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CopperString 2032

Traffic Impact Assessment - TMR

Client reference:

CU2-PW00-REP-PAS-100-0003

Prepared for

CPB Contractors Pty Ltd

Client representative

Nick Poon

Date

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Revision History

Rev No.	Description	Prepared by	Reviewed by	Authorised by	Date
A	Draft Traffic Impact Assessment	NPA/ JB	RLR	RLR	01/09/2023
00	Traffic Impact Assessment	NPA/ JB/ RLR	SM	RLR	19/09/2023
01	Traffic Impact Assessment	NPA/ JB/ RLR	SM	RLR	20/10/2023
02	Final Traffic Impact Assessment – updated with Powerlink comments	NPA/ JB/ RLR	SM	RLR	08/12/2023
03	Final Traffic Impact Assessment – updated with Powerlink comments	NPA/ JB/ RLR	SM	RLR	25/01/2024

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Executive Summary

The purpose of the CopperString 2032 Traffic Impact Assessment – TMR (this report) is to assess the risk of traffic generated by the CopperString 2032 project on Queensland Transport and Main Roads owned roads during the construction, operation and maintenance, and decommissioning phases to the operation, condition and safety of the public road network throughout the study area in Queensland using Australian Standards and Austroads Guidelines.

The risk of project-generated traffic to the road network has been assessed and quantified based on a site investigation, available information from the project description document and publicly available data.

The traffic assessment found that the additional traffic volumes generated as a result of the construction activities are low and would not be expected to reduce the road network operation to unsatisfactory levels.

There are, however, a number of areas within the road network that will require mitigation measures to be implemented as follows:

- Roads where the traffic volumes are above the practical capacity based on the road type and width. Traffic management or road widening is generally required on these roads
- Locations throughout the route with poor sight distance. Vegetation clearance and signage installation is required at these locations prior to construction, in conjunction with ongoing maintenance during construction
- Road bends within the access road network where the road width is not sufficient for a semi-trailer. Consider changing the vehicle to suit existing road geometry; changing the access route; or carrying out minor shoulder works in agreement with relevant road authority
- Road bends within the access road network where the road width is not sufficient for two heavy vehicles to pass each other, but the road width is sufficient for a single B-double truck. In these locations it is suitable to provide traffic management where road widening is not practical or cost effective due to the temporary nature of the construction works; and
- Areas with local schools. Restricted travel during peak school drop-off and pick-up times along with briefing for the community and drivers of the construction traffic is recommended.

The traffic assessment identified that the suitability of the construction access is predominantly impacted by the condition of the road, which is variable across the proposed access routes. With regular monitoring and repairs undertaken prior to and during construction, the risk of crashes due to poor road condition will be appropriately managed.

The operation and maintenance phase risks are negligible, with no recommended actions required for implementation. The decommissioning phase risks have the potential to be comparable to the construction phase risks.

Abbreviations

Table 1: Abbreviations

Abbreviation	Description
AADT	Annual Average Daily Traffic
ASD	Approach Sight Distance
CSC	Cloncurry Shire Council
CTRC	Charters Towers Regional Council
EDD	Extended Design Domain
ESA	Equivalent Standard Axles
FFS	Free Flow Speed
FSC	Flinders Shire Council
GN	Granular Pavement
HML	Higher Mass Limit
HV	Heavy Vehicle
JV	UGL/CPB Joint Venture
LGA	Local Government Authority
LOS	Level of Service
MICC	Mount Isa City Council
MID	Major Infrastructure Development
MSC	McKinlay Shire Council
NDD	Normal Design Domain
NEM	National Electricity Market
NQCEH	North Queensland Clean Energy Hub
NWMP	North West Minerals Province
OSOM	Oversize Overmass
PIA	Pavement Impact Assessment
PTSF	Percentage Time Spent Following
RSC	Richmond Shire Council
RUMP	Road User Management Plan
SAR	Standard Axle Repetition
SC	State Controlled
SISD	Safe Intersection Sight Distance
SSD	Stopping Sight Distance

Abbreviation	Description
TCC	Townsville City Council
TIA	Traffic Impact Assessment
TMR	Department of Transport and Main Roads (Queensland)
VPD	Vehicles Per Day
VPH	Vehicles Per Hour

1. Introduction

1.1 Project scope

The purpose of this Traffic Impact Assessment (TIA) for the CopperString 2032 project is to assess the risk and impact of the project-related construction vehicles to the operation, condition and safety of the Queensland Department of Transport and Main Roads (TMR) road network, between Townsville and Mount Isa.

The risks from project-generated traffic to the road network have been assessed and quantified based on site visits, available information from the UGL/CPB Joint Venture (JV) and publicly available data. Mitigation measures and ongoing monitoring are proposed in response to identified issues.

The report evaluates the impact on the public road network using Australian Standards and Austroads Guidelines. Details of the road network assessed are provided in Section 3.1 of this report and were based on the construction vehicle access route data provided by the JV.

1.2 Project description

The CopperString 2032 Project will connect the North West Minerals Province (NWMP) of Queensland to the National Electricity Market (NEM) to reduce the cost of power supply and facilitate the large-scale development of the Hughenden wind resource and solar resources within the North Queensland Clean Energy Hub (NQCEH).

The project will traverse a region of significant potential renewable energy resources that are currently constrained by the lack of access to the state electricity grid. The project is expected to unlock potential areas for renewable energy generation in the Northern Queensland Renewable Energy Zone between Townsville and Hughenden, particularly wind resources, and in the North West Minerals Province.

The scope of work, traversing east to west, consists of the following sections:

- Mulgrave Substation and 275kV line augmentation as the CopperString 275kV connection point to the NEM
- Woodstock Substation as the CopperString 2032 500kV connection point to the Queensland SuperGrid
- Pentland Substation to support the NQCEH expansion and as the core for future load connections in the area
- Flinders Substation (Hughenden) as the core for the NQCEH
- Dajarra Road Substation (Cloncurry) as the core for distributions to larger load centres
- The primary CopperString 2032 transmission backbone; and
- Termination via the Mount Isa augmentation.

The North West Minerals Province is one the world's richest producing mineral regions and is emerging as an exploration area for new economy minerals and metals, such as vanadium, that are critical to the production of renewable energy technologies such as solar panels, wind turbines and large scale batteries. The project is predicted to reduce electricity prices in the North West Power System and has the potential to stimulate investment in the North West Minerals Province.

1.3 Project location

The Project will generally be undertaken in stages from east to west between Townsville and Mount Isa. The transmission line will run approximately parallel to the Flinders Highway at an average of 15km south of the Highway for its length.

The Project traverses 7 Local Government Areas (LGAs):

- Burdekin Shire Council
- Charters Towers Regional Council
- Flinders Shire
- Richmond Shire
- McKinlay Shire
- Shire of Cloncurry; and
- City of Mount Isa.

TMR and LGA roads are used to access the transmission lines, camps, substations, materials and storage for the project in the majority of the LGAs. In Burdekin Shire Council only TMR roads are used for access.

It is noted that vehicles use TMR and LGA roads in the Townsville LGA to access the Townsville Port for delivery of materials.

The major towns within proximity to the Project are Townsville, Charters Towers, Hughenden, Richmond, Julia Creek, Cloncurry and Mount Isa.

The project traverses the traditional lands of the Birriah, Jangga, Yirendali, Wanamara, Mitakoodi, Kalkadoon and Yulluna Peoples, Traditional Custodians of the land.

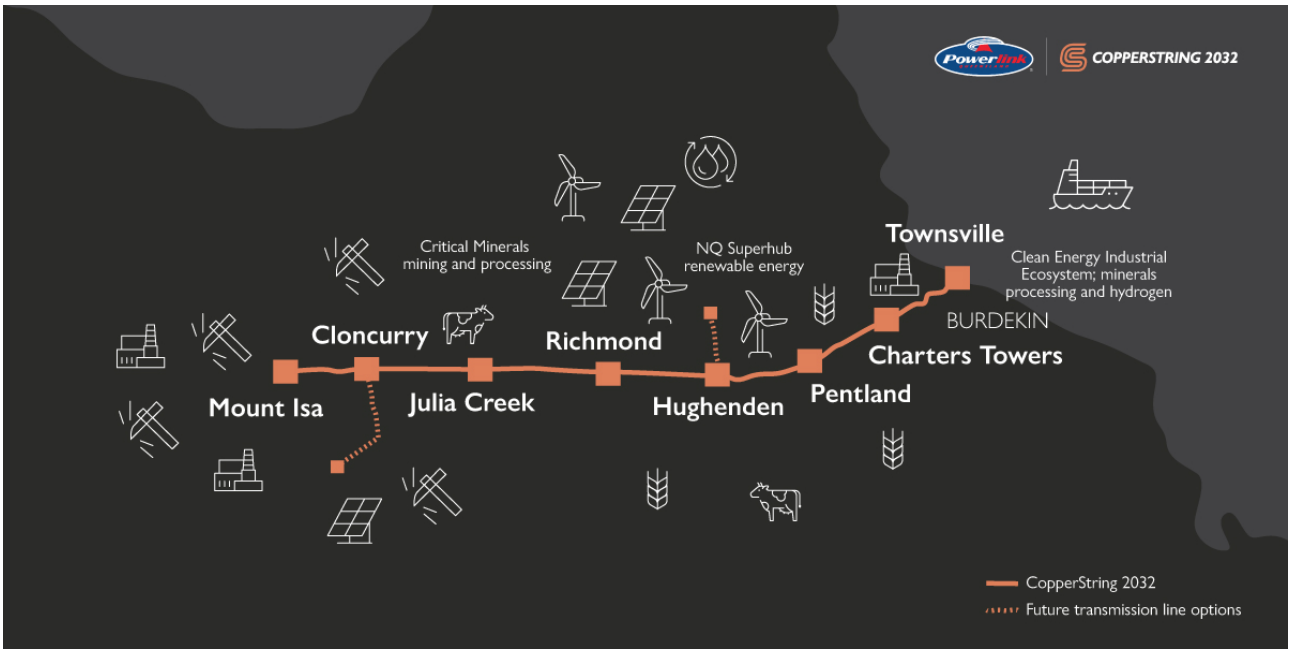


Figure 1 - Project Map Geographic Location (source document https://www.powerlink.com.au/projects/CopperString-2032)

The CopperString 2032 Project is divided into eight logistics hubs, essentially creating Sub-Projects which have a defined scope based on the elements within their defined geographical area. Each hub has a geographical area defined by the minimisation of travel time from the camp to the tower location.

Work zones are based around the construction hubs and intended to limit travel time to tower sites to no more than 90 minutes.

Table 2: Logistics hubs

#	Hub	Camp	Substation	Towers
1	Mount Isa	Local accommodation	Mount Isa Substation	Mount Isa Sub to Cloncurry & Mount Isa midpoint
2	Cloncurry	Camp	Dajarra Rd Substation	Dajarra Sub to Cloncurry River Dajarra Sub to Cloncurry & Mount Isa midpoint Dajarra Sub to Cloncurry & Julia Creek Midpoint
3	Julia Creek	Camp	Nil	Cloncurry & Julia Creek midpoint to Julia Creek & Richmond midpoint
4	Richmond	Camp	Nil	Julia Creek & Richmond midpoint to Richmond & Hughenden midpoint
5	Hughenden	Camp	Flinders Substation	Flinders Sub to Richmond & Hughenden midpoint Finders Sub to Mount James Flinders Sub to Hughenden & Pentland midpoint
6	Penland	Camp	Pentland Substation	Hughenden & Pentland midpoint to Pentland & Charters Towers midpoint
7	Charters Towers	Camp	Nil	Pentland & Charters Towers midpoint to Burdekin River
8	Woodstock	Local accommodation	Mulgrave Substation	Burdekin River to Mulgrave Substation

The location of camps proposed to be utilised during the Project is shown below in Table 3. It is noted that there are no camps at Woodstock or Mount Isa with workers staying in accommodation in the nearest town.

Table 3: Camp Locations

Location	Council	Distance from Nearest Town
Charters Towers	Charters Towers Regional Council	3km
Pentland	Charters Towers Regional Council	2km
Hughenden	Flinders Shire Council	2km
Richmond	Richmond Shire Council	1km
Julia Creek	McKinlay Shire Council	1km
Cloncurry	Cloncurry Shire Council	4km
Woodstock	Townsville City Council	In south Townsville
Mount Isa	Mount Isa City Council	In Mount Isa

1.4 Project generated traffic

The following construction/ operational items generated project related traffic

- Construction/ demobilisation of the CopperString 2032 camps
- Construction of the transmission line between Woodstock and Mount Isa including traffic generated by the camps and from the Flinders and Barkly Highways; and
- Construction of the substations.

1.5 Project timing and duration

A detailed project program for the CopperString 2032 project, as supplied by the JV is included in Appendix A. It is noted that this program is subject to change.

1.6 Other reports for reference

There are several other reports being completed by pitt&sherry for the CopperString 2032 projects that may provide more detail as follows:

Client reference number	Report title	Completion Date
CopperString 2032 Camps		
CU2-PW00-REP-PAS-100-0001	CopperString 2032 Early Works Package Camp Hubs MID Submission Support	15 September 2023
CU2-CT00-REP-PAS-100-0001	CopperString 2032 Charters Towers Camp Traffic Impact Assessment	15 September 2023
CU2-PE00-REP-PAS-100-0001	CopperString 2032 Pentland Camp Traffic Impact Assessment	15 September 2023
CU2-HU00-REP-PAS-100-0001	CopperString 2032 Hughenden Camp Traffic Impact Assessment	15 September 2023
CU2-RI00-REP-PAS-100-0001	CopperString 2032 Richmond Camp Traffic Impact Assessment	18 September 2023
CU2-JC00-REP-PAS-100-0001	CopperString 2032 Julia Creek Camp Traffic Impact Assessment	18 September 2023
CU2-CL00-REP-PAS-100-0001	CopperString 2032 Cloncurry Camp Traffic Impact Assessment	18 September 2023
CopperString 2032 TIAs (Councils)		
CU2-TS00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - TCC	25 January 2024
CU2-CT00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - CTRC	25 January 2024
CU2-FL00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - FSC	25 January 2024
CU2-RI00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - RSC	25 January 2024
CU2-MC00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - MSC	25 January 2024
CU2-CL00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - CSC	25 January 2024
CU2-MI00-REP-PAS-100-0003	CopperString 2032 Traffic Impact Assessment - MICC	25 January 2024

Client reference number	Report title	Completion Date
CopperString 2032 RUMPs		
CU2-PW00-REP-PAS-100-0002	CopperString 2032 Road Use Management Plan – TMR	15 September 2023
CU2-PW00-REP-PAS-100-0004	CopperString 2032 – Road Use Management Plan - Councils	3 November 2023

1.7 Legislative context and standards

The following Australian Standards and Guidelines have been used throughout this report:

- AS 1742.2:2009 Manual of uniform traffic control devices – Part 2: Traffic control devices for general use
- AS 1742.7:2016 Manual of uniform traffic control devices – Part 7: Railway crossings
- AS 2890.2:2018 Parking facilities – Part 2: Off-street commercial vehicle facilities
- Austroads Guide to Road Design Part 3: Geometric Design
- Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections
- Austroads Guide to Road Design Part 4B: Roundabouts
- Austroads Guide to Road Safety Part 6A: Implementing Road Safety Audits
- Austroads Guide to Traffic Management Part 3: Transport Studies and Analysis Methods
- Austroads Guide to Traffic Management Part 6: Interchanges and Crossings Management
- Department of Transport and Main Road's Supplement to Austroads Guide to Road Design Part 3: Geometric Design
- Department of Transport and Main Road Supplement to Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections
- Department of Transport and Main Road Supplement to Austroads Guide to Road Design Part 4B: Roundabouts
- Department of Transport and Main Roads - Guide to Traffic Impact Assessment Practice Note: Pavement Impact Assessment, December 2018
- Department of Transport and Main Roads Routine Maintenance Guidelines – November 2017
- Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis; and
- Department of Transport and Main Road's Guide to Traffic Impact Assessment – December 2018.

1.8 Report Revisions

The submitted report revisions and their content is shown below

Revision No.	Description
A	Draft Traffic Impact Assessment – for JV and Powerlink comments
00	Final Traffic Impact Assessment – incorporating JV comments
01	Final Traffic Impact Assessment – incorporating additional JV comments
02	Final Traffic Impact Assessment – incorporating Powerlink comments from Rev 00
03	Final Traffic Impact Assessment – incorporating Powerlink comments from Rev 01 (comments register in Appendix H)

2. Study method

2.1 Overview

The study area includes a significant number of roads that were investigated as potential construction traffic routes. The assessment included site investigations as well as desktop analysis, as outlined in Section 2.2.

The assessment was based on:

- Information provided by the JV in relation to construction and operational traffic (routes, vehicle types, and traffic volumes), construction program and construction methodology
- Information available from road authorities; and
- Observations from the site investigations.

Key assumptions made during the assessment are included in this report.

2.2 Assessment process

The assessment process used for the traffic risk assessment and the relevant sections of the report are detailed below.

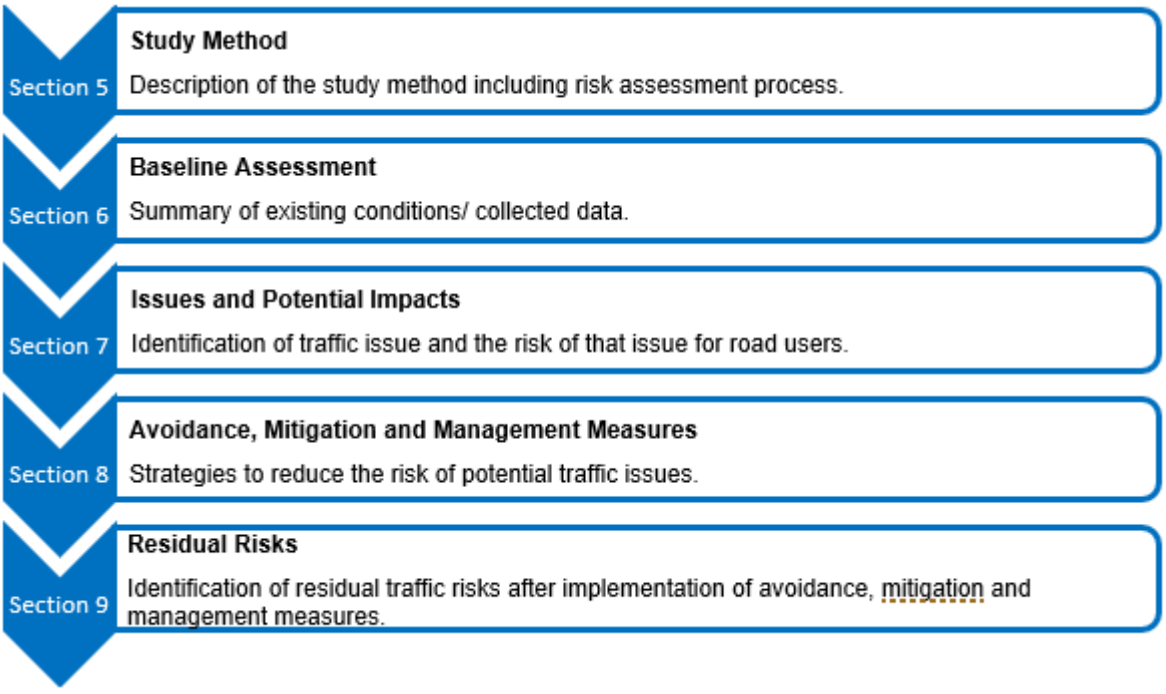


Figure 2: Assessment process

The risk assessment considers three major areas of risk as a result of the project:

- Road operation risk including:
  - Road width capacity
  - Traffic congestion
- Road condition risk; and
- Road safety risk.

2.2.1 Site investigations

Site investigations were undertaken between 19 June and 22 July 2023 to assess the current conditions of the road network where operation, condition and safety could be affected by the proposed project.

The site investigations required persons to drive along the State Controlled (SC) roads and Local Government Authority (LGA) roads that formed part of the Project route. The following parameters were captured during the site investigations:

- Road attributes and high-level road condition
- Traffic volumes
- Sight distances at existing and proposed intersections, driveways and turnouts
- Sight distances and attributes at rail crossings
- Locations/ structures of interest and relevant attributes; and
- Photos of the above.

Intersection traffic counts were undertaken during the site visits, where such data was deemed to be required, for a 15-minute period. The collected traffic data was subsequently scaled by a factor of 4 to extrapolate the hourly traffic volume. To establish the relationship between peak hour and the observed hour, data from the nearest traffic counter on TMR roads was extracted. This information was applied to calculate a peak-to-hour ratio. Multiplying the recorded traffic volumes by this ratio allowed for the estimation of the peak hour traffic volume at the specific location.

It is noted that this method provides a high-level estimate of traffic volumes which was considered acceptable due to the generally low traffic volumes on the road network.

It is noted that only public roads were assessed, however, where sufficient space was provided to safely pull over within the public road reserve, intersections between public and private roads were also assessed. It is noted that the use of private roads will be agreed between the road owner and the JV, including any requirements to implement management measures.

2.2.2 Data collection

Data was collected from various sources as follows:

- Site investigations
- Queensland Government's Queensland Globe and Open Data Portal; and
- LGAs.

Collectively, the data was used to inform the TIA.

2.2.3 Data analysis – baseline assessment

Due to the project's large area of interest, a significant amount of data was collected for analysis. The data was first analysed at a high-level via tabulation. Data was entered into tabular form to allow roads, intersections, and defects to be analysed individually and holistically. This approach identified intersections and roads that had potential issues and required assessment in further detail.

The purpose of the baseline assessment was to establish the current Level of Service (LOS) of roads with respect to:

- Suitability for construction access
- Traffic volumes
- Vehicle types
- Road (pavement) condition
- Road geometry
- Sight distances; and
- Other road safety issues.

2.2.4 Data analysis – risk assessment

Risk ratings

The risk ratings in the *Austroads Guide to Road Safety Part 6A: Implementing Road Safety Audits* were used to assess the potential for hazards associated with project activities to increase levels of risk for the proposed access roads. This process is suitable to use for road operation (road width and traffic congestion) risk and road condition risk, as well as road safety risk.

Potential issues identified as a result of the project have been ranked based on the likelihood of an operational hazard occurring and the potential consequence of that hazard.

Likelihood

The likelihood of a hazard and a consequential crash occurring is shown in Table 4.

Table 4: Likelihood of a hazard/crash occurring (Austroads 2019)

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five to ten years
Improbable	Less often than once every ten years

Consequence

The consequence of the hazard will depend on the assessment type (i.e. road operation, road condition or road safety) and type specific consequence tables are shown in Section 2.2.6.

Resulting level of risk and treatment

The level of risk is dependent on the likelihood and consequence of the hazard and is shown in Table 5. The treatment approach that should be applied is shown in Table 6.

Table 5: Resulting level of risk (Austroads 2019)

	Frequent	Probable	Occasional	Improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table 6: Treatment approach (Austroads 2019)

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

2.2.5 Traffic risk assessment ratings

Road operation (road width capacity)

The width of a road is related to how much traffic it can carry without affecting the safety of vehicles. Roads do not necessarily need to be carrying high levels of traffic causing congestion for volumes to impact the safety to vehicles. This is generally crucial to roads with a one lane carriageway or roads where there are large numbers of parked vehicles that reduce the available carriageway width.

The *Austroads Guide to Road Design Part 3* (AGRD Part 3) and TMR's *Supplement to Austroads Guide to Road Design Part 3: Geometric Design* (Supplement to AGRD Part 3) describe the minimum road width requirements for both urban and rural roads, including rural roads with very low traffic volumes.

The minimum urban arterial road widths are described below in Table 7.

Table 7: Urban road widths – general traffic lane (Source: AGRD Part 3 and Supplement to AGRD Part 3)

Element	Lane width (m)	Comments
General traffic lane	3.5	General traffic lane widths to be used for all roads
	3.0-3.4	For use on low speed roads with low truck volumes
	3.3-3.5	General traffic lane widths for use on roads in constrained corridors

The minimum single carriageway rural road widths for the Normal Design Domain (NDD) are described in Figure 3 and are based on the design AADT.

Design AADT	250 – 400[6]	400 – 1000	1000 – 2000		2000 – 4000		> 4000
Road Carriageway Type[1]	All	All	L	N	L	N	L/N
Lane Width	3.25	3.25/3.50[3]	3.50	3.50	3.50	3.50	- ([7])
Shoulders	1.00	1.25/1.00[3]	1.00	1.50	1.50	2.00	- ([7])
Carriageway[2]	8.50[5]	9.00	9.00	10.00	10.00	11.00	- ([7])
Cycling[4]				P	P	P	- ([7])

Notes:

(1) Road Carriageway formation type:

L – Low embankments (i.e. < 1 m) on lower order roads where batter slopes do not exceed 1 on 4.

N – nominal road values.

(2) Full width of seal required.

(3) Optional combination of lane width and shoulder width.

(4) A 'P' in these columns indicates cross sections generally considered suitable for 'Principle cycle routes' in rural areas. Refer to Section 4.9 for further details.

(5) Where a road is subject to the *State-controlled Priority Road Network Investment Guidelines* (2011) and *State-controlled Low Priority Road Network Investment Guideline* (2013), the final seal width to be applied is 9 m. In these cases, the cross-section widths for the next column (400 - 1000 AADT) should be adopted.

(6) Refer to Table 4.2.6(a) for carriageway width options for roads with less than 250 vpd AADT.

(7) Rural roads with AADT greater than 4,000 vpd should have a WCLT and ATLM. Refer to Appendix G for general guidance and particularly Section G.4 for cross section dimensions.

Figure 3: Minimum single carriageway rural road widths (m) – normal design domain (Source: Supplement to AGRD Part 3)

For roads with very low volumes (<250 vpd), the NDD is as shown in Figure 4.

Road Carriageway Option	Unsealed	Single-lane seal	Two-lane seal
Seal width	-	3.70	8.00
Unsealed width – each direction	4.00	2.50	0.00
Carriageway	8.00	8.70	8.00

Figure 4: Very low volume (<250 vpd) rural road minimum widths (m) – normal design domain (Source: Supplement to AGRD Part 3)

The Extended Design Domain (EDD) provided in the Supplement to AGRD Part 3 notes that many existing rural roads in Queensland often have carriageway widths less than the 8.5m total seal width specified, particularly those which carry less than 400vpd. The minimum single carriageway rural road widths are shown in Figure 5.

Table A.2.2 – Minimum single carriageway rural road widths (m) – extended design domain

Design AADT	250 – 400	400 – 1000	1000 – 2000		2000 – 4000			> 4000
Road Carriageway Type([1])	All	All	L	N	L	N	H	Rural roads with AADT greater than 4,000 vehicles per day should have a wide centreline and ATLM. Refer to Appendix G for general guidance and in particular Section G.4 for cross section dimensions.
Lane Width	3.00	3.25	3.50	3.50	3.50	3.50	- ([5])	
Shoulders	1.00	1.00	1.00	1.25	1.00	1.50	- ([5])	
Wide Centre Line Treatment							- ([5])	
Carriageway([2])	8.00([4])	8.50	9.00	9.50	9.00	10.00	- ([5])	
Cycling([3])						P		

Notes:

1. Road Carriageway formation type:
2. L – Low embankments (i.e. < 1 m) on lower order roads where batter slopes do not exceed 1 on 4
   N – nominal road values
   H – Higher order roads requiring a WCLT
3. Full width of seal required.
4. A 'P' in these columns indicates cross sections generally considered suitable for 'Priority cycle routes' in rural areas. Otherwise if a route is part of a cycle network, additional sealed shoulder width will be required. Refer to Section 4.3.2 for further details.
5. Where a road is subject to the *State-controlled Priority Road Network Investment Guidelines* (2011) or the *State-controlled Low Priority Road Network Investment Guideline* (2013), the interim seal width to be applied is 8 m with allowance for a vision seal width of 9 m.
6. Higher order roads with AADT 2000-4000 should have a wide centreline and ATLM. Refer to Appendix G for general guidance and in particular Section G.4 for cross section dimensions.

Figure 5: Minimum single carriageway rural road widths (m) – extended design domain (Source: Supplement to AGRD Part 3)

The guidance above has informed the assessment in Section 5.1 of this report, which identifies state controlled roads which are carrying traffic volumes higher than their intended capacity or expected to carry traffic higher than their intended capacity as a result of the project.

There are several intersections within the study area with tight geometry during instances in which B-doubles, the largest vehicle proposed to be utilised during construction, are required to overtake turning vehicles in the opposing direction.

Road operation (traffic congestion)

When roads carry high traffic volumes relative to their capacity, congestion is the result. To ensure safe and efficient traffic flow on roads it is necessary to manage congestion levels.

Theory from the *Austroads Guide to Traffic Management Part 3: Transport Studies and Analysis Methods* has been used to assess the expected risk of congestion, from the project to road operation (traffic congestion). The theory is derived from the Highway Capacity Manual 2016 (HCM 2016).

The conditions for the different levels of performance of two-lane highways are described in the following terms:

- At LOS A, motorists experience high operating speeds on Class I highways and little difficulty in passing. Platoons (or groups) of three or more vehicles are rare. On Class II highways, speed would be controlled primarily by roadway conditions. A small amount of platooning would be expected. On Class III highways, drivers should be able to maintain operating speeds close or equal to the Free Flow Speed (FFS) of the highway (i.e. drivers able to travel at their desired speed either at or below the speed limit)
- At LOS B, passing demand and passing capacity are balanced. On both Class I and Class II highways, the degree of platooning becomes noticeable. Some speed reductions are present on Class I highways. On Class III highways, it becomes difficult to maintain FFS operation, but the speed reduction is still relatively small
- At LOS C, most vehicles are travelling in platoons. Speeds are noticeably curtailed on all three classes of highway
- At LOS D, platooning increases significantly. Passing demand is high on both Class I and II facilities but passing capacity approaches zero. A high percentage of vehicles are now travelling in platoons, and Percentage Time Spent Following (PTSF) another vehicle is quite noticeable. On Class III highways, the fall-off from FFS is now significant
- At LOS E, demand is approaching capacity. Passing on Class I and II highways is virtually impossible, and PTSF is more than 80%. Speeds are seriously curtailed. On Class III highways, speed is less than two-thirds the FFS. The lower limit of this LOS represents capacity; and
- LOS F exists whenever arrival flow in one or both directions exceed the capacity of the segment. Operating conditions are unstable, and heavy congestion exists on all classes of two-lane highway.

The consequence of traffic congestion on the operation of the road network has been defined as shown in Table 8.

Table 8: Consequence of congestion

Severity	Description	Performance
Catastrophic	Significant risk to operation of multiple roads	LOS F
Serious	Considerable traffic delays expected	LOS D or E
Minor	Some acceptable delays expected	LOS C
Limited	Minor or no delays expected	LOS A or B

The levels of performance above have informed the assessment in Section 5.2, which assesses the LOS that is expected on each of the project route roads as a result of the project's construction traffic.

2.2.6 Road condition

Large volumes of heavy vehicles travelling on roads not designed for heavy vehicles can impact the condition of the road. Hazards such as potholes can change a vehicles course on the road and result in a collision and/ or a vehicle leaving the road.

Road condition was qualitatively assessed during site investigations. It is noted that the road condition may change over time.

Likelihood

The likelihood of a crash occurring on a road has been assessed based on the road condition. The condition of each road in the study area has been given a rating of between excellent and poor. The road condition ratings, typical defects and resultant assessed likelihood of a crash occurring is shown in Table 9.

Table 9: Suitability for construction access ratings

Road condition	Defect frequency and type	Likelihood of crash occurring as a result of road condition
Excellent	None or very minor defects Defects may include: • Polishing • Minor cracking • Minor potholing; and • Expedient patching.	Improbable
Good condition	Minor defects at sparse intervals Defects may include: • Polishing • Minor cracking • Minor potholing; and • Expedient patching.	Improbable
Reasonable condition	Minor defects at frequent intervals: Defects may include: • Polishing • Minor cracking • Minor potholing; and • Expedient patching.	Occasional
Average condition	Some major defects: Defects may include: • Corrugations • Significant shoving • Significant rutting • Wide cracking; and • Large potholes.	Probable
Poor condition	Major defects at multiple locations or on long sections: Defects may include: • Corrugations • Significant shoving • Significant rutting • Wide cracking; and • Large potholes.	Probable

Consequence

The consequence of a hazard occurring based on the road condition deteriorating has been based on several factors. The factors used are shown in Table 10 and have been developed from the *TMR Routine Maintenance Guidelines*.

Table 10: Factors influencing the consequence of a road condition hazard/ crash

Factor	Conditions of study roads	Severity
Speed	>80km/h	Serious
	50-80km/h	Minor
	<50km/h	Limited
Visibility	Less than safe stopping sight distance* (SSD) (i.e. insufficient time to correct travel path)	Serious
	More than safe SSD (i.e. sufficient time to correct travel path)	Limited
Weather	Flooding or tropical cyclone (worst case scenario)	Serious

*SSD is the time taken to react to a hazard ahead and stop in time to avoid the hazard.

The consequences in the *Austroads Guide to Road Safety Part 6A: Implementing Road Safety Audits* were to assess the potential increased levels of safety risk arising from hazards associated with project activities for the proposed access roads. Where a road has varying consequence levels each of the factors have been considered and a conservative severity level has been applied (i.e. the highest severity).

The consequence of a crash is shown in Table 11.

Table 11: Consequence of a safety hazard on crash severity (Austroads 2019)

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

The suitability and condition of the roads has informed the assessment in Section 5.4, which considers the risk of a crash on each of the study roads as a result of road condition and deterioration.

2.2.7 Recommendations: avoidance, mitigation, and management

The above risk-based approach was used to identify those items that were deemed to require mitigation measures. Potential courses of action were assessed, and recommendations concluded for mitigation using the hierarchy of avoid, minimise, manage, and offset.

Any residual risks to construction, operation and maintenance, and decommissioning phases were also considered with recommendations of ongoing monitoring during those phases as appropriate.

2.2.8 Project limitations

These notes are additional to any limitations noted elsewhere within this report. They have been provided by pitt&sherry to clarify the limitations of the report, and to clearly identify the individual responsibilities of all parties involved. It is important that all documents from pitt&sherry are read thoroughly, and that clarification is sought where necessary.

2.2.9 Specificity

This report has been developed based on pitt&sherry's understanding of the project requirements and applies only to this project. If there are subsequent changes to the proposed project, pitt&sherry should be consulted to assess how the changes would impact the recommendations detailed in this report. If pitt&sherry are not consulted, we do not accept responsibility for issues that may occur due to project changes. No responsibility is accepted for the use of this report, in whole or in part, in other contexts or for any other purpose.

2.2.10 Report integrity

This report is presented as a whole; with conclusions and recommendations reliant upon data presented in other sections. Reading parts of the report in isolation may lead to misinterpretations, and as such the report should not be copied in part or altered in any way.

Where information contained within this report is to be used for other purposes, such as tendering, it is recommended that the entire report be made available. In situations where this is not appropriate, pitt&sherry can assist in preparing a specially edited document to provide the information within an appropriate context.

2.2.11 Site variability

The results presented in this report represent the site conditions at specific locations at the time that the site investigations were carried out. Variations in site conditions may occur between or beyond assessment locations for various reasons due to natural variability (flooding, heat, landslides) or driven by human activities (cutting or filling in the vicinity and road upgrades or deterioration over time).

The advice presented in this report is based on the data gathered during the site investigations, the accuracy may be impacted by undetected variations in ground conditions or later changes to the site. Involving pitt&sherry throughout the development stages can assist in reducing the impact of these issues by identifying variances, conducting additional investigations, if required, and recommending solutions to problems encountered on site.

2.2.12 Interpretation by others

Costly problems can occur when other design professionals develop plans based on misinterpretation of a traffic risk assessment report. To assist in avoiding these problems, pitt&sherry can work with other project design professionals to interpret the findings in this report, and to review the suitability of any plans and specifications that reference the findings and recommendations of this report. pitt&sherry will not be responsible for any misinterpretation of report findings and recommendations.

2.2.13 Third party and client supplied information

Data and information supplied by the JV or third parties is assumed to be correct, unless otherwise stated. While every care has been taken by pitt&sherry in producing the report, pitt&sherry has not verified the accuracy of supplied information (unless specifically included in pitt&sherry's scope of services). Accordingly, no responsibility is accepted by pitt&sherry for incomplete or inaccurate data supplied by others.

Data and information provided by the JV includes but is not limited to:

- Project overview and description documentation including Traffic Management Plan
- Project construction phases and timing
- Workforce size including the number of workers at each camp hub and the size and number of work crews
- Estimates of construction traffic volumes during each project construction phase including traffic generated by the camp hubs
- Construction vehicle types; and
- GIS location data (construction traffic routes, camp hub and substation locations, tower locations, access track route, material sources).

3. Existing environments

3.1 Road network

3.1.1 Roads

The Project proposes to utilise both SC roads and LGA roads through the seven LGAs. All roads to be utilised during construction are shown in Figure 6. The roads, as listed below, are referred to as the Project route throughout this report.

Table 12: Roads

Road ID	Road Name	Road owner	Section relevant to project
1	Archer Street	TCC	Perkins Street to Townsville Port Road
2	Benwell Street	Private	Windlass Crossing to Archer Street
3	Hubert Street	TCC/ private	Full extent
4	Townsville Port Road	TMR	Full extent
5	Bruce Highway	TMR	Ayr to Ayr Dalbeg Road
6	Ayr Dalbeg Road	TMR	Bruce Highway to Ayr Ravenswood Road
7	Flinders Highway	TMR	Full extent
8	Ayr Ravenswood Road	TMR	Full extent
9	Downing Street	CTRC	Full extent
10	Christie Street	CTRC	Chapel Street to Sandy Creek Road
11	Burdekin Falls Dam Road	TMR	Flinders Highway to Ayr Ravenswood Road
12	Silver Valley Road	CTRC	Full extent
13	Unnamed Road (off Silver Valley Road)	Private	Silver Valley Road to transmission line easement
14	Amity Road	CTRC	Full extent
15	Gregory Developmental Road (north)	TMR	Flinders Highway to Hewett Street
16	Millchester Road	CTRC	Full extent
17	Macdonald Street	CTRC	Full extent
18	Broughton Road	CTRC	Full extent
19	Lornesleigh Road	CTRC	Broughton Road to transmission line easement
20	Cameron Downs Road	CTRC	Lornesleigh Road to transmission line easement
21	Hewett Street	CTRC	Full extent
22	Macpherson Street	CTRC	Full extent
23	Corinda Avenue	CTRC	Macpherson Street to Hughenden Camp
24	Phillipson Road	CTRC	Flinders Highway to Bluff Road

Road ID	Road Name	Road owner	Section relevant to project
25	Bluff Road	CTRC	Phillipson Road to transmission line easement
26	Gregory Developmental Road (south)	TMR	Flinders Highway to transmission line easement
27	Braceborough Road (east)	CTRC	Full extent
28	Braceborough Road (west)	Private	Full extent
29	Red Road	CTRC	Full extent
30	Homestead Lascelles Road	CTRC	Full extent
31	Helenslee Road	CTRC	Homestead Lascelles Road to transmission line easement
32	Laidlow Crossing	CTRC	Full extent
33	Paterson Street	CTRC	Laidlow Crossing to Longton Road
34	Longton Road	CTRC	Paterson Street to transmission line easement
35	Lauderdale Road (east)	CTRC	Full extent
36	Lyons Creek Road	CTRC	Flinders Highway to transmission line easement
37	Aramac Torrens Creek Road	TMR	Flinders Highway to transmission line easement
38	Cotonvale Road	Private	Flinders Highway to transmission line easement
39	Prairie Road	FSC	Flinders Highway to Woodbine Access
40	Woodbine Access	Private	Prairie Road to transmission line easement
41	Kennedy Energy Park Access Track	Private	Flinders Highway to transmission line easement
42	Redcliffe Road	FSC	Flinders Highway to transmission line easement
43	Unnamed Road (off Flinders Highway at Hughenden - to Hughenden Store)	FSC	Flinders Highway to storage
44	Unnamed Road (off Flinders Highway at Hughenden - to Hughenden Camp)	FSC	Flinders Highway to Hughenden Camp
45	Kennedy Developmental Road (south)	TMR	Flinders Highway to transmission line easement
46	Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82)	FSC	Flinders Highway to transmission line easement
47	Thornhill Tamworth Road	Private	Flinders Highway to transmission line easement
48	Marathon Stamford Road	FSC	Flinders Highway to transmission line easement
49	Barabon Terranburby Road	FSC	Flinders Highway to transmission line easement

Road ID	Road Name	Road owner	Section relevant to project
50	Benean Road	RSC	Flinders Highway to existing access track
51	Crawford Street	RSC	Flinders Highway to Magoffin Street
52	Magoffin Street	RSC	Crawford Street to Pattel Drive
53	Pattel Drive	RSC	Flinders Highway to Richmond Camp
54	Richmond Winton Road	TMR	Flinders Highway to Unnamed Road (off Richmond Winton Road)
55	Maxwelton Kynuna Road	RSC	Flinders Highway to Unnamed Road (off Maxwelton Kynuna Road)
56	Unnamed Road (off Maxwelton Kynuna Road)	RSC	Maxwelton Kynuna Road to transmission line easement
57	Minamere Nelia Road	MSC	Flinders Highway to transmission line easement
58	Yorkshire Nelia Road	MSC	Flinders Highway to Proa Road
59	Proa Road	MSC	Yorkshire Nelia Road to transmission line easement
60	Yorkshire Road	MSC	Flinders Highway to transmission line easement
61	Julia Creek Kynuna Road	TMR	Flinders Highway to transmission line easement
62	Allison Street	MSC	Goldring Street to Old Normanton Road
63	Old Normanton Road	MSC	Allison Street to Julia Creek camp
64	McKinlay Gilliat Road	MSC	Flinders Highway to transmission line easement
65	Ivellen Road	MSC	Flinders Highway to transmission line easement
66	Oorindi McKinlay Road	MSC	Flinders Highway to transmission line easement
67	Oorindi Park Access Road	Private	Flinders Highway to transmission line easement
68	Landsborough Highway	TMR	Flinders Highway to transmission line easement
69	Andrew Daniels Drive	CSC	Full extent
70	Hensley Drive	CSC	Full extent
71	Round Oak Road	CSC	Full extent
72	Unnamed Road (off Round Oak Road)	CSC	Round Oak Road to transmission line easement
73	Barkly Highway	TMR	Cloncurry to Mount Isa
74	Powerhouse Road (Cloncurry)	CSC	Flinders Highway to Phillips Street
75	Roxmere Road	CSC	Full extent
76	Burke Developmental Road	TMR	Barkly Highway to Cloncurry Camp

Road ID	Road Name	Road owner	Section relevant to project
77	Chinaman Creek Dam Road	CSC	Barkly Highway to access track to transmission line easement
78	Cloncurry Duchess Road	TMR	Barkly Highway to transmission line easement
79	Mount Frosty Road	CSC	Barkly Highway to transmission line easement
80	East Leichardt Road	CSC (initial 150m from Barkly Highway, private thereafter)	Barkly Highway to transmission line easement
81	Mount Isa Duchess Road	TMR	Full extent of TMR-owned section
82	Mount Isa Duchess Road (Council-owned section)	MICC	From TMR-owned section to transmission line easement
83	Diamantina Developmental Road	TMR	Barkly Highway to Boulia Mount Isa Highway
84	Twenty Third Avenue	MICC	Mount Isa Duchess Road to Diamantina Developmental Road
85	Diamantina Developmental Road (Council-owned section)	MICC	Diamantina Developmental Road to Mica Creek Road
86	Powerhouse Road (Mount Isa)	Private	Full extent
87	Boulia Mount Isa Highway	TMR	Diamantina Developmental Road to Moran Road
88	Moran Road	MICC (initial 600m from Boulia Mount Isa Highway, private thereafter)	Boulia Mount Isa Highway to transmission line easement
89	Mica Creek Road	MICC	Diamantina Developmental Road to Mica Creek Road

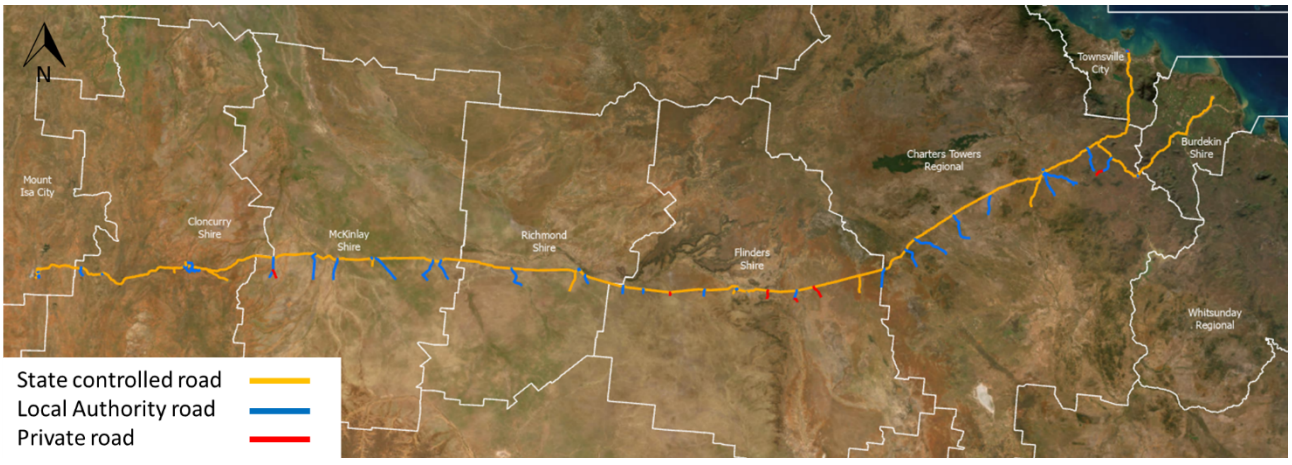


Figure 6: Project route

Road attributes and condition

SC road and shoulder widths, seal types and road condition are summarised below in Table 13. Refer to Appendix G for photos of the road condition where available. Also note that Google Street View has recently been updated on many of the SC roads.

Road condition has been determined to be excellent, good, reasonable, average or poor, with the following definitions applied to each:

- Excellent condition – no or very minor defects generally present
- Good condition – minor defects generally present at sparse intervals
- Reasonable condition – minor defects generally present at frequent intervals
- Average condition – some major defects present or minor defects continuously present; and
- Poor condition – major defects present at multiple locations, greatly limiting the viability of the road for construction traffic.

Note that this report will primarily focus on SC roads from this point onwards, noting that this is the Traffic Impact Assessment – TMR. Further information on LGA roads is provided in the relevant CopperString 2032 TIAs (Councils) outlined in Section 1.6 of this report.

Table 13: Road attributes and condition

Road ID	Road Name	Road owner	Section relevant to project	Section distance (km)	Speed limit	Road Surface Type	Centreline (Yes/ No)	Edge line	Road width (typical)	Shoulder width - typical (on-site)	Road condition comment
4	Townsville Port Road	TMR	Full extent	7.8	Typically 100km/h, slowing at either end approaching Townsville Port and the Bruce Highway	Sealed	Yes	Yes	7.0m	2.0 - 2.5m each side	Excellent condition Minor polishing in the wheel path
5	Bruce Highway	TMR	Burke Street to Ayr Dalbeg Road	8.1	Typically 100km/h, slowing to 80km/h at Ayr-Dalbeg intersection, 70km/h approaching Ayr and 50km/h through Ayr	Sealed	Yes	Yes	7.2m	0.5m	Excellent condition Minor expedient patching and polishing
6	Ayr Dalbeg Road	TMR	Bruce Highway to Ayr Ravenswood Road	29.8	Typically 100km/h, slowing to 60km/h east of Brown Road 60km/h eastbound from Brown Road	Sealed	Yes	Typically yes, not located in various sections	Variable - 6.0 to 8.0m	0.0 to 0.2m wide	Good condition Fading centreline, minor rutting/ depressions, minor potholing and edge breaks
7	Flinders Highway	TMR	South of Townsville to Cloncurry	777.2	Typically 100 to 110km/h, slowing at towns along the extent	Sealed	Yes	Yes, short section south of Charters Towers without	7.0m	1.0m	Good condition Various minor defects present along the extent including patching, cracking, surface wear and bleeding, polishing, delamination, shoving, corrugations and depressions. Infrequent more significant defects present at very infrequent intervals, such as wide filled cracking west of Maxwelton.
8	Ayr Ravenswood Road	TMR	Full extent	57.1	Typically 100km/h (due to the condition of the road, vehicles travel much more slowly)	Sealed through Ravenswood. Typically gravel or dirt thereafter other than at a steep descent at -20.047056, 146.949096	Typically not provided other than along Macrossan Street through Ravenswood	No	Variable - 4.2 to 10.5m	0.0 to 0.3m	Poor condition Significant corrugation for extended periods, difficult to traverse floodways and minor laminations and cracking.
11	Burdekin Falls Dam Road	TMR	Flinders Highway to Ayr Ravenswood Road	39.4	Typically 100km/h, slowing to 60km/h through Mingela	Sealed	Yes	No	Variable - 6.0 to 8.5m	No shoulder provided	Good condition Minor patching, transverse cracking, edge damage and stripping of seal.
15	Gregory Developmental Road (north)	TMR	Flinders Highway to Hewett Street	4.2	Typically 70km/h, slowing to 60km/h through Charters Towers	Sealed	Yes	Yes	7.0m	0.6m minimum, significantly wider in some sections	Excellent condition Very minor expedient patching
26	Gregory Developmental Road (south)	TMR	Flinders Highway to transmission line easement	23.3	100km/h for approximately 1km south of Flinders Highway, 110km/h thereafter.	Sealed	Yes	Yes	6.7 to 7.0m	0 to 1.3m wide	Excellent condition Minor polishing in wheel path
37	Aramac Torrens Creek Road	TMR	Flinders Highway to transmission line easement	12.7	Unposted - Assume 100km/h Queensland rural speed limit	Sealed	Yes	No	7.8 to 8.1m wide	No shoulder provided	Good condition Significant pothole at Mount Isa Line
45	Kennedy Developmental Road (south)	TMR	Flinders Highway to transmission line easement	5.7	Typically 100km/h, slowing to 80km/h and then 50km/h approaching Hughenden	Sealed	Yes	Yes - Hughenden No - south of Hughenden	6.4 to 7.6m	No shoulder provided, other than in Hughenden itself	Good condition Minor infrequent shoving, rutting, delineation, edge break and longitudinal cracking present. Minor rutting and depressions also present.

Road ID	Road Name	Road owner	Section relevant to project	Section distance (km)	Speed limit	Road Surface Type	Centreline (Yes/ No)	Edge line	Road width (typical)	Shoulder width - typical (on-site)	Road condition comment
54	Richmond Winton Road	TMR	Flinders Highway to Unnamed Road (off Richmond Winton Road)	15.4	100km/h	Sealed	No	No	Variable – 2.9 to 9.0m wide	No shoulder provided	Good condition Filled longitudinal cracking, minor corrugations in edgeline, signed section with rough surface, edge break.
61	Julia Creek Kynuna Road	TMR	Flinders Highway to transmission line easement	4.9	Typically 100km/h, slowing to 60km/h in Julia Creek	Sealed	No	No	Variable - 3.7 to 5.4m wide	No shoulder provided	Good condition Polishing in wheel path
68	Landsborough Highway	TMR	Flinders to transmission line easement	16.3	60km/h at northern end, increasing to 100km/h approximately 750m south of Flinders Highway and furthermore to 110km/h 9.5km south of Flinders Highway	Sealed	Yes	Yes	7.0 to 7.2m	0.2 to 0.5m wide	Good condition Very minor polishing, minor shoving in edgeline, rutting in wheelpath and depressions.
73	Barkly Highway	TMR	Cloncurry to Mount Isa	123.1	Typically 100km/h, slowing on approach to and through Cloncurry and Mount Isa	Sealed	Yes	Yes	7.0 to 8.2m	0.5 to 1.0m	Reasonable condition Significant polishing west of Cloncurry. Various minor defects including shoving in the edgeline, rutting, depressions, corrugations, potholing and expedient patching.
76	Burke Developmental Road	TMR	Barkly Highway to Cloncurry Camp	2.4	Typically 80km/h, increasing to 100km/h in the northbound direction approximately 0.4km north of Burke Developmental Road/ Hensley Drive intersection	Sealed	Yes	Yes	7.0 to 7.2m	0.3m wide	Good condition Minor shoving in edgeline, rutting and polishing present.
78	Cloncurry Duchess Road	TMR	Barkly Highway to transmission line easement	3.5	Not posted - assume 100km/h rural default speed limit	Sealed	Yes	Yes and no, provided in some sections	6.0 to 6.5m	No shoulder provided	Good condition Polishing, minor rutting, expedient patching, edge break and edge drop-off present.
81	Mount Isa Duchess Road	TMR	Full extent of TMR-owned section	5.8	60km/h through Mount Isa, increasing to 80km/h approximately 3.3km south of Barkly Highway intersection	Sealed	Yes	Yes in Isa, no further south	Variable - Typically 6.2 to 8.8m south of Mount Isa CBD	No shoulder provided south of Mount Isa CBD	Reasonable condition Minor corrugations, polishing, potholing, edge break, rutting, and cracking present.
83	Diamantina Developmental Road	TMR	Barkly Highway to Boulia Mount Isa Highway	7.2	60km/h through Mount Isa, increasing to 80km/h approximately 0.55km south of Oban Road intersection	Sealed	Yes	Typically, no	6.0 to 7.0m	No shoulder provided	Reasonable condition Edge break and cracking present near Oban Road, minor cracking and expedient patching further south.
87	Boulia Mount Isa Highway	TMR	Diamantina Developmental Road to Moran Road	1.8	80km/h, increasing to 100km/h approximately 1.7km south of Diamantina Developmental Road intersection	Sealed	Yes	No	8.0m	No shoulder provided	Good condition Minor edge break and stripping present

Traffic volumes

Traffic volumes on SC roads were determined using the TMR 2021 and 2022 traffic census data. The 2023 AADT along SC roads has been estimated by multiplying the 2021 AADT by the growth rate provided for the most recent 5-year period, where the growth rate was positive. Where the 5-year growth rate was negative, a 1% compounding annual growth rate has been applied. Where a 5-year growth rate was not provided due to counts not having been undertaken for a period of 5-years, the growth rate was estimated based on other historic counts.

The 2023 AADT projections are expected to be conservative, although it is noted that many SC roads, other than the Flinders Highway, have had historically fluctuating vehicle volumes, likely due to the timing of counts and the economy of the various industries which utilise the roads.

Table 14: Traffic volumes on State-controlled roads on the Project route

Road ID	Road Name	Lat	Lon	Approximate Location	Background traffic (two-way)					
					Count Site ID	2021 AADT	Heavy Vehicle %	5-year Growth Rate	Expected 2023 AADT	Estimated peak Hour veh/hr (2023)
4	Townsville Port Road	-19.2644	146.836	60m south of Archer Street	92236	3836 (2019)	28%	-2.14%	3,992	~520
4	Townsville Port Road	-19.2822	146.841	2.3km south of Archer Street	92206	2724	30%	3.20%	2,901	~300
7	Flinders Highway	-19.3341	146.842	0.5km south-west of Bruce Highway/ Flinders Highway/ Townsville Port Road intersection, Townsville	92192	1,899	34%	2.98%	2,014	~250
5	Bruce Highway	-19.582	147.4	40m south of the Bruce Highway/ Little Drysdale Street intersection, Ayr	91396	6,362 (2019)	6%	0.50%	6,490	~680
5	Bruce Highway	-19.5911	147.397	0.2km north of Bruce Highway/ Kilrie Road intersection, Ayr	91443	13,486 (2019)	17%	5.95%	16,994	~1,510
5	Bruce Highway	-19.6123	147.393	2.0km north of the Bruce Highway/ Ayr Dalbeg Road intersection, Mcdesme	90004	8,828	13%	-0.26%	9,005	~850
6	Ayr Dalbeg Road	-19.7028	147.291	1.8km east of Ayr Dalbeg Road/ Brown Road intersection, Mona Park	91502	927 (2019)	22%	10.99%	1,407	~180
6	Ayr Dalbeg Road	-19.7964	147.233	0.5km south of Ayr Dalbeg Road/ Granshaw Road intersection, Clare	90018	436	17%	-0.32%	445	~45
8	Ayr Ravenswood Road	-19.8185	147.226	0.2km west of Ayr Dalbeg Road/ Ayr Ravenswood Road intersection, Clare	90080	144 (2019)	17%	4.83%	174	~30
8	Ayr Ravenswood Road	-19.8322	147.13	50m east of Woodhouse Station, Mulgrave	91557	46 (2019)	11%	-10.9%	48	~15
8	Ayr Ravenswood Road	-20.0647	146.924	4.4km north-east of Ayr Ravenswood Road/ Downing Street intersection, Mulgrave	91558	36 (2019)	6%	-12.6%	38	~10
8	Ayr Ravenswood Road	-20.1013	146.88	0.5km south-east of Burdekin Falls Dam Road/ Ayr Ravenswood Road intersection, Ravenswood	91715	275 (2019)	8%	-1.99%	286	~60
11	Burdekin Falls Dam Road	-19.8837	146.635	1.65km south of Flinders Highway/ Burdekin Falls Dam Road intersection, Mingela	91295	197 (2019)	24%	-3.76%	205	~35
7	Flinders Highway	-19.3626	146.837	0.2km south of Flinders Highway/ Mount Stuart Road intersection, Roseneath	90060	5,998 (2019)	27%	2.15%	6,531	~660
7	Flinders Highway	-19.6246	146.837	3.3km south of Flinders Highway/ Woodstock Giru Road intersection, Woodstock	91389	2,642	-	3.65%	2,838	~290
15	Gregory Developmental Road (north)	-20.0631	146.286	0.4km west of Flinders Highway/ Gregory Developmental Road (north) intersection, Charters Towers	91298	1,595	14%	1.85%	1,655	~190
15	Gregory Developmental Road (north)	-20.0664	146.259	0.1km north of Gregory Developmental Road (north)/ Hackett Terrace/ Bridge Street intersection, Charters Towers	91327	3,013 (2019)	14%	0.07%	3,021	~330
15	Gregory Developmental Road (north)	-20.0471	146.25	0.8km north-west of Gregory Developmental Road (north)/ Old Dalrymple Road intersection, Charters Towers	90087	932 (2019)	27%	2.90	1,045	~110
26	Gregory Developmental Road (south)	-20.1264	146.241	2.1km south of Flinders Highway/ Gregory Developmental Road (south) intersection, Charters Towers	91701	865	17%	7.27%	992	~110

Road ID	Road Name	Lat	Lon	Approximate Location	Background traffic (two-way)					
					Count Site ID	2021 AADT	Heavy Vehicle %	5-year Growth Rate	Expected 2023 AADT	Estimated peak Hour veh/hr (2023)
7	Flinders Highway	-20.0654	122.509	0.4km south-west of Flinders Highway/ Gregory Developmental Road (north) intersection, Charters Towers	91328	2,052 (2019)	28%	4.98%	2,492	~220
7	Flinders Highway	-20.083	125.749	0.3km south-west of Flinders Highway/ Bluff Road intersection, Charters Towers	91329	2,839 (2019)	23%	0.77%	2,927	~290
7	Flinders Highway	-20.0994	146.249	1.2km north-east of Flinders Highway/ Gregory Developmental Road (south) intersection, Charters Towers	91299	2,336 (2019)	20%	0.76%	2,408	~170
7	Flinders Highway	-20.1111	146.24	0.5km south-west of Flinders Highway/ Gregory Developmental Road (south) intersection, Charters Towers	91324	1,139 (2019)	31%	2.80%	1,272	~120
7	Flinders Highway	-20.3634	145.653	0.5km south-west of Flinders Highway/ Red Road intersection, Homestead	90009	700	40%	5.88%	785	~75
7	Flinders Highway	-20.7636	145.051	4.0km north-east of Flinders Highway/ Aramac Torrens Creek Road intersection, Torrens Creek	100107	621	36%	2.95%	658	~70
37	Aramac Torrens Creek Road	-21.0788	145.008	35.4km south of Flinders Highway/ Aramac Torrens Creek Road intersection, Torrens Creek	100048	111	34%	21.46%	164	~20
45	Kennedy Developmental Road (south)	-20.8474	144.197	0.2km south of Kennedy Developmental Road (south)/ Moran Street intersection, Hughenden	100080	908	15%	-6.83%	926	~85
45	Kennedy Developmental Road (south)	-20.9655	144.1	16.2km south-east of Kennedy Developmental Road (south)/ Disraeli Street intersection	100033	163	30%	4.15%	177	~20
7	Flinders Highway	-20.8664	144.042	17.4km south-west of Flinders Highway/ Kennedy Developmental Road (north), Hughenden	100148	497	43%	2.61%	523	~55
54	Richmond Winton Road	-20.8804	143.071	16.5km south of Flinders Highway/ Richmond Winton Road intersection, Richmond	100049	57	35%	-3.47%	58	~5
7	Flinders Highway	-20.6516	142.051	32.3km east of Flinders Highway/ Julia Creek Kynuna Road intersection, Julia Creek	100019	382	48%	0.01%	383	~40
61	Julia Creek Kynuna Road	-20.702	141.743	5.1km south of Flinders Highway/ Julia Creek Kynuna Road	100050	52	31%	10.20%	63	~5
7	Flinders Highway	-20.6577	141.712	0.4km east of Flinders Highway/ Wills Developmental Road intersection, Julia Creek	100178	519	37%	1.87%	539	~45
7	Flinders Highway	-20.6608	141.682	2.8km west of Flinders Highway/ Wills Developmental Road intersection, Julia Creek	100154	388	36%	-0.01%	396	~45
7	Flinders Highway	-20.7325	140.649	1.7km east of Flinders Highway/ Landsborough Highway intersection, Cloncurry	100005	425	40	2.87%	450	~40
68	Landsborough Highway	-20.7942	140.757	15.3km south-east of Flinders Highway/ Landsborough Highway intersection, Cloncurry	100047	417	47%	2.64%	439	~40
7	Flinders Highway	-20.724	140.607	2.9km north-west of Flinders Highway/ Landsborough Highway intersection, Cloncurry	100052	858	49	4.42%	936	~80
7	Flinders Highway	-20.7071	140.528	0.2km west of Flinders Highway/ Round Oak Road intersection, Cloncurry	100060	1,058	26%	2.00%	1,101	~90

Road ID	Road Name	Lat	Lon	Approximate Location	Background traffic (two-way)					
					Count Site ID	2021 AADT	Heavy Vehicle %	5-year Growth Rate	Expected 2023 AADT	Estimated peak Hour veh/hr (2023)
7	Flinders Highway	-20.7069	140.505	At Flinders Highway/ Sheaffe Street intersection, Cloncurry	100035	4,098	9%	4.57%	4,481	~400
73	Barkly Highway	-20.7035	140.491	0.55km east of Barkly Highway/ Burke Developmental Road, Cloncurry	100062	1,488	22%	1.49%	1,533	~140
76	Burke Developmental Road	-20.6376	140.464	8.0km north-west of Barkly Highway/ Burke Developmental Road intersection, Cloncurry	100026	328	43%	2.01%	341	~35
73	Barkly Highway	-20.7184	140.444	5km south-west of Barkly Highway/ Burke Developmental Road, Cloncurry	100021	1,078	39%	3.15%	1,112	~95
73	Barkly Highway	-20.7231	139.526	0.3km east of Barkly Highway/ Breakaway Drive intersection, Mount Isa	100063	1,245	39%	-31.2%	1,270	~120
73	Barkly Highway	-20.7241	139.49	0.3km east of Barkly Highway/ Diamantina Developmental Road intersection, Mount Isa	100175	4,085	17%	-7.25%	4,167	~270
81	Mount Isa Duchess Road	-20.7366	139.493	1.4km south of Barkly Highway/ Mount Isa Duchess Road intersection, Mount Isa	100076	7,067	10%	1.62%	7,298	~690
81	Mount Isa Duchess Road	-20.7576	139.497	1.4km south of Mount Isa Duchess Road/ Twenty Third Avenue intersection, Mount Isa	100085	371	14%	-20.0%	378	~40
83	Diamantina Developmental Road	-20.7339	139.485	1.2km south of Barkly Highway/ Diamantina Developmental Road intersection, Mount Isa	100075	3,094	17%	Fluctuating	3,156	~280
83	Diamantina Developmental Road	-20.7496	139.48	0.5km south of Diamantina Developmental Road/ Oban Road intersection, Mount Isa	100123	609	16%	2.74%	643	~75

Current heavy vehicle (HV) routes and restrictions, as outlined by the relevant layer per Queensland Government's Queensland Globe, are designated as follows in Table 15 for SC roads along the Project route.

Table 15: HV routes and restrictions on SC roads

Road Name	HV approval
Townsville Port Road	Type 2 road train approved (8pm to 5am) B-double approved (all other times)
Bruce Highway	Higher Mass Limit approved
Ayr Dalbeg Road	Higher Mass Limit approved (north of Brown Road during sugar cane planting and crushing season, no access otherwise) 25m B-double approved (Between Granshaw Road and Bruce Highway)
Flinders Highway	Type 2 road train approved (Restricted between Station Street and Isley Street, Cloncurry, between 6am and 10pm)
Ayr Ravenswood Road	No HV approval
Burdekin Falls Dam Road	Type 2 road train approved
Gregory Developmental Road (north)	Type 2 road train approved
Gregory Developmental Road (south)	Type 2 road train approved
Aramac Torrens Creek Road	Type 2 road train approved
Kennedy Developmental Road (south)	Type 2 road train approved
Richmond Winton Road	Type 2 road train approved
Julia Creek Kynuna Road	Type 2 road train approved
Landsborough Highway	Type 2 road train approved
Barkly Highway	Type 2 road train approved
Burke Developmental Road	Type 2 road train approved
Cloncurry Duchess Road	Type 2 road train approved
Mount Isa Duchess Road	Type 2 road train approved (for 6.4km south of Barkly Highway)
Diamantina Developmental Road	Type 2 road train approved
Boulia Mount Isa Highway	Type 2 road train approved

3.1.2 Intersections

State-controlled intersections

Intersections between SC roads and other SC roads, and between SC roads and LGA roads proposed to be utilised during construction are summarised in Table 16.

Table 16: State-controlled intersections

Intersection ID	Intersection			HV approval	Intersection Type
	Road 1	Road 2	Road 3		
4.1	Townsville Port Road	Archer Street		Type 2 road train approved	Unsignalised T-intersection
4.2	Townsville Port Road	Bruce Highway	Flinders Highway	Type 2 road train approved	Signalised 4-way intersection
5.1	Bruce Highway	Ayr Dalbeg Road		HML approved	Unsignalised T-intersection
6.1	Ayr Dalbeg Road	Ayr Ravenswood Road		Not approved	Unsignalised T-intersection
8.1	Ayr Ravenswood Road	Downing Street	Murray Street	Not approved	Unsignalised 4-way intersection
8.2	Ayr Ravenswood Road* (Macrossan Street)	Ayr Ravenswood Road* (Deighton Street)		Not approved	Unsignalised T-intersection
11.1	Burdekin Falls Dam Road	Ayr Ravenswood Road		Not approved	Unsignalised T-intersection
11.2	Burdekin Falls Dam Road	Silver Valley Road		Not approved	Unsignalised T-intersection
11.3	Burdekin Falls Dam Road* (Hervey Street)	Burdekin Falls Dam Road		Type 2 road train approved	Unsignalised T-intersection
7.1	Flinders Highway	Burdekin Falls Dam Road		Type 2 road train approved	Unsignalised T-intersection
7.2	Flinders Highway	Amity Road		Not approved	Unsignalised T-intersection
7.3	Flinders Highway	Gregory Developmental Road (north)		Type 2 road train approved	Unsignalised T-intersection
7.4	Flinders Highway	Millchester Road		Type 1 road train approved	Unsignalised 4-way intersection

Intersection	Intersection				
15.1	Gregory Developmental Road (north)* (Dalrymple Road)	Bridge Street	Hackett Terrace	Type 2 road train approved (for legs on Project route)	Unsignalised 4-way intersection
15.2	Gregory Developmental Road (north)	Hewett Street		Not approved	Unsignalised 4-way intersection
7.5	Flinders Highway	Phillipson Road		Not approved	Unsignalised T-intersection
7.6	Flinders Highway	Gregory Developmental Road (south)		Type 2 road train approved	Unsignalised T-intersection
7.7	Flinders Highway	Braceborough Road (west)		Not approved	Unsignalised T-intersection
7.8	Flinders Highway	Red Road		Not approved	Unsignalised T-intersection
7.9	Flinders Highway	Laidlow Crossing		Type 2 road train approved	Unsignalised T-intersection
7.10	Flinders Highway	Lauderdale Road (east)		Not approved	Unsignalised T-intersection
7.11	Flinders Highway	Lyons Creek Road		Not approved	Unsignalised T-intersection
7.12	Flinders Highway	Aramac Torrens Creek Road		Type 2 road train approved	Unsignalised T-intersection
7.13	Flinders Highway	Prairie Road		Not approved	Unsignalised 4-way intersection
7.14	Flinders Highway	Redcliffe Road		Not approved	Unsignalised T-intersection
7.15	Flinders Highway	Unnamed Local Road (off Flinders Highway at Hughenden – to Hughenden Store)		Not approved	Unsignalised T-intersection
7.16	Flinders Highway	Unnamed Road (off Flinders Highway at Hughenden - to Hughenden Camp)		Not approved	Unsignalised T-intersection
7.17	Flinders Highway	Kennedy Developmental Road (south)		Type 2 road train approved	Unsignalised 4-way intersection

Intersection	Intersection			HV approval	Intersection Type
45.1	Resolution Street	Kennedy Developmental Road (south)		Type 2 road train approved	Unsignalised 4-way intersection
45.2	Kennedy Developmental Road (south)	Kennedy Developmental Road (south)* (Mclaren Street)		Type 2 road train approved	Unsignalised T-intersection
7.18	Flinders Highway* (Gray Street)	Flinders Highway* (Stansfield Street)		Type 2 road train approved	Unsignalised 4-way intersection
7.19	Flinders Highway	Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82)		Not approved	Unsignalised T-intersection
7.20	Flinders Highway	Marathon Stamford Road		Not approved	Unsignalised 4-way intersection
7.21	Flinders Highway	Barabon Terranburby Road		Not approved	Unsignalised 4-way intersection
7.22	Flinders Highway	Benean Road		Not approved	Unsignalised T-intersection
7.23	Flinders Highway* (Goldring Street - Richmond)	Flinders Highway* (Larsen Street)		Type 2 road train approved	Unsignalised 4-way intersection
7.24	Flinders Highway	Crawford Street		Type 2 road train approved	Unsignalised 4-way intersection
7.25	Flinders Highway	Pattel Drive		Not approved	Unsignalised T-intersection
7.26	Flinders Highway	Richmond Winton Road		Type 2 road train approved	Unsignalised T-intersection
7.27	Flinders Highway	Maxwelton Kynuna Road		Not approved	Unsignalised 4-way intersection
7.28	Flinders Highway	Minamere Nelia Road		Not approved	Unsignalised 4-way intersection
7.29	Flinders Highway	Yorkshire Nelia Road		Not approved	Unsignalised T-intersection
7.30	Flinders Highway	Yorkshire Road		Not approved	Unsignalised T-intersection

Intersection	Intersection			HV approval	Intersection Type
7.31	Flinders Highway	Flinders Highway* (Burke Street (eastern intersection))		Not approved	Unsignalised T-intersection
7.32	Flinders Highway	Flinders Highway* (Burke Street (western intersection))		Not approved	Unsignalised T-intersection
7.33	Flinders Highway	Julia Creek Kynuna Road		Type 2 road train approved	Unsignalised 4-way intersection
7.34	Flinders Highway	Allison Street		Not approved	Unsignalised 4-way intersection
7.35	Flinders Highway	McKinlay Gilliat Road		HML approved	Unsignalised T-intersection
7.36	Flinders Highway	Ivellen Road		Not approved	Unsignalised T-intersection
7.37	Flinders Highway	Oorindi McKinlay Road		Not approved	Unsignalised T-intersection
7.38	Flinders Highway	Landsborough Highway		Type 2 road train approved	Unsignalised T-intersection
7.39	Flinders Highway	Andrew Daniels Drive		Type 2 road train approved	Unsignalised T-intersection
7.40	Flinders Highway	Round Oak Road		Type 2 road train approved	Unsignalised T-intersection
76.1	Burke Developmental Road	Hensley Drive		Type 2 road train approved	Unsignalised T-intersection
73.1	Barkly Highway	Powerhouse Road (Cloncurry)		HML approved	Unsignalised T-intersection
73.2	Barkly Highway	Burke Developmental Road		Type 2 road train approved	Unsignalised T-intersection
73.3	Barkly Highway	Chinaman Creek Dam Road		Not approved	Unsignalised T-intersection
73.4	Barkly Highway	Cloncurry Duchess Road		Type 2 road train approved	Unsignalised T-intersection
73.5	Barkly Highway	Mount Frosty Road		Not approved	Unsignalised T-intersection
73.6	Barkly Highway	East Leichardt Road		Not approved	Unsignalised T-intersection

Intersection	Intersection			HV approval	Intersection Type
73.7	Barkly Highway	Mount Isa Duchess Road		Type 2 road train approved	Signalised 4-way intersection
81.1	Mount Isa Duchess Road	Rodeo Drive		Type 2 road train approved	Roundabout
81.2	Mount Isa Duchess Road	Twenty Third Avenue		Type 2 road train approved	Unsignalised T-intersection
73.8	Barkly Highway	Diamantina Developmental Road		Type 2 road train approved	Signalised T-intersection
83.1	Diamantina Developmental Road	Twenty Third Avenue		Type 2 road train approved	Unsignalised Y-intersection
83.2	Diamantina Developmental Road	Diamantina Developmental Road (Council owned)		Type 2 road train approved	Unsignalised Y-intersection
87.1	Boulia Mount Isa Highway	Moran Road		Not approved	Unsignalised T-intersection

*Intersection is the continuation of a single defined SC road, however, requires navigation of two separate streets.

Intersections along the Project route are shown in Figure 7, and further broken down by LGA in Figure 8 to Figure 14.

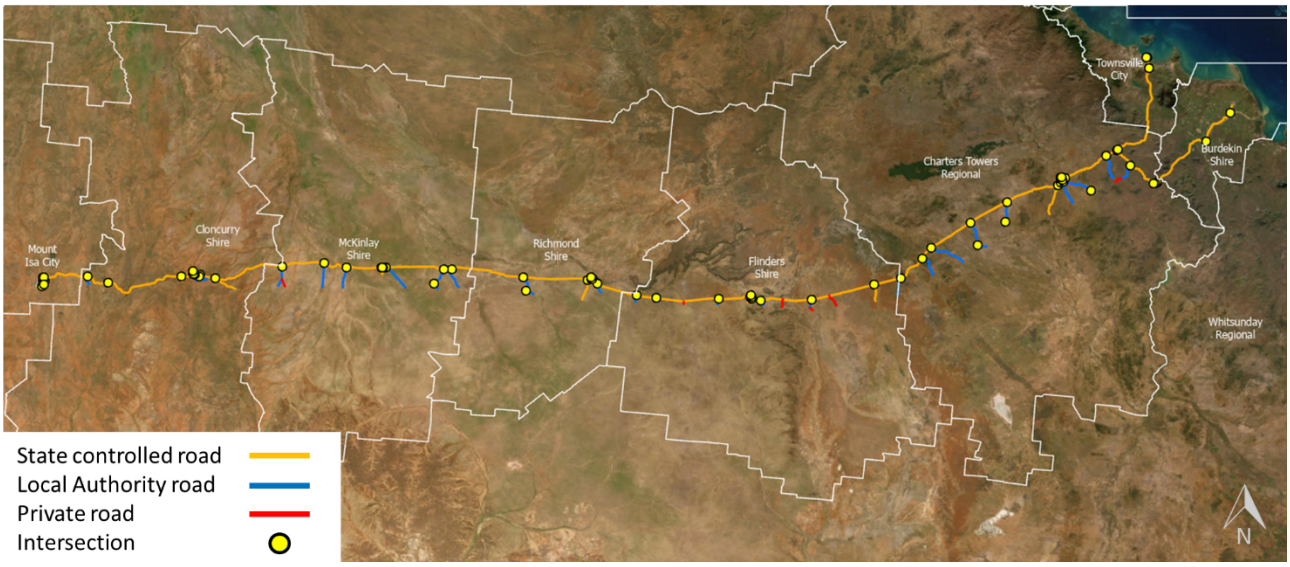


Figure 7: Intersections on the Project route

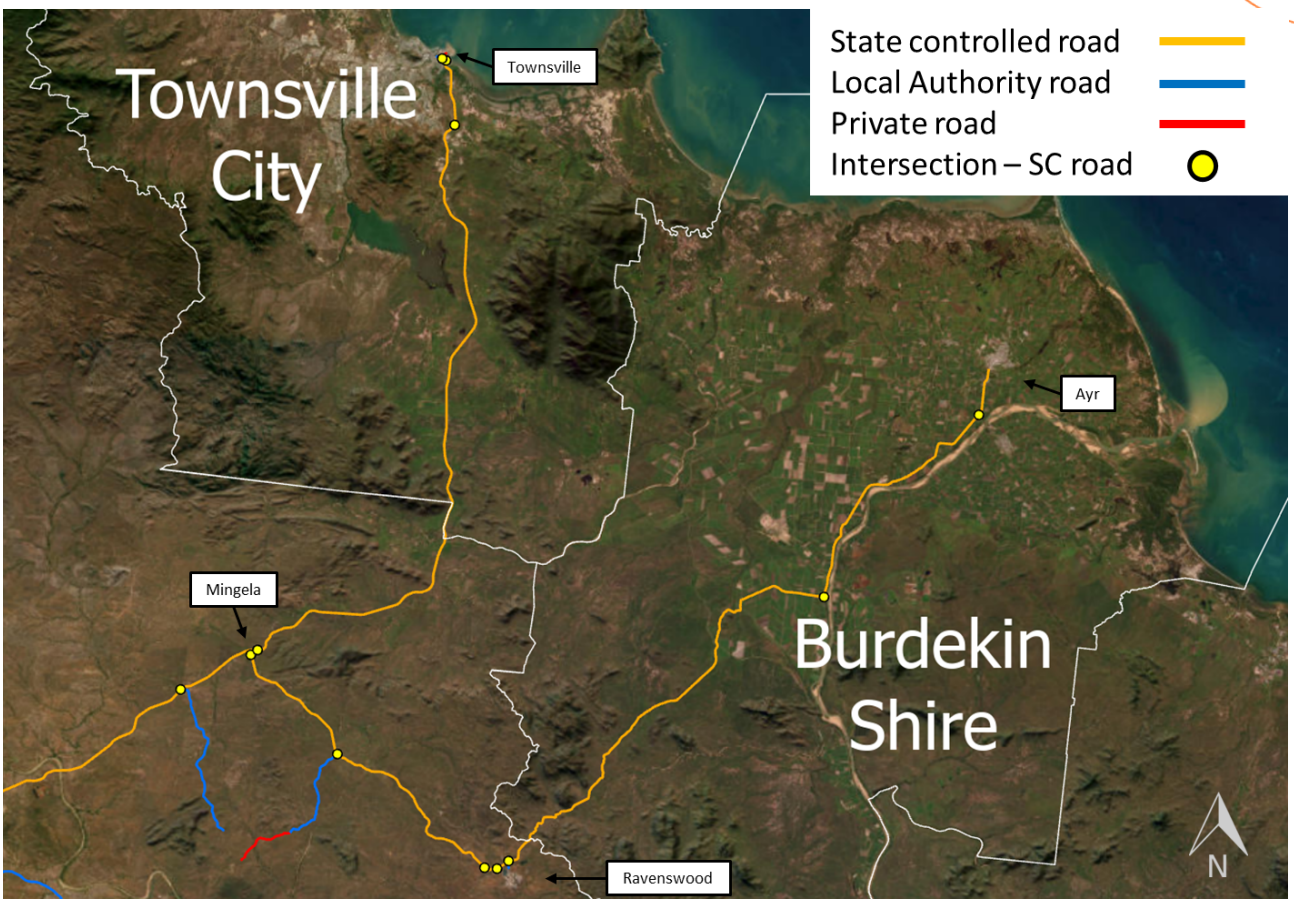


Figure 8: Intersections on the Project route – TCC and BSC

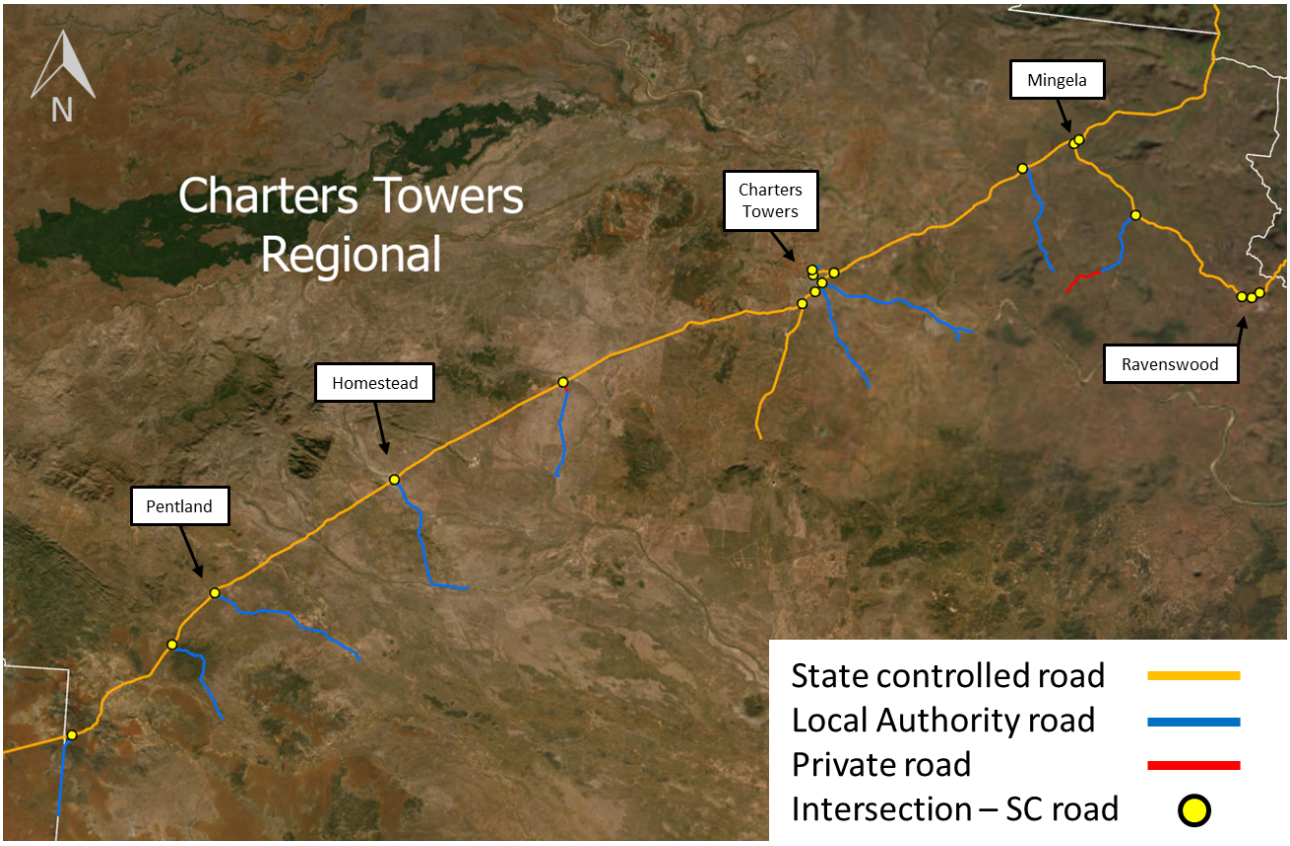


Figure 9: Intersections on the Project route – CTRC

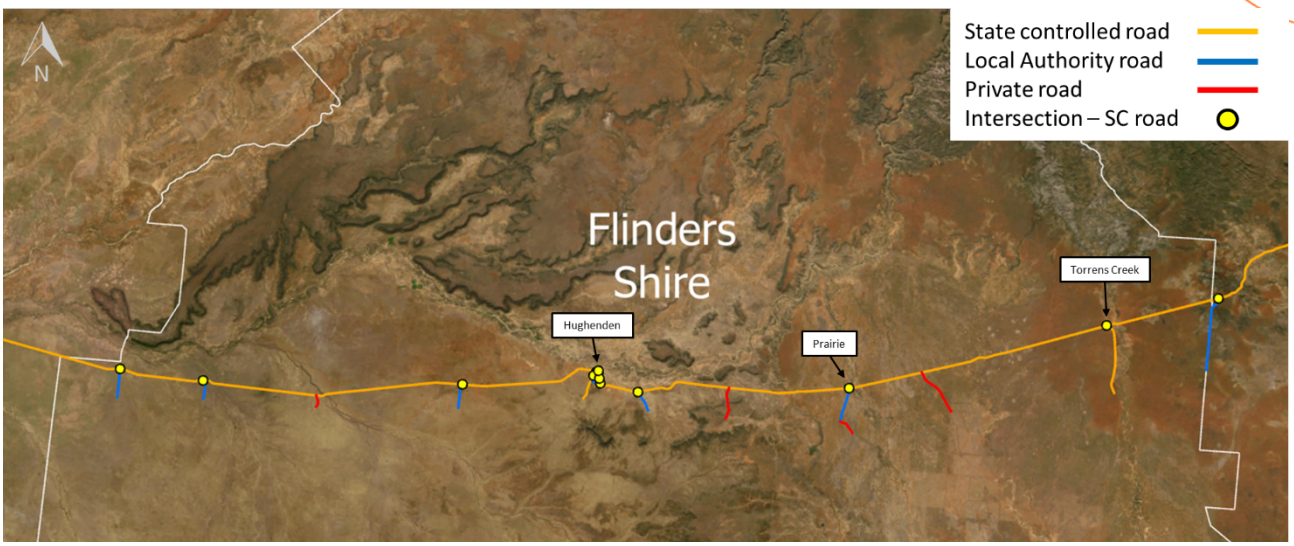


Figure 10: Intersections on the Project route – FSC

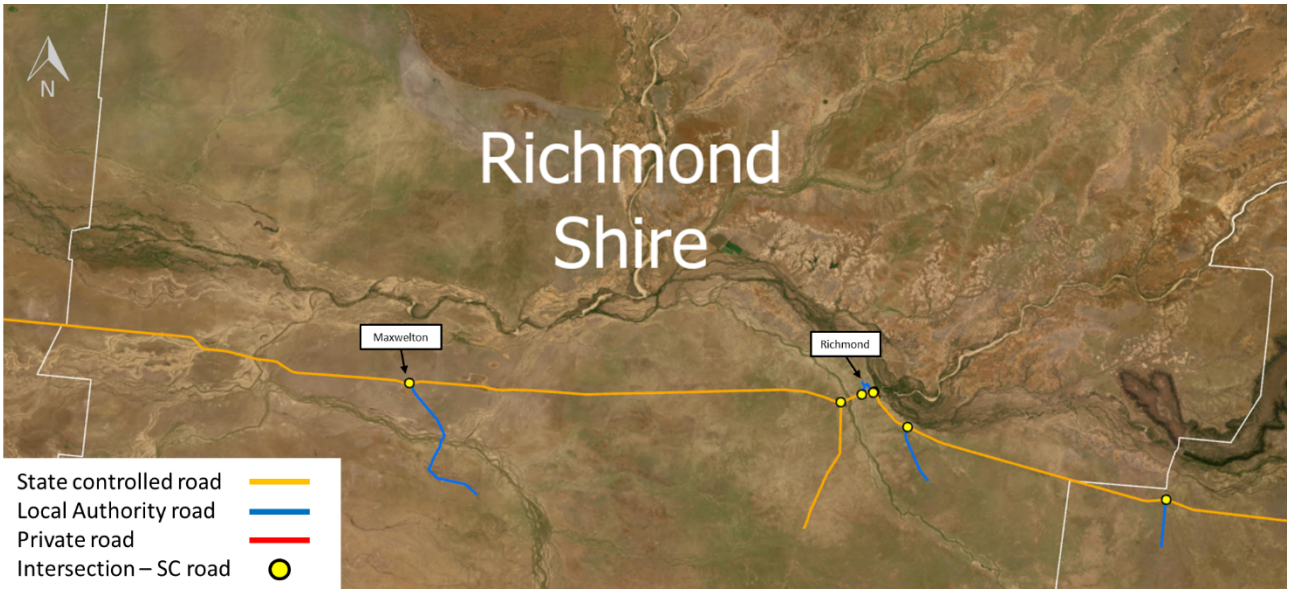


Figure 11: Intersections on the Project route – RSC

Figure 12: Intersections on the Project route – MSC

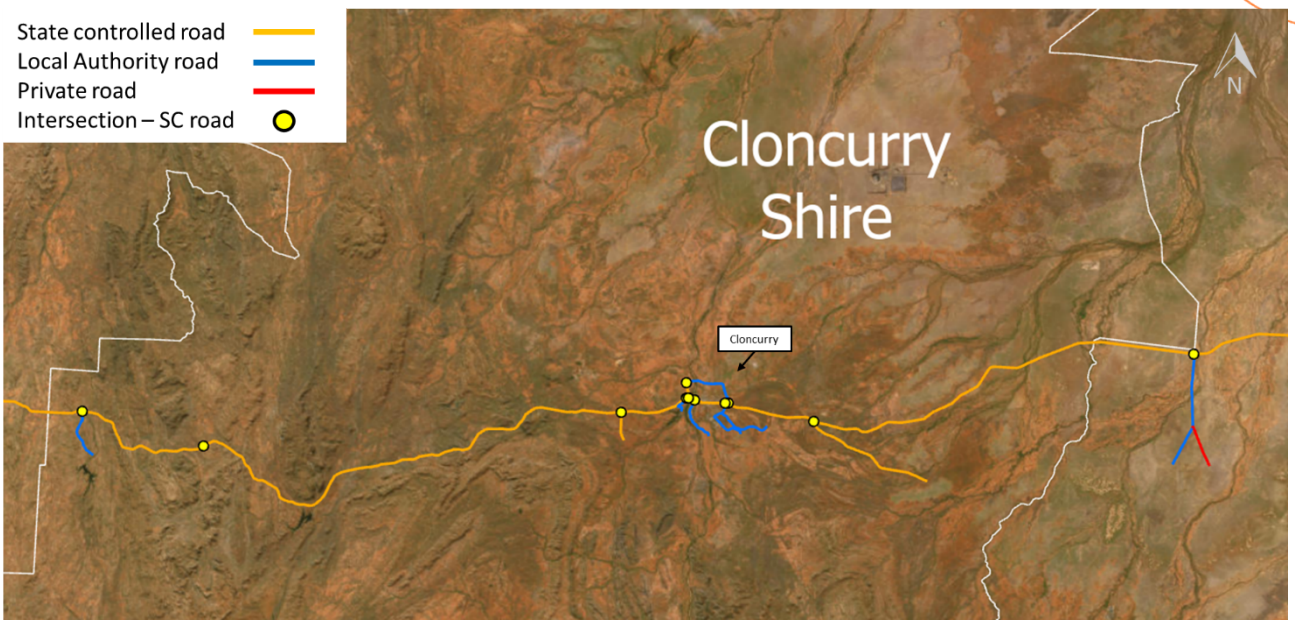


Figure 13: Intersections on the Project route – CSC

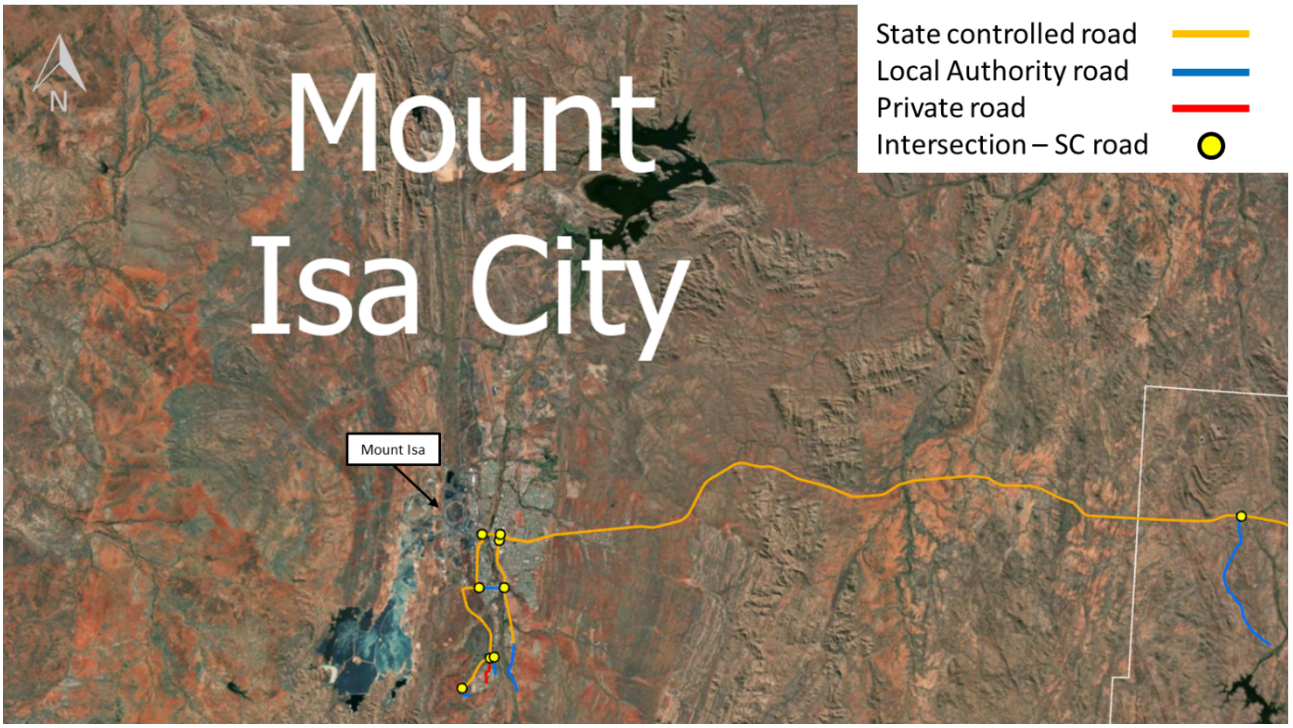


Figure 14: Intersections on the Project route – MICC

Sight distance

During the site investigations the available Approach Sight Distance (ASD) and Safe Intersection Sight Distance (SISD) at each of the intersections in the study area was measured. ASD is the minimum sight distance which a motorist should have along the minor road to an intersection hold line or other sign or device indicating an upcoming intersection. ASD allows sufficient recognition of an upcoming intersection. SISD is the minimum sight distance which should be provided between a vehicle travelling on a major road and a vehicle on a minor road attempting to turn into or travel through the major road. SISD allows enough time for a vehicle on the minor road to complete a necessary manoeuvre onto or through a major road without a collision.

Approach Sight Distance

The ASD was taken from a point on the minor road to the hold line in accordance with the *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads Guide Part 4A) as shown in Figure 15. ASD was generally measured from a height of 1.1m, noting that this would generally produce a lower ASD, however was also considered at a height of 2.4m for trucks. The Austroads ASD requirements are defined by the equation shown in Figure 16.

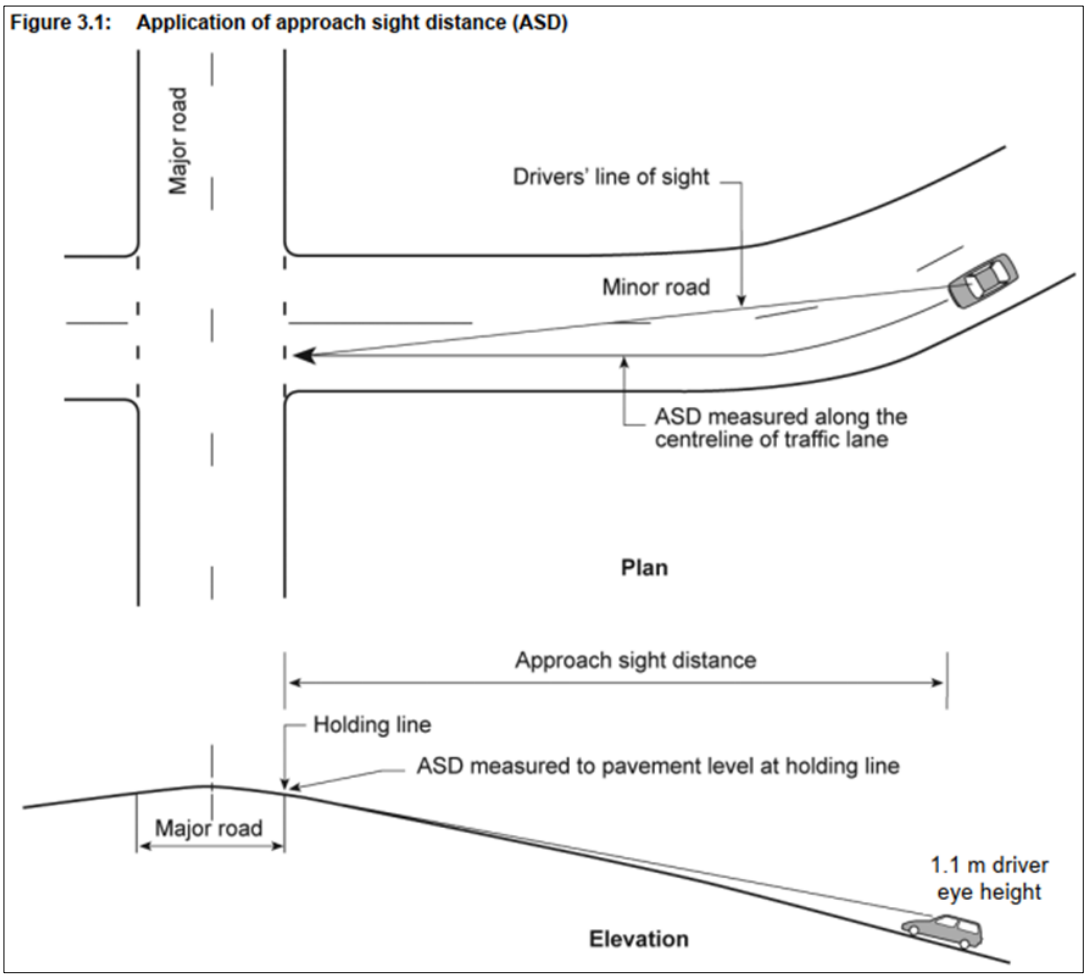


Figure 15: Austroads Guide to Road Design Part 4A: unsignalised and signalised intersections application of ASD

$$ASD = \frac{R_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

where

ASD = approach sight distance (m)

R_T = reaction time (sec), refer to *AGRD Part 3* (Austroads 2016b) for guidance on values

V = operating (85th percentile) speed (km/h)

d = coefficient of deceleration, refer to Table 3.3 and *AGRD Part 3* for values

a = a longitudinal grade in % (in direction of travel: positive for uphill grade, negative for downhill grade)

Figure 16: Austroads ASD equation

Using the above ASD equation, the following parameters were assumed for the largest vehicle proposed to be utilised during construction, a 26m B-double.

Table 17: ASD and SISD parameters

Reaction time ($\mathbf{R_T}$)	2.5 – Desirable reaction time
Operating speed ($\mathbf{V}$)	Road speed limit
Coefficient of deceleration ($\mathbf{d}$)	0.24 – provided by Austroads for trucks
Longitudinal grade in percentage ($\mathbf{a}$)	Typically taken to be 0 noting the typically flat grade of the road network

The Austroads ASD requirements for the varying road speed limits were calculated as shown below in Table 18.

Table 18: Austroads ASD requirements for trucks on flat grades

Travel speed	**Austroads ASD minimum requirement**
40km/h	54m
50km/h	76m
60km/h	101m
80km/h	161m
100km/h	233m
110km/h	275m

SC road intersections with insufficient ASD are outlined below in Table 19, with commentary regarding the sight distance limitation. Note that, in the cases below, improvement of the ASD to meet the Austroads standards would require modification to the existing LGA roads. Where a stop-sign controlled rail crossing was located within the ASD requirement and the major road could be seen from the stopping location, the ASD was considered sufficient as vehicles approaching the major road are required to stop.

Table 19: Intersections with insufficient ASD

Intersection ID	Road 1	Road 2	Minor road owner	Speed limit (minor road)	ASD	Required ASD	Comments
7.14	Flinders Highway	Redcliffe Road	FSC	Assume 100km/h rural default speed limit	135m	233m	Limited by crest Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit
73.6	Barkly Highway	East Leichardt Road	CSC	Assume 100km/h rural default speed limit	140m	233m	Limited by vegetation and crest Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit
87.1	Boulia Mount Isa Highway	Moran Road	MICC	Assume 100km/h rural default speed limit	75m	233m	Limited by vegetation - may improve to 150m+ with vegetation removal Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit. Also note the location of a cattle grid 25m south-east of the intersection, which is likely to slow vehicles considerably, as is the floodway located approximately 110m south of the intersection.

Assessment of initial risk, potential mitigations and expected residual risk of the above intersections is provided in Section 5.3, Table 57 of this report.

Safe Intersection Sight Distance

The SISD was taken at a point 7m back (5m minimum) from the vehicle/ vehicle conflict point in accordance with the *TMR Supplement to Austroads Guide to Road Design Part 4A* (Supplement to AGRD Part 4A) as shown in Figure 16 below. SISD was generally measured from a height of 1.1m, noting that this would generally produce a lower SISD, however was also considered at a height of 2.4m for trucks.

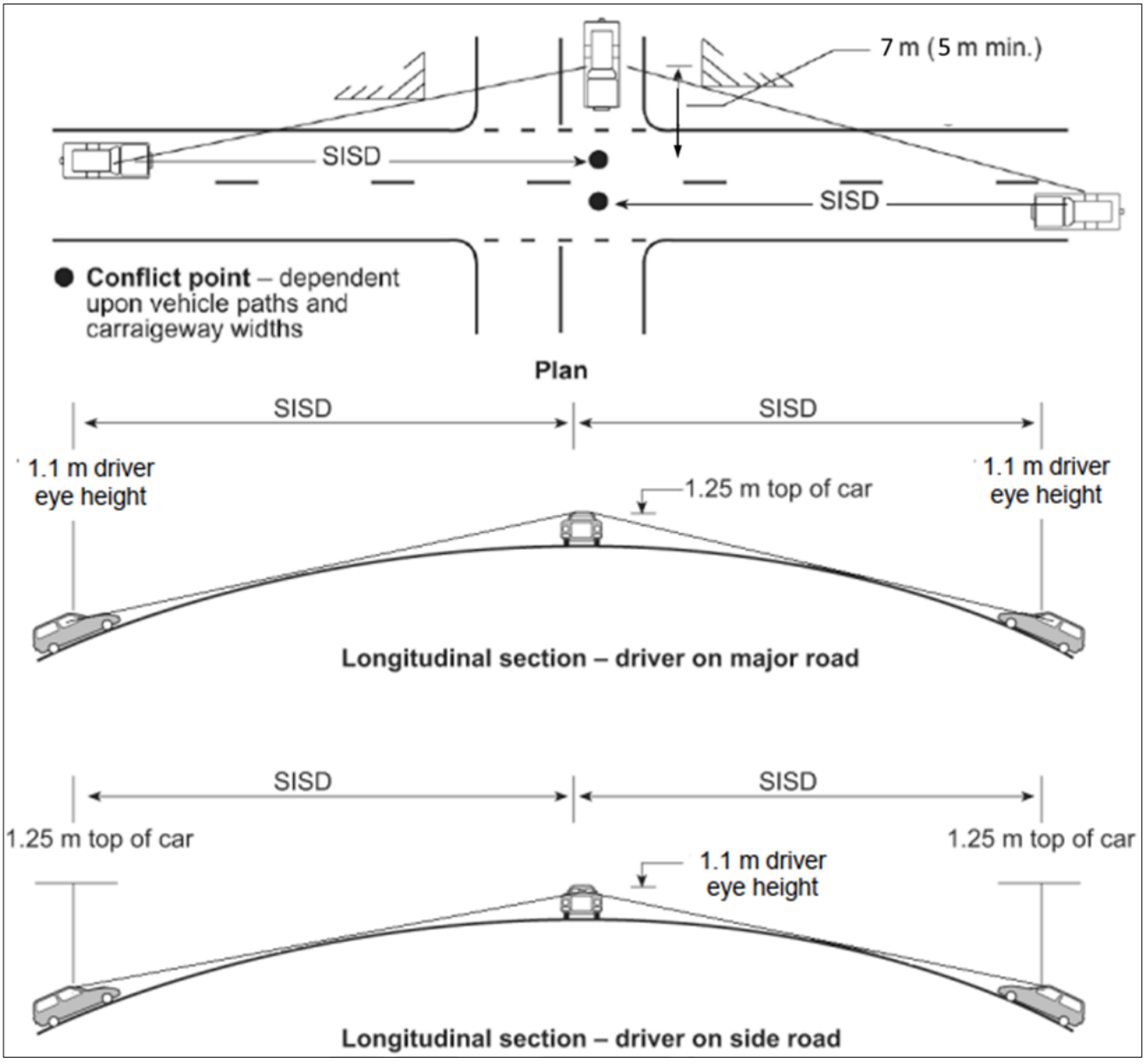


Figure 17: Supplement to AGRD Part 4A SISD

The Austroads SISD requirements are defined by the equation shown in Figure 18.

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

where

SISD	=	safe intersection sight distance (m)
D_T	=	decision time (sec) = observation time (3 sec) + reaction time (sec) – refer to *AGRD Part 3* (Austroads 2016b) for a guide to values
V	=	operating (85th percentile) speed (km/h)
d	=	coefficient of deceleration – refer to Table 3.3 and *AGRD Part 3* for a guide to values
a	=	longitudinal grade in % (in direction of travel: positive for uphill grade, negative for downhill grade)

Figure 18: Austroads SISD equation

The parameters defined in Table 17 were again used to determine the Austroads SISD requirements for B-doubles for varying road speed limits, shown below in Table 20.

Table 20: Austroads SISD requirements for trucks on flat grades

Travel speed	Austroads SISD minimum requirement
40km/h	87m
50km/h	117m
60km/h	151m
80km/h	227m
100km/h	317m
110km/h	367m

SC road intersections with insufficient SISD are outlined below in Table 21, with commentary regarding the sight distance limitation. Note that some intersections were not able to be inspected on foot due to Project safe working procedures. At these intersections, survey data was collected by Veris, however this data has not yet been provided. As such, intersections at which the sight distance may be insufficient, per visual survey, have been included in Table 21 to be conservative.

Table 21: Intersections with insufficient SISD

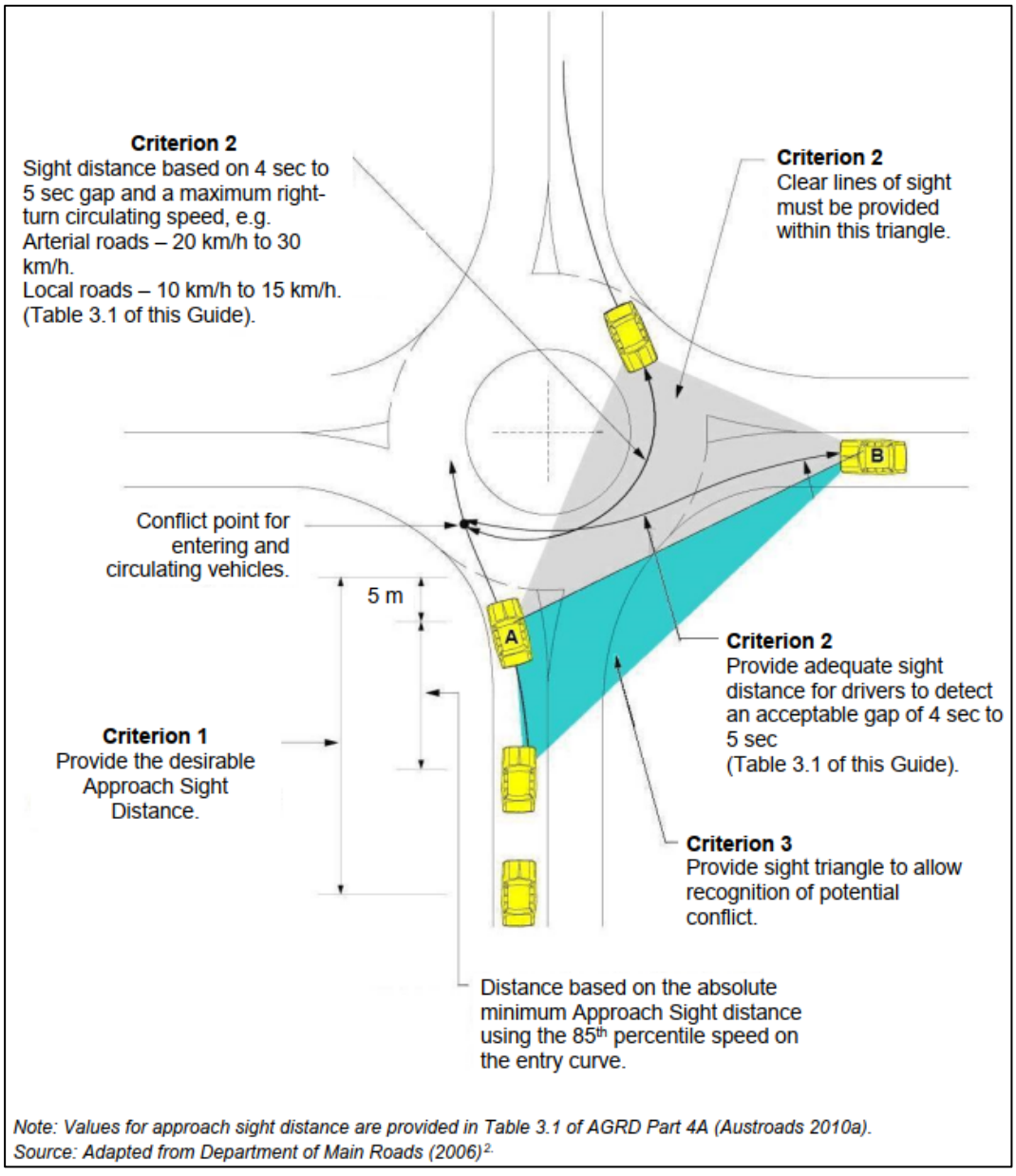
Intersection ID	Road 1	Road 2	Road 1 (major road) owner	Road 2 (minor road) owner	Speed limit (major road)	SISD	Required SISD	Comments	Estimated SISD if vegetation removed
11.2	Burdekin Falls Dam Road	Silver Valley Road	TMR	CTRC	100km/h	North - 300m	317m	Limited by vegetation and horizontal curve	320m
7.4	Flinders Highway	Millchester Road	TMR	CTRC	60km/h	North - 125m	151m	Limited by horizontal curve	
7.8	Flinders Highway	Red Road	TMR	CTRC	80km/h	East - 175m	227m	Limited by dip	
7.21	Flinders Highway	Barabon Terranburby Road	TMR	FSC	110km/h	East - 270m	367m	Limited by vegetation, horizontal curve and minor dip Note that the dip is minor and may not impede the view of a truck driver at the intersection	300m
7.30	Flinders Highway	Yorkshire Road	TMR	MSC	100km/h	West - 120m	317m	Limited by vegetation	>400m
7.31	Flinders Highway	Flinders Highway* (Burke Street (eastern intersection))	TMR	TMR/ MSC	60km/h	West - 130m	151m	Limited by vegetation in the median	>200m
7.38	Flinders Highway	Landsborough Highway	TMR	TMR	100km/h	West – 200m	317m	Limited by horizontal curve	>320m
73.3	Barkly Highway	Chinaman Creek Dam Road	TMR	CSC	80km/h	East - 200m	227m	Limited by vegetation	>300m
						West – 170m	227m	Limited by vegetation and sign	>300m
73.4	Barkly Highway	Cloncurry Duchess Road	TMR	TMR	100km/h	East – 280m	317m	Limited by dip	
73.5	Barkly	Mount Frosty	TMR	CSC	100km/h	East - 220m	317m	Limited by vegetation and dip	240m

Intersection ID	Road 1	Road 2	Road 1 (major road) owner	Road 2 (minor road) owner	Speed limit (major road)	SISD	Required SISD	Comments	Estimated SISD if vegetation removed
	Highway	Road				West - 280m	317m	Limited by vegetation	>320m
73.6	Barkly Highway	East Leichardt Road	TMR	CSC	100km/h	East - 215m	317m	Limited by vegetation and crest	260m
83.1	Diamantina Developmental Road	Twenty Third Avenue	TMR	MICC	60km/h	West - 135m	151m	Limited by vegetation	>250m
87.1	Boulia Mount Isa Highway	Moran Road	TMR	MICC	100km/h	North - 200m	317m	Limited by vegetation and crest	230m

Assessment of initial risk, potential mitigations and expected residual risk of the above intersections is provided in Section 5.3, Table 57 of this report

Roundabouts

The relevant sight distances were also measured at roundabouts. This included measuring ASD (Criterion 1), as described above, as well as measuring sight distance to vehicles circulating from the right (Criterion 2) and determination of a clear sight triangle (Criterion 3) as per the *TMR Supplement to Austroads Guide to Road Design Part 4B: Roundabouts* (Supplement to AGRD Part 4B). Each relevant sight distance measurement was taken at each roundabout approach proposed to accommodate project traffic. A diagram from Austroads Guide Part 4B is shown below in Figure 19. Criterion 2 ensures drivers have time to detect an acceptable gap of 4 to 5 seconds, depending on the approaching road type. Criterion 3 ensures drivers are able to recognise potential conflict.



Note: Values for approach sight distance are provided in Table 3.1 of AGRD Part 4A (Austroads 2010a).
Source: Adapted from Department of Main Roads (2006)[2].

Figure 19: Austroads Guide to Road Design Part 4B: roundabouts sight distance criteria for roundabouts

Criterion 1, 2 and 3 were measured in accordance with the *Austroads Guide to Road Design Part 4B: Roundabouts*. The Austroads Criterion 2 requirements are shown below in Table 22.

Table 22: Austroads roundabout Criterion 2 sight distance requirements

85th percentile on approach to the roundabout	**Criterion 2 sight distance**	
	Local residential street (4s critical acceptance gap)	**Arterial road (4s critical acceptance gap)**
20km/h	22m	28m
30km/h	33m	42m
40km/h	44m	56m
50km/h	55m	70m
60km/h	67m	84m

The single roundabout on the Project route, the Mount Isa Duchess Road/ Rodeo Drive roundabout, meets the Criterion 1, 2 and 3 requirements at all approaches.

Driveways

To access the transmission line easement, a number of existing and proposed access tracks will be utilised. The access tracks have been named based on the towers in which they are proposed to service. The naming convention is as follows:

'Road Name' and Access to 'Stringing Line'-'easternmost tower number'_'westernmost tower number'

Intersections between SC roads and access tracks, and between LGA roads and access tracks have been termed as driveways. The driveways that intersect SC roads are outlined below in Table 23.

Table 23: State-controlled driveways

Driveway ID	**Driveway**	**Road owner**	**Latitude**	**Longitude**
8.B	Ayr-Ravenswood Road and Western Access to WDS-PTL-T1_12	TMR	-19.98593348	147.0001537
8.C	Ayr-Ravenswood Road and Eastern Access to WDS-PTL-T13_77	TMR	-19.98589575	147.0000264
11.A	Burdekin Falls Dam Road and Western Access to WDS-PTL-T13_77	TMR	-19.96995901	146.7196183
26.A	Gregory Developmental Road (south) and Western Access to WDS-PTL-T196_214	TMR	-20.30129044	146.1841948
26.B	Gregory Developmental Road (south) and Eastern Access to WDS-PTL-T215_278	TMR	-20.30132233	146.1841103

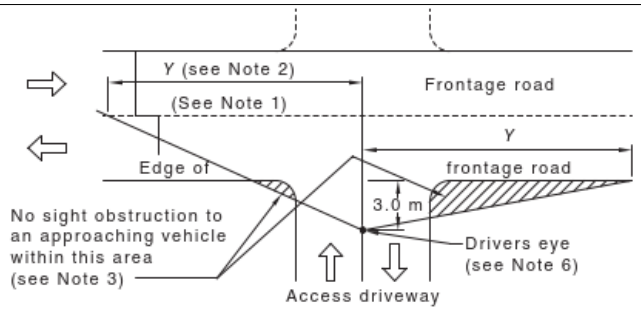
Driveway ID	Driveway	Road owner	Latitude	Longitude
37.A	Aramac Torrens Creek Road and Western Access to PTL-FLR-T89_118	TMR	-20.87870429	145.0265674
37.B	Aramac Torrens Creek Road and Eastern Access to PTL-FLR-T119_168	TMR	-20.87871775	145.0264362
7.A	Flinders Highway and Cotonvale Road	TMR	-20.84610402	144.7184491
7.B	Flinders Highway and Kennedy Energy Park Access Track	TMR	-20.87059872	144.4094707
45.A	Kennedy Developmental Road (south) and Western Access to PTL-FLR-T264_283	TMR	-20.88713636	144.1760751
45.B	Kennedy Developmental Road (south) and Eastern Access to PTL-FLR-T284_FLR-DJR-38	TMR	-20.88709695	144.1760069
7.C	Flinders Highway and Thornhill Tamworth Road	TMR	-20.88273699	143.7482221
54.A	Richmond Winton Road and Western Access to FLR-DJR-179_211	TMR	-20.86716228	143.0739756
54.B	Richmond Winton Road and Eastern Access to FLR-DJR-212_247	TMR	-20.86720308	143.0738757
7.D	Flinders Highway and Access to FLR-DJR-212_274	TMR	-20.733564	142.9017909
61.A	Julia Creek Kynuna Road and Western Access to FLR-DJR-434_475	TMR	-20.70209794	141.7433737
61.B	Julia Creek Kynuna Road and Eastern Access to FLR-DJR-476_545	TMR	-20.7020636	141.7433437
68.A	Landsborough Highway and Access to FLR-DJR-705_716	TMR	-20.73293398	140.634378
68.B	Landsborough Highway and Access to FLR-DJR-703_704	TMR	-20.74379644	140.6482989
68.C	Landsborough Highway and Access to FLR-DJR-694_699	TMR	-20.7456099	140.6536174
68.D	Landsborough Highway and Access to FLR-DJR-700_702	TMR	-20.74875949	140.6598716
68.E	Landsborough Highway and Access to FLR-DJR-682_693	TMR	-20.77330672	140.7036233
68.F	Landsborough Highway and Access to FLR-DJR-650_672	TMR	-20.79771493	140.7644051

Driveway ID	Driveway	Road owner	Latitude	Longitude
68.G	Landsborough Highway and Access to FLR-DJR-673_689	TMR	-20.78688357	140.7363781
76.A	Burke Developmental Road and Cloncurry Camp Access	TMR	-20.67849919	140.4859823
78.A	Cloncurry Duchess Road and Access to Dajarra Substation Laydown	TMR	-20.74057451	140.4081214
78.B	Cloncurry Duchess Road and Access to FLR-DJR-743_749	TMR	-20.74910126	140.4112541
78.C	Cloncurry Duchess Road and Access to FLR-DJR-750	TMR	-20.74909989	140.4111796
73.A	Barkly Highway and Access to DJR-MIS-7_27	TMR	-20.715105	140.3312314
73.B	Barkly and Access to DJR-MIS-20_34	TMR	-20.73769501	140.2790608
73.C	Barkly Highway and Access to DJR-MIS-35_43	TMR	-20.76181281	140.2232453
73.D	Barkly Highway and Access to DJR-MIS-44_49	TMR	-20.76700605	140.1976092
73.E	Barkly Highway and Access to DJR-MIS-50_56	TMR	-20.77305708	140.1552455
73.F	Barkly Highway and Access to DJR-MIS-57_60	TMR	-20.78149863	140.1181871
73.G	Barkly Highway and Access to DJR-MIS-61_66	TMR	-20.7845545	140.0961992
73.H	Barkly Highway and Access to DJR-MIS-67_68	TMR	-20.7935375	140.0735113
73.I	Barkly Highway and Access to DJR-MIS-69_72	TMR	-20.79349939	140.0734466
73.J	Barkly Highway and Access to DJR-MIS-73_86	TMR	-20.80194766	139.9986963
73.K	Barkly Highway and Access to DJR-MIS-87_97	TMR	-20.78096639	139.9731763
73.L	Barkly Highway and Access to DJR-MIS-98_99	TMR	-20.75969396	139.9510302
73.M	Barkly Highway and Access to DJR-MIS-100_103	TMR	-20.75688012	139.9467865

Driveway ID	Driveway	Road owner	Latitude	Longitude
73.N	Barkly Highway and Access to DJR-MIS-107_108	TMR	-20.76153913	139.905399
73.O	Barkly Highway and Access to DJR-MIS-109_112	TMR	-20.7615116	139.8955972
73.P	Barkly Highway and Access to DJR-MIS-113_118	TMR	-20.7624946	139.8779762
73.Q	Barkly and Access to DJR-MIS-115_121	TMR	-20.76422375	139.8629076
73.R	Barkly Highway and Eastern Access to DJR-MIS-122_126	TMR	-20.75849936	139.8280736
73.S	Barkly Highway and Access to DJR-MIS-143_153	TMR	-20.71561474	139.7189765
73.T	Barkly Highway and Access to DJR-MIS-154_177	TMR	-20.70829919	139.6424866
81.A	Mount Isa Duchess Road and Access to DJR-MIS-178_192	TMR	-20.78225547	139.4996341
81.B	Mount Isa Duchess Road and Access to DJR-MIS-193	TMR	-20.78466571	139.5001429
81.C	Mount Isa Duchess Road and Access to DJR-MIS-194	TMR	-20.78467329	139.5000929
83.A	Diamantina Developmental Road and Northern Access to Mount Isa Substation Laydown	TMR	-20.7598791	139.4882954
87.A	Boulia Mount Isa Highway and Southern Access to Mount Isa Substation Laydown	TMR	-20.7598791	139.4882954

Sight distance for commercial vehicle traffic entering a public roadway from an access driveway

The sight distance for commercial vehicle traffic entering a public roadway from an access driveway was taken at driver's eye height 3.0m back from the edge of the frontage road in accordance with AS 2890.2:2018 Off-street commercial vehicle facilities (AS 2890.2) as shown in Figure 20 below. The required sight distances for both a 5 second and 8 second gap are also shown below in Figure 20.



Frontage road speed (see Note 4) km/h	Distance (*Y*) along frontage road (see Note 5) m	
	5 s gap	8 s gap
40	55	89
50	69	111
60	83	133
70	97	156
80	111	178
90	125	200
100	139	222
110	153	244

NOTE 1 Centre-line or centre of roadway (undivided road), or right-hand edge of right-hand through lane (divided road).

NOTE 2 A check to the left is not required at a divided road where the median is wide enough to shelter a vehicle leaving the driveway.

NOTE 3 Parking on this side of the frontage road may need to be restricted on either side of the driveway so that the sight distance required by the above table to an approaching vehicle is not obstructed.

NOTE 4 This is the posted or general speed limit unless the 85th percentile speed is significantly higher.

NOTE 5 These distances are equivalent to minimum gap sight distance (MGSD) for an exiting vehicle. The minimum requirement is a 5 s gap. A right turn exit into a six lane road may require up to an 8 s gap, unless the median is wide enough to shelter a vehicle leaving the driveway.

NOTE 6 When checking sight distance the height of the object (approaching vehicle) is to be taken as 1.15 m above the road surface. The driver's eye height is to be taken as any height in the range 1.15 m to 2.5 m, to cater for both car and commercial vehicle drivers.

Figure 20: AS 2890.2 sight distance requirements

Sight distance was assessed against the requirements for an 8s gap, which is expected to be conservative. SC road driveways with insufficient sight distance for commercial vehicles are outlined below in Table 24, with commentary regarding the sight distance limitation. Note that some driveways were not able to be inspected on foot due to Project safe working procedures. At these driveways, survey data was collected by Veris, however this data has not yet been assessed as part of access design development. As such, driveways at which the sight distance may be insufficient, per visual observations, have been included in Table 24Table 21 to be conservative.

Further note that the Diamantina Developmental Road (Council-owned) and Powerhouse Road (Mount Isa) junction has insufficient sight distance to the west (20m), limited by the Diamantina Developmental Road and Diamantina Developmental Road (Council-owned) intersection. However, as there is sufficient sight distance from the junction to both northbound and southbound vehicles travelling along Diamantina Developmental Road and Boulia Mount Isa Highway, it was considered sufficient, noting that vehicles will also slow whilst navigating the Diamantina Developmental Road and Diamantina Developmental Road (Council-owned) intersection.

Table 24: Driveways with insufficient sight distance

Driveway ID	Driveway	Road owner	Speed limit (major road)	Sight distance	Required sight distance	Comments	Estimated sight distance if vegetation removed
8.C	Ayr-Ravenswood Road and Eastern Access to WDS-PTL-T13_77	TMR	100km/h	South – 90m	222m	Limited by vegetation	>230m
11.A	Burdekin Falls Dam Road and Western Access to WDS-PTL-T13_77	TMR	100km/h	South – 165m	222m	Limited by dip	
45.A	Kennedy Developmental Road (south) and Western Access to PTL-FLR-T264_283	TMR	100km/h	South - 160m	222m	Limited by crest	
45.B	Kennedy Developmental Road (south) and Eastern Access to PTL-FLR-T284_FLR-DJR-38	TMR	100km/h	South - 160m	222m	Limited by crest	
68.D	Landsborough Highway and Access to FLR-DJR-700_702	TMR	100km/h	West – 160m	222m	Limited by crest	
73.B	Barkly and Access to DJR-MIS-20_34	TMR	100km/h	South - 200m	222m	Limited by crest	
73.E	Barkly Highway and Access to DJR-MIS-50_56	TMR	100km/h	West – 150m	222m	Limited by vegetation and horizontal curve	>300m
73.F	Barkly Highway and Access to DJR-MIS-57_60	TMR	100km/h	East - 150m	222m	Limited by crest	
73.H	Barkly Highway and Access to DJR-MIS-67_68	TMR	100km/h	East - 120m	222m	Limited by horizontal curve	
73.O	Barkly Highway and Access to DJR-MIS-109_112	TMR	100km/h	East - 200m	222m	Limited by crest and horizontal curve	
73.Q	Barkly and Access to DJR-MIS-	TMR	100km/h	East – 200m	222m	Limited by	

Driveway ID	Driveway	Road owner	Speed limit (major road)	Sight distance	Required sight distance	Comments	Estimated sight distance if vegetation removed
	115_121					horizontal curve	
73.T	Barkly Highway and Eastern Access to DJR-MIS-154_177	TMR	100km/h	West – 180m	222m	Limited by vegetation and horizontal curve	>300m
83.A	Diamantina Developmental Road and Northern Access to Mount Isa Substation Laydown	TMR	80km/h	North - 80m	178m	Limited by crest	
		TMR		South - 130m	178m	Limited by sign	>200m

Assessment of initial risk, potential mitigations and expected residual risk of the above driveways is provided in Section 5.3, Table 57 of this report

3.1.3 Rail crossings

The Project route will require vehicles to travel over Mount Isa Line, Invicta Mill, Pioneer Mill, and North Coast rail crossings. The location of rail crossings on the Project route is shown in Figure 21 and outlined below in Table 25, noting that there is an impact of queueing onto SC roads from rail crossings located on LGA and privately-owned roads at some locations.

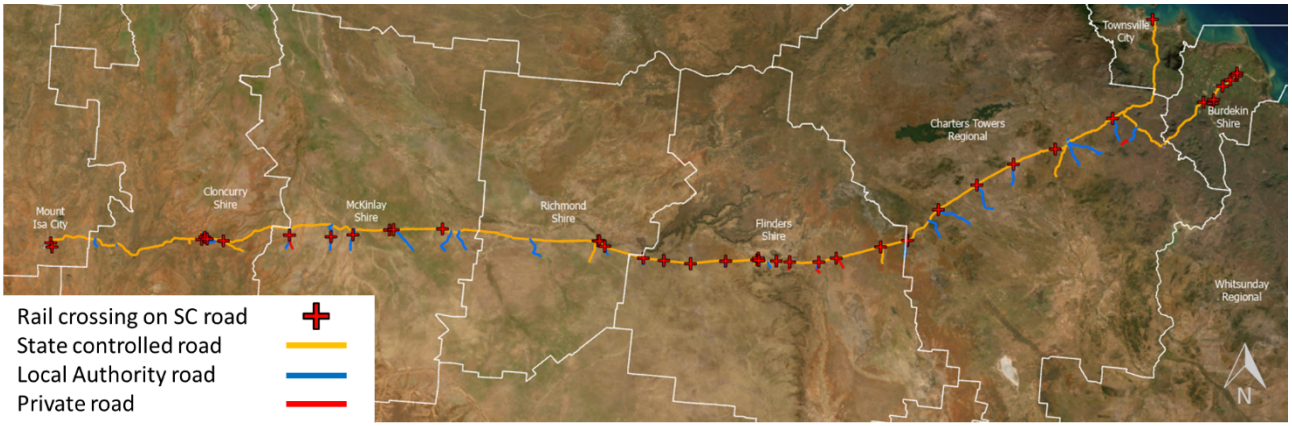


Figure 21: Rail crossings

Table 25: Rail crossings on SC roads

Crossing Name	Road owner	Active or passive control	Latitude	Longitude
Pioneer Mill: Bruce Highway crossing	TMR	Active	-19.617305	147.392121
North Coast Line: Ayr Dalbeg Road crossing	TMR	Active	-19.631266	147.386995
Pioneer Mill: Ayr Dalbeg Road (east) crossing	TMR	Active	-19.660903	147.3463
Pioneer Mill: Ayr Dalbeg Road (west) crossing	TMR	Active	-19.702436	147.293763
Invicta Mill: Ayr Dalbeg Road (north) crossing	TMR	Unknown	-19.793262	147.233489
Invicta Mill: Ayr Dalbeg Road (south) crossing	TMR	Active	-19.818253	147.228085
Invicta Mill: Ayr Ravenswood Road (east) crossing	TMR	Active	-19.818645	147.227718
Invicta Mill: Ayr Ravenswood Road (west) crossing	TMR	Unknown	-19.810619	147.168086
Mount Isa Line: Amity Road crossing	CTRC	Passive - stop sign controlled	-19.917413	146.561992
Mount Isa Line: Flinders Highway (west of Gregory Developmental Road (south)) crossing	TMR	Active	-20.121893	146.178516
Mount Isa Line: Braceborough Road (west) crossing	CTRC	Passive - stop sign controlled	-20.221832	145.899943
Mount Isa Line: Red Road crossing	CTRC	Passive - stop sign controlled	-20.361445	145.657311
Mount Isa Line: Laidlow Crossing crossing	CTRC	Passive - stop sign controlled	-20.524394	145.399527
Mount Isa Line: Lyons Creek Road crossing	CTRC	Passive - stop sign controlled	-20.728431	145.194176

Crossing Name	Road owner	Active or passive control	Latitude	Longitude
Mount Isa Line: Aramac Torrens Creek Road crossing	TMR	Passive - give-way controlled (southbound), stop controlled (northbound)	-20.771843	145.014835
Mount Isa Line: Cotonvale Road crossing	Private	Passive - stop sign controlled	-20.843179	144.734995
Mount Isa Line: Prairie Road crossing	FSC	Passive - stop sign controlled	-20.871547	144.60266
Mount Isa Line: Kennedy Energy Park Access Track crossing	Private	Passive - stop sign controlled	-20.871321	144.409346
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	TMR	Active	-20.865722	144.320159
Mount Isa Line: Flinders Highway (Hughenden south) crossing	TMR	Active	-20.862986	144.203219
Mount Isa Line: Flinders Highway (Hughenden north) crossing	TMR	Active	-20.846558	144.199869
Mount Isa Line: Kennedy Developmental Road (south) crossing	TMR	Passive - give-way controlled	-20.857077	144.189793
Mount Isa Line: Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82) crossing	Private	Passive - stop sign controlled	-20.865709	143.98156
Mount Isa Line: Thornhill Tamworth Road crossing	Private	Passive - give-way controlled	-20.883069	143.748177
Mount Isa Line: Marathon Stamford Road crossing	FSC	Passive - stop sign controlled	-20.862421	143.569433
Mount Isa Line: Barabon Terranburby Road crossing	FSC	Passive - stop sign controlled	-20.846347	143.433425
Mount Isa Line: Benean Road crossing	RSC	Passive - stop sign controlled	-20.767637	143.17689
Mount Isa Line: Flinders Highway (West of Simpson Street) crossing	TMR	Active	-20.734253	143.140254
Mount Isa Line: Pattel Drive crossing	RSC	Passive - stop sign controlled	-20.731492	143.131089
Mount Isa Line: Flinders Highway (West of Yorkshire Nelia Road) crossing	TMR	Active	-20.651927	142.094901
Mount Isa Line: Yorkshire Road crossing	MSC	Passive - stop sign controlled	-20.657097	141.767509
Mount Isa Line: Julia Creek Kynuna Road crossing	TMR	Passive - stop sign controlled	-20.659497	141.74167
Mount Isa Line: McKinlay Gilliat Road crossing	MSC	Passive - stop sign controlled	-20.691568	141.498233

Crossing Name	Road owner	Active or passive control	Latitude	Longitude
Mount Isa Line: Ivellen Road crossing	MSC	Passive - stop sign controlled	-20.704867	141.351852
Mount Isa Line: Oorindi McKinlay Road crossing	MSC	Passive - stop sign controlled	-20.693436	141.074637
Mount Isa Line: Landsborough Highway crossing	TMR	Active	-20.732785	140.634288
Mount Isa Line: Round Oak Road crossing	CSC	Active	-20.718531	140.526454
Mount Isa Line: Flinders Highway (Cloncurry) crossing	TMR	Active	-20.706991	140.510822
Mount Isa Line: Diamantina Developmental Road crossing	TMR	Active	-20.744749	139.484999

AS 1742.7:2016 Railway crossings (AS 1742.7) outlines signage, pavement marking, queuing, bicycle treatment and sight distance requirements of railway crossings. This is supplemented by the TMR Queensland Manual of Uniform Traffic Control Devices Part 7: Railway crossings.

Signage

Passive control

Figure 22 and Figure 23 show the required signage assembly for railway crossings controlled by Give Way signs and by Stop signs, respectively. These are known as passive control devices.

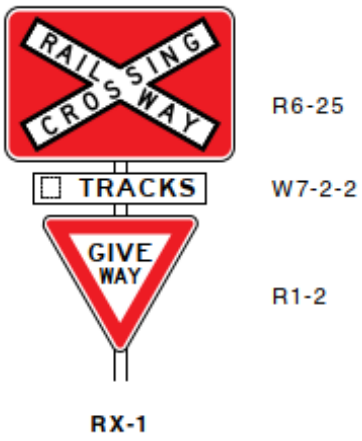


Figure 22: Railway crossing give-way assembly (RX-1)

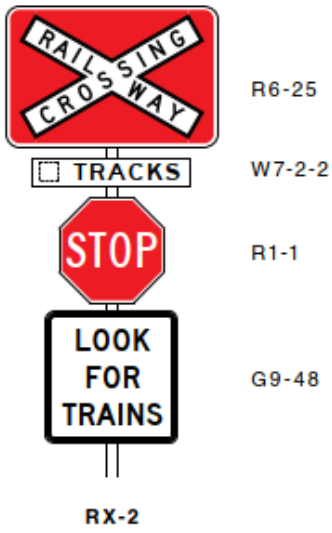


Figure 23: Railway crossing stop assembly (RX-2)

Give-way passive control is to be used where there is sufficient sight distance such that a driver of a vehicle approaching the rail crossing at the 85th percentile speed can see an approaching train and has time to stop prior to the rail crossing. Where this is not provided, a stop assembly shall be implemented.

Use of passive control also requires that sufficient sight distance for a vehicle stopped at the railway crossing to be able to start off and clear the crossing before the arrival of a previously unseen train is provided. Where there is inadequate sight distance for passive control, it may be improved by widening, clearing or geometric alteration of the crossing. Where this is not feasible or sight distance still does not meet the requirement, further risk mitigations may be implemented.

Railway crossing ahead and diagrammatic warning assemblies shall be used to give advance warning of a railway crossing controlled by passive devices (i.e. give-way or stop assemblies). Railway crossing ahead signs shall be the first warning sign encountered on approach to a passive rail crossing. Diagrammatic warning assemblies should be used as the second or as an intermediate sign on approach to a passive rail crossing. Where a passive railway crossing is located on a side road and is too close to the intersection to provide sufficient sight distance required to safely navigate, on side road signs may be used in conjunction with railway crossing ahead and diagrammatic warning assemblies on the major road. Examples of these signs are shown below in Figure 24 to Figure 27.

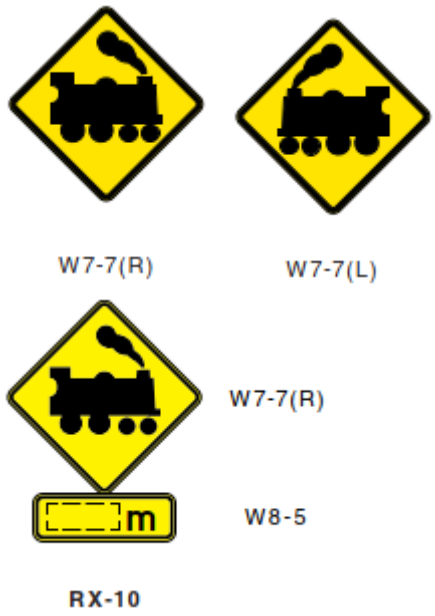


Figure 24: Railway crossing ahead passive control signs

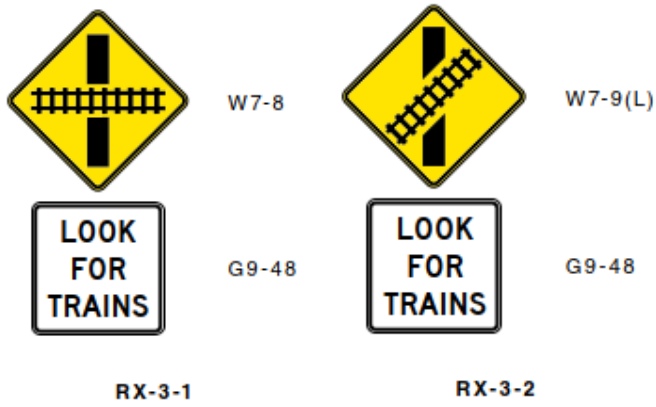


Figure 25: Railway crossing diagrammatic warning assemblies

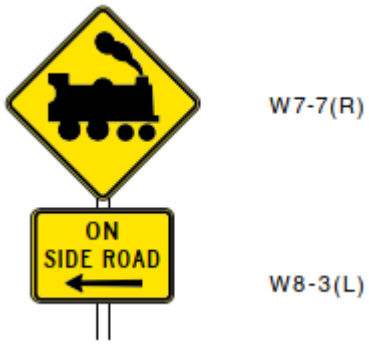


Figure 26: Railway crossing ahead passive control signs – on side road

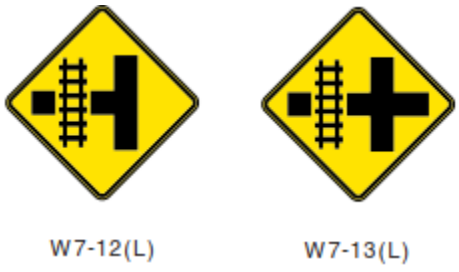


Figure 27: Railway crossing diagrammatic warning assemblies – on side road

The Stop Sign Ahead sign shall be used as the second or as an intermediate sign on approach to a rail crossing controlled by stop signs.

Signs other than those shown in Figure 22 or Figure 23 are not required in the following instances, shown in Figure 28.

TABLE 4.1

LIMITS ON USE OF MINIMUM TREATMENT CROSSINGS

Case	Maximum road approach speed (85th percentile approach speed)	Maximum visibility distance to controls for road users	Application
1	60 km/h	90 m	Applicable where traffic volume is less than 200 vehicles per day
2	40 km/h	40 m	Applicable to any road
3	any speed	20 m	Applicable only to a crossing on a side road not more than 40 m from the main road

Figure 28: AS 1742.7 minimum treatment crossings

Modified treatments may also be used in particular circumstances, as defined by AS 1742.7.

An assessment of the signage at passive controlled rail crossings on SC roads has been undertaken and is shown below in Table 26.

Table 26: Signage assessment – passive controlled rail crossings

Crossing Name	Active or passive control	Applicable minimum treatment crossings	Provides crossing ahead signs	Provides diagrammatic signs/ stop sign ahead signs - passive only
Mount Isa Line: Aramac Torrens Creek Road crossing	Passive - give-way controlled (southbound), stop controlled (northbound)	Not applicable	Northbound - Yes Southbound - Yes (on Flinders Highway eastbound and westbound)	Northbound - Yes Southbound - Yes (on Flinders Highway eastbound and westbound)
Mount Isa Line: Kennedy Developmental Road (south) crossing	Passive - give-way controlled	Not applicable	Northbound - Unknown Southbound - Yes	Northbound - Unknown Southbound - Yes
Mount Isa Line: Julia Creek Kynuna Road crossing	Passive - stop sign controlled	Not applicable	Northbound - Yes, unknown whether missing initial sign Southbound - No	Northbound - Yes Southbound - No

Assessment of initial risk, potential mitigations and expected residual risk of the above rail crossings is provided in Section 5.5, Table 59 of this report. Note that video was not taken at the Mount Isa Line: Kennedy Developmental Road (south) crossing and thus it was unknown as to whether crossing ahead signs and diagrammatic signs were provided on approach to the rail crossing in the northbound direction, noting Google Street View in this location was not sufficiently clear to determine this.

Active control

Active control rail crossings shall be installed per either assembly shown in Figure 29, unless supplemented by a boom barrier or providing additional flash signals. W7-2-2 is only required to be used at crossings of multiple tracks.

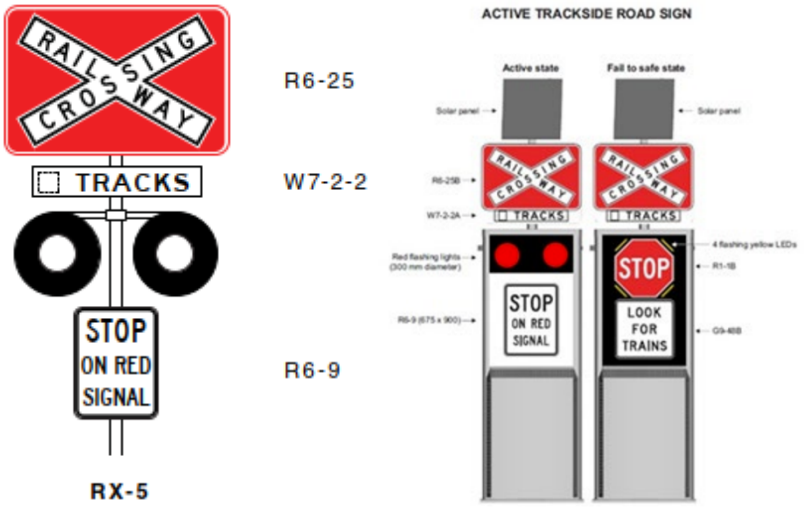


Figure 29: Railway crossing flashing signal assembly

Overhead flashing signals should be used in conjunction with pedestal mounted assemblies where there are obstructions to the latter, or where there are more than two traffic lanes on the approach.

Railway crossing flashing signals ahead shall be used to give advance warning of a railway crossing controlled by active devices. Railway crossing flashing signals ahead signs shall be used on approach to an active rail crossing. Where an active railway crossing is located on a side road and is too close to the intersection to provide sufficient sight distance required to safely navigate, on side road signs may be used in conjunction with railway crossing ahead and diagrammatic warning assemblies on the major road. Examples of these signs are shown below in Figure 30 and Figure 31.

Figure 30: Railway crossing ahead active control signs

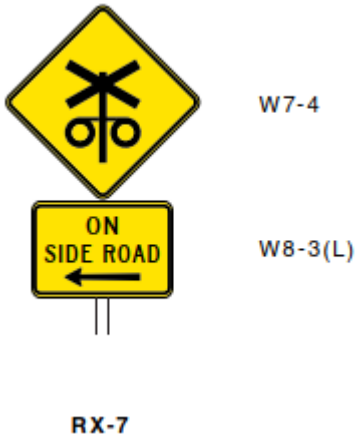


Figure 31: Railway crossing ahead active control signs – on side road

An assessment of active controlled rail crossings on SC roads has been undertaken and is shown below in Table 27. Note that as site staff were unable to be within 3m of SC roads whilst outside of a vehicle, the illumination and retro-reflectivity of signage, and location and size of signage was not assessed.

Table 27: Signage assessment – active controlled rail crossings

Crossing Name	Applicable minimum treatment crossings	Provides crossing ahead signs	Provides diagrammatic signs/ stop sign ahead signs - passive only
Pioneer Mill: Bruce Highway crossing	Not applicable	Northbound: Yes Southbound: Yes Eastbound: Yes, incorrect use of passive control sign Westbound: Unknown	Not applicable
North Coast Line: Ayr Dalbeg Road crossing	Not applicable	Northbound: Yes Southbound: Yes	Not applicable
Pioneer Mill: Ayr Dalbeg Road (east) crossing	Not applicable	Northbound: Yes Westbound: Yes	Not applicable
Pioneer Mill: Ayr Dalbeg Road (west) crossing	Not applicable	Eastbound: Yes Westbound: Yes	Not applicable
Invicta Mill: Ayr Dalbeg Road (north) crossing	Not applicable	Northbound: Unknown Southbound: Unknown	Not applicable
Invicta Mill: Ayr Dalbeg Road (south) crossing	Not applicable	Northbound: Unknown Southbound: Unknown	Not applicable
Invicta Mill: Ayr Ravenswood Road (east) crossing	Applicable - westbound direction	Eastbound: Unknown Westbound: Unknown	Not applicable
Invicta Mill: Ayr Ravenswood Road (west) crossing	Not applicable	Eastbound: Unknown Westbound: Unknown	Not applicable
Mount Isa Line: Flinders Highway (west of Gregory Developmental Road (south)) crossing	Not applicable	Eastbound - Yes Westbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	Not applicable	Eastbound - No Westbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (Hughenden south) crossing	Not applicable	Northbound - Yes Southbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (Hughenden north) crossing	Not applicable	Northbound - Yes Southbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (West of Simpson Street) crossing	Not applicable	Eastbound - Yes Westbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (West of Yorkshire Nelia Road) crossing	Not applicable	Northbound - Yes, incorrect use of passive control device signs Southbound - Yes, incorrect use of passive control device signs	Not applicable

Crossing Name	Applicable minimum treatment crossings	Provides crossing ahead signs	Provides diagrammatic signs/ stop sign ahead signs - passive only
Mount Isa Line: Landsborough Highway crossing	Not applicable	Northbound - Yes Southbound - Yes	Not applicable
Mount Isa Line: Flinders Highway (Cloncurry) crossing	Not applicable	Eastbound - No Westbound - Yes	Not applicable
Mount Isa Line: Diamantina Developmental Road crossing	Not applicable	Eastbound - Yes Southbound - Yes, incorrect use of passive control device signs Westbound - No	Not applicable

Based on the above, multiple rail crossings are missing required signage on approach. Furthermore, both the Flinders Highway (west of Yorkshire Nelia Road) crossing, and the Diamantina Developmental Road crossing incorrectly use passive control device signs on approach to active controlled rail crossings. The latter, however, are not expected to be detrimental to road safety as they still provide prior warning of an upcoming railway crossing, to which sufficient stopping sight distance is provided (documented below). Note that video was not taken of multiple crossings along the Bruce Highway, Ayr Dalbeg Road and Ayr Ravenswood Road and thus it was unknown as to whether crossing ahead signs were provided on approach to the rail crossings, noting Google Street View in this location was not sufficiently clear, nor up-to-date, to determine this.

Assessment of initial risk, potential mitigations and expected residual risk of the above rail crossings is provided in Section 5.5, Table 59 of this report.

Pavement markings

The following pavement marking is required on both approaches to a passive or active rail crossing:

- RAIL X marking – unless the rail crossing on a side road is within 60m of the major road or within a speed zone of 80km/h or less
- Stop or give-way lines; and
- No overtaking lines – on undivided sealed two-way roads with seal width greater than 5.5m, extending from the crossing to the initial warning sign or the major road.

An assessment of pavement markings at and on approach to rail crossings on SC roads has been completed and is shown below in Table 28.

As site staff were unable to be within 3m of SC roads whilst outside of a vehicle, the sizing and location of pavement markings was not assessed.

Table 28: Pavement marking assessment

Crossing Name	Pavement markings – Rail X required	Pavement markings - RAIL X provided	Pavement markings - Stop or give-way lines required	Pavement markings - Stop or give-way lines	Pavement markings - No overtaking lines required	Pavement markings - No overtaking lines
Pioneer Mill: Bruce Highway crossing	Northbound: Yes Southbound: Yes Eastbound: No Westbound: No	Northbound: No Southbound: No Eastbound: No Westbound: No	Northbound: Yes Southbound: Yes Eastbound: Yes Westbound: Yes	Northbound: Yes Southbound: Yes Eastbound: Yes Westbound: Yes	Northbound: No (controlled intersection) Southbound: No (controlled intersection) Eastbound: No (controlled intersection) Westbound: No (controlled intersection)	Northbound: No (controlled intersection) Southbound: No (controlled intersection) Eastbound: No (controlled intersection) Westbound: No (controlled intersection)
North Coast Line: Ayr Dalbeg Road crossing	Northbound: No Southbound: No	Northbound: No Southbound: No	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: Yes (breaks in centreline due to property accesses) Southbound: Yes (breaks in centreline due to property accesses)
Pioneer Mill: Ayr Dalbeg Road (east) crossing	Northbound: No Westbound: No	Northbound: No Westbound: No	Northbound: Yes Southbound: Yes	Northbound: Yes Westbound: Yes	Northbound: Yes Southbound: Yes	Northbound: Yes (unknown if it extends to the initial warning sign) Westbound: Yes (unknown if it extends to the initial warning sign)
Pioneer Mill: Ayr Dalbeg Road (west) crossing	Eastbound: No Westbound: No	Eastbound: No Westbound: No	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: Unknown Westbound: Unknown

Crossing Name	Pavement markings – Rail X required	Pavement markings - RAIL X provided	Pavement markings - Stop or give-way lines required	Pavement markings - Stop or give-way lines	Pavement markings - No overtaking lines required	Pavement markings - No overtaking lines
Invicta Mill: Ayr Dalbeg Road (north) crossing	Northbound: Yes Southbound: Yes	Northbound: No Southbound: No	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: No Southbound: No
Invicta Mill: Ayr Dalbeg Road (south) crossing	Northbound: Yes Southbound: Yes	Northbound: No Southbound: No	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: Yes Southbound: Yes	Northbound: No Southbound: No
Invicta Mill: Ayr Ravenswood Road (east) crossing	Eastbound: Yes Westbound: No	Eastbound: No Westbound: No	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: Yes (unknown if it extends to the initial warning sign) Westbound: Yes (unknown if it extends to the initial warning sign)
Invicta Mill: Ayr Ravenswood Road (west) crossing	Eastbound: Yes Westbound: Yes	Eastbound: No Westbound: No	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: Yes Westbound: Yes	Eastbound: No Westbound: No

Crossing Name	Pavement markings – Rail X required	Pavement markings - RAIL X provided	Pavement markings - Stop or give-way lines required	Pavement markings - Stop or give-way lines	Pavement markings - No overtaking lines required	Pavement markings - No overtaking lines
Mount Isa Line: Flinders Highway (west of Gregory Developmental Road (south)) crossing	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound: Yes Westbound: Yes	Eastbound - Yes Westbound - Yes	Eastbound: Yes Westbound: Yes	Eastbound - Yes Westbound - Yes
Mount Isa Line: Aramac Torrens Creek Road crossing	Northbound - Yes Southbound - No	Northbound - Unknown Southbound - No	Northbound: Yes Southbound: Yes	Northbound - No Southbound - No	Northbound: Yes Southbound: Yes	Northbound - Yes, however does not extend to hold line as no hold line is provided Southbound - No
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound: Yes Westbound: Yes	Eastbound - Yes Westbound - Yes
Mount Isa Line: Flinders Highway (Hughenden south) crossing	Northbound: No Southbound: No	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound: Yes Southbound: Yes	Northbound - Yes Southbound - Yes
Mount Isa Line: Flinders Highway (Hughenden north) crossing	Northbound: No Southbound: No	Northbound - No Southbound - No	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound: Yes Southbound: Yes	Northbound - Yes Southbound - Yes
Mount Isa Line: Kennedy Developmental Road (south) crossing	Northbound: No Southbound: No	Northbound - Yes Southbound - No	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - No	Northbound: Yes Southbound: Yes	Northbound - Unknown Southbound - Unknown

Crossing Name	Pavement markings – Rail X required	Pavement markings - RAIL X provided	Pavement markings - Stop or give-way lines required	Pavement markings - Stop or give-way lines	Pavement markings - No overtaking lines required	Pavement markings - No overtaking lines
Mount Isa Line: Flinders Highway (West of Simpson Street) crossing	Eastbound - No Westbound - No	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound: Yes Westbound: Yes	Eastbound - Yes Westbound - Yes
Mount Isa Line: Flinders Highway (West of Yorkshire Nelia Road) crossing	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound: Yes Southbound: Yes	Northbound - Yes Southbound - Yes
Mount Isa Line: Julia Creek Kynuna Road crossing	Northbound - No Southbound - No	Northbound - Unknown Southbound - No	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound: Yes Southbound: Yes	Northbound - No Southbound - No
Mount Isa Line: Landsborough Highway crossing	Northbound: No Southbound: No	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound - Yes Southbound - Yes	Northbound: Yes Southbound: Yes	Northbound - Yes Southbound - Yes
Mount Isa Line: Flinders Highway (Cloncurry) crossing	Eastbound - No Westbound - No	Eastbound - No Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound - Yes Westbound - Yes	Eastbound: Yes Westbound: Yes	Eastbound - No Westbound - Yes
Mount Isa Line: Diamantina Developmental Road crossing	Eastbound - No Southbound - No Westbound - No	Eastbound - Yes Southbound - Yes Westbound - Yes	Eastbound - Yes Southbound - Yes Westbound - Yes	Eastbound - Yes Southbound - Yes Westbound - Yes	Eastbound - Yes Southbound - Yes Westbound - Yes	Eastbound - Yes Southbound - Yes Westbound - Yes

Based on the above, multiple rail crossings are missing required pavement markings on approach. Note that video was not taken of various crossings along the Bruce Highway, Ayr Dalbeg Road, Ayr Ravenswood Road and Kennedy Developmental Road (south) and thus it was unknown as to whether pavement markings were provided on approach to the rail crossings, noting Google Maps and Google Street View in these locations was not sufficiently clear, nor up-to-date, to determine this.

Assessment of initial risk, potential mitigations and expected residual risk of the above rail crossings is provided in Section 5.5, Table 59 of this report.

Sight distance

Various sight distances have been assessed against the requirements of AS1742.7. These include:

- Stopping sight distance (SSD) – S1
- Visibility to an approaching train for the driver of a vehicle approaching a GIVE WAY sign needing to judge whether it must stop or can cross the crossing before the train arrives – S2; and
- Visibility to an approaching train for a vehicle stopped at a crossing and needing to start up and clear the crossing before the arrival of the train – S3.

The latter two are only required for passive control rail crossings.

The requirements for S1, S2 and S3 are given by the following equations:

$$S_1 = \frac{(R_T + B_T)V_v}{3.6} + \frac{{V_v}^2 \times S_c}{254(d+G)} + L_d + C_v$$

$$S_2 = \frac{V_T}{V_v}\left(\frac{(R_T + B_T)V_v}{3.6} + \frac{{V_v}^2 \times S_c}{254(d+G)} + \frac{W_T}{sinZ} + 2C_v + C_T + L\right)$$

$$S_3 = \frac{V_T}{3.6}\left(J + G_s\left(2\frac{\frac{W_R}{tanZ} + \frac{W_T}{sinZ} + 2C_v + C_T + L}{a}\right)^{\frac{1}{2}}\right)$$

Where,

R_T = total perception reaction time in seconds (general case assumption = 2.5s)

B_T = brake delay time (s)

V_v = vehicle approach speed (km/h)

S_c = unsealed road correction factor

d = coefficient of longitudinal deceleration

G = average approach grade in metres per metre, positive up-grade, negative down-grade

L_d = distance from the driver to the front of the vehicle (general case assumption = 1.5 metres)

C_v = clearance from the vehicle stop of give-way line to the nearest rail (general case assumption = 3.5m)

V_T = the speed of the train approaching the crossing (km/h)

W_T = width, outer rail to outer rail. Of the rail tracks at the crossing (m)

Z = angle between the road and the railway at the crossing (degrees)

C_T = clearance or safety margin from the vehicle stop or give-way line on the departure side of the crossing (general case assumption = 5 metres)

L = length of design vehicle

J = sum of the perception time and time to depress clutch

G_s = grade correction factor

W_R = width of the travelled way at the crossing (road width)

a = average acceleration of the design vehicle in starting gear

Parameters, as listed and described above, were typically determined via desktop assessment, as site staff were unable to be within 3m of SC roads whilst outside of a vehicle or determined from relevant tables in AS 1742.7.

The S1, S2 and S3 requirements at rail crossings on SC roads are shown below in Table 29.

Table 29: S1, S2 and S3 requirements

Crossing Name	S1 requirement (m)	S2 requirement (m)	S3 requirement (m)
Pioneer Mill: Bruce Highway crossing	193	125	273
North Coast Line: Ayr Dalbeg Road crossing	114	365	833
Pioneer Mill: Ayr Dalbeg Road (east) crossing	120	112	280
Pioneer Mill: Ayr Dalbeg Road (west) crossing	136	133	343
Invicta Mill: Ayr Dalbeg Road (north) crossing	179	115	235
Invicta Mill: Ayr Dalbeg Road (south) crossing	185	120	274
Invicta Mill: Ayr Ravenswood Road (east) crossing	181	116	244
Invicta Mill: Ayr Ravenswood Road (west) crossing	195	128	314
Mount Isa Line: Flinders Highway (west of Gregory Developmental Road (south)) crossing	192	250	602
Mount Isa Line: Aramac Torrens Creek Road crossing	173	225	417
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	199	245	488
Mount Isa Line: Flinders Highway (Hughenden south) crossing	141	208	456
Mount Isa Line: Flinders Highway (Hughenden north) crossing	97	205	444
Mount Isa Line: Kennedy Developmental Road (south) crossing	138	203	415
Mount Isa Line: Flinders Highway (West of Simpson Street) crossing	96	201	437
Mount Isa Line: Flinders Highway (West of Yorkshire Nelia Road) crossing	199	245	495
Mount Isa Line: Julia Creek Kynuna Road crossing	113	206	454
Mount Isa Line: Landsborough Highway crossing	108	194	421
Mount Isa Line: Flinders Highway (Cloncurry) crossing	95	199	429
Mount Isa Line: Diamantina Developmental Road crossing	110	197	447

The stopping sight distance (S1) has been estimated using pictures and video taken during the site visit and via Google Streetview. S2 and S3 were unable to be estimated using this approach and should be assessed against the relevant requirements. Note that, due to technical difficulties, video was not taken at the Mount Isa Line: Kennedy Developmental Road (south) crossing and at the Pioneer Mill: Ayr Dalbeg Road (east) crossing in the southbound direction and thus S1 was unable to be estimated on site.

Further note that westbound vehicles have insufficient SSD to the Invicta Mill: Ayr Ravenswood (east) crossing due to the nearby location of the Ayr Dalbeg Road and Ayr Ravenswood Road intersection, per the S1 requirements and based on the assumed vehicle approach speed. However, as there is sufficient sight distance to the crossing from the north and south approaches to the intersection on Ayr Dalbeg Road, the SSD has been considered sufficient, noting that vehicles will also slow whilst navigating the Ayr Dalbeg Road and Ayr Ravenwood Road intersection.

Table 30: S1 assessment

Crossing Name	S1 requirement (m)	S1 estimate (m) - Northbound/ Westbound	S1 estimate (m) - Southbound/ Eastbound	S1 meets requirements - Northbound/ Westbound	S1 meets requirements - Southbound/ Eastbound
Pioneer Mill: Bruce Highway crossing	193	>200	>200	Yes	Yes
North Coast Line: Ayr Dalbeg Road crossing	114	>150	>150	Yes	Yes
Pioneer Mill: Ayr Dalbeg Road (east) crossing	120	>150	Unknown	Yes	Unknown
Pioneer Mill: Ayr Dalbeg Road (west) crossing	136	>150	>150	Yes	Yes
Invicta Mill: Ayr Dalbeg Road (north) crossing	179	>200	>200	Yes	Yes
Invicta Mill: Ayr Dalbeg Road (south) crossing	185	>200	>200	Yes	Yes
Invicta Mill: Ayr Ravenswood Road (east) crossing	181	29 (From Ayr Dalbeg Road/ Ayr Ravenswood Road intersection)	>200	Yes*	Yes
Invicta Mill: Ayr Ravenswood Road (west) crossing	195	>200	>200	Yes	Yes
Mount Isa Line: Flinders Highway (west of Gregory Developmental Road (south)) crossing	192	>200	>200	Yes	Yes
Mount Isa Line: Aramac Torrens Creek Road crossing	173	>200	49 (From Flinders Highway/ Aramac Torrens Creek Road intersection)	Yes	Yes*
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	199	>200	>200	Yes	Yes

Crossing Name	S1 requirement (m)	S1 estimate (m) - Northbound/ Westbound	S1 estimate (m) - Southbound/ Eastbound	S1 meets requirements - Northbound/ Westbound	S1 meets requirements - Southbound/ Eastbound
Mount Isa Line: Flinders Highway (Hughenden south) crossing	141	>200	>200	Yes	Yes
Mount Isa Line: Flinders Highway (Hughenden north) crossing	97	>200	>200	Yes	Yes
Mount Isa Line: Kennedy Developmental Road (south) crossing	138	>150m	>150m	Yes	Yes
Mount Isa Line: Flinders Highway (West of Simpson Street) crossing	96	>200	>200	Yes	Yes
Mount Isa Line: Flinders Highway (West of Yorkshire Nelia Road) crossing	199	>200	>200	Yes	Yes
Mount Isa Line: Julia Creek Kynuna Road crossing	113	>200	70 (From Flinders Highway/ Aramac Torrens Creek Road intersection)	Yes	Yes*
Mount Isa Line: Landsborough Highway crossing	108	>200	>200	Yes	Yes
Mount Isa Line: Flinders Highway (Cloncurry) crossing	95	>200	>200	Yes	Yes
Mount Isa Line: Diamantina Developmental Road crossing	110	>150	~85	Yes	No

*The S1 estimate at the southbound approaches to the Aramac Torrens Creek Road and at the Julia Creek Kynuna Road crossings do not meet their respective S1 requirements for the 100km/h speed limit. However, due to the nearby location of upstream intersections which slow vehicles considerably, the sight distances are expected to be sufficient.

As shown above, the stopping sight distance (S1) to all rail crossings located on SC roads, where known, meets the S1 requirements, other than the eastbound approach to the Diamantina Developmental Road crossing, which is limited by vegetation and a horizontal curve. Assessment of initial risk, potential mitigations and expected residual risk of the Mount Isa Line: Diamantina Developmental Road crossing, due to having insufficient sight distance, is provided in Section 5.5, Table 59 of this report.

Queueing

Due to the Mount Isa Line running parallel to the Flinders Highway along much of its extent, there are multiple locations on the Project route in which intersections with the Flinders Highway are located in close proximity to rail crossings. As a result, both due to queuing on the minor road at intersections and due to queueing at train tracks when waiting for a train to pass, there is potential for vehicles to block either the intersections or the rail crossing.

Locations where there is an intersection with a SC road within proximity of a rail line is shown in Table 31.

Where the proximity results in a high risk of queues forming on major road or a rail line, mitigation is discussed in Section 5 of this report.

Table 31: Distance between rail crossing and nearest intersection

Crossing Name	Distance to northern/ eastern intersection (track to hold line)	Distance to southern/ western intersection (track to hold line)
Mount Isa Line: Amity Road crossing	300m	-
Mount Isa Line: Braceborough Road (west) crossing	25m	-
Mount Isa Line: Red Road crossing	35m	-
Mount Isa Line: Laidlow Crossing	35m	44m
Mount Isa Line: Lyons Creek Road crossing	142m	-
Mount Isa Line: Aramac Torrens Creek Road crossing	49m	-
Mount Isa Line: Cotonvale Road crossing	87m	-
Mount Isa Line: Prairie Road crossing	35m	-
Mount Isa Line: Kennedy Energy Park Access Track crossing	77m	-
Mount Isa Line: Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82) crossing	39m	-
Mount Isa Line: Thornhill Tamworth Road crossing	38m	-
Mount Isa Line: Marathon Stamford Road crossing	590m	-
Mount Isa Line: Barabon Terranburby Road crossing	735m	-
Mount Isa Line: Benean Road crossing	37m	-
Mount Isa Line: Pattel Drive crossing	-	390m
Mount Isa Line: Yorkshire Road crossing	136m	-

Crossing Name	Distance to northern/ eastern intersection (track to hold line)	Distance to southern/ western intersection (track to hold line)
Mount Isa Line: Julia Creek Kynuna Road crossing	70m	-
Mount Isa Line: Landsborough Highway crossing	470m	-
Mount Isa Line: Diamantina Developmental Road crossing	17m	164m

3.1.4 Locations and structures of interest

Table 32 details other locations or structures of interest that were identified during the site investigations. Locations or structures of interest typically are those which may require change of proposed routes or cause an increased risk for traffic generated by the project within the study area. They include bridges, school zones, tight curves and turns, cattle grids, floodways and roads with load limits or that are B-double exempt. Note that some locations and structures of interest may have been missed, particularly culverts and the like, due to them often being difficult to see whilst driving at higher speeds. A further assessment of loading of bridge structures (bridges and culverts) should be undertaken prior to the start of construction.

Table 32: Locations and structures of interest on SC roads

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
5	Bruce Highway	TMR	Culvert	-19.5873136	147.3979048
5	Bruce Highway	TMR	Culvert	-19.58951723	147.3976249
5	Bruce Highway	TMR	Culvert	-19.59213427	147.3972898
5	Bruce Highway	TMR	Culvert	-19.59869997	147.3940619
6	Ayr Dalbeg Road	TMR	Rail crossing	-19.63140201	147.3869371
6	Ayr Dalbeg Road	TMR	Bridge	-19.63785768	147.3814824
6	Ayr Dalbeg Road	TMR	Rail crossing	-19.66112424	147.3463815
6	Ayr Dalbeg Road	TMR	Culvert	-19.68473535	147.3294371
6	Ayr Dalbeg Road	TMR	Rail crossing	-19.70251313	147.2938815
6	Ayr Dalbeg Road	TMR	Rail crossing	-19.79334647	147.2336037
6	Ayr Dalbeg Road	TMR	Rail crossing	-19.81826225	147.2280706
7	Flinders Highway	TMR	Culvert	-19.52066279	146.8639072
7	Flinders Highway	TMR	Bridge	-19.54581416	146.8611026
7	Flinders Highway	TMR	Bridge	-19.4740045	146.8558436
7	Flinders Highway	TMR	Bridge	-19.43443916	146.8550866
7	Flinders Highway	TMR	Bridge	-19.31054361	146.8447707

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Bridge	-19.30950224	146.8446954
7	Flinders Highway	TMR	Bridge	-19.30257962	146.8426433
7	Flinders Highway	TMR	Bridge	-19.28738381	146.8412426
7	Flinders Highway	TMR	Culvert	-19.71600844	146.8410689
7	Flinders Highway	TMR	Bridge	-19.68767109	146.8408255
7	Flinders Highway	TMR	Culvert	-19.42166592	146.8402175
7	Flinders Highway	TMR	Culvert	-19.33589701	146.8399049
7	Flinders Highway	TMR	Bridge	-19.33614256	146.8395204
7	Flinders Highway	TMR	Culvert	-19.33651753	146.8388861
7	Flinders Highway	TMR	Culvert	-19.59699892	146.8376819
7	Flinders Highway	TMR	Culvert	-19.6428964	146.8365393
7	Flinders Highway	TMR	Culvert	-19.63364702	146.8365366
7	Flinders Highway	TMR	Culvert	-19.61153864	146.8365316
7	Flinders Highway	TMR	Culvert	-19.61374045	146.8365308
7	Flinders Highway	TMR	Bridge	-19.37314717	146.8358726
7	Flinders Highway	TMR	Bridge	-19.26992148	146.8357787
7	Flinders Highway	TMR	Culvert	-19.6529273	146.835214
7	Flinders Highway	TMR	Bridge	-19.75785216	146.8351776
7	Flinders Highway	TMR	Culvert	-19.67197301	146.8348542
7	Flinders Highway	TMR	Bridge	-19.34211958	146.8345503
7	Flinders Highway	TMR	Bridge	-19.65926716	146.8343126
7	Flinders Highway	TMR	Bridge	-19.34304654	146.8342551
7	Flinders Highway	TMR	Bridge	-19.39437264	146.8320273
7	Flinders Highway	TMR	Culvert	-19.3855823	146.830909
7	Flinders Highway	TMR	Culvert	-19.79671382	146.822751
7	Flinders Highway	TMR	Culvert	-19.8126923	146.814282
7	Flinders Highway	TMR	Bridge	-19.82202916	146.7902606
7	Flinders Highway	TMR	Bridge	-19.83584616	146.7261745
7	Flinders Highway	TMR	Culvert	-19.83459807	146.708141
7	Flinders Highway	TMR	Bridge	-19.83327088	146.7005461
7	Flinders Highway	TMR	Bridge	-19.83642017	146.6912286

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Culvert	-19.84157253	146.6863508
7	Flinders Highway	TMR	Culvert	-19.85177516	146.66636
7	Flinders Highway	TMR	Bridge	-19.87372452	146.6395536
7	Flinders Highway	TMR	Culvert	-19.88286122	146.6127942
7	Flinders Highway	TMR	Culvert	-19.90020913	146.5914483
7	Flinders Highway	TMR	Culvert	-19.90190777	146.5889255
7	Flinders Highway	TMR	Culvert	-19.93670918	146.5247936
7	Flinders Highway	TMR	Culvert	-19.9382547	146.5225906
7	Flinders Highway	TMR	Bridge	-19.96628459	146.4935478
7	Flinders Highway	TMR	Culvert	-19.97163145	146.4881404
7	Flinders Highway	TMR	Bridge	-19.99829519	146.4392386
7	Flinders Highway	TMR	Culvert	-20.00899413	146.4056305
7	Flinders Highway	TMR	Culvert	-20.01365419	146.3906826
7	Flinders Highway	TMR	Culvert	-20.02026176	146.3752709
7	Flinders Highway	TMR	Culvert	-20.024336	146.3670834
7	Flinders Highway	TMR	Culvert	-20.02618539	146.3634674
7	Flinders Highway	TMR	Culvert	-20.02701493	146.361855
7	Flinders Highway	TMR	Culvert	-20.03285932	146.3528096
7	Flinders Highway	TMR	Culvert	-20.04065583	146.3364858
7	Flinders Highway	TMR	Culvert	-20.04673178	146.3219544
7	Flinders Highway	TMR	Culvert	-20.05048716	146.3158446
7	Flinders Highway	TMR	Culvert	-20.05467453	146.310256
7	Flinders Highway	TMR	Bridge	-20.0593532	146.3034776
7	Flinders Highway	TMR	Culvert	-20.06340163	146.2950992
7	Flinders Highway	TMR	Culvert	-20.07096706	146.2771803
7	Flinders Highway	TMR	Bridge	-20.07399459	146.2771226
7	Flinders Highway	TMR	Culvert	-20.08839117	146.2627664
7	Flinders Highway	TMR	Culvert	-20.11279935	146.237485
7	Flinders Highway	TMR	Culvert	-20.11505999	146.2249467
7	Flinders Highway	TMR	Rail crossing	-20.12190621	146.1785086
7	Flinders Highway	TMR	Culvert	-20.12072491	146.1726039

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Culvert	-20.12576559	146.1417793
7	Flinders Highway	TMR	Culvert	-20.12827921	146.1338016
7	Flinders Highway	TMR	Culvert	-20.17461708	145.9921707
7	Flinders Highway	TMR	Bridge	-20.21473623	145.9124796
7	Flinders Highway	TMR	Culvert	-20.29334088	145.7657481
7	Flinders Highway	TMR	Culvert	-20.30703834	145.737959
7	Flinders Highway	TMR	Culvert	-20.31724366	145.7189407
7	Flinders Highway	TMR	Culvert	-20.32340419	145.7101181
7	Flinders Highway	TMR	Culvert	-20.3455088	145.6756737
7	Flinders Highway	TMR	Culvert	-20.35578733	145.6635762
7	Flinders Highway	TMR	Culvert	-20.35738854	145.6617166
7	Flinders Highway	TMR	Bridge	-20.35936324	145.6593376
7	Flinders Highway	TMR	School zone (Homestead State School - 60 zone (8am to 9am and 2:30pm to 3:30pm))	-20.36003924	145.6584766
7	Flinders Highway	TMR	Culvert	-20.36797054	145.6462182
7	Flinders Highway	TMR	Bridge	-20.39357425	145.6049604
7	Flinders Highway	TMR	Culvert	-20.40318364	145.5908469
7	Flinders Highway	TMR	Culvert	-20.41473141	145.5719257
7	Flinders Highway	TMR	Bridge	-20.43278625	145.5470556
7	Flinders Highway	TMR	Culvert	-20.43962507	145.5341779
7	Flinders Highway	TMR	Bridge	-20.44147816	145.5325158
7	Flinders Highway	TMR	Bridge	-20.45626875	145.5095199
7	Flinders Highway	TMR	Culvert	-20.4580112	145.5073903
7	Flinders Highway	TMR	Bridge	-20.47568825	145.4764846
7	Flinders Highway	TMR	Bridge	-20.51849526	145.4038935
7	Flinders Highway	TMR	Bridge	-20.58449386	145.3466765
7	Flinders Highway	TMR	Culvert	-20.63192346	145.3124558
7	Flinders Highway	TMR	Bridge	-20.64569127	145.2924766
7	Flinders Highway	TMR	Bridge	-20.71841227	145.2184186
7	Flinders Highway	TMR	Bridge	-20.76818102	145.0327662
7	Flinders Highway	TMR	Bridge	-20.8223237	144.8171786

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	School zone (Prairie State School - 40 zone (7am to 9am and 2pm to 4pm))	-20.87088731	144.6061855
7	Flinders Highway	TMR	Culvert	-20.8767069	144.4719753
7	Flinders Highway	TMR	Culvert	-20.87620971	144.46555
7	Flinders Highway	TMR	Culvert	-20.86973832	144.4008565
7	Flinders Highway	TMR	Culvert	-20.86923375	144.3957958
7	Flinders Highway	TMR	Rail crossing	-20.86573533	144.3201515
7	Flinders Highway	TMR	Culvert	-20.86759887	144.3185899
7	Flinders Highway	TMR	Culvert	-20.87142709	144.2947931
7	Flinders Highway	TMR	Culvert	-20.87209366	144.2913426
7	Flinders Highway	TMR	Rail crossing	-20.86299938	144.2032117
7	Flinders Highway	TMR	Rail crossing	-20.84657134	144.1998615
7	Flinders Highway	TMR	Culvert	-20.84282673	144.1948405
7	Flinders Highway	TMR	Culvert	-20.84088859	144.1773307
7	Flinders Highway	TMR	Culvert	-20.84827126	144.1575258
7	Flinders Highway	TMR	Culvert	-20.86735678	144.0087713
7	Flinders Highway	TMR	Culvert	-20.88021928	143.7678219
7	Flinders Highway	TMR	Bridge	-20.88164399	143.7624969
7	Flinders Highway	TMR	Bridge	-20.88232007	143.7609064
7	Flinders Highway	TMR	Culvert	-20.88354241	143.7554193
7	Flinders Highway	TMR	Culvert	-20.86492235	143.5947326
7	Flinders Highway	TMR	Bridge	-20.86393779	143.5863282
7	Flinders Highway	TMR	Bridge	-20.86383312	143.5854424
7	Flinders Highway	TMR	Culvert	-20.86008225	143.5534759
7	Flinders Highway	TMR	Culvert	-20.85393095	143.5010816
7	Flinders Highway	TMR	Culvert	-20.85080381	143.4745102
7	Flinders Highway	TMR	Bridge	-20.84289101	143.4443007
7	Flinders Highway	TMR	Culvert	-20.81490457	143.322801
7	Flinders Highway	TMR	School zone (Richmond State School - 40 zone (7am to 9am and 2pm to 4pm))	-20.7324174	143.1432664
7	Flinders Highway	TMR	Rail crossing	-20.73426597	143.1402458

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Bridge	-20.73840401	143.1203653
7	Flinders Highway	TMR	Bridge	-20.73904811	143.1189741
7	Flinders Highway	TMR	Culvert	-20.73001801	142.7758365
7	Flinders Highway	TMR	Culvert	-20.72989187	142.7691869
7	Flinders Highway	TMR	Culvert	-20.72978024	142.7679465
7	Flinders Highway	TMR	Culvert	-20.70611741	142.5546614
7	Flinders Highway	TMR	Culvert	-20.70469989	142.5524746
7	Flinders Highway	TMR	Culvert	-20.70054204	142.536978
7	Flinders Highway	TMR	Culvert	-20.70052182	142.5367868
7	Flinders Highway	TMR	Culvert	-20.69913352	142.5262072
7	Flinders Highway	TMR	Culvert	-20.69894436	142.5255245
7	Flinders Highway	TMR	Culvert	-20.68530682	142.4710762
7	Flinders Highway	TMR	Culvert	-20.67508167	142.1850278
7	Flinders Highway	TMR	Culvert	-20.67089619	142.1660142
7	Flinders Highway	TMR	Bridge	-20.67113873	142.1622011
7	Flinders Highway	TMR	Culvert	-20.65249648	141.8870443
7	Flinders Highway	TMR	Bridge	-20.65693286	141.7608431
7	Flinders Highway	TMR	Bridge	-20.65733486	141.7590965
7	Flinders Highway	TMR	Bridge	-20.65414717	141.543563
7	Flinders Highway	TMR	Culvert	-20.63830501	141.4443761
7	Flinders Highway	TMR	Culvert	-20.63980538	141.4421015
7	Flinders Highway	TMR	Bridge	-20.64035106	141.4412798
7	Flinders Highway	TMR	Bridge	-20.64092055	141.4404174
7	Flinders Highway	TMR	Culvert	-20.64700666	141.4312079
7	Flinders Highway	TMR	Bridge	-20.64741926	141.4305796
7	Flinders Highway	TMR	Culvert	-20.64772835	141.4301097
7	Flinders Highway	TMR	Culvert	-20.65125769	141.4245558
7	Flinders Highway	TMR	Bridge	-20.65185094	141.4233724
7	Flinders Highway	TMR	Culvert	-20.6523894	141.4222668
7	Flinders Highway	TMR	Culvert	-20.65264691	141.4217624
7	Flinders Highway	TMR	Bridge	-20.65297414	141.4210824

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Culvert	-20.65322193	141.4205724
7	Flinders Highway	TMR	Culvert	-20.62187007	141.3293628
7	Flinders Highway	TMR	Culvert	-20.62224298	141.3269049
7	Flinders Highway	TMR	Culvert	-20.62217402	141.29891
7	Flinders Highway	TMR	Culvert	-20.62783642	141.1749219
7	Flinders Highway	TMR	Culvert	-20.62770606	141.1721432
7	Flinders Highway	TMR	Bridge	-20.6274287	141.1662022
7	Flinders Highway	TMR	Culvert	-20.64962734	141.0891365
7	Flinders Highway	TMR	Bridge	-20.64981152	141.0837302
7	Flinders Highway	TMR	Bridge	-20.64981152	141.0837302
7	Flinders Highway	TMR	Culvert	-20.6498217	141.083245
7	Flinders Highway	TMR	Culvert	-20.63804399	140.9837015
7	Flinders Highway	TMR	Bridge	-20.63662407	140.959947
7	Flinders Highway	TMR	Bridge	-20.63728653	140.9467142
7	Flinders Highway	TMR	Bridge	-20.63734857	140.9452807
7	Flinders Highway	TMR	Culvert	-20.65992817	140.885327
7	Flinders Highway	TMR	Culvert	-20.66040565	140.8842952
7	Flinders Highway	TMR	Culvert	-20.66096303	140.8830916
7	Flinders Highway	TMR	Bridge	-20.66223253	140.8803382
7	Flinders Highway	TMR	Bridge	-20.66477767	140.874839
7	Flinders Highway	TMR	Culvert	-20.73858081	140.6864786
7	Flinders Highway	TMR	Culvert	-20.73714125	140.6797689
7	Flinders Highway	TMR	Culvert	-20.73766494	140.671732
7	Flinders Highway	TMR	Culvert	-20.73766755	140.6693389
7	Flinders Highway	TMR	Culvert	-20.73348926	140.6521946
7	Flinders Highway	TMR	Culvert	-20.73306533	140.6508284
7	Flinders Highway	TMR	Culvert	-20.72529265	140.627921
7	Flinders Highway	TMR	Culvert	-20.71667524	140.5696204
7	Flinders Highway	TMR	Culvert	-20.71300229	140.5524965
7	Flinders Highway	TMR	Culvert	-20.71130496	140.5403693
7	Flinders Highway	TMR	Culvert	-20.70704394	140.5157364

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
7	Flinders Highway	TMR	Rail crossing	-20.70700415	140.5108142
7	Flinders Highway	TMR	Road train restriction (Between Station Street and Isley Street from 6:00am to 10:00pm)	-20.70700355	140.5105952
7	Flinders Highway	TMR	Culvert	-20.70564282	140.5007483
7	Flinders Highway	TMR	Bridge	-20.70475434	140.4975991
8	Ayr Ravenswood Road	TMR	Rail crossing	-19.81873165	147.2276015
8	Ayr Ravenswood Road	TMR	Culvert	-19.81748489	147.2174621
8	Ayr Ravenswood Road	TMR	Culvert	-19.81411226	147.1947603
8	Ayr Ravenswood Road	TMR	Culvert	-19.80951406	147.1705543
8	Ayr Ravenswood Road	TMR	Rail crossing	-19.81056869	147.1677704
8	Ayr Ravenswood Road	TMR	Culvert	-19.81556869	147.1566593
8	Ayr Ravenswood Road	TMR	Cattle grid	-19.83279092	147.1399926
8	Ayr Ravenswood Road	TMR	Culvert	-19.83362425	147.1363815
8	Ayr Ravenswood Road	TMR	2x floodway	-19.85112425	147.1197148
8	Ayr Ravenswood Road	TMR	Cattle Grid	-19.8555687	147.118326
8	Ayr Ravenswood Road	TMR	Floodway	-19.86834647	147.1172149
8	Ayr Ravenswood Road	TMR	Cattle Grid	-19.89029092	147.113326
8	Ayr Ravenswood Road	TMR	Floodway	-19.91529092	147.0869371
8	Ayr Ravenswood Road	TMR	Floodway and power line crossing road	-19.92029092	147.0813815
8	Ayr Ravenswood Road	TMR	3 x floodway	-19.93001314	147.0574926
8	Ayr Ravenswood Road	TMR	Floodway	-19.93640203	147.0461037
8	Ayr Ravenswood Road	TMR	Cattle grid and floodway	-19.97251315	147.0113815
8	Ayr Ravenswood Road	TMR	Floodway	-19.9755687	147.0086037
8	Ayr Ravenswood Road	TMR	Floodway	-19.98029093	147.0044371
8	Ayr Ravenswood Road	TMR	Floodway	-19.98723537	146.9997149
8	Ayr Ravenswood Road	TMR	Floodway and speed reduced due to sharp turn	-20.00612426	146.9980482
8	Ayr Ravenswood Road	TMR	Floodway	-20.02640204	146.9838815
8	Ayr Ravenswood Road	TMR	3x floodways and powerline crossing road	-20.03251315	146.9730482
8	Ayr Ravenswood Road	TMR	Floodway and steep approach	-20.04056871	146.9588815

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
8	Ayr Ravenswood Road	TMR	Floodway and steep incline	-20.04362426	146.9522149
8	Ayr Ravenswood Road	TMR	Floodway	-20.04501315	146.9497149
8	Ayr Ravenswood Road	TMR	Floodway	-20.04667982	146.9427704
8	Ayr Ravenswood Road	TMR	Floodway	-20.04667982	146.9397149
8	Ayr Ravenswood Road	TMR	Floodway	-20.05279093	146.9319371
8	Ayr Ravenswood Road	TMR	Cattle grid	-20.07029093	146.9224926
8	Ayr Ravenswood Road	TMR	Cattle grid	-20.08473538	146.9111037
8	Ayr Ravenswood Road	TMR	Culvert	-20.0974377	146.8939032
8	Ayr Ravenswood Road	TMR	Culvert	-20.099861	146.8900324
8	Ayr Ravenswood Road	TMR	Bridge	-20.10010725	146.8891636
11	Burdekin Falls Dam Road	TMR	Bridge	-20.08347056	146.8577354
11	Burdekin Falls Dam Road	TMR	Cattle grid	-20.0769576	146.8480482
11	Burdekin Falls Dam Road	TMR	Bridge	-20.07204816	146.8417606
11	Burdekin Falls Dam Road	TMR	Cattle grid	-20.05556872	146.8174926
11	Burdekin Falls Dam Road	TMR	Cattle grid	-20.04612427	146.8141593
11	Burdekin Falls Dam Road	TMR	Bridge	-20.00037062	146.7703944
11	Burdekin Falls Dam Road	TMR	Cattle grid	-19.99917983	146.7583259
11	Burdekin Falls Dam Road	TMR	Bridge	-19.99800317	146.7558056
11	Burdekin Falls Dam Road	TMR	Bridge	-19.96051382	146.7177439
11	Burdekin Falls Dam Road	TMR	Floodway	-19.93917984	146.6963815
11	Burdekin Falls Dam Road	TMR	Bridge	-19.92917984	146.686937
11	Burdekin Falls Dam Road	TMR	Bridge	-19.92832217	146.6863946
11	Burdekin Falls Dam Road	TMR	Floodway	-19.92056873	146.6730482

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
15	Gregory Developmental Road (north)	TMR	Culvert	-20.06314141	146.2863032
26	Gregory Developmental Road (south)	TMR	Culvert	-20.14277918	146.2343837
26	Gregory Developmental Road (south)	TMR	Bridge	-20.16780817	146.2208744
26	Gregory Developmental Road (south)	TMR	Bridge	-20.1712062	146.2206446
26	Gregory Developmental Road (south)	TMR	Heavy vehicle stopover bays/ Inspection bays	-20.18167987	146.2177704
26	Gregory Developmental Road (south)	TMR	Culvert	-20.26147998	146.1816546
37	Aramac Torrens Creek Road	TMR	Railway crossing	-20.77188328	145.0147655
45	Kennedy Developmental Road (south)	TMR	School zone (Hughenden State School - 40 zone (8am to 9am and 2:30pm to 3:30pm))	-20.84500734	144.1978025
45	Kennedy Developmental Road (south)	TMR	Rail crossing	-20.85709034	144.1897965
54	Richmond Winton Road	TMR	Cattle grid	-20.74418041	143.1108754
54	Richmond Winton Road	TMR	Rail crossing	-20.74279118	143.1105479
54	Richmond Winton Road	TMR	Floodway	-20.78640229	143.1097146
54	Richmond Winton Road	TMR	Change of road condition to single lane	-20.79612441	143.1080484
54	Richmond Winton Road	TMR	Flood plain	-20.84806896	143.0811035
54	Richmond Winton Road	TMR	Change of road condition to single lane	-20.86223541	143.0761034
61	Julia Creek Kynuna Road	TMR	Cattle grid	-20.66806948	141.7447145

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
68	Landsborough Highway	TMR	Culvert	-20.79370057	140.755545
68	Landsborough Highway	TMR	Culvert	-20.77061656	140.7014242
68	Landsborough Highway	TMR	Culvert	-20.75607554	140.6704555
68	Landsborough Highway	TMR	Culvert	-20.74493548	140.6516306
68	Landsborough Highway	TMR	Culvert	-20.74012562	140.6420506
68	Landsborough Highway	TMR	Rail crossing and cattle grid	-20.73249954	140.6340902
68	Landsborough Highway	TMR	Culvert	-20.73145477	140.6332727
73	Barkly Highway	TMR	Road train restriction (Between Station Street and Isley Street from 6:00am to 10:00pm)	-20.70481855	140.4982422
73	Barkly Highway	TMR	Bridge	-20.70338339	140.4911692
73	Barkly Highway	TMR	Culvert	-20.70204319	140.4818538
73	Barkly Highway	TMR	Culvert	-20.7172416	140.4540339
73	Barkly Highway	TMR	Culvert	-20.71842375	140.4434173
73	Barkly Highway	TMR	Heavy vehicle rest area	-20.71768755	140.4073252
73	Barkly Highway	TMR	Bridge	-20.71758911	140.3468973
73	Barkly Highway	TMR	Culvert	-20.71830408	140.3002189
73	Barkly Highway	TMR	Culvert	-20.72172739	140.2965298
73	Barkly Highway	TMR	Culvert	-20.72501618	140.2949864
73	Barkly Highway	TMR	Culvert	-20.75755539	140.2332814
73	Barkly Highway	TMR	Culvert	-20.76308571	140.2076545
73	Barkly Highway	TMR	Culvert	-20.76780381	140.1957039
73	Barkly Highway	TMR	Culvert	-20.7680781	140.1922846
73	Barkly Highway	TMR	Culvert	-20.76986299	140.1729017
73	Barkly Highway	TMR	Culvert	-20.7715125	140.1699302
73	Barkly Highway	TMR	Culvert	-20.77277094	140.1662913
73	Barkly Highway	TMR	Culvert	-20.77290297	140.1610144
73	Barkly Highway	TMR	Culvert	-20.77645995	140.1458366

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
73	Barkly Highway	TMR	Culvert	-20.77788407	140.1359998
73	Barkly Highway	TMR	Culvert	-20.77994874	140.124857
73	Barkly Highway	TMR	Culvert	-20.78053733	140.122441
73	Barkly Highway	TMR	Bridge	-20.78179313	140.1147999
73	Barkly Highway	TMR	Culvert	-20.78871043	140.0803794
73	Barkly Highway	TMR	Culvert	-20.80045957	140.0694307
73	Barkly Highway	TMR	Culvert	-20.81902857	140.0586041
73	Barkly Highway	TMR	Culvert	-20.82535339	140.0352331
73	Barkly Highway	TMR	Culvert	-20.82381848	140.0282829
73	Barkly Highway	TMR	Culvert	-20.80365358	140.0013702
73	Barkly Highway	TMR	Bridge	-20.79557355	139.9818997
73	Barkly Highway	TMR	Culvert	-20.78076952	139.97288
73	Barkly Highway	TMR	Culvert	-20.76956772	139.9655279
73	Barkly Highway	TMR	Culvert	-20.76251599	139.9549532
73	Barkly Highway	TMR	Culvert	-20.75183842	139.932456
73	Barkly Highway	TMR	Culvert	-20.75569355	139.9250759
73	Barkly Highway	TMR	Culvert	-20.76108084	139.9130288
73	Barkly Highway	TMR	Culvert	-20.76138591	139.8957757
73	Barkly Highway	TMR	Culvert	-20.76270924	139.8808451
73	Barkly Highway	TMR	Culvert	-20.76331132	139.8698836
73	Barkly Highway	TMR	Culvert	-20.76483098	139.8655646
73	Barkly Highway	TMR	Culvert	-20.76318969	139.8610646
73	Barkly Highway	TMR	Culvert	-20.76138198	139.857741
73	Barkly Highway	TMR	Culvert	-20.76037639	139.8408746
73	Barkly Highway	TMR	Culvert	-20.7608118	139.8383626
73	Barkly Highway	TMR	Culvert	-20.75975476	139.8325209
73	Barkly Highway	TMR	Culvert	-20.72992399	139.8147024
73	Barkly Highway	TMR	Culvert	-20.72850201	139.8120598
73	Barkly Highway	TMR	Culvert	-20.72310967	139.8019369
73	Barkly Highway	TMR	Bridge	-20.71807675	139.7887065
73	Barkly Highway	TMR	Culvert	-20.71671741	139.7770964

Road ID	Road name	Road owner	Location/ structure type	Latitude	Longitude
73	Barkly Highway	TMR	Culvert	-20.71737339	139.7726197
73	Barkly Highway	TMR	Culvert	-20.71883012	139.761024
73	Barkly Highway	TMR	Culvert	-20.71826081	139.7487546
73	Barkly Highway	TMR	Culvert	-20.71758815	139.7360129
73	Barkly Highway	TMR	Culvert	-20.70525692	139.6959501
73	Barkly Highway	TMR	Culvert	-20.70188804	139.6805084
73	Barkly Highway	TMR	Bridge	-20.70403968	139.6508009
73	Barkly Highway	TMR	Culvert	-20.72362783	139.5203527
73	Barkly Highway	TMR	Bridge	-20.72410201	139.4896386
76	Burke Developmental Road	TMR	Culvert	-20.69671417	140.4869883
76	Burke Developmental Road	TMR	Culvert	-20.68118499	140.4852432
81	Mount Isa Duchess Road	TMR	Bridge	-20.75829372	139.4975964
83	Diamantina Developmental Road	TMR	Rail crossing	-20.7447626	139.4849911
83	Diamantina Developmental Road	TMR	Culvert	-20.75549175	139.4841194

It is expected that the vast majority of bridges and culverts on TMR roads would be sufficient for the project traffic. On roads which B-double trucks do not frequently use, all bridges, culverts and other items of interest should be inspected prior to project traffic travelling on them.

3.1.5 Crash history

Queensland Government's Queensland Globe has been utilised to investigate the most recent 10-year crash history (2013 to Mid-2021 – 2022 not available) along the Project route. All data along the Proposed route was downloaded and analysed and is presented below in Table 33.

Table 33: Crash history - most recent 10-year period

Location	Road owner	Roadway feature	Crash severity	Count	Prominent crash types
Townsville City Council					
Flinders Highway	TMR	Midblock	Fatal - 3 Hospitalisation - 29 Medical treatment - 10 Minor injury - 1	43	Off-path on curve - 7 Off-path on straight - 17 Vehicles from same direction - 5 Passenger and miscellaneous (Hit animal) - 5 Vehicles from opposing directions - 6
		Intersections	Hospitalisation - 10 Medical treatment - 5	15	Vehicles from same direction - 6
Townsville Port Road	TMR	Midblock	Fatal - 1 Hospitalisation - 13 Medical treatment - 3	17	Off-path on straight - 4 Vehicles manoeuvring - 6
		Intersections	Medical treatment - 1	1	
Burdekin Shire Council					
Bruce Highway	TMR	Midblock	Hospitalisation - 10 Medical treatment - 1 Minor injury - 1	12	Pedestrian - 1 Rear end - 6
		Intersections	Hospitalisation - 4 Medical treatment - 4	8	Vehicles from adjacent directions - 4
Ayr Dalbeg Road	TMR	Midblock	Fatal - 1 Hospitalisation - 2 Medical treatment - 3	6	
		Intersections	Medical treatment - 1	1	
Ayr Ravenswood Road	TMR	Midblock	Hospitalisation - 4 Medical treatment - 1 Minor injury - 1	6	
Charters Towers Regional Council					
Flinders Highway	TMR	Midblock	Fatal - 8 Hospitalisation - 50 Medical treatment - 24 Minor injury - 3	85	Pedestrian - 3 Off path on curve - 18 Off path on straight - 39
		Intersections	Hospitalisation - 7 Medical treatment - 4 Minor injury - 1	12	Vehicles from adjacent directions - 5

Location	Road owner	Roadway feature	Crash severity	Count	Prominent crash types
Burdekin Falls Dam Road	TMR	Midblock	Hospitalisation - 3 Medical treatment - 3	6	
		Intersections	Hospitalisation - 1	1	
Gregory Developmental Road (north)	TMR	Midblock	Hospitalisation - 1	1	
		Intersections	Hospitalisation - 6 Medical treatment - 3	9	Vehicles from adjacent directions - 8
Millchester Road	CTRC	Midblock	Hospitalisation - 2	2	
Broughton Road	CTRC	Midblock	Hospitalisation - 2	2	
Bluff Road	CTRC	Midblock	Fatal - 1 Hospitalisation - 1 Medical treatment - 1	3	
		Intersections	Hospitalisation - 1 Medical treatment - 1	2	
Gregory Developmental Road (south)	TMR	Midblock	Hospitalisation - 3 Medical treatment - 2	5	
Longton Road	CTRC	Midblock	Hospitalisation - 1	1	
Flinders Shire Council					
Flinders Highway	TMR	Midblock	Fatal - 1 Hospitalisation - 26 Medical treatment - 7 Minor injury - 1	35	Pedestrian - 1 Off path on straight - 26
Kennedy Developmental Road (south)	TMR	Midblock	Hospitalisation - 1	1	Pedestrian - 1
Richmond Shire Council					
Flinders Highway	TMR	Midblock	Hospitalisation - 7 Medical treatment - 1	8	Off path on straight - 8
		Intersection	Hospitalisation - 1 Medical treatment - 1	2	
		Intersection	Hospitalisation	1	
McKinlay Shire Council					
Flinders Highway	TMR	Midblock	Hospitalisation - 10 Medical treatment - 2 Minor injury - 1	13	Off path on curve - 4 Off path on straight - 7
		Intersection	Hospitalisation - 1	1	
McKinlay Gilliat Road	MSC	Midblock	Hospitalisation - 1	1	

Location	Road owner	Roadway feature	Crash severity	Count	Prominent crash types
Cloncurry Shire Council					
Flinders Highway	TMR	Midblock	Fatal - 1 Hospitalisation - 7 Medical treatment - 1	9	Off path on straight - 5
		Intersection	Hospitalisation - 3	3	
Landsborough Highway	TMR	Midblock	Fatal - 1 Hospitalisation - 1 Medical treatment - 1	3	
Andrew Daniels Drive	CSC	Intersection	Hospitalisation - 1	1	
Hensley Drive	CSC	Midblock	Minor injury - 1	1	
Burke Developmental Road	TMR	Intersection	Medical treatment - 1	1	
Barkly Highway	TMR	Midblock	Fatal - 5 Hospitalisation - 23 Medical treatment - 8 Minor injury - 1	37	Off path on curve - 9 Off path on straight - 17 Vehicles from opposing direction - 6
		Intersection	Medical treatment - 1	1	
Mount Isa City Council					
Barkly Highway	TMR	Midblock	Hospitalisation - 20 Medical treatment - 2 Minor injury - 2	24	Pedestrian - 1 Off path on curve - 4 Off path on straight - 11
		Intersection	Fatal - 2 Hospitalisation - 18 Medical treatment - 8 Minor injury - 1	29	Pedestrian - 2 Vehicles from adjacent directions - 21 Vehicles from opposing direction - 4
Mount Isa Duchess Road	TMR	Midblock	Fatal - 1 Hospitalisation - 8 Medical treatment - 3 Minor injury - 3	15	Pedestrian - 3 Manoeuvring - 7
		Intersection	Hospitalisation - 2 Medical treatment - 4 Minor injury - 3	9	Pedestrian - 2
Twenty Third Avenue	MICC	Midblock	Hospitalisation - 2 Medical treatment - 1	3	Pedestrian - 2
		Intersection	Hospitalisation - 3 Medical treatment - 2	5	Pedestrian - 1

Location	Road owner	Roadway feature	Crash severity	Count	Prominent crash types
Diamantina Developmental Road	TMR	Midblock	Medical treatment - 1	1	
		Intersection	Hospitalisation - 6 Medical treatment - 2	8	
Boulia Mount Isa Highway	TMR	Midblock	Hospitalisation - 2	2	

A total of 452 crashes were recorded along the Project route during the period from the start of 2013 to Mid-2021, of which 419 of these (as detailed in Table 33 above) occurred on SC roads.

A heat map of crashes along the Project route during the period is shown below in Figure 32.

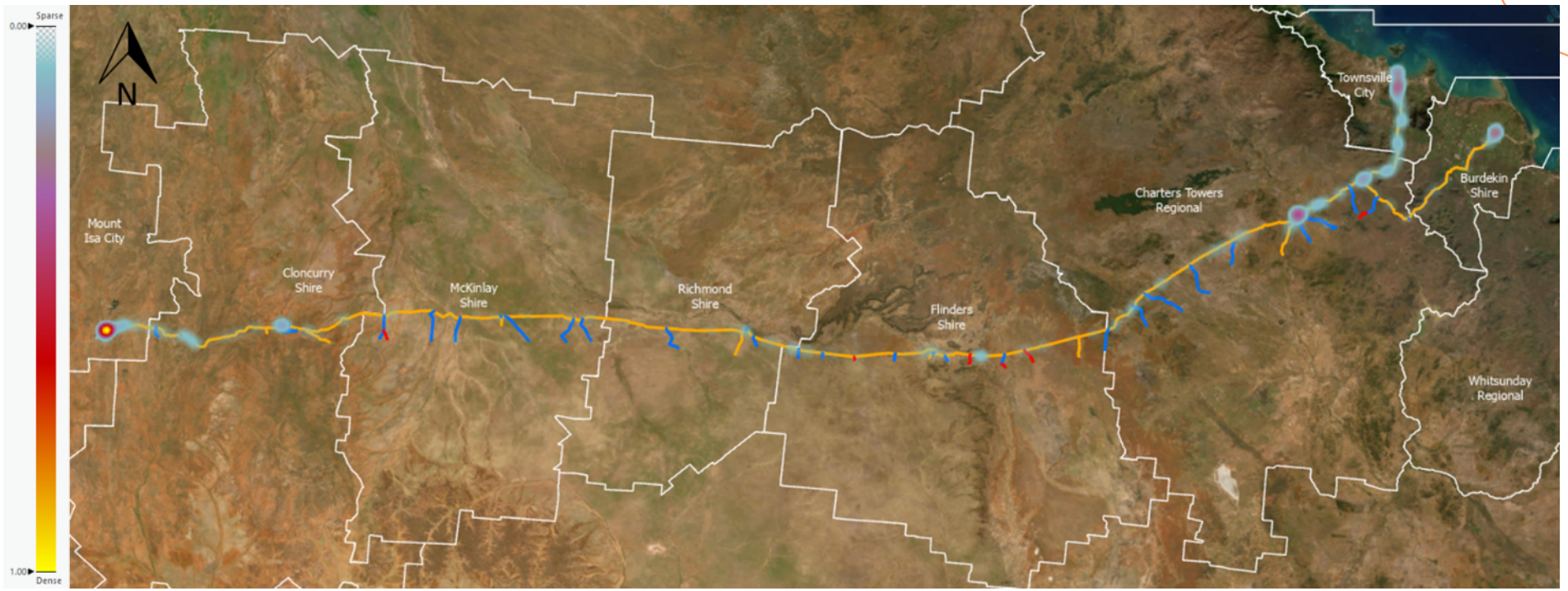


Figure 32: Crash history heat map

Crash patterns

Crashes by year

Shown below in Figure 33, crashes per year have generally stayed consistent, although there has been somewhat of a downturn since 2015. This may be due to recent improvements to the condition and safety of the Flinders and Barkly Highways in particular, the modernisation and thus improved safety of vehicles (noting the Queensland Government does not record crashes that result in property damage only) or several other factors, including weather, fluctuating traffic volumes and the like. Note that both SC roads and LGA roads have been included in this, and the below crash patterns.

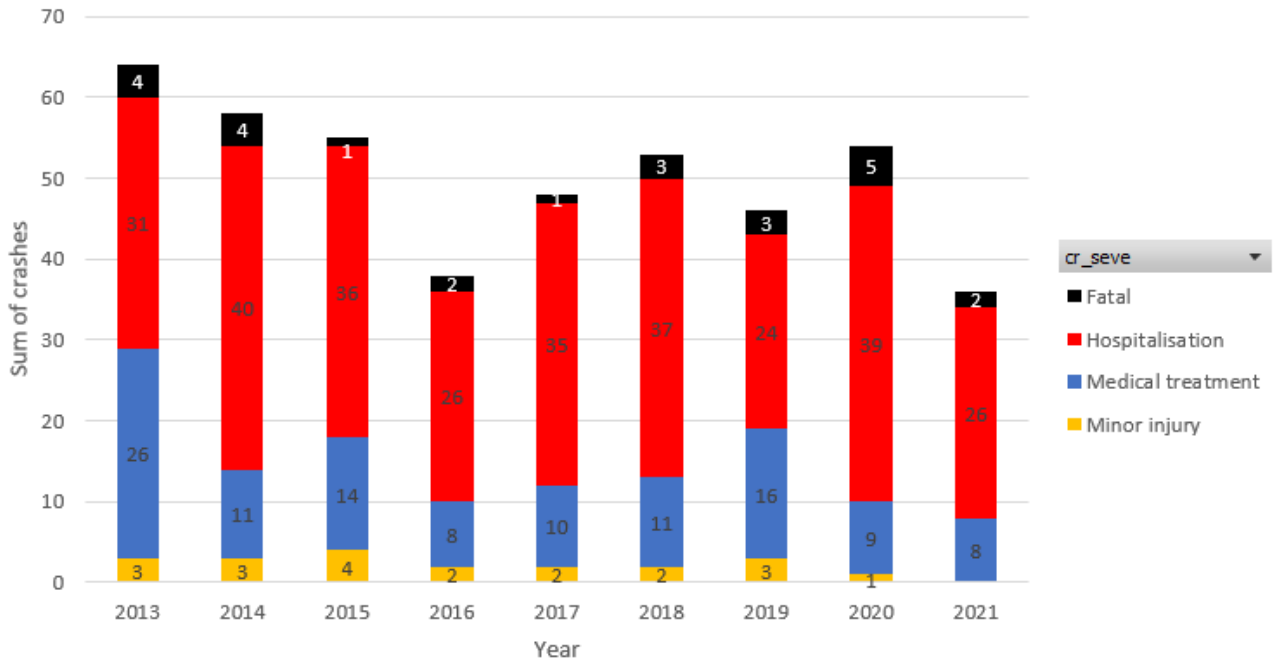


Figure 33: Crashes by year

Crashes by hour

The sum of crashes per hour during the period of analysis is shown below in Figure 34, and highlights that a greater number of crashes occurred during the morning and afternoon peak periods, during which more vehicles utilise the Project route.

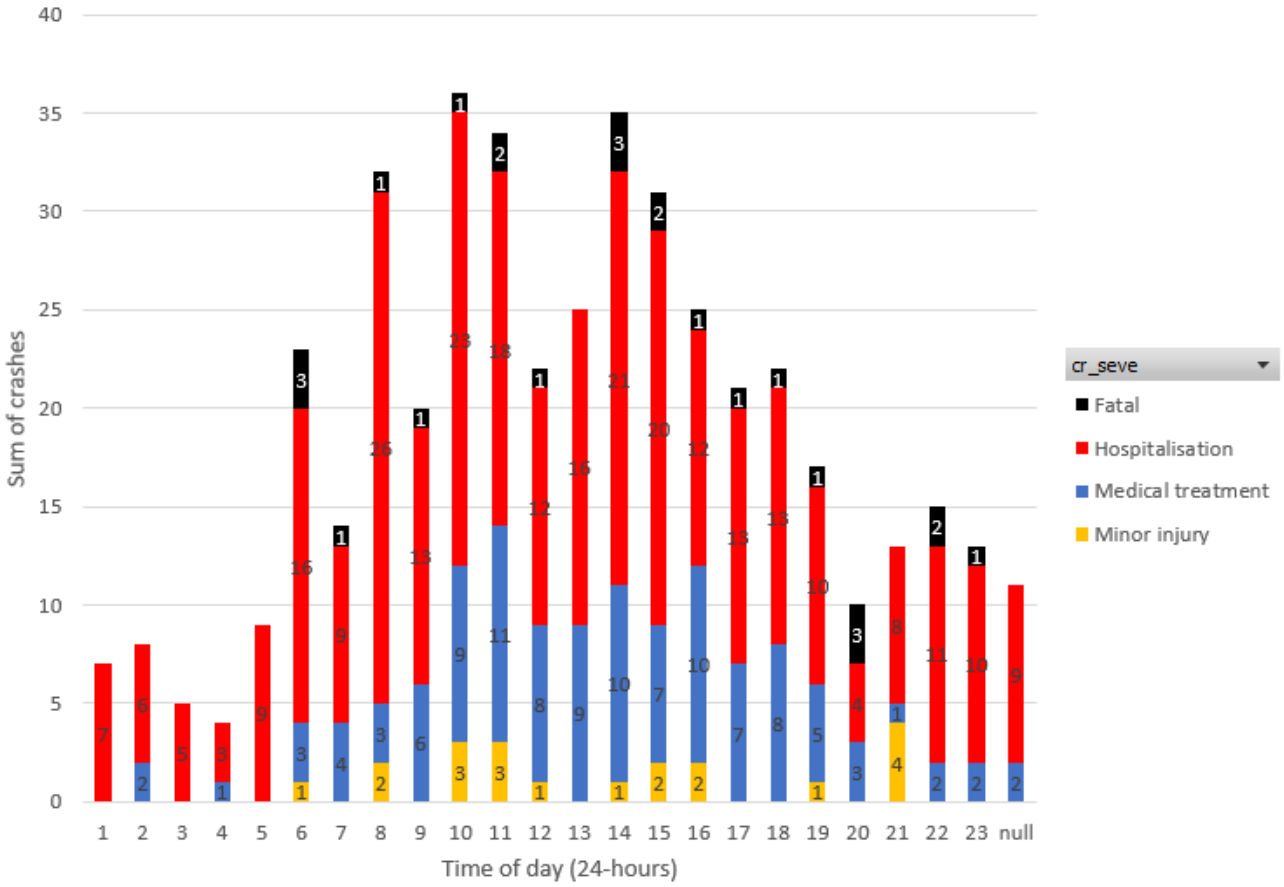


Figure 34: Crashes per hour

Types of crashes

The types of crashes that occurred along the Project route are shown below in Figure 35. As evidenced, the most frequent type of crash along the route is due to vehicles exiting the carriageway on straight sections of road, often hitting objects such as trees or road furniture. Other frequent crash types included off path on curve crashes, and vehicles from adjacent, opposite or the same direction, the latter of which is primarily comprised of rear-end crashes. A further breakdown of the types of crashes along the Project route during the most recent 10-year period is attached in Appendix B.

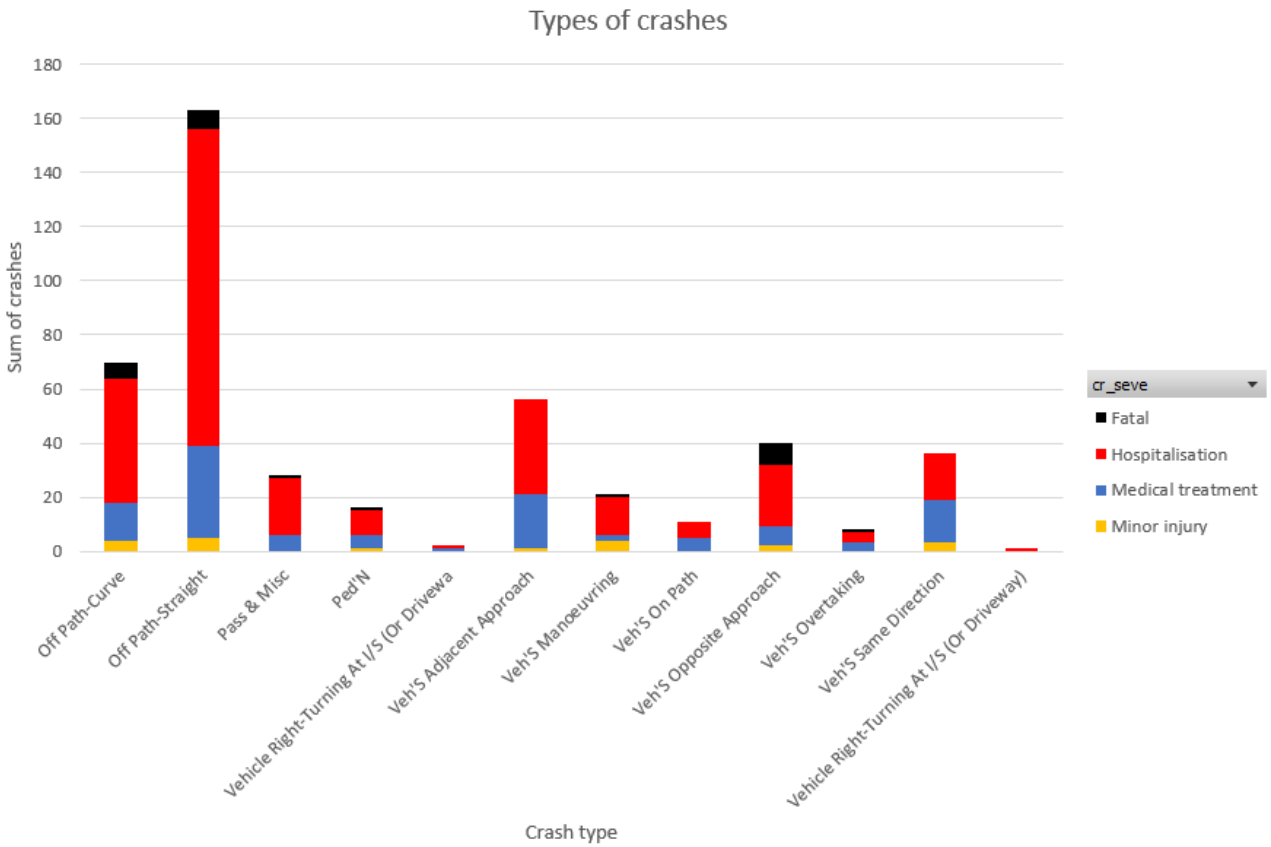


Figure 35: Crash types

Crash location

The location of crashes has furthermore been determined in relation to the feature of the road (i.e. whether the crash occurred at a midblock, intersection, bridge, etc.) and is shown below in Figure 36. As is evidenced, 76% of crashes occurred at midblocks and 24% occurred at intersections. The low number of crashes at intersections as compared to at midblocks is thought to be based on the rurality of the Project route and the low volumes of vehicle turning movements.

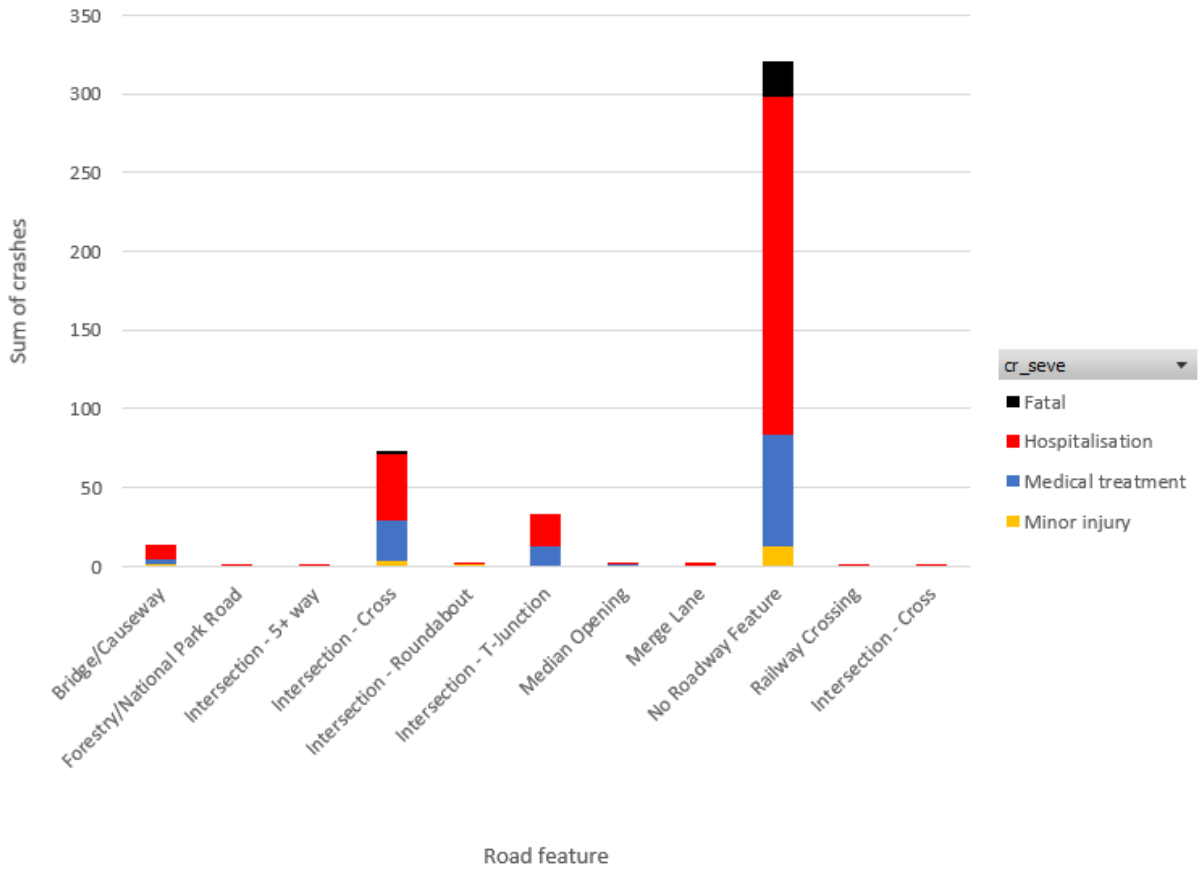


Figure 36: Crash location – road feature

Off path on curve crashes

Six off path on curve crashes were recorded within 2.5km on the horizontal curves east of Mingela, four of which resulted in hospitalisations, one required medical treatment to be administered at the scene and a further one resulted in minor injury. The crashes may be partly attributed to both the horizontal curves and relatively steep grade at this section of the Flinders Highway, as well as high vehicle speed and the presence of overtaking lanes.

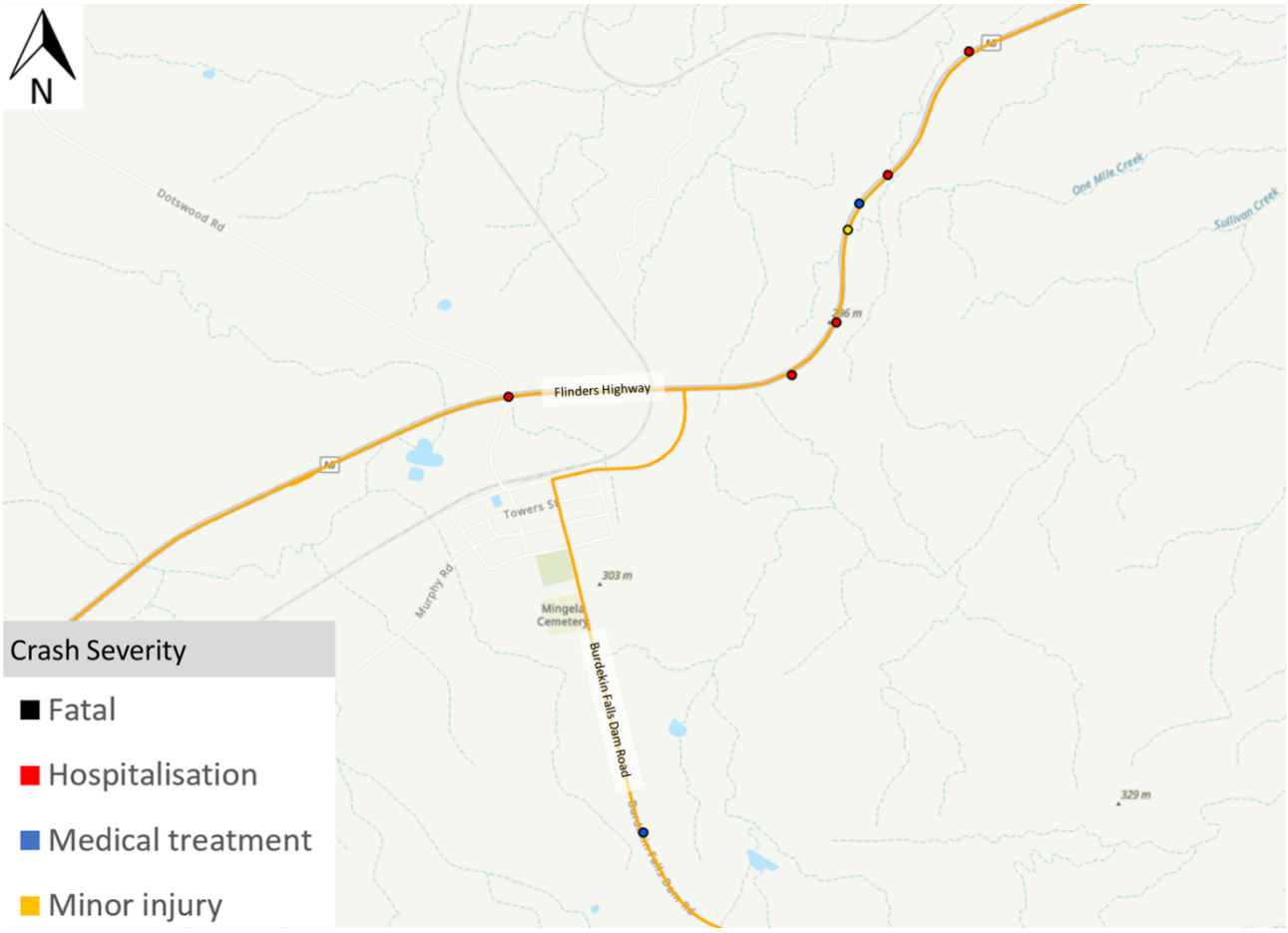


Figure 37: Off path on curve crashes – Mingela

Vehicles from adjacent approach crashes

Five vehicles from adjacent approaches crashes were recorded at the Gregory Developmental Road/ Prior Street/ Peek Street intersection during the most recent 10-year period, with one additional vehicles from opposite approaches crash having also occurred at the intersection. Three of the vehicles from adjacent approaches crashes resulted in hospitalisations and another two resulted in medical treatment needing to be administered.

Based on the intersection geometry, there are no obvious reasons for the high number of crashes, other than both Prior Street and Peek Street being the major road for intersections both to the north and south, thus potentially resulting in drivers on the minor roads assuming they have right of way. Due to the crash history, it was determined that Prior Street should not be utilised as part of the Project route. Vehicles will thus continue through on Gregory Developmental Road (north) along the Project route (shown in yellow (SC road) and blue (LGA road)).

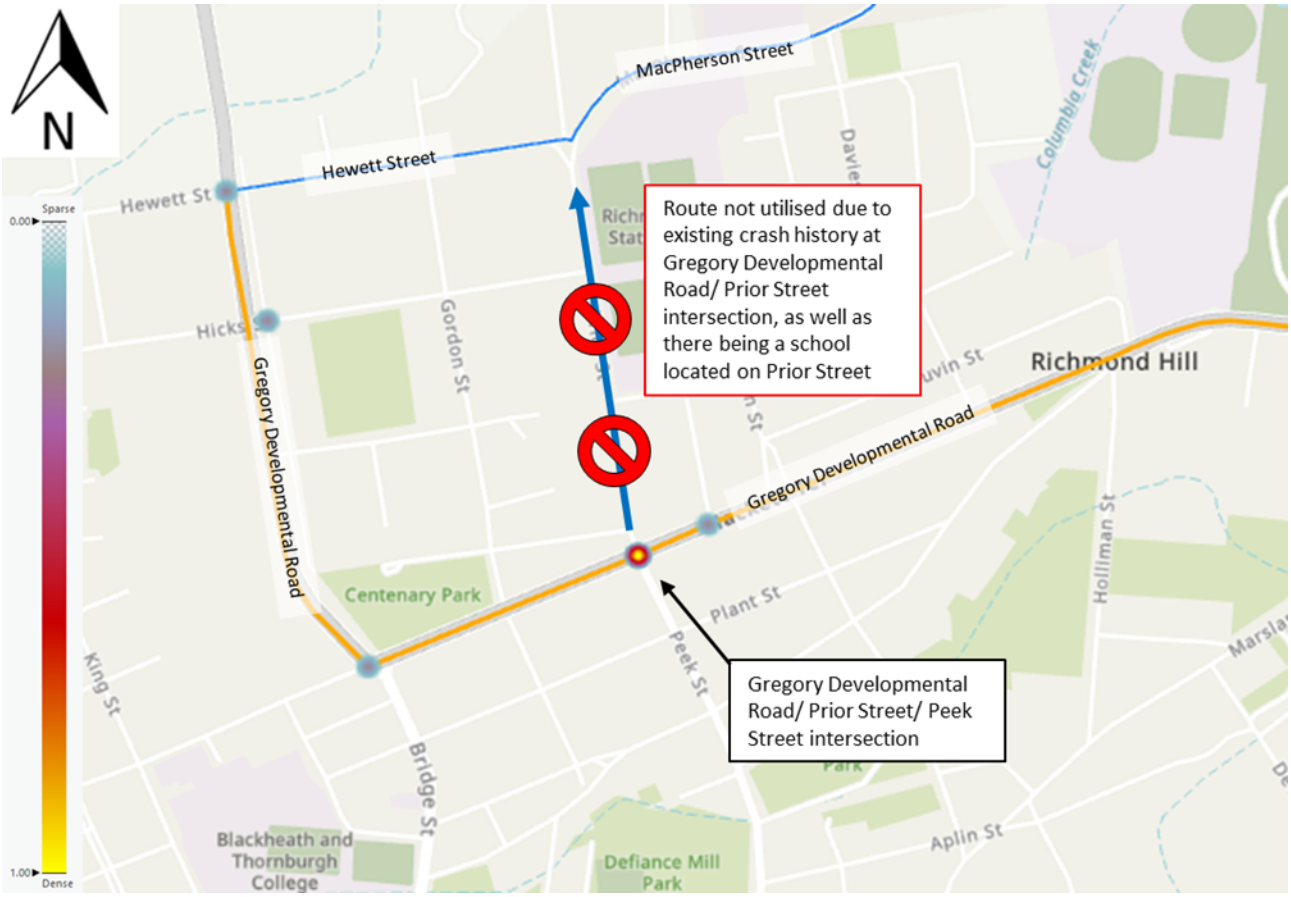


Figure 38: Vehicles from adjacent approach crashes – Gregory Developmental Road/ Prior Street/ Peek Street intersection

Pedestrian crashes

Eleven crashes involving pedestrians were recorded along the Project route in the centre of Mount Isa, five on Mount Isa Duchess Road, three on Twenty Third Avenue and three on the Barkly Highway. One crash at the Barkly Highway/ East Street intersection resulted in a fatality and occurred in daylight. A further eight crashes resulted in hospitalisations and two required medical treatment to be administered. The high number of pedestrian crashes highlights that there is friction in the movements of vehicles and pedestrians and the need to be vigilant when navigating these roads, particularly in the vicinity of schools, at which three of the crashes occurred.

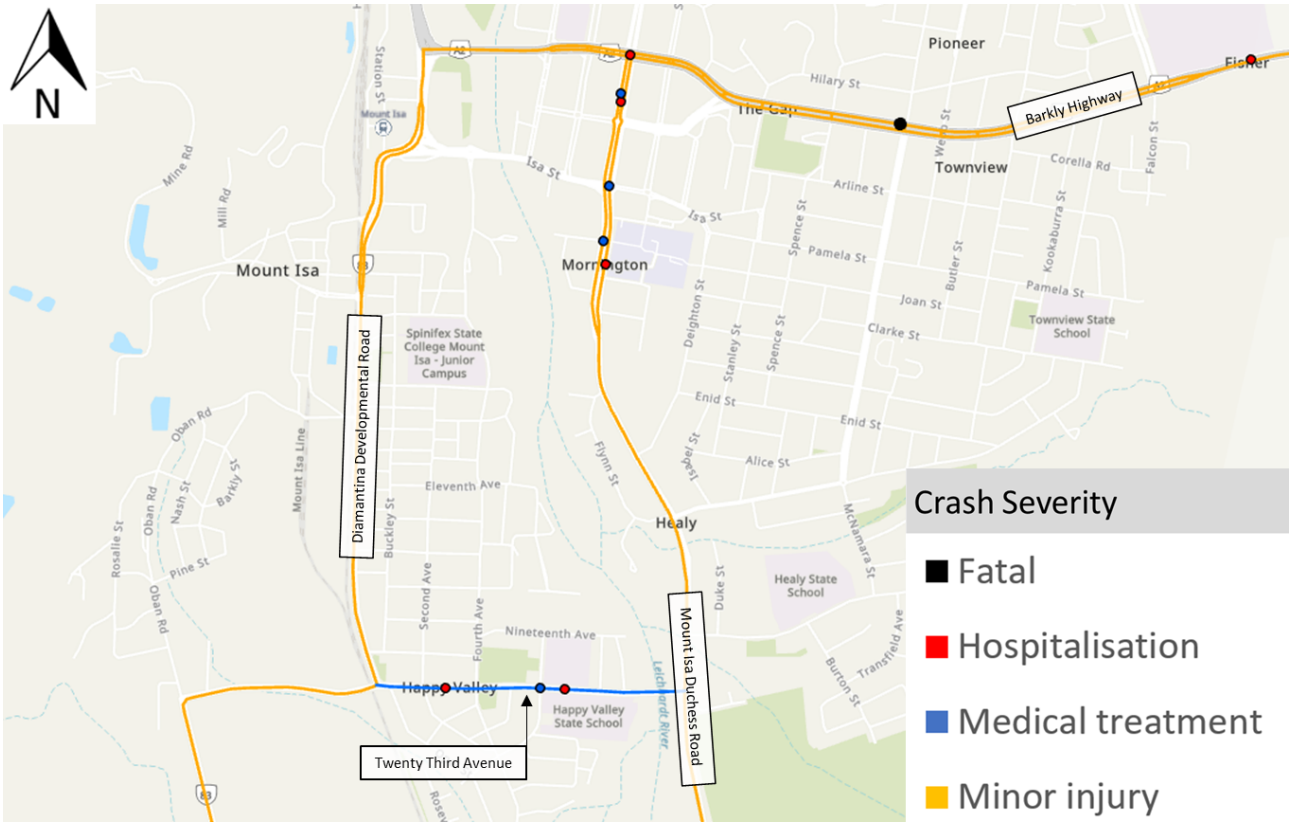


Figure 39: Pedestrian crashes - Mount Isa

Vehicles from same direction crashes

Seven vehicles from same direction crashes were recorded on the Bruce Highway south of Ayr, five of which resulted in hospitalisation and two required medical treatment to be administered at the scene. Such crashes are expected to be a result of the comparatively high level of vehicles that travel along this section of the Bruce Highway per day and do not represent an issue with the safety of the existing road infrastructure.

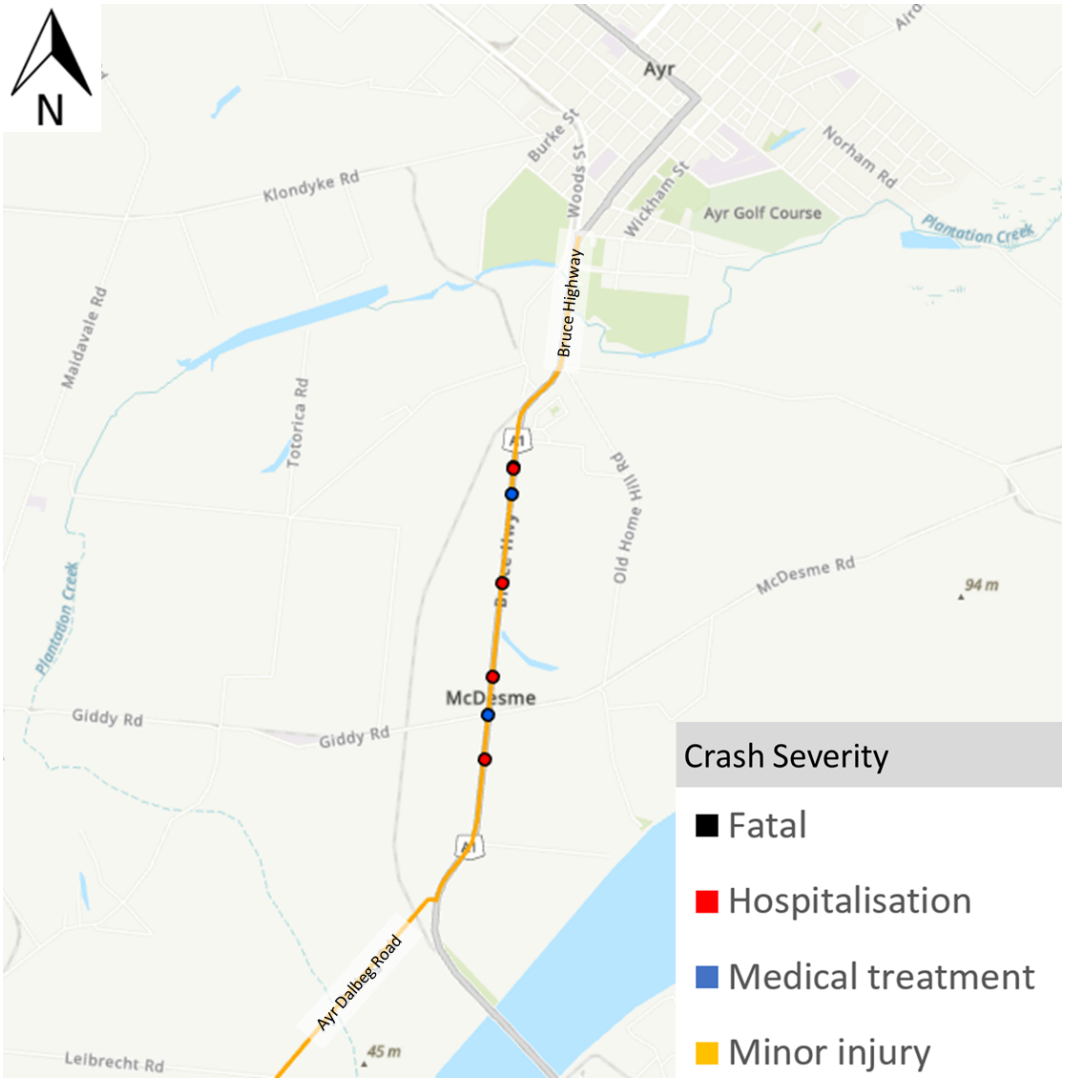


Figure 40: Vehicles from same direction crashes

Vehicles leaving driveway crashes

A total of 13 vehicles leaving driveway crashes were recorded along the Project route, of which five were recorded along Townsville Port Road and six were recorded along Mount Isa Duchess Road. The crashes on Townsville Port Road, which included one fatal crash and four crashes resulting in hospitalisations, are expected to have occurred whilst vehicles entered the road from the verge. Based on the sight distance, road geometry and speed limit on this section of Townsville Port Road, such a crash rate is considered unusual and likely a result of driver inattention or poor judgement rather than a specific infrastructure issue. The crashes along Mount Isa Duchess Road, which included three crashes which resulted in hospitalisation, one crash which required medical treatment to be administered and two crashes resulting in minor injuries, occurred both from vehicles exiting from 90-degree median parking and from the various off-street car parks along the road. Such crashes are not uncommon in urban areas with various conflicting movements.

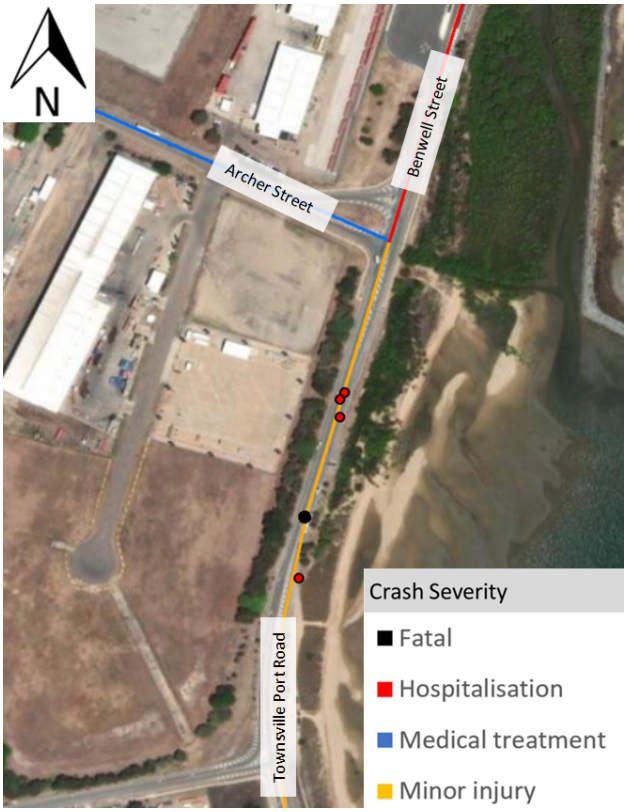


Figure 41: Vehicle leaving driveway crashes – Townsville Port Road

Figure 42: Vehicle leaving driveway crashes – Mount Isa Duchess Road

Speed zones

Crash severity is greatly influenced by the speed of vehicles. Figure 43 shows that along the Project route, fatal crashes primarily occurred in speed zones of 100 or 110km/h, although it was noted that crashes resulting in hospitalisations accounted for between 68 and 70% of all crashes in 60km/h, 80km/h and 100 to 110km/h speed zones, respectively. Note that the speed zone doesn't generally reflect the speed of collision, however it is expected that crashes occurring in higher speed zones would typically occur at greater speeds.

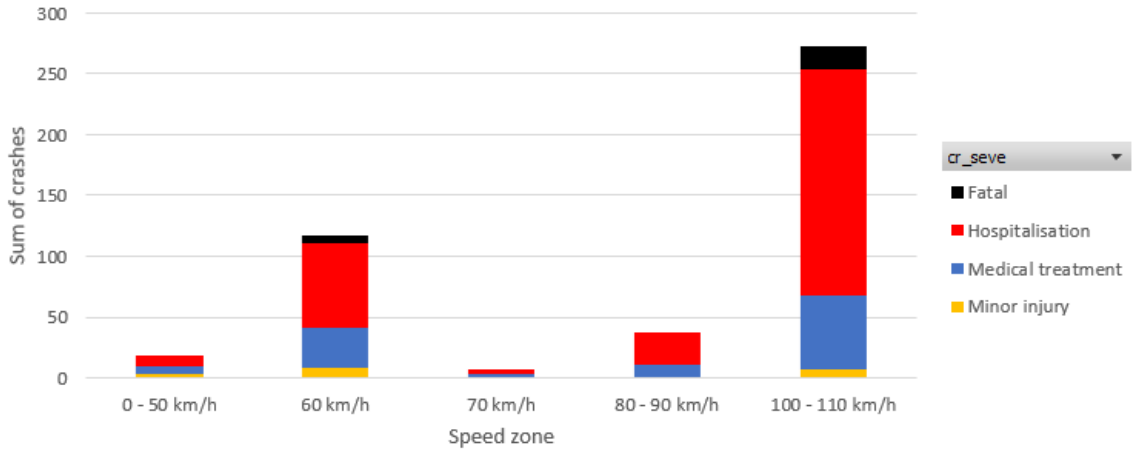


Figure 43: Crashes by speed zone

4. Proposed development traffic

4.1 Overview

Many different components of the CopperString 2032 project generate traffic onto the public road network. These include:

- Construction, operation and demobilisation of the worker camps
- Construction and operational maintenance of the transmission line; and
- Construction and operational maintenance of the substations.

The item that results in the highest traffic generation on the road network and has therefore been assessed in this report is shown in Table 34.

Table 34: Traffic generation project phases

Construction item	Construction phase traffic	Operational phase traffic
Camps		X
Transmission line	X	
Substations	X	

4.2 Camp operation traffic

4.2.1 Operational traffic information

Workforce

As discussed, there are 6 camps located along the CopperString 2032 project length. Each camp is proposed to house a maximum number of workers with those numbers differing from camp-to-camp dependent on the location of the next nearby camp and the number of transmission towers and substations in its designated area.

The maximum workforce for each camp is as follows:

- Charters Towers 210
- Pentland 300
- Hughenden 410
- Richmond 210
- Julia Creek 210; and
- Cloncurry 230.

It is noted that existing local accommodation will also be utilised at Townsville and Mount Isa.

Vehicle types and use

The following vehicle types would be generated by the camps:

- Light crew vehicles
- 12-seater minibuses (to take larger crews)
- Rigid crew trucks with equipment
- Rigid delivery trucks to take materials in and out of the camps
- Truck and dog vehicles to take materials in and out of the camps
- Semi-trailers to take materials in and out of the camps; and
- B-double trucks to take materials in and out of the camps.

Workforce movement and traffic routes

All movements in and out of the camps will take the most direct route to the nearest major highway (generally either the Flinders or Barkly Highway) and travel to their destination.

Generally, all workers will depart the camp in the morning peak hour (6:30am to 7:30am) and head to their worksite on the CopperString 2032 corridor; in the afternoon peak hour (5:30pm to 6:30pm) they will return to the camp. Deliveries occur periodically throughout the day.

More detailed information regarding the operation and traffic routes used by the camps can be found in the CopperString 2032 Camps TIAs (see Section 1.6 of this report for references to the CopperString 2032 Camps TIAs).

4.2.2 Camp traffic volumes

Table 35 shows the expected traffic volumes to be generated by each camp on the expected typical busiest day and Table 36 shows the expected traffic volumes to be generated by each camp during the peak hour of the expected typical busiest day.

It is noted that all traffic volumes stated in the traffic generation of the works are movements, i.e. if a vehicle travels in and out of the site that would generate two movements.

Table 35: Camp traffic generation – typical busiest day

Camp	General workforce traffic generation			Deliveries/ Removing Goods Traffic Generation		
	Light vehicles	Minibuses	Rigid trucks	Rigid trucks	Semi trailers/ truck and dog	B-doubles
Charters Towers	236	14	24	40	4	4
Pentland	236	30	24	40	4	4
Hughenden	310	40	32	40	4	4
Richmond	236	14	24	40	4	4
Julia Creek	236	14	24	40	4	4
Cloncurry	236	18	24	40	4	4

Table 36: Camp traffic generation – peak hour of typical busiest day

Camp	General workforce traffic generation			Deliveries/ Removing Goods Traffic Generation		
	Light vehicles	Minibuses	Rigid trucks	Rigid trucks	Semi trailers/ truck and dog	B-doubles
Charters Towers	118	7	12	4	-	-
Pentland	118	15	12	4	-	-
Hughenden	155	20	16	4	-	-
Richmond	118	7	12	4	-	-
Julia Creek	118	7	12	4	-	-
Cloncurry	118	9	12	4	-	-

4.3 Transmission lines

4.3.1 Construction traffic information

Construction activities

Construction of the transmission lines results in the following traffic generating activities:

- Site establishment (civil, earthworks)
- Tower foundation works
- Tower assembly and erection
- Line stringing
- Anti climbing device; and
- Rehabilitation.

Construction Vehicles

The following vehicle types would be generated during the construction works:

- Vehicles from the camps
- Water trucks
- Rigid delivery vehicles and semi-trailers and truck and dog vehicles for other materials (i.e. fill from quarries, waste removal, cages for foundations, concrete trucks etc.); and
- B-double trucks for delivery of the tower sections from Townsville.

Construction program

A detailed construction program is included in Appendix A.

The peak of construction around each camp or accommodation hub to the CopperString 2032 transmission line is expected to occur at the following times:

- Woodstock Apr 2025 - Feb 2027
- Charters Towers Nov 2024 - Sep 2026
- Pentland Aug 2024 - Jan 2026
- Hughenden Sept 2024 - Jul 2026
- Richmond May 2025 - Oct 2026
- Julia Creek Sept 2025 - May 2027
- Cloncurry Jun 2026 - Oct 2027; and
- Mount Isa Sep 2026 - Jan 2028.

It is noted that the construction program is still fluid at the time of publishing this report due to ongoing changes to the permanent design scope.

4.3.2 Construction traffic volumes

Table 37 shows the expected traffic volumes to be generated in a localised area of the CopperString 2032 construction on the expected typical busiest day and Table 38 shows the expected traffic volumes to be generated in a localised area of the CopperString 2032 construction during the peak hour of the expected typical busiest day. It is noted that during the peak hours the crews travel to/ from site, with deliveries occurring periodically throughout the day.

Table 37: Transmission line construction traffic volumes (localised area) – typical busiest day

Construction Item	**Workforce traffic generation from camps**			**Deliveries/ Removing Goods Traffic Generation**			
	Light vehicles	**Minibuses**	**Rigid trucks**	**Water trucks**	**Rigid trucks**	**Semi trailers/ truck and dog**	**B-doubles**
Site Establishment, Civil and Earthworks	8	4	2	10	30	8	
Foundation Works	4		2	10	10	2	
Tower Assembly and Erection	18 (assembly)	4 (assembly)	4 (assembly)	10	10		8
Line Stringing	24	6	4	10	10	6	
Anti Climbing Device	6				10	4	
Rehabilitation	4				10	4	

Table 38: Transmission line construction traffic volumes (localised area) – peak hour of typical busiest day

Construction Item	Workforce traffic generation from camps			Deliveries/ Removing Goods Traffic Generation			
	Light vehicles	Minibuses	Rigid trucks	Water trucks	Rigid trucks	Semi trailers/ truck and dog	B-doubles
Site Establishment, Civil and Earthworks	4	2	1				
Foundation Works	2		1				
Tower Assembly and Erection	9 (assembly)	2 (assembly)	2 (assembly)				
Line Stringing	12	3	2				
Anti Climbing Device	3						
Rehabilitation	2						

Overlap of construction stages

Based on the construction program, roads and access routes which access a large number of towers may carry traffic for multiple construction stages.

Generally, the site establishment works occur well before other construction stages. For roads and access points that access only a few towers, this stage is likely to generate the highest traffic volumes.

Between Woodstock and Hughenden, as the construction program is condensed, there is potential for foundation works, tower assembly and erection and line stringing to overlap on some roads.

Between Hughenden and Mount Isa, the construction program is less condensed, however there is still the potential for tower assembly and erection and line stringing to overlap on some roads.

Table 39 shows the overlap of crews on roads and at access points between Woodstock and Hughenden, dependent on the number of towers the road services.

Table 39: Overlap of construction phases – Woodstock to Hughenden

No of towers being serviced by a road or access point	No. of crews on typical peak day				
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device
1 tower	1				
5 towers	1				
10 towers		1	1		
20 towers		2	2		
50 towers		2	4	1	

Based on the above, between Woodstock and Hughenden, the number of vehicle movements generated by overlap of construction stages for a peak day and a peak hour are shown in Table 40 and Table 41.

Table 40: Construction traffic volumes on typical busiest day based on number of towers accessed – Woodstock to Hughenden

No of towers being serviced by a road or access point	No. of movements on typical peak day					
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device	TOTAL
1 tower	62					62
5 towers	62					62
10 towers		28	54			82
20 towers		56	108			164
50 towers		56	216	60		332

Table 41: Construction traffic volumes at peak hour of typical busiest day based on the number of towers accessed – Woodstock to Hughenden

No of towers being serviced by a road or access point	No. of movements on typical peak hour					
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device	TOTAL
1 tower	7					7
5 towers	7					7
10 towers		3	13			16
20 towers		6	26			32
50 towers		6	52	17		75

Table 42 shows the overlap of crews on roads and at access points, between Hughenden and Mount Isa, dependent on the number of towers it services.

Table 42: Overlap of construction phases – Hughenden to Mount Isa

No of towers being serviced by a road or access point	No. of crews on typical peak day				
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device
1 tower	1				
5 towers	1				
10 towers	1				
20 towers			2		
50 towers			4	1	

Based on the above, between Woodstock and Hughenden, the number of vehicle movements generated by overlap of construction stages for a peak day and a peak hour are shown in Table 43 and Table 44.

Table 43: Construction traffic volumes on typical busiest day based on the number of towers accessed – Hughenden to Mount Isa

No of towers being serviced by a road or access point	No. of movements on typical peak day					
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device	TOTAL
1 tower	62					62
5 towers	62					62
10 towers	62					62
20 towers			88			88
50 towers			176	60		236

Table 44: Construction traffic volumes at peak hour of typical busiest day based on the number of towers accessed – Hughenden to Mount Isa

No of towers being serviced by a road or access point	No. of movements on typical peak hour					
	Site Establishment, Civil and Earthworks	Foundation Works	Tower Assembly and Erection	Line Stringing	Anti Climbing Device	TOTAL
1 tower	7					7
5 towers	7					7
10 towers	7					7
20 towers			26			26
50 towers			52	17		69

4.4 Substations

4.4.1 Construction traffic information

Construction activities

Construction of the substations results in the following traffic generating activities:

- Site establishment (civil, earthworks)
- Platform construction
- Drainage, conduits and cable trench
- Earth grid
- Pavements
- Landscaping
- Civil
- Oil separator tank
- Helicopter pad
- Installation of modular buildings
- Common services building; and
- Electrical work.

Construction vehicles

The following vehicle types would be generated during the construction works

- Vehicles from the camps
- Rigid delivery vehicles and semi-trailers and truck and dog vehicles for other materials (i.e. fill from quarries, waste removal, concrete trucks etc.); and
- OSOM vehicles as required for delivery of over-sized sub-station and electrical equipment across the entire project for the modular buildings.

Construction program

A detailed construction program is included in Appendix A.

The construction timing for each substation is expected to be as follows, noting that the construction program is still fluid at the time of publishing this report:

- Mulgrave May 2024-Aug 2025
- Woodstock May 2024-Oct 2025
- Flinders Jun 2024-Mar 2026
- Dajarra Jun 2024-May 2026; and
- Mount Isa Oct 2024-Jul 2026.

4.4.2 Construction traffic volumes

Table 45 shows the expected traffic volumes to be generated by a substation on the expected typical busiest day and Table 46 shows the expected traffic volumes to be generated by a substation during the peak hour of the expected typical busiest day. It is noted that during the peak hours the crews travel to/ from site, with deliveries occurring periodically throughout the day.

Table 45: Substation construction traffic volumes (localised area) – typical busiest day

Construction Item	Workforce traffic generation from camps			Deliveries/ Removing Goods Traffic Generation			
	Light vehicles	Minibuses	Rigid trucks	Water trucks	Rigid trucks	Semi trailers/ truck and dog	B-doubles
Site Establishment	12		2		10		
Roadworks	12		2		10	4	
Platform	12		2		10	12	
Drainage, Conduits and Cable trench	12		2		10		
Earth Grid	12		2		10		
Pavements	12		2		10	6	
Landscaping	12		2		10	2	
Civil	12		2		10	4	
Oil separator tank	12		2		10	4	
Helicopter pad	12		2		10	4	
Installation of modular buildings	12		2		10	4	
Common Services Building	12		2		10	4	
Electrical work	8-16 (wiring)		2-4 (wiring)		10	4	

Table 46: Substation construction traffic volumes (localised area) – peak hour of typical busiest day

Construction Item	Workforce traffic generation from camps			Deliveries/ Removing Goods Traffic Generation			
	Light vehicles	Minibuses	Rigid trucks	Water trucks	Rigid trucks	Semi trailers/ truck and dog	B-doubles
Site Establishment	6		1		5		
Roadworks	6		1		5	2	
Platform	6		1		5	6	
Drainage, Conduits and Cable trench	6		1		5		
Earth Grid	6		1		5		
Pavements	6		1		5	3	
Landscaping	6		1		5	1	
Civil	6		1		5	2	
Oil seperator tank	6		1		5	2	
Helicopter pad	6		1		5	2	
Installation of modular buildings	6		1		5	2	
Common Services Building	6		1		5	2	
Electrical work	4-8 (wiring)		1-2 (wiring)		5	2	

4.5 Overall traffic generation to roads

Based on the assessment above, the expected traffic generation to each road during the busiest period of construction for that road is shown in Table 47. The table specifies the highest daily and peak hourly traffic generation, the period in which the volumes are expected to peak and the activities that result in the highest traffic generation to that road.

Table 47: Traffic generation to public roads

Road ID	Road	Expected highest daily traffic generation	Expected highest peak hour traffic generation	Expected busiest period	Activity/ies resulting in highest traffic generation
4	Townsville Port Road	<50	<10	Jun 2024-Sep 2028 (construction duration)	Transport of large items from Townsville Port to camps and transmission line
5	Bruce Highway	<50	<10	Jun 2024-Sep 2028 (construction duration)	Transport of large items from Townsville Port to camps and transmission line
6	Ayr Dalbeg Road	<50	<10	Jun 2024-Sep 2028 (construction duration)	Transport of large items from Townsville Port to camps and transmission line
7	Flinders Highway	Varies – up to 500	Varies – up to 200	Jun 2024-Sep 2028 (construction duration)	Overlap of: • Transport of large items from Townsville Port to camps and transmission line • Transmission line construction • Substation construction; and • Movements to/ from camps.
8	Ayr Ravenswood Road	90	39	Nov 2025-Jun 2026	Overlap of: • Foundation works • Tower Assembly and Erection; and • Line stringing.

Road ID	Road	Expected highest daily traffic generation	Expected highest peak hour traffic generation	Expected busiest period	Activity/ies resulting in highest traffic generation
11	Burdekin Falls Dam Road	1194	231	Nov 2025-Jun 2026	Overlap of: • Foundation works; and • Tower Assembly and Erection.
15	Gregory Developmental Road (north)	322	141	Nov 2025-Jun 2026	Charters Towers camp operational traffic
26	Gregory Developmental Road (south)	436	107	Nov 2025-Jun 2026	Overlap of: • Foundation works • Tower Assembly and Erection; and • Line stringing.
37	Aramac Torrens Creek Road	354	82	Jun-Oct 2025	Overlap of: • Foundation works • Tower Assembly and Erection; and • Line stringing.
45	Kennedy Developmental Road (south)	252	55	Apr-Jun 2026	Overlap of: • Foundation works; and • Tower Assembly and Erection.
54	Richmond Winton Road	324	95	May-Aug 2026	Overlap of: • Tower Assembly and Erection; and • Line stringing.
61	Julia Creek Kynuna Road	236	76	Oct 2026	Tower Assembly and Erection
68	Landsborough Highway	460	68	Jun-Jul 2026	Site establishment, civil and earthworks

Road ID	Road	Expected highest daily traffic generation	Expected highest peak hour traffic generation	Expected busiest period	Activity/ies resulting in highest traffic generation
73	Barkly Highway	Varies – up to 500	Varies – up to 150	Jun 2024-Sep 2028 (construction duration)	Overlap of: • Transport of large items from Townsville Port to camps and transmission line • Transmission line construction • Substation construction; and • Movements to/ from camps.
76	Burke Developmental Road	326	143	Jul 2026-Oct 2027	Cloncurry camp operational traffic
78	Cloncurry Duchess Road	248	47	Mar-Apr 2027	Tower Assembly and Erection
81	Mount Isa Duchess Road	186	21	Oct 2026	Site establishment, civil and earthworks
83	Diamantina Developmental Road	160	28	Oct 2026	Site establishment, civil and earthworks
87	Boulia Mount Isa Highway	62	7	Oct 2026	Site establishment, civil and earthworks

5. Traffic and Road Impact Assessment

The Traffic and Road Impact Assessment focuses on the construction phase of the CopperString 2032 (camps under operation) which will generate the highest volumes of traffic.

5.1 Road Operation Assessment (road width)

5.1.1 Issues and potential impacts

At midblocks

The traffic capacity for each road against the normal design domain (NDD) and extended design domain (EDD) has been calculated using the road capacity tables in Section 2.2.5 of this report. Table 48 discusses the existing traffic volumes and proposed CopperString 2032 traffic volumes for any road that is non-compliant.

Table 48 details the extent of the road which is narrower than as required by the EDD.

Table 48: Road width assessment

Road ID	Road Name	Road width (typical)	Shoulder width (typical)	Existing traffic volume (vpd)	Expected project generated traffic volume (vpd)	Complies with NDD	Complies with EDD	Reason non-compliant
4	Townsville Port Road	7.0m	No shoulder provided	3,992 (Townsville Port Road/ Archer Street intersection)	<50	No	No	No shoulder
5	Bruce Highway	7.2m	0.5m	13,486 (Ayr)	<50	No	No	Shoulder too narrow
6	Ayr Dalbeg Road	Variable - 6.0 to 8.0m	0.0 to 0.2m	965 (Mona Park) 445 (Clare)	<50	No	No	Carriageway and shoulder too narrow
7	Flinders Highway	7.0m	1.0m	6,505 (Roseneath) 2,964 (Charters Towers) 633 (Torrens Creek) 390 (Julia Creek)	Varies – up to 500	No (at Eastern end)	Yes	-
8	Ayr Ravenswood Road	Variable - 4.2 to 10.5m	0.0 to 0.3m	150 (Clare) 48 (Mulgrave) 286 (Ravenswood)	90	No	No	Carriageway and shoulder too narrow
11	Burdekin Falls Dam Road	Variable - 6.0 to 8.5m	No shoulder provided	205 (at Mingela)	1194	No	No	Carriageway too narrow and no shoulder
15	Gregory Developmental Road (north)	7.0m	0.6m or greater	3,021 (0.1km north Hackett Terrace)	322	No	No	Narrow shoulder in sections
26	Gregory Developmental Road (south)	6.7 to 7.0m	0.0m to 1.3m	992	436	In areas	In areas	Carriageway and shoulder too narrow
37	Aramac Torrens Creek Road	7.8 to 8.1m wide	No shoulder provided	164	354	No	No	No shoulder

Road ID	Road Name	Road width (typical)	Shoulder width (typical)	Existing traffic volume (vpd)	Expected project generated traffic volume (vpd)	Complies with NDD	Complies with EDD	Reason non-compliant
45	Kennedy Developmental Road (south)	6.4 to 7.6m	Typically no shoulder provided, >6m shoulder at Hughenden	926 (Hughenden) 177 (16.2km south-east of Kennedy Developmental Road (south)/ Disraeli Street intersection)	252	No (excl. Hughenden)	No (excl. Hughenden)	No shoulder
54	Richmond Winton Road	Variable - 2.9 to 4.7m	No shoulder provided	58	324	No	No	Carriageway too narrow and no shoulder provided
61	Julia Creek Kynuna Road	Variable - 3.7 to 5.4m	No shoulder provided	63	236	No	No	Carriageway too narrow and no shoulder provided
68	Landsborough Highway	7.0 to 7.2m	0.2 to 0.5m	439	460	No	No	Shoulder too narrow
73	Barkly Highway	7.0 to 8.2m	1.0m	1,533 (Cloncurry) 1,112 (0.3km east of Barkly Highway/ Breakaway Drive intersection) 4,167 (Mount Isa)	Varies – up to 500	Yes	Yes	-
76	Burke Developmental Road	7.0 to 7.2m	0.3m	341	326	No	No	Shoulder too narrow
78	Cloncurry Duchess Road	6.0 to 6.5m	No shoulder provided	87	248	No	No	No shoulder

Road ID	Road Name	Road width (typical)	Shoulder width (typical)	Existing traffic volume (vpd)	Expected project generated traffic volume (vpd)	Complies with NDD	Complies with EDD	Reason non-compliant
81	Mount Isa Duchess Road	Variable - Typically 6.2 to 8.8m south of Mount Isa CBD	No shoulder provided south of Mount Isa CBD	7,298 (Mount Isa) 378 (1.4km south of Mount Isa Duchess Road/ Twenty Third Avenue intersection)	186	No	No	No shoulder
83	Diamantina Developmental Road	6.0 to 7.0m	No shoulder provided	3094 - 1.2km south of Barkly Highway 609 - 3.5km south of Barkly Highway	160	No	No	No shoulder
87	Boulia Mount Isa Highway	8.0m	No shoulder provided	206	62	No	No	No shoulder

Based on the above assessment, 17 roads do not currently comply with the TMR EDD requirements. As discussed, each of these roads has been further assessed as shown in Table 49 with the roads either being recommended for mitigation or justification as to why the current width of the road is considered suitable has been provided.

Table 49: Road width suitability assessment

Road ID	Road Name	Suitability Assessment	Mitigation required	Length of road where mitigation is required
4	Townsville Port Road	Road considered suitable without mitigation due to the following: • 7.0m road carriageway; and • B-double approved at all times, road train approved overnight.	No	-
5	Bruce Highway	Road considered suitable without mitigation due to the following: • Minor shoulder width non compliance • 7.2m road carriageway; and • Higher Mass Limit (HML) approved.	No	-
6	Ayr Dalbeg Road	Road considered suitable without mitigation as it is B-double approved for its entire length except for 3km between Granshaw Road and Lincoln Road in which the road has a consistent width and condition.	No	-
8	Ayr Ravenswood Road	Road not considered suitable without mitigation	Yes See section 5.1.3.	Up to 13km
11	Burdekin Falls Dam Road	Although type 2 road train approved, the additional volumes and road width result in the road not being considered suitable without mitigation.	Yes See section 5.1.3.	Up to 17km
15	Gregory Developmental Road (north)	Road considered suitable without mitigation due to the following: • Minor shoulder width non compliance in some sections only • 7.0m road carriageway; and • Type 2 road train approved.	No	-
26	Gregory Developmental Road (south)	Road considered suitable without mitigation due to the following: • Minor shoulder width non compliance in some sections only • 7.0m road carriageway or close; and • Type 2 road train approved.	No	-
37	Aramac Torrens Creek Road	Road considered suitable without mitigation due to the following: • 7.0m road carriageway; and • Type 2 road train approved.	No	-
45	Kennedy Developmental Road (south)	Road considered suitable without mitigation due to the following: • 7.0m road carriageway or close; and • Type 2 road train approved.	No	-

Road ID	Road Name	Suitability Assessment	Mitigation required	Length of road where mitigation is required
54	Richmond Winton Road	Although type 2 road train approved, the additional volumes and road width result in the road not being considered suitable without mitigation.	Yes See section 5.1.3.	Up to 15.4km
61	Julia Creek Kynuna Road	Although type 2 road train approved, the additional volumes and road width result in the road not being considered suitable without mitigation.	Yes See section 5.1.3.	Up to 4.9km
68	Landsborough Highway	Road considered suitable without mitigation due to the following: • Minor shoulder width non compliance • 7.0-7.2m road carriageway; and • Type 2 road train approved.	No	-
76	Burke Developmental Road	Road considered suitable without mitigation due to the following: • Minor shoulder width non compliance • 7.0-7.2m road carriageway; and • Type 2 road train approved.	No	-
78	Cloncurry Duchess Road	Road considered suitable without mitigation as it is type 2 road train and expected traffic volumes from construction are not overly high.	No	-
81	Mount Isa Duchess Road	Road considered suitable without mitigation as it is type 2 road train approved and expected traffic volumes from construction are not overly high.	No	-
83	Diamantina Developmental Road	Road considered suitable without mitigation as it is type 2 road train approved and expected traffic volumes from construction are not overly high.	No	-
87	Boulia Mount Isa Highway	Road considered suitable without mitigation due to the following: • 8m road carriageway; and • Type 2 road train approved.	No	-

Based on the further assessment, there are 4 SC roads which require mitigation to accommodate the expected construction vehicles.

Around sharp bends

Swept paths have been prepared on aerial imagery for several tight bends on Ayr Ravenswood Road and are included in Appendix C.

It is noted that the swept paths are indicative as they have been completed on aerial imagery and the accuracy could be in the order of 0.5m. The swept paths have been completed to indicate corners where trucks may require a wider lane than straighter sections of the road.

Two scenarios have been checked:

- 26m B-double and 8.8m service vehicle – likely conflict that will occur regularly; and
- 26m B-double and 25m low loader – worst-case conflict that could possibly occur.

It is noted that a 25m low loader has been run instead of a 19m semi-trailer as a worst-case scenario as they are similar vehicles.

Table 50shows each of the sharp bends where swept paths were checked, the vehicle type and whether the bend is suitable or may require mitigation.

Table 50: Swept path assessment around sharp bends – Ayr Ravenswood Road

Swept Path Plan	Bend Number	Vehicle 1	Vehicle 2	Does bend accommodate both vehicles	Mitigation required
Sheet 1 to 4	1 – 11.9km east of Burdekin Dam Falls Road	B-double truck/ 25m low loader	8.8m service vehicle	No	Yes See section 5.1.3
	2 – 11.6km east of Burdekin Dam Falls Road			Yes	No
	3 – 10.3km east of Burdekin Dam Falls Road			Yes	No
	4 – 9.5km east of Burdekin Dam Falls Road			Yes	No
	5 – 9.2km east of Burdekin Dam Falls Road			Yes	No
Sheet 5 and 6	1 – 11.9km east of Burdekin Dam Falls Road	B-double truck	25m low loader	No	Yes See section 5.1.3
	2 – 11.6km east of Burdekin Dam Falls Road			Yes	No
	3 – 10.3km east of Burdekin Dam Falls Road			Yes	No
	4 – 9.5km east of Burdekin Dam Falls Road			Yes	No
	5 – 9.2km east of Burdekin Dam Falls Road			Yes	No

The swept paths on Ayr Ravenswood Road shows the following:

- Bend 1 cannot accommodate any vehicles; and
- Bends 2 to 5 can accommodate all vehicles.

Based on this Bend 1 may not be able to accommodate heavy vehicles in both directions based on the current road layout. Section 5.1.3 further explains the mitigation that should be applied for the probable conflict scenario (26m B-double and 8.8m service vehicle) and the worst-case conflict scenario (26m B-double and 25m low loader).

At intersections

A swept path assessment was undertaken for the largest construction-stage design vehicle, a B-double truck, at existing SC road – SC road intersections and SC road – LGA road intersections as required.

As B-double movements are infrequent, the swept path assessment has been undertaken with an 8.8m service vehicle travelling in the opposite lane, concurrently. This is expected to be far more likely to occur on site.

It is noted that the swept paths drawings show widening required per swept path analysis as an indication of potential widening only. Intersections will instead be designed to meet the relevant requirements of the Austroads Guide to Road Design Part 3 and the Department of Transport and Main Road's Supplement to Austroads Guide to Road Design Part 3: Geometric Design, as required. It is also noted that each turning movement is shown at most intersections, however it is understood that vehicles will not complete all turning movements shown. As such, widening of existing intersections may not be required to accommodate the swept paths for all movements.

Due to the low-resolution of the available aerial imagery and no survey data available at the time of undertaking the swept paths, the results are considered indicative.

The swept paths are provided in Appendix C and show that the following intersections may require mitigation to accommodate vehicles based on the swept paths:

- Barkly Highway/ Chinaman Creek Road
- Flinders Highway/ Oorindi McKinlay Road
- Flinders Highway/ Braceborough Road (west)
- Burdekin Falls Dam Road/ Silver Valley Road
- Burdekin Falls Dam Road/ Ayr Ravenswood Road
- Ayr Ravenswood Road/ Downing Street
- Ayr Ravenswood Road (Macrossan Street)/ Ayr Ravenswood Road (Deighton Street)
- Flinders Highway/ Redcliffe Road
- Flinders Highway/ Unnamed Road (to Hughenden Camp)
- Flinders Highway/ Ivellen Road
- Flinders Highway/ Yorkshire Road
- Flinders Highway/ Yorkshire Nelia Road
- Barkly Highway/ East Leichardt Road
- Barkly Highway/ Mount Frosty Road
- Boulia Mount Isa Highway/ Moran Road
- Flinders Highway/ Lauderdale Road (east)
- Flinders Highway/ Benean Road
- Flinders Highway/ Marathon Stamford Road
- Flinders Highway/ Unnamed Road (to PTL-FLR_284 to FLR-DJR_82); and
- Flinders Highway/ Amity Road.

Intersections that are Type 1 or Type 2 road train approved are expected to have sufficient geometry for CopperString 2032 construction vehicles.

5.1.2 Avoidance, mitigation and management measures

Mitigation strategies have been developed for the issues identified. Table 51 shows each identified issue, a description of the issue and mitigation measures that can be applied to either remove the issue or reduce the risk.

Issues have been grouped with a minimum of one mitigation measure developed to address the issue. It is noted that mitigation measures have not been identified for items classified as “low” risk, as deemed unnecessary as per the risk assessment methodology.

The issues and management and mitigation measures in Table 51 are for all issues identified throughout the project and are shown holistically. Specific mitigation measures for each assessment type (i.e. road capacity, road safety and road condition) are identified in the relevant subsequent sections of this report.

Table 51: Avoidance, management and mitigation measures

Issue	Avoidance	Management and mitigation measures	
Insufficient road geometry (midblock sections)	Where roads do not meet the minimum widths required by the governing road authority, implement controls to mitigate the likelihood of crashes.	1	For roads between 4m and 7m in width, the following options can be considered: • Use traffic management (shuttle flow or similar) to manage traffic where the road width is less than TMR Standard for predicted AADT. This is considered suitable due to the temporary nature of the construction work; or • Widen the road to the required width based on the TMR requirement for the predicted AADT.
		2	For roads under 4m in width, specific guidance for mitigation will depend on the road condition and location. The following options can be considered for these roads: • Consider changing the vehicle types to suit existing road geometry • Use an alternate access route; or • Carry out minor shoulder widening works in agreement with the relevant road authority.

Issue	Avoidance	Management and mitigation measures	
Insufficient road geometry (sharp bends)	Where turning paths indicate insufficient road geometry on sharp bends, implement controls to mitigate the likelihood of crashes.	3	Use traffic management to manage large vehicles around tight bends where they are required to cross the centreline to complete the manoeuvre, following consultation with the relevant road authority. This is considered suitable due to the temporary nature of the construction work.
		4	In locations where the road width is not sufficient to accommodate a B-double truck around bends, the following options can be considered: • Consider changing the vehicle types to suit existing road geometry • Use an alternate access route; or • Carry out minor shoulder widening works in agreement with the relevant road authority.
	Where sharp bends require vehicles to slow to speeds significantly lower than the speed limit, implement controls to mitigate the likelihood of crashes.	5	Design and install advance warning signage (or other traffic control devices as warranted) to suitably warn drivers of the approaching sharp bend.
Insufficient road geometry (intersections)	Where turning paths indicate insufficient road geometry at intersections, implement controls to mitigate the likelihood of crashes.	6	In locations where the intersection width is not sufficient to accommodate a B-double truck, the following options can be considered: • Carry out intersection widening works in agreement with the relevant road authority; • Consider changing the vehicle types to suit existing road geometry; or • Use an alternate access route.
	Where intersections do not have the required left and right turn lanes as specified in the *Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management*, implement controls to mitigate the likelihood of crashes and congestion.	7	Install suitable left and right turn lanes as specified by the Austroads Guide.

Issue	Avoidance	Management and mitigation measures	
Sight distance obstructions	Keep minimum required sight distances clear of obstructions	8	Inspect the condition of the road network being used for the construction works prior to construction and periodically during construction to identify any sight distance obstructions that can be rectified. This may commonly relate to overgrown trees/ shrubs/ grasses.
		9	Encourage drivers associated with the project to report any sight distance concerns that may impact the safety of drivers. This information will supplement/ inform any periodic inspections. Consideration may be given to more advanced reporting system such as electronic reporting systems using phones and GPS.
		10	Where specific reports and/ or periodic road condition inspections determine that vegetation maintenance is required, perform vegetation maintenance. This may include mowing grass, removing tree branches and/or clearing re-sprouting vegetation, in consultation with the relevant road authority.
		11	Where new or amended traffic arrangements are required and sight distance is insufficient due to topography (or otherwise), design and install advance warning signage (or other traffic control devices as warranted) to suitably warn of the intersection condition.
		12	Where the JV considers sight distance (existing, unchanged conditions) is obscured by signage or other road furniture, contact the relevant road authority to have them re-assess and/ or relocate the signs.

Issue	Avoidance	Management and mitigation measures	
Road deterioration (i.e. potholes, road corrugations, faded linemarking etc.)	Maintain roads, particularly gravel roads.	13	Inspect the condition of the road network being used for the construction works prior to construction to establish a baseline road standard that would need to be re-instated after completion of the construction works. Periodic inspections to be undertaken during construction to identify any road deterioration that may require repair now or in the near future.
		14	Encourage drivers associated with the project to report any road condition concerns that may impact the safety of drivers. This information will supplement/ inform the periodic inspections. Consideration may be given to more advanced reporting system such as electronic reporting systems using phones and GPS. Concerns may include: • Potholes • Loss of road traction • Corrugations in road surface • Water over the road • Faded linemarking • Missing delineators/ reflectors • Impacted safety barriers/ fences; and • Deterioration of road shoulders.
		15	Where specific reports and/ or periodic road condition inspections determine that repairs are warranted, make repairs that may include: • Filing potholes • Regrading gravel roads • Surface improvements; and • Repainting faded linemarking.

Issue	Avoidance	Management and mitigation measures	
Missing controls at rail crossings	Where rail signage is not provided in accordance with the relevant requirements of AS 1742.7, provide required signage.	16	Install rail crossing ahead signs, railway crossing diagrammatic warning assemblies, railway crossing on side road assemblies, rail crossing diagrammatic warning signs on side roads assemblies and stop sign ahead assemblies as required per AS 1742.7 for passive-controlled railway crossings.
		17	Install railway crossing flashing signals ahead signs, railway crossing flashing signals ahead on side road assemblies and/or active advanced warning assemblies as required per AS 1742.7 on active-controlled railway crossings.
	Where rail pavement markings are not provided in accordance with the relevant requirements of AS 1742.7, provide required pavement marking or implement other controls.	18	Provide Rail X, stop line, give-way lines and/ or no-overtaking lines pavement marking as required per AS 1742.7
Sight distance obstructions at rail crossings	Keep minimum required sight distances clear of obstructions	19	Where sight distance is insufficient due to topography (or otherwise) the following options can be considered: • design and install advance rail warning signage (or other traffic control devices as warranted) to suitably warn of the upcoming rail crossing; • clear obstructions such as vegetation/ signage where viable, as outlined in management and mitigation measures 8 to 12; or • reduce the approach speed limit of road vehicles such that the sight distance meets the requirements of AS 1742.7.
Queued vehicles blocking rail crossings or nearby roads	Ensure vehicles queuing back from a rail line do not extend into an intersection	20	Inform drivers associated with the project of the location of rail crossings. In locations where a traffic queue has the possibility of extending into an intersection with high traffic speeds, instruct the drivers to drive past the intersection if there is a queue and identify a suitable location to turn around and wait (if necessary) until the train has passed.
	Ensure vehicle queues back from an intersection do not stop on the rail line	21	Inform drivers associated with the project of the location of rail crossings. Educate drivers to check the other side of the rail line before travelling over the rail line, particularly if there is a known intersection ahead that could cause queues back to the rail line.

Issue	Avoidance	Management and mitigation measures	
Schools and school bus routes.	Limit heavy vehicles during school start and finish times and bus commute times where possible, generally 7-9am and 3-5pm.	22	If it is necessary to travel during the times when school buses are operating, brief the drivers of the additional risk.
General		23	Provide safety training for drivers prior to works commencing to advise of road conditions and locations of higher risk along the Project route. In this part of Queensland, heavy rain can occur, and drivers should alter their speed and/or route based on the conditions.

The following management and mitigation measures would be considered relatively low cost:

- Driver training
- Developing a process for drivers to submit concerns
- Filling potholes
- Repainting faded linemarking
- Traffic management
- Clearing vegetation; and
- Installing signs.

The following management and mitigation measures may incur higher costs:

- Shoulder widening; and
- Regrading of gravel roads.

Mitigation measures #1 and #2 are applicable to insufficient road widths at midblocks. Mitigation measures #3, #4 and #5 are applicable to management of vehicles around sharp bends. Mitigation measures #6 is applicable to road widths at intersections.

Mitigation measure #7 is applicable to the turn lanes assessment in Section 5.2.

Mitigation measures #8 to #12 and #23 are relevant to the road safety assessment in Section 5.3.

Mitigation measures #13 to #15 are relevant to the road condition assessment in Section 5.4.

Mitigation measures #16 to #21 are relevant to the rail assessment as discussed in Section 5.5.

Mitigation measure #22 regards school zones and is generic to all parts of the project.

Where advanced warning signage is recommended to be implemented as a mitigation measure at sharp horizontal curves, it is suggested to use Chevron Alignment Markers (D4-6) and Advisory Speed (W8-2, W1-3) assemblies. An example of their use is shown below in Figure 44.

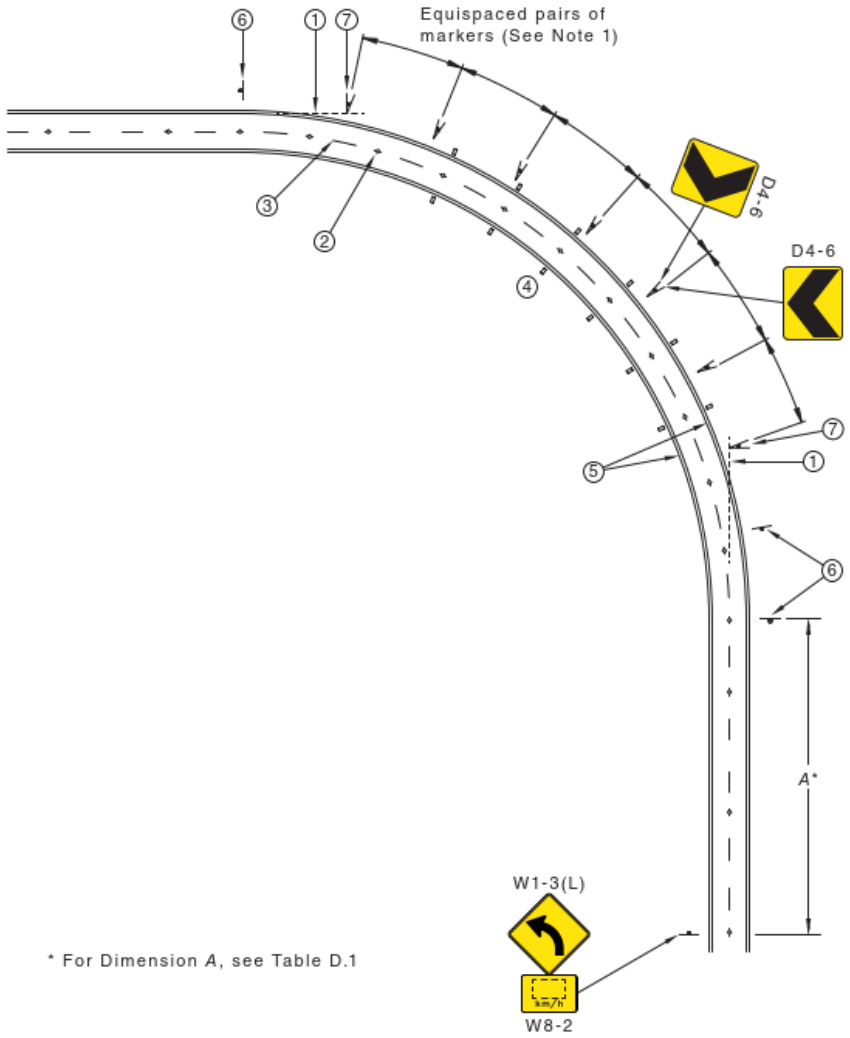


Figure 44: Example of curve warning signage (Source: AS 1742.2)

5.1.3 Residual risks

At midblocks

The assessment identified 4 roads which are of an unsuitable width for the CopperString 2032 construction traffic volumes. Proposed mitigation for each of these roads is shown in Table 52. Application of the mitigation measures is expected to sufficiently mitigate the existing risk to vehicle movements and safety as a result of insufficient road width.

Table 52: Road width mitigation

Road ID	Road	Existing road width	Mitigation required	Extent of mitigation required – subject to more detailed assessment
8	Ayr Ravenswood Road	4.2m to 10.5m	Apply mitigation measure #1 from Table 51	Assume up to 14km
11	Burdekin Falls Dam Road	6.0m to 8.5m	Apply mitigation measure #1 from Table 51	Assume up to 17km
54	Richmond Winton Road	2.9 to 9.0m	Apply mitigation measure #1 from Table 51 Apply mitigation measure #2 from Table 51 where the road is less than 4m in width	Assume up to 12km
61	Julia Creek Kynuna Road	3.7 to 5.8m	Apply mitigation measure #1 from Table 51	Assume entire 4.9km

At sharp bends

The assessment identified one bend on Ayr Ravenswood Road which may not be suitable for two heavy vehicles to pass. Proposed mitigation is shown in Table 53. Application of the mitigation measures is expected to sufficiently mitigate the existing risk to vehicle movements and safety as a result of insufficient road width around the bend.

It is noted that mitigation is already required on Ayr Ravenswood Road due to the carriageway width not being sufficient in general. Mitigation measures addressing the sharp bend and the road width could be applied as one scheme.

Application of the mitigation measures is expected to reduce the existing risk to vehicle movements and safety if there is insufficient road width at the sharp bend.

It is noted that where a B-double truck and 8.8m service vehicle cannot pass, mitigation from Table 53 should be applied. Where a B-double truck and 25m low loader cannot pass, traffic management and project controls will be sufficient.

Table 53: Sharp bends mitigation

Bend number	Road	Mitigation required
1	Ayr Ravenswood Road	Apply mitigation measure #3 or 4 from Table 51 Apply mitigation measure #5 from Table 51

At intersections

Should mitigation measure #6 be applied to each intersection with insufficient geometry for B-double trucks, as listed in Section 5.1.1, the intersections would be considered suitable for the necessary movements.

5.2 Road operation assessment (traffic congestion)

Delay and level of service at intersections

SIDRA Intersection 9 modelling software was utilised to determine the Level of Service (LOS) at selected intersections on the project route. Intersections were selected as follows:

- Along routes that access camps, whereby concentration of construction traffic movements are highest (see Section 1.6 of this report for references to the CopperString 2032 Camps TIAs for detailed assessments)
- At the following intersections that have the highest overall traffic volumes along the route:
    - Flinders Highway/ Burdekin Falls Dam Road
    - Flinders Highway/ Millchester Road
    - Flinders Highway/ Kennedy Developmental Road (south)
    - Barkly Highway/ Burke Developmental Road
    - Barkly Highway/ Mount Isa Duchess Road (Camooweal Street)
    - Mount Isa Duchess Road (Camooweal Street)/ Rodeo Drive; and
    - Barkly Highway/ Diamantina Developmental Road.

Table 54 shows the criteria that SIDRA Intersection modelling software adopts in assessing the LOS.

Table 54: SIDRA Level of Service (LOS) criteria

LOS	Delay per vehicle (secs)		
	Signals	**Roundabout**	**Sign control**
A	10 or less	10 or less	10 or less
B	10 to 20	10 to 20	10 to 15
C	20 to 35	20 to 35	15 to 25
D	35 to 55	35 to 50	25 to 35
E	55 to 80	50 to 70	35 to 50
F	Greater than 80	Greater than 70	Greater than 50

All of the intersections modelled (including on routes to camps) are expected to operate at an overall LOS A (the best level of performance). There are some select traffic movements that are expected to operate at LOS B which is still considered a good LOS. The additional traffic expected as a result of the construction is not expected to reduce the operation of intersections significantly or to an unacceptable level. As such, there is minimal risk of the construction activity affecting the available road capacity.

Turning treatments assessment

The *Austroads Guide to Traffic Management Part 6 Intersections, Interchanges and Crossings Management* (AGTM Part 6) specifies warrants for providing left and right turn treatments at unsignalised intersections. Figure 45 is an excerpt from the AGTM Part 6 that shows the preferred treatments based on the peak hour traffic volumes.

Note that Curve 1 (red) and Curve 2 (blue) represent the boundary between the treatment types.

The *Queensland Government Road Planning and Design Manual Edition 2: Volume 3 Supplement to Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Qld V3 Supplement) also specifies warrants where installation of turning treatments is considered impractical due to low traffic volumes. These warrants apply to two-lane two-way roads only (2L2W). Figure 46 is an excerpt from the supplement, volumes that are to the left of the green line signify that turning treatments may not be necessary.

Each of the acronyms in this section are described below:

- SL Simple left turn (i.e. no turning lane)
- SR Simple right turn (i.e. no turning lane)
- BAL Basic left turn lane
- BAR Basic right turn lane
- AUL Auxiliary left turn lane
- AUL(s) Short auxiliary left turn lane
- CHL Channelised left turn lane
- CHR Channelised right turn lane; and
- CHR(s) Short channelised right turn lane.

There are several intersections and driveways in the project length that are considered suitable for SL and SR. Each of these intersections and driveways have been assessed for the following to ensure a turn lane is not required:

- Low turning traffic volumes (less than 100 vehicles per hour)
- Excellent sight distance; and
- No other nearby issues identified in this assessment that could not be mitigated to a low risk.

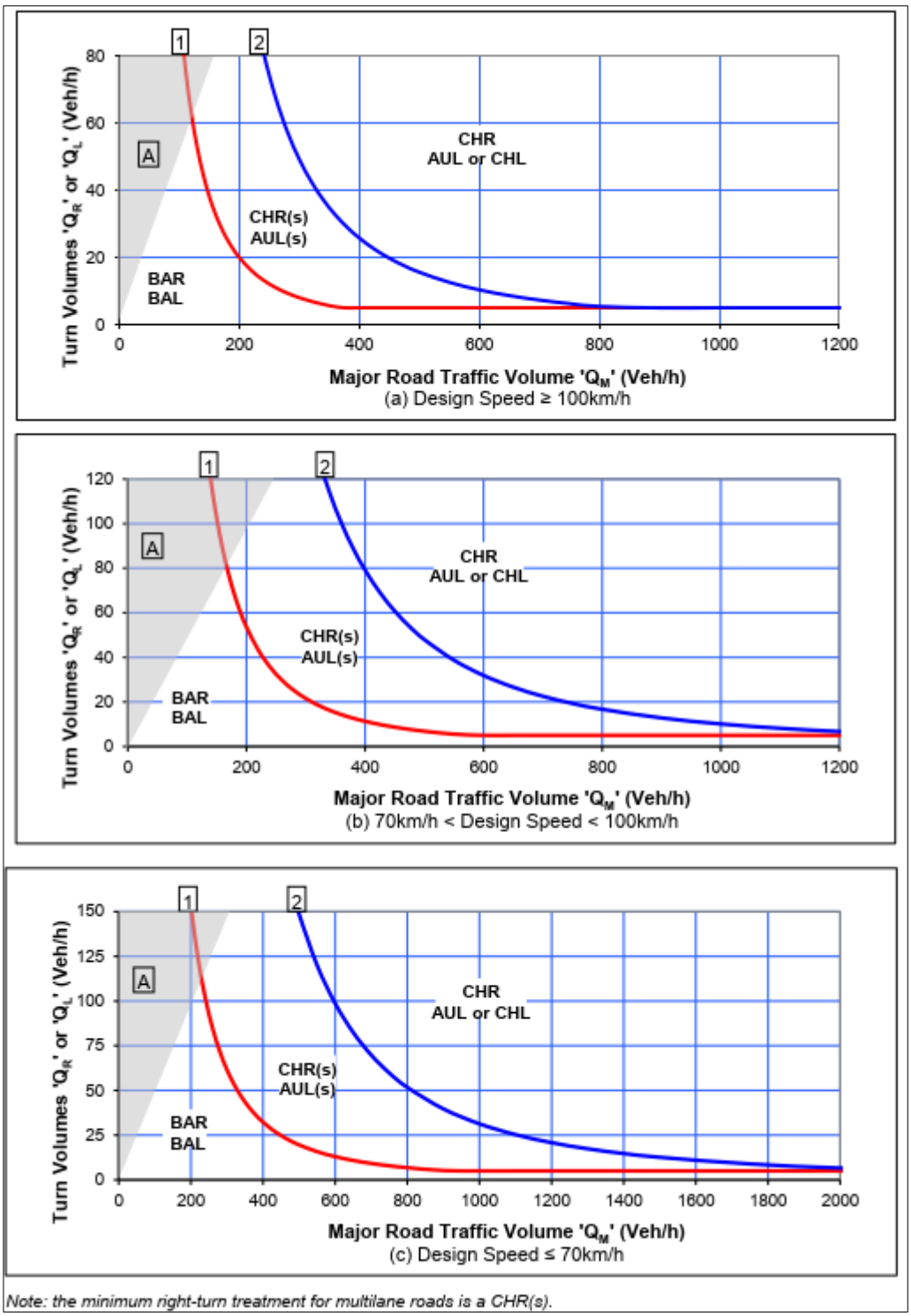
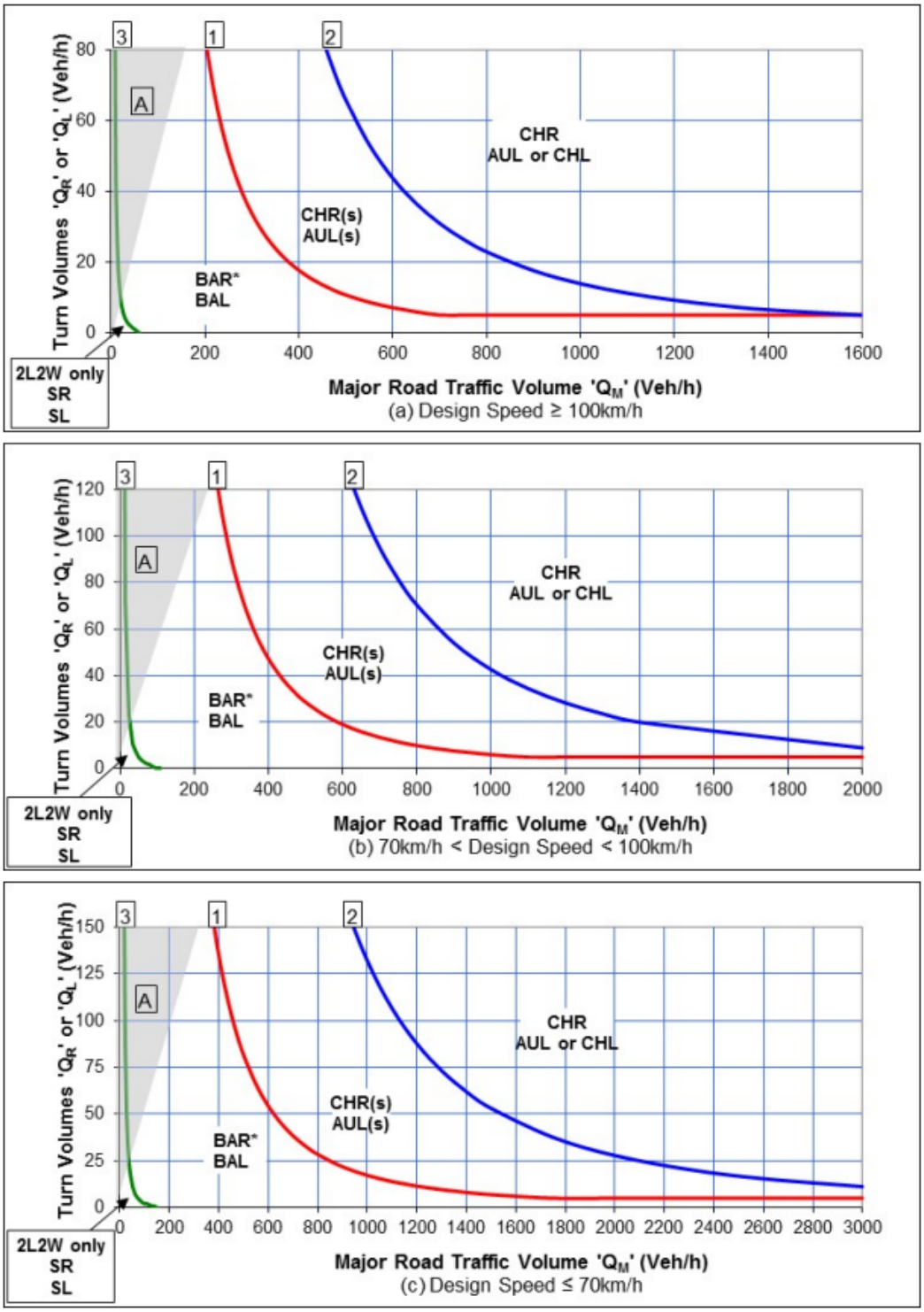


Figure 45: Warrants for turning treatments at unsignalised intersections (AGTM Part 6)

Figure 4A-A 4 - Warrants - Major road turn treatments - Extended Design Domain



* - the minimum right-turn treatment for multi-lane roads is a CHR(s)

Figures 4A-A 4(d), (e) and (f) respectively expand the view of the bottom left corner of diagrams(a), (b) and (c)

Figure 46: Warrants for turning treatments at unsignalised intersections (Qld V3 Supplement)

A summary of the existing and preferred treatments for intersections and driveways, applying mitigation measure #7 and based on peak construction traffic volumes, is shown in Table 55 and Table 56 respectively. Should the turn lanes and guidance in Table 55 and Table 56 be applied, the intersections would be considered to have sufficiently minimised the risk of crashes and congestion at the identified intersections and driveways.

Table 55: Turn lane requirements at intersections

Intersection ID	Major Road	Minor Road	Turn movement	Existing peak hour traffic volumes		Existing turn treatment	Required turn treatment with existing traffic volumes	Upgrade required due to existing traffic	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume				Major road (opposing)	Turn volume		
Intersections between SC and SC roads												
11.1	Burdekin Falls Dam Road	Ayr Ravenswood Road	Left	2	18	SL	SL	No	2	57	SL	No
11.3	Burdekin Falls Dam Road* (Hervey Street)	Burdekin Falls Dam Road	Left	8	0	SL	SL	No	253	0	SL	No
7.1	Flinders Highway	Burdekin Falls Dam Road	Left	81	6	CHL	BAL	No	82	113	BAL	No
			Right	188	1	BAR	BAR	No	296	125	BAR	No
7.3	Flinders Highway	Gregory Developmental Road (north)	Left	48	74	AUL	BAL	No	48	74	BAL	No
			Right	54	46	CHR	BAR	No	247	116	BAR	No
7.6	Flinders Highway	Gregory Developmental Road (south)	Left	49	38	CHL	BAL	No	81	145	BAL	No
			Right	151	1	BAR	BAR	No	290	1	BAR	No
7.12	Flinders Highway	Aramac Torrens Creek Road	Left	24	2	SL	SL	No	24	84	BAL	Yes
			Right	65	3	SR	BAR	No	147	3	BAR	No
7.17	Flinders Highway	Kennedy Developmental Road (south)	Left	71	7	SL	BAL	No[1]	114	62	BAL	No[2]
			Right	164	36	SR	BAR	No[1]	262	36	BAR	No[2]
7.18	Flinders Highway* (Gray Street)	Flinders Highway* (Stansfield Street)	Left	86	30	SL	BAL	No[1]	86	73	BAL	No[2]
45.1	Resolution Street	Kennedy Developmental Road (south)	Right	No data	No data	SR	-	-	-	+55	BAR	No[1 2]
7.23	Flinders Highway (Goldring Street - Richmond)	Flinders Highway (Larsen Street)	Left	56	15	SL	BAL	No[1]	56	15	BAL	No[2]
			Right	26	17	SR	BAR	No[1]	92	17	BAR	No[2]
7.26	Flinders Highway	Richmond Winton Road	Left	18	2	SL	SL	No	18	97	BAL	Yes
			Right	37	1	SR	SR	No	132	1	BAR	Yes[3]
7.33	Flinders Highway	Julia Creek Kynuna Road	Left	15	5	SL	SL	No	15	5	BAL	Yes
			Right	35	5	SR	SR	No	35	5	BAR	Yes
7.38	Flinders Highway	Landsborough Highway	Left	8	3	SL	SL	Yes	8	3	BAL	Yes
			Right	36	35	SR	BAR	Yes	36	103	BAR	Yes
73.2	Barkly Highway	Burke Developmental Road	Left	69	14	CHL	BAL	No	69	79	BAL	No
			Right	138	31	CHR	BAR	No	203	38	BAR	No

[1] Wide carriageway at intersection, located in urban, low speed, environment with good sight distance, turn volumes are generally not high enough to warrant turn lanes as a result of congestion
[2] If required, linemarking could be used to show turn lanes
[3] Frequent turning movements are not anticipated at this location. As a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway however if this movement is confirmed as not required for the CopperString 2032 construction traffic, the turning treatment is not necessary

Intersection ID	Major Road	Minor Road	Turn movement	Existing peak hour traffic volumes		Existing turn treatment	Required turn treatment with existing traffic volumes	Upgrade required due to existing traffic	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume				Major road (opposing)	Turn volume		
73.4	Barkly Highway	Cloncurry Duchess Road	Left	57	5	BAL	BAL	No	82	52	BAL	No
			Right	88	1	BAR	BAR	No	160	1	BAR	No
Intersections between SC and LGA roads												
11.2	Burdekin Falls Dam Road	Silver Valley Road	Right	24	0	SR	SR	No	100	124	BAR	Yes
7.2	Flinders Highway	Amity Road	Left	85	0	SL	SL	No	85	0	BAL	Yes[4]
			Right	186	0	SR	SR	No	310	75	BAR	Yes[4]
7.4	Flinders Highway	Broughton Road (Millchester)	Left	77	5	SL	SL	No	182	42	BAL	Yes
			Right	175	49	CHR	BAR	No	316	49	BAR	No
15.2	Gregory Developmental Road (north)	Hewett Street	Right	234	18	BAR	BAR	No	234	159	BAR	No
7.5	Flinders Highway	Phillipson Road	Left	100	42	CHL	BAL	No	177	106	BAL	No
			Right	291	8	CHR	BAR	No	432	8	BAR	No
7.7	Flinders Highway	Braceborough Road (west)	Left	65	0	SL	SL	No	65	32	BAL	Yes
			Right	122	0	SR	SR	No	154	0	BAR	Yes[5]
7.8	Flinders Highway	Red Road	Left	43	0	BAL	SL	No	43	0	BAL	No
			Right	101	0	BAR	SR	No	101	32	BAR	No
7.9	Flinders Highway	Laidlow Crossing	Left	8	0	SL	SL	No	8	75	BAL	Yes
			Right	53	23	SR	BAR	Yes	128	97	BAR	No
7.10	Flinders Highway	Lauderdale Road (east)	Left	9	0	SL	SL	No	83	75	BAL	Yes
			Right	64	0	SR	SR	No	139	0	BAR	Yes[4]
7.11	Flinders Highway	Lyons Creek Road	Left	28	0	SL	SL	No	110	64	BAL	Yes
			Right	74	0	SR	SR	No	220	0	BAR	Yes[4]
7.13	Flinders Highway	Prairie Road	Left	24	0	SL	SL	No	24	0	BAR	Yes
			Right	63	0	SR	SR	No	63	48	BAR	Yes
7.14	Flinders Highway	Redcliffe Road	Left	24	0	SL	SL	No	24	0	BAR	Yes
			Right	63	0	SR	SR	No	209	23	BAR	Yes
7.15	Flinders Highway	Unnamed Local Road (off Flinders Highway at Hughenden – to Hughenden Store)	Left	24	0	SL	SL	No	24	0[6]	BAL	Yes
			Right	63	0	SR	SR	No	63	0[5]	BAR	Yes
7.16	Flinders Highway	Unnamed Road (off Flinders Highway at Hughenden - to Hughenden Camp)	Left	24	0	SL	SL	No	24	98	BAL	Yes
			Right	63	0	SR	SR	No	161	98	BAR	Yes

[4] Only if Amity Road is used as a route – this assessment has determined that there are preferable alternative routes due to the condition of Amity Road
[5] Frequent turning movements are not anticipated at this location. As a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway however if this movement is confirmed as not required for the CopperString 2032 construction traffic, the turning treatment is not necessary
[6] Traffic volumes in and out of store are unknown but are expected to be nil or low in peak hours - as a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway

Intersection ID	Major Road	Minor Road	Turn movement	Existing peak hour traffic volumes		Existing turn treatment	Required turn treatment with existing traffic volumes	Upgrade required due to existing traffic	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume				Major road (opposing)	Turn volume		
45.2	Kennedy Developmental Road (south)	McLaren Street	Left	No data	No data	BAL	BAL	No	-	+55	BAL	No
7.19	Flinders Highway	Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82)	Left	27	0	SL	SL	No	30	95	BAL	Yes
			Right	55	0	SR	SR	No	153	0	BAR	Yes[4]
7.20	Flinders Highway	Marathon Stamford Road	Left	25	1	SL	SL	No	25	1	BAL	Yes
			Right	52	1	SR	SR	No	26	15	BAR	Yes
7.21	Flinders Highway	Barabon Terranburby Road	Left	25	1	SL	SL	No	25	1	BAL	Yes
			Right	52	1	SR	SR	No	26	53	BAR	Yes
7.22	Flinders Highway	Benean Road	Left	27	0	SL	SL	No	27	0	BAL	Yes[7]
			Right	55	0	SR	SR	No	121	52	BAR	Yes[7]
7.25	Flinders Highway	Pattel Drive	Left	14	0	SL	SL	No	14	75	BAL	Yes
			Right	33	0	SR	SR	No	109	66	BAR	Yes
7.27	Flinders Highway	Maxwelton Kynuna Road	Left	14	0	SL	SL	No	14	95	BAL	Yes
			Right	41	0	SR	SR	No	136	0	BAR	Yes[8]
7.28	Flinders Highway	Minamere Nelia Road	Left	23	0	SL	SL	No	23	0	BAL	Yes
			Right	46	0	SR	SR	No	46	33	BAR	Yes
7.29	Flinders Highway	Yorkshire Nelia Road	Left	23	0	SL	SL	No	23	0	BAL	Yes
			Right	79	0	SR	SR	No	79	33	BAR	Yes
7.30	Flinders Highway	Yorkshire Road	Left	23	0	SL	SL	No	23	0	BAL	Yes
			Right	112	0	SR	SR	No	112	102	BAR	Yes
7.31	Flinders Highway	Burke Street (eastern intersection)	Left	0	22	SL	SL	No	0	69	BAL	Yes
			Right	22	1	SR	SR	No	69	1	BAR	Yes[8]
7.32	Flinders Highway	Burke Street (western intersection)	Left	0	1	SL	SL	No	0	1	BAL	Yes[8]
			Right	1	18	SR	SR	No	1	65	BAR	Yes
7.34	Allison Street	Flinders Highway	Left	8	2	SL	SL	No	102	49	BAL	Yes
			Right	19	1	SR	SR	No	113	48	BAR	Yes
7.35	Flinders Highway	McKinlay Gilliat Road	Left	18	0	SL	SL	No	18	52	BAL	Yes
			Right	39	0	SR	SR	No	109	0	BAR	Yes[8]
7.36	Flinders Highway	Ivellen Road	Left	20	0	SL	SL	No	20	76	BAL	Yes
			Right	25	0	SR	SR	No	121	0	BAR	Yes[8]
7.37	Flinders Highway	Oorindi McKinlay Road	Left	20	1	SL	SL	No	20	1	BAL	Yes
			Right	18	0	SR	SR	No	39	109	BAR	Yes

[7] Only if Benean Road is used as a route – this assessment has determined that there are preferable alternative routes
[8] Frequent turning movements are not anticipated at this location. As a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway however if this movement is confirmed as not required for the CopperString 2032 construction traffic, the turning treatment is not necessary

Intersection ID	Major Road	Minor Road	Turn movement	Existing peak hour traffic volumes		Existing turn treatment	Required turn treatment with existing traffic volumes	Upgrade required due to existing traffic	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume				Major road (opposing)	Turn volume		
7.39	Flinders Highway	Andrew Daniels Drive	Left	30	3	CHL	BAL	No	30	19	BAL	No
			Right	48	14	CHR	BAR	No	64	71	BAR	No
7.40	Flinders Highway	Round Oak Road	Left	10	5	AUL	SL	No	10	33	BAL	No
			Right	45	25	CHR	BAR	No	73	25	BAR	No
76.1	Burke Developmental Road	Hensley Drive	Left	40	1	AUL	BAL	No	112	73	BAL	No
73.1	Barkly Highway	Powerhouse Road (Cloncurry)	Left	38	19	AUL	BAL	No	38	19	BAL	No
			Right	120	0	BAR	BAR	No	120	7	BAR	No
73.5	Barkly Highway	Mount Frosty Road	Left	47	0	SL	SL	No	47	0	BAL	Yes
			Right	95	0	SR	SR	No	102	14	BAR	Yes
73.6	Barkly Highway	East Leichardt Road	Left	60	0	SL	SL	No	118	0	BAL	Yes
			Right	120	0	SR	SR	No	178	28	BAR	Yes
81.2	Mount Isa Duchess Road	Twenty Third Avenue	Left	35	25	BAL	BAL	No	56	25	BAL	No
			Right	90	125	CHR	BAR	No	111	125	BAR	No
83.1	Diamantina Developmental Road	Twenty Third Avenue	Left	57	28	SL	SL	No[9]	57	35	BAL	No[10]
			Right	99	14	SR	SR	No[9]	127	35	BAR	No[10]
87.1	Boulia Mount Isa Highway	Moran Road	Left	5	0	SL	SL	No	5	7	SL	No
			Right	15	0	SR	SR	No	22	0	SR	No

[9] Wide carriageway at intersection, located in urban, low speed, environment with good sight distance, turn volumes are generally not high enough to warrant turn lanes as a result of congestion
[10] If required, linemarking could be used to show turn lanes

Table 56: Turn lane requirements at driveways

Driveway ID	Driveway	Turn movement	Existing turn treatment	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume		
8.A	Ayr-Ravenswood Road and Access to Mulgrave Substation	Right	SR	0	7	SR	No
8.B	Ayr-Ravenswood Road and Western Access to WDS-PTL-T1_12	Right	SR	0	16	SR	No
8.C	Ayr-Ravenswood Road and Eastern Access to WDS-PTL-T13_77	Left	SL	0	16	SL	No
11.A	Burdekin Falls Dam Road and Western Access to WDS-PTL-T13_77	Right	SR	187	7	BAR	Yes
26.A	Gregory Developmental Road (south) and Western Access to WDS-PTL-T196_215	Right	SR	0	75	SR	No
26.B	Gregory Developmental Road (south) and Eastern Access to WDS-PTL-T216_278	Left	SL	0	32	SL	No
37.A	Aramac Torrens Creek Road and Western Access to PTL-FLR-T89_118	Right	SR	0	7	SR	No
37.B	Aramac Torrens Creek Road and Eastern Access to PTL-FLR-T119_168	Left	SL	0	16	SL	No
7.A	Flinders Highway and Cotonvale Road	Right	SR	63	23	BAR	Yes
7.B	Flinders Highway and Kennedy Energy Park Access Track	Left	SL	63	0	BAL	Yes
		Right	SR	134	75	BAR	Yes
45.A	Kennedy Developmental Road (south) and Western Access to PTL-FLR-T264_283	Right	SR	Unknown	32	BAR	Yes
45.B	Kennedy Developmental Road (south) and Eastern Access to PTL-FLR-T284_FLR-DJR-38	Left	SL	Unknown	32	BAL	Yes
7.C	Flinders Highway and Thornhill Tamworth Road	Left	SL	25	34	BAL	Yes
		Right	SR	85	1	BAR	Yes[11]
54.A	Richmond Winton Road and Western Access to FLR-DJR-179_211	Right	SR	0	69	SR	No
54.B	Richmond Winton Road and Eastern Access to FLR-DJR-212_247	Left	SL	0	26	SL	No
7.D	Flinders Highway and Access to FLR-DJR-212_274	Right	SR	135	1	BAR	Yes[9]
		Left	SL	18	97	BAL	Yes
61.A	Julia Creek Kynuna Road and Western Access to FLR-DJR-434_475	Right	SR	0	69	SR	No
61.B	Julia Creek Kynuna Road and Eastern Access to FLR-DJR-476_545	Left	SL	0	7	SL	No
68.A	Landsborough Highway and Access to FLR-DJR-705_716	Right	SR	61	7	BAR	Yes
68.B	Landsborough Highway and Access to FLR-DJR-703_704	Right	SR	54	7	BAR	Yes
68.C	Landsborough Highway and Access to FLR-DJR-694_699	Left	SL	47	7	BAL	Yes
68.D	Landsborough Highway and Access to FLR-DJR-700_702	Right	SR	40	7	BAR	Yes
68.E	Landsborough Highway and Access to FLR-DJR-682_693	Left	SL	40	7	BAL	Yes
68.F	Landsborough Highway and Access to FLR-DJR-650_672	Left	SL	26	7	SL	No
68.G	Landsborough Highway and Access to FLR-DJR-673_689	Left	SL	0	26	SL	No
76.A	Burke Developmental Road and Cloncurry Camp Access	Left	SL	14	143	BAL	Yes
78.A	Cloncurry Duchess Road and Access to Dajarra Substation Laydown	Right	SR	40	7	BAR	Yes
78.B	Cloncurry Duchess Road and Access to FLR-DJR-743_749	Right	SR	0	14	SR	No
78.C	Cloncurry Duchess Road and Access to FLR-DJR-750	Left	SL	0	26	SL	No

[11] Frequent turning movements are not anticipated at this location. As a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway however if this movement is confirmed as not required for the CopperString 2032 construction traffic, the turning treatment is not necessary

Driveway ID	Driveway	Turn movement	Existing turn treatment	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume		
73.A	Barkly Highway and Access to DJR-MIS-7_27	Left	SL	124	7	BAL	Yes
		Right	SR	179	0	BAR	Yes[12]
73.B	Barkly Highway and Access to DJR-MIS-20_34	Left	SL	117	7	BAL	Yes
		Right	SR	172	0	BAR	Yes[10]
73.C	Barkly Highway and Access to DJR-MIS-35_43	Left	SL	110	7	BAL	Yes
		Right	SR	165	0	BAR	Yes[10]
73.D	Barkly Highway and Access to DJR-MIS-44_49	Left	SL	103	7	BAL	Yes
		Right	SR	158	0	BAR	Yes[10]
73.E	Barkly Highway and Access to DJR-MIS-50_56	Left	SL	96	7	BAL	Yes
		Right	SR	151	0	BAR	Yes[10]
73.F	Barkly Highway and Access to DJR-MIS-57_60	Left	SL	89	7	BAL	Yes
		Right	SR	144	0	BAR	Yes[10]
73.G	Barkly Highway and Access to DJR-MIS-61_66	Left	SL	82	7	BAL	Yes
		Right	SR	137	0	BAR	Yes[10]
73.H	Barkly Highway and Access to DJR-MIS-67_68	Left	SL	68	7	BAL	Yes
		Right	SR	123	0	BAR	Yes[10]
73.I	Barkly Highway and Access to DJR-MIS-69_72	Left	SL	48	0	BAL	Yes
		Right	SR	116	7	BAR	Yes
73.J	Barkly Highway and Access to DJR-MIS-73_86	Left	SL	48	0	BAL	Yes
		Right	SR	109	7	BAR	Yes
73.K	Barkly Highway and Access to DJR-MIS-87_97	Left	SL	48	0	BAL	Yes
		Right	SR	102	7	BAR	Yes
73.L	Barkly Highway and Access to DJR-MIS-98_99	Left	SL	48	0	BAL	Yes
		Right	SR	95	7	BAR	Yes
73.M	Barkly Highway and Access to DJR-MIS-100_103	Left	SL	47	0	BAL	Yes
		Right	SR	95	7	BAR	Yes
73.N	Barkly Highway and Access to DJR-MIS-107_108	Left	SL	47	0	BAL	Yes
		Right	SR	116	7	BAR	Yes
73.O	Barkly Highway and Access to DJR-MIS-109_112	Left	SL	47	0	BAL	Yes
		Right	SR	123	7	BAR	Yes
73.P	Barkly Highway and Access to DJR-MIS-113_118	Left	SL	47	0	BAL	Yes
		Right	SR	130	7	BAR	Yes
73.Q	Barkly and Access to DJR-MIS-115_121	Left	SL	47	0	BAL	Yes
		Right	SR	137	7	BAR	Yes

[12] Frequent turning movements are not anticipated at this location. As a minimum pitt&sherry has recommended BAL/BAR treatments on the Flinders Highway however if this movement is confirmed as not required for the CopperString 2032 construction traffic, the turning treatment is not necessary

Driveway ID	Driveway	Turn movement	Existing turn treatment	Construction peak hour traffic		Required turn treatment	Turn treatment upgrade required due to increased project volumes
				Major road (opposing)	Turn volume		
73.R	Barkly Highway and Access to DJR-MIS-122_126	Left	SL	88	0	BAL	Yes
		Right	SR	144	7	BAR	Yes
73.S	Barkly Highway and Access to DJR-MIS-143_153	Left	SL	88	0	BAL	Yes
		Right	SR	232	7	BAR	Yes
73.T	Barkly Highway and Access to DJR-MIS-154_177	Left	SL	88	0	BAL	Yes
		Right	SR	232	7	BAR	Yes
81.A	Mount Isa Duchess Road and Access to DJR-MIS-178_192	Left	SL	14	7	SL	No
81.B	Mount Isa Duchess Road and Access to DJR-MIS-193	Left	SL	0	7	SL	No
81.C	Mount Isa Duchess Road and Access to DJR-MIS-194	Right	SR	0	7	SR	No
83.A	Diamantina Developmental Road and Northern Access to Mount Isa Substation Laydown	Left	SL	0	0	BAL	Yes
		Right	SR	7	0	BAR	Yes
87.A	Boulia Mount Isa Highway and Southern Access to Mount Isa Substation Laydown	Left	SL	0	7	BAL	Yes
		Right	SR	0	0	BAR	Yes

5.3 Road safety assessment

The level of risk for each road has been determined with respect to the identified hazards.

Mitigation measures #8 to #12 and #23 from Table 51 are relevant for the road safety assessment.

Where advance warning signage is recommended for mitigation, as per mitigation measure 11, we suggest use of warning signs from the W2 list as detailed in the Australian Standard AS1742.2-2009 Manual of uniform traffic control devices – Part 2: Traffic control devices for general use. Sign W2-4(R) as shown in Figure 47 is an example of a sign in the class which would be used on a major road to warn of an upcoming T-intersection on the right, typically utilised when sight distance to the intersection is limited due to road works.

Figure 47: Example W2 class signage

The initial identified risks, and residual risks for road issues after applying avoidance, management and mitigation measures are shown in Table 57.

Table 57: Road safety risks

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
4	Townsville Port Road	North of Boundary Street	Five vehicles leaving driveway crashes were recorded along Townsville Port Road in the most recent 10-year period, one of which resulted in a fatality and four of which resulted in hospitalisations. Despite the slower speed limit and straight section of road, vehicles travelling on Townsville Port Road should be aware of vehicles leaving driveways/ car parking. Such a crash at this location has the potential to result in a moderate-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #23 from Table 51.	Improbable	Serious	Medium
5	Bruce Highway	South of Ayr	Seven vehicles from same direction crashes were recorded on the Bruce Highway south of Ayr, five of which resulted in hospitalisation and two required medical treatment to be administered at the scene. Such crashes are expected to be a result of the comparatively high level of vehicles that travel along this section of the Bruce Highway per day and do not represent an issue with the safety of the existing road infrastructure.	Occasional	Serious	High	Apply mitigation measure #23 from Table 51.	Improbable	Serious	Medium
7	Flinders Highway	2.5km section along horizontal curves east of Mingela	Six off path on curve crashes were recorded in the most recent 10-year period, four of which resulted in hospitalisations, one required medical treatment to be administered at the scene and a further one resulted in minor injury. As such, the road alignment and high vehicle speed, noting the provision of overtaking lanes at this location, may lead to an inflated crash risk, in which a crash may result in serious injury.	Occasional	Serious	High	Apply mitigation measure #23 from Table 51.	Improbable	Serious	Medium
		Intersection 7.4 Flinders Highway and Millchester Road	Measured SISD: 125m Required SISD: 151m Insufficient SISD to north, limited by horizontal curve This has the potential to result in a moderate-speed collision causing minor injury.	Improbable	Minor	Low	Apply mitigation measure #11 from Table 51.	Improbable	Minor	Low

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
		Intersection 7.8 Flinders Highway and Red Road	Measured SISD: 175m Required SISD: 227m Insufficient SISD to east, limited by dip. This has the potential to result in a moderate-speed collision between two vehicles causing minor injury.	Occasional	Minor	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Minor	Low
		Intersection 7.14 Flinders Highway and Redcliffe Road	Measured ASD: 135m Required ASD: 233m Insufficient approach sight distance, limited by crest. Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit. This has the potential to result in a moderate-speed side-on collision with another vehicle, or a single car collision with infrastructure opposite the minor road.	Improbable	Serious	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Intersection 7.21 Flinders Highway and Barabon Terranburby	Measured SISD: 270m Required SISD: 367m Insufficient SISD to east, limited by vegetation, horizontal curve and minor dip. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
		Intersection 7.30 Flinders Highway and Yorkshire Road	Measured SISD: 120m Required SISD: 317m Poor SISD to west, limited by vegetation. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
		Intersection 7.31 Flinders Highway and Flinders Highway* (Burke Street (eastern access))	Measured SISD: 130m Required SISD: 151m Insufficient SISD to west, limited by vegetation in the median. This has the potential to result in a moderate-speed collision between two vehicles causing minor injury.	Improbable	Minor	Low	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
		Intersection 7.38 Flinders Highway and Landsborough Highway	Measured SISD: 200m Required SISD: 317m Insufficient SISD to west, limited by horizontal curve. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #11 from Table 51.	Improbable	Serious	Medium
8	Ayr Ravenswood Road	Driveway 8.C Ayr-Ravenswood Road and Eastern Access to WDS-PTL-T13_77	Measured SISD: 90m Required SISD: 222m Insufficient SISD to west, limited by vegetation. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
11	Burdekin Falls Dam Road	Intersection 11.2 Burdekin Falls Dam Road and Silver Valley Road	Measured SISD: 300m Required SISD: 317m Insufficient SISD to north, limited by vegetation and horizontal curve. This has the potential to result in a high-speed collision causing serious injury.	Improbable	Serious	Medium	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
		Driveway 11.A Burdekin Falls Dam Road and Western Access to WDS-PTL-T13_77	Measured SD: 165m Required SD: 222m Insufficient sight distance to south, limited by dip. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
45	Kennedy Developmental Road (south)	Driveway 45.A Kennedy Developmental Road (south) and Western Access to PTL-FLR-T264_283	Measured SD: 160m Required SD: 222m Insufficient sight distance to south, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Driveway 45.B Kennedy Developmental Road (south) and Eastern Access to PTL-FLR-T284_FLR-DJR-38	Measured SD: 160m Required SD: 222m Insufficient sight distance to south, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
68	Landsborough Highway	Driveway 68.D Landsborough Highway and Access to FLR-DJR-700_702	Measured SD: 160m Required SD: 222m Insufficient sight distance to west, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
73	Barkly Highway	Intersection 73.3 Barkly Highway and Chinaman Creek Dam Road	Measured SISD: 200m Required SISD: 227m Insufficient SISD to east, limited by vegetation. This has the potential to result in a moderate-speed collision between two vehicles causing minor injury.	Improbable	Minor	Medium	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
			Measured SISD: 170m Required SISD: 227m Insufficient SISD to west, limited by vegetation and sign. This has the potential to result in a moderate-speed collision between two vehicles causing minor injury.	Occasional	Minor	High	Apply mitigations measures #8 to #10 and #12 from Table 51.	Expected to have sufficient sight distance with removal of vegetation and signage		

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
		Intersection 73.4 Barkly Highway and Cloncurry Duchess Road	Measured SISD: 280m Required SISD: 317m Insufficient sight distance to east, limited by dip. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Improbable	Serious	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Intersection 73.5 Barkly Highway and Mount Frosty Road	Measured SISD: 220m Required SISD: 317m Insufficient SISD to east, limited by vegetation and dip. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Improbable	Serious	Medium	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
			Measured SISD: 280m Required SISD: 317m Insufficient SISD to west, limited by vegetation. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
		Intersection 73.6 Barkly Highway and East Leichardt Road	Measured SISD: 215m Required SISD: 317m Insufficient SISD to east, limited by vegetation and crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
			Measured ASD: 140m Required ASD: 233m Insufficient approach sight distance, limited by vegetation and crest. Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit. This has the potential to result in a moderate-speed side-on collision with another vehicle, or a single car collision with infrastructure opposite the minor road.	Improbable	Serious	Medium	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
		Driveway 73.B Barkly and Access to DJR-MIS-20_34	Measured SD: 200m Required SD: 222m Insufficient sight distance to south, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Improbable	Serious	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Driveway 73.E Barkly Highway and Access to DJR-MIS-50_56	Measured SD: 150m Required SD: 222m Insufficient sight distance to west, limited by vegetation and horizontal curve. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #11 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
		Driveway 73.F Barkly Highway and Access to DJR-MIS-57_60	Measured SD: 150m Required SD: 222m Insufficient sight distance to east, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
		Driveway 73.H Barkly Highway and Access to DJR-MIS-67_68	Measured SD: 120m Required SD: 222m Insufficient sight distance to east, limited by horizontal curve. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Driveway 73.O Barkly Highway and Access to DJR-MIS-109_112	Measured SD: 200m Required SD: 222m Insufficient sight distance to east, limited by crest and horizontal curve. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Improbable	Serious	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Serious	Medium
		Driveway 73.R Barkly Highway and Access to DJR-MIS-122_126	Measured SD: 180m Required SD: 222m Insufficient sight distance to west, limited by vegetation. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #11 from Table 51	Expected to have sufficient sight distance with removal of vegetation		
		Mount Isa	Three crashes involving pedestrians occurred along the Barkly Highway in Mount Isa in the most recent 10-years, one of which resulted in a fatality and two which resulted in hospitalisations. The high number of pedestrians in Mount Isa results in an increased vehicle-pedestrian crash risk. Such a crash has the potential to result in serious injury.	Occasional	Serious	High	Apply mitigation measure #23 from Table 51.	Improbable	Serious	Medium
81	Mount Isa Duchess Road	Mount Isa CBD	Five crashes involving pedestrians occurred along Mount Isa Duchess Road in the most recent 10-years, two of which resulted in hospitalisations and three of which resulted in medical treatment being administered at the scene. The high number of pedestrians in Mount Isa results in an increased vehicle-pedestrian crash risk. Such a crash has the potential to result in serious injury.	Occasional	Serious	High	Apply mitigation measure #23 from Table 51.	Improbable	Serious	Medium
		Mount Isa CBD	Six vehicles leaving driveway crashes were recorded along Mount Isa Duchess Road in the most recent 10-year period, three of which resulted in hospitalisations, one of which resulted in medical treatment being administered at the scene and two of which resulted in minor injury. Despite the slower speed limit, the provided on-street and off-street parking results in a high number of conflicting movements at midblocks which can cause crashes. Such a crash has the potential to result in minor injury.	Occasional	Minor	Medium	Apply mitigation measure #23 from Table 51.	Improbable	Minor	Low
83	Diamantina Developmental Road	Intersection 83.1 Diamantina Developmental Road and Twenty Third Avenue	Measured SISD: 135m Required SISD: 151m Insufficient SISD to west, limited by vegetation. This has the potential to result in a moderate-speed collision between two vehicles causing minor injury.	Improbable	Minor	Medium	Apply mitigation measures #8 to #10 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		
		Driveway 83.A Diamantina Developmental Road and Northern Access to Mount Isa Substation Laydown	Measured SD: 80m Required SD: 178m Poor sight distance to north, limited by crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Minor	Medium	Apply mitigation measure #11 from Table 51.	Improbable	Minor	Low
			Measured SD: 130m Required SD: 178m Insufficient sight distance to south, limited by sign. This has the potential to result in a moderate-speed collision between two vehicles causing serious injury.	Occasional	Minor	Medium	Apply mitigation measure #12 from Table 51.	Expected to have sufficient sight distance with removal of vegetation		

Road ID	Road section	Location	Issue	Initial risk			Additional management measures	Residual risk		
				Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
87	Boulia Mount Isa Highway	Intersection 87.1 Boulia Mount Isa Highway and Moran Road	Measured SISD: 200m Required SISD: 233m Insufficient SISD to north, limited by vegetation and crest. This has the potential to result in a high-speed collision between two vehicles causing serious injury.	Occasional	Serious	High	Apply mitigation measures #8 to #11 from Table 51.	Improbable	Serious	Medium
			Measured ASD: 75m Required ASD: 233m Poor approach sight distance, limited by vegetation. Note that this may improve to 150m+ with vegetation removal. Note that vehicles would likely be travelling slower than the 100km/h rural default speed limit. Also note the location of a cattle grid 25m south-east of the intersection, which is likely to slow vehicles considerably, as is the floodway located approximately 110m south of the intersection. This has the potential to result in a moderate-speed side-on collision with another vehicle, or a single car collision with infrastructure opposite the minor road.	Improbable	Serious	Medium	Apply mitigation measures #8 to #10 from Table 51.	Improbable	Serious	Medium

Post implementation of mitigation measures, it is expected that there will be 23 medium risks, 4 low risks and 10 locations which would have sufficient sight distance with removal of vegetation. This results in a reduction of 21 high risks and 5 medium risks.

It is further noted that some improbable likelihood risks have remained as there is not a lower risk likelihood. Although the likelihood has not changed in this rating table, the risk of a crash is further decreased through the additional management measures.

There remains an ongoing operational risk due to any planned major maintenance or capital works programs along sections of the access route. This may increase short term safety risks for road users due to diverted traffic, congestion, and temporary traffic management. This is outside the remit of project controls.

5.4 Road condition risk assessment

The level of risk for each road has been determined with respect to the identified hazards.

Mitigation measures #13 to #15 from Table 51 are relevant for the road condition. The initial identified risks, and residual risks for road condition after applying avoidance, management and mitigation measures are shown in Table 58.

Table 58: Road condition risks

Road ID	Road name	Road surface type	Road condition	Speed limit	Additional Mitigation Measures	Visibility (general)	Initial risk			Residual risk		
							Likelihood	Consequence	Level of risk	Likelihood	Consequence	Level of risk
4	Townsville Port Road	Sealed	Excellent condition Minor polishing in the wheel path	Typically 100km/h, slowing at either end approaching Townsville Port and the Bruce Highway	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
5	Bruce Highway	Sealed	Excellent condition Minor expedient patching and polishing	Typically 100km/h, slowing to 80km/h at Ayr-Dalbeg intersection, 70km/h approaching Ayr and 50km/h through Ayr	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
6	Ayr Dalbeg Road	Sealed	Good condition Fading centreline, minor rutting/ depressions, minor potholing and edge breaks	Typically 100km/h, slowing to 60km/h east of Brown Road	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
7	Flinders Highway	Sealed	Good condition Various minor defects present along the extent including patching, cracking, surface wear and bleeding, polishing, delamination, shoving, corrugations and depressions. Infrequent more significant defects present at very infrequent intervals, such as wide filled cracking west of Maxwelton.	Typically 100 to 110km/h, slowing at towns along the extent	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
8	Ayr Ravenswood Road	Sealed through Ravenswood. Typically gravel or dirt thereafter other than at a steep descent at -20.047056, 146.949096	Poor condition Significant corrugation for extended periods, difficult to traverse floodways and minor laminations and cracking.	Typically 100km/h (due to the condition of the road, vehicles travel much more slowly)	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Probable	Minor	High	Improbable	Minor	Low
11	Burdekin Falls Dam Road	Sealed	Good condition Minor patching, transverse cracking, edge damage and stripping of seal.	Typically 100km/h, slowing to 60km/h through Mingela	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
15	Gregory Developmental Road (north)	Sealed	Excellent condition Very minor expedient patching	Typically 70km/h, slowing to 60km/h through Charters Towers	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
26	Gregory Developmental Road (south)	Sealed	Excellent condition Minor polishing in wheel path	100km/h for approximately 1km south of Flinders Highway, 110km/h thereafter.	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low

Road		Road surface			Additional	Visibility	Initial risk			Residual risk		
37	Aramac Torrens Creek Road	Sealed	Good condition Significant pothole at Mount Isa Line	Unposted - Assume 100km/h Queensland rural speed limit	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
45	Kennedy Developmental Road (south)	Sealed	Good condition Minor infrequent shoving, rutting, delineation, edge break and longitudinal cracking present. Minor rutting and depressions also present.	Typically 100km/h, slowing to 80km/h and then 50km/h approaching Hughenden	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
54	Richmond Winton Road	Sealed	Good condition Filled longitudinal cracking, minor corrugations in edgeline, signed section with rough surface, edge break.	100km/h	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
61	Julia Creek Kynuna Road	Sealed	Good condition Polishing in wheel path	Typically 100km/h, slowing to 60km/h in Julia Creek	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
68	Landsborough Highway	Sealed	Good condition Very minor polishing, minor shoving in edgeline, rutting in wheelpath and depressions.	60km/h at northern end, increasing to 100km/h approximately 750m south of Flinders Highway and furthermore to 110km/h 9.5km south of Flinders Highway	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
73	Barkly Highway	Sealed	Reasonable condition Significant polishing west of Cloncurry. Various minor defects including shoving in the edgeline, rutting, depressions, corrugations, potholing and expedient patching.	Typically 100km/h, slowing on approach to and through Cloncurry and Mount Isa	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Occasional	Minor	Medium	Improbable	Minor	Low
76	Burke Developmental Road	Sealed	Good condition Minor shoving in edgeline, rutting and polishing present.	Typically 80km/h, increasing to 100km/h in the northbound direction approximately 0.4km north of Burke Developmental Road/ Hensley Drive intersection	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
78	Cloncurry Duchess Road	Sealed	Good condition Polishing, minor rutting, edge break and edge drop-off present.	Not posted - assume 100km/h rural default speed limit	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low
81	Mount Isa Duchess Road	Sealed	Reasonable condition Minor corrugations, polishing, potholing, edge break, rutting, and cracking present.	60km/h through Mount Isa, increasing to 80km/h approximately 3.3km south of Barkly Highway intersection	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Occasional	Minor	Low	Improbable	Minor	Low
83	Diamantina Developmental Road	Sealed	Reasonable condition Edge break and cracking present near Oban Road, minor cracking and expedient patching further south.	60km/h through Mount Isa, increasing to 80km/h approximately 0.55km south of Oban Road intersection	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Occasional	Minor	Low	Improbable	Minor	Low
87	Boulia Mount Isa Highway	Sealed	Good condition Minor edge break and stripping present	80km/h, increasing to 100km/h approximately 1.7km south of Diamantina Developmental Road intersection	Apply mitigation measures #13 to #15 from Table 51	More than SSD	Improbable	Minor	Low	Improbable	Minor	Low

Applying the mitigation measures will not be expected to change the consequence of a crash but should the measures be applied; it would become improbable that the crash would occur as there would be minimal or no hazards.

Post mitigation, there are 19 low risks, a reduction in one road from high to low risk and another reduction of one road from medium to low risk.

5.5 Rail safety risk assessment

The rail assessment using the Australian Standards from Section 3.1.3 of this report has considered where there are identified issues or missing signage and line marking at rail crossings.

In addition, SIDRA Intersection traffic modelling has been completed for the AM and PM peak hours for rail crossings to determine whether issues could arise as a result of:

- Vehicle queues as a result of stopping for a train to pass extending into an intersection; and
- Vehicle queues back from an intersection extending to a rail line.

Information about the trains using the Mount Isa Rail Line has been sourced from the *Queensland Rail – Mount Isa System Information Pack (2017)* and details:

- The maximum train length is 1009m
- Trains between Stuart (Townsville) and Hughenden travel at 80km/h (i.e. 45 seconds to pass through a point); and
- Trains between Hughenden and Mount Isa travel at 60km/h (i.e. 60 seconds to pass through a point).

Based on the above, the following conservative assumptions have been included in the traffic models:

- Between Stuart (Townsville) and Hughenden vehicles stop for a train for 75 seconds (to allow for speed variation of the train plus wait time before the train arrives and after the train departs)
- Between Hughenden and Mount Isa vehicles stop for a train for 90 seconds; and
- Due to the nature of traffic movements from camps being condensed, the models assume all vehicles pass through the rail line in a 15 minute period.

Mitigation measures #16 to #21 are relevant for the rail assessment.

Where there is potential for drivers to queue across a rail line due to a downstream intersection, as per mitigation measure #21, we suggest use of KEEP TRACKS CLEAR signs from the Australian Standard AS1742.7-2016 Manual of uniform traffic control devices – Part 7: Railway crossings. The signs shown in Figure 48 are suitable options.

Figure 48: Keep tracks clear signage

The initial identified risks, and residual risks at rail crossings on SC roads after applying avoidance, management and mitigation measures are shown in Table 59.

Table 59: Rail residual risks

Rail Crossing Name	Issue	Initial risk			Additional management measures	Residual risk		
		Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
Pioneer Mill: Bruce Highway crossing	It is unknown as to whether rail crossing flashing signals ahead signage are provided on the westbound approach to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
	RAIL X pavement markings are not located on the northbound and southbound approaches to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Pioneer Mill – Ayr Dalbeg Road (east) crossing	Potentially insufficient sight distance to the rail crossing from the north-east, limited by vegetation and a horizontal curve. This has the potential to result in a moderate-speed between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #19 from Table 51.	Improbable	Serious	Medium
Pioneer Mill: Ayr Dalbeg Road (west) crossing	It is unknown whether no-overtaking lines are provided within the centreline on the eastbound and westbound approaches to the rail crossing. Should no-overtaking lines not be provided, drivers may overtake on approach to a rail crossing, limiting their ability to if a train is approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Invicta Mill: Ayr Dalbeg Road (north) crossing	It is unknown as to whether rail crossing flashing signals ahead signage is provided on both the northbound and southbound approaches to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
	RAIL X pavement markings are not located on the northbound and southbound approaches to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in both the northbound and southbound direction. Should no overtaking lines be provided, the lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium

Rail Crossing Name	Issue	Initial risk			Additional management measures	Residual risk		
		Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
Invicta Mill: Ayr Dalbeg Road (south) crossing	It is unknown as to whether rail crossing flashing signals ahead signage is provided on both the northbound and southbound approaches to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
	RAIL X pavement markings are not located on the northbound and southbound approaches to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in both the northbound and southbound direction. Should no overtaking lines be provided, the lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Invicta Mill: Ayr Ravenswood Road (east) crossing	It is unknown as to whether rail crossing flashing signals ahead signage is provided on both the eastbound and westbound approaches to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
	RAIL X pavement markings are not located on the westbound approach to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Invicta Mill: Ayr Ravenswood Road (west) crossing	It is unknown as to whether rail crossing ahead/ rail crossing flashing signals ahead signage is provided on both the eastbound and westbound approaches to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium
	RAIL X pavement markings are not located on the eastbound and westbound approaches to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in both the eastbound and westbound direction. The lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium

Rail Crossing Name	Issue	Initial risk			Additional management measures	Residual risk		
		Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
Mount Isa Line: Braceborough Road (west) crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Laidlow crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
	There is potential for the queue back from the Flinders Highway/ Laidlow Crossing intersection to reach the rail line	Occasional	Serious	High	Apply mitigation measure #21 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Aramac Torrens Creek Road crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
	It is unknown whether RAIL X pavement markings are provided on the northbound approach to the rail crossing. The lack of RAIL X pavement marking may reduce a drivers awareness of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
	A stop line is not provided in the northbound direction and a give-way line in the southbound direction at the rail crossing. This has the potential to result in vehicles stopping too close to the rail line, resulting in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in the southbound direction. The lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Prairie Road crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Kennedy Energy Park Access Track crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Flinders Highway (east of Redcliffe Road) crossing	Rail crossing flashing signals ahead signage is not provided on the eastbound approach to the rail crossing. As such, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Kennedy Developmental Road (south) crossing	It is unknown as to whether rail crossing ahead signage is provided on the northbound approach to the rail crossing. Should no rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium
	It is unknown as to whether rail crossing diagrammatic warning assemblies are provided on the northbound approach to the rail crossing. Should no diagrammatic warning assemblies and rail crossing ahead signage be provided, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium

Rail Crossing Name	Issue	Initial risk			Additional management measures	Residual risk		
		Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
	A give-way line is not provided in the southbound direction at the rail crossing. This has the potential to result in vehicles stopping too close to the rail line, resulting in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
	It is unknown as to whether no-overtaking lines are provided within the centreline on the northbound and southbound approaches to the rail crossing. Should no-overtaking lines not be provided, drivers may overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Potentially apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82) crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
	There is potential for the queue back from the Flinders Highway/ Unnamed Road (off Flinders Highway - to PTL-FLR_284 to FLR-DJR_82) intersection to reach the rail line	Occasional	Serious	High	Apply mitigation measure #21 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Thornhill Tamworth Road crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Yorkshire Road crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Julia Creek Kynuna Road crossing	There is potential for the queue back from the rail line to extend to the Flinders Highway	Occasional	Serious	High	Apply mitigation measure #20 from Table 51.	Improbable	Serious	Medium
	Rail crossing ahead signage is not provided on the southbound approach to the rail crossing. As such, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium
	Rail crossing diagrammatic warning assemblies are not provided on the southbound approach to the rail crossing. As such, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #16 from Table 51.	Improbable	Serious	Medium
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in both the northbound and southbound direction. The lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Flinders Highway (Cloncurry) crossing	Rail crossing flashing signals ahead signage is not provided on the eastbound approach to the rail crossing. As such, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium

Rail Crossing Name	Issue	Initial risk			Additional management measures	Residual risk		
		Likelihood	Consequence	Level of risk		Likelihood	Consequence	Level of risk
	No-overtaking lines are not provided within the centreline on approach to the rail crossing in the eastbound direction. The lack of no-overtaking lines enables drivers to overtake on approach to rail crossings, reducing their ability to stop during times in which a train may be approaching. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #18 from Table 51.	Improbable	Serious	Medium
Mount Isa Line: Diamantina Developmental Road crossing	Rail crossing flashing signals ahead signage is not provided on the westbound approach to the rail crossing. As such, drivers may be unaware of an upcoming rail crossing, reducing the time in which they have to stop at a rail crossing. This has the potential to result in a moderate-speed collision between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #17 from Table 51.	Improbable	Serious	Medium
	Insufficient (~85m) sight distance to the rail crossing from the west, limited by vegetation and a dip. This has the potential to result in a moderate-speed between a vehicle and a train, causing death or serious injury.	Occasional	Serious	High	Apply mitigation measure #19 from Table 51.	Improbable	Serious	Medium

Post mitigation, there are 41 medium risks, a reduction in 41 risks from high to medium.

5.6 Traffic and road impacts during the operational and maintenance phase

Inspections of the transmission lines will be completed periodically, generating very low traffic volumes. The substations would also have low operational traffic volumes, expected to be less than one vehicle per day. Additional light and heavy vehicle movements may occur during minor and major maintenance outages.

Based on this, the traffic and road risks during the operation and maintenance phase are lower than the construction traffic risks due to the significantly lower traffic volumes.

5.7 Inspection and monitoring

There are many cases where additional monitoring will be required during the life of the project, these can be broken down into maintenance of vegetation to maintain adequate sight distances, adequate maintenance of gravel roads, monitoring all roads for deterioration of road condition, and reporting crashes.

5.7.1 Vegetation growth

During the site investigations there were various locations where the sight distances at intersections could be greatly increased by regular maintenance of the surrounding vegetation. The required maintenance includes cutting grass and/or removal of tree branches. It is recommended that prior to construction phase commencing, in consultation with the relevant road authority, vegetation is cleared at the locations identified as having poor sight distances by the JV. It is recommended that these locations are then checked periodically, and vegetation cleared where necessary in consultation with the road owner.

Once construction commences, the periodic checks are to be undertaken by the JV. The JV should consult with the road owner to determine whether they would like a representative present at the periodic checks.

5.7.2 Road monitoring

While the road defects that were observed during the site investigations may be rectified prior to the project's construction phase commencing, they show the general condition of the roads and what could be expected during the project. None of the contacted Councils have future works programmes for the proposed project period, with the proposed works only programmed one year ahead.

It is recommended that prior to construction, a detailed dilapidation survey be performed. Areas of particular concern should be rectified and recorded as such in negotiation with the relevant road authority.

It is recommended that the access routes are continually monitored by construction work drivers, with poor/ degrading conditions reported as part of their daily driver records. Any specific issues should be closely monitored and rectified where necessary. Periodic surveys from the construction contractor should be undertaken to mitigate the risk of drivers not reporting issues.

5.7.3 Gravel road maintenance

Many of the gravel roads that were visited were in poor condition with rutting and potholes being prevalent. The increase in heavy vehicle traffic on these roads will increase the rate of degradation. Close monitoring of the gravel roads will give early warning to enable early intervention and prevent further damage to the pavement condition.

It is recommended that prior to construction, all gravel roads along the access route are assessed for areas of poor condition and recorded as part of a dilapidation survey. Areas of particular concern should be rectified and recorded as such in negotiation with the relevant road authority.

It is recommended that the gravel roads are continually monitored by drivers, with poor/ degrading conditions reported as part of their daily driver records. Any specific issues should be closely monitored and rectified where necessary. Additional surveys by the contractor should be undertaken to mitigate the risk of drivers not reporting issues.

5.7.4 Crash reporting

Project-related crashes along the project routes are to be reported to the relevant authorities and to the responsible project personnel. The potential causes of the accident should be investigated, and where appropriate action(s) taken such as those recommended in this report (road maintenance, vegetation clearance, additional signage).

5.7.5 Construction work driver consultation

Drivers of both heavy and light vehicles should be consulted during the life of the project to determine if they have any concerns along the route. Drivers are a valuable resources for condition monitoring as they can enable early detection of problem areas that may need further assessment.

Drivers should also be regularly briefed of risks or issues associated with particular sections of the route they will be driving as part of their upcoming shift(s).

It is also recommended that heavy and light vehicle drivers are regularly consulted regarding risks and issues with the access routes being used.

5.7.6 Post construction inspection

Inspections should be completed post construction in conjunction with the road owner. The mitigation measures in Table 51 are relevant to any post construction remediation for public roads. Remediation should be carried out in a timely manner post construction.

5.7.7 Traffic management plan

A traffic management plan provides the means of planning and implementing a road work operation that will ensure that first and foremost road workers and road users are safe during construction works. A traffic management plan aims to minimise risk to workers and road users as a result of construction.

A traffic management plan also provides guidance through or around a construction site, advises drivers of changing conditions and ensures that the performance of the road network is not unduly impacted and that inconvenience to road users is minimised.

It is expected that the Contractor(s) delivering the Project implement a Traffic Management Plan prepared in accordance with the requirements of Australian Standard AS1742.3-2019 Manual of uniform traffic control devices – Part 3: Traffic Control for Works on Roads. This will be required to manage safety risks, particularly at access points to construction sites and within construction sites.

Traffic management plans should include:

- Proposed vehicle routes
- Works times
- Traffic volumes
- Signage (speed and regulatory)
- Delineation (bollards, cones, markers)
- Pavement markings
- Detours
- Traffic control (electronic devices, human controllers, controlled site entry)
- Driver training
- Consideration for vulnerable road users (pedestrians, bicycles, motorcycles); and
- Lighting.

5.8 Special permit vehicles

OSOM vehicles which require a special permit will be required for transportation and delivery of the modular buildings and other oversized electrical equipment at the substations. The size of these vehicles is currently unknown; and therefore, the following is recommended:

- Once the size of the vehicles are known, the exact route of the vehicle is assessed and specified based on road geometry, condition, and safety considerations
- The oversized vehicle travels to site with escort vehicle(s); and
- Appropriate traffic management is in place when the vehicle is accessing / egressing the site, in accordance with the requirements of Australian Standard AS1742.7-2016 Manual of uniform traffic control devices – Part 7: Railway crossings.

6. Pavement Impact Assessment

6.1 Assumptions

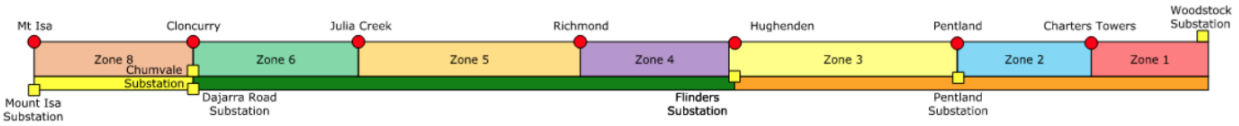
The following assumptions have been adopted as part of the Pavement Impact Assessment (PIA):

- Background and Project loadings have been assigned in accordance with TMR's Pavement Impact Assessment Note (2018) as follows:
  - Background SARs on sealed roads:
    - Bruce Highway = 2.9 SAR4s/HV
    - All other roads = 3.2 SAR4s/HV
  - All roads are assumed to be granular pavement (GN), with a damage unit of ESA/ SAR4
  - The average marginal cost for GN pavements noted in Table 6 of the Note of 13.60 cents/ SAR-km has been adopted for all roads
  - The following information extracted from Table 3 of the note states the adopted SAR4 values for loaded and unloaded vehicles:

	Class									
	3	4	5	6	7	8	9	10	11	12
Unloaded SAR4	0.54	0.5	0.46	0.6	0.56	0.52	0.51	0.53	0.55	0.58
Loaded SAR4	2.98	3.57	4.09	4.43	5.02	5.61	4.93	6.3	8.34	11.75

- Background traffic has been calculated for all TMR roads within the scope of the assessment based on traffic data available from the TMR counters kml file (latest data generally for either 2019 or 2021) and extrapolated forward to the construction period. Traffic growth rate was calculated based on historic growth rate from previous data points at each counter. Where the calculated growth rate was negative, a presumptive 1% growth rate was adopted
- Traffic generated for the project has been based on traffic analysis completed as part of this TIA. Refer to Section 5 of this report for traffic breakdown
- This assessment separates the generated traffic into sections centred around each camp or local accommodation hub as follows:
  - Mount Isa
  - Cloncurry
  - Julia Creek
  - Richmond
  - Hughenden
  - Pentland
  - Charters Towers; and
  - Woodstock.

  Camp operation traffic is available for all above camp locations with the exception of Mount Isa and Woodstock. Traffic for these camps was estimated based on the traffic for all other camps.
- For the PIA, the traffic generated as part of the project has been broken down as follows:
  - Camp Establishment traffic – centred around camps/ accommodation
  - Substation traffic – centred around camps, based on substation locations noted in traffic management plan for the project. Refer to below extract from Figure 5 of the traffic management plan – project zoning plan



- Daily operational traffic – centred around camps/ accommodation; and
- Transporting tower components to site. **All tower deliveries come from Townsville. 8 B-Double movements/ tower have been allowed for – this is a major contributor to the total traffic increase along the highways.**

All camps have been designated a radius around which traffic is generated, based on the CopperString 2.0 Final ECI Submission TiLOS document which shows a distance corresponding to each camp. All camps have been assumed to be located at the midpoint of this distance, except Mount Isa which was assumed to be at the western end.

The above traffic movements have been assumed to approximate a linear distribution around camp extents or per distance from Townsville. Generated traffic volumes have been calculated every 5km for sections along the highway. Refer to Appendix E for all calculations.

- For all movements around camps, including substation traffic, outbound traffic (from camp to tower) is assumed to be loaded, and inbound traffic is assumed to be unloaded
- For tower deliveries from Townsville, all westbound traffic is assumed to be loaded, and eastbound traffic is assumed to be unloaded; and
- The timing of all traffic generation has been assumed to follow the *CopperString 2.0 Final ECI Submission TiLOS* document. An estimate of yearly traffic based on the peak values calculated for each traffic phase and the distributions shown in the document has been calculated for all sites – refer to Appendix E.

6.2 Impact scoping assessment

From the PIA, greater than 5% of the background traffic was generated for a given year on the roads detailed in Appendix F. A summary of the contributions per year corresponding to each camp is shown in Table 60:

Table 60: Total pavement contributions per camp per year

Camp	2024	2025	2026	2027	Total Contributions
Mount Isa	0	0	0	0	0
Cloncurry	0	$16,690.10	$132,125.28	$200,643.26	$349,458.64
Julia Creek	0	0	$396,827.32	$490,185.43	$887,012.75
Richmond	0	$24,229.28	$542,311.02	$472,238.78	$1,038,779.08
Hughenden	0	$494,734.78	$589,040.93	0	$1,083,775.71
Pentland	$25,095.31	$922,768.90	$469,280.78	$469,280.78	$1,886,425.78
Charters Towers	0	$187,311.66	$188,489.41	$140,429.52	$516,230.59
Woodstock	0	$34,753.43	$25,550.79	0	$60,304.22
Total	$25,095.31	$1,680,488.15	$2,343,625.53	$1,772,777.78	**$5,821,986.77**

6.3 Pavement contribution

From the PIA it has been calculated that the pavement contributions for the impacted segments of the SC roads from 2024-2027 (site establishment and construction phases) is $5,821,896.77. Refer to Appendix E for PIA calculations.

The above is a theoretical estimate only based on the assumptions discussed in Section 6.1, including historical base rates. The estimate shall be used as a guide only. A Road Use Agreement that considers the above as well as maintenance obligations etc. falls outside the scope of this Report.

7. Summary

An assessment of the CopperString 2032 project-related vehicle impacts on the operation, condition and safety of the public road network has been undertaken with reference to relevant Australian Standards and Guidelines.

The analysis presented in this report is summarised as follows:

Traffic assessment

- The completed assessment concludes that the increase in traffic volumes would not reduce the road network operation to unacceptable levels. However, there are some roads where the traffic volumes are above the practical capacity based on the road width. Mitigation has been proposed for some of these roads where appropriate
- There are several locations throughout the route with insufficient existing sight distances. With increased traffic volumes, there is an increased risk of crashes. Through vegetation clearance and signage installation, both prior to construction and ongoing maintenance during construction, this risk can be reduced
- Turning paths (shown in Appendix C) undertaken on road bends on Ayr Ravenswood Road indicate that the road width is not sufficient for two heavy vehicles to pass each other. Suitable mitigation should be applied
- There are a small number of areas with local schools, which introduces a crash risk associated with additional traffic volumes and heavy vehicles. The recommendation is to limit travel during peak school drop-off and pick-up times and brief the community and drivers of the construction traffic and associated risks
- Construction access suitability is predominantly impacted by the condition of the road, which is variable across the proposed access routes. With regular monitoring and maintenance undertaken prior to and during construction, the risk of crashes due to poor road condition can be appropriately managed; and
- The operation and maintenance phase risk is negligible, with no recommended actions required for implementation.

A summary of the required mitigations is shown in Table 61, noting that where the initial risk due to road condition was considered low, it was not included.

Table 61: Summary of required mitigations

Road ID	Road Name	Existing Issue Summary	Required Mitigation Summary
4	Townsville Port Road	Concentrated specific crash history.	Provide safety training for drivers.
5	Bruce Highway	Concentrated specific crash history.	Provide safety training for drivers.
		Rail crossings do not meet relevant standards.	Install relevant rail signage and linemarking.
6	Ayr Dalbeg Road	Rail crossings do not meet relevant standards.	Install relevant rail signage and linemarking.

Road ID	Road Name	Existing Issue Summary	Required Mitigation Summary
7	Flinders Highway	Concentrated specific crash history.	Provide safety training for drivers.
		Missing turn treatments at several intersections.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Sight distances at various intersections/ driveways/ approaches do not meet relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance, contact the relevant road authority to get it removed.
		Rail crossings do not meet relevant standards.	Install relevant rail crossing signage and linemarking.
		Existing intersection geometry may not be suitable to accommodate construction vehicles.	Upgrade intersections to ensure there is sufficient space for vehicles to safely manoeuvre.
		Potential queuing back onto Flinders Highway due to rail crossings on side roads.	Inform drivers as to the location of rail crossings and instruct them to avoid queuing when trains are crossing, by continuing ahead on the Flinders Highway and turning around, or by other means.
8	Ayr Ravenswood Road	Road width too narrow for two-way traffic.	Use traffic management OR complete road/ shoulder widening.
		Road in poor condition.	Inspect the condition of the road prior to construction works, encourage drivers to report road condition concerns, make road repairs where warranted.
		Road has sections of tight geometry.	Use traffic management or consider changing vehicle types, use alternative access route, carry out minor shoulder widening works, design and install advance warning signage.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Rail crossings do not meet relevant standards.	Install relevant rail crossing signage and linemarking.

Road ID	Road Name	Existing Issue Summary	Required Mitigation Summary
		Sight distances at driveway does not meet relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance, contact the relevant road authority to get it removed.
11	Burdekin Falls Dam Road	Road width too narrow for two-way traffic.	Use traffic management OR complete road/ shoulder widening.
		Missing turn treatments at several intersections.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		A turn treatment is required to be added at a driveway entry to the proposed construction access road.	Add a turn treatment that is sufficient for the proposed peak construction traffic volumes.
		Sight distances at various intersections/ driveways do not meet the relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance.
15	Gregory Developmental Road (north)	Concentrated specific crash history.	Provide safety training for drivers.
		Missing turn treatments at an intersection.	Add a turn treatments that is sufficient for the proposed peak construction traffic volumes.
26	Gregory Developmental Road (sorth)	Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
37	Aramac Torrens Creek Road	Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Rail crossing does not meet relevant standards.	Install relevant rail crossing signage and linemarking.
45	Kennedy Developmental Road (south)	Sight distances at various driveways do not meet the relevant requirements.	Design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance.
		Missing turn treatments at several intersections.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Turn treatments are required to be added at several driveway entries to the proposed construction access	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.

Road ID	Road Name	Existing Issue Summary	Required Mitigation Summary
		road.	
		Rail crossing does not meet relevant standards.	Install relevant rail crossing signage and linemarking.
54	Richmond Winton Road	Road width too narrow for two-way traffic.	Use traffic management OR complete road/ shoulder widening.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
61	Julia Creek Kynuna Road	Road width too narrow for two-way traffic.	Use traffic management OR complete road/ shoulder widening.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Rail crossing does not meet relevant standards.	Install relevant rail crossing signage and linemarking.
68	Landsborough Highway	Sight distances at one driveway does not meet the relevant requirements.	Design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
73	Barkly Highway	Concentrated specific crash history.	Provide safety training for drivers.
		Missing turn treatments at several intersections.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Sight distances at various intersections/ driveways/ approaches do not meet the relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance.
		Road in reasonable condition.	Inspect the condition of the road prior to construction works, encourage drivers to report road condition concerns, make road repairs where warranted.
76	Burke Developmental Road	Turn treatments are required to be added at the proposed access to the Cloncurry Camp Hub.	Add turn treatments that are sufficient for the proposed peak traffic volumes at the camp hub.

Road ID	Road Name	Existing Issue Summary	Required Mitigation Summary
78	Cloncurry Duchess Road	Turn treatments are required to be added at several driveway entries to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
81	Mount Isa Duchess Road	Concentrated specific crash history.	Provide safety training for drivers.
		Road in reasonable condition.	Inspect the condition of the road prior to construction works, encourage drivers to report road condition concerns, make road repairs where warranted.
83	Diamantina Developmental Road	Sight distances at various intersections/ driveways do not meet the relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage, where Council/ TMR-owned road furniture is obstructing sight distance.
		Turn treatments are required to be added at a driveway entry to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.
		Road in reasonable condition.	Inspect the condition of the road prior to construction works, encourage drivers to report road condition concerns, make road repairs where warranted.
		Existing intersection geometry may not be suitable to accommodate construction vehicles.	Upgrade intersections to ensure there is sufficient space for vehicles to safely manoeuvre.
		Insufficient sight distance at rail crossing.	Design and install advanced rail warning signage, clear obstructions such as vegetation/ signage, reduce the approach speed limit to the rail crossing.
87	Boulia Mount Isa Highway	Sight distances at various intersections/ approaches do not meet the relevant requirements.	Inspect the road prior to construction works, encourage drivers to report concerns, maintain vegetation where limiting, design and install advanced warning signage.
		Turn treatments are required to be added at a driveway entry to the proposed construction access road.	Add turn treatments that are sufficient for the proposed peak construction traffic volumes.

8. Certification

As a professional engineer registered by the Board of Professional Engineers of Queensland pursuant to the Professional Engineers Act 2002 as competent in my areas of nominated expertise, I understand and recognise:

- The significant role of engineering as a profession
- The community has a legitimate expectation that my certification affixed to this engineering work can be trusted; and
- I am responsible for ensuring its preparation has satisfied all necessary standards, conduct and contemporary practice.

As the responsible RPEQ, I certify:

- I am satisfied that all submitted components comprising this Traffic Impact Assessment, listed in the following table, have been completed in accordance with the *Guide to Traffic Impact Assessment* published by the Queensland Department of Transport and Main Roads and using sound engineering principles
- Where specialised areas of work have not been under my direct supervision, I have reviewed the outcomes of the work and consider the work and its outcomes as suitable for the purposes of this Traffic Impact Assessment
- The outcomes of this Traffic Impact Assessment are a true reflection of results of assessment; and
- I believe the strategies recommended for mitigating impacts by this Traffic Impact Assessment embrace contemporary practice initiatives and will deliver the desired outcomes.

Name:	Rebekah Ramm	Registration Number	29697
RPEQ Competency:	Civil		
Signature:		Date:	25/01/2024
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CopperString 2032 Detailed Project Program

Appendix A

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Types of Crashes

Appendix B

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Swept Paths Around Sharp Bends

Appendix C

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Swept Paths at TMR Intersections

Appendix D

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Pavement Calculations

Appendix E

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Roads Assessed for Pavement Calculations

Appendix F

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Road Condition Photos

Appendix G

Responses to Powerlink Comments

Appendix H

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CopperString 2032

Traffic Impact Assessment - TMR

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