The background image shows a two-lane road stretching into the distance, flanked by trees and vegetation. On the left side of the road, there is a red rectangular speed limit sign with a white border. Inside the sign, there is a yellow diamond-shaped warning sign with a black arrow pointing left, indicating a sharp curve. Below the diamond, the number '45' is displayed in black. The text 'ROAD SAFETY RISKS' and 'ROUTE DESCRIPTION REPORT' is overlaid in large, bold, green capital letters on the road surface.

BOOTHENBA RD – OLD MENDOORAN RD – GOLDEN HWY

ROAD SAFETY RISKS ROUTE DESCRIPTION REPORT

Reference: 289298 / D



Version: **FINAL**

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1. CONTACT DETAILS

CLIENT DETAILS

Client Organisation: Dubbo Regional Council

Address: P.O. Box 81 Dubbo NSW 2830

Risk Manager: Chris Rath

Phone: 02 6840 6411

WAYSFAE DETAILS

ABN: 30 603 394 458

Address: PO Box 272 Parkes NSW 2870

Contact: Wayde Hazelton

Phone: 0414 769 330

Web: www.waysafe.com.au

DOCUMENT VERSION CONTROL

Version	Date	Comment
Draft Version 1	03/07/2021	Initial draft
Draft Version 2	11/07/2021	Updated draft report with further information. Adjusted formatting, fixed typos.
Draft Version 3	18/08/2021	Updated report incorporating correspondence from Dubbo Regional Council including reviewing traffic data, typos, and amendments due to reviewed traffic data. New traffic counts are currently underway; the intention is to incorporate any major changes into the final report.
Draft Version 4	12/09/2021	Updated report with new traffic count data and revisited text and findings to align with new traffic data. Provided to Dubbo Regional Council for comment.
Final Version	04/10/2021	Updated Table 4 to align with new traffic count data. Finalised report.

2. LOCATION OF INTERSECTIONS

Figure 1 provides a Google Maps aerial photograph of the three intersections showing the Boothenna – Old Mendooran Rd intersection and adjacent level crossing (red circle); the Boothenna Rd – Golden Hwy intersection and adjacent level crossing (green circle), and the Old Mendooran Rd – Golden Hwy intersection (white circle).

The white line shows route 1, the blue line shows route 2, as described in Section 3.3 Scope of Described Route, on page 4.

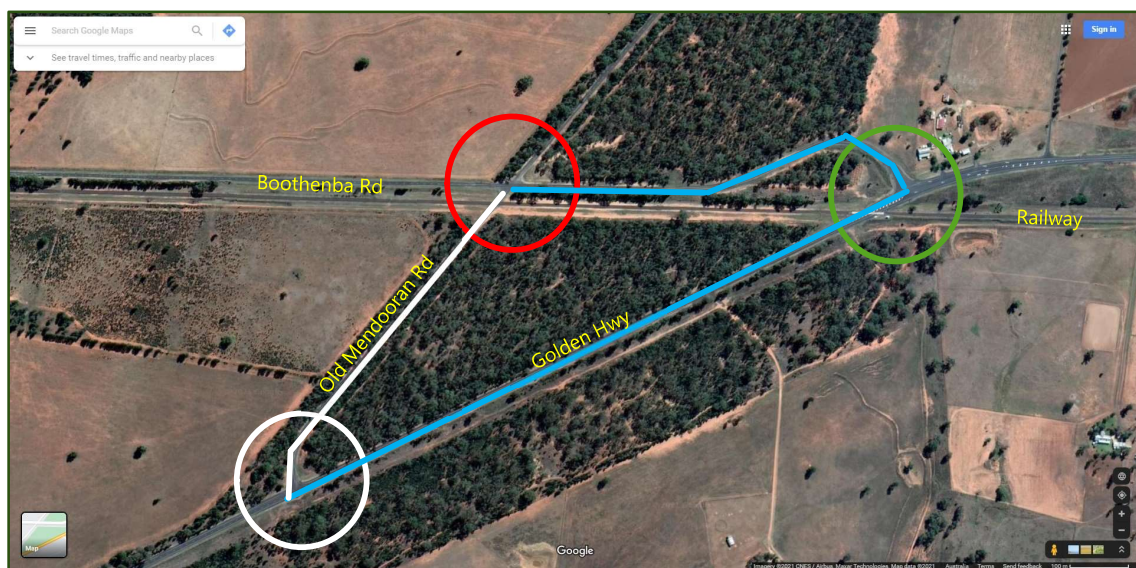


Figure 1. Aerial photograph of road safety audit locality, intersections, and level crossings.

3. INTRODUCTION

3.1. Objective

The objective of this Route Description Report, is to describe the potential road safety risks for road users using Old Mendooran Rd south of Boothenna to access the Golden Hwy and the potential road safety risks using the alternative route via Boothenna Rd to access the Golden Hwy.

3.2. Background

The intersection of Old Mendooran Rd and Boothenna Rd Dubbo has a history of near misses and crashes, including a fatal crash in November 2020.

Boothenna Rd forms a northern heavy vehicle bypass of Dubbo and includes direct access to Dubbo Regional Saleyards and freight intensive industries. Boothenna Rd travels approximately 11.5km between the Golden Hwy in the east to the Newell Hwy to the north of Dubbo. The route continues west on Troy Bridge Rd and Bunglegumbie Rd to the Mitchell Hwy west of Dubbo.

Boothenna Rd is a B-double, CML, 4.6m high route between the Golden Hwy and Yarrandale Rd. West of Yarrandale Rd the route is open to AB-triple, HML, 4.6m high vehicles. The default rural speed limit of 100km/h applies to this eastern end of Boothenna Rd.

The Golden Hwy is a B-double, HML, 4.6m high route. The default rural speed limit of 100km/h applies to this road.

Old Mendooran Rd is general access only i.e., 19m semitrailer; the default rural speed limit of 100km/h applies to this road. The distance between the railway and Boothenna Rd is around 26m; this is barely adequate to safely store a semitrailer and inadequate to safely store a B-double between Boothenna Rd and the railway should a B-double illegally use this road. Queueing is also possible should a car and a semitrailer proceed into the area between the railway and Boothenna Rd, failing to keep clear of the railway, or Boothenna Rd.

Boothenna Rd is the priority road at the Old Mendooran Rd, the intersection controlled by Give Way signs facing Old Mendooran Rd traffic. The Golden Hwy is the priority road at both the Old Mendooran Rd junction and at the Boothenna Rd junction.

The Troy Junction (Dubbo) to Merrygoen railway runs parallel with Boothenna Rd at this location. The Old Mendooran Rd and the railway intersect on an acute skew. The level crossing is controlled by a Stop sign.

This railway and the Golden Hwy intersect immediately west of the Boothenna Rd junction. The Golden Hwy crosses the railway on an acute skew however, it is fitted with active (Type F) controls in the form of flashing lights and bells.

3.3. Scope of Described Routes

This Road Safety Risk Route Description Report considers the main potential road safety risks for road users travelling in either direction between Old Mendooran Rd north of Boothenna Rd and the Golden Hwy east of Old Mendooran Rd. There are two choices for the route:

1. Old Mendooran Rd north of Boothenna Rd, straight across Boothenna Rd and the passive Stop controlled level crossing to turn right at the Golden Hwy; or
2. Old Mendooran Rd north of Boothenna Rd, left onto Boothenna Rd, right onto the Golden Hwy and across the active flashing-light controlled level crossing.

An Existing Road (Stage 6) road safety audit of the Boothenna Rd – Old Mendooran Rd intersection and adjacent level crossing was completed in March 2021. A Feasibility Design (Stage 2) road safety audit of two safety upgrade options was also completed in March 2021.

These two road safety audits provided an insight into the main road safety risks facing road users at this intersection under the existing road layout and conditions, and of the two proposed intersection safety upgrade options.

This report draws together the highest risk level potential road safety risks noted in these reports, along with potential road safety risks along Old Mendooran Rd south of Boothenna Rd, along Boothenna Rd east of Old Mendooran Rd, and along the Golden Hwy between these roads and their junctions with the Golden Hwy, to give a holistic comparison of the road safety risks facing road users on either route.

3.4. Exclusions / Not Assessed

Several road safety items could not be assessed as no information was provided. These include:

- Detail of any proposed or planned works, the designs provided for the Stage 2 road safety audit being in the feasibility stage of development.

3.5. Road Safety Audits

Two road safety audits were completed in March 2021:

1. Existing Road (Stage 6) road safety audit of the Boothenna Rd – Old Mendooran Rd intersection and adjacent level crossing.
2. Feasibility Design (Stage 2) road safety audit of two safety upgrade options for the Boothenna Rd – Old Mendooran Rd intersection and adjacent level crossing.

3.6. Background Data

CRASH HISTORY

A study of the recent crash history has been conducted in the vicinity of the Boothenna Rd – Old Mendooran Rd intersection for the five-year period 2015 to 2019. This showed there were five reported crashes within the road safety audit area, four at the intersection and one run-off-road immediately east of the intersection. These crashes resulted in nine people being injured, including six in one crash event. On 20 November 2020 there was a fatal crash at the intersection, involving a car and a truck. The driver of the car died; the truck driver was injured.

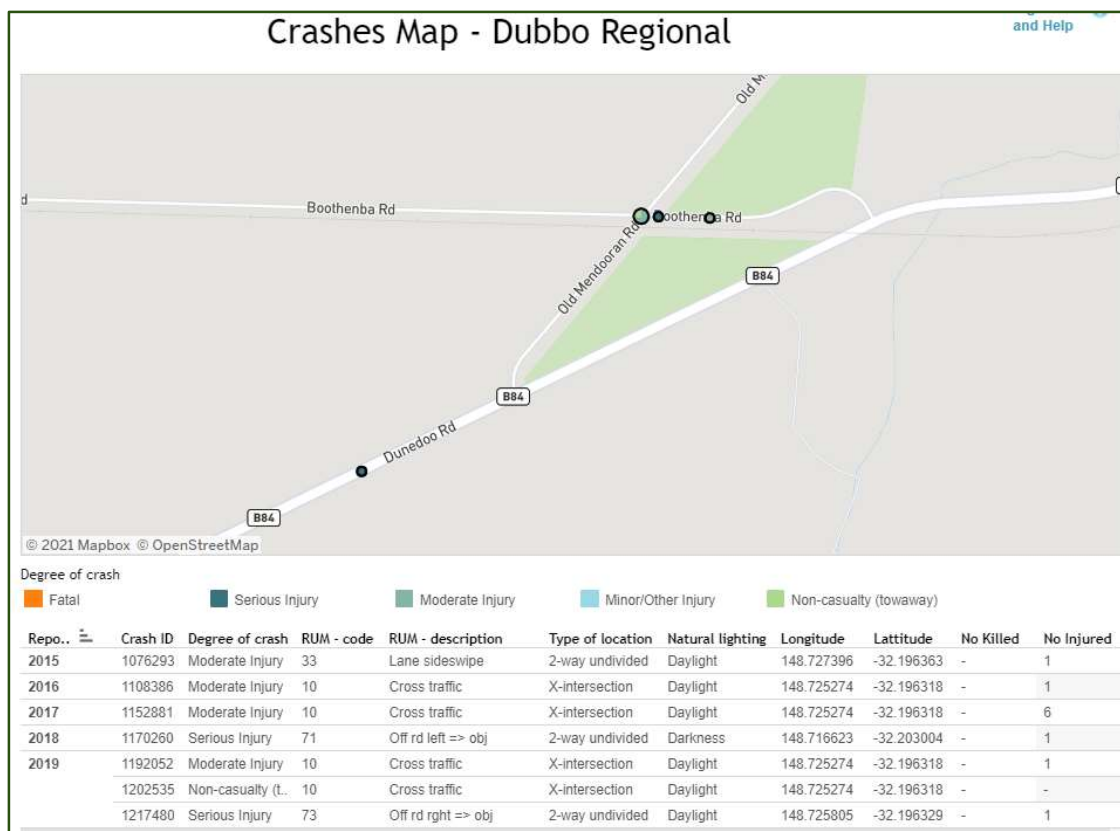


Figure 2. Crashes map in the vicinity of the Boothenna Rd – Old Mendooran Rd – Golden Hwy (shown as Dunedoo Rd B84) triangle.

The only recorded crash on the Golden Hwy is 500m west of the Old Mendooran Rd junction. Four of the seven crashes in the 2015-2019 crash database occurred at the Boothenna Rd – Old Mendooran Rd intersection, with a fifth and fatal crash occurring in November 2020 (not listed). In total, 13 people have been injured in crashes in the vicinity, included one fatally: ten of the injured people, including the fatality, sustained their injuries in crashes at the Boothenna Rd – Old Mendooran Rd intersection. Only one crash at this site did not result in injuries.

RAIL DATA

The Troy Junction (Dubbo) – Merrygoen Railway crosses both Old Mendooran Rd and Golden Hwy within the study area. The Old Mendooran Rd level crossing is controlled by Stop signs. Safety deficiencies noted for the level crossing include S3 sighting, queueing, and sun glare. The Golden Hwy level crossing is controlled by Type F (flashing lights) control.

Train speeds through both level crossings (LXM1257 and LXM1258) vary between 60km/h and 100km/h, with the longest trains being 1,500m. On average there are 4 trains per day.

Operation of the level crossings causes delay for road users. For the level crossing on the Golden Hwy, the maximum delay is around 1 minute 27 seconds, the minimum delay is around 1 minute 2 seconds, and this will vary with train length and speed. The road traffic delay on Old Mendooran Rd will be similar, also depending on gap acceptance of the road user. Typically, active controls operate for a minimum of 28 seconds before the train arrives.

Note that freight trains can take over 1km to stop, trains cannot swerve to avoid a collision, and freight trains may weigh around 5,000t when loaded. In any impact with a road vehicle the train is the largest source of energy; even at slow speeds this energy proves to be well above the limit of vehicle energy absorption capability and well above the human tolerance for survivability of the applicable crash types.

ROAD TRAFFIC AND SPEED DATA

Dubbo Regional Council re-collected traffic data between 27th July 2021 and 9th September 2021, for the three road sections of interest, viz:

- A. Old Mendooran Rd, between the Golden Hwy and Boothenna Rd (south)
- B. Old Mendooran Rd, north of Boothenna Rd (north)
- C. Boothenna Rd, between Old Mendooran Rd and the Golden Hwy (east)

A summary of the two-way traffic data for each site is provided in Table 1, and shows:

- total number of vehicles detected, by vehicle class, over the data collection period
- summary vehicle volumes in speed ranges, over the data collection period
- peak hour time and peak hour volume during the AM and PM weekday peak hours
- average weekday traffic volume over the data collection period.

The highest traffic volume, average 355 vehicles per day, use Boothenna Rd east of old Mendooran Rd to access the Golden Hwy. This is more than the other two sites combined, suggesting that most of the vehicles using Boothenna Rd continue east on the Golden Hwy. An unknown number of vehicles using Boothenna Rd west of the intersection also use the Old Mendooran Rd south route. Use of this may be due in part to the next north-south oriented road being Yarrandale Rd, approximately 9km to the west; drivers wishing to travel to south Dubbo, or the Mitchell Hwy, may find this route shorter and quicker than using Yarrandale Rd.

Table 1. Traffic and speed data for the three road sections.

TRAFFIC COUNT SITES	Site A - Old Mendooran Rd south		Site B - Old Mendooran Rd north		Site C - Boothenda Rd east	
VEHICLE CLASSES	Total	%	Total	%	Total	%
Class 1 (light: car, motorbike)	5395	84	3005	44	6067	45
Class 2 (light + trailer)	309	5	259	4	585	4
Class 3 (2-axle truck)	577	9	3028	45	1903	14
Class 4 (3-axle truck)	38	1	90	1	573	4
Class 5 (4-axle truck)	14	0	21	0	122	1
Class 6 (3-axle articulated)	10	0	85	1	103	1
Class 7 (4-axle articulated)	40	1	177	3	224	2
Class 8 (5-axle articulated)	9	0	36	1	243	2
Class 9 (6-axle articulated)	27	0	69	1	1342	10
Class 10 (B-double)	12	0	20	0	2371	17
Class 11 (Double Road Train)	0	0	0	0	72	1
Class 12 (Triple Road Train)	0	0	0	0	0	0
Total for Data Period	6,431	100	6,790	100	13,605	101*
VEHICLE SPEEDS	Total	%	Total	%	Total	%
0 - 50	229	4	228	3	418	6
50 - 80	4657	72	3973	59	5880	43
80 - 100	1478	23	1713	25	5436	40
100 - 120	66	1	706	10	1674	12
>120	1	0	170	3	197	1
Exceeding speed limit (100km/h)	67	1	876	13	1871	14
85th percentile speed	84km/h		98km/h		99km/h	
PEAK HOUR PEAK TIMES†						
AM	Mon 0700-0800		Mon 0700-0800		Thu 0700-0800	
PM	Fri 1500-1600		Fri 1500-1600		Thu 1500-1600	
PEAK HOUR PEAK VOLUME						
AM (maximum)	18		29		53	
PM (maximum)	20		37		60	
AVERAGE WEEKDAY VOLUME	150		178		355	
DATA PERIOD	From:		26 July 2021			
	To:		05 Sep 2021			

Note on Table 1: The data for Vehicle Classes and for Vehicle Speeds was derived from the full data collection period, that is, from when the MetroCounters were turned on until they were turned off. The Peak Hour Peak Times and Volumes, and Average Weekday Volume, were derived from a subset of the full data to only include full weeks (Monday to Sunday) of data, no orphan days or split weeks were included.

* Percentages greater than 100 due to rounding

† Peak times and days varied across the data collection period

3.7. Travel Time and Cost

Although the primary focus of this report is road safety, a generalised estimate of the additional time and cost incurred by road users should any of the options be adopted is considered.

Currently, 150 vehicles per weekday use Old Mendooran Rd south of Boothenna Rd, of these 133 (89%) are light vehicles. In comparison, 355 vehicles per weekday use Boothenna Rd east, of these 174 (49%) are light vehicles; and 178 vehicles per weekday use Old Mendooran Rd north of Boothenna Rd, of these 86 (48%) are light vehicles. Table 2 provides traffic data for three vehicle groups; Light, Classes 1 & 2; Rigid Truck, Classes 3 to 5; and Articulated Truck, Classes 6 to 12.

No Class 12 vehicles were recorded however, 72 of Class 11 (Double Road Train / B-Triples) vehicles were recorded on Boothenna Rd east, which is a B-double route. Although errors may occur in data collection and coding, 72 appears to be too high to be coding errors alone.

Table 2. Total vehicular traffic; average daily traffic; and percentage of total traffic across three vehicle groups at each of the three traffic count sites.

Traffic Count Sites	Site A - Old Mendooran Rd south			Site B - Old Mendooran Rd north			Site C - Boothenna Rd east		
Vehicle Group	Total	Daily	%	Total	Daily	%	Total	Daily	%
Light	5,704	133	89%	3,264	86	48%	6,652	174	49%
Rigid Truck	629	15	10%	3,139	82	46%	2,598	68	19%
Articulated	98	2	1%	387	10	6%	4,355	114	32%
TOTAL	6,431	150	100%	6,790	178	100%	13,605	355	100%

Note on Table 2: Rigid Truck includes buses.

ROUTE COMPARISON

There are two routes considered that are applicable to the three project options:

- Route 1, Old Mendooran Rd between Boothenna Rd and Golden Hwy, which is around 0.655km in length.
- Route 2, Boothenna Rd between Old Mendooran Rd and Golden Hwy, and Golden Hwy between Boothenna Rd and Old Mendooran Rd, which at around 1.90km in length, is almost three times further, adding around 1.24km to each trip.

Using the Old Mendooran Rd / Boothenna Rd intersection as the common starting point, and the Old Mendooran Rd / Golden Hwy intersection as the common finish point, the traffic data presented in Table 2, Site A is applicable to both routes to determine indicative efficiency differences between the two routes; that is, the vehicles currently using Route 1 that would be

diverted to Route 2. Please note it is not the intention of this report to provide a modelled comparison of the two routes, rather to present an indicative summary of cost and time for the two routes. It is noted that there are marked performance differences between vehicles, and between drivers; only the most basic differences are considered. Table 3 provides a basic high-level estimate of the vehicle running costs and the time taken to traverse the two routes; it is important to read and understand the purpose of this Table as is provided in the 'Note to Table 3'. The Excel spreadsheet is provided with this report to allow editing or better refining of the estimations.

Table 3. An estimate of running cost and time between Route A and Route B.

TRAVEL COST and TIME COMPARISON																
Old Mendooran Rd -vs- Boothenna Rd and Golden Hwy, Dubbo																
Vehicle	Daily Volume	Running Costs			Time Markup	Route 1 Cost		Route 2 Cost		Difference						
		ltr/100km	Fuel Cost	Markup		Cost	Time (s)	Cost	Time (s)	Cost	Time (s)					
Light	133	10	1.5	3.0	1.0	\$ 0.29	35	\$ 0.86	78	\$ 0.56	43					
Rigid Truck	15	20	1.5	4.0	1.2	\$ 0.79	42	\$ 2.28	94	\$ 1.49	51					
Articulated	2	30	1.5	6.0	1.4	\$ 1.77	49	\$ 5.13	109	\$ 3.36	60					
Total Volume	150	TOTAL DAILY COST				\$ 54.53	5,394	\$ 158.18	11,990	\$ 103.65	6,596					
WaySafe2 13901v1						TOTAL DAILY TIME		1h 29m 54s		3h 19m 50s						
DISTANCE (km)							Notes 1. Blue shaded cells can be edited. 2. ltr/100km fuel consumption is a nominal figure, that provides a means of comparison rather than the actual cost of operation. 3. Fuel cost is an approximate figure at the time of writing. 4. Running cost markup provides a basic factor to estimate of the total cost of running a vehicle based on the fuel cost. 5. Time markup provides a basic factor to provide some allowance for additional deceleration / acceleration of heavy vehicles. 6. Delay is an estimate of additional time lost due to other factors, such as the mandatory Stop at the Old Mendooran Rd level crossing. 7. Speed is derived from the recorded 85th percentile speed or 10km/h above the curve advisory speeds, whichever is lower. 8. Delay due to train activity is not included as it is similar for both routes and is infrequent. 9. Delay entering the Golden Hwy is not included. It may be higher at the Boothenna Rd intersection due to higher right turn demand into Boothenna Rd than Old Mendooran Rd.									
Segment	Total	D1	D2	D3	D4	D5										
Route 1	0.655	0	0	0	0	0.655										
Route 2	1.900	0.31	0.24	0.185	1.165	0										
SPEED (km/h)																
Segment		D1	D2	D3	D4	D5										
Route 1						84										
Route 2		98	75	55	100											
m/s		27	21	15	28	23										
Seconds		11	12	12	42	28										
TIME (s)																
Time	Calculated	Delay	Total													
Route 1	28	7	35													
Route 2	77	1	78													
Difference	49	-6	43													
Segment	Description															
D1	Boothenna Rd, between Old Mendooran Rd and 1st curve 65km/h advisory speed															
D2	Boothenna Rd, between 1st curve and 2nd curve 45km/h advisory speed															
D3	Boothenna Rd, between 2nd curve and Golden Hwy															
D4	Golden Hwy, between Boothenna Rd and Old Mendooran Rd															
D5	Old Mendooran Rd, between Boothenna Rd and Golden Hwy															

Note on Table 3: This is a high-level estimate and should not be relied upon for data purposes. The purpose of this Table is to provide an indication of the vehicle running costs and travel time of the two routes as an indication of potential ongoing financial costs. For a more accurate estimate, traffic modelling should be undertaken. Similarly, potential savings in reduced road trauma are not included in this comparison.

As can be derived from Table 3, for a light vehicle, the cost to travel via Route 2 is around triple that of travelling via Route 1; and will take around twice as long. The potential community saving from reduced road trauma is significantly more.

4. INCORPORATING SAFE SYSTEM FINDINGS

The aim of the Safe System Framework, in the road environment perspective, is to focus road safety on considering safe speeds and providing forgiving roads and roadsides. This is delivered by accepting that people make mistakes, and by considering the known limits to crash forces the human body can tolerate. In road safety reports this may be achieved by focusing the risk rating findings on identified crash types that are known to result in higher severity outcomes in relatively lower speed environments, with the aim to reduce the risk of fatal and serious injury crashes.

The annotation “IMPORTANT” is used to provide emphasis to any road safety finding that has the potential to result in fatal or serious injury, or findings that are likely to result in the following crash types above the related speed environment:

- head-on (>70km/h),
- right angle (>50km/h),
- run-off-road side impact into a rigid object (>40km/h), and
- crashes involving vulnerable road users (>30km/h),

as these crash types are known to result in higher severity outcomes in relatively lower speed environments. Rear-end crashes are also an important cause of serious injury in Australia.

The exposure and likelihood of crash occurrence is then considered for all findings deemed “IMPORTANT” and evaluated based on professional judgement. Factors such as traffic volumes and movements, speed environment, crash history and the road environment should be considered, and road safety engineering and crash investigation experience should be applied to determine the likelihood of crash occurrence. In this report, the risk rating of crash occurrence is considered either “INTOLERABLE”, “HIGH”, “MODERATE”, or “LOW”. This report only includes the five Safe System crash types noted above.

Adapted from Austroads (2019), Guide to Road Safety Part 6: Managing Road Safety Audits.

The nominal speeds provided by the Safe System are indicative only and represent the 10% likelihood of a fatality (or 90% survivability) for the crash type. The likelihood of sustaining serious injuries is significantly higher than the likelihood of a fatality at these speeds.

The likelihood of the crash outcome being fatal increases exponentially with increased speed.

In this road safety risks route description report the Risk Ranking of Findings methodology used is that provided in Austroads (2019), Guide to Road Safety Part 6A: Implementing Road Safety Audits.

5. DISCUSSION: ROAD SAFETY RISKS ROUTE DESCRIPTIONS

This section provides an outline of the recent history of the two route options, and provides a description of the road safety risks most likely to lead to serious injury or death of a road user as identified in the Safe System Framework, discussed in Section 4 Incorporating Safe System Findings. Note that high-speed rear end crashes are treated similarly to high-speed head-on crashes, and that crashes with trains are either right-angle side impact, where the train runs into the side of the road vehicle, or similar to head-on where the road vehicle runs into the side of a train.

5.1. Boothenna Rd – Old Mendooran Rd Intersection and Level Crossing

An Existing Road (Stage 6) Road Safety Audit of the Boothenna Rd – Old Mendooran Rd intersection and the adjacent level crossing was completed in March 2021. This audit described several potential risks to road safety; two were assessed to have an *Intolerable* level of risk. These were:

- The angle that Old Mendooran Rd intersects both Boothenna Rd and the level crossing is too acute, it being impossible for the driver of a heavy vehicle, and difficult for the driver of a light vehicle, to sight to the left along Boothenna Rd, and similarly along the railway line. This is exacerbated by sun glare, roadside vegetation, and a similar distraction for drivers eastbound on Boothenna Rd.
- The look-through affect for southbound drivers on Old Mendooran Rd on approach to Boothenna Rd. The level crossing appears more centrally in the driver's field of view and may distract from the Give Way control at Boothenna Rd.

A Feasibility Design (Stage 2) Road Safety Audit of this location was also completed in March 2021. This audit considered the potential road safety risks associated with the two design options proposed to improve safety at the intersection and level crossing. Although none of the potential road safety risks identified in the design options were found to be *Intolerable*, the highest-level risks included:

Short stacking and queueing risks on Old Mendooran Rd between Boothenna Rd and the level crossing. Option 1 proposed realigning the Old Mendooran Rd approaches to Boothenna Rd and to the level crossing to address the first *Intolerable* risk described in the first dot point above, the angle of intersection. Changing the approach angle south of Boothenna Rd shortened the available storage length between the intersection and level crossing to less than desirable to safely store a 19m semi-trailer. It is noted in the Vehicle Class data, which was not available at the time of the road safety audit, has since been recorded and is summarised in Table 1Table 2.

- That between 26 July 2021 and 5 September 2021, twelve B-doubles used this section of road despite it not being an approved B-double route. (Note: It is possible that these B-doubles were $\leq 19\text{m}$ in length, but that is unlikely.)
- Consideration of implementing the Safe System philosophy into the design options. Section 4 Incorporating Safe System Findings (above) briefly discusses the Safe System philosophy and the crash types and threshold speeds that most likely, and commonly, lead to serious injury or death outcomes in the event of a road crash. Realigning Old Mendooran Rd to meet Boothenna Rd at 90 degrees, and to meet the railway at close to 90 degrees, reduces the likelihood of a 'right angle' crash; drivers having improved ability to sight approaching vehicles, and trains. However, it does not reduce the consequences if such a crash occurs, which is likely serious injury or death.

A Road Safety Risk Options Report of this location was completed in March 2021 to describe potential risks to road safety under the three options proposed. Data for this report was drawn from the two Road Safety Audit Reports noted above and provided a means for the risk owner to compare the relative level of risk for each option under 16 risk criteria provided across the road safety audits. The options provided by Dubbo Regional Council were:

- Option 1. Do nothing.
- Option 2. Realign the Old Mendooran Rd approaches to Boothenna Rd and the level crossing, forming a staggered 'T' at Boothenna Rd.
- Option 3. Realign the northern Old Mendooran Rd approach to Boothenna Rd, to provide a 90-degree junction, and close the section of Old Mendooran Rd south of Boothenna Rd, including the level crossing. This would see Old Mendooran Rd terminating at Boothenna Rd, traffic heading to/from the Golden Hwy using Boothenna Rd.

5.2. Old Mendooran Rd – Golden Hwy Intersection

In the past, Old Mendooran Rd met the Golden Hwy at an acute angle of around 25 degrees. The approach has since been realigned to meet at near 90 degrees. This has added a curve in the braking zone on approach to the intersection, and with the roadside vegetation, reduced the sight distance for southbound drivers to the termination of Old Mendooran Rd. The curve and impending termination of Old Mendooran Rd is not readily obvious to an unwary driver, a single warning sign provides advice of both hazards.

For drivers leaving Old Mendooran Rd, sight distance along the Golden Hwy is adequate, meeting SISD specifications as described in the Austroads (2021) Guide to Road Design. However, sighting may be adversely affected by sun glare, see Figure 3 on page 13.

Drivers turning into Old Mendooran Rd from the Golden Hwy are provided with a narrow BAR and a narrow BAL/AUL. Although these designs do not provide turn bays to remove the turning vehicle from the path of through vehicles, they do provide widened sealed shoulders for the left turning vehicle (BAL) to move out of the path of through vehicles, and for through vehicles

to use the widened sealed shoulder to pass to the left of a vehicle turning right (BAR). This intersection design is safer than that currently provided at the Old Mendooran Rd – Boothenna Rd intersection, which is not provided with shoulder widening or sealing, but less safe than the intersection design provided at the Boothenna Rd – Golden Hwy intersection, which is provided with CHR and CHL auxiliary lanes – see section 5.3 below for a description of this site.

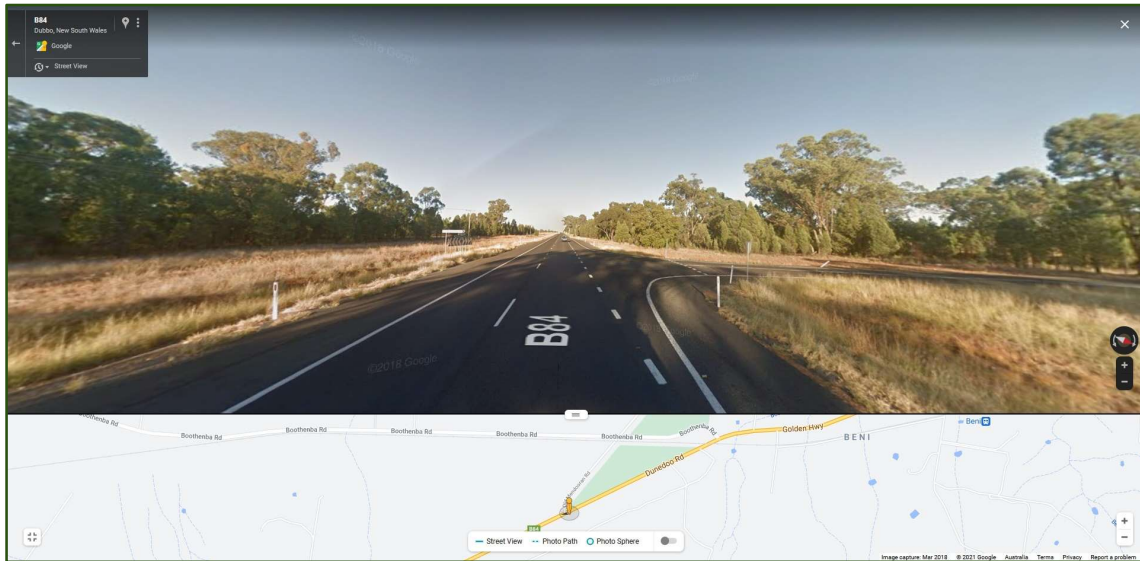


Figure 3. Google Street View image and map (March 2018); looking west at the Old Mendooran Rd – Golden Hwy intersection. The shoulder widening and sealing is evident, providing an escape area for drivers. Note the direction of the shadows, sun glare is a potential issue in the mornings in the middle of the year.



Figure 4. Google aerial photograph of the intersection, Old Mendooran Rd terminating at the Golden Hwy; Dubbo is to the west (left of photograph). Note the BAL and BAR layout.

5.3. Boothenna Rd – Golden Hwy Intersection and Level Crossing

In the past, Boothenna Rd also met the Golden Hwy at an acute angle, of around 25 degrees. Works were completed in 2013 to realign the approach to the current layout, providing an approach angle near 90 degrees. The works included the introduction of auxiliary lanes that provide drivers on the Golden Hwy, and turning into Boothenna Rd, a dedicated turning lane. This enables them to move out of the path of through vehicles. A left turn acceleration lane is also provided for vehicles that turn left onto the Golden Hwy.

These turning lanes, and the eastbound acceleration lane, reduce the likelihood of rear-end crashes. As noted in Section 4 Incorporating Safe System Findings on page 10, rear-end crashes are an additional Safe System crash type of importance in NSW. The right turn lane (CHR) on the Golden Hwy also reduces the likelihood of side impact crashes for a vehicle turning right into Boothenna Rd; the driver is not under pressure from westbound through traffic to attempt the turn in an inappropriate gap in oncoming traffic.

Drivers turning right from Boothenna Rd are not provided with an acceleration lane however, the painted median could provide a place for the vehicle to wait clear of the through traffic should the driver realise they had made an error and failed to give way to westbound traffic.

On turning right onto the Golden Hwy, the driver is faced with a level crossing around 50m west of Boothenna Rd. This level crossing is controlled by active (Type F) controls in the form of flashing lights and bells. This type of control has superior safety potential compared to the passive control provided at the Old Mendooran Rd level crossing, as follows:

- Passive controls (Stop and Give Way) require the vehicle driver to realise they are approaching a level crossing within a safe distance, to look (and know where and how far down the railway to look) for any approaching trains, to judge the speed and time it will take for the train to arrive, and to judge if they can safely complete the crossing before the train arrives.
- Active controls (Flashing lights and bells, with or without boom barriers) activate when a train is approaching and operate until the train has cleared the level crossing. A driver approaching this control must realise they are approaching a level crossing within a safe distance and make the decision to stop if the controls are operating.

Further discussion and information of safety at level crossings is available in WaySafe (2017), Review of Railway Level Crossing Standards.

In realigning Boothenna Rd two 'substandard' curves were introduced to allow Boothenna Rd to meet the Golden Hwy at around 90 degrees. For an eastbound driver, travelling at the 100km/h speed limit, the first of these curves has an advisory speed of 65km/h, the second curve has an advisory speed of 45km/h, which then leads to the Golden Hwy junction. No crashes are reported at these curves or at the intersection in the TfNSW crash database: https://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tblga=1

Potentially, that there are no recorded crashes may be due to the extent of delineation and warning signposting provided on approach to, and through these curves, which also serve to slow drivers on approach to the road junction. However, for an eastbound driver approaching Old Mendooran Rd at night, the extensive delineation and newer signposting creates a bright image, which distracts from the Old Mendooran Rd intersection, potentially reducing awareness of the intersection or road users approaching on Old Mendooran Rd.



Figure 5. Google aerial photograph of the intersection, Boothenna Rd terminating at the Golden Hwy. Note the approach angle, level crossing and the auxiliary lanes provided on the Golden Hwy.

5.4. Comparison of Relative Risk Associated with Safe System Framework Important Crash Types

As provided in Section 4, Incorporating Safe System Findings, on page 10, there are four main crash types globally recognised, and in Australia a fifth is also considered important. These crash types are known to result in higher severity outcomes in relatively lower speed environments. They are:

- head-on (>70km/h),
- right angle (>50km/h),
- run-off-road side impact into a rigid object (>40km/h),
- crashes involving vulnerable road users (>30km/h),
- rear-end crashes (>70km/h).

The noted speed ranges (>xxkm/h) provide the speed at time of crash at which there is a 10% probability of a fatal injury occurring with this crash type; probability of a fatality increases exponentially as speed increases.

Table 4. Relative level of risk of the associated Safe System Framework 'important' crash types for both routes, and the three options.

'Important' Crash Type	Option 1 - Route 1 (Existing road layout remains unchanged)	Option 2 - Route 1 (Intersection changed to staggered 'T')	Option 3 - Route 2 (Old Mendooran Rd south closed)
Head-on (>70km/h)	<p><i>Route is characterised by:</i></p> <ul style="list-style-type: none"> ✖✖ Narrow lanes and narrow unsealed shoulders (L) ✖✖ Opposing lanes separated by a faded centreline (L) ✖ The curve at the southern end is poorly delineated (L) ✓ Traffic volumes are half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E) ✖ Moderate to High travel speeds on Old Mendooran Rd (C) ✖✖ Passive control level crossing (L) ✖✖ Non-compliant sighting angles, intersection, and level crossing (L) 	<p><i>Route is characterised by:</i></p> <ul style="list-style-type: none"> ✖✖ Narrow lanes and narrow unsealed shoulders (L) ✖✖ Opposing lanes separated by a faded centreline (L) ✖ The curve at the southern end is poorly delineated (L) ✓ Traffic volumes are less than half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E) ✖ Moderate to High travel speeds on Old Mendooran Rd (C) ✖ Staggered 'T' intersection (L) ✖✖ Passive control level crossing (L) <p>(Note: running into the side of a train is equated to a head-on type crash)</p>	<p><i>Boothenna Rd:</i></p> <ul style="list-style-type: none"> ✖✖ Narrow lanes and narrow unsealed shoulders, western end (L) ✖ Opposing lanes separated by a centreline (L) ✖ Substandard curves eastern end, for eastbound (L) ✓ The curves at the eastern end are well delineated (L) ✖ Traffic volumes are low, but potentially increase by 50% on Boothenna Rd (E) ✖ High travel speeds recorded (C) <p><i>Golden Hwy:</i></p> <ul style="list-style-type: none"> ✓ Wide lanes and wide sealed shoulders (L) ✖ Opposing lanes separated by a centreline (L) ✓✓ No curves (L) ✓ Traffic volumes are moderate for a State road (E) ✖ The road length is 1.16km (E) ✓✓ Active control level crossing (L) ✖ High travel speeds recorded (C)
Risk Rating ³	Improbable + Serious = MEDIUM	Improbable + Serious = MEDIUM	Improbable + Serious = MEDIUM
<p>Key: ✓ positive impact on road safety; ✖ negative impact on road safety (E) = Exposure of road users to the road safety risk; (L) = Likelihood of a crash occurring; (C) = Consequences should a crash occur.</p> <p>NOTE: The crash types considered in this report are the crash types noted as 'IMPORTANT' in Austroads (2019), and outlined in Section 4, Incorporating Safe System Findings, on page 10.</p>			

³ Austroads (2019) Guide to Road Safety Part 6A: Implementing Road Safety Audits, Section 4.8C risk rating tables and terminology used in determining these risk ratings.

'Important' Crash Type	Option 1 - Route 1 (Existing road layout remains unchanged)	Option 2 - Route 1 (Intersection changed to staggered 'T')	Option 3 - Route 2 (Old Mendooran Rd south closed)
Right angle (>50km/h)	<p>Route requires negotiating one 'four-way' intersection, one 'T' junction and one passive control level crossing:</p> <p><i>Old Mendooran Rd – Boothenba Rd four-way intersection:</i></p> <ul style="list-style-type: none"> ✖✖ History of crashes, including one fatal of this crash type (L) ✓ Low traffic volume on Old Mendooran Rd (E) ✖✖ No escape areas, such as wide sealed shoulders, wide medians, auxiliary lanes (L) ✖ High travel speeds on Boothenba Rd (C) ✖ 'Look-through' affect for southbound approach to intersection (L) ✖✖ Non-compliant sighting angles (L) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✖✖ Passive control (L) ✖✖ Non-compliant sighting angles (L) ✓ Low train volumes (E) ✖ High train speed (C) <p><i>Old Mendooran Rd – Golden Hwy intersection:</i></p> <ul style="list-style-type: none"> ✓✓ Adequate sight distance and angles (L) ✓ Escape area - wide sealed shoulders on Golden Hwy (L) ✖ High traffic speeds on Golden Hwy (C) 	<p>Route requires negotiating one staggered 'T' intersection, one 'T' junction and one passive control level crossing:</p> <p><i>Old Mendooran Rd – Boothenba Rd staggered 'T' intersection:</i></p> <ul style="list-style-type: none"> ✓ Low traffic volume on Old Mendooran Rd (E) ✖✖ No escape areas, such as wide sealed shoulders, wide medians, or auxiliary lanes (could be addressed in detailed design ✓) (L) ✖ High travel speeds on Boothenba Rd (C) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✖✖ Passive control (L) ✓ Low train volumes (E) ✖ High train speed (C) <p><i>Old Mendooran Rd – Golden Hwy 'T' junction:</i></p> <ul style="list-style-type: none"> ✓ Traffic volumes on Old Mendooran Rd are half those of Boothenba Rd east (E) ✓✓ Adequate sight distance and angles (L) ✓ Escape area - wide sealed shoulders on Golden Hwy (L) ✖ High traffic speeds on Golden Hwy (C) 	<p>Route requires negotiating two 'T' junctions and one active control level crossing:</p> <p><i>Old Mendooran Rd – Boothenba Rd 'T' junction:</i></p> <ul style="list-style-type: none"> ✖ Traffic volumes are low, but potentially increase by 50% on Boothenba Rd (E) ✖✖ Potentially no escape areas, such as wide sealed shoulders, wide medians, auxiliary lanes (could be addressed in detailed design ✓) (L) ✓ Reduced number of conflict points with redesign to a 'T' intersection (L) ✖ High travel speeds on Boothenba Rd (C) <p><i>Boothenba Rd – Golden Hwy 'T' junction:</i></p> <ul style="list-style-type: none"> ✖ Traffic volumes are low on Boothenba Rd, but potentially increase by 50% on Boothenba Rd (E) ✓✓ Adequate sight distance and angles (L) ✓ Escape areas, wide sealed shoulders on Golden Hwy (L) ✓✓ Auxiliary lanes on Golden Hwy (L) ✖ High traffic speeds on Golden Hwy (C) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✓✓ Active control (L) ✓ Low train volumes (E) ✖ High train speed (C)
Risk Rating	Probable + Serious = INTOLERABLE	Occasional + Serious = HIGH	Improbable + Serious = MEDIUM

'Important' Crash Type	Option 1 - Route 1 (Existing road layout remains unchanged)	Option 2 - Route 1 (Intersection changed to staggered 'T')	Option 3 - Route 2 (Old Mendooran Rd south closed)
Run-off-road, side impact into a rigid object (>40km/h)	<p><i>Route is characterised by:</i></p> <ul style="list-style-type: none"> ✖✖ Narrow lanes and narrow unsealed shoulders (L) ✖✖ No edge lines (L) ✖ The curve at the southern end is poorly delineated (L) ✖✖ Infrangible objects in run-off area (C) ✖ Moderate to High speeds on Old Mendooran Rd (C) ✓ Traffic volumes are half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E) 	<p><i>Route is characterised by:</i></p> <ul style="list-style-type: none"> ✖✖ Narrow lanes and narrow unsealed shoulders (L) ✖✖ No edge lines (L) ✖ The curve at the southern end is poorly delineated (L) ✖✖ Infrangible objects in run-off area (C) ✖ Moderate to High speeds on Old Mendooran Rd (C) ✓ Traffic volumes are half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E) 	<p><i>Boothenna Rd:</i></p> <ul style="list-style-type: none"> ✖ Unsealed shoulders (L) ✓ Edge lines (L) ✖ Substandard curves eastern end, for eastbound (L) ✓ The curves at the eastern end are well delineated (L) ✖✖ History of crashes of this crash type (L) ✓ Traffic volumes will potentially increase by 50% (E) ✖ The road length is 0.74km (E) ✖✖ Infrangible objects in run-off area (C) <p><i>Golden Hwy:</i></p> <ul style="list-style-type: none"> ✓ Wide lanes and wide sealed shoulders (L) ✖ Opposing lanes separated by a centreline (L) ✓ No curves (L) ✓ Edge lines (L) ✓ Traffic volumes are moderate for a State road (E) ✖ The road length is 1.16km (E) ✖ Total route length ~3 times further than existing (E)
Risk Rating	Occasional + Serious = HIGH	Occasional + Serious = HIGH	Improbable + Serious = MEDIUM

'Important' Crash Type	Option 1 - Route 1 (Existing road layout remains unchanged)	Option 2 - Route 1 (Intersection changed to staggered 'T')	Option 3 - Route 2 (Old Mendooran Rd south closed)
Crashes involving vulnerable road users (>30km/h)	<i>Route is characterised by:</i> ✖✖ There are no facilities for pedestrians or cyclists (L) ✖✖ Non-compliant sighting angles at the Old Mendooran Rd-Boothenna Rd intersection, and at the level crossing (L) ✓ There are few pedestrians and cyclists (E) ✖ Moderate to High traffic speed (C) ✓ Traffic volumes are half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E)	<i>Route is characterised by:</i> ✖✖ There are no facilities for pedestrians or cyclists (L) ✓ Compliant sighting angles at the Old Mendooran Rd-Boothenna Rd staggered 'T' intersection, and at the level crossing (L) ✓ There are few pedestrians and cyclists (E) ✖ Moderate to High traffic speed (C) ✖ Traffic volumes are half those of Boothenna Rd east (E) ✓ The road length is 0.65km, 1.25km shorter than Route 2 (E)	<i>Boothenna Rd:</i> ✖✖ There are no facilities for pedestrians or cyclists (L) ✓ There are few pedestrians and cyclists (E) ✖ High speed traffic (C) ✓ The road length is 0.74km (E) <i>Golden Hwy:</i> ✓ Wide sealed shoulders (L) ✓ There are few pedestrians and cyclists (E) ✖ High speed traffic (C) ✓ The road length is 1.16km (E)
Risk Rating	Improbable + Serious = MEDIUM	Improbable + Serious = MEDIUM	Improbable + Serious = MEDIUM

'Important' Crash Type	Option 1 - Route 1 (Existing road layout remains unchanged)	Option 2 - Route 1 (Intersection changed to staggered 'T')	Option 3 - Route 2 (Old Mendooran Rd south closed)
Rear-end crashes (>70km/h)	<p><i>Old Mendooran Rd – Bootherba Rd intersection:</i></p> <ul style="list-style-type: none"> ✓ Traffic volumes are around half those of Bootherba Rd east (E) ✗✗ No escape areas, such as wide sealed shoulders, wide medians, auxiliary lanes (L) ✗✗ No turning lanes (L) ✗ High traffic speeds on Bootherba Rd (C) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✗ Non-compliant sighting (L) ✗✗ Short stacking (L) ✗✗ Potential queueing (L) <p><i>Old Mendooran Rd – Golden Hwy 'T' junction:</i></p> <ul style="list-style-type: none"> ✗ Traffic volumes on Old Mendooran Rd are half those of Bootherba Rd east (E) ✗ Approach sight distance may not be adequate for southbound (L) ✓ Wide sealed shoulders on Golden Hwy (L) ✗ High traffic speeds on Golden Hwy (C) 	<p><i>Old Mendooran Rd – Bootherba Rd staggered 'T' intersection:</i></p> <ul style="list-style-type: none"> ✓ Traffic volumes are around half those of Bootherba Rd east (E) ✗✗ No escape areas, such as wide sealed shoulders, wide medians, auxiliary lanes (this may be addressed in detailed design ✓) (L) ✗✗ No turning lanes (this may be addressed in detailed design ✓) (L) ✗ High traffic speeds on Bootherba Rd (C) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✗ Non-compliant sighting (L) ✗✗ Short stacking (L) ✗✗ Potential queueing (L) <p><i>Old Mendooran Rd – Golden Hwy 'T' junction:</i></p> <ul style="list-style-type: none"> ✗ Traffic volumes on Old Mendooran Rd are half those of Bootherba Rd east (E) ✗ Approach sight distance may not be adequate for southbound drivers (L) ✓✓ Wide sealed shoulders on Golden Hwy (L) ✗ High traffic speeds on Golden Hwy (C) 	<p><i>Old Mendooran Rd – Bootherba Rd 'T' junction:</i></p> <ul style="list-style-type: none"> ✗ Traffic volumes are low, but would more than double on Bootherba Rd east (E) ✗✗ Potentially no escape areas, such as wide sealed shoulders, wide medians, auxiliary lanes (this may be addressed in detailed design ✓) (L) ✗✗ No turning lanes (this may be addressed in detailed design ✓) (L) ✓ Reduced number of conflict points with redesign to a 'T' intersection (L) ✗ High traffic speeds on Bootherba Rd (C) <p><i>Bootherba Rd – Golden Hwy 'T' junction:</i></p> <ul style="list-style-type: none"> ✗ Traffic volumes are low, but would more than double on Bootherba Rd east (E) ✓ Adequate sight distance and angles (L) ✓ Escape areas - wide sealed shoulders (L) ✓✓ Auxiliary lanes on Golden Hwy (L) ✗ High traffic speeds on Golden Hwy (C) <p><i>Level Crossing:</i></p> <ul style="list-style-type: none"> ✗ Driver not expecting or sighting queued vehicles (potential sun glare issue) (L)
Risk Rating	Occasional + Serious = HIGH	Occasional + Serious = HIGH	Improbable + Serious = MEDIUM

6. DISCLAIMER

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Documents provided by Dubbo Regional Council

Table 5. Traffic data provided by Dubbo Regional Council, 10 September 2021.

Location	Data Titles
Site A - Old Mendooran Rd south	Class Bin-452; Speed Stat-455; VirtWeekly Vehicle-454
Site B - Old Mendooran Rd north	Class Bin-445; Speed Stat-446; VirtWeekly Vehicle-447
Site C - Boothenna Rd east	Class Bin-451; Speed Stat-450; VirtWeekly Vehicle-449