Moorebank Avenue – Anzac Road (MAAI) Works: Phase 2A

Post-Opening Road Safety Audit Report

March 2024

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TRANSPORT PLANNING & TRAFFIC ENGINEERING

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Contents

Appendices

1. Introduction

1.1 Background

BMD Constructions Pty Ltd (BMD) is the successful tenderer for the Design and Construction of the Moorebank Avenue Upgrade Works, which will involve two separate packages of work as follows:

1. Moorebank Avenue Upgrade Works (MAUW); and
2. Moorebank Avenue and Anzac Road Intersection Works (MAAI).

The scope of works involves the widening and upgrade of the existing Moorebank Avenue and Anzac Road signalised intersection and the raising and widening of the existing Moorebank Avenue for approximately 1.5 km adjacent to the Moorebank Precinct East (MPE) intermodal facility.

Moorebank Avenue is a privately owned, publicly accessible road currently used by commuters with larger traffic volumes in the morning and afternoon peak, and by warehousing tenants using Moorebank Avenue to access their respective warehouses in the precinct.

Moorebank Avenue / Anzac Road intersection (MAAI) and the Moorebank Avenue Upgrade Works (MAUW) include traffic and capacity improvements, changes in alignment to accommodate adjacent development levels and works to drainage and services requirements. These works are required to ensure that Moorebank Avenue has the capacity, integrity and ability to maintain its use as a publicly accessible major arterial road, and to facilitate operational access to the surrounding area.

During construction, the Moorebank Avenue / Anzac Road intersection has been arranged in a temporary layout to allow works to be undertaken in the vicinity of the intersection area. Some temporary / existing pavement will be available to maintain existing access for all movements at the subject intersection and along Moorebank Avenue.

This report details an independently undertaken post-opening stage road safety audit for the MAAI Phase 2A works area – refer to *Figure 1* following for the audit area. The audit was undertaken by *Samsa Consulting Pty Ltd*, Transport Planning & Traffic Engineering Consultants. The report has been prepared for BMD as part of its Project obligations.

1.2 Report Structure

The remainder of this report is presented as follows:

Chapter 2 describes details of the road safety audit undertaken including the methodology, administration and documentation audited.

Chapter 3 details the road safety issues identified and audit findings.

Chapter 4 provides a formal audit statement.

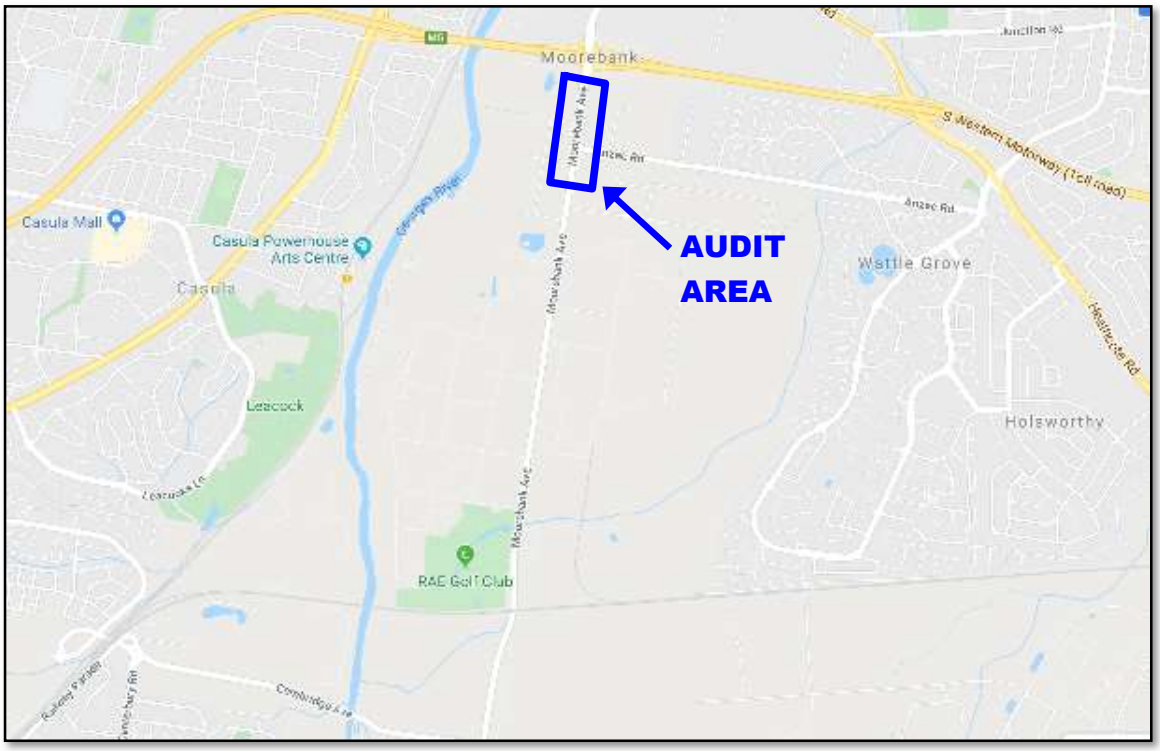


Figure 1: Audit Area and Location

2. Audit Details

2.1 Audit Methodology

A road safety audit is "*... a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project's crash potential and safety performance*" (Austroads 2009).

This post-opening audit followed a standard practice in identifying road safety related issues of the recently implemented temporary roadwork traffic scheme for the subject road section during the site inspections. It involved a desktop assessment of relevant design documentation and other related project material, as well as identification of issues on site during day and night inspections.

Standard issues such as road network approach conditions, site access layout, road user assessment, sight distance, speed zones, road alignment, linemarking and signage (amongst others) were assessed with respect to road safety.

The scope of the audit is in accordance with the requirements in Austroads' "*Guide to Road Safety, Part 6*" and is structured around prompt lists provided in that manual as well as RTA's "*Accident Reduction Guide – Part 2: Road Safety Audits*".

An audit commencement meeting was held with the BMD Senior Project Engineer where background information on the subject road section was discussed.

The post-opening site audit was undertaken on Monday 25 March 2024. An audit exit meeting was held at the completion of the road safety audit report.

2.2 Audit Administration

BMD Senior Project Engineer: [redacted]

Road Safety Auditors: [redacted] (*TfNSW Accredited Level 3 Lead Road Safety Auditor*)
(Auditor ID: [redacted])
[redacted] (*TfNSW Accredited Level 3 Lead Road Safety Auditor*)
(Auditor ID: [redacted])

2.3 References & Documentation Audited

- Austroads "*Guide to Road Design Part 3: Geometric Design (Edition 3.4)*", February 2021
- Austroads "*Guide to Road Design Part 4: Intersections and Crossings – General (Edition 2.1)*", February 2021
- Austroads "*Guide to Road Design Part 4A: Unsignalised and Signalised Intersections (Edition 3.1)*", February 2021
- Austroads "*Guide to Road Design Part 6: Roadside Design, Safety and Barriers (Edition 4.0)*", June 2022
- Austroads "*Guide to Road Safety, Part 6: Road Safety Audit (Edition 6.0)*", January 2022
- Austroads "*Guide to Traffic Engineering Practice: Part 13 – Pedestrians*", 1995
- Austroads "*Urban Road Design: A Guide to the Geometric Design of Major Urban Roads*", February 2003
- BMD "*TGS Plan D&D-BMD-TGS-163-MAAI Phase 2a Post-Switch*", 29/02/2024
- DM "*Traffic Signals at Moorebank Avenue and Anzac Road, Moorebank: TCS No.3094*" 23/03/2022
- Northrop "*Moorebank Avenue Works, Moorebank Avenue – Anzac Intersection (MAAI): Phase [2A–SRM]*", 8/12/23
  - *Sheets 4401 to 4407: Linemarking, Signposting and Barrier Plans*
  - *Sheets 5401 to 5407: Siteworks & Stormwater Management Plans*
  - *Sheets 6041 to 6044: Road Alignment Control Plans*
  - *Sheets 6401 to 6408: Road Longitudinal Sections*
  - *Sheets 6421 to 6429: Road Cross Sections*
  - *Sheet 7401: Details*
- Northrop "*Moorebank Precinct West, Temporary Wayfinding & Internal Configuration Entrance Via MAAI (Drawing PIWW-NTP-TP-SKC-1101[D]*" 29/11/2022
- RTA "*Accident Reduction Guide – Part 2: Road Safety Audits*", 2005
- RTA "*Road Safety Audit Technical Direction TD2003/RS03, Version 2*", August 2005
- RTA "*Delineation Guidelines: Parts 1 to 19 & Appendices A & B*", assorted dates
- RTA "*Guidelines for Road Safety Audit Practices – Part 1: Road Safety Audit"*, July 2011
- Standards Australia "*AS 1742.1 – 2003: Manual of uniform traffic control devices, Part 1: General introduction and index of signs*", 2003
- Standards Australia "*AS 1742.3 – 2009: Manual of uniform traffic control devices, Part 3: Traffic control for works on roads*", 2009
- Transport for NSW "*Traffic Control at Work Sites, Technical Manual – Issue 6.1*", 28 February 2022 including "*Technical Direction TD 00003:2022*" (16 November 2022) and "*Technical Direction TD 00031:2022*" (04 November 2022)

3. Identified Road Safety Issues

The audit of the relevant road section focussed on providing an independent identification of potential road safety hazards, regardless of current practices, standards and operations, to allow BMD to identify remedial measures as part of its works finalisation process.

In categorising and prioritising identified road safety issues, a risk assessment process was adopted. Risk assessment is the overall process of risk identification, analysis and evaluation. Preliminary risk ratings for each identified issue are assessed based on subjective professional judgement by the Road Safety Audit team with guidance from *Section 10.5* of Austroads "*Guide to Road Safety, Part 6: Road Safety Audit*". The Austroads' document provides an indication of the level of risk and what response may be appropriate. The identified road safety issue is first categorised based on its likely frequency of occurrence and severity ('likelihood' and 'consequence' of crash potential) – refer to *Figures 3.1* and *3.2* below (extracted from the Austroads' document).

Crash frequency	Description
Frequent (F)	Once or more per week
Probable (P)	Once or more per year but less than once per week
Occasional (O)	Once every five to ten years
Improbable (I)	Less than once every ten years

Figure 3.1: Likely Frequency of Issue

Severity	Description	Examples
Catastrophic (C)	Likely multiple deaths	• High-speed, multi-vehicle crash on a freeway • Car runs into crowded bus stop • Bus and petrol tanker collide • Collapse of a bridge or tunnel
Serious (S)	Likely death or serious injury	• High or medium-speed vehicle / vehicle collision • High or medium-speed collision with a fixed roadside object • Pedestrian struck at high speed • Cyclist is hit by a car
Minor (M)	Likely minor injury	• Some low-speed vehicle collisions • Cyclist falls from bicycle at low speed • Left-turn rear-end crash in a slip lane
Limited (L)	Likely trivial injury or property damage only	• Some low speed collisions • Pedestrian walks into object (no head injury) • Car reverses into post

Figure 3.2: Likely Severity of Issue

An appropriate risk rating is then selected from the risk categories in the risk matrix with a preferred treatment approach for each risk rating (refer to *Figures 3.3* and *3.4* below, both extracted from Austroads).

	Frequent (F)	Probable (P)	Occasional (O)	Improbable (I)
Catastrophic (C)	Intolerable (I)	Intolerable (I)	Intolerable (I)	High (H)
Serious (S)	Intolerable (I)	Intolerable (I)	High (H)	Medium (M)
Minor (M)	Intolerable (I)	High (H)	Medium (M)	Low (L)
Limited (L)	High (H)	Medium (M)	Low (L)	Low (L)

Figure 3.3: Risk Matrix

Risk	Suggested treatment approach
Intolerable (I)	Must be corrected
High (H)	Should be corrected or the risk significantly reduced, even if the treatment cost is high
Medium (M)	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high
Low (L)	Should be corrected or the risk reduced, if the treatment cost is low

Figure 3.4: Treatment Approach

This report may provide recommendations about possible remedial measures in response to identified road safety deficiencies. Any remedial actions recommended are based on current standards and practices. However, it should be noted that it is ultimately the responsibility of BMD and the relevant road authority to determine how to respond to each identified road safety deficiency.

Due to the nature of temporary traffic management schemes, the layout and arrangement is often frequently changing and therefore, not all road safety issues may be identified during specific audit periods. While this audit of overall road safety has been undertaken, it is not meant to replace regular inspections of traffic management schemes and devices at work sites according to TfNSW's "*Traffic Control At Work Sites*" manual and *AS 1742.3*.

The audit of the relevant road section identified a number of potential road safety issues. The road safety audit process requires that the road safety issues identified during an audit be acknowledged by the Audit Team and accordingly responded to by BMD. The road safety issues are characterised according to their risk and detailed in *Table 3.1* following.

It should be noted that not all road safety issues identified may necessarily be within the scope of the project area. This is because while the scope of the audit is generally within the project area described earlier, to complete a full audit of the project, the approaches and transitions to the project area were also audited to identify potential issues that may affect road safety within the project road sections. Therefore, some road safety issues that are outside the project design area may be the responsibility of the relevant controlling road authority.

Also, note that while this audit focussed on identifying road safety issues related to the subject road section and not the background existing conditions, some existing road conditions may have been recorded where they were deemed notable.

Table 3.1: Identified Road Safety Issues

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
1.	For some of the pedestrian crossing legs, there are no 'hold' lines to guide and separate pedestrian waiting areas from adjacent live traffic lanes – refer to *Photos 1 and 2* in *Appendix A*. This includes the marked pedestrian crossing across the Moorebank Avenue southbound left-turn slip-lane into Anzac Road.	Medium - High	Pedestrian infrastructure	North rop BMD	Linemarking of 'hold' lines to be implemented to delineate edge pedestrian waiting areas and adjacent live traffic. Completed on 25/03/2024 

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
2.	For Moorebank Avenue northbound travel, there is no physical obstruction to prevent a left-turn movement into Bapaume Road, which is a one-way exit only. Moreover, the 'No Left Turn' restriction sign for northbound Moorebank Avenue traffic could be reinforced with a 'No Entry' or 'One Way Exit' sign at Bapaume Road. During the site inspections, vehicles were observed entering Bapaume Road, ie. turning left from Moorebank Avenue northbound – refer to *Photo 3* in *Appendix A*. This is possibly due to a lack of adequate directional / destination signage to advise approaching traffic of the new intersection legs and their destinations as well as to advise traffic destined for the former Bapaume Road route to use the new Bushmaster Avenue intersection leg. This applies to traffic approaching from the south (along Moorebank Avenue northbound) and the east (along Anzac Road westbound).	Medium	Delineation	North rop BMD	Additional 'Klemmfix' or similar to be installed to further restrict left turn movements into Bapaume Road. Completed on 26/03/2024 

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
3.	For Moorebank Avenue northbound travel, the lane-drop north of Bapaume Road is poorly defined with a lack of merge arrows and the 'Left Lane Ends / Merge Right' and 'Form 1 Lane' signage being located too far left of the approach travel path – refer to *Photo 4* in *Appendix A*.	Medium	Delineation	North rop BMD	Signage to be shifted closer to the edge of the carriageway, as these signs are on temporary concrete blocks they are to be placed 5m from the edge of the carriageway. Refer AS1742.2 Appendix D, TS 02642 Supplement to Austroads Guide to Road Design and TS 06307 Installation and Maintenance of Signs Completed on 27/03/2024 

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
4.	For Moorebank Avenue southbound travel, the intersection direction signage approaching Bushmaster Avenue is located too far to the left of the approach travel path and is obstructed by lighting solar panels and other work-site obstructions – refer to *Photo 5* in *Appendix A*. Moreover, the signage would be better located to the right to reflect the destinations it is directing to.	Medium	Delineation / Traffic signs	BMD	Signage to be shifted closer to carriageway behind existing temporary road safety barriers Completed 17/04/2024 
5.	The issue of sun-glare during certain periods of the year at sunset and sunrise is applicable for east-west travel along Anzac Road and Bushmaster Avenue. Consequently, advisory / information signage and traffic control devices may be difficult to sight due to sun glare – refer to *Photo 6* in *Appendix A*.	Low - Medium	Delineation	North rop	Temporary traffic signals have been installed with target boards and visors.

6.	Existing directional signage is difficult to sight / read for westbound travel along Bushmaster Avenue approaching the precinct roundabout as well as along Moorebank Avenue northbound near the northern extent of the project works area – refer to *Photos 7 and 8* in *Appendix A*.	Low - Medium	Traffic signs	LOG OS BMD BMD	Signage at Bushmaster Ave Truck sign to be removed SIDE ROAD CLOSED to be relocated to east Completed 11/04/2024  PROHIBITED ON MOTORWAY sign which was blocking the sighting of the large directional sign to be relocated to south for better visibility of the large directional sign. Completed 15/04/2024

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
					
7.	Temporary directional signage for eastbound travel along the Loop Road approaching the roundabout still indicates the precinct exit is via Bapaume Road, which is now incorrect – refer to *Photo 9* in *Appendix A*.	Low - Medium	Delineation	LOG OS BMD	Change the arrow sticker to show go straight Completed 26/03/2024 

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
8.	Some temporary safety barrier ends do not have hazard markers to adequately delineate them, which is undesirable, eg. approach to the Anzac Road left-turn splitter island for Moorebank Avenue southbound travel – refer to *Photo 10* in *Appendix A*.	Low - Medium	Delineation	BMD	Klemmfix delineation installed Completed 26/03/2024 
9.	On Bushmaster Avenue, there is a lip between the temporary, incomplete pavement surface and the gutter and drains. This may result in excessive water ponding and extending into the adjacent travel lanes – refer to *Photo 11* in *Appendix A*. It is acknowledged that the travel speeds are likely to be relatively low (minimising the risk of any aquaplaning) and that temporary drain holes have been provided on the pavement surface into drains at some sag points.	Low	Drainage	BMD	Temporary drain hole not required for this location (refer MAAI RFI-124) There wasn't any water pooling observed post-rain event drive through check on 05th Apr 2024

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
10.	For both Moorebank Avenue approaches and the Anzac Road approach to the new four-way junction, there is no advance warning (as per the design drawings) to advise of the changed traffic conditions downstream at the intersection area.	Low	Intersections / Delineation	BMD	'CHANGED TRAFFIC CONDITIONS' temporary signage have been installed for two weeks period Completed on 26/03/2024 

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
11.	For southbound travel along Moorebank Avenue turning left into Anzac Road, the 'Give Way' sign located on the right side of the approach only, which is non-standard and should be duplicated on the left side to reinforce the intersection control – refer to *Photo 10* in *Appendix A*.	Low	Traffic signs	North rop BMD	A 'Give Way' may be installed with minimum of 2m clearance to the sign in accordance with AS1742.2 2022, Appendix D (D.2.3.2 and D.2.3.3) and should not be installed on a large temporary concrete block. Completed 17/04/2024 
12.	At the former Bapaume Road exit, the 'Stop' sign is located on the right side of the approach only, which is non-standard and should be duplicated on the left side to reinforce the intersection control.	Low	Traffic signs	North rop	This arrangement matches the approved ultimate arrangement of signage. Note, this is due to the large left exit radii preventing a 'STOP' sign from being located in a prominent location on the left side of the roadway.

				For completion by BMD	
No.	**Description of Road Safety Issue**	**Risk Rating**	**Road Safety Category**	**Action by**	**Response**
13.	For Anzac Road westbound travel, the directional sign for 'Moorebank Intermodal – West / ABB Australia' has an arrow that appears to be too small in size and is inconsistent with the arrow size for the adjacent 'Moorebank Intermodal – East' sign – refer to *Photo 12* in *Appendix A*.	Low	Delineation / Traffic signs	BMD	Correct size arrow sticker has been installed Completed on 26/03/2024 
14.	The pedestrian crossing phasing times, particularly for the Bushmaster Avenue and Moorebank Avenue (southern leg) crossings, appear to be too short and do not allow pedestrians adequate time to cross before the red signals end for Moorebank Avenue northbound left-turn and Anzac Road left-turn movements (respectively). It is suggested that the timings should be reviewed.	Note only	-	LOG OS	TfNSW advised that Network Ops adjusted the pedestrian crossing time. Closed-out 09/04/2024
15.	Street lighting is not yet operational along Bushmaster Avenue – only temporary lighting is available.	Note only	-	BMD	Permanent streetlighting to be provided at later stage
16.	There is no intersection directional signage pointing along Anzac Road or Moorebank Avenue (south) on the approaches to the subject intersection. It is assumed that the permanent directional signage is to be completed at a later project stage.	Note only	-	BMD	Agreed

4. Formal Audit Statement

This road safety audit has been undertaken by *Samsa Consulting Pty Ltd*, using the references and documentation detailed previously and site inspections of the subject project area during both daylight and night conditions.

While the road safety audit may provide recommendations about possible remedial measures in response to identified road safety issues, it is ultimately the responsibility of BMD and the relevant road authority to determine how best to respond to each identified road safety issue.

The audit has been undertaken for the sole purpose of identifying any road safety-deficient features and road safety risks of the recently opened road section. Every effort was made to ensure that all relevant road safety issues were considered and the findings are the opinion and judgement of the audit team.

Due to the nature of temporary traffic management schemes, the layout and arrangement is often frequently changing and therefore, not all road safety issues may be identified during specific audit periods. While this audit of overall road safety has been undertaken, it is not meant to replace regular inspections of roadwork traffic management schemes and devices at work sites according to TfNSW's "*Traffic Control at Work Sites*" manual and *AS 1742.3*.

_____ 25 March 2024

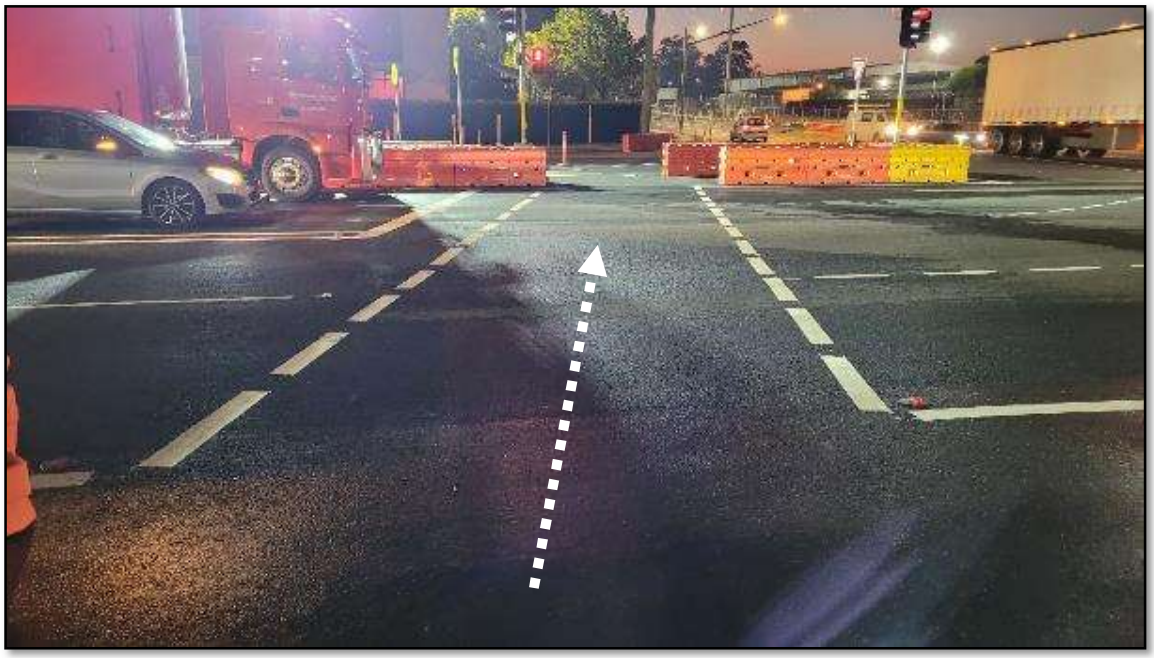
[redacted]
TfNSW Accredited Road Safety Auditor: Level 3 Lead Auditor
(Auditor ID: [redacted])

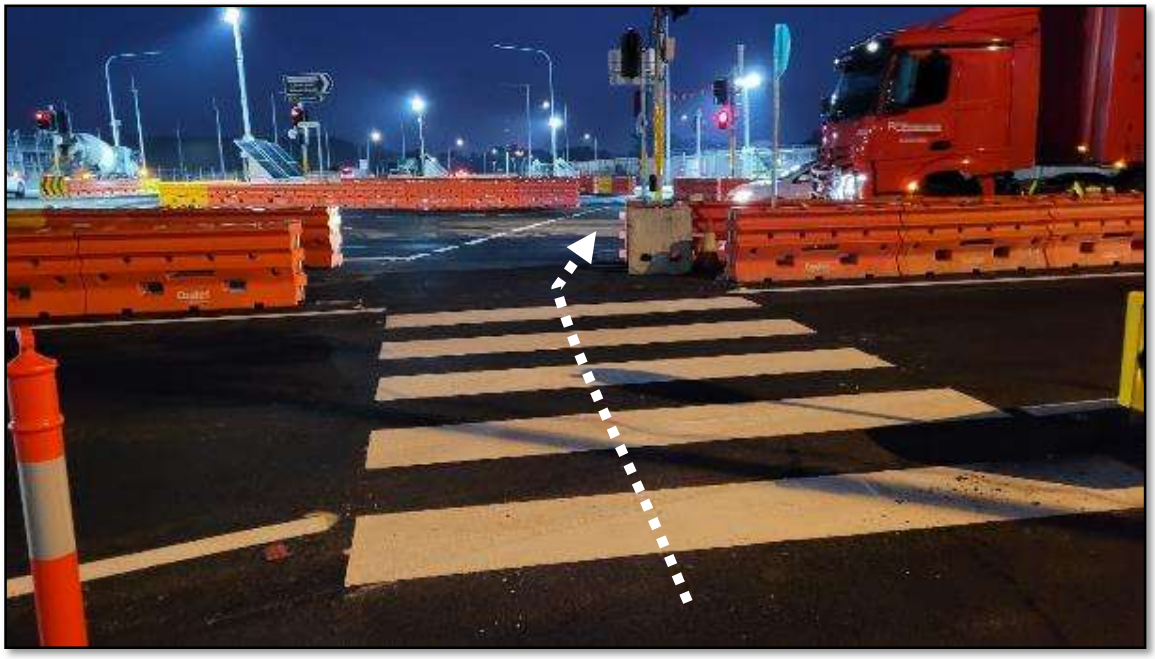
_____ 25 March 2024

[redacted]
TfNSW Accredited Road Safety Auditor: Level 3 Lead Auditor
(Auditor ID: [redacted])

Appendix A

Site Photos of Selected Road Safety Issues





PHOTOS 1 & 2: For the pedestrian crossing across Moorebank Avenue (north) (top photo) as well as across the Moorebank Avenue southbound left-turn slip-lane into Anzac Road (bottom photo), there are no 'hold' lines to guide and separate pedestrian waiting areas from adjacent live traffic lanes.

PHOTO 3: For Moorebank Avenue northbound travel, there is no physical obstruction to prevent a left-turn movement into Bapaume Road, which is a one-way exit only. During the site inspections, vehicles were observed entering Bapaume Road, ie. turning left from Moorebank Avenue northbound.

PHOTO 4: For Moorebank Avenue northbound travel, the lane-drop north of Bapaume Road is poorly defined with a lack of merge arrows and the 'Left Lane Ends / Merge Right' and 'Form 1 Lane' signage being located too far left of the approach travel path.

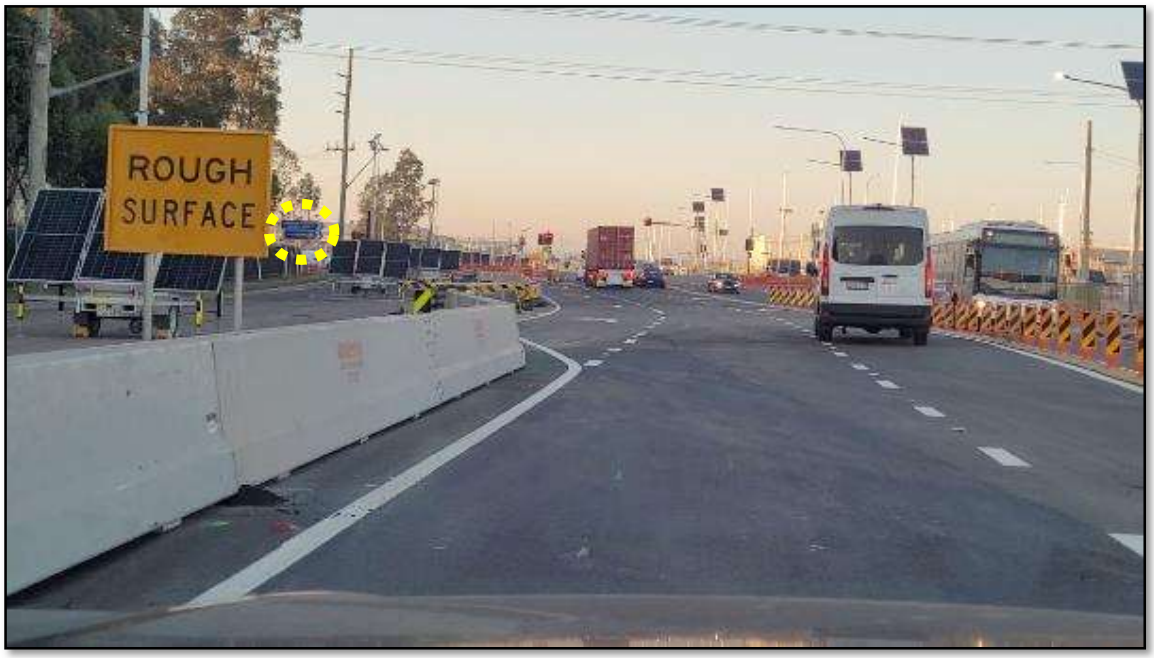


PHOTO 5: For Moorebank Avenue southbound travel, the intersection direction signage approaching Bushmaster Avenue is located too far to the left of the approach travel path and is obstructed by lighting solar panels and other work-site obstructions. Moreover, the signage would be better located to the right to reflect the destinations it is directing to.

PHOTO 6: The issue of sun-glare during sunrise is applicable for eastbound travel along Bushmaster Avenue approaching the Moorebank Avenue intersection. Consequently, advisory / information signage and traffic control devices may be difficult to sight due to sun glare.

PHOTOS 7 & 8: Existing directional signage is difficult to sight / read for westbound travel along Bushmaster Avenue approaching the precinct roundabout (top photo) as well as along Moorebank Avenue northbound near the northern extent of the project works area (bottom photo).

PHOTO 9: Temporary directional signage for eastbound travel along the Loop Road approaching and at the roundabout still indicates the precinct exit is via Bapaume Road, which is now incorrect.

PHOTO 10: For the approach to the Anzac Road left-turn splitter island for Moorebank Avenue southbound travel, the temporary safety barrier ends do not have hazard markers to adequately delineate them. Also, note the 'Give Way' sign located on the right side of the approach only, which is non-standard and should be duplicated on the left side to reinforce the intersection control

PHOTO 11: On Bushmaster Avenue, there is a lip between the temporary, incomplete pavement surface and the gutter and drains. This may result in excessive water ponding and extending into the adjacent travel lanes.

PHOTO 12: For Anzac Road westbound travel, the directional sign for 'Moorebank Intermodal – West / ABB Australia' has an arrow that appears to be too small in size and is inconsistent with the arrow size for the adjacent 'Moorebank Intermodal – East' sign.