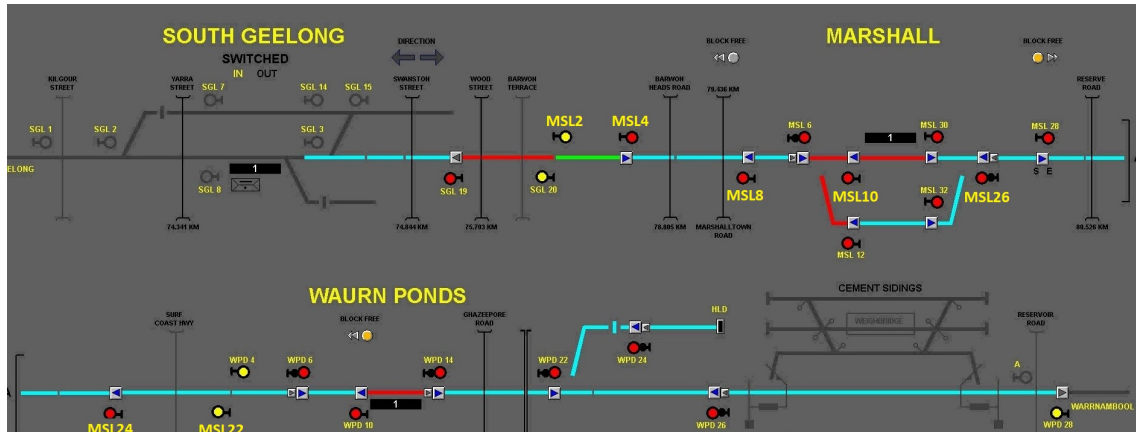


The route for train 8865 (the Melbourne to Warrnambool) was set through to MSL4 but the train had not yet been detected in the section beyond South Geelong. The status of signals and points at Marshall remained unchanged.
Source: V/Line, annotated by Chief Investigator, Transport Safety (Vic)

The third snapshot (Figure 7) showed train 7750 having passed signals MSL24 and MSL26, and these had reverted to Stop. The train was now in the track sections adjacent to the Marshall Railway Station. It had passed MSL10, but had not yet reached MSL8. The Warrnambool-bound train 8865 occupied the section up to Distant signal MSL2.

Train 8865 had a route (green) set towards Marshall, but not beyond signal MSL 4, which was at Stop.

Figure 7: Snapshot of VDU when train 7750 was passing Marshall Railway Station

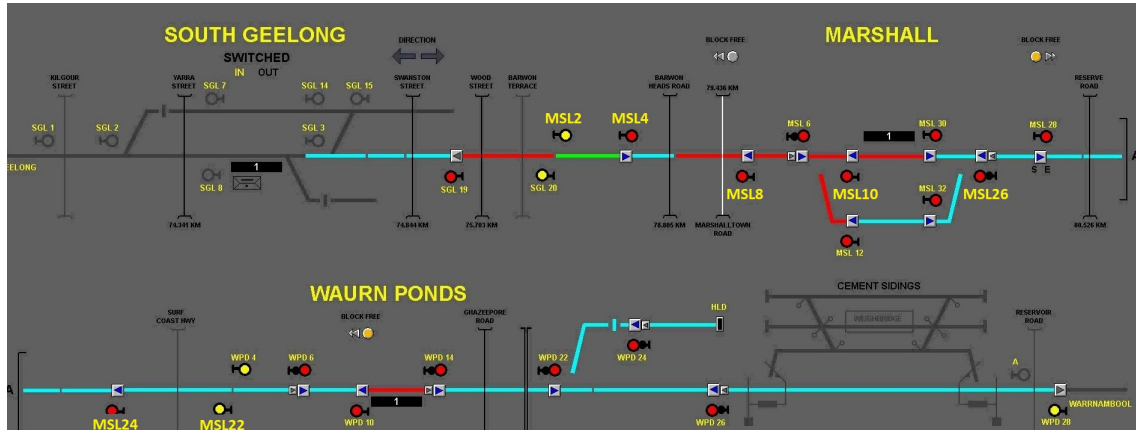


Train 7750 had passed MSL24 and MSL 26, and the train was in the track sections adjacent to the Marshall Railway Station and beyond MSL10, but not yet past MSL8. The Warrnambool-bound train 8865 was in the section up to Distant signal MSL 2, and had a route set towards Marshall, but not beyond signal MSL 4 which was at Stop.
Source: V/Line, annotated by Chief Investigator, Transport Safety (Vic)

The VDU recording showed that train 7750 travelled beyond signal MSL8 and entered the Marshalltown Road level crossing travelling on the single line towards South Geelong (Figure 8). The level crossing protection had also activated (indicated by its change on the VDU from a black line to white).

This had placed the trains in potential conflict. Once past MSL8, the next Home signal that would face train 7750 was SGL19 at South Geelong, beyond the location of train 8865.

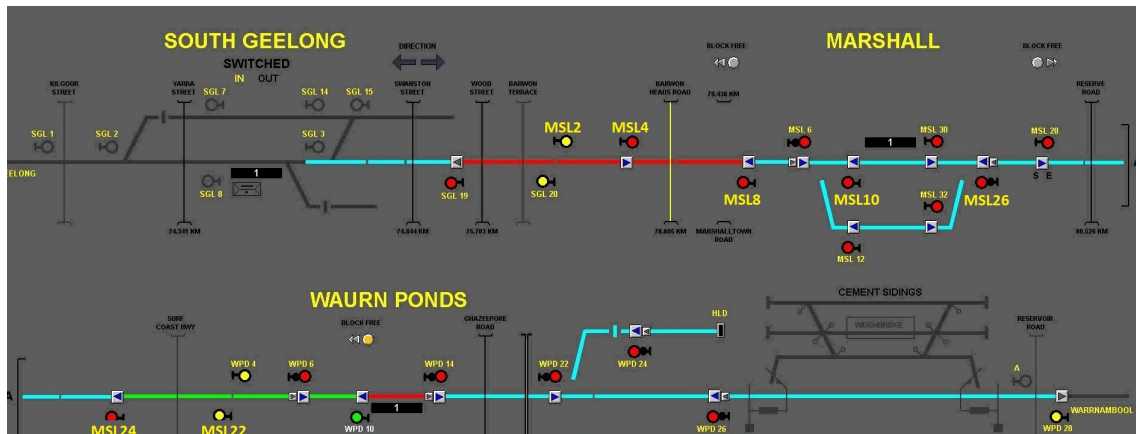
Figure 8: Snapshot of VDU when train 7750 passes MSL8 and enters the level crossing



Train 7750 was now on the single line towards South Geelong, placing the trains in conflict.
 Source: V/Line, annotated by Chief Investigator, Transport Safety (Vic)

The recording then showed that train 8865 had passed signal MSL2 and entered the section up to signal MSL4, that was at Stop (Figure 9). The trains were now in adjacent track sections. There were no further signals that could have prevented train 7750 continuing to the location of train 8865.

Figure 9: Snapshot of VDU with trains 7750 and 8865 stopped in adjacent sections



Train 8865 would be held by signal MSL4 that was at Stop. However, there was no signal ahead of train 7750 that would prevent it from continuing to the location of train 8865.
 Source: V/Line, annotated by Chief Investigator, Transport Safety (Vic)

The driver

The driver had been working with V/Line since 2005. His safeworking and route knowledge qualifications were current and he was certified as medically fit for duty. By arrangement with the rostering area, together with the mutual exchange of shifts with other drivers, he generally worked shifts commencing between 0900 and 1000. This resulted in him regularly running of services between Melbourne and Waurn Ponds.

On this day, his shift had commenced at about 1200. This shift and the previous 7 days rostering would not have contributed to a fatigue condition.

Nicotine withdrawal

The driver had been a heavy smoker. In his endeavours to stop smoking, he had been using nicotine patches for about 3 months

Tobacco smoking exposes the user to a significant number of substances. The nicotine component of tobacco is a particularly addictive compound, and it is largely this property of nicotine that leads to difficulty in ceasing smoking.^{10 11 12}

Cessation of tobacco smoking, especially if abrupt, can lead to the development of nicotine withdrawal. This is a recognised clinical entity, with clearly established criteria laid down in the World Health Organisation's International Classification of Disease. Symptoms of nicotine withdrawal usually appear quite quickly after the last tobacco intake (within 2-3 hours) and peak in 2-3 days.¹³ Tobacco withdrawal can lead to a myriad of symptoms, including task-related effects such as difficulty concentrating, memory impairment and attention difficulties. There are also other potential psychological and physiological effects.

Smoking cessation strategies usually adopt the approach of gradually reducing the nicotine intake rather than suddenly stopping. The transdermal patch is typically the first choice in terms of therapies to assist smokers to quit.¹⁴ It comes in a range of different nicotine doses, from 5 mg to 21 mg. The replacement regime depends on the usual cigarette intake of the smoker prior to quitting. For example, a smoker of more than 10 cigarettes per day might use a 21/14/7 mg regimen, that involves wearing a 21 mg patch daily for 6 weeks, then a 14 mg patch daily for 2 weeks, then a 7 mg patch daily for 2 weeks.

In this instance, the driver had maintained the use of a 21 mg patch, and had not yet commenced to taper the dosage. However, the driver reported that on the day of this incident he did not apply a nicotine patch.

¹⁰ Kessler DA, Natanblut SL, Wilkenfeld JP, Lorraine CC, Mayl SL, Bernstein IB, Thompson L: Nicotine addiction: a pediatric disease. *J Pediatr* 1997; 130:518–524.

¹¹ The Health Consequences of Smoking—Nicotine Addiction: A Report of the Surgeon General. Rockville, MD, US Department of Health and Human Services, 1988.

¹² Royal College of Physicians of London. Tobacco Advisory Group. (2000). Nicotine addiction in Britain: a report of the Tobacco Advisory Group of the Royal College of Physicians. Royal College of Physicians.

¹³ Hughes JR. Effects of abstinence from tobacco: valid symptoms and time course. *Nicotine & Tobacco Research*. 2007 Mar 1;9(3):315-27.

¹⁴ Fiore MC: Treating tobacco use and dependence: an introduction to the US Public Health Service Clinical Practice Guideline.

Use of Cannabis

The driver reported that he had been using cannabis for about 2 months to assist with sleep and nicotine withdrawal issues. Cannabis contains over 530 chemical compounds, including over 100 pharmacologically active constituents known as cannabinoids.¹⁵

The most potent and psychoactive of these is Δ 9-tetrahydrocannabinol (Δ 9-THC, or more simply THC). Cannabinoids act on a specific class of cell receptor, which are widely distributed in the brain. They tend to be particularly located in brain regions associated with cognitive processes, memory, pain perception and psychomotor coordination.¹⁶

THC is broken down into an inactive metabolite, 11-nor-9- tetrahydrocannabinol- Δ 9-carboxylic acid (THC-COOH). This substance is the principal secondary metabolite of THC and is excreted from the body over a period of days to weeks.¹⁷ THC-COOH is the metabolite targeted in blood or urine testing for cannabis use.

A single dose of THC may take up to 30 days to be fully eliminated from the body. THC may be found in the urine for at least 48 to 72 hours after oral administration.¹⁸ With repeated use, however, cannabinoids can accumulate in high levels in the body. Such chronic, long term use leads to accumulation of THC and THC-COOH in fatty tissue, with continued excretion into the urine for as long as 30 to 60 days from the time chronic use is halted.

The effects of cannabis on cognitive function and psychomotor performance are documented in literature. Studies have shown that acute cannabis use impairs cognitive functions such as attention and learning,¹⁹ increases reaction time and causes difficulty in concentration.^{20 21} Cannabis can also adversely affect human performance of complex cognitive tasks for up to 24 hours, with the extent of effects post-exposure depending on the task complexity.^{22 23} One consistent finding with cannabis exposure is the adverse effect on memory. Cannabis-induced disruption of normal memory functions, particularly short-term memory, have been described.^{24 25 26 27}

Driver toxicology

The toxicology assessment for this driver used a urine sample collected from the driver at around 1000 on 3 January. Analysis performed on 4 January 2018 revealed the presence of THC-COOH in the urine. THC-COOH is the inactive secondary metabolite of THC and there is no specific biological effect of THC-COOH. Whereas the inactive THC-COOH can be detected in urine for

¹⁵ Mehmedic Z, Chandra S, Slade D, Denham H, Foster S, Patel AS, Ross SA, Khan IA, ElSohly MA. Potency trends of Δ 9-THC and other cannabinoids in confiscated cannabis preparations from 1993 to 2008. *Journal of forensic sciences*. 2010 Sep 1;55(5):1209-17.

¹⁶ Hall W, Solowij N. Adverse effects of cannabis. *Lancet* 1998; 352:1611-6.

¹⁷ O'Kane CJ, Tutt D, Bauer L. Cannabis and driving: a new perspective. *Emerg Med* 2002; 14:296- 303.

¹⁸ Yesavage JA, Leirer VO, Denari M, Hollister LE. Carry-over effects of marihuana intoxication on aircraft pilot performance: a preliminary report. *Am J Psychiatry* 1985; 142:1325-9.

¹⁹ Beautrais AL, Marks DF. A test of state dependency effects in marihuana intoxication for the learning of psychomotor tasks. *Psychopharmacologia* 1976; 46:37-40.

²⁰ Heishman SJ, Huestis MA, Henningfield JE, Cone EJ. Acute and residual effects of marijuana: profiles of plasma THC levels, physiological, subjective, and performance measures. *Pharmacol Biochem Behav* 1990; 37:561-5.

²¹ Macavoy MG, Marks DF. Divided attention performance of cannabis users and non-users following cannabis and alcohol. *Psychopharmacologia* 1975; 44:147-52.

²² Heishman, Huestis, Henningfield, Cone, *op. cit.*

²³ Yesavage, Leirer, Denar, Hollister., *op. cit.*

²⁴ Abel EL. Marijuana and memory: acquisition or retrieval? *Science* 1971; 173:1038-40.

²⁵ Darley CF, Tinklenberg JR, Roth WT, Atkinson RC. The nature of storage deficits and state- dependent retrieval under marihuana. *Psychopharmacologia* 1974; 37:139-49.

²⁶ Heishman SJ, Arasteh K, Stitzer ML. Comparative effects of alcohol and marijuana on mood, memory, and performance. *Pharmacol Biochem Behav* 1997; 58:93-101.

²⁷ Tinklenberg JR, Melges FT, Hollister LE, Gillespie HK. Marihuana and immediate memory. *Nature* 1970; 226:1171-2.

more than 7 days after a single use, and longer for habitual use, urinary THC values have been shown to peak about two hours post cannabis use, and then decline to be unrecordable within 6 hours.²⁸ There was no level of THC (the active metabolite) recorded or reported in the toxicology assessment.

The presence of THC-COOH in urine at concentrations greater than 15 ng/mL is a strong indicator that the individual has used cannabis. If the urinary THC-COOH level is greater than 100 ng/mL, this indicates relatively recent use, probably within the previous 7 days. Levels greater than 500 ng/mL suggest chronic and recent use. The recorded level in the driver involved in this particular incident was 120 µg/L (equivalent to 120 ng/mL). This measured level was over 100 ng/mL and therefore suggests use of cannabis probably within the previous 7 days.

Methods for detecting cannabis use

Drug testing is generally effective at determining the presence of a drug or its metabolite. A drug test will have a minimum threshold ('cut-off' value) above which the test result will be considered positive, and below which it will be considered negative. A drug test may also be negative despite recent or ongoing drug use if the window of detection has passed or there has been adulteration of the specimen.

Oral fluid testing

Oral fluid testing for cannabis targets the active metabolite Delta-9-tetrahydrocannabinol (THC). This is the most potent and psychoactive of the metabolites of cannabis.²⁹ The consumption of cannabis via smoking leads to the oral tissues being exposed to high concentrations of THC. The THC is then released and is detectable in the saliva during the next several hours following use, and this process can last up to 24 hours.³⁰

Oral fluid testing represents relatively new technology, being introduced in several countries in the last 10-20 years.^{31 32} In general, it is used for detecting the presence of certain drugs in settings such as the workplace or road traffic enforcement. The accuracy and reliability of these tests has also been improving over the years.³³

Urine testing

Typically, urine is tested for THC-COOH, an inactive metabolite of cannabis. This metabolite can be detected in urine for more than 30 days after cannabis use, and so this test is effective at detecting prior use of cannabis. However, a positive result for this metabolite does not provide information about impairment at the time of testing. A more extensive test panel including testing

²⁸ Manno JE, Manno BR, Kemp PM, Alford DD, Abukhalaf IK, McWilliams ME, Hagaman FN, Fitzgerald MJ. Temporal indication of marijuana use can be estimated from plasma and urine concentrations of Δ 9-tetrahydrocannabinol, 11-hydroxy- Δ 9-tetrahydrocannabinol, and 11-nor- Δ 9-tetrahydrocannabinol-9-carboxylic acid. *Journal of analytical toxicology*. 2001 Oct 1;25(7):538-49.

²⁹ Huestis MA. Human cannabinoid pharmacokinetics. *Chemistry & Biodiversity* 2007 Aug;4(8):1770-804.

³⁰ Niedbala RS, Kardos KW, Fritch DF, Kardos S, Fries T, Waga J, Robb J, Cone EJ. Detection of marijuana use by oral fluid and urine analysis following single-dose administration of smoked and oral marijuana. *Journal of Analytical Toxicology* 2001 Jul 1;25(5):289-303.

³¹ Steinmeyer S, Ohr H, Maurer HJ, Moeller MR. Practical aspects of roadside tests for administrative traffic offences in Germany. *Forensic science international*. 2001 Sep 15;121(1-2):33-6.

³² Gallardo E, Barroso M, Queiroz JA. Current technologies and considerations for drug bioanalysis in oral fluid. *Bioanalysis*. 2009 Jun;1(3):637-67.

³³ Strano-Rossi S, Castrignanò E, Anzillotti L, Serpelloni G, Mollica R, Tagliaro F, Pascali JP, Di Stefano D, Sgalla R, Chiarotti M. Evaluation of four oral fluid devices (DDS®, Drugtest 5000®, Drugwipe 5+® and RapidSTAT®) for on-site monitoring drugged driving in comparison with UHPLC–MS/MS analysis. *Forensic science international*. 2012 Sep 10;221(1-3):70-6.

for THC and 11-hydroxy-THC as well as THC-COOH could provide a more comprehensive picture of recent cannabis use.

Urine tests have some disadvantages, including a greater potential for false samples and adulteration. Products can be used to mask the presence of certain drugs in urine samples and intentional urine dilution may reduce drug concentration below the cut-off level of the test.

V/Line systems to identify employee use of cannabis

Relevant legislation

Drug and alcohol requirements for Rail Transport Operators and Rail Safety Workers were governed by the Rail Safety National Law (RSNL)³⁴ and associated Regulations. The RSNL required that rail operators prepare and implement a Drug and Alcohol Management Program (DAMP). It also required that Rail Safety Workers not carry out, or attempt to carry out, rail safety work whilst Δ 9-THC (the active metabolite of cannabis) was present in their oral fluid or blood.

V/Line Policy and Procedures

V/Line had developed a drug and alcohol policy and implemented a drug-testing regime. The policy required that its employees not be under the influence of alcohol or illicit drugs or be impaired by any other drugs.³⁵ Further detail on the implementation of the policy was included in its management guide.³⁶

Responsibilities

The management guide specified that employees, including drivers, report to work in a fit condition without detectable levels of alcohol or other drugs, and notify their manager if their ability to undertake rail safety work might be hindered by alcohol or any other drug.

The guide also detailed responsibilities for V/Line management including supervisors of drivers. Supervisor responsibilities included ensuring persons were not hindered by the presence of alcohol or other drugs whilst reporting for or being on duty. It also included a requirement to ensure the provision of information to employees about the problems arising from the consumption or use of alcohol, tobacco and other drugs.

Testing Program

Assurance of employee compliance with its alcohol and drug management policy included random³⁷ and post-incident drug testing. Testing was conducted by an independent agency. Employees working only in Victoria were tested using sampling of oral fluid.³⁸ This method included testing for the presence of cannabis metabolites in oral fluid. The program required testing of a minimum of 30 per cent of workers per annum, of which at least 25 per cent were required to be Rail Safety Workers (RSW). In practice, the proportion of RSW tested was significantly higher than this requirement. Between commencement of random testing in 2015 and 1 January 2018 (prior to this incident), there was one positive result returned from the random drug testing program, and that was for THC.

The guide also made provision for 'for cause' testing. In the event that a supervisor or manager had reasonable grounds to suspect that a person may not meet the drug and alcohol criteria, that person could be required to undergo testing. For the same period from 2015 to 1 January 2018, there had been one 'for cause' test, and it had returned a positive result for cannabis use. There

³⁴ Rail Safety National Law (South Australia) Act 2012, as applied in Victoria.

³⁵ SAPO-1, Policy – Alcohol and Drugs Management, dated 26/10/2016.

³⁶ SAMG-51, Alcohol, Tobacco and other Drugs Management Guide, Revision 1, dated 17/08/2017.

³⁷ The random drug testing program commenced in August 2015

³⁸ In NSW, urine testing was used for drug testing.

was no specific training of supervisors to assist them to undertake fitness for duty assessment or to make decisions on the need to conduct 'for cause' testing.

In addition, its train drivers were classified as Category 1 Safety Critical Workers and were required to undertake medical assessment that included testing of urine for the presence of a number of prescribed drugs (including cannabis). Drivers were required to undergo Category 1 medical assessments every 5 years (up to the age of 50), every 2 years (50 – 60) and every year above age 60.

Other SPADs at or near Marshall

On 29 May 2015, a V/Line train passed signals MSL10 and MSL 8 at Stop.³⁹ Following its investigation of this incident, the ATSB reported that:

Marshall was re-established with infrastructure that catered for the relatively small number of passenger services. However, over a ten-year period, rail traffic increased significantly (16 services per week in 2005 to 160 in 2015), altering both the operating environment and the risk profile of the location. To improve the control of traffic through this location, there was scope to upgrade to three-position signalling and potentially introduce measures to mitigate against SPAD events.

In response to the May 2015 SPAD event, V/Line introduced a Temporary Speed Restriction (TSR) of 70 km/h at this location. This TSR was still in place at the time of the January 2018 SPADs.

Subsequent to the May 2015 SPAD, V/Line advised that its internal investigation had recommended a three-position signalling upgrade for the Geelong-Waurn Ponds section of track and that it was undertaking a study into the duplication of track between South Geelong and Waurn Ponds. V/Line has advised that track duplication was still under consideration.

Between January 2015 and January 2018, there were six other SPAD events between Waurn Ponds and South Geelong. Five involved signal MSL24 and one was at MSL4. All of these SPADs were attributed by V/Line to driver misjudgement. As a mitigation for the SPADs at MSL24, a 40 km/h TSR was introduced for the approach to this signal.

³⁹ ATSB, Investigation report RO-2015-009, Signals Passed at Danger by Train 1240 at Marshall near Geelong, Victoria on 29 May 2015

Safety analysis

The incident

The driver did not respond to the Stop indications of signals MSL10 and MSL8 and passed these signals without authority. His subsequent action to stop the train was either after noticing that the Marshalltown Road level crossing booms were not lowered, or possibly in a delayed recognition that signal MSL10 and/or signal MSL8 was at Stop. Had the driver not stopped the train, there were no other signalling defences to alert the driver against continuing through the section in conflict with the approaching Warrnambool-bound passenger train.

The actions of the train controller to monitor the passage of the trains and then make a radio call to stop trains were appropriate.

The driver

Nicotine withdrawal

Withdrawal from nicotine can produce a range of symptoms that can also affect human performance. The driver had been using the 21 mg patch for about 3 months. However, the driver reported that on the day of the incident he did not apply a patch. It is therefore likely that he was experiencing symptoms of nicotine withdrawal.⁴⁰

Nicotine withdrawal symptoms typically become apparent within a few hours of last nicotine exposure. Task-related effects can include difficulty concentrating, memory impairment and attention difficulties. These and other symptoms of nicotine withdrawal probably had an adverse effect on the performance of the driver.

Cannabis use

Cannabis has a range of short and long term adverse effects on human health and performance. There is considerable evidence of a residual effect of cannabis during the 12 - 24 hour period following use, which may occur after a single dose. The residual drug effects observed involve impairment of performance on tests of focused attention, visual and verbal memory, and visuospatial functions.⁴¹

Oral fluid testing (taken about 90 minutes after the event) returned a negative result for the presence of the active metabolite of cannabis (THC). Subsequent urine testing identified an inactive metabolite at a level suggesting cannabis use probably within the previous 7 days. Based on the available evidence, it was not possible to determine if the prior use of cannabis had affected the driver's performance on the day of the event.

Expectancy

Train 7750 was a non-passenger-carrying train returning to Geelong and was therefore not required to make passenger stops at any stations, including at Marshall Railway Station. It is possible that the notion of the service being 'express' established in the driver's mind an expectation that the train would have an unimpeded passage through to Geelong and that all signals would be at Proceed. It is possible that this expectancy affected the driver's observation of, or perception of, the signal indications of MSL10 and MSL8.

⁴⁰ Expert Opinion: Signals Passed at Danger by Train 7750, Marshall, Victoria 2 January 2018, Flight Medicine Systems, Dr David G. Newman 30 April 2018

⁴¹ Pope HG, Gruber AJ, Yurgelun-Todd D. The residual neuropsychological effects of cannabis: the current status of research. *Drug Alcohol Depend* 1995; 38:25-34.

Recall of Distant signal indication

When passed by train 7750, Distant signal MSL22 was at Caution, indicating that a subsequent signal within the Marshall location was at Stop. This Caution indication warns the driver to be prepared to stop at any upcoming Home signal within the Marshall group of signals, and the driver of train 7750 was familiar with its function and meaning.

However, this information was not utilised by the driver as the train approached signal MSL10. It is probable that the information indicated by Distant signal MSL22 was forgotten by the driver some time during the 4 minutes after passing MSL22. Such a lapse in short term memory would be consistent with symptoms associated with nicotine withdrawal.

Signalling information for driver

With two-position signalling, a Home signal at Stop (Red) may directly follow a Home signal at Proceed (Green), as it did in this case. Whereas, with three-position signalling, a driver is presented with signal aspects that indicate the status of the next signal. These aspects are also speed-related and in many locations have sequences that require the train speed to be reduced over several signal sections before a Stop indication is displayed. Three-position signalling would therefore have provided the driver with more information on the status of the next signal.

Drug testing

This driver

This driver had not been tested under the random drug testing program, and his use of cannabis had not been detected by V/Line prior to this event.

Comparison between oral fluid testing and urine testing

The detection window for oral fluid testing for cannabis use is much smaller than that for urine testing. The window of detection for cannabis in oral fluid testing is up to 24 hours, compared with 30 days or longer for testing of urine. The longer window for urine testing is due to the progressive metabolism of cannabinoids that are excreted in the urine over time.

The differences in detection windows and the targeted metabolite create different interpretations for a positive result for each type of test. Given the shorter detection window and the targeting of THC, a positive oral fluid test is indicative of recent use (within 24 hours).^{42 43} In contrast, a positive urine test indicates prior exposure to cannabis which could be 30 days prior or more. The prolonged detection window for urine testing is well outside the corresponding window of cannabis-induced impairment. A positive oral fluid test for cannabis, therefore, is much more likely to be correlated with cannabis-induced impairment, although there can be individual variation.⁴⁴

'For-cause' testing

V/Line drug management guidelines provided that 'for cause' testing could be conducted should a supervisor have grounds to believe that an employee did not meet the drug criteria. However, supervisors were not trained in how to identify impairment or assess whether such grounds existed.

⁴² Menkes DB, Howard RC, Spears GF, Cairns ER. Salivary THC following cannabis smoking correlates with subjective intoxication and heart rate. *Psychopharmacology*. 1991 Feb 1;103(2):277-9.

⁴³ Gross SJ, Worthy TE, Nerder L, Zimmermann EG, Soares JR, Lomax P. Detection of recent cannabis use by saliva δ -THC radioimmunoassay. *Journal of Analytical Toxicology*. 1985 Jan 1;9(1):1-5.

⁴⁴ Huestis, *op. cit.*

SPAD mitigation at Marshall

The Marshall location was not equipped with any form of authority-overrun intervention. A previous ATSB investigation⁴⁵ identified that, particularly due to increased traffic and associated risks at Marshall, ‘there was scope to introduce measures to mitigate against SPAD events’.

The Train Protection and Warning System (TPWS)⁴⁶ was installed at many locations with three-position signalling. TPWS initiates train braking to reduce the potential consequences of a SPAD event.

The train control system included an audible SPAD alarm for this location, to alert the train controller. However, in this instance, its volume had been turned down.

⁴⁵ ATSB, Investigation report RO-2015-009, *op.cit.*

⁴⁶ A train protection system developed in the UK and used on the Victorian rail network.

Findings

From the evidence available, the following findings are made with respect to the Signals Passed at Danger by Train 7750 at Marshall, Victoria on 2 January 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance.

A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The driver did not respond to signals MSL10 and MSL8 at Stop and passed the signals without authority.
- The driver did not use a nicotine patch on the day of the incident, probably leading to nicotine withdrawal and associated symptoms that affected performance.

Other factors that increased risk

- The driver had been using cannabis and this was not identified by V/Line.
- The signalling system was not equipped with any form of authority-overrun intervention
- The volume of the audible SPAD alarm at the train controller's station had been turned down.

Other findings

- V/Line did not provide training to its driver supervisors to assist them to effectively identify and take action to manage possible drug use by safety critical workers.

Safety issues and actions

Additional 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. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Following this incident, V/Line applied a 40 km/h speed restriction at this location as a temporary measure, issued a SPAD alert, and briefed drivers on risks associated with this location and empty car movements. This empty cars service also became a normal passenger run from Waurn Ponds.

V/Line completed its installation of a bespoke (two position signalling) TPWS for this location in June 2019. The system is designed to automatically apply the braking of a train that has had a SPAD. The system also has several over-speed sensors that are designed to prevent a train occupying an unprotected Marshalltown Road level crossing.

V/Line continues with planning for the provision of three-position signalling for this section as part of other infrastructure projects.

General details

Occurrence details

Date and time:	2 January 2018 – 1413 AEST	
Occurrence category:	Incident	
Primary occurrence type:	Signals Passed at Danger	
Location:	Marshall	
	Latitude: 38° 11.883' S	Longitude: 144° 21.306' E

Train 7750

Train operator:	V/Line	
Registration:	Train number 7750 – 3-car VLocity	
Type of operation:	Empty cars	
Departure:	Waurm Ponds	
Destination:	Geelong	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	None	

Train 8865

Train operator:	V/Line	
Registration:	Train number 8865, N427 locomotive and SN3 carriage set	
Type of operation:	Passenger	
Departure:	Southern Cross	
Destination:	Warrnambool	
Persons on board:	Crew – 2	Passengers – 166
Injuries:	Crew – 0	Passengers – 0
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- The driver of train 7750
- V/Line
- Medvet testing contractor.

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Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act 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 Directly-Involved Parties. Submissions were received from V/Line and the Office of the National Rail Safety Regulator. These submissions were reviewed and where considered appropriate, the text of the draft report amended.

Australian Transport Safety Bureau

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

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

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

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

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

Developing safety action

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

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

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

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

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

- (a) the occurrence would probably not have occurred; or
- (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or
- (c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Investigation

ATSB Transport Safety Report Rail Occurrence Investigation

Signals Passed at Danger by train 7750,
Marshall, Victoria on 2 January 2018

RO-2018-001

Final – 15 January 2020

Australian Transport Safety Bureau

Enquiries 1800 020 616

Notifications 1800 011 034

REPCON 1800 020 505

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