



Review of Road Safety

Cyclist interaction within the mixed running alignment, Newcastle Light Rail

Executive summary

This independent safety review has been conducted to determine the appropriate measures needed to help reduce risks to cyclists in the mixed running section of the Newcastle Light Rail (a mixed running alignment is when a tram shares the travel lane with general traffic and cyclists).

Tragically, on the evening of 10 July 2019 a local cyclist lost their life in a crash at the intersection of Scott Street and Pacific Street. This crash is being investigated by the NSW Police Force. We express our sincere condolences to the cyclist's family and friends.

Given this tragic incident, it has become clear that more needs to be done to help reduce the risks to cyclists in a mixed running light rail environment.

To complete this review, Transport for NSW (TfNSW) Centres for Road Safety and Maritime Safety (CRSMS) worked closely with TfNSW representatives from Assets Standards Authority (ASA), Sydney Coordination Office (SCO), Infrastructure and Place Division, Corporate Services, Office of the Secretary, Roads and Maritime Services (RMS); the operator of Newcastle Light Rail, Keolis Downer; City of Newcastle; and the NSW Police Force.

The review has put specific focus on the risk evaluation process during the design and construction process, particularly in terms of cycling safety.

The specific risk of a bicycle tyre getting caught in the rail gap was identified during project design and construction. Using an industry accepted approach, that particular risk was given a 'high' rating at that time. The 'high' rating was primarily based on two factors; the potential expected serious injury outcome, and the low expected frequency of the event occurring. During design and construction the project team implemented a range of measures in line with those implemented on other light rail networks to mitigate this high rating risk, including safety communication campaigns and signage.

As part of this review an independent road safety audit was commissioned to assess cycling safety in the mixed running section following the fatality. This audit used the same risk frameworks applied in previous audits in terms of the expected injury outcome and frequency (or chance) of the event occurring.

The audit differed from the previous (pre-opening) audits as it found there was a higher chance of the risk being realised. The higher predicted frequency resulted in the risk rating for this event increasing from 'medium' or 'high' to 'intolerable'.

This review has made eight recommendations to improve bicycle rider safety.

The chief recommendation is for TfNSW to prioritise actions to prohibit cyclists from riding in the 340 metre mixed running section, including implementing appropriate signage. This is a recommendation supported by NSW Police.

Another recommendation calls for Transport for NSW to work with City of Newcastle to provide suitable alternative paths for cyclists as soon as possible. These alternative paths should be communicated to cyclists in Newcastle and the wider community.

While Newcastle is the only light rail network in NSW with mixed running, the risks identified in this report and subsequent mitigation strategies should be shared with those other networks/operators to ensure consistent environments across the NSW network.

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1 Introduction and scope of the review

On the evening of 10 July 2019, there was a bicycle crash at the intersection of Scott Street and Pacific Street in Newcastle that resulted in the death of the bicycle rider. From reviewing CCTV, it appears the rider's front wheel became stuck in the light rail track on the southern side of the road, at which point the rider lost control and fell on to the road. A coroner will establish the exact cause of death.

The Newcastle Light Rail crosses this intersection in a mixed running alignment – that is, trams share the travel lane with general traffic and cyclists. This review will focus on cyclist safety through the alignment, including cyclist interactions with the light rail network infrastructure, trams, other road traffic and pedestrians.

While the NSW Police Force lead on crash investigations and reports to the coroner, this report provides an independent road safety review of the mixed running alignment of the Newcastle Light Rail network. Its purpose is to provide an independent road safety review of the current risks to cyclists on the mixed running alignment. Although Newcastle is the only light rail network in NSW with mixed running, all identified preventative measures should be extended to other networks where possible to increase safety through consistent environments. This report does not address project management or project governance matters.

To complete this review, Transport for NSW's (TfNSW) Centres for Road Safety and Maritime Safety (CRSMS) has worked closely with TfNSW representatives from Assets Standards Authority (ASA), Sydney Coordination Office (SCO), Infrastructure and Place Division, Corporate Services, Office of the Secretary, Roads and Maritime Services (RMS); and the operator of Newcastle Light Rail Keolis Downer; City of Newcastle; and the NSW Police Force.

2 Context to the review

This section identifies the NSW Government's road safety commitments, and the Safe System principles that underpin those. It also provides an overview of the responsibilities of different stakeholders within Newcastle and how a fatal crash is generally responded to in NSW.

2.1 Road safety is a key priority for the NSW Government

The NSW Government is committed to reducing the rates of fatalities and serious injuries resulting from road-related crashes in NSW. Achieving a 30 per cent reduction in the number of fatalities by 2021 (from 2008-10 levels) is a State Priority Target – and the NSW Government has identified using roads safely as a priority area for action.

The NSW Government is also committed to the Towards Zero vision within *Future Transport 2056*, which aims to have a NSW transport network free of death and serious injury by 2056.

Underpinning the Towards Zero vision is the internationally recognised Safe System approach to road safety, which is a holistic and proven approach.



The four pillars of the Safe System

The core Safe System principles are:

- Fatalities and serious injuries should not be accepted. 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. When one or more pillars of the system fail, the rest of the system should pick-up the load to ensure no one is killed or seriously injured.
- People make mistakes; but that shouldn't cost anyone their life. Human error is inevitable and therefore, crashes are inevitable.
- Humans are vulnerable. The human body has physical limits to withstanding the impact of a crash.

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.

2.2 Roles and responsibilities within the context of the review

CRSMS is responsible for developing practical solutions to reduce deaths and serious injuries on NSW roads, and administers the Community Road Safety Fund to deliver road safety programs across NSW. CRSMS has been tasked with leading this road safety review on behalf of TfNSW and in collaboration with other TfNSW branches; RMS; City of Newcastle; Keolis Downer; and the NSW Police. CRSMS is considered to be in a position to provide an independent safety review as it had no direct role in the project design, development and delivery.

The Newcastle light rail corridor has been declared a 'transitway', giving the NSW Government control over the alignment from boundary to boundary. As a key implementation partner, RMS's role is to build, manage and maintain state road networks and assets, while the City of

Newcastle is responsible for the surrounding cycleways. The light rail network is operated and maintained by Keolis Downer under contract to TfNSW.

While the enforcement of the NSW Road Rules is a primary responsibility of the NSW Police, TfNSW leads the development of a safe, efficient and integrated transport system that keeps people and goods moving, connects communities and shapes the future of NSW cities, centres and regions.

2.3 Responding to fatal crashes on State roads

When a fatal crash occurs on NSW State roads, the NSW Police attends, investigates and develops a crash report. Police can work with RMS Vehicle Inspectors to investigate the roadworthiness of vehicles involved.

Police provide information about the crash to CRSMS, as input to a Fatal Crash Report outlining the time, date, location, vehicles, traffic control devices and traffic movements involved in the crash. CRSMS provides such Fatal Crash Reports within NSW and Local Government, and also maintains a database of NSW crash data for the analysis and design of road safety programs across NSW.

Investigations are also conducted under general TfNSW/RMS procedures and relate to particular road safety issues, crashes and crash patterns at specific locations. The investigations have the aim of determining what action is necessary to address or ameliorate risks at specific locations.

Investigations can result in actions such as a proposal for a road improvement project in safety, asset management or other programs, minor sign posting, line marking improvements, or maintenance work. Where there is a low risk or it is not reasonably practical to remedy a risk there may be no action.

3 Project overview

The NSW Government is revitalising the Newcastle City Centre. The revitalisation reinforces the city's role as a 21st century regional centre, unlocks the potential of the city centre as a place that can meet the needs of the current and future community, and boosts economic activity across the Hunter Region.

NSW investment via the Newcastle Urban Transformation and Transport Program (NUTTP), publicly known as Revitalising Newcastle, is more than \$650 million. The aims of the program are to bring people back to the city centre by strengthening connections between the city and the waterfront, creating employment opportunities, providing more public space and amenity, and delivering better transport.

3.1 Newcastle Light Rail

TfNSW Infrastructure and Place Division managed the Newcastle Light Rail Project under the TfNSW Rail Infrastructure Manager accreditation from the Office of the Rail Safety Regulator (ONRSR). The design and construction of the light rail infrastructure was completed by Downer EDI under a Managing Contractor arrangement with TfNSW.

Newcastle Light Rail network is 2.7 kilometres of light rail track from the Newcastle Interchange at Wickham to Newcastle Beach. There are six stops along the way, starting at the Newcastle Interchange, Honeysuckle (near Hunter Street TAFE), Civic, Crown Street, Queens Wharf and Newcastle Beach.

Trams run every seven and a half minutes each way between 7am and 7pm Monday to Friday, and every 15 to 30 minutes outside of these times, with services every 15 to 30 minutes on weekends. The alignment is predominately signed and delineated as a tramway under the road rules, restricting access to trams, tram recovery vehicles and public buses. The exception is the mixed running section, where the tram tracks run in the middle of the general traffic lane and are classified as a road meaning bicycle riders are permitted to ride along the section.

The alignment is illustrated below in red.



Light Rail alignment between Newcastle Transport Interchange and Pacific Park

The light rail network is configured in three different ways, depending on the location:

Segregated running

- In the previous rail corridor where there is no interaction between the trams and road traffic other than at designated intersections (approximately 600 metres)
- In the vicinity of Newcastle Beach stop at Pacific Park – between the intersection of Scott Street and Pacific Street, and the terminus located near the intersection of Scott Street and Telford Street (approximately 60 metres)

Separated running

- Along Beresford Street where the light rail corridor runs along the northern lane adjacent to a one-way traffic lane (approximately 140 metres)
- Along Hunter Street where the light rail corridor runs along the two centre lanes adjacent to traffic lanes (approximately 1.3 kilometres)

Mixed running

- Along Scott Street where the light rail corridor is shared with road traffic lanes (approximately 340 metres)

3.2 Mixed running section

The mixed running section of the network is on Scott Street, between Newcomen Street and Pacific Park, and is approximately 340 metres in length. It is an area where the trams share the road with other traffic and cyclists, and all road users are generally required to treat trams the same as any other vehicle under the road rules.

Mixed areas are distinguished by full width concrete pavement with tracks integrated into the road. The width of the road varies, however it is around 4.2 metres from kerb to kerb to accommodate vehicles, cyclists and Light Rail Vehicle (LRV) passage.

The image below shows an overview of the mixed running alignment, followed by an indicative image of the mixed running section.



Overview of mixed running alignment



Indicative mixed running alignment

At the start of the mixed running section is a signalised intersection. LRVs have priority at these signals which reduces the risk of road vehicles merging into LRVs. Traffic lights throughout most of the network are coordinated to give priority to LRVs with the exception of Stewart Avenue. Signalised pedestrian crossings are at Newcomen, Watt and Pacific streets.

4 Newcastle cycling network

This section summarises the existing cycling network within Newcastle and also the publicly available proposed future networks to provide context for how cyclists move around the network and where missing links may exist.

4.1 Cycling network in Newcastle CBD

City of Newcastle manages the bicycle network within the Newcastle LGA, with comprehensive information available on their website about available paths, degree of difficulty and tips for staying safe.

In 2012 Council issued the *Newcastle Cycling Strategy and Action Plan* that represents Council's commitment to enhancing cycling in Newcastle. The plan builds on Council's earlier bike plans and strategies and outlines plans for expansion and upgrade of the network, in addition to actions for advocacy, promotion and education.

The Newcastle Cycleways map shows the existing cycleways, recommended connecting routes and some of the proposed future works for the whole local government area. The section on the Newcastle CBD is pictured below.



Overview of Newcastle Council's identified cycle routes

RMS has provided Strava (cycling application) data, which indicates significant cyclist demand along Scott Street.

4.2 Revitalising Newcastle

Revitalising Newcastle was a multi-agency NSW Government initiative coordinated by the Hunter and Central Coast Development Corporation, focused on activating the city to attract people, jobs and tourism.

In May 2017, Revitalising Newcastle released the Newcastle City Centre Cycleway Network Strategy. The strategy carefully considers the role cycling plays in providing access in the city centre.

While cycling infrastructure is ultimately a local government responsibility, just as public transport and the state road network are the responsibility of NSW Government; the strategy

was prepared to consider the interface between light rail and a cycleway for Newcastle’s city centre.

The strategy demonstrates a well-connected city centre-wide cycleway network that can be delivered and co-exist with Newcastle Light Rail in the future. In the interim, the risks identified in this report will need to be managed to ensure cyclists are provided safe and connected environments.

While the NSW Government will deliver the infrastructure and service improvements required to improve public transport in the city, ongoing Council led planning and delivery will be needed to achieve corresponding improvements in active transport networks.

The strategy identifies the proposed network within the Newcastle CBD, and is pictured below.



Newcastle City Centre proposed cycleways

4.3 Other proposed Newcastle City cycling infrastructure

Further to the above proposed cycling links, the City of Newcastle published the *Hunter Street Newcastle East End Stage One Streetscape Plan* in March 2018. The Plan has been prepared for the City of Newcastle to guide the design of the public domain within the study area located within the Newcastle East End precinct. The study focuses on the upgrade of Hunter Street between the intersection with Scott Street to the west, and the intersection with Newcomen Street to the east.

The concept master plan identifies future upgrades to this section of Hunter Street, including the provision for a bi-directional cycleway. This is a long term solution to provide an alternative, high quality, cycling route away from the light rail network that removes the road safety risks associated with cyclists riding along tracks and interacting with trams.



Concept master plan of future Hunter Street development

5 Risk analysis

Cyclists are considered vulnerable road users as they do not have the same protection as vehicle drivers, and often sustain serious injuries in the event of a crash. Interactions with trams and light rail infrastructure present further risks to cyclists. The main risks light rail networks present to cyclists are:

- Being struck by a tram
- Slipping on the track, especially in inclement weather
- Getting bike wheels caught in the rail groove and being thrown from their bike.

This section summarises how risks to cyclists interacting with light rail are treated in other jurisdictions, and what risk analysis and mitigation strategies were implemented throughout the design in Newcastle. It then provides details of analysis carried out since the fatal crash, including a stakeholder site investigation and an independent road safety audit.

5.1 Standards and international benchmarks

During the development of the Concept Design, Light Rail Engineering Standards were further developed in collaboration with ASA to identify the standards and guidelines to be adopted to design, procure, build, test, commission, maintain and operate the Newcastle Light Rail.

ASA is the TfNSW branch tasked with developing standards for light rail within NSW. ASA is focused on providing corporate frameworks, governance, asset assurance and advice to support an integrated transport system for NSW. Functions include asset management assurance and standards, supplier accreditation through Authorised Engineering Organisation (AEO) scheme, organisational management systems, safety systems and environmental policy to enable the transport cluster and service providers to deliver transport outcomes efficiently, effectively and safely.

ASA advised that the first Technical Note relating to light rail, TN025, was published on 16 May, 2016. This was superseded by a revised TN078, published on 3 November, 2016. These two Technical Notes were published after the Newcastle Light Rail project had started design consultation and design tasks with their chosen contractor.

However, the standards and guidelines referenced by the project are listed in Section 4 of the Newcastle Light Rail Final Preliminary Design Report (Project No 2177439D). Of note to cyclist safety is the specific reference to the Austroads Guide to Traffic Engineering Practice, which assists planners and engineers in providing cycling facilities.

Research has been undertaken throughout the world on cyclist interactions with light rail, including a study conducted by Alta Planning & Design in Portland, USA (2008). The internationally accepted benchmark is to achieve minimum cyclist crossing angle of 60 degrees, with a 90 degree or right angle crossing considered the safest outcome. Below this level, the risk of a bicycle wheel becoming trapped in the rail groove increases.

The exception to this is the Dutch Design Manual for Bicycle Traffic (2017) which indicates that cyclists should be able to cross the rails at an angle of at least 45 degrees, but preferably more than 60 degrees.

5.2 Risk analysis undertaken by the Newcastle Light Rail project

A range of risk assessments were completed throughout the design and post construction phase of the project. These included assessments of mixed running; Road Safety Audits for concept, design and post construction; Quantitative Risk Analysis (QRA); safety assurance reports; and Independent Safety Assessor (ISA) reports. A comprehensive risk register was also completed.

The Independent Certifier (IC) was required to review, comment on, and subsequently approve and issue certificates for all design submissions for the Fixed Infrastructure and Systems Integration prior to each phase of the project lifecycle.

5.2.1 Mixed running assessment

In support of a position paper prepared by TfNSW, the Technical Advisory Team produced a report explaining the selection process undertaken for the selection of the most appropriate alignment types. The report illustrated through a Multi-Criteria Analysis why the preference for separated running was adopted along Hunter Street. It also outlines why mixed running was chosen for Scott Street as no alternative exists given the reduced road width of Scott Street. The length of the mixed running section was minimised as far as possible given project constraints.

5.2.2 Road safety audits prior to opening

A road safety audit is a formal examination of proposed or existing roads and road related areas from the perspective of all road users with the intention of identifying road safety deficiencies and areas of risk that could lead to road crashes. It does not consider crash history, and is conducted by a qualified team of professional's independent to the design process.

Road Safety Audits have been carried out through the concept, design and post construction phases of this project, with the following mixed running alignment risks being highlighted at different stages.

The initial concept design road safety audit, carried out in February 2016, identified a number of risks to cyclists throughout the mixed running section including the risk of parked vehicles opening doors into the path of passing cyclists (High); loss of traction on the track slab (High); wheels becoming caught in the rails (High); and confusing delineation at the entries and exits to the mixed running (High/Medium). The designers confirmed that Scott Street was not a known cycle route and there was insufficient space for dedicated bicycle facilities along this section of the alignment. Mitigation measures to address the risks were identified as education and awareness, driver training and added delineation.

A detailed design road safety audit, carried out in August 2017, reiterated the risk that the trams and tracks present to cyclists throughout the mixed running (High) as well as the lack of dedicated bicycle facilities along the alignment further encouraging cyclists to ride along the tracks (High). The mitigation measures proposed were signage and awareness campaigns to educate the public of the risks and appropriate safe behaviours.

A pre-opening road safety audit, carried out in October 2018, again raised the risks of cyclist wheels being caught in the rail groove (Medium) and confusing delineation at the entries and exits of the mixed running (Low). The risk was assigned a Medium rating as it was the opinion of the auditors that a cyclist's wheel was more likely to fall into the rail at slower speeds with less serious injuries as a result. Additional risks raised included the presence of rail points across pedestrian and cyclist crossings (Medium), and the risk of drivers attempting to overtake cyclists riding between the kerb and outside rail and encroaching on the legalised one metre safe passing distance (Medium). The designer response confirmed that temporary signage had been installed and RMS was developing a signposting plan for permanent signage, as well as the need for more permanent delineation and extension of the red tram only pavement markings.

5.2.3 Quantitative risk assessment

A Quantitative Risk Assessment (QRA) was completed on the Newcastle Light Rail Detailed Design to estimate the safety risk profile of the Newcastle Light Rail project for passengers, works (depot and tram drivers) and members of the public. QRAs are undertaken to

demonstrate the individual risk criteria which require a more analytical approach that safety requirements are met.

The QRA did not contain a hazard specifically relating to cyclists and light rail infrastructure. This is likely due to the focus of the QRA being placed on the risks of a pedestrian or cyclist being hit by a light rail vehicle. This was considered to be the most likely event occurring involving a light rail in the mixed running section.

5.2.4 Safety Assurance Reports

Safety assurance activities for the Newcastle Light Rail have been undertaken by Nova Systems, on behalf of Downer as the systems integrator, and detailed in the Final Safety Assurance Report. These safety assurance activities were undertaken to enable the eventual handover of an Newcastle Light Rail asset that can be deemed fit for purpose and acceptably safe ie. So Far As Is Reasonably Practicable (SFAIRP). Under section 46 of the National Rail Safety National Law, duty holders are required to either eliminate risks so far as is reasonably practicable; or if it is not reasonably practicable to eliminate risks to safety, to minimise those risks so far as is reasonably practicable.

The Safety Assurance Report (SAR) presents safety claims and supporting arguments that, as far as applies to the scope of works covered by the SAR, the Newcastle Light Rail project and any assets to be handed over are acceptably safe when operated and maintained within the End User's protocols and limitations, i.e. all identified safety hazards are eliminated where practicable or residual safety risks mitigated SFAIRP and assessed as tolerable.

5.2.5 Hazard management process

The hazard management process, guided by the *Rail Safety National Law (2010)* and the *WHS Act (2011)*, ensures all reasonably foreseeable safety risks are identified and effectively managed through elimination or mitigation. The hazards identified were assessed in accordance with the *TfNSW Risk Assessment Consequence Criteria and Risk Matrix*. Three hazards relating to cyclists were identified – the risk of cyclists falling on the track form, cyclist and wheelchair wheels caught in the track groove, and visibility issues between cyclists and trams. All hazards were identified as compliant or not applicable, with the risk of falling on the track form resolved for designs, and the remaining risks transferred to operations.

5.2.6 Hazard log

The hazard log is the main risk register for the project that identifies each risk, the TfNSW safety risk rating, and details the evaluation and treatment of that risk. The identified risks to cyclists are summarised below, and the subsequent treatments and mitigation measures will be provided in the Section 7.1 of this report.

The hazard log identified seven relevant risks to cyclists. All were assigned a risk rating of C (Medium – tolerable), with the exception of cyclists and skateboarders falling on track form which was assigned a risk rating of B (High – undesirable). The risks identified include:

- Slip and trip hazard to rail at all crossings
- Light Rail Vehicle (LRV) collision with pedestrian or cyclists
- Cyclists and skateboarders falling on track form
- Pedestrians, cyclists and wheelchairs are caught in rail groove
- Cyclists hitting pedestrians
- Visibility issues leads to collision of LRV with pedestrian, cyclist or other road user

5.2.7 Independent Safety Assessor

The purpose of the Independent Safety Assessor (ISA) is to provide an independent safety assessment that the project has been undertaken with the application of appropriate safety

assurance process, in line with the level of risk, delivering assets and services where safety risks have been mitigated (SFAIRP). The ISA formed the opinion that the safety arguments for the system were appropriate and adequate.

The judgements on safety arguments must be made progressively throughout the stages of the project, with a number of assurance documents and reports issued by the ISA at significant design stages, completion of the construction stage, completion of testing and commissioning and for the final operational safety argument.

The ISA assesses each stage of the safety argument. The assessment is to ensure and confirm that relevant safety requirements, system assurance processes and supportive evidence-based documentation required for delivery and bringing the Newcastle Light Rail into service have been undertaken to a sufficient level through the use of a structured review process involving assessment and audit.

The ISA scope covers the safety of passengers, Newcastle Light Rail workers, pedestrians, cyclists and road vehicle drivers.

The ISA report – Fixed Infrastructure System Wide Detail Design, (November 2017) did not highlight any specific risks to cyclists along the alignment. However, the report did raise comments on responses and risk ratings in general. These were addressed at the time by the project team and closed out.

5.3 Summary of risk analysis before crash

A range of risk assessments were completed throughout the design and post construction phase of the project. These included assessments of mixed running; Road Safety Audits for concept, design and post construction; Quantitative Risk Analysis (QRA); safety assurance reports; and Independent Safety Assessor (ISA) reports. A comprehensive risk register was also completed.

The risk assessments identified the main risks to cyclists throughout the mixed running section:

- Being struck by a tram
- Slipping on the track, especially in inclement weather
- Getting their wheels caught in the rail groove and being thrown from their bike
- Wide travel lanes encourage motorists to pass cyclists when a safe one metre passing distance can't be achieved

These measures are in line with those implemented on other light rail networks, including safety communication campaigns and advisory signs warning cyclists of the track hazard.

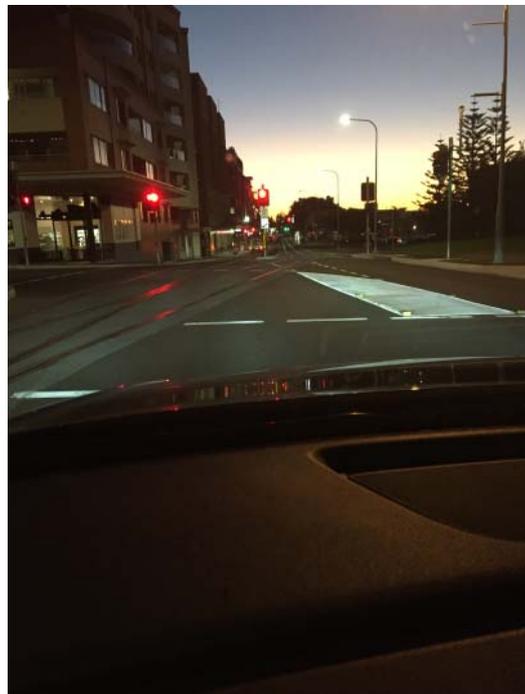
5.4 Site investigation following fatal crash

A site investigation and walkthrough of the mixed alignment section was carried out on Friday 19 July, 2019. Stakeholders involved in the walkthrough included TfNSW, RMS, City of Newcastle, NSW Police and Keolis Downer. The purpose of the walkthrough was to discuss the safety risks to cyclists and establish potential solutions to be considered for the mixed running section.

The main concern related to the commencement of the mixed running section at the intersection of Scott Street and Pacific Street (the same location where the fatal crash occurred). Cyclists travelling west bound along Scott Street are required to cross four separate tracks through the intersection, with the final two at an acute angle. Further analysis by RMS has confirmed crossing angles for cyclists are below the internationally recognised 60 degree minimum.



Calculation of cyclist crossing angles at eastern entry to mixed running section



Cyclist perspective of the entry to mixed running at Pacific Street

There is no advanced warning signage for cyclists on approach to this intersection, with temporary caution signage provided at the traffic lights following the intersection. The approach to the intersection and the temporary green signage is pictured below. The temporary signage was installed in the second half of 2018, in response to the pre-opening road safety audit identifying the risk of a bicycle tyre dropping into the rail.



Approach to and exit from intersection of Scott Street and Pacific Street

The available road width may not be sufficient to allow vehicles to pass cyclists without encroaching within the legally required metre. This issue was raised in the road safety audits on 2 February, 2016 and 24 October, 2018. The alternative is for a cyclist to 'take the lane'. However, this can increase the risk of a cyclist getting their wheel stuck in the rail. The mixed running signage depicts cars and trams and not bicycles.



Lane width through the mixed running section

5.5 Independent road safety audit following fatal crash

TfNSW engaged Jacobs Group (Australia) Pty Ltd to carry out an existing conditions road safety audit of the mixed running section. The audit was carried out on 23 July, 2019 and a final audit report was provided to CRSMS on 9 August, 2019.

The road safety audit was an independent identification of potential safety hazards, regardless of current practices, standards and operations, undertaken by a team of qualified road safety auditors and a specialist cyclist advisor. The audit team had no previous involvement in the design or construction of the works, and the audit was carried out in accordance with the Austroads *Guide to Road Safety: Part 6 Road Safety Audit* (Third Edition, 2009).

Since the fatal crash, the August 2019 road safety audit highlighted two road safety deficiencies (outlined below) have been classified as *intolerable*. In accordance with Austroads guidelines, they must be corrected. Before the fatality they had been independently rated as high-risk, based on an expected lower crash frequency.

- Scott Street westbound at Pacific Street – cyclists travelling westbound in the traffic lane are required to cross the light rail tracks at an angle that is not perpendicular
- Scott Street eastbound at Newcomen Street – cyclists travelling eastbound in the traffic lane are required to cross the light rail tracks at an angle that is not perpendicular

This audit differed from the previous (pre-opening) audits as it found there was a higher chance of the risk being realised. This issue is exacerbated by the lack permanent signs warning cyclists of the hazard. The higher predicted frequency resulted in the risk rating for this event increasing from ‘high’ to ‘intolerable’.

No.	Description of road safety deficiency	Photo of road safety deficiency	Crash frequency	Crash severity	Level of risk	Response to identified issue
1	<p>Scott Street westbound at Pacific Street – cyclists travelling westbound in the traffic lane are required to cross the light rail tracks at an angle that is not perpendicular. This presents a trap hazard for bike wheels with the potential for cyclists to fall onto the roadway into the path of oncoming traffic and light rail vehicles.</p> <p>This issue is exacerbated by the lack of permanent advisory signage warning cyclists of the hazard. The existing signage is temporary and is not positioned at the point of need, being located at the far end of the intersection after a cyclist has passed the hazard.</p>		Probable	Serious	Intolerable	
7	<p>Scott Street eastbound at Newcomen Street – cyclists travelling eastbound in the traffic lane are required to cross the light rail tracks at an angle that is not perpendicular. This presents a trap hazard for bike wheels with the potential for cyclists to fall onto the roadway into the path of oncoming traffic and light rail vehicles.</p> <p>This issue is exacerbated by the lack of permanent advisory signage warning cyclists of the hazard.</p>		Probable	Serious	Intolerable	

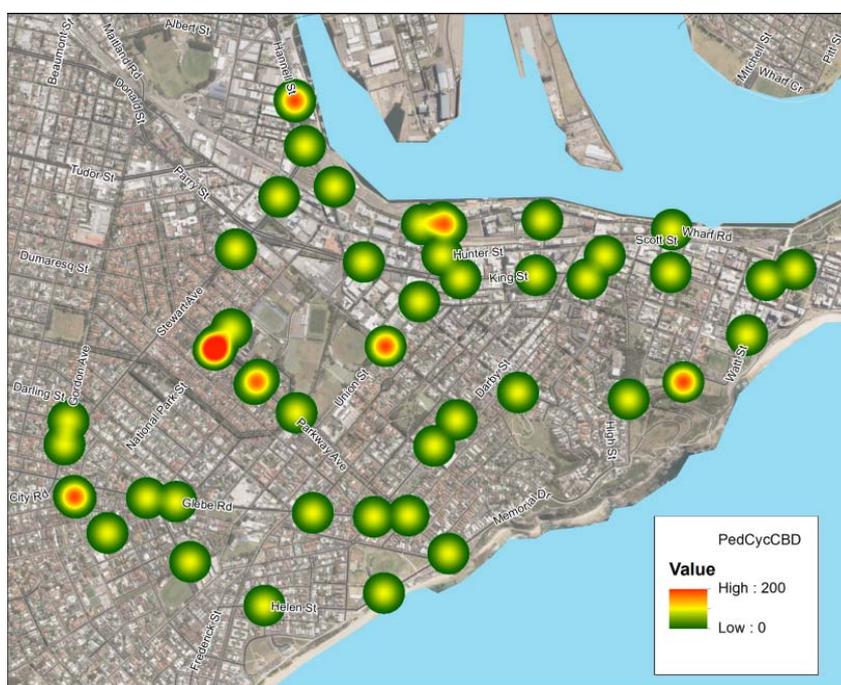
6 Crash analysis

This section analyses TfNSW data for crashes involving cyclists within the Newcastle LGA, and along the alignment. It also highlights other crashes that may not have been reported to NSW Police, and as a result are not available within the TfNSW crash data.

6.1 Cyclist crashes within Newcastle LGA

Between 1 July, 2014 and 24 July 2019, 52 crashes have been reported involving a cyclist in and around the Newcastle city centre (selected crash area below). Of these, 19 were serious injury crashes and one was a fatal crash. A separate fatality occurred in March 2019 when a cyclist was struck by a truck. This was considered a pedestrian crash in TfNSW crash data as the cyclist dismounted from the bicycle prior to the crash.

The majority of these crashes occurred at an intersection (62 per cent) and involved multiple vehicles (90 per cent). The weather was generally fine (90 per cent), with dry road conditions (90 per cent) and during daylight hours (77 per cent). All crashes were reported within speed limits at 60km/h or below.



Crash density map for crashes involving a cyclist since 1 July 2014

6.2 Cyclist crashes along the alignment

According to official TfNSW data, the fatality on 10 July 2019 is the only reported crash along the mixed running alignment involving a cyclist

6.3 Other cyclist crashes not reported

It is commonly known that cyclist crashes are generally under reported, they are often not reported to NSW Police and as such the crash data is not captured. On 16 November, 2018, the Newcastle Herald published an article: 'Cyclists say mounting Hunter Street accident toll a clear sign of a major problem' <<https://www.newcastleherald.com.au/story/5760276/newcastle-light-rail-an-accident-danger-say-cyclists/>>.

These incidents were not captured in TfNSW crash data at the time of writing this report. This is likely due to them not being reported to NSW Police.

7 Strategies for cyclist safety

This section identifies what mitigation strategies were implemented throughout the design, and provides further recommended strategies from other stakeholders following the fatal crash.

7.1 Current state

The reference design highlighted the following considerations to be taken into account during the detailed design:

- The need for a cycleway strategy to review options available to support the provision of a dedicated east-west cycleway that could potentially replace the existing cycleway along King Street. This was undertaken in consultation with relevant stakeholders, including Council and RMS. The public was invited to comment on the reference design.
- A targeted community safety campaign to be implemented to raise awareness in relation to the operation of light rail. The safety campaign, to be undertaken in the lead up to the opening and during operation, would focus on raising awareness and promoting safe behaviours at stops, in the separated and mixed running areas, and at key crossings.

TfNSW has implemented a range of measures to help cyclists stay safe when cycling along the light rail route on Hunter and Scott streets in Newcastle, including:

- Publishing safety information for cyclists and distributing this information to cycling groups around Newcastle, school students, libraries and members of the public via hard copy brochure and through social and traditional media channels. This safety information included advice for cyclists to cross the tracks at 90 degrees.
- Further to the above point, the operator also has information regarding cycling safety published on their website. This messaging is outlined in section 7.4 below.
- Designing light rail in consultation with City of Newcastle and RMS, and obtaining approvals from RMS, the principal road authority.
- Promoting the use of the existing cycling facility along Newcastle Foreshore, north of the light rail route.
- Installing temporary signs along the light rail route advising cyclists of the hazard posed by cycling on the tracks.

For each of the risks identified in the hazard log (Section 5.2.6 of this report), an evaluation and subsequent treatment and mitigation strategy was provided. These are summarised below.

The controls in place to reduce the risks were categorised as either Engineering controls or Administrative controls.

Engineering controls

- Create perpendicular crossings (90 degree angles) where possible
- Create designated crossing points
- Provide adequate wayfinding signage
- Provide alternative routes, including dedicated cycle routes and shared paths
- Lower traffic speeds to accommodate pedestrians and cyclists
- Wider travel lanes
- Provide visual (colour) and surface (texture) contrast to delineate rail corridor
- Ensure appropriate lighting levels provided
- Provide appropriate line marking and signage
- Install traffic calming measures where appropriate.

Administrative controls:

- Safety awareness campaigns
- Driver training, including when to ring the bell and sound the horn

- Vehicle lighting to signify to other road users tram movements
- Drivers to drive on line of sight
- Working with City of Newcastle on cycle strategy which directs cyclists away from the light rail corridor.

7.2 Road safety campaigns

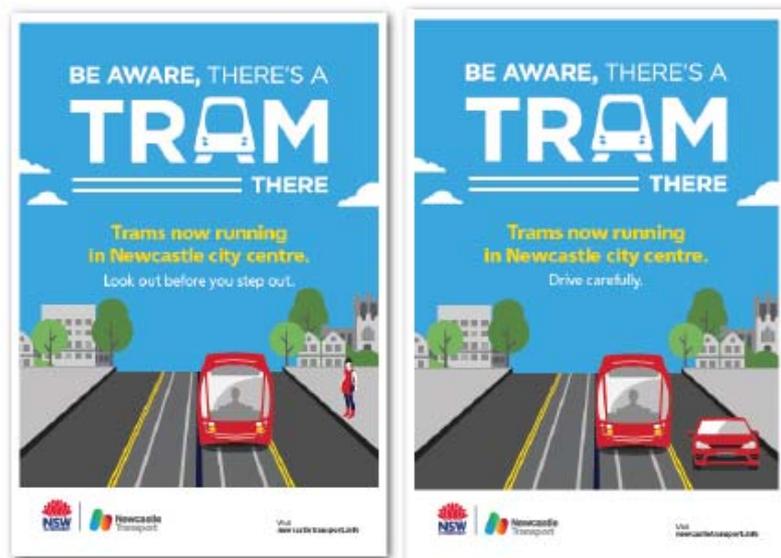
CRSMS undertook targeted research to identify the key road safety risks involved with on-street running of light rail, and understand the common misperceptions of light rail. This research was used to shape the TfNSW 'Be Aware, There's A Tram There' safety campaign, educating drivers, motorcycle riders, bicycle riders and pedestrians about how to safely move about near trams.

The objectives of the campaign were to:

- Generate awareness that trams are now operating and that the road conditions have changed
- Facilitate a heightened sense of safety and responsibility among all road users within concentrated precincts
- Interrupt habits and promote desired behaviours for each road user group.

The key considerations were to:

- Convey the new modern style of the light rail where feasible, through advertising, communications and media choices, and
- Role model positive road safety behaviours.



Be Aware, There's A Tram There creative look and feel

The campaign was rolled out across a number of channels over six months, including:

- Local press
- Digital banners and videos
- Social media
- Culturally and Linguistically Diverse (CALD) Social

In addition to the above safety messaging, the operator also has information regarding safety published on their website <<https://www.newcastletransport.info/light-rail>>. The following cycling specific safety tips are provided:

Follow the safety tips below to make sure you're safe around light rail.

 Safety for pedestrians

 Safety for drivers

 Safety for cyclists

- Take care near tracks, wheels can catch in the tracks or can slip and cause a fall. Slow down before crossing the tracks at intersections and try to cross at a right angle
- Use caution in wet weather as tracks and road markings may be slippery
- Remember light rail drivers have blind spots. Never assume the driver has seen you
- Don't ride on a tramway unless avoiding an obstacle such as a broken down vehicle
- Take the lane - ride in the centre of the lane to ensure approaching drivers can see you
- Always keep a safe distance from light rail vehicles
- When crossing the road, always use designated pedestrian crossings and dismount
- Consider using the existing off-road cycleway along Newcastle foreshore

7.3 NSW Police recommendations following fatal crash

The NSW Police preferred option is for the removal of cyclists from the mixed zone. The following are extracts from their submission to CRSMS following the fatal crash and site investigation:

NSW Police advocates for the complete removal of bicycles in the mixed running part of the light rail corridor. The amount of space available between the gutter and the first rail in this section allows for very little error on behalf of the rider before a crash is likely to occur. Moreover, the inability for vehicles to pass a cyclist safely puts added pressure on a cyclist to ride through this section of road as quickly as possible, and possibly even in a manner or at a speed that is beyond the capabilities of the cyclist, therefore increasing the likelihood of a crash. To support this decision the following should be considered:

Bi-Directional Shared Path

- Creation of bi-directional shared path utilising existing path on the northern side of Scott Street between Newcomen Street and Watt Street.

Restrict Bicycle Access on Scott Street between Telford Street and Pacific Street

- Due to the narrow lanes that run adjacent to the Newcastle Beach light rail stop and difficulty in placing any form of bicycle lane treatment on the road in that area.

7.4 Newcastle Cycleways Movement recommendations following fatal crash

The President of the Newcastle Cycleways Movement Inc has also provided a submission to TfNSW following the fatal crash and independent road safety audit. The submission outlines cyclist preferred low cost, high benefit, treatments to address the risk throughout the mixed running alignment. It addresses both eastbound and westbound riders and provides two treatment considerations, as well as the need to simplify signage and add a bicycle to the mixed running signage.

The submission recommends addressing risks to eastbound cyclists by converting the northern footpath along Scott Street to a shared path. It also suggests providing pavement markings for westbound cyclists to indicate a safe crossing angle at the intersection of Scott and Pacific Streets.

8 Recommendations

The aim of the recommendations below is to mitigate the road safety risk to cyclists posed by the mixed running alignment on the Newcastle Light Rail. These recommendations are in line with Safe System principles and TfNSW's commitment to zero deaths and serious injuries on the road network. The findings of this report will not only strengthen safety in Newcastle but will benefit the planning and design of other TfNSW projects.

Following consideration of the identified 'intolerable' risks to cyclists, the chief recommendation of this report is that cyclists should be excluded from using the mixed running section. The exclusion zone should not only apply at the intersection of Scott and Pacific streets but should extend to the entire 340 metre length of the mixed running section. This outcome is supported by NSW Police who also have also raised concerns with the ability for general traffic to maintain a safe passing distance with cyclists.

A safer alternative path for cyclists should be provided until a practical solution can be implemented to address the risk of bicycle tyres falling into the light rail tracks. TfNSW will work with industry to further develop potential solutions.

TfNSW will conduct rigorous risk assessments when changes are made to design configuration of road and light rail projects to ensure compliant and safe designs for all road users.

Learnings and recommendations from this report will be shared with other Transport for NSW light rail projects to prevent similar road safety risks and incidents.

The report recommends TfNSW complete the following eight actions:

Recommendations		
Safer Roads	Action 1	Cyclists to be excluded from the mixed running section and Transport for NSW to work with City of Newcastle to provide safe alternate routes. Appropriate regulatory signage and wayfinding to be erected ASAP.
	Action 2	TfNSW to communicate with the City of Newcastle and cycling groups within Newcastle on the changed conditions and appropriate safe paths of travel for cyclists following completion of Action 1.
	Action 3	TfNSW to review the entire route and install suitable permanent cyclist advisory signage to warn cyclists of the risk that the tracks present at all locations of obvious risk.
	Action 4	TfNSW to continue workshops with key stakeholders in order to investigate potential solutions and prioritise solutions for implementation that will remove or reduce the risks to cyclists.
Strategy and Policy	Action 5	TfNSW to review NSW Guidelines for Road Safety Audit Practices, with regard to the recently published Managing Road Safety Audits (2019) report published by Austroads, to ensure that a process is in place for all major projects to carry out road safety audits during design, construction and operation.
	Action 6	TfNSW to review formal standards and policies catering for cyclists within light rail networks. To ensure a safe system compliant design for all road users, cyclists should be considered in the initial design phases.
	Action 7	TfNSW to ensure that the learnings from this incident and subsequent report are passed on to other light rail projects within NSW to prevent similar road safety risks and incidents.
	Action 8	TfNSW to carry out market sounding and assessment of potential innovative safety technologies that would address the specific risk of bicycle and other wheeled vehicles being trapped in the tram tracks.