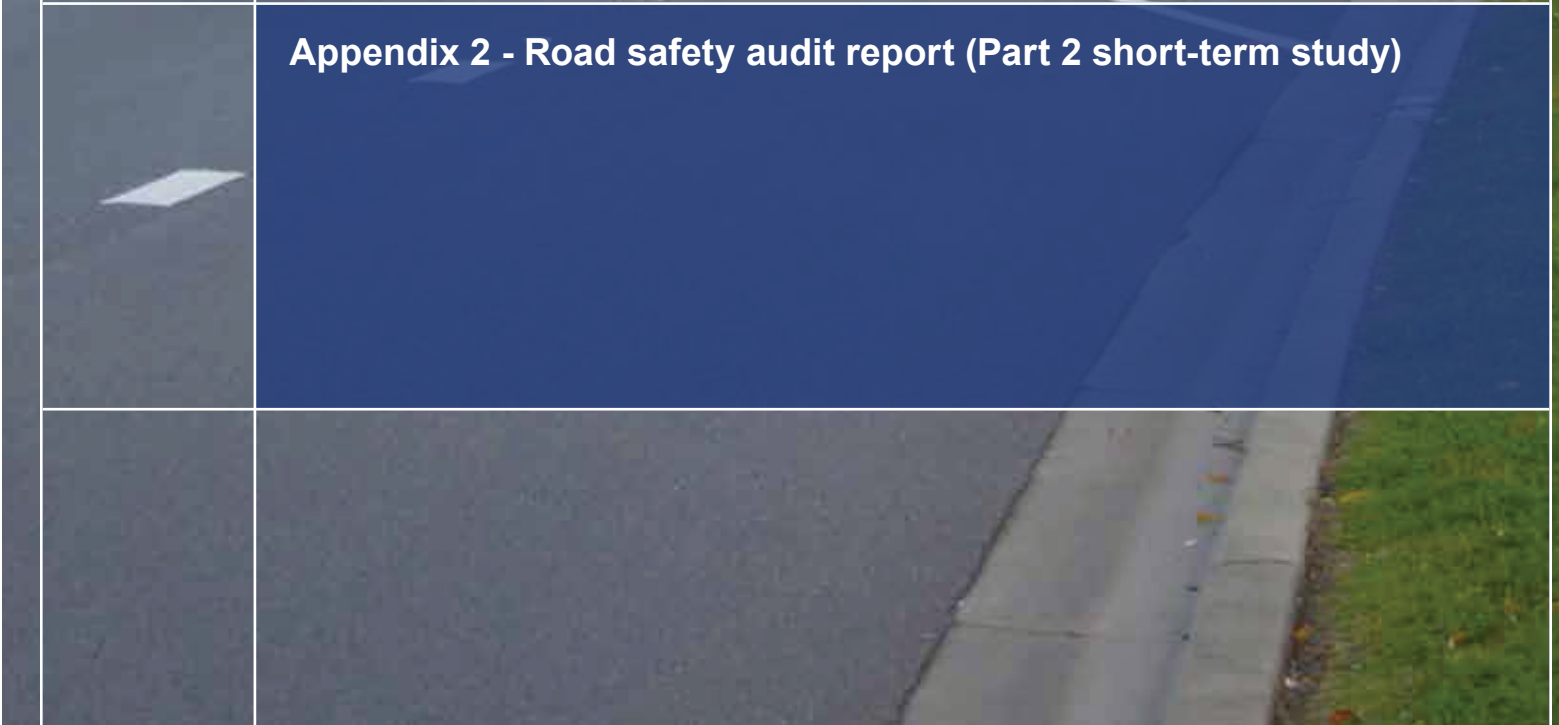




Appendix 2 - Road safety audit report (Part 2 short-term study)





ROADS AND MARITIME SERVICES

RICHMOND BRIDGE AND APPROACHES

ROAD SAFETY AUDIT



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ROADS AND MARITIME SERVICES

RICHMOND BRIDGE AND APPROACHES

ROAD SAFETY AUDIT

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Checker Damien Chee

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Report No F0006-AA005381-AAR-01 Richmond Bridge and approaches RSA Rev01

Revision 01

Date 13 September 2012

This report has been prepared for Roads and Maritime Services in accordance with the terms and conditions of appointment dated 27 August 2012. Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.



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APPENDIX A: ROAD SAFETY AUDIT CHECKLIST

1 INTRODUCTION

1.1 Project and audit details

Details of the audit have been summarised in Table 1-1.

Table 1-1 Details of the road safety audit

Audited project	<ul style="list-style-type: none"> ▪ Proposed intersection upgrade at Bells Line of Road/ Grose Vale Road/ Terrace Road, North Richmond. ▪ Proposed intersection upgrade at Kurrajong Road/ Old Kurrajong Road, Richmond. ▪ Proposed intersection upgrade at Kurrajong Road/ Bosworth Street/ March Street, Richmond. ▪ Existing local road precinct in Richmond and Agnes Banks including: <ul style="list-style-type: none"> ▪ Old Kurrajong Road – Yarramundi Lane from Kurrajong Road to Crowleys Lane. ▪ Crowleys Lane from Yarramundi Lane to Castlereagh Road. ▪ Innalls Lane from Yarramundi Lane to Castlereagh Road. ▪ Drift Road from Castlereagh Road to Innalls Lane.
Client/ contact	<p>Siva Satchi Project Development Roads and Maritime Services (02) 8849 2019</p>
Audit type	<p>Preliminary design road safety audit.</p>
Purpose	<p>As part of the proposed Richmond Bridge and approaches upgrade a number of intersections in the surrounding road network will need to be upgraded. The purpose of this audit was to identify potential safety issues associated with a number of intersection upgrades proposed, as well as identify safety issues associated with any potential or perceived re-distribution of traffic.</p>
Background	<p>In July 2012 the Richmond Bridge and Approaches Congestion Study was prepared by Hyder Consulting (Hyder) documenting traffic performance of the eight short-term improvement options (Options A to H) which have potential to improve traffic flow at Richmond Bridge and approach roads in the Richmond and North Richmond areas. Each option was assessed in terms of key traffic factors which are most likely to influence a decision on the best performing option. The Congestion Study has identified Option H as the best performing option.</p> <p>This road safety audit is inclusive of the existing conditions as outlined in the scope (below), and the preliminary design of Option H.</p>
Scope of audit	<p>The auditable materials included the following:</p> <ul style="list-style-type: none"> ▪ The Bells Line of Road/ Grose Vale Road/ Terrace Road intersection with regards to: <ul style="list-style-type: none"> ▪ Its current layout. ▪ The concept option with reference number SK1108-1 and date 10 May 2012. ▪ The concept option with reference number 30011177-120820-Gross-Terrace-Int-Plan. ▪ The Kurrajong Road/ Old Kurrajong Road intersection with regards to: <ul style="list-style-type: none"> ▪ Its current layout. ▪ The concept option with reference number SK1109-4 and date 16

	<p>November 2011.</p> <ul style="list-style-type: none"> ▪ The Kurrajong Road/ Bosworth Street/ March Street intersection with regards to: <ul style="list-style-type: none"> ▪ Its current layout. ▪ The concept option with reference number SK1108-4 and date 24 May 2012. ▪ The concept option with reference number 30011177-120820-Bosworth-Int-Plan. ▪ The current layout of the local road precinct in Richmond and Agnes Banks including: <ul style="list-style-type: none"> ▪ Old Kurrajong Road – Yarramundi Lane from Kurrajong Road to Crowleys Lane. ▪ Crowleys Lane from Yarramundi Lane to Castlereagh Road. ▪ Innalls Lane from Yarramundi Lane to Castlereagh Road. ▪ Drift Road from Castlereagh Road to Innalls Lane. <p>This local road precinct is herein referred to as the Richmond-Agnes Banks local road precinct. The review of this precinct was in consideration of the other proposed intersection improvements described above.</p> <p>These roads are depicted in Figure 1.</p>
Audit team details	Damien Chee, Hyder Consulting (level 3, lead auditor – RSA-02-0094). Josh Kleinhans, Hyder Consulting.
Audit methodology	<ul style="list-style-type: none"> ▪ A day and night time inspection was carried out on 6 September July 2012. This included a walkover and drive through inspection of each of the intersections as well as the Richmond-Agnes Banks local road precinct. A follow up site inspection was also carried out on 13 September 2012. ▪ Reporting of audit deficiencies in accordance with the NSW Centre for Road Safety's <i>Guidelines for Road Safety Audit Practices</i> (2011). ▪ Report includes a completed checklist as provided in the Austroads <i>Guide to Road Safety Part 6</i>. The audit team chose to use the <i>existing road</i> checklist rather than the one associated with <i>preliminary design</i>. This was due to the proposed intersection upgrades being retrospective improvements on an existing road network. Furthermore, it is understood that there are no current plans to upgrade the Richmond-Agnes Banks local road precinct. As such, this component of the audit was considered to be an <i>existing road</i> audit. ▪ Report does not specify suggestions or recommendations for action. This is an RMS policy and the responsibility of the project manager, it will highlight the specific deficiencies of intersections, roads and the concept design as advised in the project scope.
Material supplied	See <i>Scope of audit</i> .
Meeting and assessment details	Project start up meeting held on 4 September 2012 Site inspection carried out on 6 September 2012.

1.2 Responding to the audit report

Road safety audits provide the opportunity to highlight potential road safety problems and have them formally considered by the project manager in conjunction with all other project considerations.

The responsibility for the project rests with the project manager, not with the auditor. The project manager is under no obligation to accept the audit findings. Also, it is not the role of the auditor to agree to, or approve the project manager's responses to the audit.

1.3 Previous audits and outstanding issues

A number of road safety issues were identified in the *Richmond Bridge and Approaches Congestion Study*. These have not been formally raised as road safety deficiencies in this audit.



Figure 1 Locality map

2 SAFETY AUDIT FINDINGS

Table 2-1 describes the road safety audit findings based on the existing conditions. Table 2-2 describes the road safety audit findings based on the proposed preliminary designs.

Table 2-1 Road safety audit findings – existing conditions




Item	Location	Safety findings	Risk rating	Photo
1	Bells Line of Road/ Grose Vale Road/ Terrace Street intersection – existing conditions.	On the Grose Vale Road (southern) approach to intersection, there is a high degree of pavement shoving creating a rough and variable surface. This may de-stabilise a vehicle or compromise the skid resistance available. This is also in an environment where there would be heavy braking demands due to the traffic signals and associated queues. It should be noted that during the site inspection, the audit team witnessed a rear-end crash in this approach.	Low	

Figure 2 Variable pavement surface



Figure 3 Pavement shoving

Item	Location	Safety findings	Risk rating	Photo
2	Bells Line of Road/ Grose Vale Road/ Terrace Street intersection – existing conditions.	<p>The pedestrian ramp directionality is poor for most of the crossings. The alignment of the ramp does not line up with the marked crossing. This could lead vision-impaired users into the control area of the intersection where they would be at increased risk of impact from vehicles.</p> <p>Furthermore, the poor condition of line marking could exacerbate this issue.</p>	Low	
<p>Figure 4 Poor ramp directionality and pavement marking condition.</p>				
3	Bells Line of Road/ Grose Vale Road/ Terrace Street intersection – existing conditions.	<p>The designated parking on the eastern side of Grose Vale Road (southern) departure is too close to the intersection. This could lead to a number of safety risks including (i) increased rear-end crash risk associated with through vehicles and parked cars, (ii) increased side swipe and lane-change crash risk associated with through vehicles changing lanes, (iii) rear-end crash conflicts due to traffic flow turbulence.</p>	Med	
<p>Figure 5 Start of kerb side parking in Grose Vale Road departure.</p>				

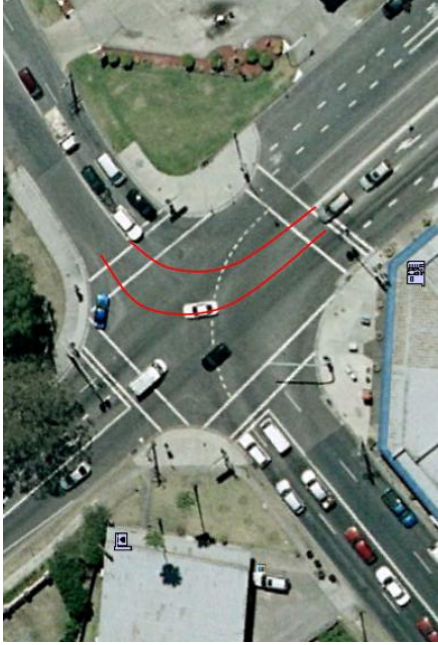
Item	Location	Safety findings	Risk rating	Photo
4	Bells Line of Road/ Grose Vale Road/ Terrace Street intersection – existing conditions.	<p>The increased setback of the hold line in the Bells Line of Road eastern approach has resulted in a non-uniform turn radius for right-turning traffic heading to Terrace Street. Right-turning drivers are required to adjust their steering angle mid-way through the turn. The tightening of the turn radius may lead to encroachment into the southbound traffic lanes in Terrace Street.</p> <p>This issue also inhibits the opposing right-turn (from Bells Line of Road into Grose Vale Road) from running in the same phase (ie. a diamond phase). Although this has more of a direct impact on traffic performance rather than road safety performance, the capacity issues in general are a major source of road safety risk due to queues (rear-end crash risks) and driver frustration leading to unsafe behaviours.</p>	Med	

Figure 6 Likely swept path for right-turning vehicle from Bells Line of Road East to Terrace Street.


5	Terrace Street, departure from intersection with Bells Line of Road – existing conditions.	<p>The drainage facilities on the western side of this intersection departure are discontinuous with poor transition from one treatment to the other. The kerb and gutter stops abruptly with no inlet drain or kerb splay. Water then runs off to the un-formed shoulder area and into the mountain drain. The poor transition between these drainage facilities has resulted in water damage of the pavement, which has led to pavement depressions. This has further led to deposition of leaf and dirt materials which compromises ride quality and skid resistance.</p> <p>The poor surface conditions and discontinuity of the footpath may also increase the potential for pedestrian slips and trips.</p>	low	
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Figure 7 Poor transition between drainage facilities on Terrace Street departure.


Item	Location	Safety findings	Risk rating	Photo
6	Old Kurrajong Road, at the intersection with Kurrajong Road – existing conditions.	The guardrails at this intersection lack diaphragm plates in the buffered end terminals. This would increase the spearing potential of the terminals.	Med	

Figure 8 Buffered end terminal.


7	Old Kurrajong Road / Kurrajong Road intersection – existing conditions.	The intersection alignment is a major issue. Both Old Kurrajong Road approaches are staggered forcing vehicles to negotiate longer distances for right-turns and through movements on Old Kurrajong Road. For a road with high traffic volumes and poor gap availability, the extra duration required to complete these movements increases the crash exposure. The staggered alignment of the two side road approaches also means that opposing right-turns on Kurrajong Road cannot occur at the same time without a head-on crash conflict.	High	
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Figure 9 Old Kurrajong Road looking southbound towards the intersection with Kurrajong Road.


Item	Location	Safety findings	Risk rating	Photo
8	Old Kurrajong Road / Kurrajong Road intersection – existing conditions.	There is a lack of lighting at the intersection creating dangerous night time driving conditions. The lack of delineators also exacerbates this problem.	Med	

Figure 10 Lack of lighting at Kurrajong Road/ Old Kurrajong Road intersection.


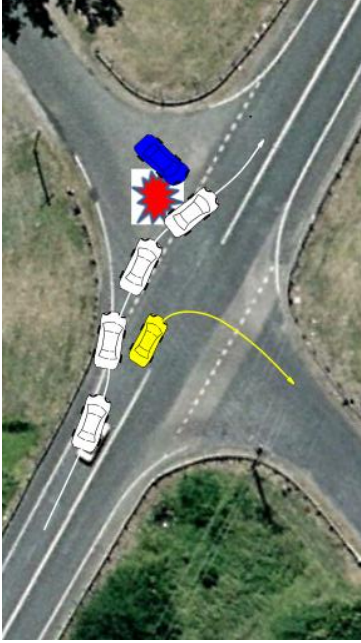
Item	Location	Safety findings	Risk rating	Photo
9	Old Kurrajong Road / Kurrajong Road intersection – existing conditions.	Old Kurrajong Road has poor pavement quality including loose gravel and a narrow sealed width (less than 5.5m). This may lead to loss of control of vehicles entering and egressing from the road. It may also lead to loss of control when braking in advance of the intersection hold lines and associated queues.	Low	
10	Old Kurrajong Road / Kurrajong Road intersection – existing conditions.	Vehicles turning right from Kurrajong Road West to Old Kurrajong Road South (yellow vehicle in diagram) block the eastbound through traffic on Kurrajong Road. As a result, many eastbound through vehicles (white vehicles in diagram) were observed to pass around the queued vehicle by using the space in the Old Kurrajong Road North intersection approach. This could increase the risk of collision with queued traffic in Old Kurrajong Road North (blue vehicle in diagram).	Med	

Figure 11 Poor pavement quality in Old Kurrajong Road

Figure 12 Crash conflict due to the lack of turning facilities at Kurrajong Road/Old Kurrajong Road intersection.




Item	Location	Safety findings	Risk rating	Photo
11	Kurralong Road/ Old Kurralong Road intersection – existing conditions.	<p>The entering sight distance from Old Kurralong Road South to Kurralong Road west is obscured by road side vegetation. This creates issues when turning right from Old Kurralong Road West. This traffic may need to advance further beyond the hold line in this approach to establish a good sight line. This could increase crash risk with westbound through vehicles on Kurralong Road.</p> <p>The lack of clear sight line from this approach to the west increases the “follow up” (t₁) time which may affect the capacity of this approach. That is, without a clear sight line, vehicles queued behind a lead vehicle are unable to take advantage of large gaps in the eastbound traffic stream. Rather they would each need to progress to the hold line and check for separate five second gaps.</p> <p>As observed by the audit team, the long delays due to the above issue, have resulted in poor gap acceptance behaviour due to driver frustration. The increased start-stop pattern in the Old Kurralong Road South approach (due to the lack of follow up sight distance) also increases the rear-end crash risk in this approach.</p>	Low	

Figure 13 Poor entering sight distance from Old Kurralong Road South to Kurralong Road West.

Item	Location	Safety findings	Risk rating	Photo
12	Kurralong Road/ Old Kurralong Road intersection – existing layout.	<p>The constant traffic flow along Kurralong Road during peak traffic periods does not provide sufficient gaps to allow vehicles to turn right into and left/right out of the two Old Kurralong Road approaches. The lack of gaps is due to the lack of metering points in the up and downstream road network. The audit team observed delays of up to two minutes which may force the lower priority traffic to take unsafe gaps.</p> <p>The audit team noted a number of symptoms of unsafe gap acceptance such as hard acceleration from rest, drivers creeping out into the main road travel lanes, drivers stalling beyond the hold line, and main line traffic “borking” and braking hard in response to unexpected egressing vehicles.</p>	High	See Figure 13 and Figure 14.
				
<p>Figure 14 High traffic volumes on Kurralong Road.</p>				
13	Richmond Bridge – existing conditions.	<p>The bridge barriers are not crashworthy and are not capable of containing and re-directing errant vehicles. Any errant vehicles may be at risk of breaching the system or alternatively experiencing poor ridedown performance compared with the approved barrier systems.</p>	Med	
<p>Figure 15 – Substandard bridge barriers.</p>				

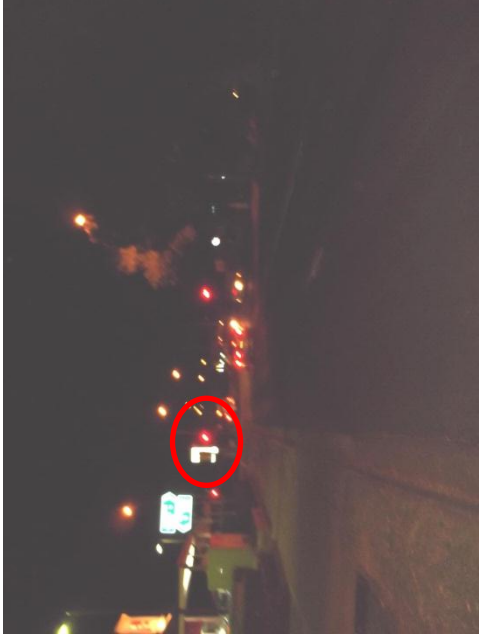
Item	Location	Safety findings	Risk rating	Photo
14	Kurralong Road/ Bosworth Street/ March Street intersection – existing conditions.	The speed limit sign in the Bosworth Street (northern) intersection approach obscure visibility to the primary signal lanterns. Approaching drivers may not be aware of the prevailing signal phase.	High	

Figure 16 Obscured traffic signals.



Item	Location	Safety findings	Risk rating	Photo
15	Kurrajong Road/ Bosworth Street/ March Street intersection – existing conditions.	There are numerous pavement failures at this intersection including polishing and cracking. These may lead to loss-of-control and rear-end crashes, especially since this is a high braking environment.	Low	

Figure 17 Example of Bosworth Street / Kurrajong Road/
March Street pavement issues.

Item	Location	Safety findings	Risk rating	Photo
16	Kurrajong Road/ Bosworth Street/ March Street intersection – existing conditions.	The kerb ramps at this intersection have poor directionality as they do not line up with the alignment of the marked crossings. This may lead visually impaired pedestrians into the control area of the intersection where they would be at increased risk of impact from vehicles. There was also a high degree of pavement cracking which may form a trip hazard for pedestrians.	Low	
17	Kurrajong Road/ Bosworth Street/ March Street intersection – existing conditions.	During the time of the night time inspection, there were two street lights on the northern approach to the intersection that were not operating.	Low	<p>Figure 18 Misleading Intersection directionality.</p>


Item	Location	Safety findings	Risk rating	Photo
18	Kurralong Road/ Bosworth Street/ March Street intersection – existing conditions.	The western approach to the intersection does not have a marked foot crossing. This may lead to pedestrians jaywalking across this approach rather than walking the more circuitous route via the other three crossings. This could increase the risk of pedestrian crashes.	High	

Figure 19 No pedestrian crossing on Kurralong Road western intersection approach.





Item	Location	Safety findings	Risk rating	Photo
19	Kurralong Road/ Bosworth Street/ March Street intersection – existing conditions.	There is a pronounced road crown in the March Street approach. This may act as a pedestrian trip hazard.	Low	
20	Innals Lane - existing conditions.	There is a lack of lighting and night-time delineation on this route which provides insufficient guidance to road users. Furthermore, there is limited the sight distance and little warning provided regarding vehicles egressing (and possibly reversing) from driveways.	Low	

Figure 20 - Pronounced crown in the road.

Figure 21 – Lack of streetlighting in Innals Lane.

Item	Location	Safety findings	Risk rating	Photo
21	Innals Lane - existing conditions.	This road contains several pavement deficiencies including shoving, depressions and polishing which may increase the loss of control crash potential. This road also contains reverse curves on a downhill grade which may further exacerbate the loss of control and run off road crash risk. Additionally the road has unsealed shoulders, poor edge conditions and a lack of run off road areas.	Med	
<p>Figure 22 Innals Lane pavement issues – note polishing in right-hand lane.</p>				
22	Innals Lane- existing conditions.	Utility poles are located within the clear zone which can present a potential crash hazard for errant vehicles.	Med	
23	Innals Lane - existing conditions.	Innals Lane runs through a flood plain which has resulted in a fill embankment on either side of the road. Although delineators are present to mitigate this risk, these do not provide sufficient safeguards against errant vehicles that may run off road.	Med	
<p>Figure 23 Fill embankment and drop off.</p>				

Item	Location	Safety findings	Risk rating	Photo
24	Yarramundi Lane - existing conditions.	There is a lack of line marking and night-time delineation throughout the entire length of Yarramundi Lane. This would lead to very poor visibility of the road ahead.	Med	 <p>Figure 24 Yarramundi Lane.</p> <p>As seen in Figure 24 there are no streetlights and a general lack of delineation.</p>
25	Yarramundi Lane - existing conditions.	There is a lack of lighting and night-time delineation on this route which provides insufficient guidance to road users. Furthermore, there is limited the sight distance and little warning provided regarding vehicles egressing (and possibly reversing) from driveways.	Low	Refer to Figure 24.
26	Yarramundi lane - existing conditions.	There are utility poles located within the clear zone which can present a potential crash hazard for errant vehicles. There is also a length of barbed wire fence in the clear zone presenting a crash hazard for errant vehicles.	Low	Refer to Figure 24.


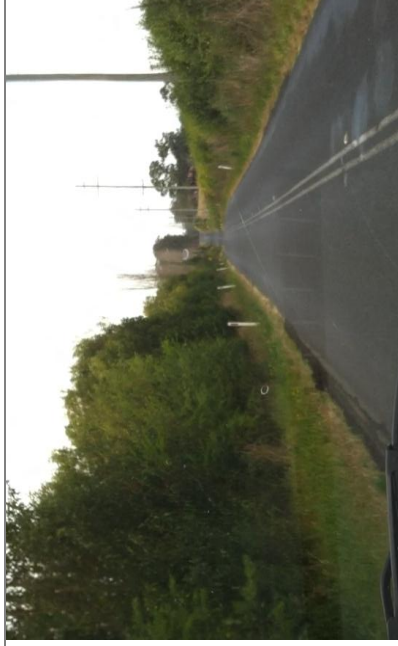
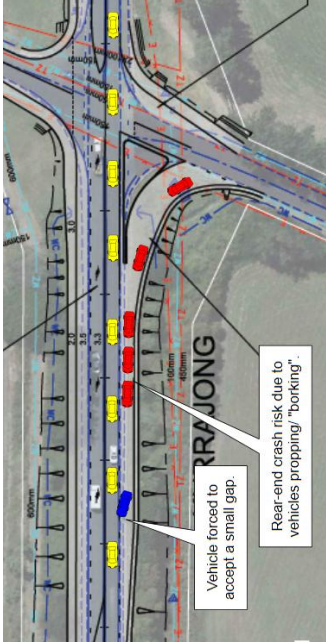
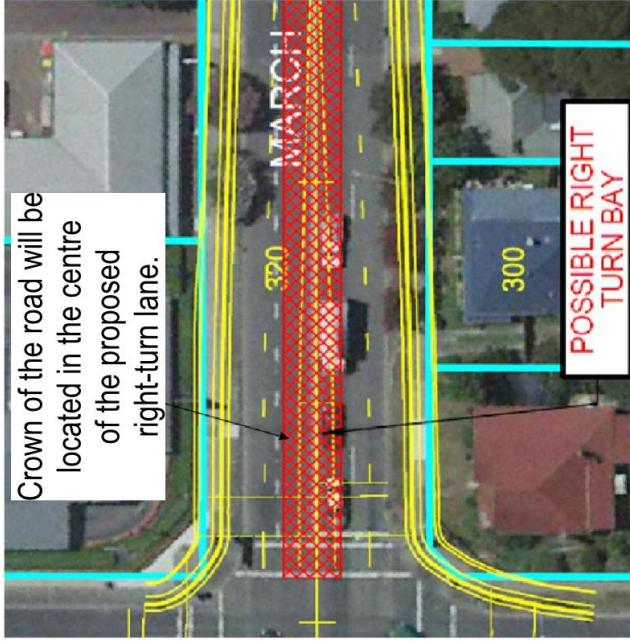
Item	Location	Safety findings	Risk rating	Photo
27	Crowleys Lane – existing conditions.	A speed limit and warning sign are obstructed on this route, when travelling northbound	Low	
Figure 25 Obstructed warning sign.				
28	Crowleys lane – existing conditions.	<p>There are a number of pavement deficiencies along this route including a narrow sealed width with no sealed shoulders. The pavement also contains depressions, shoving and poor edge quality. This may result in an increase in the loss of control crash potential.</p> <p>It should be noted that the road side vegetation is dense and presents a run off road crash hazard.</p>	Low	
Figure 26 Pavement deficiencies.				
29	Crowleys Lane – existing conditions.	<p>There is a lack of lighting and night-time delineation on this route which provides insufficient guidance to road users. Furthermore, there is limited sight distance and little warning provided regarding vehicles egressing (and possibly reversing) from driveways.</p>	Low	Refer to Figure 26.

Table 2-2: Road safety audit findings – Preliminary design

Item	Location	Safety findings	Risk rating	Photo
30	Old Kurrajong Road to the north of Kurrajong Road - Preliminary design SK1109-4	There are utility poles located on the western side of Old Kurrajong Road. If these are not relocated, they may pose as crash hazards to traffic on this road. The offset between the edge of traffic lane and the poles would reduce with the proposed design. This could increase the likelihood and severity of hazardous pole crashes.	Med	
31	Bells Line of Road/ Grose Vale Road/ Terrace Street intersection – Preliminary design 30011177-120820.	The turn paths of the dual right-turn lanes from Grose Vale Road into Bells Line of Road appear to clash with the right-turn from Terrace Road.	Med	

Item	Location	Safety findings	Risk rating	Photo
32	Kurradjong Road/ Old Kurradjong Road intersection – preliminary design SK1109-4	<p>The proposed acceleration lane on Kurradjong Road for left-turning vehicles from Old Kurradjong Road South will improve the ability of cars to enter Kurradjong road in heavy traffic conditions (ie. reduced gap acceptance requirement from 5 seconds to 3 seconds). However this may lead to new crash risks as described below.</p> <p>Due to the high and constant westbound traffic volumes on Kurradjong Road (particularly during the PM peak) there may still be difficulty in finding acceptable gaps for side road traffic to enter. If a vehicle in the acceleration lane is unable to find a gap, they may either:</p> <ul style="list-style-type: none"> ▪ Attempt to merge via a substandard gap which increases side swipe, lane changing and rear end crash risk (blue vehicle), or ▪ “Bork” or brake hard and be at risk of rear-end crashes from following vehicles in the acceleration lane (red vehicles). <p>The audit team acknowledges that this crash risk would involve low-angled impacts with small differences in relative velocity between the entering traffic and the main line traffic. As such, the potential crash severity would be controlled in this manner. By contrast, the “do nothing” approach would retain the potential for higher angled crashes with higher speed differentials which are potentially more severe.</p>	Med	
<p>Figure 27 Likely safety risks with acceleration lane.</p>				
33	Old Kurradjong Road / Kurradjong Road intersection – preliminary design SK1109-4	<p>Under the preliminary design the hold line on Old Kurradjong Road North is being moved back to accommodate the proposed intersection widening works. Drivers at the new hold line would have reduced entering sight distance due to the presence of trees and vegetation on the northern side of Kurradjong Road.</p> <p>This could result in drivers creeping forwards to establish a better sightline. This could in turn result in increased crash risk with vehicles on Kurradjong Road.</p>	Med	

Item	Location	Safety findings	Risk rating	Photo
34	Kurralong Road/ Old Kurralong Road intersection – preliminary design SK1109-4.	<p>Similar to item 12, the constant traffic flow along Kurralong Road during peak traffic periods does not provide sufficient gaps to allow vehicles to turn right into and left/right out of the two Old Kurralong Road approaches. The lack of gaps is due to the lack of metering points in the up and downstream road network. The audit team observed delays of up to two minutes which may force the lower priority traffic to take unsafe gaps.</p> <p>The audit team noted a number of symptoms of unsafe gap acceptance such as hard acceleration from rest, drivers creeping out into the main road travel lanes, drivers stalling beyond the hold line, and main line traffic “borking” and braking hard in response to unexpected egressing vehicles.</p> <p>Under the proposed design, it was noted that the widening of the intersection will increase the travel path for vehicles turning into and out of the two Old Kurralong Road approaches (as well as the through movements between these approaches). This may prolong road users’ exposure to crashes in the “conflict area” of the intersection.</p>	High	

Item	Location	Safety findings	Risk rating	Photo
35	Kurralong Road/ Bosworth Street/ March Street intersection – Preliminary design SK30011177- 120820-Bosworth- Int-Plan	<p>The March Street (eastern) approach to the intersection has a pronounced road crown with steep crossfalls either side. The proposed intersection widening works in March Street may lead to the right-turn lane straddling the crown (if the crown is not relocated). This could result in variable and awkward level transitions for vehicles turning right.</p> <p>This could also result in vehicles “bottoming out” or scraping of the undercarriage.</p>	Low	
Figure 28	Possible grading issue Kurralong Road and March Street.			
36	Kurralong Road/ Bosworth Street/ March Street intersection – Preliminary design SK30011177- 120820-Bosworth- Int-Plan	<p>The proposed widening works on the northern sides of Kurralong Road and March Street appear to clash with the property lines. This may lead to fences and walls associated with properties being at a significantly reduced offset from the road, and hence a higher risk road side hazard. Furthermore, there are a number of driveways that would have an abrupt level transition to the new road boundary.</p>	Low	

Item	Location	Safety findings	Risk rating	Photo
37	Kurrajong Road/ Bosworth Street/ March Street intersection – Preliminary design SK30011177- 120820-Bosworth- Int-Plan Western Colonial Hotel Richmond.	Drivers egressing from the hotel and stopped at the new hold line will have reduced entering sight distance available due to vegetation and utility poles.	Med	
38	Kurrajong Road/ Bosworth Street/ March Street intersection – Preliminary design SK1108-4.	The increased setback of the hold line in the March Street approach could result in a larger turning path for right-turns into Bosworth Street North. This may clash with the opposing right turn from Kurrajong Road (into Bosworth Street South).	Med	

3 CONCLUDING STATEMENT

We have undertaken a preliminary design road safety audit using reference documents detailed in Section 1 of this report.

The audit has been carried out for the sole purpose of identifying any features of road and intersections surrounding Richmond Bridge that are deemed to be unsafe. These identified issues to outline roadways which could be reviewed for safety performance.

Issues identified have been noted in this report for the Project Manager and Designer to review and assess, and where appropriate make the necessary recommendations to improve safety, this report does not make any suggestions and recommendations.



Damien Chee
Audit Team Leader
Hyder Consulting Pty Ltd



Joshua Kleinhans
Hyder Consulting Pty Ltd

APPENDIX A: ROAD SAFETY AUDIT CHECKLIST

CHECKLIST 6: EXISTING ROADS: ROAD SAFETY AUDIT

Issue	Yes	No	Comment
6.1 Road alignment and cross-section			
6.1.1 Visibility; sight distance			
Is sight distance adequate for the speed of traffic using the route?	✓		issues on Kurrajong Rd & old Kurrajong road.
Is adequate sight distance provided for intersections and crossings? (for example, pedestrian, cyclist, cattle, railway)	✓		refer to above comment & section 2-8 of the audit.
Is adequate sight distance provided at all private driveways and property entrances?	✓		during night time frames. limited sight dist at all crossings lane and lanes rd
6.1.2 Design speed			
Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed?	✓		
If not:			
<ul style="list-style-type: none"> ▪ are warning signs installed? ▪ are advisory speed signs installed? 			
Are the posted advisory speeds for curves appropriate?	✓		
6.1.3 Speed limit/speed zoning			
Is the speed limit compatible with the function, road geometry, land use and sight distance?	✓		
6.1.4 Overtaking			
Are safe overtaking opportunities provided?			✓ limited opportunities, single lane road.
6.1.5 Readability by drivers			
Is the road free of elements that may cause confusion? For example:			
<ul style="list-style-type: none"> ▪ is alignment of the roadway clearly defined? ▪ has disused pavement (if any) been removed or treated? ▪ have old pavement markings been removed properly? ▪ do tree lines follow the road alignment? ▪ does the line of street lights or the poles follow the road alignment? 	✓		poor intersection alignment at old Kurrajong Road & Kurrajong Road
Is the road free of misleading curves or combinations of curves?	✓		
6.1.6 Widths			

GUIDE TO ROAD SAFETY PART 6: ROAD SAFETY AUDIT

Issue	Yes	No	Comment
Are medians and islands of adequate width for the likely users?			NA
Are traffic lane and carriageway widths adequate for the traffic volume and mix?		✓	arterial roads have adequate width. link roads have small seal width, Yarramundi ln & Innals ln
Are bridge widths adequate?		✓	Richmond Bridge has single lane
6.1.7 Shoulders			
Are shoulders wide enough to allow drivers to regain control of errant vehicles?		✓	no sealed shoulders are provided arterial state roads are kerb/gutter. council roads have no sealed shoulders
Are shoulders wide enough for broken-down or emergency vehicles to stop safely?			no breakdowns affect traffic flow
Are shoulders sealed?		✓	
Are shoulders traffickable for all vehicles and road users? (i.e. are shoulders in good condition)			NA.
Is the transition from road to shoulder safe? (no drop-offs)			NA.
6.1.8 Crossfalls			
Is appropriate superelevation provided on curves?	✓		
Is any adverse crossfall safely managed (for cars, trucks, etc.)?	✓		
Do crossfalls (carriageway and shoulder) provide adequate drainage?	✓		
6.1.9 Batter slopes			
Are batter slopes traversable by cars and trucks that run off the road?	✓		
6.1.10 Drains			
Are roadside drains and culvert end walls traversable?		✓	terrace st - poor culvert (Section 2.3)
6.2 Auxiliary lanes			
6.2.1 Tapers			
Are starting and finishing tapers located and aligned correctly?	✓		
Is there sufficient sight distance to the end of the auxiliary lane?	✓		
6.2.2 Shoulders			
Are appropriate shoulder widths provided at merges?	✓		on arterial routes not council roads
Have shoulder widths been maintained beside the auxiliary lane?			no auxiliary lanes

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Issue	Yes	No	Comment
6.2.3 Signs and markings			
Have all signs been installed in accordance with the appropriate guidelines?		✓	signs not installed at Bosworth Street & Yarramundi Lane
Are all signs conspicuous and clear?	✓		yes for the signs that are unobscured.
Does all linemarking conform with these guidelines?		✓	many lane markings are faded or absent
Is there advance warning of approaching auxiliary lanes?	✓		
6.2.4 Turning traffic			
Have right turns from the through lane been avoided?	✓		
Is there advance warning of turn lanes?	✓		markings need to be upgraded.
6.3 Intersections			
6.3.1 Location			
Are all intersections located safely with respect to the horizontal and vertical alignment?	✓		many intersections do suffer surface depressions.
Where intersections occur at the end of high-speed environments (for example, at approaches to towns), are there traffic control devices to alert drivers?			NA
6.3.2 Visibility; sight distance			
Is the presence of each intersection obvious to all road users?	✓		
Is the sight distance appropriate for all movements and all road users?		✓	refer to section 2
Is there stopping sight distance to the rear of any queue or slow-moving turning vehicles?	✓		
Has the appropriate sight distance been provided for entering and leaving vehicles?		✓	Refer to section 2.
6.3.3 Controls and delineation			
Are pavement markings and intersection control signs satisfactory?		✓	many pavement markings are absent or faded
Are vehicle paths through intersections delineated satisfactorily?		✓	at Kurralong / Kurralong Rd provided no intersection delineation
Are all lanes properly marked (including any arrows)?	✓		
6.3.4 Layout			
Are all conflict points between vehicles safely managed?		✓	refer to section 2
Is the intersection layout obvious to all road users?	✓		

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Issue	Yes	No	Comment
Is the alignment of kerbs obvious and appropriate?	✓		
Is the alignment of traffic islands obvious and appropriate?	✓		
Is the alignment of medians obvious and appropriate?	✓		
Can all likely vehicle types be accommodated?	✓		
Are merge tapers long enough?	✓		
Is the intersection free of capacity problems that may produce safety problems?	✓		all intersections suffer from capacity issues which impact visibility & traffic flow
6.3.5 Miscellaneous			
Particularly at rural sites, are all intersections free of loose gravel?	✓		loose gravel on old Kurrajong Road intersection entrance exit
6.4 Signs and lighting			
6.4.1 Lighting			
Has lighting been adequately provided where required?	✓		lands lane, yarra munda lane, Cotham road st & old kurrajong / Kurrajong rd
Is the road free of features that interrupt illumination? (for example, trees or overbridges)	✓		
Is the road free of lighting poles that are a fixed roadside hazard?	✓		several light poles are a road side hazard on lands lane &
Are frangible or slip-base poles provided?	✓		on arterial roads others have fixed non-frangible poles
Ambient lighting: if it creates special lighting needs, have these been satisfied?			na
Is the lighting scheme free of confusing or misleading effects on signals or signs?	✓		
Is the scheme free of any lighting black patches?	✓		extensive black patches throughout the project scope
6.4.2 General signs issues			
Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear?	✓		
Are the correct signs used for each situation, and is each sign necessary?	✓		
Are all signs effective for all likely conditions? (for example, day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)	✓		
If restrictions apply for any class of vehicle, are drivers adequately advised?			na
If restrictions apply for any class of vehicle, are drivers advised of alternative routes?			na

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Issue	Yes	No	Comment
6.4.3 Sign legibility			
In daylight and darkness, are signs satisfactory regarding visibility and: <ul style="list-style-type: none"> ▪ clarity of message? ▪ readability/legibility at the required distance? 	✓		
Is sign retroreflectivity or illumination satisfactory?		✓	<i>RRPM's are needed.</i>
Are signs able to be seen without being hidden by their background or adjacent distractions?	✓		
Is driver confusion due to too many signs avoided?	✓		
6.4.4 Sign supports			
Are sign supports out of the clear zone?	✓		
If not, are they: <ul style="list-style-type: none"> ▪ frangible? ▪ shielded by barriers (for example, guard fence, crash cushions)? 			
6.5 Markings and delineation			
6.5.1 General issues			
Is the line marking and delineation: <ul style="list-style-type: none"> ▪ appropriate for the function of the road? ▪ consistent along the route? ▪ likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc.) 	✓		<i>however needs to be updated.</i>
Is the pavement free of excessive markings? (for example, unnecessary turn arrows, unnecessary barrier lines, etc.)	✓		
6.5.2 Centrelines, edgelines, lane lines			
Are centrelines, edgelines, lane lines provided? If not, do drivers have adequate guidance?		✓	<i>yes.</i>
Have RRPMs been installed where required?	✓		
If RRPMs are installed, are they correctly placed, correct colours, in good condition?	✓		
Are profiled (audible) edgelines provided where required?			<i>NA.</i>
Is the linemarking in good condition?		✓	<i>several linemarkings are faded</i>
Is there sufficient contrast between linemarking and pavement colour?	✓		

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Issue	Yes	No	Comment
6.5.3 Guideposts and reflectors			
Are guideposts appropriately installed?	✓		
Are delineators clearly visible?	✓		
Are the correct colours used for the delineators?	✓		
Are the delineators on guard fences, crash barriers and bridge railings consistent with those on guideposts?	✓		
6.5.4 Curve warning and delineation			
Are curve warning signs and advisory speed signs installed where required?	✓		
Are advisory speed signs consistent along the route?	✓		
Are the signs correctly located in relation to the curve? (i.e. not too far in advance)	✓		
Are the signs large enough?	✓		
Are chevron alignment markers (CAMs) installed where required?	✓		
Is the positioning of CAMs satisfactory to provide guidance around the curve?	✓		
Are the CAMs the correct size?	✓		
Are CAMs confined to curves? (not used to delineate islands, etc)	✓		used to delineate end of Road ie T intersection boundary CAMs are in the through direction
6.6 Crash barriers and clear zones			
6.6.1 Clear zones			
Is the clear zone width traversable? (i.e. drivable)	✓		
Is the clear zone width free of rigid fixtures? (if not, can all of these rigid fixtures be removed or shielded?)		✓	refer above for obstructions in the clear zone
Are all power poles, trees, etc., at a safe distance from the traffic paths?		✓	many are located on the kerb edge
Is the appropriate treatment or protection provided for any objects within the clear zone?		✓	no protection is provided
6.6.2 Crash barriers			
Are crash barriers installed where necessary?	✓		
Are crash barriers installed at all necessary locations in accordance with the relevant guidelines?		✓	crash barriers are below standard - refer to section 1
Are the barrier systems suitable for the purpose?		✓	
Are the crash barriers correctly installed?		✓	
Is the length of crash barrier at each installation adequate?	✓		

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Issue	Yes	No	Comment
Is the guard fence attached correctly to bridge railings?	✓		
Is there sufficient width between the barrier and the edge line to contain a broken-down vehicle?		✓	
6.6.3 End treatments			
Are end treatments constructed correctly?	✓		
Is there a safe run-off area behind breakaway terminals?	✓		
6.6.4 Fences			
Are pedestrian fences frangible?			na
Are vehicles safe from being speared by horizontal fence railings located within the clear zone?	✓		Innards road barbed wire fencing presents a safety issue
6.6.5 Visibility of barriers and fences			
Is there adequate delineation and visibility of crash barriers and fences at night?	✓		
6.7 Traffic signals			
6.7.1 Operations			
Are traffic signals operating correctly?	✓		
Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment?	✓		
Where necessary, are there provisions for visually impaired pedestrians? (for example, audio-tactile push buttons, tactile markings)	✓		Issues with crossing directional ability with offset usually impaired users (rubin T)
Where necessary, are there provisions for elderly or disabled pedestrians? (for example, extended green or clearance phase)			unknown
Is the controller located in a safe position? (i.e. where it is unlikely to be hit, but maintenance access is safe)	✓		
Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?			unknown
6.7.2 Visibility			
Are traffic signals clearly visible to approaching motorists?	✓		
Is there adequate stopping sight distance to the ends of possible vehicle queues?	✓		
Have any visibility problems that could be caused by the rising or setting sun been addressed?	✓		
Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?	✓		

Issue	Yes	No	Comment
Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?			NA.
Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues?			NA.
Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, light poles, signs, bus stops, etc.)	✓		
6.8 Pedestrians and cyclists			
6.8.1 General issues			
Are there appropriate travel paths and crossing points for pedestrians and cyclists?	✓		
Is a safety fence installed where necessary to guide pedestrians and cyclists to crossings or overpasses?		✓	
Is a safety barrier installed where necessary to separate vehicle, pedestrian and cyclist flows?			NA.
Are pedestrian and bicycle facilities suitable for night use?	✓		
6.8.2 Pedestrians			
Is there adequate separation distance between vehicular traffic and pedestrians on footways?	✓		footways not shared.
Is there an adequate number of pedestrian crossings along the route?	✓		
At crossing points is fencing oriented so pedestrians face oncoming traffic?			NA.
Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages? (for example, holding rails, kerb and median crossings, ramps)	✓		
Are adequate hand rails provided where necessary? (for example, on bridges, ramps)	✓		
Is signing about pedestrians near schools adequate and effective?			NA.
Is signing about pedestrians near any hospital adequate and effective?			NA.
Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?	✓		

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Issue	Yes	No	Comment
6.8.3 Cyclists			
Is the pavement width adequate for the number of cyclists using the route?	✓		
Is the bicycle route continuous? (i.e. free of squeeze points or gaps)	✓		
Are drainage pit grates bicycle safe?		✓	culvert is a risk.
6.8.4 Public transport			
Are bus stops safely located with adequate visibility and clearance to the traffic lane?	✓		
Are bus stops in rural areas signposted in advance?	✓		
Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate?	✓		
Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?	✓		
6.9 Bridges and culverts			
6.9.1 Design features			
Are bridges and culverts the full formation width?	✓		
Are bridge and culvert carriageway widths consistent with approach conditions?	✓		
Is the approach alignment compatible with the 85th percentile travel speed?	✓		
Have warning signs been erected if either of the above two conditions (i.e. width and speed) are not met?			NA.
6.9.2 Crash barriers			
Are there suitable traffic barriers on bridges and culverts and their approaches to protect errant vehicles?			NA
Is the connection between barrier and bridge safe?			NA. check
Is the bridge free of kerbing that would reduce the effectiveness of barriers or rails?	✓		
6.9.3 Miscellaneous			
Are pedestrian facilities on the bridge appropriate and safe?	✓		NA
Is fishing from the bridge prohibited? If not, has provision been made for safe fishing?	✓		
Does delineation continue over the bridge?	✓		

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Issue	Yes	No	Comment
6.10 Pavement			
6.10.1 Pavement defects			
Is the condition of the pavement edges satisfactory?		✓	
Is the transition from pavement to shoulder free of dangerous edge drop offs?	✓		<i>no solid shoulders</i>
Is the pavement free of defects (for example, excessive roughness or rutting, potholes, loose material, etc.) that could result in safety problems (for example, loss of steering control)?		✓	<i>refer to section 2</i>
6.10.2 Skid resistance			
Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓		
Has skid resistance testing been carried out where necessary?			<i>unknown</i>
6.10.3 Ponding			
Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?		✓	<i>culvert on terrace st creates ponding</i>
6.10.4 Loose stones/material			
Is the pavement free of loose stones and other material?		✓	<i>loose gravel on old Kaurajong Rd.</i>
6.11 Parking			
6.11.1 General issues			
Are the provisions for, or restrictions on, parking satisfactory in relation to traffic safety?		✓	<i>parking on grass side road is unsafe (Section 1.3)</i>
Is the frequency of parking turnover compatible with the safety of the route?	✓		
Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur?	✓		
Are parking manoeuvres along the route possible without causing safety problems? (for example, angle parking)	✓		
Is the sight distance at intersections and along the route, unaffected by parked vehicles?	✓		
6.12 Provision for heavy vehicles			
6.12.1 Design issues			
Are overtaking opportunities available for heavy vehicles where volumes are high?		✓	<i>single lane travel</i>

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Issue	Yes	No	Comment
Does the route generally cater for the size of vehicle likely to use it?	✓		
Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.?	✓		
Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (consider acceleration, deceleration, shoulder widths, etc.)			NA.
6.12.2 Pavement/shoulder quality			
Are shoulders sealed at bends to provide additional pavement for long vehicles?		✓	only on castle reagh road.
Is the pavement width adequate for heavy vehicles?	✓		castle reagh, kurrajong rd & old kurrajong rd
In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles?	✓		
On truck routes, are reflective devices appropriate for truck drivers' eye heights?	✓		
6.13 Floodways and causeways			
6.13.1 Ponding, flooding			
Are all sections of the route free from ponding or flow across the road during wet weather?		✓	ferrance st ponding.
If there is ponding or flow across the road during wet weather, is there appropriate signposting?		✓	
Are floodways and causeways correctly signposted?	✓		
6.13.2 Safety of devices			
Are all culverts or drainage structures located outside the clear roadside recovery area?		✓	ferrance st culvert is in adequate.
If not, are they shielded from the possibility of vehicle collision?		✓	
6.14 Miscellaneous			
6.14.1 Landscaping			
Is landscaping in accordance with guidelines? (for example, clearances, sight distance)	✓		
Will existing clearances and sight distances be maintained following future plant growth?	✓		
Does the landscaping at roundabouts avoid visibility problems?	✓		

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Issue	Yes	No	Comment
6.14.2 Temporary works			
Are all locations free of construction or maintenance equipment that is no longer required?	✓		
Are all locations free of signs or temporary traffic control devices that are no longer required?	✓		
6.14.3 Headlight glare			
Have any problems that could be caused by headlight glare been addressed? (for example, a two-way service road close to main traffic lanes, the use of glare fencing or screening)	✓		
6.14.4 Roadside activities			
Are the road boundaries free of any activities that are likely to distract drivers?	✓		
Are all advertising signs installed so that they do not constitute a hazard?	✓		
6.14.5 Errant vehicles			
Is the roadside furniture on the verges and footways free of damage from errant vehicles that could indicate a possible problem, hazard or conflict at the site?	✓		
6.14.6 Other safety issues			
Is the embankment stability safe?	✓		
Is the route free of unsafe overhanging branches?	✓		
Is the route free of visibility obstructions caused by long grass?	✓		
Are any high-wind areas safely dealt with?			NA.
If back-to-back median kerbing is used is it: <ul style="list-style-type: none"> ▪ adequately delineated? ▪ obvious where it starts? ▪ obvious at intersections? ▪ unlikely to be a hazard to pedestrians? 			NA.
6.14.7 Rest areas			
Is the location of rest areas and truck parking areas along the route appropriate?			NA.
Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas at all times of the day?			NA.

Issue	Yes	No	Comment
6.14.8 Animals			
Is the route free from large numbers of animals? (for example, cattle, sheep, kangaroos, koalas, wombats, etc.)	✓		
If not, is it protected by animal-proof fencing?			NA
6.14.9 Safety aspects for heavy vehicles not already covered			
Have all other matters which may have a bearing on safety for heavy vehicles been addressed?	✓		