



Office of  
Transport Safety  
Investigations

**BUS**

# Safety Investigation Report



**Pedestrian Fatality  
Bondi Junction, NSW**

16 December 2020

Published October 2022

# BUS SAFETY INVESTIGATION REPORT

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## **Pedestrian Fatality Bondi Junction NSW**

16 December 2020

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OTSI is empowered under the *Transport Administration Act 1988* to investigate rail, bus, and ferry accidents and incidents in accordance with the provisions of the *Passenger Transport Act 1990* and *Marine Safety Act 1998*. It also conducts rail investigations on behalf of the Australian Transport Safety Bureau under the *Transport Safety Investigation Act 2003* (Cth).

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Investigation reports strive to reflect OTSI's balanced approach to the investigation, explaining what happened and why in a fair and unbiased manner. All Directly Involved Parties (DIPs) are given the opportunity to comment on the draft investigation report.

The final investigation report will be provided to the Minister for tabling in both Houses of the NSW Parliament in accordance with section 46D of the *Passenger Transport Act 1990*. The Minister is required to table the report within seven days of receiving it.

Following tabling, the report is published on the OTSI website – [www.otsi.nsw.gov.au](http://www.otsi.nsw.gov.au) – and information on the safety lessons promoted to relevant stakeholders.

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## EXECUTIVE SUMMARY

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Shortly after the morning peak at 1009 on 16 December 2020, Transit Systems bus m/o 8159 was negotiating a left-hand turn from Grosvenor Street into Grafton Street, Bondi Junction. During the turn, the left (near) side of the bus struck a pedestrian who was crossing Grafton Street in a northerly direction with a green walk signal indication and within the designated pedestrian crossing walk lines. As a result of the incident, the pedestrian was fatally injured.

The investigation found that the bus driver did not see the pedestrian and the bus entered the pedestrian crossing area before the pedestrian was safely clear of the bus's path. The bus collided with the pedestrian twice. The investigation found several factors contributed to the incident. These factors included:

- a. The bus driver positioned the bus beyond the road stop line on approach to turning left into the pedestrian intersection and commenced the left-hand turn about 1 second prior to the intersection lights changing from red to green. These factors culminated in the bus advancing into the turning sequence prematurely. The forward movement of the bus would have placed the pedestrian within the near-side bus blind spot areas as opposed to being positioned in the direct line of sight of the bus driver as the bus approached and entered the pedestrian foot crossing walk lines.
- b. During the left-hand turn sequence, the position of the bus driver's head was largely directed on the near-side mirror and front windscreen. In the time taken for the bus to negotiate the left-hand turn into Grafton Street, the potential for the driver to detect the pedestrian via these views would have been minimal.
- c. The traffic light sequence at the intersection provided for a simultaneous green walk signal for pedestrians and a green signal for vehicle traffic ('green-on-green') to turn left. An alternate traffic signal phasing design (pedestrian protection) would have held the left-hand turning traffic signal on red for an additional 8 seconds. This delay would have increased the likelihood of the pedestrian being detected in the driver's front field of vision as the bus negotiated the left-hand turn. This feature is designed to improve pedestrian safety at higher risk traffic intersections aimed at reducing the risk of pedestrian / vehicle adverse interaction.

Recommendations made to TfNSW focused on:

- i. exploring the use of pedestrian detection technology on buses to assist drivers when transiting through busy traffic intersections, and
- ii. reviewing its signalised pedestrian crossing risk assessment model to factor in the assessment of heavy vehicle traffic to identify if additional pedestrian protection mechanisms should be installed at more intersections.

Recommendations made to Transit Systems focused on:

- iii. a review of their driver performance monitoring system to consider random discrete driver reviews at high risk operating areas covering turning at pedestrian intersections and stopping at road traffic lights, and
- iv. a review of their driver instructions covering a driver's response to critical accidents, with additional instruction to stop a bus as soon as possible in the event of a bus collision particularly in the event of a pedestrian collision at a busy intersection.

Full details of the Findings and Recommendations of this bus safety investigation are contained in Parts 3 and 4 respectively.

## PART 1 FACTUAL INFORMATION

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### Events leading up to the occurrence

- 1.1 On Wednesday 16 December 2020 a Transit Systems Bus Operator (driver) signed onto work at 0501<sup>1</sup>. The driver completed the first half of their shift without incident and then took a scheduled meal break at the Bondi Junction Interchange (BJI) between 0922 and 1004. During the first half of the shift the driver travelled through the Grosvenor/Grafton Street intersection 2 times and had completed 5 trips of the bus route 389. The second half of the driver's shift commenced from BJI to operate route 389, with the first passenger pickup location at Grafton Street scheduled to commence at 1010.
- 1.2 The driver boarded bus m/o 8159 from the bus bay within the Southern Portal of BJI at 1004:28 and started the bus. There were no passengers on board the bus at that time. At 1007:48 the driver activated the speaker function on their phone with a person's voice being audible talking in a continuous manner.<sup>2</sup> The driver then placed their mobile phone within their left front shorts pocket and proceeded to the driver's seat within the driver's cabin area. The audio of the person talking is captured on the bus CCTV from the time the driver placed the mobile phone in their pocket until after the bus collided with the pedestrian.
- 1.3 Commencing at 1008:11 the driver adjusted the driver's seat, latched the seatbelt, turned their head to the left (near-side) and right (off-side) in the direction of both side mirrors.<sup>3</sup>
- 1.4 At 1008:21 the driver released the park brake, turned their head left, then right, in the direction of both side mirrors, and at 1008:24 the bus began moving to exit the BJI off Grosvenor Street (Figure 1). The bus at that time was running on schedule to commence its first pickup of passengers at Grafton Street.
- 1.5 At 1008:40 the driver closed their eyes briefly, shook their head and removed one hand from the steering wheel in a waving gesture as the mobile phone

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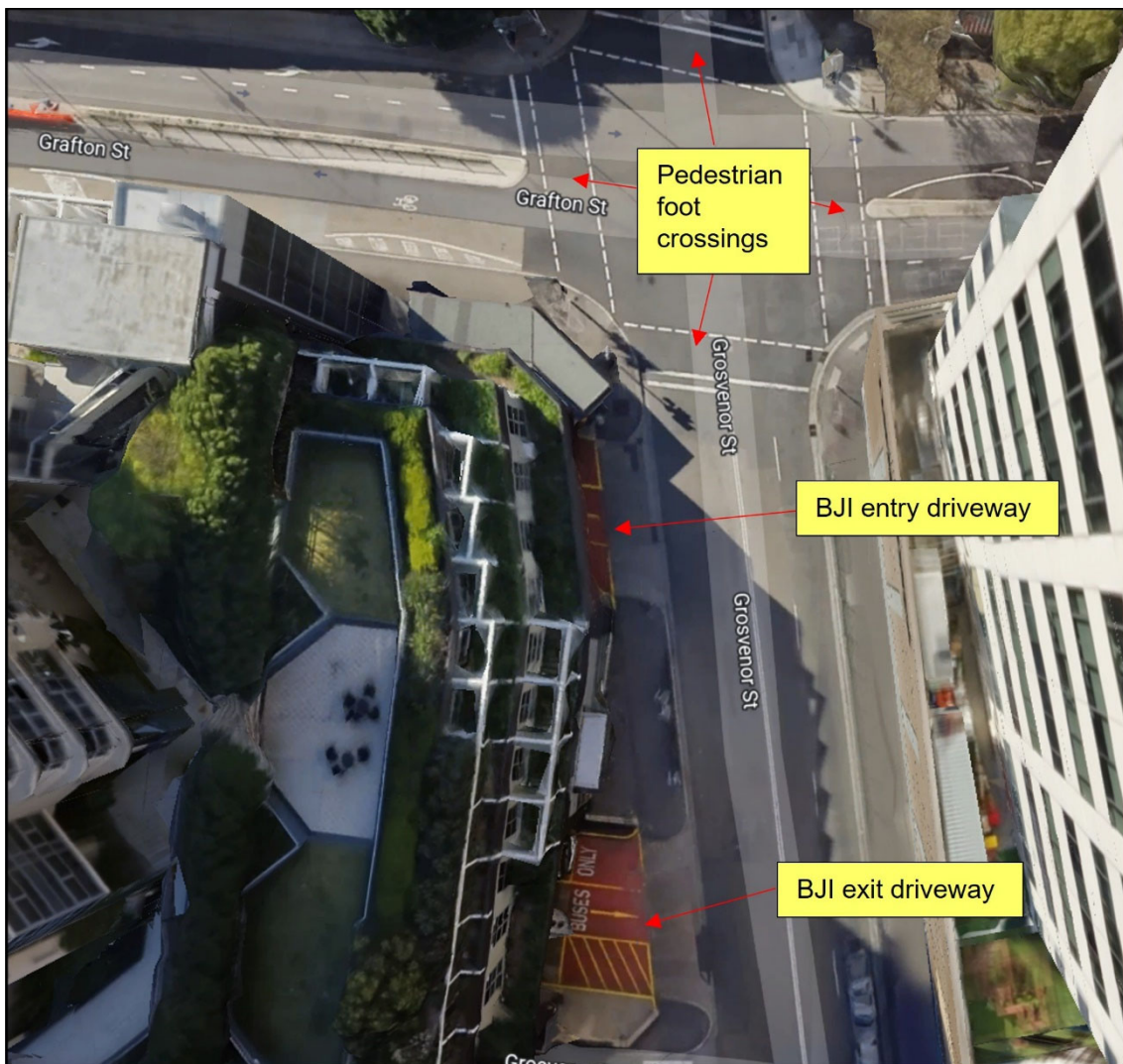
<sup>1</sup> The 24-hour clock is used in this report. Local time was Australian Eastern Daylight Time.

<sup>2</sup> CCTV onboard bus m/o 8159 captured both visual and audio.

<sup>3</sup> The left side when looking forward in the bus is the near-side. The right side is the off-side.

audio of a person talking is played. Shortly after the driver placed their left hand back on the wheel and continued to the BJI exit.

- 1.6 At 1008:58 the driver turned their head right in a southerly direction up Grosvenor Street. It is likely at this point the driver observed another bus travelling north on Grosvenor Street towards the Grosvenor Street BJI. At 1009:01 the driver executed a left-hand turn to exit the BJI onto Grosvenor Street. At 1009:04 the Grosvenor Street traffic lights were at stop (red). At 1009:06 a bus is captured in the off-side CCTV with that bus being behind m/o 8159 in Grosvenor Street. Shortly after, the driver turned their head in the direction of the near-side mirror.



Source: Google Earth: Image annotated by OTSI

**Figure 1: BJI exit and entry locations off Grosvenor Street**

- 1.7 At 1009:12 the bus trailing m/o 8159 began to turn into the BJI off Grosvenor Street as captured on the near-side CCTV of bus m/o 8159. At this point the driver's head turned towards the near-side mirror with the bus slowing and moving past the first solid stop line at the Grosvenor Street/Grafton Street intersection.
- 1.8 At 1009:14 the driver turned their head left towards the near-side mirror. At this point the bus trailing m/o 8159 negotiated the left-hand turn into the BJI entry lanes.
- 1.9 At 1009:17 the driver brought m/o 8159 to a complete stop with the park brake being applied. The driver's head was turned in the direction of the near-side mirror at this time with the bus trailing m/o 8159 having passed over the BJI driveway entry (Figure 2).
- 1.10 At 1009:20 the driver then turned their head from the direction of the near-side mirror towards the ETS (Electronic Ticketing System) console located adjacent to the near-side of the steering wheel. In the stationary position the front of m/o 8159 is approximated to be 3.0 m beyond the Grosvenor Street stop line at the intersection (Figure 3).<sup>4</sup>

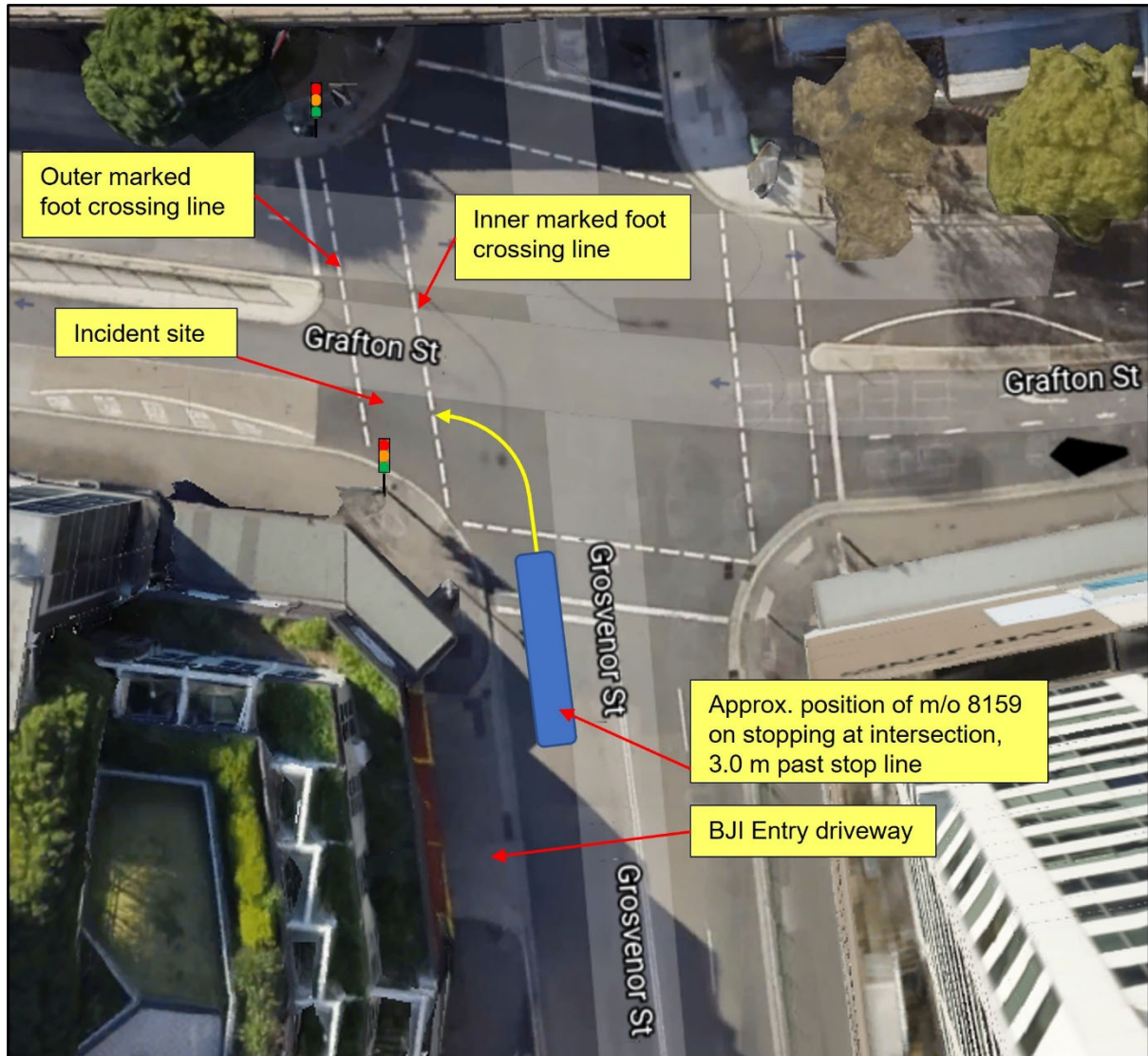


Source: Transit Systems: Image annotated by OTSI

**Figure 2: CCTV view of bus trailing m/o 8159 into the Grosvenor Street BJI entry (1009:17)**

<sup>4</sup> Distance calculated from reviewing incident CCTV and static post incident CCTV with measurements taken from the front of m/o 8159 to the front wheel centreline and applying applicable scaling to the stop line.





Source: Google maps: Image annotated by OTSI – size of bus approx. at 12.5 m

Figure 3: Grosvenor Street and Grafton Street incident location

## The occurrence

- 1.11 At 1009:39 the driver turned their head left towards the near-side mirror with the park brake released at 1009:41. The driver then turned their head right towards the off-side mirror. At this point, the bus began to move forward, the driver started turning the steering wheel anticlockwise to turn left and the Grosvenor Street traffic light was still at stop (red) (1009:42). One second later the Grosvenor Street traffic light turned green with the driver facing forward.
- 1.12 At 1009:44 the driver continued to turn the steering wheel anticlockwise and turned their head toward the near-side mirror (Figure 6). At this point the bus passed the inner pedestrian cross walk (PCW) line of Grosvenor Street as the driver moved their head down in the direction towards the near-side of the front

windscreen (Figure 6). The bus then moved slowly in a left-hand turn, and at 1009:46, the driver's head lifted toward the near-side mirror and a second later turned forward toward the front windscreen.

- 1.13 At 1009:48 the pedestrian is first identified via the bus CCTV positioned approximately 2 m from the Grafton Street kerb within the marked PCW lines and approximately 0.5 m to the right of the outer Grafton Street cross PCW line (Figure 3). At this point the driver's head was facing forward, as the front of the bus crossed over the inner Grafton Street PCW line. Shortly after the driver turned their head slightly towards the front windscreen near-side and then towards the near-side mirror. Within the same second the driver then turned their head back toward the front windscreen near-side. At that time the pedestrian is located adjacent to the centre of the glass near-side door leaf one (Figure 6).
- 1.14 As the bus continued to negotiate the left-hand turn the driver then turned their head to the near-side with the pedestrian advancing toward the bus. The pedestrian at this point was close to the front near-side door leaf weather seal join (the middle of the two front entry doors Figure 6). At this time there was no visual or audible indication observed from the pedestrian or the driver that a collision was about to occur.
- 1.15 At 1009:49 the bus made contact with the pedestrian just forward of the near-side front wheel at the glass near-side door leaf two. The pedestrian at this point was facing in a forward direction consistent with a forward walking movement across the pedestrian crossing. The pedestrian was also identified with a mobile device held in their left hand with a corded earphone set connected, and two earpieces extending to their ears. Shortly after impact the driver turned their head left and then down to the near-side. A noise was also made consistent with the bus contacting the pedestrian. The driver then physically reacted by slightly raising their shoulders. Immediately after the impact the driver turned the steering wheel anticlockwise at an increased speed towards the kerb.
- 1.16 At 1009:50 the pedestrian fell to the road away from the front near-side wheel, with the driver faced forward towards the near-side and then down continuing to steer the bus towards the kerb. Shortly after the pedestrian is no longer

visible from CCTV and is presumed positioned under the bus. At 1009:57 the pedestrian is run over by the rear bus wheels.

- 1.17 At 1009:59 CCTV indicated the pedestrian was located adjacent to the near-side rear of the bus on the road.

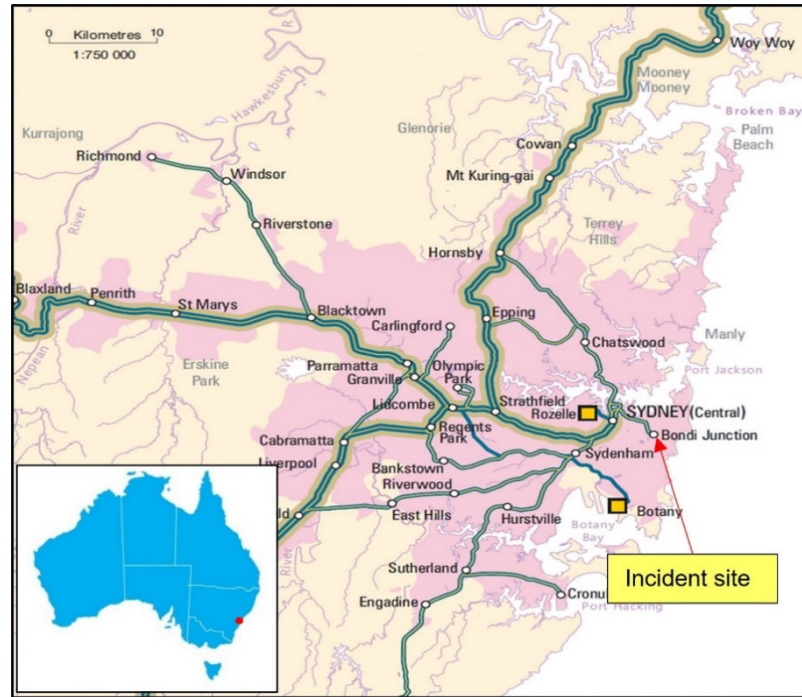
## **Events following the occurrence**

- 1.18 At 1010 the bus came to a complete stop and the driver applied the park brake. The driver then exited the bus and proceeded to its rear.
- 1.19 On reaching that position the driver identified the pedestrian and called 000. The pedestrian was initially treated at the scene by a bystander.
- 1.20 Emergency services attended the scene shortly after the incident.
- 1.21 At 1030 a Transit Systems On Road Coordinator attended the incident site and checked on the welfare of the driver. The On Road Coordinator tested the driver for alcohol at the incident site and they returned a negative result.

## **Incident location**

- 1.22 The incident occurred on Grafton Street at Bondi Junction NSW, in proximity to the intersection of Grosvenor Street and Grafton Street, Bondi Junction and the BJI (Figure 1, Figure 3 and Figure 4). The Grosvenor Street and Grafton Street pedestrian crossing was configured with a continuous stop line and two pedestrian crossing walk lines across each of the four pedestrian foot crossings as depicted in Figure 1 and Figure 3.
- 1.23 The road and pedestrian traffic light configuration at the intersection provided a green walk indication at the same time as a green light indication for road motor vehicles on Grosvenor Street.





Source: Geoscience Australia: OTSI annotation

Figure 4: Incident location

## Environmental conditions

- 1.24 The morning of 16 December 2020 was dry and overcast. The road surface appeared damp being consistent with having had rainfall earlier that morning. There was no visible water on the road surface at the time of the incident. It was determined that environmental conditions did not contribute to the incident.

## Bus information

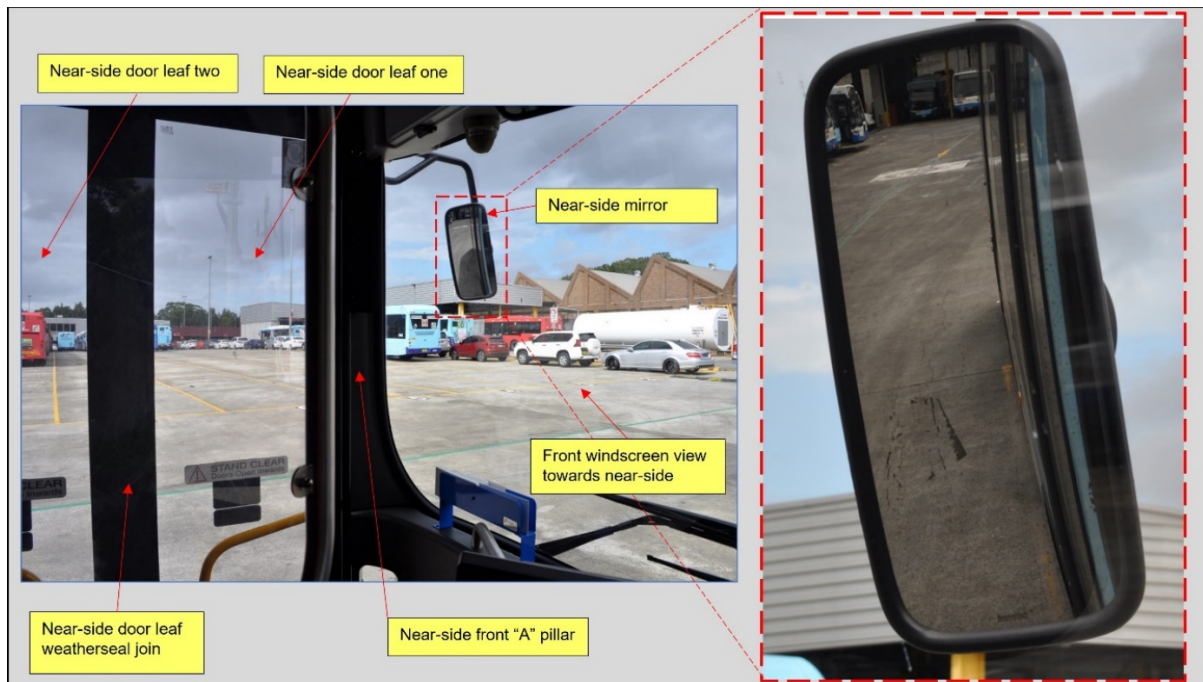
- 1.25 The bus involved was a diesel fuelled Volgren bodied 0500LE Mercedes bus. The body was manufactured by Volgren Australia Pty Ltd in July 2020 and was registered in NSW as m/o 8159 (Figure 5). The bus was 12.5 m in length, 2.5 m in width, twin axle and permitted to carry 43 seated and 34 standing passengers. The involved bus was approved to operate under the Heavy Vehicle National Law and classified as a heavy vehicle.



Source: OTSI

**Figure 5: Transit Systems bus m/o 8159**

- 1.26 The bus was fitted with a CCTV system that incorporated eight cameras. Four cameras were placed in varying positions within the passenger saloon area of the bus and four were mounted externally. Two internal cameras provided some visibility of the near-side kerb through the passenger doors and recorded audio. One external camera was located above the driver's window area providing forward visibility. One near-side camera was located above the front passenger door on the cant rail and faced rearward towards the roadway alongside the bus (Figure 2).
- 1.27 All cameras were operational at the time of the incident. The footage from the cameras was stored on a hard drive contained within the control unit of the system. The CCTV footage was provided to OTSI following the incident.
- 1.28 The bus was a rigid body heavy vehicle that contained several known visual blind spots that a driver was expected to be cognisant of when manoeuvring the bus through a left-hand turn. The near-side blind spots were created by the A pillar, near-side door leaf weather seal join, and B Pillar. The driver's near-side mirror viewing area also provided sighting limitations that created a near-side blind spot forward from at least a third of the near-side front wheel arch (Figure 6 and Figure 7).



Source: OTSI with annotation

**Figure 6: View from driver's seat on m/o 8159 – front windscreen and near-side view of door leaves**



Source: OTSI with annotation

**Figure 7: Indicative driver near-side blind spots**

1.29 Following the incident, the bus was quarantined by the NSW Police Accident Investigation Unit as evidence and forensically inspected.



- 1.30 An examination of the bus undertaken post incident did not identify any defect that was considered to have impacted on the bus performance in negotiating the left-hand turn into Grafton Street. The condition of mirrors, front windscreen and front glass door leaf seals provided visibility consistent with standard requirements.

## **Driver information**

- 1.31 The following driver information has been obtained by OTSI as relevant to the incident.

## **Bus licence and employment**

- 1.32 The driver held a valid Transport for NSW (TfNSW) Bus Driver Authority, Heavy Vehicle licence and had almost 2 years of experience driving buses.
- 1.33 The driver had been employed by Transit Systems since 20 January 2019 and worked from the Leichhardt Depot for the duration of their employment.
- 1.34 Transit Systems reported the driver had no significant medical history.

## **Training and assessment**

- 1.35 The driver underwent training and assessment with Transit Systems prior to undertaking bus driver routes. The training and relevant competency assessment details for the driver include the following.

### *Bus setup and safe driving techniques*

- 1.36 Training in the required safety set up of a bus was carried out by Transit Systems where the requirement for a driver to adjust the bus mirrors was detailed to provide optimum vision. Training in safe driving techniques, cornering, traffic signals and use of mirrors was also carried out. The training and assessment were carried out during initial induction training and annually.
- 1.37 Transit Systems advised that their driver training covered left and right-hand cornering techniques with an emphasis on drivers carrying out the necessary visual scanning for hazards during the turning manoeuvre. The visual scanning included several distinct areas of focus: near-side mirror, near-side door viewing area, front windscreen, driver's off-side window and off-side mirror.

- 1.38 The Transit Systems annual training assessment identified a driver's assessment of crash avoidance competency, noting the requirement for a driver to be assessed in their ability to scan continuously to the '*front and side*'. The annual assessment also covered a driver's review of obeying '*traffic signs*' and '*traffic lights*'.
- 1.39 The driver passed initial induction training and assessment on 22 February 2019. The driver was also assessed as competent to drive electric buses on 15 January 2020.
- 1.40 Transit Systems also conducted a six-month review of the driver on 3 July 2019 which assessed them as satisfactory, meeting all company and regulatory requirements. The assessment covered predeparture checks of the driver's seat and mirror adjustments, moving off mirrors checked, blind spot checked and turning mirrors checked left and right.

#### *Emergency stopping*

- 1.41 In the event of an incident Transit System drivers were instructed to '*Stop the vehicle in a safe location, where possible*' and '*secure the bus*'. The actions of the driver to manoeuvre the bus towards the left-hand kerb immediately after the incident had taken place was consistent with the Transit Systems documented instruction.

#### *Bus routes*

- 1.42 The driver was assessed by Transit Systems as competent for route 389 on 29 January 2019. The driver was also assessed against a further 16 routes between the period from 29 January to 22 February 2019.

#### *Use of mobile phones*

- 1.43 The driver training noted that at all times drivers should pull over, stop and get out of the driver's seat if they make a call on a mobile phone. The training emphasised that use of a mobile phone whilst driving has '*significant impacts on vehicle control and safety*' with the risks associated with their use including an '*associated lack of concentration*' that '*could lead to a significant accident*' and that using or touching a mobile phone whilst driving is illegal. The mobile phone policy also precluded the use of a mobile phone using a Bluetooth speaker to play music or for any other purpose.

### **Driver incident history**

- 1.44 Prior to the incident the driver had been involved in a total of 7 accidents since their employment commenced. Of these accidents the driver was determined by their employer to have been responsible on 4 occasions. A review of these occurrences identified the driver had been involved in one near-side collision with a parked car. The operator's investigation report made no comment regarding the number of occurrences the driver had been involved in up to the incident date. The driver was noted as not having any significant disciplinary history since working with Transit Systems.

### **Driver route history**

- 1.45 The driver had operated bus services on 450 occasions between January 2019 and December 2020 over the same route (route 389) on which the incident took place.

### **Bus operator information**

- 1.46 Transit Systems has operated buses under contract to the NSW Government since 2013 for Region 3. In 2018 Transit Systems expanded its operation in NSW when awarded the Region 6 contract in central Sydney. Region 6 included route 389 on which m/o 8159 operated. At that time Transit Systems had expanded its NSW operation to 600 buses and 1200 staff. As at June 2022 Transit Systems managed 6 bus depots, operated 822 buses and employed 1878 staff in NSW.

### **NSW Road Rules**

- 1.47 NSW Road Rules required drivers of road motor vehicles to stop at pedestrian crossings, such as the one at Grosvenor Street, as close as possible behind the designated stop line. At stop lines and signalised pedestrian crossings (pelican crossings) the drivers of road motor vehicles are required to give way to pedestrians that have a green walk signal. Advancement of any road motor vehicle into Grafton Street across the Grafton Street pedestrian crossing would have required giving way to pedestrians if a green walk signal was active.

## Traffic signalling design guide

- 1.48 The design requirements for pedestrian traffic signalling are contained within the Traffic Signal Design Guide which was last updated in July 2016.<sup>5</sup> Signal traffic design is a specialised discipline taking into consideration a multitude of factors. At the time of the incident the traffic signal design for the Grosvenor/Grafton Street intersection was known as 'green-on-green'. The green-on-green traffic light sequence at the intersection provided for a simultaneous green walk signal for pedestrians and a green signal for vehicles to turn left.
- 1.49 The Traffic Signal Design Guide noted as a general principle that all traffic signals with marked foot crossings should incorporate pedestrian protection. New or reconstructed intersections designed without pedestrian protection (as green-on-green) are only permitted with special approval. Special approval has not been obtained since 2016.
- 1.50 Use of pedestrian protection in the design of a pedestrian crossing under the Guide was consistent with research for its use. That is, where pedestrians are present, use of pedestrian protection leads to increased visibility at signalled intersections which may reduce crash likelihood.<sup>6</sup>
- 1.51 The Guide at section 7.10.5 mandated that pedestrian protection was to be provided at any intersection where B-double trucks turn left or right as part of a designated B-double route. Bus route 389 was not a designated B-double route. However, the Guide does acknowledge that pedestrian protection may be provided at any intersection where it is considered that there is a risk to pedestrians due to the number of left and right turning heavy vehicles. That requirement would have applied to buses like m/o 8159 (being a heavy vehicle) and the incident intersection. This was introduced into the Guide in December 2010. The Guide was not prescriptive as to how the heavy vehicle risk to pedestrians was to be assessed.

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<sup>5</sup> Roads and Traffic Authority Traffic Signal Design Section 7 Phasing and Signal Group Display Sequence, Issue No. 1.3 14 July 2016.

<sup>6</sup> Jacobsen PL 2003, 'Safety in numbers: more walkers and bicyclists, safer walking and bicycling', *Journal of Injury Prevention*, vol. 9.

- 1.52 OTSI notes the *NSW Road Safety Strategy 2012-2021* adopted a Safe System approach to road safety.<sup>7</sup> That approach sought to develop road safety methods that were more tolerant of human errors such that road users were not penalised with a high risk of death or serious injury. The adoption of pedestrian protection at signalised intersections was consistent with the strategy.

## Related occurrences

- 1.53 A fatal crash occurred on 2 May 2012 at Beecroft Road and Hannah Street in Beecroft which resulted in a pedestrian suffering fatal injuries after a collision with a bus on a pedestrian crossing. At the time of the incident, both the pedestrian and bus driver were given the green signal to proceed with their respective manoeuvres (green-on-green operation).
- 1.54 Coronial findings of the Beecroft incident concluded.
- a. The pedestrian was not distracted prior to being struck by the bus in the middle of the street.
  - b. The pedestrian was walking across the intersection in a straight line and within the markings of the pedestrian crossing.
  - c. The pedestrian had pressed the pedestrian button and was walking with the green pedestrian walk signal.
  - d. The bus driver was completing a left turn manoeuvre on a green light, was distracted by obstacles in the road environment and did not see the pedestrian who was unfortunately in a moving blind spot.
- 1.55 The Coroner recommended that Roads and Maritime Services (RMS, now TfNSW) review and assess all two-phase intersections (with no pedestrian protection) on State roads in order to consider installing traffic signal delay phasing (i.e. pedestrian protection). This would allow pedestrians to enter the road unimpeded for a period of time while vehicle traffic is held on a red light.
- 1.56 This recommendation was adopted by TfNSW with a program of pedestrian intersection reviews and upgrades that commenced in August 2015. The program identified 560 intersections across NSW to receive an upgrade of

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<sup>7</sup> Transport for NSW (2012), op. cit.



pedestrian protection. Four intersections were identified within Bondi Junction to receive upgrades. However, the Grosvenor / Grafton Street intersection was not one of the identified pedestrian crossing intersections which received the safety upgrade. The other four identified pedestrian crossings at Bondi Junction were upgraded with pedestrian protection by October 2017. Intersection locations in the program were assessed against a collective risk measurement which considered incident data, road speed, intersection configuration, pedestrian risk, geographic location and lighting. Of the 560 intersections identified in the program two intersections remain outstanding with these due to be completed by the end of 2022.

- 1.57 Prior to the upgrade program TfNSW produced a research report in May 2015 titled *Pedestrian Protection at Signalised Intersections* (Signal Phasing). This report identified statistics on left turning vehicle pedestrian collisions between 2008-2012 as detailed in Table 1.

Crash type	Number	%
Pedestrian near-side	177	70.2%
Pedestrian off-side	56	22.2%
Other	19	7.5%

Table 1: Left turning vehicle into pedestrian crashes in NSW (2008-2012) by crash type

- 1.58 OTSI has reviewed more recent pedestrian collision data between 2010 to 2021 from the TfNSW Bus Incident Management System (BIMS) database and OTSI's incident reporting records (Figure 8). This review has identified a similar ratio of left- and right-hand pedestrian collisions with a left-hand pedestrian collision being approximately 50% more likely when compared to a right-hand collision.

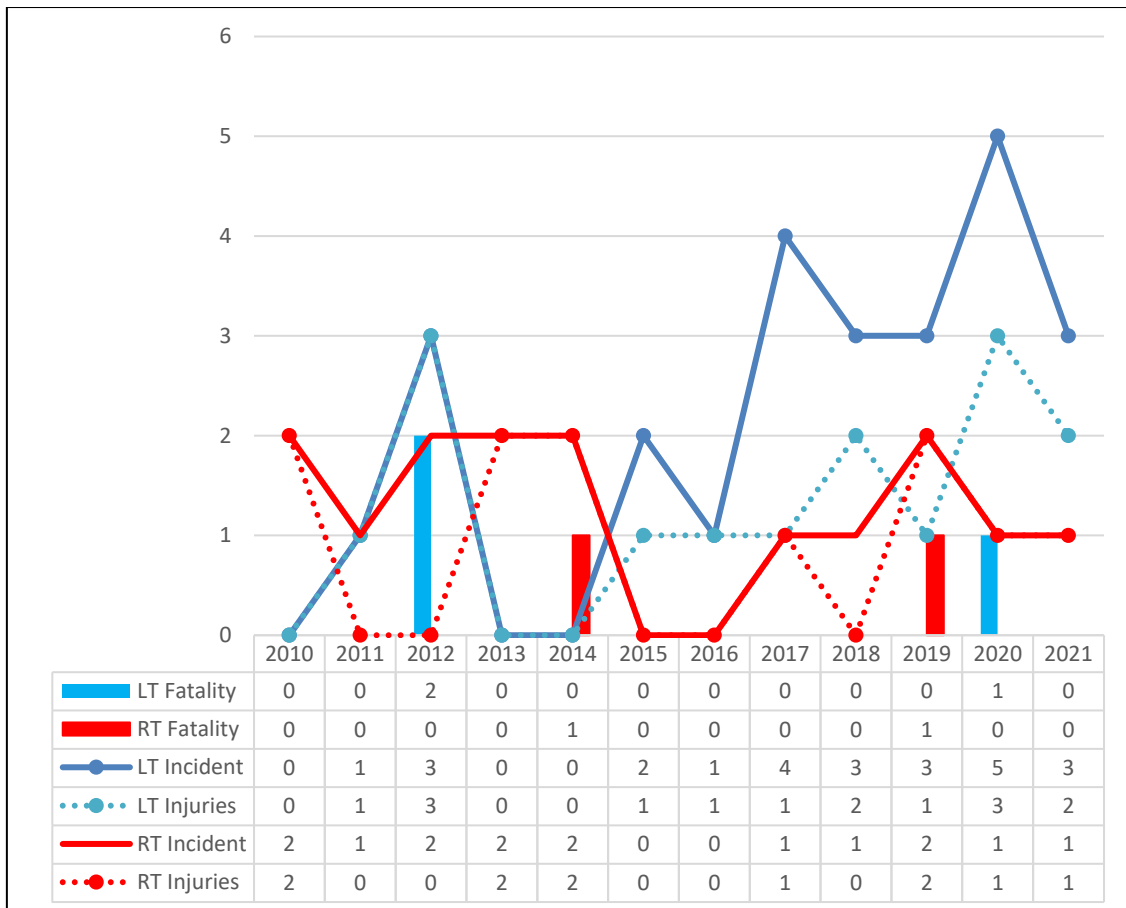


Figure 8: BIMS reported pedestrian left and right turn bus collision incidents, injuries and fatalities

1.59 Over the five-year period from 1 January 2015 to 31 December 2019 there were two reported crashes at the signalised intersection of Grafton/Grosvenor Street in Bondi Junction. Of these two crashes, one involved a pedestrian walking across the carriageway of Grosvenor Street resulting in an injury to the pedestrian.

## Bus driver performance monitoring

1.60 Transit Systems undertook a number of activities to monitor driver performance. These activities were in addition to the initial driver induction training and assessment and the annual driver assessments carried out by qualified driver assessors. The additional activities include the following:

### Mystery shopper

1.61 Transit Systems engaged people to perform a role of a 'Mystery Shopper' on approximately 100 runs per month. This role carried out an assessment of

driver presentation, driver interaction, general vehicle presentation and condition. The Mystery Shopper was not a competent heavy vehicle assessor. Mystery Shoppers also assessed a bus driver's compliance with mobile phone restrictions. Mystery Shoppers prepared trip reports for Transit Systems with bus driver safety performance forming part of those reports.

### **On Road Coordinators**

- 1.62 Transit Systems employed On Road Coordinators to; provide first response (in a vehicle) to bus incidents (collisions, assault, complaints, accidents etc), carry out drug and alcohol testing, review bus route conditions and carry out revenue protection. On Road Coordinators were not necessarily heavy vehicle assessor qualified. However, the position may have carried out some secondary bus driver performance reviews in the same way Mystery Shoppers did.

### **Customer Salesforce reporting**

- 1.63 Transit Systems received 'Salesforce' reports from passengers that provided feedback on driver performance. Driver reports received from Salesforce were reviewed by Transit Systems and followed up. The outcomes of those reviews may have resulted in driver assessment and retraining. Transit Systems reviewed corresponding CCTV as required, and if the results of such a review were inconclusive, they may have reviewed the driver performance via a discrete driver review.

### **Discrete driver reviews**

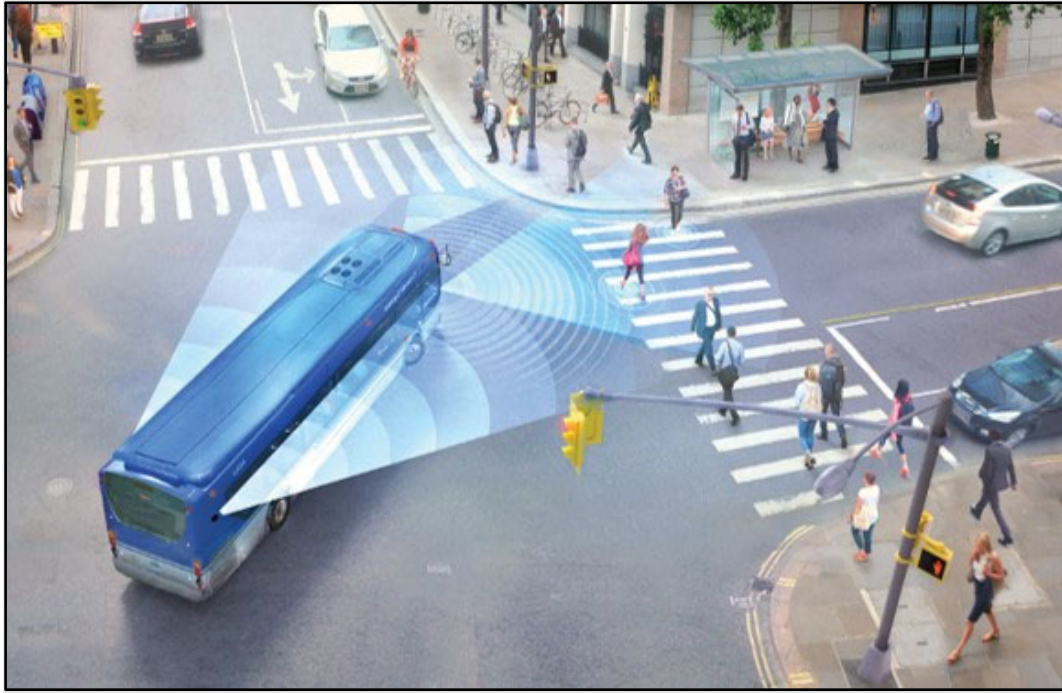
- 1.64 Transit Systems employed qualified driver assessors to carry out discrete driver reviews initiated from driver performance concerns identified in Mystery Shopper reports, incident reports or Salesforce reports. In these reviews the driver's safety performance was evaluated by a plain clothes driver assessor. The driver assessor was not known to the driver. A discrete driver review may assess any driver competency including compliance with NSW Road Rules, pedestrian awareness and safe turning techniques. The driver of bus m/o 8159 had not been subject to any discrete driver reviews.

**GreenRoad 'Drive Right' system**

- 1.65 All Transit Systems buses, including m/0 8159, were fitted with GreenRoad's Vehicle Telematics Technology at the time of the incident. This technology monitored driver performance and provided feedback to the driver on how they could improve their driving skills. The GreenRoad technology measured G-forces impacting the vehicle as it was driven. Sensors analysed separate driving events in the five categories of speed handling, cornering, direction change, braking/acceleration and lane handling.
- 1.66 The system analysed G-forces, speed data and GPS location to calculate driving event scores. Events or manoeuvres identified as yellow or red events were recorded. The system gave feedback to drivers via their mobile phone application. Transit Systems reviewed the driver's performance, but it was not used to performance manage drivers. The system was used to encourage good driver performance with some depots acknowledging good performance via an annual awards scheme. The driver's green score was provided to OTSI for the month prior to the incident. The score was noted to indicate good driver performance as measured by the five identified categories.

**Heavy vehicle blind spot monitoring systems**

- 1.67 At the time of the investigation report there was technology that could be retrofitted to buses to provide visual, audible and vibration alerts to bus drivers, in the event pedestrians were detected in defined blind spots. This technology employed sensors and detection algorithms to identify pedestrians in vulnerable locations. The technology was promoted to function at slow speeds (below 30km/h), recognise inanimate objects and pedestrians located within safe zones (e.g., footpaths). Figure 9 provides a pictorial representation of the capabilities of the technology.



Source: Blind Spot detection system

**Figure 9: Pedestrian and cyclist warning detection technology - example of system detection envelopes**

- 1.68 Transit Systems commenced trialling similar technology on a selection of its buses, with that technology providing warning for potential vehicle collisions in the forward direction only. The extension of that technology to protect against pedestrian and cyclist collisions may reduce the risk of such collisions.
- 1.69 TfNSW has reviewed available blind spot detection systems since it established a dedicated road safety technology group in 2008 (Road Safety Technology (RST) Team). In 2016 the RST Team commenced market scanning and testing new technologies that could detect cyclists and pedestrians within the sweep path of heavy vehicles making a left-hand turn. The testing at that time did not provide reliable results with detection rates being less than expected, and the number of false alarms generated from pedestrians walking on a footpath near the road being high.
- 1.70 In July 2021, the RST Team released a global request for information and technology (RFI) that could improve the safety of child pedestrians in the vicinity of school buses. The RFI included 8 submissions related to blind spot detections and were under review at the time of writing. TfNSW were aware of the prior technology limitations and the need for any new technology to be capable of reliably differentiating between pedestrians standing on the footpath

from those standing on the road. The requirement for improved detection reliability will reduce the number of false alarms and potential distraction to the bus driver.

- 1.71 In 2020-2021 TfNSW Safer Roads undertook a research program that aimed to examine the effectiveness of Fresnel lenses in enhancing road safety by minimising near-side “blind spots” on Australian heavy vehicles.<sup>8</sup> The research program also assessed driver acceptance of using Fresnel Lenses to improve their field of view. The research program identified positive results in the application of Fresnel lenses in improving heavy vehicle blind spot visibility and their acceptance of use. A Fresnel lens may provide a reduction of the near-side mirror blind spot area towards the rear of the B side pillar depicted in Figure 7 on page 9.
- 1.72 OTSI also noted that the United Nations (UN) bus regulation was developed to detail performance requirements for the design, testing, and acceptance of emerging technology in this area.<sup>9</sup> The UN reference may aid in the testing and evaluation of the developing technology’s suitability.
- 1.73 In March 2022 Transit Systems was to retrofit several buses with similar technology that could run on the same platform as the GreenRoad system they used to promote good driver performance. Transit Systems was to undertake an initial deployment evaluation of the technology by the end of October 2022.

## Fatigue

- 1.74 The driver had not worked for four consecutive days prior to the date of the incident. Transit Systems reviewed the driver’s roster and confirmed that the driver’s work hours had not breached the operator’s fatigue management standards.

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<sup>8</sup> TfNSW Fresnel lens trial research, Summary report, August 2022 ([Fresnel lens trial research - Summary report \(nsw.gov.au\)](https://www.nsw.gov.au/fresnel-lens-trial-research-summary-report))

<sup>9</sup> UN Regulation No. 159 Uniform provisions concerning the approval of motor vehicles with regard to the Moving Off Information System for the Detection of Pedestrians and Cyclists ([UN Bus Regulation R151e 2022\\_2.pdf](https://www.un.org/Depts/los/convention_agreements/texts/159/159e_2022_2.pdf))

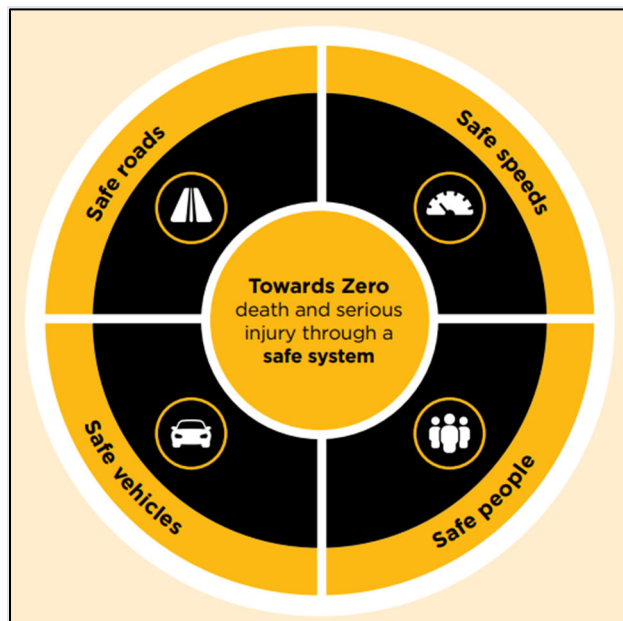
## Drug and alcohol

1.75 The bus driver was tested for drug and alcohol in the bloodstream after the accident and returned a negative result for both tests.

## NSW Road Safety Plan 2026

1.76 OTSI noted the NSW Government's Road Safety Plan 2026 included several focus areas, one being the adoption of a Safe System approach to road safety management. The Safe System approach has been recognised in prior road safety strategies and it acknowledged:

- a. The human body has physical limits to withstanding the impact of a crash.
- b. People sometimes make mistakes – but this shouldn't cost anyone their life.
- c. Roads, roadsides, travel speeds and vehicles need to be designed to help avoid a crash or reduce the impact of a crash if it happens.
- d. Road safety is a shared responsibility. We all need to make decisions with safety in mind, from the design of our roads and vehicles, investments, laws and education, to each road user acting safely every day.



Source: NSW Road Safety Plan 2026

Figure 10: NSW Road Safety Plan 2026 – holistic approach to drive safety improvement

- 1.77 In addition, the NSW Road Safety Plan 2026 identified that new technology innovations with different purposes and functions are rapidly increasing. One priority of the plan was to do more to protect vulnerable road users such as pedestrians. The development, trialling, and implementation of new technologies to protect pedestrians was consistent with the NSW Road Safety Plan 2026.



## PART 2 ANALYSIS

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### Introduction

- 2.1 The focus of OTSI's investigation into the incident was to review the safety controls designed to mitigate against the risk of a bus and pedestrian collision at pedestrian intersection crossings, considering the events of the incident.
- 2.2 The investigation focused principally on the factors that were considered to have contributed to the fatality: the driver's pedestrian awareness, driver performance in approaching and negotiating the left-hand turn, traffic light signal phasing, and pedestrian awareness.

### Operation of the bus

- 2.3 The driver reported they had received two external cues that something had occurred when the bus was about three-quarters of the way through the left turn into Grafton Street. Those external cues were at the time the pedestrian had been run over by the rear wheels of the bus. The driver recalled that they then stopped the bus immediately, activated the emergency button to the bus operator's Operations Control Centre, and secured and exited the bus.
- 2.4 The driver did not report sighting the pedestrian at any time before the collisions or indicate that they were aware that the bus had collided with a pedestrian before viewing the injured pedestrian on the road, after the incident. The driver's account of events differed from the CCTV evidence which identified that the driver physically responded to the first collision with the pedestrian in the vicinity of the near-side front door, and that the driver did not stop the bus immediately after this collision took place.
- 2.5 The driver's operation of bus m/o 8159 on the approach and execution of the left-hand turn from Grosvenor Street into Grafton Street did not occur as per the NSW Road Rules and Transit Systems bus operating standard requirements. The non-standard bus operating requirements that were considered to have increased the risk of a bus and pedestrian collision included the following:
- a. The bus driver positioned the bus beyond the road stop line at Grosvenor Street on approach to the turn left into Grafton Street (Figure 6). It was

likely the bus driver positioned the bus beyond the stop line to provide easier access for a bus, that was trailing m/o 8159 at the time, to enter the BJI. The extension of the bus approximately 3 m beyond the stop line equated to approximately 1.5 seconds in average bus travel time over that 3 m distance.

- b. The bus driver commenced the left-hand turn into Grafton Street about 1 second prior to the intersection lights changing from red to green.
- c. The times identified above resulted in the advancement of m/o 8159 some 2.5 seconds ahead of any pedestrian that commenced their crossing at the intersection as the pedestrian green walk sign activated. A pedestrian walking at an average speed of 1.2 m/s would have covered approximately 3 m in that period of time.<sup>10</sup> This additional distance would have placed the pedestrian further towards the driver's front field of vision just prior to the incident. The position of a pedestrian at that location may have increased the likelihood of the bus driver identifying the pedestrian before an incident took place.
- d. The bus driver had possession of a mobile device playing audio of a person speaking in the lead up to and at the time of the incident. This audio may have impacted on the driver's attention in the lead up to the incident.
- e. In the period the bus negotiated the left-hand turn from Grosvenor Street into the Grafton Street pedestrian crossing, the bus driver's head position appeared limited towards the direction where visual detection of the pedestrian was possible. This area being towards the bus lower near-side, through the front door leaf viewing area. The focus of a driver in that area was required in order to account for pedestrian blind spots created by the near-side A pillar, near-side door leaf weather seals and near-side B pillar. The driver's head position throughout the left-hand turn was primarily turned towards the near-side mirror and front windscreen. A driver's visual attention on the near-side mirror indicated

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<sup>10</sup> The estimated pedestrian speed is taken as 1.2 m/s being consistent with the Roads and Traffic Authority Traffic Signal Design Section 2 Warrants for pedestrian crosswalk clearance times.

the monitoring of the bus to avoid it striking the kerb and/or coming into contact with other hazards with that area of the bus as it progressed through the left-hand turn.

- 2.6 The driver's initial response at the time when bus m/o 8159 collided with the pedestrian was to continue movement of the bus towards the Grafton Street near-side kerb. This action was consistent with the instruction material provided to drivers as defined in the Transit Systems Driver Guidelines Handbook which advised for a driver to initially locate a safe place to stop.<sup>11</sup> However, had the driver applied the brakes and stopped the bus as soon as possible after the collision, it is possible the pedestrian would not have been run over by the rear wheels of the bus.

### **Bus configuration and potential pedestrian blind spots**

- 2.7 It was likely the pedestrian was positioned within two bus blind spot areas during the sequence of bus m/o 8159 as it negotiated the left-hand turn into Grafton Street. These bus driver blind spots were created as a consequence of the near-side A pillar and near-side centre door leaf weather seal as depicted in Figure 6 and Figure 7. Whilst the driver positioned their head in the forward direction at 1009:48 (refer to paragraph 1.13) and towards the near-side door in the same second, it is possible the pedestrian at those times was obscured from the driver's view as a result of the A pillar and centre door weather seal blind spots. The position of the pedestrian within the blind spots at that time in the turning sequence may account for the driver being unaware of the pedestrian's location.

### **Left and right-hand bus and pedestrian collisions**

- 2.8 OTSI's review of pedestrian and bus collision incidents involving buses turning left and right indicates an increase in left-hand turn incidents between 2010 and 2021. Right-hand turn incidents appear to have remained constant between the review period. OTSI's review of this information has not considered the intersection configuration (i.e., whether the intersection was configured with a

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<sup>11</sup> Transit Systems Driver Guidelines Handbook Version 1 May 2019 current as at 16 December 2020, Getting Help #2 accidents, collisions and incidents 23.2.

pedestrian crossing and the extent of any pedestrian protection signal phasing provided). However, the frequency and potential for injuries and fatalities arising from such incidents is noted as being high.

### Grosvenor Street stop line condition

- 2.9 The condition of the Grosvenor Street stop line, with respect to its visibility, appeared worn as at the incident date, with the condition depicted in the forward-facing CCTV from m/o 8159 (Figure 11). If the stop line and PCW line were more visible, the driver may have been provided with a clearer reference point to stop the bus on approach to the intersection.



Source: Transit Systems, OTSI annotation

**Figure 11: CCTV image of Grosvenor Street stop line as m/o 8159 approached the intersection on 16 December 2020**

- 2.10 In contrast, the Grosvenor Street stop line appeared repainted as at 3 March 2022, being clearly visible from the forward-facing CCTV of m/o 8159 (Figure 12).



Source: Transit Systems, OTSI annotation

**Figure 12: CCTV image of Grosvenor Street stop line as at the intersection on 4 March 2022**

## **Pedestrian crossing signal design**

- 2.11 The traffic light sequence in place for the left-hand turn at the time of the incident provided for a pedestrian green indication together with a green road motor vehicle indication (green-on-green). The TfNSW risk assessment system used to review signalised pedestrian traffic light configurations for NSW intersections did not identify the Grosvenor/Grafton Street intersection for upgrade. As such the green-on-green signalised traffic light upgrade program that commenced in 2015 did not include the Grosvenor/Grafton Street intersection. The TfNSW risk assessment considered incident data, road speed, intersection configuration, pedestrian risk, geographic location and lighting. The risk assessment did not factor into the assessment the heightened potential risk posed from a number of heavy vehicles (buses) turning at a busy intersection with high pedestrian traffic.
- 2.12 Post incident, the intersection traffic lights were upgraded with pedestrian protection on 21 April 2021. This protection provided a pedestrian activated red arrow for vehicles turning left into Grafton Street. The red arrow remained active

for 8 seconds with left-hand turn traffic being held for that period of time before being permitted to turn in a safe manner. That period of time provides pedestrians with a head start to move onto and across the pedestrian crossing. The effect of that lead time should place pedestrians more reliably in the forward view of road motor vehicle drivers as they negotiate the left-hand turn and hence reduce the likelihood of pedestrians being overlooked by drivers.

## **Pedestrian behaviour**

- 2.13 It is likely the pedestrian was not aware of m/o 8159 approaching and moving into the pedestrian walkway just prior to the incident. This assessment is supported by the following observations from a review of incident CCTV:
- a. The pedestrian was holding a mobile device in their left hand with a corded earphone connected to the device extending towards both of their ears.
  - b. The pedestrian's movements, just prior to and on being struck by the bus, where there was no visible reaction of the pedestrian to the presence of the bus in any way until the collision took place.
- 2.14 The pedestrian's movement onto the PCW was permitted based on the green pedestrian walk indication provided by the traffic lights at the Grafton Street intersection. Pedestrians walking within the crosswalk lines with the permission of a green light would have an expectation that their passage would be made in safety.
- 2.15 The increased use of mobile phones and earpods/headphones is common practise across society. The use and application are expected to continue to increase, and, with improved technology including noise cancellation, wireless connection and high interactive mobile phone applications, the potential risk this presents will remain. Although many distractions exist in any environment, the ongoing and increased use of mobile phones and associated peripherals is an additional risk layer impacting all pedestrians irrespective of age.

## Safety actions taken

### Transit Systems

2.16 Transit Systems had undertaken the following safety actions post incident.

- a. Updated its mobile phone policy in March 2021 to further define that only certain mobile devices are permitted for use (such as a Driver's Navigation device being the property of Transit Systems) or any other device approved by Transit Systems management. The changes to the policy also prohibited use of a mobile phone to access company safety information and use of any mobile device to access the same unless a bus is legally parked and the driver has left the driver's seat.
- b. Issued a Safety Alert to its drivers in April 2021 reminding them of the requirement to stay alert when operating in high pedestrian areas, follow the road rules and obey traffic lights, be aware of pedestrian activity around them, wait until pedestrians have completely cleared the intersection before proceeding, always be observant and look before completing a turn. The Safety Alert also referred to three pedestrian awareness attachments referenced from the Transit Systems driver's guideline handbook.
- c. Updated its online driver training materials in April 2021 to include an additional module on Pedestrian Awareness. This module included instructions for drivers:
  - i. to be aware of bus blind spots and lean forward and back if necessary to check for pedestrians
  - ii. to not assume that a pedestrian has seen a bus as the pedestrian may be distracted by their phone
  - iii. if turning left or right at an intersection, to give way to any pedestrian crossing the road the bus is about to enter.
- d. Issued a Safety Alert to its drivers in December 2021 covering requirements of bus entry into the BJI from Grosvenor Street. The Safety Alert detailed that when drivers are stopped at the intersection, they must not proceed beyond the stop line in Grosvenor Street and that any

following bus wishing to turn left into the BJI from Grosvenor Street will need to wait until the entrance portal to the Interchange is clear to safely enter. The Safety Alert also reminded drivers to be observant and aware of pedestrians around a bus in this area and to always look for pedestrians and other hazards before completing a turn.

- e. Commenced trialling the use of 360° video camera technology to increase driver visibility of pedestrians, cyclists, and other hazards in close proximity to a bus (Figure 13). Feedback from drivers who have used this form of warning device was positive with further refinements being suggested.



Source: Transit Systems

**Figure 13: Transit Systems trial 360° external camera system**



## Transport for NSW

2.17 TfNSW initiated the following safety actions post incident.

- a. Upgraded the Grosvenor/Grafton Street pedestrian crossing signalling on 21 April 2021 to include:
  - i. Pedestrian activation, where the crossing protection was only activated on the demand of a pedestrian pushing the pedestrian walk button. If the pedestrian activation was not engaged in sufficient time for the light sequencing or was not engaged at all, pedestrians were not permitted to cross the intersection with a red 'don't walk' symbol displayed.
  - ii. Pedestrian protection, provides pedestrians with an 8 second head start on left-hand turning road traffic at the intersection when the green walk signal is activated. That was achieved through addition of a red left turn arrow displayed for 5 seconds before the arrow is extinguished to permit traffic to make a left-hand turn giving way to pedestrians into Grafton Street. The upgraded left turn red arrow indication together with green walk signal is shown in Figure 14.
- b. The repainting of the stop line and PCW line at the Grosvenor Street intersection as depicted in Figure 12.



Source: OTSI

**Figure 14: Grosvenor/Grafton Street Pedestrian Crossing with red arrow pedestrian protection on activation of green walk signal fitted post incident**

- c. Identified an additional 30 plus signalled pedestrian crossings to upgrade with pedestrian protection for delivery in 2022-2023, subject to funding approval.

## PART 3 FINDINGS

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From the evidence available, the following findings are made with respect to the pedestrian fatality involving on Volgren bodied 0500LE Mercedes bus registration m/o 8159, that occurred in Grafton Street, NSW on 16 December 2020.

### Contributory factors

- 3.1 The driver initially positioned the bus approximately 3 metres beyond the road stop line at Grosvenor Street on approach to turn left into Grafton Street at the pedestrian intersection. The advancement of m/o 8159 towards the Grafton Street pedestrian crossing effectively reduced the amount of time the bus took to advance into the PCW lines, ahead of any pedestrian crossing movement that may have occurred as the pedestrian walk lights changed to green. The advancement of m/o 8159 is likely to have positioned the bus near-side blind spot areas in closer proximity of pedestrian movements within the pedestrian crossing leading up to the collision. This was likely to have reduced the bus driver's visibility of pedestrians at the time of the pedestrian crossing, thereby increasing the risk of a pedestrian and bus collision.
- 3.2 The driver commenced the left-hand turn into Grafton Street about 1 second prior to the intersection lights changing from red to green. This action further increased the advancement of m/o 8159 towards the Grafton Street pedestrian crossing ahead of any pedestrian crossing movement. The additional time advancement of m/o 8159 towards the PCW lines, in combination with the 3 m advancement of the bus, was likely to have further positioned the bus near-side blind spot areas in closer proximity to the pedestrian movements leading up to the collision. This in turn was likely to have reduced the bus driver's visibility of pedestrians at the time of the pedestrian's crossing, thereby increasing the risk of a pedestrian and bus collision.
- 3.3 The driver's head position was directed infrequently towards the area where visual detection of the pedestrian was possible throughout the left-hand turn sequence. This area being through the near-side front window and near-side window door leaves, considering the advancement of m/o 8159 towards the pedestrian crossing. Of the instances when the driver positioned their head

towards the front window near-side and near-side window door leaves, the pedestrian was likely to have been obscured from the driver by blind spots created from the A pillar and centre door leaf weather seal. Consequently, the driver was likely unaware that the pedestrian was located within the pedestrian crossing immediately prior to the bus colliding with the pedestrian.

- 3.4 The intersection traffic light and pedestrian crossing signal configuration of a simultaneous green signal, for both vehicles and pedestrians, increased the potential for compromised separation between vehicles and pedestrians. The signal configuration relied on driver and pedestrian deconfliction at the busy intersection. The BJI is located very near the intersection, and by default of operation saw a high volume of pedestrian foot traffic and heavy vehicle movement in and around the intersection, competing for the same area in space and time.

### **Other safety factors**

- 3.5 It is likely the bus driver positioned the bus beyond the stop line to provide easier access for a bus behind m/o 8159 which was at the time seeking to enter the BJI.
- 3.6 The driver had possession of a mobile device which could be heard playing some form of voice commentary during the time m/o 8159 negotiated the left-hand turn on exit from the BJI. This audio may have impacted on the driver's attention to scan for pedestrians in the lead up to the incident and was not in line with company policy for use.
- 3.7 It is likely that the pedestrian did not expect the bus to enter the pedestrian crossing area in which they were situated before they were safely clear. As such it was likely the pedestrian did not perceive a need to maintain active vigilance on traffic proximity and movement balanced with their own personal risk, which likely reduced their opportunity to react to the proximity of the bus. Notwithstanding an individual's need to maintain their own awareness of their surroundings, any pedestrian crossing on a green walk indication, within the pedestrian safety line markings at a busy intersection should have confidence the intersection is designed to provide a safe area to enter and cross the intersection.

- 3.8 The Grosvenor Street stop line appeared worn at incident occurrence with areas of the stop line erased due to vehicle traffic wear. The reduced visibility of the worn stop line may not have provided an easily recognisable reference marking for a driver to position the bus correctly at the intersection.
- 3.9 The Transit Systems driver performance review system had not carried out any discreet random monitoring of a driver conducting heavy vehicle left-hand turns and stopping at stop lines by a qualified driver assessor prior to the incident.
- 3.10 The pedestrian received fatal injuries as a result of being run over by the bus rear wheels. Had the bus been stopped as soon as possible after the initial pedestrian impact with the bus near-side, it is possible the pedestrian may not have been run over by the bus rear wheels. The Transit Systems driver procedures covering collisions advise a driver to initially locate a safe place to stop the bus. The point of collision part way through a turn within the intersection may have contributed to the decision to continue the bus to a perceived safer location immediately through the intersection in accordance with company procedures.

## PART 4 RECOMMENDATIONS

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Noting that some remedial safety action has already been implemented, it is recommended that the following additional safety actions be undertaken by the specified responsible entity.

### Transport for NSW

- 4.1 Review and amend as appropriate its current risk assessment model that assesses signalled pedestrian crossings to identify any additional crossings that may warrant an upgrade to include pedestrian protection. Such a review is recommended to consider the Grosvenor/Grafton Street pedestrian crossing configuration as a means of identifying other like intersections that may be considered for upgrade. The review should also consider assessment of whether the intersection is included in a bus heavy vehicle route and the applicable risk such a route imposes on the intersection.
- 4.2 Assess the viability of implementing bus sensors to detect and alert drivers to the presence of pedestrians in proximity to buses and within the bus blind spot areas when they are turning left or right. The assessment of bus sensor viability is recommended to include a human factor review which considers the efficacy and reliability confirmation of the technology including how this new technology could integrate into the NSW road and passenger transport model.

### Transit Systems

- 4.3 Review the driver performance monitoring system and consider expanding it to cover a level of random discrete driver performance reviews. These performance reviews could include discrete assessment of driver cornering techniques, compliance with NSW Road Rules on stopping at intersections and road traffic lights, and any other high risk driver situations considered essential. The program should consider higher risk operating areas along the prospective route and include education about and assessments at known risk intersections.
- 4.4 Review internal instruction to drivers covering collisions and incidents to consider additional instruction where appropriate on stopping a bus as soon as

possible in the event a bus collision. This should include further consideration at busy pedestrian intersections or crossing points and what may be immediate action in the event of a pedestrian collision at an intersection.

## PART 5 APPENDICES

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### Appendix 1: Sources, Submissions and Acknowledgements

#### Sources of Information

- Transit Systems Pty Ltd
- Transport for NSW
- NSW Road Rules

#### References

OTSI Incident Database

NSW Road Rules p 85 & 99

TfNSW Fatal Crash Reports

TfNSW Research Report Lead Pedestrian Intervals (LPIs)

TfNSW Fresnel lens trial research Summary report, August 2022

TfNSW BIMS database

Transit Systems Competency Assessment System and Records

Transit Systems Driver Guidelines Handbook

Transit Systems Investigation Report Grafton Street Pedestrian Fatality 12 Dec 2020

#### Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Transit Systems Pty Ltd
- Transport for NSW

Submissions were received from all the DIPs. The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.