



Public Transport  
Authority

## INVESTIGATION REPORT

### FINAL REPORT

#### Level crossing collision Transperth Train Service 5604C and Swan Transit Bus TP 1593



**File:**

PTA 5590/13

**Incident Date:**

23 October 2013



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## EXECUTIVE SUMMARY

On Wednesday, 23 October 2013 at approximately 14:40hrs, a bus operated by Swan Transit, TP 1593, was struck by a PTA operated Perth bound urban passenger train on the Armadale line at the Kelvin Road level crossing, Maddington, after failing to completely clear the designated crossing area.

Passengers on the train were immediately evacuated owing to a gas leak from the bus that resulted from the collision.

The bus was operating “out of service” meaning that there were no passengers aboard, and it was travelling towards a terminus in order to pick up the next portion of the drivers rostered shift, service 229TS, commencing at 1454 hours.

The Bus Driver sustained minor injuries and one train passenger reported minor injuries but declined treatment by ambulance officers who attended the scene.

The Railcar Driver was not injured; however he elected to take two days critical incident leave following the incident.

The train comprised of a four car “A” series set operating as part of roster C39 with this particular segment designated as train service 5604C, operating from Armadale to Perth.

The bus was a Mercedes model OC500 LE Compressed Natural Gas (CNG) powered vehicle being operated by a Swan Transit employee from their Southern River Depot, this series having been introduced at the Southern River Depot in 2006.

The bus driver was found to be negligent by Swan Transit Management in that he failed to follow clearly stated safety precautions in how to safely negotiate a level crossing and his services were terminated on the day following the collision.

Post incident corrective actions included issue of a further safety alert to contract bus service providers by the Public Transport Authority in relation to level crossings and the commencement of risk assessment processes by Swan Transit specific to level crossing activities.

The PTA has identified 3 findings and recommended 2 Safety Actions as a result of this investigation; Swan Transit has recommended 6 Safety Actions.



## GLOSSARY OF TERMS

**Automatic Train Protection:** Automatic Train Protection (ATP) is an electronic safety system fitted to the PTA's Railcar fleet and track infrastructure to ensure the observance of train speed and signal aspects. The system is in place to monitor train speeds and signal aspects and to take action in the event that the railcar exceeds allowable track speed or passes a signal without authority. The system utilises track mounted transponders which relay live information including signal aspect, track speed and track gradient to the train mounted ATP computer.

**Brake Rate:** The calculated effort required to satisfactorily retard a railcar set.

**Compressed Natural Gas (CNG):** Stored in a high-pressure containers it is used as an alternative fuel for internal combustion engines generating low hydrocarbon emissions.

**FAID (Fatigue Audit InterDyne):** Bio-mathematical model which measures shift work patterns and identifies opportunities for restorative sleep.

**IFRS:** Incident Fault Reporting System, a PTA reporting system for rail related faults and incidents.

**Up Direction (Up Main):** On the Armadale to Perth railway this is the line that leads from Armadale towards Perth.

**Wayfarer System:** An integrated on board data collection tool installed on Transperth buses.



## TERMS OF REFERENCE

### The Objective/Purpose of the investigation

The objective of the investigation was to gather evidence and undertake research to determine the causal factors that led to the collision of Transperth Train Service 5604C and Swan Transit bus TP 1593 at the Kelvin Road level crossing at Maddington, on 23 October, 2013.

### Scope of the Investigation

In accordance with Section 83 (1) of the Rail Safety Act 2010, the Office of Rail Safety requested the PTA to conduct an investigation and report on the above occurrence.

The Terms of Reference included:-

- Conducting a systemic investigation into the events surrounding the occurrence consistent with the requirements of AS 4292.7;
- Obtaining statements from the train driver and any witnesses;
- Obtaining and analysing downloads from CCTV, forward vision from the drivers cab and red light camera footage if available to create a timeline of events;
- Reconciling data downloads from signal and level crossing equipment and the train data logger to determine whether the strike in times for the flashlights and boom gates provided sufficient warning of the train's approach;
- Consulting with Main Roads and the local authority whether there is adequate interaction with the traffic lights at the Albany Highway/Kelvin Road intersection;
- Reviewing the emergency responses to the occurrence;
- Identifying the organisational influences, latent and inherent conditions, individual and team actions and absent and failed defences that contributed to the occurrence;
- Examining any human factors relating to the occurrence;
- Applying the Contributing Factors Framework to the findings from the investigation and include the outcomes as a separate appendix to the Investigation Report; and
- Identifying any safety actions to be implemented to assist in the prevention, or reduce the risk of a recurrence of a similar event from a lessons learnt perspective.



## **CONDUCT OF THE INVESTIGATION**

The investigation conducted into the events surrounding the occurrence was consistent with the principles of Australian Standard 4292 part 7 and utilised the failed and absent defence principles.

The acting Manager Investigations and Safeworking for the Public Transport Authority was the Lead Investigator assisted by the TTO Safety Coordinator (Rail) for this incident.

The methodology of the investigation included:

- Interviewed the Driver of the affected train service;
- Collected and reviewed SCADA data;
- Collected and reviewed forward facing camera data from Railcars involved in the incident;
- Collected and reviewed CCTV data from the bus TP 1593 and other buses in the vicinity at the time of the incident;
- Collected and analysed the ATP data from the Railcars involved in the incident;
- Reviewed and incorporated aspects of the Swan Transit Investigation report;
- Collected and analysed IFRS incident data;
- Collected and analysed Railcar and Bus maintenance, repair and collision damage reports; and
- Stakeholder engagement and consultation;

## **REPORTING**

The PTA has prepared a report consistent with Australian Standard 4292 part 7, Level 2, which has been approved by the PTA Incident Evaluation Committee.

The report was compiled by the Lead Investigator with input from the Safety and Quality Coordinator Transperth Regional Bus Services and Swan Transit, and outlines the investigation and analysis, the findings and conclusions, and the agreed safety actions that arose from the investigation.



## 1. FACTUAL INFORMATION

### 1.1. The Incident

On Wednesday, 23 October 2013 at approximately 14:40hrs, a bus operated by Swan Transit, TP 1593, was struck by a PTA operated Perth bound train on the Armadale line at the Kelvin Road level crossing, Maddington.

The train was comprised of a four car "A" series set operating as part of the Railcar Driver's roster, C39, with this particular segment designated as train service 5604C, from Armadale to Perth.

The service departed Armadale on time and was on time when the collision occurred; the journey from Armadale to Maddington being uneventful prior to the collision.

Review of the Automatic Train Protection download indicates that the train was being driven within acceptable parameters in terms of speed and braking patterns prior to the collision.

The bus was a Mercedes model OC 500 LE powered by Compressed Natural Gas (CNG) being operated by an employee of Swan Transit from the Southern River Depot and was "out of service" meaning that there were no passengers aboard, and it was travelling between termini to pick up the next portion of the drivers rostered shift, service 229TS, commencing at 1454 hours.

The out of service running saw the bus executing a left hand turn from The Crescent into Kelvin Road at the level crossing. Road vehicles effecting this turn are immediately into the cross hatched area of the level crossing. There is good visibility of Kelvin Road in both directions for vehicles stopped at the stop sign at The Crescent.

CCTV footage identified that the bus was stationary at the stop sign on the corner of The Crescent prior to entering Kelvin Road, from 14:37 hours until 14:38 hours, giving way to both road and rail traffic. When the opportunity presented, the Bus Driver moved the bus into the crossing but was prevented from completely clearing the crossing by the vehicles in the lane ahead of the bus.

The Bus Driver was able to make three short forward movements as the vehicles ahead of the bus moved forward, however these actions were not enough to allow the bus to clear the crossing to prevent the collision from occurring.



## 1.2. Background Leading Up to the Incident

### Bus Driver

The Bus Driver was rostered from 06:05 to 09:32hrs, 1 hour 54 minute meal break, then 11:26 to 16:17hrs, representing a total daily working time of 8 hours and 18 minutes out of a total shift spread of 10 hours and 12 minutes, the same shift that he worked on the previous two days, Monday 21<sup>st</sup> and Tuesday 22<sup>nd</sup> October.

The trip prior to the accident identified as 850F is scheduled to depart at 13:45hrs from Murdoch University and due to arrive at Maddington Station (Kelvin Road) at 14:32hrs.

The Wayfarer system shows that on Monday, 21 October, the driver departed Murdoch on time and arrived at Maddington four minutes early at 14:28hrs, then arrived at Maddington Metro to commence 229TS (scheduled to depart at 14:54hrs) at 14:34hrs, which is 20 minutes prior to the timetabled departure time.

On Tuesday, 22 October, the driver departed Murdoch on time and arrived at Maddington Station on time, and arrived at Maddington Metro at 14:40hrs, 14 minutes prior to his scheduled departure time.

On Wednesday 23 October the day of the accident, the driver departed Murdoch on time at 13:35hrs and arrived at Maddington Station at 14:33hrs, one minute late.

Despite the late arrival there was adequate time for the driver to have the bus at Maddington Metro Centre to commence the next run at 14:54 hours. There are two known out of service routes taken by drivers from the Maddington station to Maddington Metro;

1. Continue along Kelvin Rd until the roundabout at Maddington Rd, execute a U-Turn and travel back along Kelvin Rd, across Albany Hwy into Olga Rd, right into Attfield St, execute a U-Turn at the roundabout back to the terminus, a distance of 3.06 km with a calculated driving time of 5 minutes; or
2. Continue along Kelvin Rd, right into Weston St, right into Clifton St, right into The Crescent, left into Kelvin Rd, across Albany Hwy into Olga Rd, right into Attfield St, execute a U-Turn at the roundabout back to the terminus, a distance of 2.3 km with a calculated driving time of 4 minutes;
3. Option 2 was the route selected by the Bus Driver on 23 Oct 13.

Both routes require the bus to cross the level crossing on Kelvin Road however under option 1 the bus is already on Kelvin Road while option 2 has the bus approaching from the side road, i.e.,



The Crescent. The second route is sometimes used as there is a layover on The Crescent where buses can be parked when running ahead of schedule between termini.

While not contributory, review of the CCTV footage captured from the inside of the bus indicates that the Bus Driver was not wearing the fitted seat belt as he was required to do.

It was also noted that the bus driver exceeded the speed limit in at least one section of the run prior to the collision, as advised by Swan Transit; *"I reviewed the CCTV we have available from bus TP1593. The Bus Driver appears to drive appropriately prior to the accident. However, it was noted he travelled above the residential speed limit of 50 kph for a brief time (18 seconds) while travelling along Clifton Street Maddington. The bus reached a maximum speed of 57 kph briefly."*

Swan Transit identified in their report *"that the Bus Driver had 15 years experience and had specifically been driving in the Southern River and the Canning Contract Areas since 2002.*

*Since March 2006 he had been operating on a fixed shift that had not changed significantly over time and this shift included a school service that went via Maddington Station and over the level crossing at that station on Kelvin Rd at a minimum of twice daily.*

*It can confidently be said that the driver was extremely familiar with this area and particularly the intersections of The Crescent / Kelvin Rd and the level crossing on Kelvin Rd, Maddington Train Station".*

### **Railcar Driver**

At interview, the Railcar Driver advised that after signing on duty, he took over a set of railcars at Claisebrook station platform, and drove the set into Perth.

He then embarked on a Perth to Armadale service on a "C" pattern, however, he erroneously stopped at Queens Park due to a speed restriction near the platform, and as the train reduced speed in line with the restriction, passengers at Queens Park station stood up and moved toward the train to board; the driver advised that he then stopped at Queens Park to ensure that passengers were able to board the train.

This was the only thing that he recalled was out of the ordinary for the shift until the accident occurred. He advised that he had a 20 minute turnaround at Armadale and departed on time at 1426 hours.

He recalled after departing Gosnells station, the train negotiated level crossings at Stalker and Fremantle Roads and transited into a curve at the required speed of 75 kmh (the limitation is due to the curved track).



He recalled that there was a 40kmh speed restriction in place prior to Maddington station that had recently been lifted and so after exiting the curve he allowed the speed of the train to increase marginally to between 75 and 80 kmh (top speed on the ATP is recorded at 85 kmh).

The train then transitioned out of the curve into straight track 500 metres from the level crossing (at the lineside board) and this is where the Railcar Driver had initial vision of the rear of the bus obstructing the level crossing, and where he applied a partial service brake. His focus at this time was on the 500m board, the ATP, and the Speedo.

Noting that there was a vehicle part way across the crossing the driver sounded the horn and realised that the vehicle had moved forward a short distance, and he thought it was moving clear of the crossing, however it stopped again.

When the bus stopped still foul of the crossing the Railcar Driver applied a full service brake and then quickly followed that with an emergency brake application.

He advised that he was continuously sounding the railcar horn during this time.

He noted that when he deployed the emergency brake that it did not appear to take effect immediately and his eyes were focussed on the bus and the likely point of collision. He indicated that he was unable to leave the seat prior to the collision occurring as it happened so quickly.

### **1.3. Injuries**

#### **1.3.1. Railcar Driver and Bus Driver**

The Railcar Driver did not report any injuries as a result of the collision but had two days critical incident leave following the accident.

The Bus Driver sustained a minor abrasion to his right elbow.

#### **1.3.2. Passengers**

Transit Officers who attended the scene and assisted with the evacuation of the Railcars estimated there were 50 passengers on the train. Vision extracted from the internal CCTV cameras on the railcars reveals there were no obvious signs of injury to any passengers with no one falling or being thrown to the floor of the railcar.

There was one report of an injury to a train passenger immediately following the collision however the passenger declined offers of assistance or treatment.



## 1.4. Equipment Information

### 1.4.1. Railcars

The “A” Series Railcars entered service in W.A. in 1991 followed by the second intake in 1998. “A” series Railcars can be operated as two or four car sets and are for the most part contained to the heritage lines, Fremantle, Armadale and Midland. The train service involved in the incident was operating as a four car set with Railcar sets 215 and 217.

The leading railcar set (215) was examined at Claisebrook on 23 October following the collision and both railcars (215 and 217) were recoupled and examined together on 30 October, 2013 and the following observations were made;

- Brake pad thicknesses were within engineering specifications;
- Brake cylinder pressures were found to be within specification when applying the full service train brake and the emergency brake;
- Brake pipe pressures were recorded and found to be normal;
- Head light operation on high and low intensity was found to be operational; and
- The sound pressure level from the horn in the leading cab was within specification.

These test results confirmed that the Railcar was in a satisfactory operating condition at the time of the incident.

The Rollingstock Manager, in response to the Drivers Statement advised that the ATP log indicated that the emergency brake rate was close to the absolute maximum in terms of railcar specifications and the railcar was stopped in line with expectations. The time between Railcar Driver “requesting the brake” and the brake applying, can be expected to be in the order of seconds and the Railcar Driver, through the training regime, is expected to be familiar with this.

### 1.4.2. Automatic Train Protection

The Railcars are fitted with Automatic Train Protection (ATP) which monitors train speed and brake operation and provides a reminder to the Driver of current line speed information, and a warning with regard to any potential over speed situation. Additionally it updates the status of signals, applying warnings and automatic brake applications where required, to prevent trains going past signals at danger, or exceeding the authorised speed limit.

The Automatic Train Protection was reviewed in relation to this incident and analysis provided on 28 October which indicates:



- A top speed was achieved of 85 kmh prior to the final stop with the maximum allowable speed for that location of 100 kmh;
- A partial service brake was applied at 14:39:55;
- The service brake was fully applied at 14:39:56;
- The emergency brake was fully applied at 14:40:00 by which time the railcar speed had decreased to 70 kmh;
- It is estimated that the train was travelling at 57 kmh at the point of impact;
- The emergency brake rate achieved by the railcars was 1.39m/s/s which complies with the PTA specification in Procedure 4080-109-001 Rev 8; and
- The analysis of the ATP supported the Railcar Drivers statement from the interview with regard to train handling.

### 1.5. Railcar maintenance

The maintenance record for Railcar 15 has been reviewed and reveals the following;

- Series "A" examination was completed on 15 September, 2013;
- Series "B" examination was completed on 10 October, 2013;
- Deferred work included reprofiling a traction motor, replacing transformer oil and investigation into railcar power issues; and
- The railcar was awaiting materials to effect repairs to a worn brake calliper at wheel L7.

None of the above items are considered to be contributory to the incident.

#### 1.5.1. Buses

Buses allocated at to the Southern River depot are;

- 63 Full size OC500LE CNG Mercedes buses;
- 6 Midi OC500LE CNG Mercedes buses;
- 1 Full size 405NH Mercedes bus;
- 4 Midi 405NH Mercedes buses; and
- 2 Renault Articulated buses.

Table 1 on Page 14 provides vehicle specifications.



Manufacturer	Year	Model	Length (m)	Width (m)	Mass (t)	Wheel base (m)	Front overhang (m)	Rear overhang (m)
Mercedes Benz	2000	0405 NH Midi Euro 2	11	2.5	15	5.175	2.7	3.08
Mercedes Benz	2000	0405 NH 900 Series Euro 2	12.3	2.5	16	6.325	2.73	3.25
Mercedes Benz	2004	OC 500 LE Euro 4	12.3	2.48	16	6.3	2.73	3.29

**Table 1 – Specifications of Mercedes buses operated at Southern River depot**

The bus is powered by an inline 6-cylinder 11.967-litre turbocharged intercooled, lean burn, spark ignition single point injection Compressed Natural Gas engine.

It has a seating capacity for 43 people and is equipped with an extendable ramp and kneeling technology for ease of passenger boarding.

With the exception of the two articulated buses (which are allocated to set shifts and are operated by the same two drivers), drivers at Southern River work a rotating roster which would require them to drive both midi and full size buses (diesel and CNG) alternating between different bus types on a daily and weekly basis.

### 1.6. Bus Maintenance

Details of maintenance and repair activities were provided by Swan Transit with the following noted;

- Since the 15 January, 2013 there were 65 separate maintenance /repair items attended to on TP 1593;
- Included in that count were 3 x 15,000 km body services, a 135,000 km transmission service and a 45,000 km engine service; and
- There were various other reports for the period reviewed that related to two way radio reception quality, air conditioning not operating correctly, replacement of internal and external lighting and ticket system repairs.



## 1.7. Damage to Equipment

### Bus

Swan Transit reported that the Bus, TP 1593, sustained rear end damage to the body work and engine bay, which included chassis frame damage. The collision also ruptured the main CNG fuel supply line from the overhead tanks mounted on the roof of the bus to the engine compartment, above the location of the cut off valve.

Swan Transit's Workshop Manager from Southern River, was the first of Swan Transit's personnel to attend the scene. He was able to initially secure the scene of the accident and isolate the battery however did not have the means to reach the shut off valve located on the roof of the bus until Fire and Emergency Service personnel arrived on scene with a ladder.

Due to the significance of the structural damage, the bus has been determined to be uneconomical to repair, and has been written off.

### Railcar

Damage to the railcar was assessed by EDI Bombardier who advised that the following damage repairs to railcar set 15 were undertaken. (Note railcar set 17 was not damaged)

- DMA cab LH side fibreglass front renewed;
- DMA cab LH door step renewed
- DMA cab LH front nose cone step tread renewed;
- DMA cab LH front grab rail renewed;
- DMA cab windscreen frame renewed;
- DMA cab LH quarter window renewed;
- DMA cab LH quarter window frame renewed;
- DMA cab LH front cowling renewed;
- DMA cab LH cowling flap, strut and hinges renewed;
- DMA cab front windscreens (quantity of 3) removed and resealed;
- DMA cab destination glass removed and resealed;
- DMA cab windscreen demister ducting straightened;
- DMA cab fibre optic cable repaired; and



- DMA cab radox cable repaired.

It should be noted that railcar set 15 has been returned to active service.

### 1.8. Level Crossing Protection Equipment

The level crossing protection equipment was tested and evaluated immediately following the collision by a Signal Technician who checked the operation of the level crossing and the adjacent pedestrian crossing, including the boom gates, lights and audible warning devices, and reported them as functioning correctly.

The Technician also visually observed the operation of the level crossing for trains travelling in both the up and down direction before declaring the level crossing to be operating correctly, and the fault form created for the level crossing testing process, Signalling Failure Report Form (55400), was signed off by the Signals Superintendent on 28 October, 2013.

The former PTA level crossing standard determines the standard warning time for deployment of level crossing protection at 21 seconds, while the existing PTA standard requires 25 seconds warning time.

As the design of the Maddington level crossing occurred before the change in PTA standard, the minimum warning time for this facility is 21 seconds. Australian Standard AS1742.7-2007 specifies a minimum of 20 seconds warning time.

The event logger downloaded following the incident shows that the actual warning time for the level crossing for this event was 28 seconds which is in excess of the required minimum and which provided more than adequate warning of the approaching train and Table 2, below, refers.

Old Standard (Secs)	New Standard (Secs)	AS 1742.7/2007 (Secs)	Kelvin Road Level Crossing (Secs) Required	Kelvin Road Level Crossing (Secs) Actual
21	25	20	21	28

**Table 2 - Level crossing protection timing**

The most recent maintenance activity on the level crossing equipment was identified as a “B” service carried out on 14 October, 2013.

Network and Infrastructure Procedure “Actions required by signalling personnel following signalling Irregularities” 8110-600-040 Rev 2.00 has as the primary purpose; “...to provide a process for signalling maintenance personnel to adhere to following a collision or confirmed or suspected wrong side irregularity within signal interlocked territory”.



The procedure includes a 45 point inspection list that is required to be completed following a level crossing accident, and it is noted that an internal review determined that the inspection regime was not required in relation to this incident.

### **1.9. Main Roads Western Australia assessment of level crossing**

Main Road Western Australia was requested to confirm that the level crossing met their standards in relation to signage and cross hatching and whether there were any other factors that might have influenced the incident.

They advised that where an incident has been reported at a level crossing involving a road user, the condition and level of regulatory control is assessed, reporting that the cross hatching, in terms of colour, dimensions and appropriate signage at Kelvin Road met the standard.

The reflective properties of the signs and line marking could not be assessed at the time of the inspection however this would not have been an influencing factor for a day time event. This will be followed up by Main Roads maintenance personnel.

There is currently no synchronisation between the traffic signals on Albany Highway and the level crossing on Kelvin Road and Main Roads have advised that they will investigate whether coordination is required.

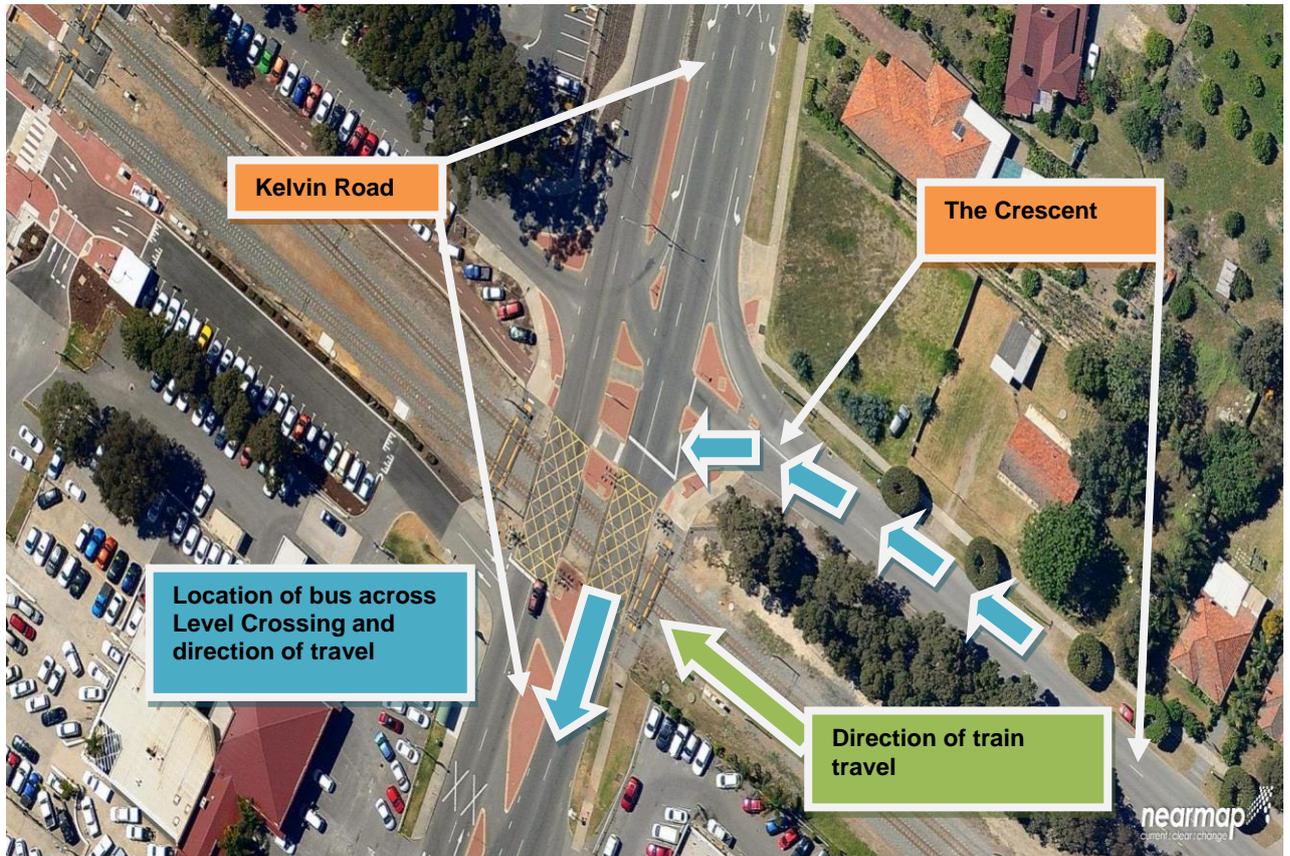
Main Roads have further advised that they are following up warning signage, "Railway Crossing Signals Ahead", on both approaches on Kelvin Road which require replacement due to reflectivity issues.

### **1.10. Location Description**

The Armadale to Perth railway comprises narrow gauge track and is designed for urban and country passenger, and work trains. It consists primarily of:

- 50 kg rail with pandrol "E" 1800 series clips on concrete sleepers (at 1430 per kilometre) and supported by 50 mm ballast rock to a depth of 175 mm.

The railway is designated as double line with exclusive up and down unidirectional main lines to facilitate train operations in each direction. The ruling gradient is 1 in 120 from Armadale to Kenwick, Figure 1 Page 18 refers.



**Figure 1: Near map view of incident location**

Immediately prior to the level crossing for trains travelling towards the City is a protected pedestrian maze.

Signals and points for this section of track and the wider PTA network are controlled by the Train Controllers located at the Train Control Centre within the Public Transport Centre in East Perth.

All communications are conducted via open channel radio and mobile telephone.

### **1.11. Lighting Conditions**

This incident occurred on a bright clear day with very good general visibility and lighting is not considered to have contributed to the incident.

### **1.12. Drug and Alcohol Testing**

Breath testing for the presence of alcohol was conducted on the Railcar Driver of 5604C at the scene by WA Police, and AOD testing was conducted at Claisebrook in line with PTA Policy and procedures. The Railcar Driver returned a negative sample for both tests.



The Railcar Driver has been tested for the presence of alcohol and other drugs on three occasions over the last 15 months and has returned negative results each time.

The Bus Driver was subjected to random alcohol testing at the commencement of his shift at the Southern River depot, and additionally following the incident by a police officer who attended the scene, and returned a negative sample for both tests.

He was subjected to a drug urine test on the day following the collision, again returning a negative sample.

Data provided by Swan Transit indicates that the Bus Driver had been tested for the presence of alcohol or drugs on 16 separate occasions since 2002 and returned negative samples on each occasion.

### 1.13. Organisational Information

#### 1.13.1. Training

#### 1.13.2. Railcar Driver Training

The Driver of service 5604C on the 23 October, 2013 had a current Track Access Permit, Category WTO 11, which expires on 4 October, 2015, and has successfully completed all training applicable to the position.

Training relevant to this event which includes the operation of the railcars is covered in TTO Procedure 4040-409-512 Rev. 5 – “Technical Instructions - Emu Traction Training Procedures for Driver Trainer” and highlights the use of marker boards by Railcar Drivers which are strategically located on the rail reserve to ensure consistency in driving and braking applications. The following has been extracted from that procedure:

*“During initial training the trainer is to get the trainee to drive consistently whilst stopping the train on the platform as this allows them to gain experience in the braking capacity of the railcar. Utilise the 1000, 750, 500 and 250 metre boards when stopping at stations taking into consideration track gradient and the distance between stations, do not use landmarks as braking indicators where possible, depending on the track gradient at the time, generally speaking for “A” series railcars you would apply a minimum brake application at the 750 metre board, and then half brake at the 500 metre board. At the 250 metre board ensure the train speed is down to approximately 75-80kph, adjust the power brake controller to ensure at the beginning of the platform the speed is down to approximately 40kmh followed by a final stop at the correct platform marker on a releasing brake in order to maintain “Passenger comfort”. Ensure P/B*



*controller is in the full brake mode upon stopping.”*

At interview the Railcar Driver referred to this procedure and was able to clearly explain how he used this methodology bringing railcars to a stop as required. The Railcar Driver’s actions prior to the collision were consistent with this methodology.

### 1.13.3. Bus Driver Training and Assessments

The following training has been delivered to the Bus Driver since 2003.

5/08/2003 - Bus Lane Driving Kwinana Freeway Bus Lane

24/08/2005 - Hot or Not Security

23/05/2006 - 500OLE Familiarization Operational Gas Bus

21/06/2006 - Compressed Natural Gas (CNG) Refuelling

29/08/2006 - Duty of Care & Hazard Identification

16/02/2009 - Disability Training

19/08/2009 - Dealing With Difficult Situations and Conflict

07/07/2010 - Articulated Driving Training

07/01/2013 - Fogmaker Fire Suppression System

The Bus Driver also held a Motor Driver’s Licence, N<sup>o</sup> 4147917, Class HC-R, with an expiry date of 4 December, 2013, and was reassessed on bus types as indicated at Table 3, below.

Date	Vehicle	Type	Assessment	Outcome
24/10/2002	Mercedes 405	Rigid	Unknown	Pass
17/11/2003	Renault	Rigid	Unknown	Pass
14/02/2005	Mercedes	Rigid	Unknown	Pass
7/07/2006	Mercedes OC 500	Rigid	Annual	Pass
15/10/2007	Mercedes OC 500	Rigid	Annual	Pass
27/08/2008	Mercedes OC 500	Rigid	Follow up	Pass
20/11/2009	Mercedes OC 500	Rigid	Annual	Pass
25/02/2011	Mercedes 405	Rigid	Annual	Pass
28/06/2012	Mercedes OC 500	Rigid	Annual	Pass
17/06/2013	Mercedes OC 500	Rigid	Annual	Pass

**Table 3 – Reassessment of Bus Driver on bus types**



#### 1.14. Risk and Hazard Management Swan Transit Southern River

Swan Transit (Southern River Depot) had not completed any formal risk assessments in relation to the road/rail interface at level crossings with regard to the operation of buses.

There were three semi-formal assessments undertaken as part of the reporting process for hazards and near misses which were considered relevant to this location and/or this incident and are reported in the Table 4, below and on Page 22.

Depot	Date	Location	Hazard	Action	Assessed risk
Southern River	07/08/2008	Kelmscott train station	Not enough room between boom gates and road for long wheel and articulated bus	Situation monitored for previous six months and there have been no traffic accidents at this location. The Layout as current does cause some extra traffic congestion but no serious safety issue. The only way to change layout is negotiation between state and local government departments which are progressing slowly _ Hazard corrected 9 May, 2009.	Likelihood 3, Exposure 10, Consequence 3, total risk score 90.
Southern River	23/07/2010	Kenwick station level crossing	It is a safety issue. People waiting there and a bus being parked can create a problem.  Recommendation - Move the start for a 230 (route) to Maddington, to first stop in Kenwick road.	Terminus to be changed – Hazard corrected November 2010.	Likelihood 3, Exposure 6, Consequence 3, total risk score 54.



Southern River	03/04/2013	Kelmescott train station	Bus exit from station across railway tracks, at times, two buses crossing together, the behind bus encroaches on the cross hatched section surrounding the tracks. Insufficient space for two buses between tracks and roundabout, further, the approach to the crossing is on a right hand bend.	Appropriate signage and road markings are in place at this location as outlined in Road Traffic Code 2000. Notice to staff reminding them of their responsibility under the Road Traffic Code 2000 not to enter a railway crossing if they cannot wholly clear the crossing. Notice with Road Code extract attached.	<p>Unmanaged risk</p> <p>Likelihood 6, Exposure 6, Safety 10, total risk score 90.</p> <p>Managed risk</p> <p>Likelihood 1, Exposure 6, Safety 10, total risk score 60.</p>
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**Table 4 – Hazard reports Southern River Depot**

**1.15. Proactive Hazard Awareness and Communication**

Swan Transit identified and managed the hazard of bus and train interaction at level crossings by means of a series of documentation including the Transperth Service Handbook (9.2.2) and the Swan Transit Bus Drivers Manual which clearly states:

*“... The driver must never enter a railway crossing unless their exit on the other side of the railway line is safely clear”.*

The Bus Driver signed acknowledging he had received both documents.

On 19 April 2013, Swan Transits Operations Manager from the Southern River Depot posted a Notice to Driver’s specific to Kelmescott Station Railway Crossing which stated:

*“... A driver approaching a railway crossing shall not enter the level crossing if they are unable to wholly clear the level crossing yellow hatched area”*

This notice remained on display to drivers until 18 July 2013.

In addition to this Notice, the Transperth Safety Bulletin Railway Crossings 01/2013 (See Appendix 1, page 32) was posted on the Southern River Depot’s Safety Notice board as well as the Driver’s General Notice board and the Workshop General Notice board on 27 September 2013. This notice was still on display on the day of the accident, which states in part:

*“... Do not enter a level crossing until there is sufficient distance to traverse your whole bus over the crossing and fully exit the other side.”*

During the Occupational Health, Safety and Environment Committee Meeting held at the Swan Transit Southern River Depot on 02 October 2013, the issue of level crossings was raised

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discussed and minuted by the committee.

The minutes were displayed on the Depot's Safety Notice board and made available to all staff.

### **1.16. Hazard and Risk Management Public Transport Authority**

Risk Management at TTO does not specifically contemplate the risk of a road rail collision at a level crossing.

Network and Infrastructure have lodged a risk in Riskbase identified as NI\_Divisional -07, Safety – Failure to Manage Level Crossing Protection to ALARP.

The risk was entered on 8 May, 2012 with an acceptance date of 8 November, 2013 and is listed as under review. It is noted that the assessment due date for the controls was 7 June, 2012 and this has not been actioned.

### **1.17. Human Factors Railcar Driver and Bus Driver**

At interview the Railcar Driver appeared to be relaxed and advised that he was in relatively good spirits.

In terms of driving experience he was accepted as a Railcar Driver Trainee in September, 2012.

He qualified as a Railcar Driver for Main line and Shed operations on 7 March, 2013.

The Driver was able to demonstrate good situational awareness describing the events leading up to the collision and the decisions taken in relation to the management of the train.

He was comfortable that he was trained appropriately and had the requisite knowledge to safely and efficiently operate train services.

He advised that there were no external influences affecting his work and that his social and domestic life was stress free.

As the Bus Driver was dismissed by Swan Transit the day following the incident, without making a statement, or being available to the PTA investigation team, it is not possible to report further in relation to his frame of mind on the day of the incident.

#### **1.17.1. Rostering and Fatigue Management**

PTA fatigue management analyses and reports fatigue related rostering scores to measure the opportunity for sleep available to a worker as a result of carefully considered rostering techniques.

The score is based on the time of day that the work is occurring, work breaks, the duration of



work and breaks, the work history over the last seven days (weighted so that the most recent days provide the most input) and the biological limits on recovery of sleep.

The rosters applicable to Railcar Drivers in the PTA are subject to fatigue management and comply with Fatigue Audit Inter/Dyne (FAID) modelling to ensure that there are sufficient opportunities for restorative sleep incorporated into the roster.

Swan Transit Fatigue Management is captured in the Swan Transit Fatigue Management System, and the following elements inform rostering guidelines to address issues of fatigue;

- All shift parts are to be constructed so that the maximum period of Work Time does not exceed 5 hours and 30 minutes;
- All shifts are to be constructed so that a minimum of 30 minute breaks from driving is scheduled every 5½ hour period;
- The maximum daily Work Time is to be 10 hours. However, if operational requirements necessitate then the maximum hours worked in any 24 hour period is not to exceed 14 hours;
- The maximum number of hours worked in any one week should not exceed 60 hours;
- The minimum Major Rest Period scheduled in any shift is to be 30 minutes. The Major Rest Period does not include crib breaks, layover periods etc. The Major Rest Period is to be scheduled at a location that has toilet facilities and an area for consumption of food and beverages;
- There is to be a minimum of 10 hours of Non-Work Time allocated between shifts.
- The number of rostered days off in any pay week is to be a minimum of 1 day. Where a driver has sick leave during the pay week, these sick days are to be counted as days worked when determining the number of days worked in any pay week.
- Where exceptional operational needs necessitate the number of rostered days worked, the number of days allowed to work may increase to 7 days within the same pay week. However, whenever an employee works during the seventh day in any pay week, plans are to be implemented to ensure that the employee has a minimum of 10 hours rest before commencing their next rostered shift; and their total hours worked must not exceed 70 hours for that pay week; and the total number of days of 24 hours continuous Non Work Time in the 28 day cycle must be four.



The make up of the shifts for the Bus Driver for the week of the collision are in line with the requirements of the fatigue guidelines. The policy does not recognise accumulation of fatigue over extended periods of time as identified in the PTA fatigue management process.

**1.17.2. Railcar Driver Fatigue**

The Railcar Driver working service 5604C was rostered on pattern C39, and commenced duty at 1308 hours with a rostered finish time of 1940 hours.

Review of the roster and FAID analysis for the Driver is captured in table 4, Page 23, indicating that the roster was not onerous and the forecast fatigue levels were low to mid range with ample opportunities for sleep recovery.

The Railcar Driver was rostered for 45.5 hours in 6 shifts over 9 days prior to the 23 October, with the two days prior to the event rostered off duty. The maximum FAID score applicable to Railcar Drivers is 90.

Date	Time on	Time off	Duration	FAID score
14 October	0451	1335	6h 44m	56
15 October				
16 October	0800	1653	8h 53m	34
17 October	0745	1636	8h 51m	42
18 October	0509	1010	5h 1m	60
19 October	0405	1123	7h 18m	65
20 October	0900	1739	8h 39m	47
21 October				
22 October				
23 October	1308	1940	6h 32m	21

**Table 5: Railcar Driver roster and fatigue score**

Based on the scores at Table 5 above, and interview with the Railcar Driver, it is not considered that fatigue played any part in the actions or responses of the Railcar Driver.

**1.17.3. Bus Driver Fatigue**

On the day of the accident the Bus Driver was operating shift 2024, which commences at 06:05 hours to 09:32 hours, 1hour 54 minute meal break, then 11:26 hours to 16:17 hours, representing a total daily working time of 8 hours and 18 minutes out of a total shift spread of 10 hours and 12 minutes.

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The Driver was rostered on the same shift for the previous two days, Monday, 21 October 2013 and Tuesday, 22 October 2013 with no complaints of late running or any other such issues being reported. The second half of this shift is scheduled as depicted in Table 6, below.

Service	Start	Finish	Break (Minutes)
232 F	1143	1202	12
228 T	1214	1245	19
207 T	1304	1340	5
850 F	1345	1432	22
229 TS	1454	-	-

**Table 6 – Break times for shift 2024 in addition to the rostered major break**

The accident occurred 3 hours and 14 minutes after the Driver commenced the second half of his shift, and 8 hours and 35 minutes after commencing duty for the day. Meal breaks are not planned to be taken at Depots or specific locations, however, in line with the Fatigue Management System, “The Major Rest Period is to be scheduled at a location that has toilet facilities and an area for consumption of food and beverages”. The rostered shift for the day of the collision (and the previous two days) met the requirements outlined at 1.17.1, Rostering and Fatigue Management, at page 21 and 22 of this report.

### 1.18. Swan Transit Record of Traffic Infringements

The information in Table 7, below, was drawn from the PTA Executive HSE reports and identifies traffic infringements for Swan Transit for the period 2010 - 2013.

It is important to note that there was a step change in service kilometres for Swan Transit from 2011 as a result of taking on additional contracts. When normalising factors have been applied, Swan Transit has consistently returned lower levels of infringements per million kilometres than other contract service providers.

Swan Transit	2010/2011	2011/2012	2012/2013
Red Light	17	8	10
Speeding	71	180	137
Miscellaneous	0	0	2
Infringements per million km	4.0	6.9	6.46
Comparative per million km (Ave of other contract providers)	5.0	7.7	7.8

**Table 7 – Traffic infringements Swan Transit, 2010 – 2013**



As the owner of the buses, PTA receives traffic infringements, the details of which are entered into an internal database, and then directed to the appropriate contract provider, for follow up action with the individual driver.

On a quarterly basis the Safety and Quality Coordinator summarises the infringements and communicates with the contract providers highlighting areas of concern such as locations where there have been multiple offences recorded and drivers are advised of these locations.

### 1.19. Previous Level Crossing incidents on the PTA Network

Data drawn from the PTA Incident and Fault Reporting System (IFRS) for the PTA rail network demonstrates an overall reduction in level crossing incidents over the past four years as indicated at Figure 2, below.

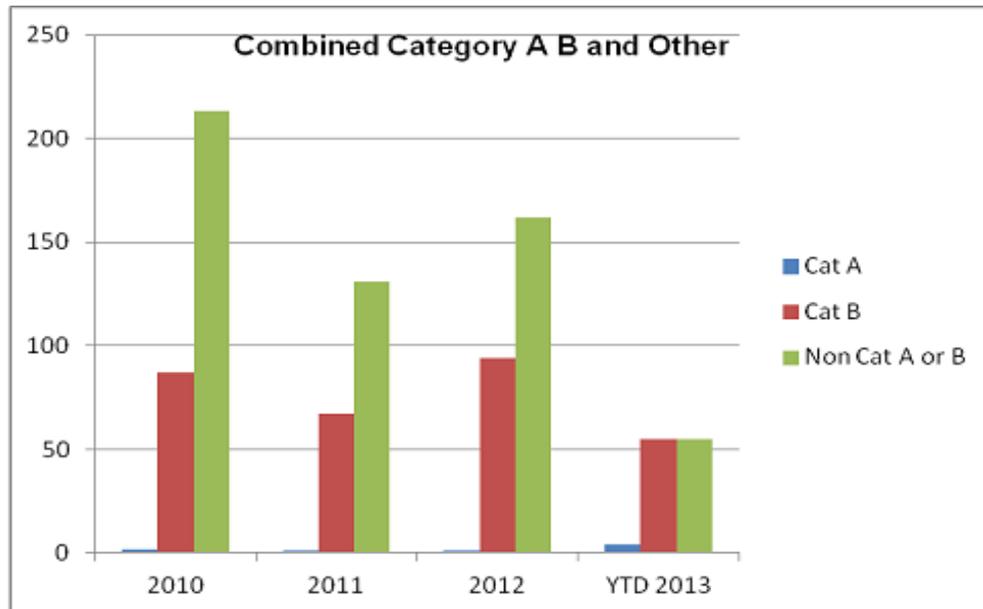


Figure 2 – Number of level crossing incidents since 1 January, 2010

The location and type of level crossing incidents is illustrated in the graphs at Figure 3 and 4, page 28.

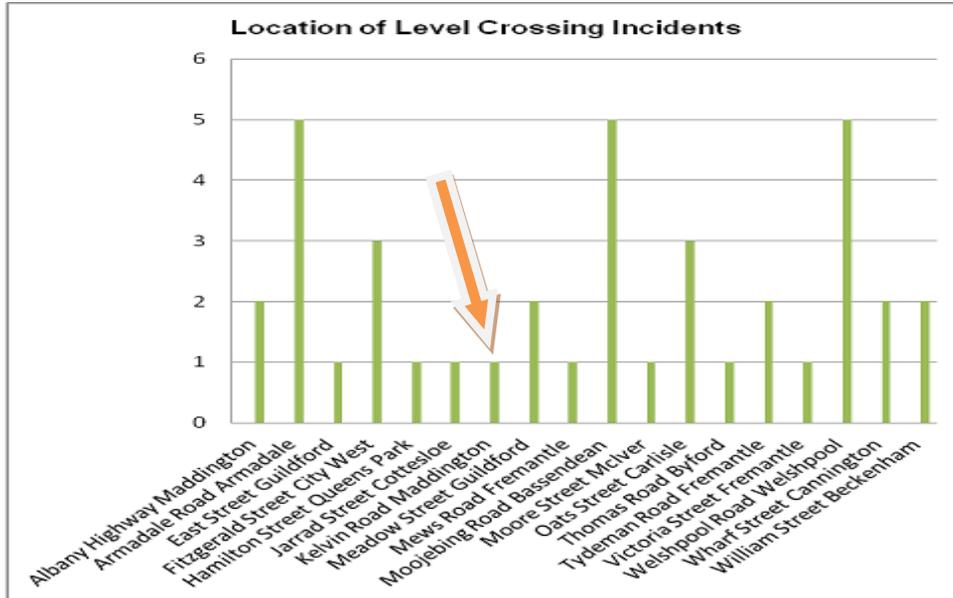


Figure 3 – Location of level crossing incidents since 1 January, 2010

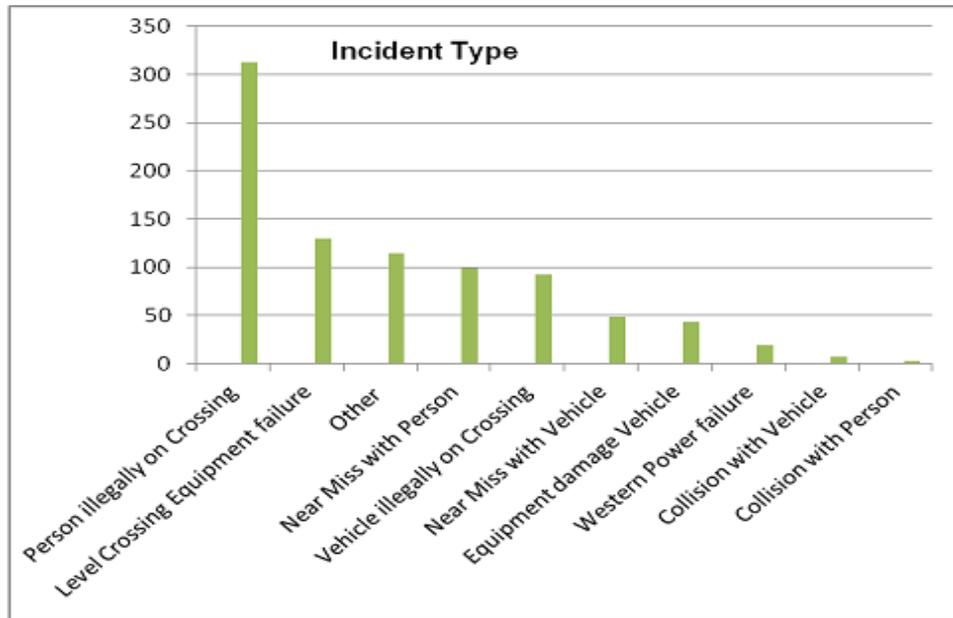


Figure 4 – Level Crossing incident type since 1 January, 2010

Review of the data indicates that there were no reported precursor events at the Kelvin Road level crossing involving road and rail traffic that would give rise to concerns about the safety of the crossing. There have been 6 collisions between trains and road vehicles across the PTA Network since January, 2010.

(Note that data was drawn on 28 October, and the reference to Kelvin Road at Figure 3 refers to the incident under investigation).



## 1.20. Functioning of Rolling Stock and Technical Installations

### 1.20.1. Signalling and Train Control Systems – Including Data Records

The Train Control and ECO (SCADA) functions were downloaded following the incident. The Train Control replay did not provide evidence that was of value to the investigation.

### 1.21. Review of Emergency Processes

The collision required full emergency response from all emergency services including PTA personnel.

The table at Appendix 2 (Page 42 and 43) illustrates recording of the incident and details of notifications and response times.

From a PTA perspective the emergency was activated at 14:46 hours, WA Police were called and responded within one minute, FESA responded immediately and St John Ambulance were on site within six minutes.

The following information was provided by the PTA Operations Manager who is the nominated Incident Controller for the PTA as identified in PTA's Emergency Management Manual.

- Call received from Train Control at 14:42 hours to state that a railcar had collided with a bus at Kelvin Road Level Crossing. The accident had just occurred but at this stage no reports of injuries and level of damage. Indicated to Train Control that I was at the Nowergup Depot but would leave immediately to attend site with an estimated travel time of about 45 mins.
- The General Manager Transperth Train Operations and Manager Corporate Communication were advised of the occurrence.
- Contacted the Shift Commander who indicated that CCTV showed bus caught on level crossing was clipped by train but that bus was turned 90 degrees by impact.
- Made a call to Train Control and discussed train operations which included Armadale to Gosnells and Perth to Cannington to continue to operate. Perth Station Coordinator had been contacted by Train Control to arrange bus replacement between Cannington and Gosnells.
- Contacted Manager Investigations and Safeworking to confirm attendance at site to commence PTA investigation. After discussion called the Office of Rail Safety personnel who confirmed they would attend site.



- Tried to contact Rollingstock Manager a number of times but no answer.
- Contacted the Depot Manager Claisebrook to check that relief driver was on the way to scene and this was confirmed. Also indicated to Depot Manager Claisebrook to contact EDI Rail – Bombardier to alert them as I could not get hold of Rollingstock Manager and we would need damaged train to be assessed before moving it.
- Signal Superintendent called me looking for further detail of incident. He confirmed that signalling staff were on the way to site to check operation of all equipment at Kelvin Road.
- Multiple discussions with Train Services Manager who confirmed 50 people approx on train and no reports of injuries and also that there was no reports of injuries on bus.
- Arrived on site at 15:30 hours and made my presence known to police officer in charge.
- Also spoke to Swan Transit staff that were organising removal of bus who stated that they had this under control with the assistance of police and separate traffic management staff.
- Noted that TTO Rollingstock Mechanical Engineer was on site meaning that railcar checks could be completed by him.
- Had a quick discussion with the Train Driver who seemed OK. Relief Driver arrived on site about 5 minutes after me.
- ORS officers arrived at site and were given a quick update.
- Police confirmed at 15:45 hours that they were taking final photos and that train could be released back to depot very soon. A metal cover at side under cab fibreglass was badly bent and needed to be removed prior to the train moving as it would strike infrastructure. DFES assisted with the removal of this cover from the train.
- Liaised with on site signalling staff that were completing final checks of level crossing equipment. Okay on signalling equipment given at approximately 16:00 hours.
- Incident train given Okay to move 16:05 hours from site. Mechanical Engineer placed a 60 km/hr speed restriction on its movement and travelled with the train to Claisebrook.
- Okay given at 16:15 to restart all services as signalling staff confirmed all was working Okay. First train on Up main came through at about 16:25 hours.
- 16:30 hours contacted Train Control to confirm I was leaving site.

The emergency response was appropriately managed in line with the requirements of the



Emergency Management Manual.

The emergency was concluded at 17:33 hours.

## 1.22. Operational Considerations

Recovery of the site was undertaken in discrete stages following the first response;

- Passengers, PTA Railcar Driver and Swan Transit Bus Driver were assessed for injuries and treated as required;
- The disabled bus was positioned for towing from the site under the direction of Swan transit personnel; and
- The Railcar was inspected and authorised for travel (empty) from the site to the Claisebrook Railcar Depot accompanied by a Rollingstock Engineering representative;

The Operations Manager reported calls were received from a number of the PTA Executive which caused phone congestion suggesting that all calls should be coordinated by the General Manager TTO in future events.

## 1.23. Sequence of Events (Timeline)

For ease of reference the clear background depicted at Table 8, below, represents the Swan Transit timeline and commentary, pink background represents PTA Railcar timeline and green background represents the PTA Signals timeline; note that there is a differential in times due to an incorrect time recorded on PTA signalling equipment. It should be noted that the incorrect time did not affect the operation of the warning signals or the level crossing.

Time	Actions
06:05:00	Bus Driver commences duty
13:08:00	Train Driver commences duty
14:06:00	Train arrives Armadale from Perth
14:26:00	Train departs Armadale for Perth
14:30:51	CCTV footage commences. The Bus Driver is driving TP 1593 in service operating route 850F @ 13:45hrs. It can clearly be seen that the Bus Driver is not wearing the fitted seatbelt. There are approximately eight passengers on board the bus.
14:33:36	The bus arrives at the Maddington Station terminus for the 850F service on Kelvin Rd.
14:34:11	All the passengers have disembarked; The Bus Driver has retracted the front door wheelchair ramp and is departing the terminus. He travels along Kelvin Rd, turns right into Weston St, right into Clifton St, right into The Crescent and then left into Kelvin Rd.
14:37:44	The Bus Driver stops at the intersection of The Crescent and Kelvin Rd. Vehicles are stopped on Kelvin Rd with the level crossing boom gates down and presumably red lights flashing.
14:38:11	An Armadale bound train passes through the intersection.



14:38:20	The level crossing boom gates are up and road traffic commences to travel across the rail crossing.
14:38:49	Traffic has been flowing across the level crossing however at this point of time a blue car travelling in the near side lane seems to slow considerably or even pause at the white stop line marked on the road just prior to the yellow hatched area designating the level crossing, before proceeding across. The actions of the blue car cause the following red 4WD to slow down at the white stop line before proceeding across the level crossing.
14:38:56	The Bus Driver commences to move pulling left out of The Crescent into Kelvin Rd.
14:38:58	The bus has yet to reach the white stop line preceding the yellow hatch area designating the level crossing.
	A view from the CCTV camera facing out through the bus's front doors show that the driver of the last car to have passed in front of the bus along Kelvin Rd, the red 4WD, has applied the vehicle's brakes with the red brake lights being clearly illuminated.
14:38:59	The forward facing CCTV camera shows traffic ahead of the bus in the near side lane has stopped.
	Vision also clearly shows that a white commodore station wagon in the off side lane on Kelvin Rd heading west in the same direction as the bus, has stopped on the yellow hatched area of the level crossing prior to the rail tracks. Traffic in front of this vehicle has also stopped.
	The Bus Driver does not pause or hesitate but drives past the stationary commodore in the off side lane, across the level crossing despite the fact that the vehicles ahead of him have stopped and there only appears to be a distance of about four metres between the end of the yellow hatched area and the red 4WD, the last car in the stopped and queued traffic.
14:39:10	The Bus Driver stops behind the red 4WD leaving approximately one metre clearance. Traffic in the off side lane is now flowing with vehicles turning right onto Albany Hwy.
14:39:32	The red 4WD moves forward and the Bus Driver closes up behind the vehicle.
14:39:41	The red 4WD again moves slightly forward with all other traffic in the near side lane stopped. The Bus Driver closes up again behind the vehicle in front.
14:39:50	The red 4WD moves even closer to the blue car in front of it and the Bus Driver again closes up behind the red 4WD leaving no gap or clearance.
14:39:54	The position of the railcar leading axle when the transponders are logged is 16.704 km point
14:39:55	The Railcar Driver begins braking (12 metres later) at 16.692 km point
14:39:56	The Railcar Driver applied a full service brake application (23 metres later)
14:40:00	The Railcar Driver applied the emergency brake (81 metres from the centre of the level crossing)
14:40:03	The CCTV on board stops recording, presumably this is the moment of impact with the train.
14:40:10	The railcars travelled 149 metres after the emergency brake was applied which placed the leading railcar 68 metres past the centre of the Kelvin Road level crossing
	<b>Note: Timing differential between Signaling/level crossing logs and ATP/Phoenix</b>
14:37:59	The level crossing at Kelvin Road Maddington activated
14:37:59	The crossing flashing light activated simultaneously
14:38:05	The boom gates started to descend at 14:38:05, 6 seconds after the crossing was activated
14:38:13	Both boom gates were in the horizontal position 14 seconds after the crossing was



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	activated
14:38:27	The warning time of 28 seconds elapsed at 14:38:27 which is in excess of the design and PTA and Australian Standards
14:38:31	The collision occurred at 14:38:31

**Table 8 - Timeline of events**



## 2. ANALYSIS

The contributing factors of this incident were analysed using the Incident Cause Analysis Method (ICAM).

Organisational factors	Task / environmental conditions	Individual/team actions	Absent or failed defences	Non Contributory factors
There was no formal specific risk assessment conducted by Swan Transit in relation to the road/rail level crossing interface	Bus Driver elected to take route between termini that meant the bus negotiated the level crossing from a side street(task allowing shortcuts)	Bus Driver breached training and company instructions by negotiating the level crossing without being able to completely clear the crossing	The Bus Driver travelled over this level crossing on a daily basis for more than 10 years	Bus Driver was not wearing his seatbelt prior to the collision
	Bus Driver has undertaken repetitive services during school terms since 2006	There was no formal risk assessment conducted in relation to the road rail interface at level crossings	Company action against the Driver over repeated traffic infringements and minor accidents limited to verbal warnings	Bus Driver was driving in excess of the authorised speed prior to the collision



Organisational factors	Task / environmental conditions	Individual/team actions	Absent or failed defences	Non Contributory factors
	Bus was running 1 minute late on the previous service	Railcar Driver had no prior notice of the obstruction situation and was unable to prevent the collision from occurring	Safety notices and bulletins were displayed at numerous locations within the Southern River depot but did not deter the Bus Driver from infringing the level crossing	
	Bus travelling out of service		Sighting distance did not allow the Railcar Driver sufficient time to react to the hazard to avoid the collision	



## INVESTIGATION METHODOLOGY

ICAM is an analysis tool that sorts the findings of an investigation into a structured framework, with the contributing factors classified into the following four categories:

### 2.1. Absent or Failed Defences

Defences are those measures designed to prevent the consequences of a human act or component failure producing an incident. Defences include equipment or procedures for detection, warning, recovery, containment, escape and evacuation, as well as individual awareness and protective equipment.

These contributing factors result from inadequate or absent defences that failed to detect and protect the system against technical and human failures. These are the control measures which did not prevent the incident or limit its consequences.

The absent and failed defences are:

- Safety notices and bulletins were displayed at numerous locations within the Southern River depot but did not deter the Bus Driver from infringing the level crossing;
- Sighting distance did not allow sufficient time for the Railcar Driver to react to the hazard and avoid the collision; and

### 2.2. Individual or Team Actions

The Individual / Team Actions identified in this incident are:

- Bus Driver breached training and company instructions by negotiating the level crossing without being able to completely clear the crossing;
- There was no formal risk assessment conducted in relation to the road rail interface at level crossings; and
- The Railcar Driver had no prior notice of the obstruction situation and was unable to prevent the collision from occurring.

### 2.3. Task and Environmental Conditions

These are the conditions in existence immediately prior or at the time of the incident that directly influences human and equipment performance in the workplace. These are the circumstances under which the errors and violations took place and can be embedded in task demands, the work environment, individual capabilities and human factors. Deficiencies in these conditions can promote the incident of errors and violations. They may also stem from an Organisational

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Factor Type such as Risk Management, Training, Incompatible Goals, or Procedures, when the system tolerates their long term existence.

The Task / Environmental Conditions were:

- Bus Driver elected to take route between termini that meant the bus negotiated the level crossing from a side street;
- Bus Driver had driven repetitive routes during school terms since 2006;
- Bus was running one minute late on the previous service; and
- The bus was travelling out of service.

#### **2.4. Organisational Factors**

Organisational Factors are the underlying organisational factors that produce the conditions that affect performance in the workplace. They may lie dormant or undetected for a long time within an organisation and only become apparent when they combine with other contributing factors that led to the incident.

The Organisational Factors identified in this incident are:

- There was no formal specific risk assessment conducted by Swan Transit in relation to the road/rail level crossing interface.

#### **3. Root Causes**

The root causes of the incident were:

- a. The Bus Driver attempted to traverse the crossing despite not having sufficient clearance on the western side of the crossing; and
- b. The Railcar Driver did not have sufficient sighting distance (after exiting the curve) or time to react to prevent the collision from occurring.

#### **4. Non Contributory Factors**

- a. The Bus Driver was not wearing his seatbelt prior to the collision; and
- b. The Bus Driver was driving in excess of the authorised speed for a short period of time prior to the collision.



## 5. Findings

- a. The Bus Driver entered the level crossing without being able to fully exit the crossing despite repeated communications from his employer and a safety notice from the PTA; (Action Already Undertaken 6 (a))
- b. The geographical layout of the railway does not allow sighting distance of the level crossing for Railcar Drivers on trains travelling in the up direction (from Armadale) until approximately 500 metres from the station at Maddington; and (Recommended Safety Action (7a))
- c. There were no specific formal risk assessments compiled by Swan Transit in relation to the road rail interface at railway level crossings; (Action Already Undertaken 6 (b))

## 6. Actions Already Undertaken

- a. PTA have issued a Safety Notice to all Contract Bus service providers in relation to the rail / road interface at level crossings; (Finding (5a))
- b. It is noted that immediately following the incident, the Executive Director Transperth Regional and School Bus Services (TRSBS) directed all Contract Bus service providers to undertake risk assessments at all rail level crossings in their areas of operation, Swan Transit have commenced risk assessments specific to level crossings in their operating areas and at the time of this report the assessments were in draft format; (Finding (5b) RSA Swan Transit 10(b))
- c. Swan Transit terminated the services of the Bus Driver on the day following the collision; (RSA Swan Transit 8 (a)) and
- d. The Safety and Quality Coordinator TRSBS has requested all Transperth bus contractors to provide information for inclusion in the EHSE report for this quarter that includes; (RSA 7 (b))
  - I. The total number of accidents by the total number of drivers (including part time drivers);
  - II. The number of accidents by the number of full time drivers; and
  - III. The number of “at fault” accidents by the total number of drivers.



## 7. Recommended Safety Actions

- a. Network and Infrastructure and Transperth Train Operations to review the speed of trains operating over the Kelvin Road level crossing in the first instance, and then all at-grade level crossings on the PTA Network to determine the adequacy of the existing authorised train speeds and the correlation to level crossing sighting distances; (Finding 5 (c))
- b. Contract surveillance to be reviewed to improve the quality of reporting between the PTA and Contract Bus service providers in relation to traffic infringements which includes analysis and trending, and the management approach for dealing with repeat offenders who evidence at risk behaviours; (Action Already Undertaken 6 (d))

## 8. Non Contributory Recommendations

- a. PTA Network and Infrastructure Procedure “Actions required by signalling personnel following signalling Irregularities” 8110-600-040 Rev 2.00. The procedure includes a 45 point inspection list that is required to be completed following a level crossing accident and it is noted that was not undertaken in relation to this incident. It is recommended that the decision to not undertake the full inspection report be reviewed and the outcome of the review used to inform the decision making process for Network and Infrastructure Signals personnel;
- b. Breath testing for the presence of alcohol was conducted on the Railcar Driver of 5604C at the scene of the collision by WA Police, and AOD testing was conducted at Claisebrook in line with PTA Policy and procedures. It is recommended that clarification is sought from the WA Police service with regard to their intention to test rail personnel for blood alcohol content following serious rail safety incidents at level crossings;
- c. Network and Infrastructure have lodged a risk in Riskbase identified as NI\_Divisional -07, Safety – Failure to Manage Level Crossing Protection to ALARP. The risk was entered on 8 May, 2012 with an acceptance date of 8 November, 2013 and is listed as under review. It is noted that the assessment due date for the controls was 7 June, 2012 which has not been actioned, it is recommended that this risk is managed as soon as possible; and
- d. The Operations Manager reported calls were received from a number of the PTA Executive which caused phone congestion suggesting that all calls should be coordinated through the General Manager TTO in any future similar events. It is recommended that the General Manager TTO liaise with members of the executive team to provide updates from site as advised by the Operations Manager for any future such events and the



Emergency Management Manual be revised to reflect this requirement.

#### 9. Recommended Safety Actions – Swan Transit

- a. Disciplinary action is taken against the Bus Driver for serious misconduct in that he negligently failed to take the appropriate safety precautions when attempting to traverse the railway level crossing at Maddington Station located on Kelvin Rd; (Action already undertaken 6 (c))
- b. While the environment and physical conditions around the Maddington Station's level crossing did not contribute to the accident it is believed it would still be prudent to conduct fresh risk assessments on level crossings within Swan Transit contract areas; (Actions Already Undertaken 7 (b))

#### 10. Non Contributory Recommendations – Swan Transit

- a. Review driver training in the safe negotiation of level crossings; even though this training was not seen to be a contributing factor in this accident undertake retrospective training of all current Swan Transit staff due to the consequences of any similar error;
- b. Workshop vehicles to be equipped with an extension ladder so that at the scene of an accident there is access to the CNG shut off valve located on the roof of an OC500LE CNG bus;
- c. Risk assessment and a job safety analysis conducted in the use of a ladder to access the roof of an OC500LE CNG bus at the scene of an accident to shut of CNG supply to the engine; and
- d. Investigate with the PTA the feasibility of installing a method or system which will allow CNG shut off valve located on the roof to be operated remotely without the need for someone to physically climb up onto the roof to gain access to the valve. (Significant work has been undertaken by the PTA in relation to providing an alternative method of operating the gas shut off valve)



**Appendix 1 – Copy of the Transperth Safety Bulletin, 01/2013, issued by OSH Coordinator Transperth, Regional and School Bus Services, 25 September, 2013. (Paragraph 1.15, P 20)**

## **RAILWAY CROSSINGS**

The purpose of this **SAFETY BULLETIN** is to bring your attention to the hazards associated with controlled **RAILWAY CROSSINGS** particularly in view of the required reaction and stopping distance of a bus.

Safe driving behaviours underpin the Transperth's endeavours to deliver a high level of safe, reliable and comfortable customer service. One of the key areas of known safety risks for driving is the failure to manage the approach to and exit from roadway hazards such as railway crossings.



The WA Road Traffic Code 2000, states:

- Rule 102, (1) - A driver shall not enter a level crossing if an approaching train is visible or emits an audible signal and there is danger of collision between the driver's vehicle and the train, and the driver shall not proceed until he or she has ascertained that in the circumstances it is safe to do so. Penalty – 4 points.
- Rule 102, (2) - A driver shall not enter a level crossing where twin alternating red lights are flashing or a warning bell is ringing at or near the level crossing, and the driver shall not proceed until the lights or bell have ceased to flash or ring unless otherwise directed or instructed by a railway employee. Penalty – 4 points.

Bus drivers must consider the following points when approaching a railway crossing:



- Approach the crossing at a speed that will allow the bus to be brought to a stop without heavy braking or cause passenger alarm or discomfort;
- Do not rely on the crossing warning systems alone. A quick look observation, in both directions, during the approach is required;
- Ensure that when travelling in a traffic queue, that;
  - 1) There is a sufficient separation distance to allow an unimpeded view of the approach to the railway crossing; and
  - 2) Do not enter a level crossing until there is sufficient distance to traverse your whole bus over the crossing and fully exit on the other side.
- When approaching a railway crossing signal that is activated, all drivers are required to stop their vehicles prior to entering the crosshatched area marked on the road.

Further direction on actions to be taken should a crossing become inoperable or if the bus becomes stuck at a crossing is provided within the Transperth Service Handbook – Section 9, Transperth Bus System - Operational Rules.



Appendix 2 – Emergency response details (Paragraph 1.22, Page 29)

Emergency Management Input Details

<b>Incident ID:</b>	25360		
<b>Username:</b>	George Compton		
<b>Position:</b>	PTA Incident Team		
<b>Operation Centre:</b>	Central Monitoring Room		
<b>Date/Time Detected:</b>	23/10 1441hrs	<b>Date/Time Response Ended</b>	23/10 1733hrs
<b>Incident Status:</b>	Closed		
<b>Incident Type:</b>	Rail Crossing Incident	<b>Level of Emergency:</b>	Level 1
<b>Description:</b>	Train vs. Bus Kelvin Rd. CCTV reviewed and shows Bus overhanging up main due to traffic lights and traffic build up. Up service bus has struck rear of bus on approach to platform causing bus to spin around. Approx 50 passengers on train and no passengers reported on bus. Camera 301 @ 1440 hrs refers incident. Emergency services and relevant parties contacted. Refer Webeoc updates.		
<b>AR Number:</b>	231013144087008	<b>Service Num:</b>	
<b>Train /Driver Info:</b>		<b>Camera Number:</b>	301/601
<b>Attachment:</b>			
<b>Attachment 2:</b>			

Rail Line Information

<b>Rail Line:</b>	Armadale <b>Turn Around Points:</b> Gosnells, Cannington	<b>Closest Station:</b>	Maddington	<b>Camera Number:</b>	301/601
<b>Signal or Mast No.</b>					

Standard Operating Procedures NOTIFICATIONS

<b>Emergency Callout System</b>	Activated	By: George Compton	At: 23/10 1446hrs	
<b>WAPOL</b>	Called: Yes 23/10 1446hrs	Arrived On Site: Yes 23/10 1447hrs	Off Site: No	
<b>FESA</b>	Called: Yes 23/10 1456hrs	Arrived On Site: Yes 23/10 1456hrs	Off Site: No	
<b>St John Ambulance</b>	Called: Yes 23/10 1450hrs	Arrived On Site: Yes 23/10 1456hrs	Off Site: No	
<b>PTA Media Manager</b>	Called: Yes 23/10 1500hrs	Arrived On Site: Yes 23/10 1500hrs	Off Site: No	
<b>Perth Station Coordinator</b>	Called: Yes 23/10 1502hrs	Rail Replacement: Yes 23/10 1502hrs		
<b>Operations Manager</b>	Called: Yes 23/10 1456hrs	Arrived On Site: No	Off Site: No	
<b>Ticketing &amp; Performance Manager</b>	Called: Yes 23/10 1517hrs	Arrived On Site: No	Off Site: No	
<b>Transit Manager of</b>	Called: Yes	Arrived On Site: Yes	Off Site: No	GS 1520hrs JK



**INVESTIGATION REPORT**

**FINAL REPORT**

<b>Security</b>	23/10 1445hrs	23/10 1520hrs		1530hrs
<b>Safe Working and Investigations</b>	Called: Yes	Arrived On Site: Yes	Off Site: No	
	23/10 1508hrs	23/10 1508hrs		
<b>POWER, GAS, WATER</b>	Called: No	Arrived On Site: No	Off Site: No	
<b>MAIN ROADS WA</b>	Called: No	Arrived On Site: No	Off Site: No	
<b>LOCAL GOVERNMENT</b>	Called: No	Arrived On Site: No	Off Site: No	
<b>WORKSAFE</b>	Called: No	Arrived On Site: No	Off Site: No	
<b>Other:</b>	Called: No	Arrived On Site: No	Off Site: No	

**RESPONSE ACTIONS**

<b>DEPLOY TRANSIT/TRANSPERTH SECURITY OFFICER</b>	Called: Yes	Arrived On Site: Yes	Off Site: No	
	23/10 1446hrs	23/10 1500hrs		
<b>Electrical Control Officer</b>	Called	By: George Compton	At: 23/10 1517hrs	
<b>Overhead De Energised</b>	Yes	By: George Compton	At: 23/10 1517hrs	
<b>Overhead Re Energised</b>		By:	At:	
<b>Train Control</b>	Called	By: George Compton	At: 23/10 1452hrs	
<b>Train Movements Stopped</b>	Yes	By: George Compton	At: 23/10 1452hrs	
<b>Train Movements Resumed</b>		By:	At:	
<b>Overhead Line Crew</b>	Called: No	Arrived On Site: No	Off Site: No	
<b>Overhead Isolated</b>	Yes	By: George Compton	At: 23/10 1517hrs	
<b>Overhead Activated</b>		By:	At:	
<b>Handover to WAPOL</b>	Yes	By: George Compton	At: 23/10 1446hrs	
<b>Crisis Management Group</b>				