Appendix 16.

SLR Consulting Australia (2020g) *Rum Jungle Rehabilitation – Stage 2A Detailed Design – Traffic Impact Assessment External Roads.* Report to the Department of Primary Industry and Resources, Northern Territory.

NORTHERN TERRITORY GOVERNMENT

Department of **Primary Industry and Resources**

RUM JUNGLE REHABILITATION - STAGE 2A DETAILED DESIGN

Traffic Impact Assessment
External Roads

Prepared for:

NT DPIR - Mines Division
GPO Box 4550
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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with NT DPIR - Mines Division (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
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1 Introduction

1.1 Background

The Northern Territory Government (NTG), represented by the Department of Primary Industry and Resources (DPIR), proposes the rehabilitation of the former Rum Jungle Mine site (the Project), located 6 km north of Batchelor, Northern Territory (NT).

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by the DPIR to provide engineering advice to inform the proposed rehabilitation strategy, including cost planning, for the Project. The Project plan is included at Appendix A.

The former Rum Jungle mine site is located approximately 105km south of Darwin (by road), to the north of Batchelor in the Northern Territory. The site was declared a Restricted Use Area in 1989 under the Soil Conservation and Land Utilisation Act (Northern Territory) and is closed to public access.

Mining and mineral processing occurred from 1954 to 1971 producing some 3,530 tonnes of uranium oxide and some 20,000 tonnes of copper concentrate.

Activities at the site led to significant environmental impacts primarily caused by acid rock drainage, resulting in pollution of the East Branch of the Finniss River. The site underwent rehabilitation from 1983 to 1986 at a total cost of $18.6 million.

The original objectives of the 1980's rehabilitation works were to:

- Achieve a major reduction in surface water pollution
- Reduce public health hazards, including radiation levels
- Reduce pollution in White's and Intermediate open cut pits; and
- Implement aesthetic improvements including revegetation.

The former Rum Jungle mine site contained within Area 4 of the Finniss River Land Claim (1981) was excluded from grant to the Finniss River Land Trust due to the concerns of the joint traditional Aboriginal owners of the site - Kungarakan and Warai. A decision in respect of the grant of the former Rum Jungle mine site is still pending.

Although at the time of the 1980's rehabilitation works the objectives were deemed to have been achieved, more recent studies have documented the gradual deterioration of the original rehabilitation works. In light of this and given advances in best practice standards in mine closure and rehabilitation, the Northern Territory and Commonwealth Governments recognise a need to develop an improved rehabilitation strategy for the site so that the quality objectives achieved in the 1980's can be improved in a modern context.

1.2 Proposed Rehabilitation Strategy

The scope of works for the Project was developed from an understanding of current site conditions, contamination processes and a Land Use Plan goals as established with Traditional Owners. There are several key elements that have been incorporated in the strategy in order to satisfy the cultural needs of sacred site Custodians.

1.2.1 Remediation Action Plan

The actions planned to address contamination processes and improve prospects of future land use are:

- Slow down or halt the AMD production reactions from waste rock onsite by consolidating waste rock into one of three new facilities based on PAF characteristics. These facilities are:
  - Main Pit backfill zone – 1.9 Mm^3 stored volume
  - Eastern WSF – 3.8 Mm^3 stored volume
  - Western WSF – 3.2 Mm^3 stored volume
- Slow down or halt the future generation and transportation mechanisms for copper and other metals in the new WSF by adopting leading practice methodology for storage of PAF waste rock.
- Treat existing groundwater sources (i.e. the Main and Intermediate WRDs) that contaminate the EBFR by pumping and treating these impacted waters.
- Treat other AMD-impacted groundwater that does not contribute to the EBFR copper load (i.e. old ore stockpile area) by pumping and treating these impacted waters.
- Isolate radiological and AMD affected soils at the Rum Jungle site and Mt Burton from environmental and human receptors by relocating these soils to the new WSFs on site.
- Isolate asbestos materials at the Rum Jungle site from environmental and human receptors by removing from surface soils and relocating to the new WSFs or by another approved means offsite.

Detail on these actions are described within the Design Report.

1.2.2 Reestablishment of Cultural Values

The actions that are planned to address the compromised environmental and cultural values that are not related to contamination processes are:

- Return the EBFR to its original course as far as possible.
- Restore land parcels that are poorly vegetated such as the Old Tailings Dam area and vine thicket stand.
- Revegetate new landforms to stabilise the surface and restore ecological function as far as practicable.

1.3 Assessment Scope

In order to support the rehabilitation strategy, a large volume of off-site materials will be required to be delivered to the Project site. A Traffic Impact Assessment (TIA) has therefore been undertaken to identify the potential impacts of the Project on the surrounding road network, and where appropriate, identify management and mitigation strategies.

The TIA has been carried out generally in accordance with Austroads *Guide to Traffic Management Part 12: Traffic Impacts of Developments* which provides the methodology for assessing a project's potential transport impacts.

It should be noted that this assessment does not present any consideration of the transport task on the roads internal to the site.

1.4 Report Structure

Table 1 details the structure of the TIA, including a brief description of the content of each section.

Table 1 TIA Report Structure

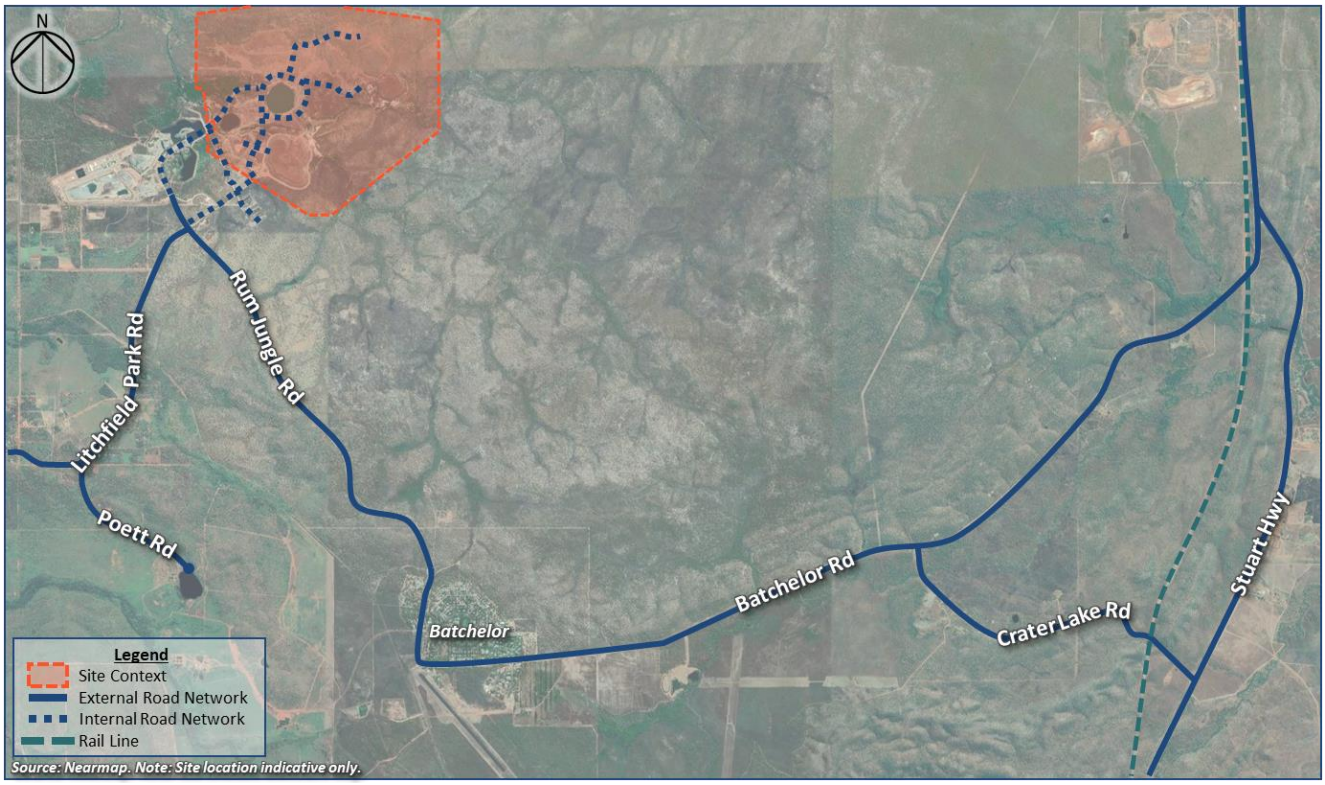
Section	Description
1	Identifies the Project context and the assessment scope.
2	Describes the Project including location, operational details and haulage arrangements.
3	Describes the existing transport network including traffic volumes, crash history, bus services and rail infrastructure.
4	Details the Project generated traffic demands and assessed traffic volumes.
5	Identifies the assessed intersections and presents a summary of the assessment.
6	Presents consideration of the cross-sectional requirements associated with the Project's transport task.
7	Presents consideration of the potential pavement impacts associated with the Project's transport task.
8	Presents consideration of the other traffic issues associated with the Project's transport task.
9	Identifies the requirements in relation to the future preparation of a Road Use Management plan.
10	Summarises the findings of the assessment.

2 Project Description

2.1 Site Overview

The Rum Jungle site is located approximately 105km south of Darwin within the local government jurisdiction of Coomalie Community Government Council (CCGC). Figure 1 details the location of the Rum Jungle site.

Figure 1 Site Context



2.2 Operational Details

The transport demands on the external road network associated with the remediation of the Rum Jungle site can be broadly grouped into the following categories:

- Haulage of cover material from the nearby borrow pit located at Rum Jungle South via Poett Road and Litchfield Park Road;
- Haulage of lime material from plant located in Mataranka via Stuart Highway to the south.
- Haulage of other construction inputs from more remote locations such as Darwin including fuel, equipment and other consumables;
- Commuting of staff to site on a daily basis.

It is anticipated that the remediation of the site will be largely complete in 7 years from commencement, with the material haulage transport task on the external road network completed within 5 years.

The quantities of material haulage from the external road network that are estimated to be required to facilitate the Project at the time of completion of this assessment are summarised in Table 2.

Table 2 Material Haulage Quantities

Year	Season	Weeks	Cover Material (m^3)		Lime (t)
			Low permeability	Growth medium	
1	Dry	30	27,042	83,206	10,626
	Wet	17	22,345	68,754	13,758
2	Dry	30	66,671	205,142	41,987
	Wet	17	22,912	126,282	20,663
3	Dry	30	65,107	211,105	65,235
	Wet	17	19,924	70,500	30,297
4	Dry	30	53,370	164,216	59,799
	Wet	18	19,953	81,192	24,050
5	Dry	30	152,730	118,146	18,725
	Wet	17	0	40,956	658
6	Dry	30	0	0	3,247
	Wet	17	0	0	0
7	Dry	30	0	0	0
Total	-	**313**	**450,054 m^3**	**1,169,499 m^3**	**289,045 t**

It is understood that the quantities detailed in Table 2 have been updated since the traffic analysis documented within this report was completed. SLR has assessed conservatively higher quantities than those represented in Table 2 to allow flexibility for incremental changes to the forecast material quantities to occur as project planning is further refined and as the project is delivered. The assessed material quantities are described in further detail within Section 4 of this report.

2.3 Site Access and Proposed Haulage Routes

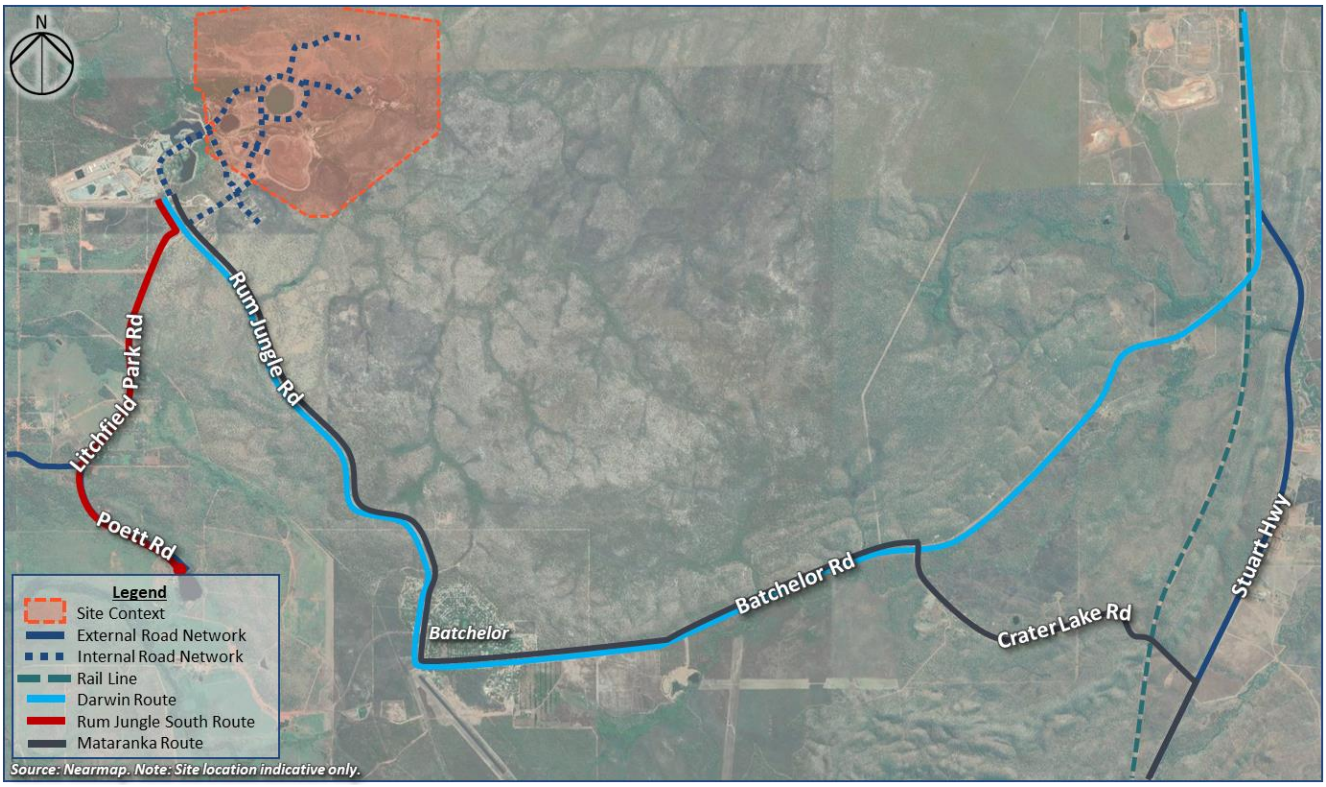
Access to the Rum Jungle site is currently provided via Rum Jungle Road north of its intersection with Litchfield Park Road.

Table 3 and Figure 2 detail the public road routes that are proposed to accommodate the transport task associated with the movement of materials to and from the Rum Jungle site. These routes include sections of Stuart Highway, Rum Jungle Road, Batchelor Road, Crater Lake Road, Litchfield Park Road and Poett Road.

Table 3 Proposed Haulage Routes

Route	Project Element	Road Sections
Rum Jungle South	Cover material haulage	Rum Jungle Rd – Litchfield Park Rd – Poett Rd
Darwin	Haulage of fuel, equipment, etc. Commuting of staff	Rum Jungle Rd – Batchelor Rd – Stuart Hwy (North)
Mataranka	Lime material haulage	Rum Jungle Rd – Batchelor Rd – Crater Lake Rd – Stuart Hwy (South)

Figure 2 Proposed Haulage Routes



3 Existing Road Conditions

SLR undertook a site inspection of the road network proximate to the Project during early December 2019 to confirm the condition of the existing public road network. The following sections summarise various findings both from a desktop assessment as well as the site inspection that are to be considered in the TIA.

3.1 Road Network

The key roads located within proximity to the Project are illustrated on Figure 3, with the detailed road characteristics summarised in Table 4.

Figure 3 Road Network

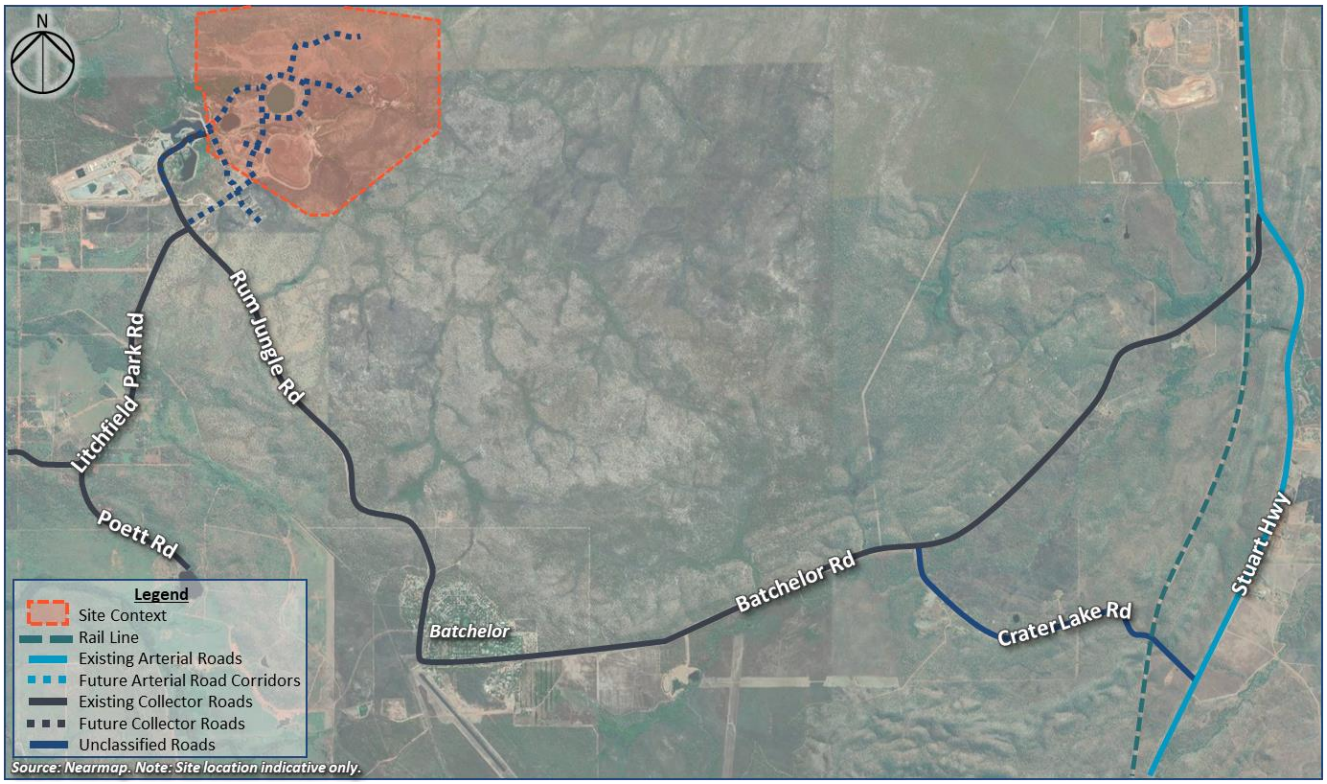
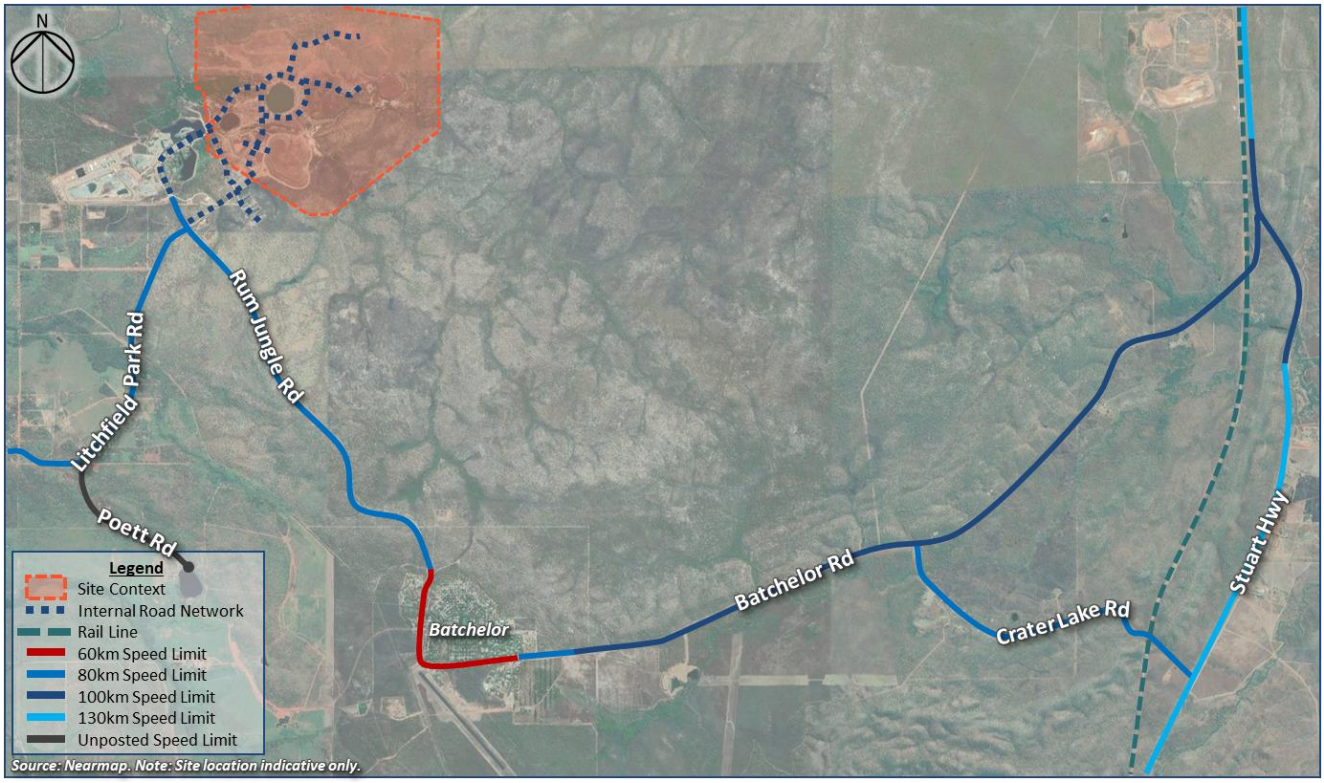


Table 4 Public Road Network

Road Name	Jurisdiction	LGA Classification
Rum Jungle Road	NT Gov	Existing Collector Road
Litchfield Park Road	NT Gov	Existing Collector Road
Batchelor Road	NT Gov	Existing Collector Road
Poett Road	CCGC	Existing Collector Road
Stuart Highway	NT Gov	Existing Arterial Road
Crater Lake Road	CCGC	Unclassified

The posted speed limits on the key roads are shown in Figure 4.

Figure 4 Posted Speed Limits



3.2 Intersection Traffic Volumes

During the site inspection, traffic survey cameras were installed that monitored traffic turning movements at the following intersections:

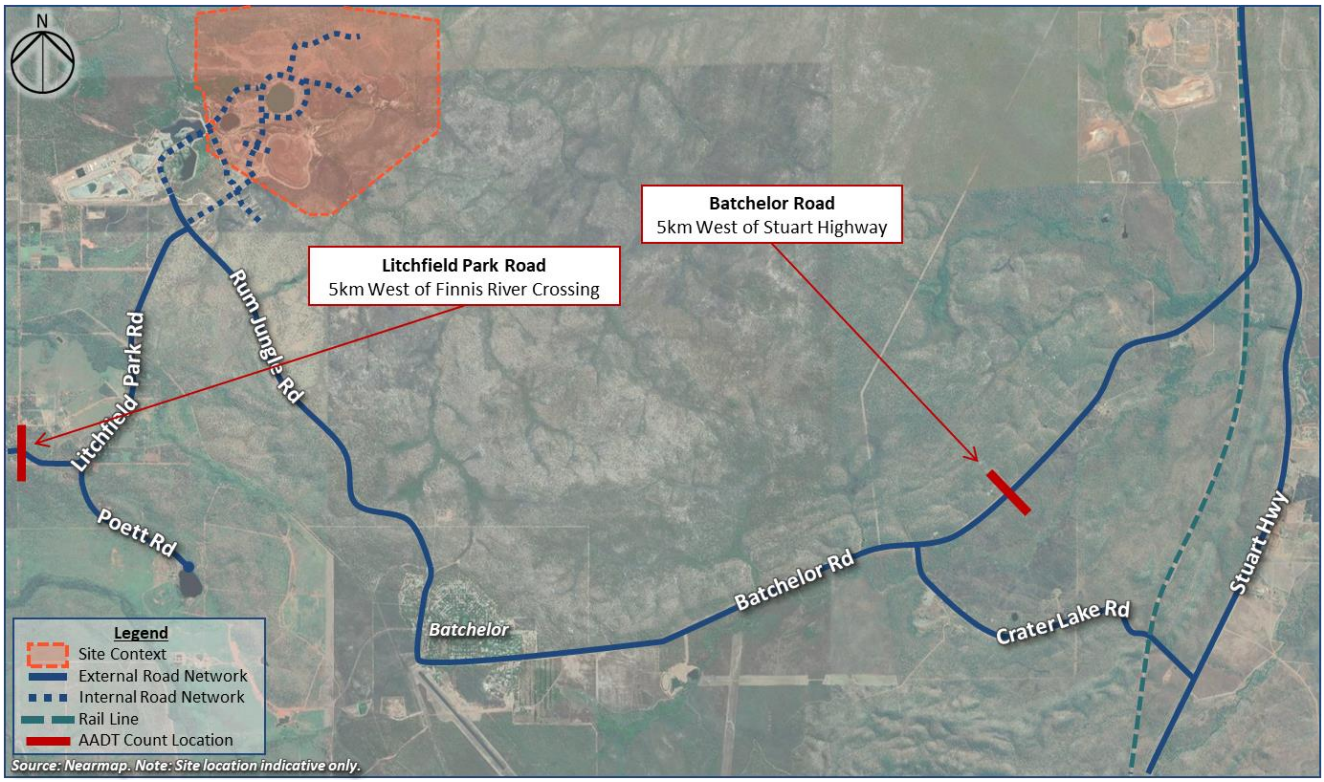
- Stuart Highway / Batchelor Road;
- Rum Jungle Road / Litchfield Park Road;
- Litchfield Park Road / Poett Road.

Unfortunately, due to the site inspection being undertaken during the annual wet season, the traffic volumes captured were very low and were not considered to be representative of the peak traffic volumes at these locations during the busy annual dry season. Therefore, the surveyed volumes were not directly utilised in this analysis.

Alternatively, the existing peak hour traffic volumes were sourced from Annual Average Daily Traffic (AADT) data published by the Northern Territory government's Department of Infrastructure, Planning and Logistics (DIPL) within their *Annual Traffic Report 2018* (NT Gov Traffic Report). The NT Gov Traffic Report provides annual AADT data at several locations throughout the Northern Territory. There are two count locations within this report that are relevant to this assessment as follows and shown in Figure 5:

- Batchelor Road – 5km West of Stuart Highway;
- Litchfield Park Road – 5km West of Finnis River Crossing.

Figure 5 AADT Count Locations – *Annual Traffic Report 2018*



The annual AADT data from the NT Gov Traffic Report at the two relevant count locations is reproduced in Figure 6 and Table 5. The report also provides monthly AADT data for the 2018 year, which is shown in Figure 7 and Table 6.

Figure 6 Annual AADT Data – *Annual Traffic Report 2018*

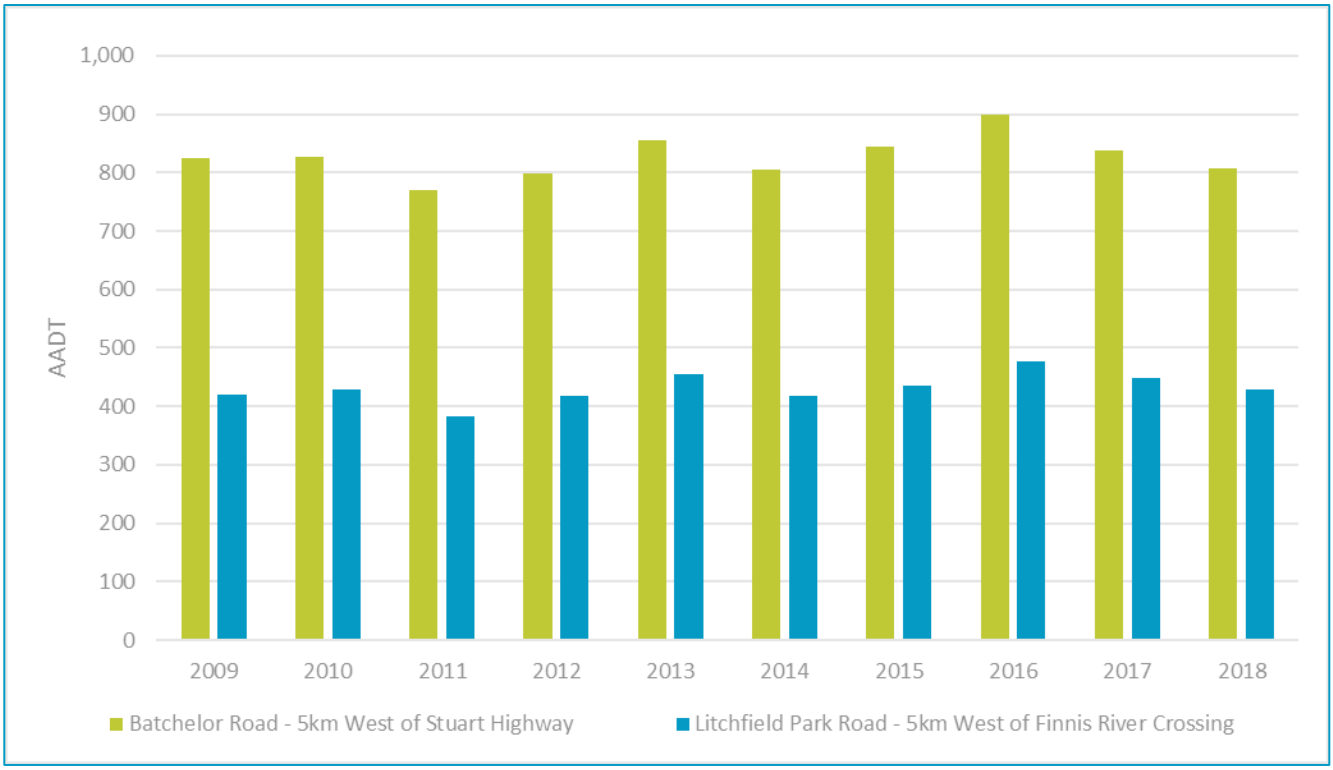


Table 5 Annual AADT Data – *Annual Traffic Report 2018*

Location	Direction	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Batchelor Road 5km West of Stuart Highway	Inbound	408	456	425	413	426	400	420	456	425	410
	Outbound	417	370	344	386	430	404	424	443	412	397
	Total	**825**	**826**	**769**	**799**	**856**	**804**	**844**	**899**	**837**	**807**
Litchfield Park Road 5km West of Finnis River Crossing	Inbound	202	207	190	199	217	196	204	227	212	202
	Outbound	217	222	193	218	237	222	232	249	237	227
	Total	**419**	**429**	**383**	**417**	**454**	**418**	**436**	**476**	**449**	**429**

Table 5 indicates that there is essentially no steady growth in background traffic on Batchelor Road and Litchfield Park Road, therefore no background traffic growth has been considered in this assessment.

Figure 7 Monthly AADT Data – *Annual Traffic Report 2018*

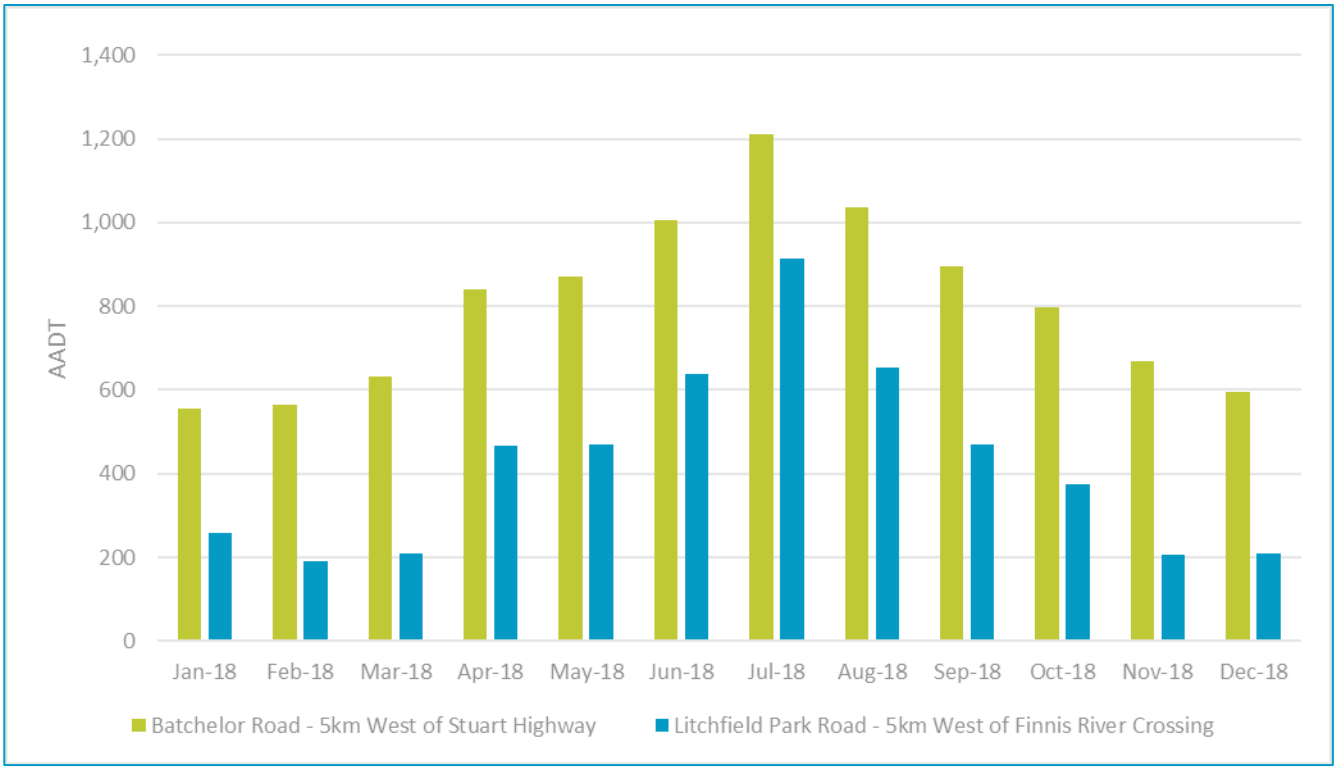


Table 6 Monthly AADT Data – *Annual Traffic Report 2018*

Location	Direction	2018											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Batchelor Road 5km West of Stuart Highway	Inbound	278	284	321	424	445	514	615	526	455	406	341	307
	Outbound	278	281	310	416	426	492	597	511	440	391	328	287
	Total	**556**	**565**	**631**	**840**	**871**	**1,006**	**1,212**	**1,037**	**895**	**797**	**669**	**594**
Litchfield Park Road 5km West of Finnis River Crossing	Inbound	127	95	102	223	219	296	428	306	220	176	96	98
	Outbound	132	96	106	244	251	341	487	347	250	199	110	112
	Total	**259**	**191**	**208**	**467**	**470**	**637**	**915**	**653**	**470**	**375**	**206**	**210**

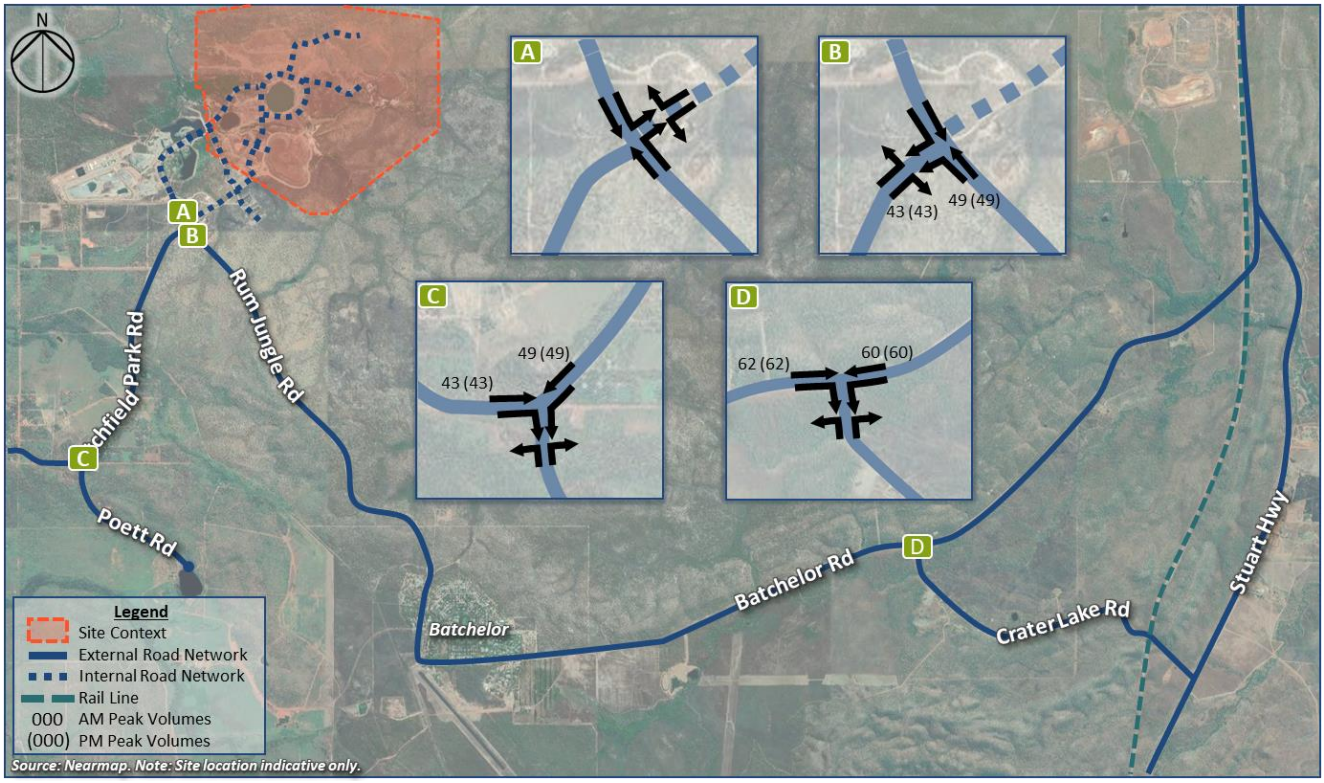
Table 6 indicates that the traffic volumes at these locations are very seasonal throughout the year:

- On Batchelor Road, the highest monthly AADT (July) is 118% higher that the lowest monthly AADT (January) and 104% higher than the December AADT (time of year of SLR's site inspection);
- On Litchfield Park Road, the highest monthly AADT (July) is 379% higher than the lowest monthly AADT (February) and 336% higher than the December AADT (time of year of SLR's site inspection).

Therefore, the existing volumes have been determined from the July 2018 AADT count rather than the traffic volumes surveyed during SLR site inspection. The July 2018 AADT count data is more representative of the peak traffic volumes on the roads surrounding the Rum Jungle site.

The existing peak-hour traffic volumes are summarised on Figure 8.

Figure 8 2018 Background Traffic Volumes



3.3 National Heavy Vehicle Regulator Approved Routes

A review of the National Heavy Vehicle Regulator (NHVR) approved routes has been completed in order to identify any potential constraints associated with vehicle access. Table 7 and Figure 9 summarise the existing NHVR road use conditions for various combination vehicles throughout the subject road network.

Table 7 NHVR Route Restrictions

Combination Vehicle Network		Description	Additional Comment
General Mass Limits (GML)	Road Train (32m)	No restrictions through the following roads: - Stuart Highway; - Batchelor Road; - Rum Jungle Road; - Litchfield Park Road. No approvals through the following roads: - Crater Lake Road; - Poett Road.	An application to the NHVR is required to allow heavy vehicle haulage tasks to be performed on the following roads: - Crater Lake Road; - Poett Road.
	Road Train (36.5m)		
	Road Train (53.5m)		
Higher Mass Limits (HML)			

Figure 9 NHVR Route Restrictions

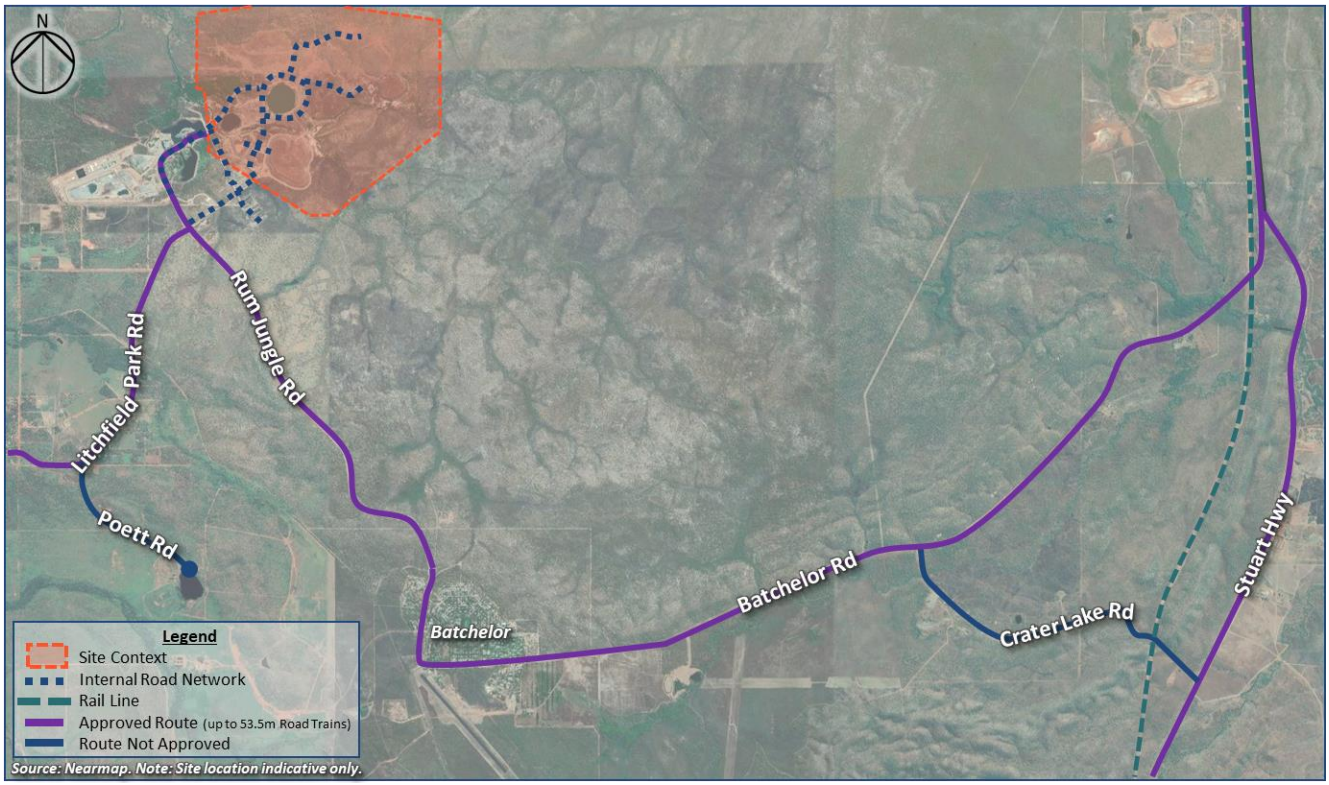


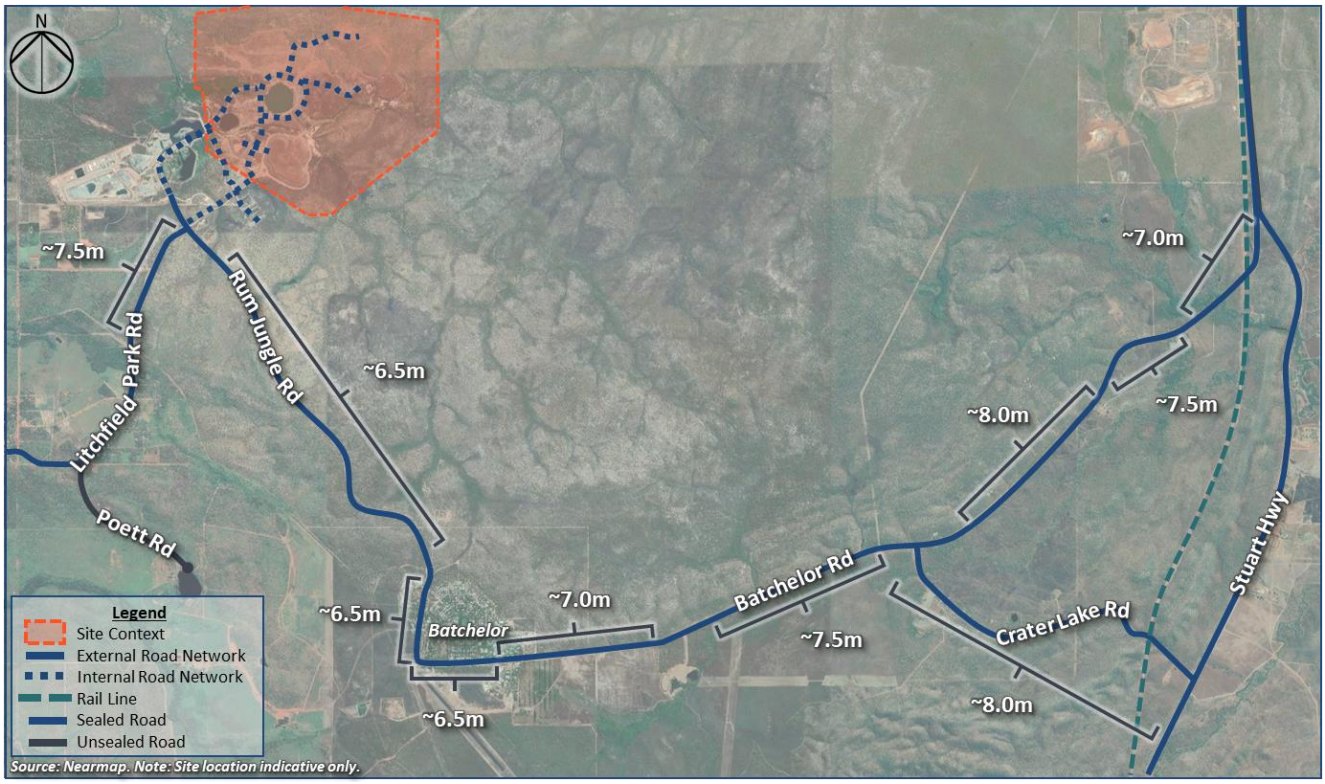
Table 7 and Figure 9 indicate that the majority of the external road network surrounding the Project site is approved for GML and HML for vehicles up to 53.5m in length. However, the two surrounding roads of Crater Lake Road and Poett Road are currently not approved for heavy vehicle activity and will require approval.

The proposed haulage routes for the Project, as shown within Section 2.3, indicate that traffic arriving to the Project site from the south via Stuart Highway is proposed to utilise Crater Lake Road. Crater Lake Road is not the only route available to these drivers, as they could also utilise Batchelor Road from Stuart Highway. However, this would result in an additional 16.0km per return trip. As documented in subsequent sections there are estimated to be a total of 9,375 return trips generated from the south via Stuart Highway, this equates to an additional 150,000 vehicle kilometres across the lifespan of the Project which will result in a greater impact on the pavement, safety and operation of the road sections on which the additional trips occur. Therefore, there is considered to be a considerable benefit in using Crater Lake Road as part of the haulage routes for the Project.

3.4 Road Pavement Geometry

Figure 10 shows the existing road network characteristics observed. Locations of all pavement measurements are provided at Appendix B.

Figure 10 Existing Road Cross-Section Summary



3.5 Crash History

Figure 11 and Table 8 detail the crash data provided by NT Gov for all crashes occurring between January 2015 and December 2019 for a total period of 5 years.

Figure 11 Study Road Network Crash Data

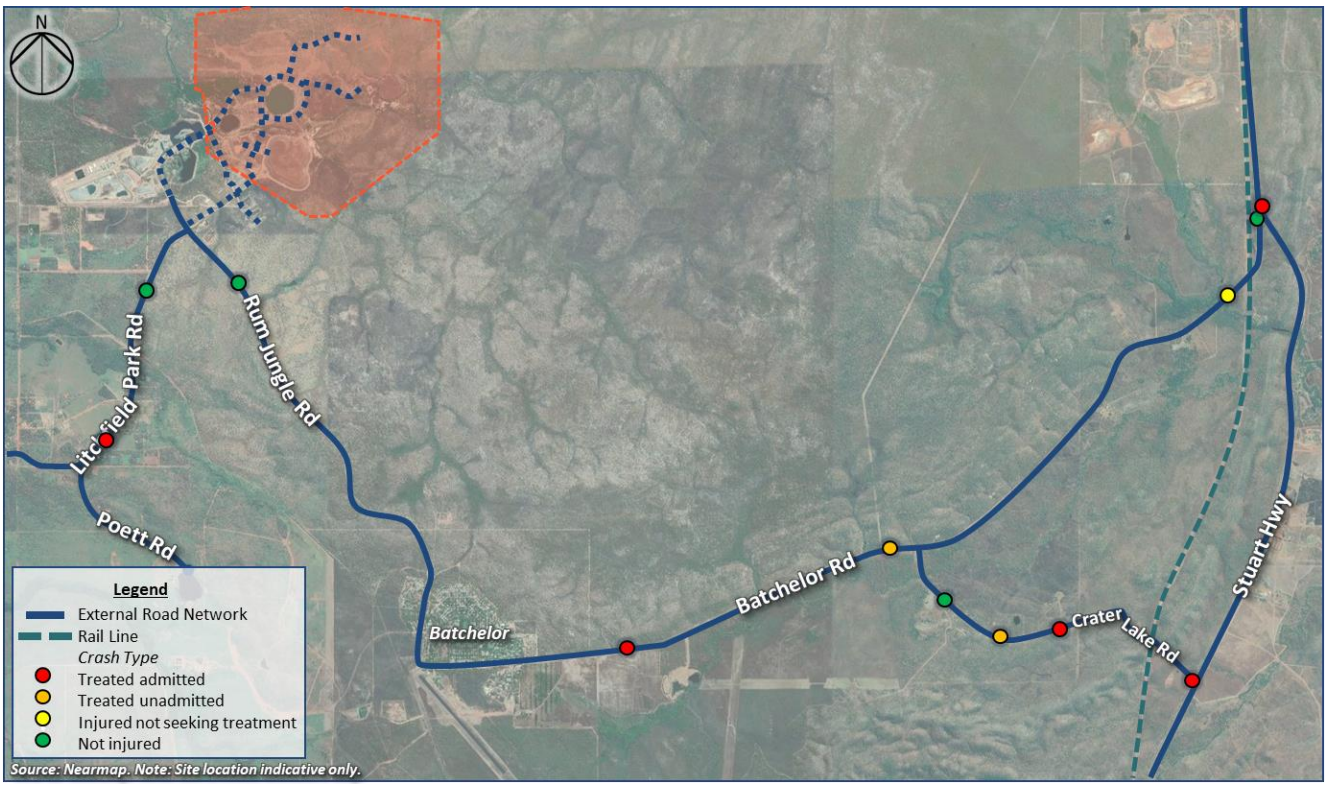


Table 8 Crash History Summary

Year	Location	Crash Type	Crash Severity
2015	Batchelor Road	Fell off motorcycle	Treated admitted
2016	Batchelor Road	Overturned	Injured not seeking treatment
2016	Crater Lake Road	Overturned	Treated admitted
2016	Rum Jungle Road	Other accident	Not injured
2016	Litchfield Park Road	Ran off road	Not injured
2016	Stuart Highway / Batchelor Road	Ran off road	Not injured
2016	Crater Lake Road / Stuart Highway	Other accident	Treated unadmitted
2017	Crater Lake Road	Hit fixed object	Not injured
2018	Batchelor Road	Other accident	Treated unadmitted
2018	Stuart Highway / Crater Lake Road	Angle collision	Treated admitted
2018	Litchfield Park Road	Ran off road	Treated admitted
2019	Stuart Highway	Hit pedestrian	Treated admitted

Figure 11 and Table 8 indicate that several crashes were recorded along the external road network surrounding the Project site during the period between 2015 and 2019.

3.6 School Bus Routes

It is understood that school buses operate in the area, however the nature of the services are time dependant such that they are reliant on the residential addresses of the enrolled students at any given time. Therefore, there is not considered to be substantial merit in considering this aspect in detail at this stage. It is recommended that a future Road Use Management Plan should consider school bus routes in more detail.

3.7 Rail Network

The Adelaide-Darwin railway system is located in proximity of the proposed Project and intersects with the surrounding road network at one location at Batchelor Road. The train line is currently used by The Ghan passenger train and freight trains operated by Genesee & Wyoming Australia.

The following are the two existing railway line crossing locations of relevance to the Project access routes as shown in Figure 12 and described as follows:

- Batchelor Road / Adelaide-Darwin railway line crossing location – open level crossing with signage and signalised boom gate control systems as shown in Figure 13.
- Crater Lake Road / Adelaide-Darwin railway line crossing location – grade-separated crossing as shown in Figure 14.

Figure 12 Surrounding Rail Network

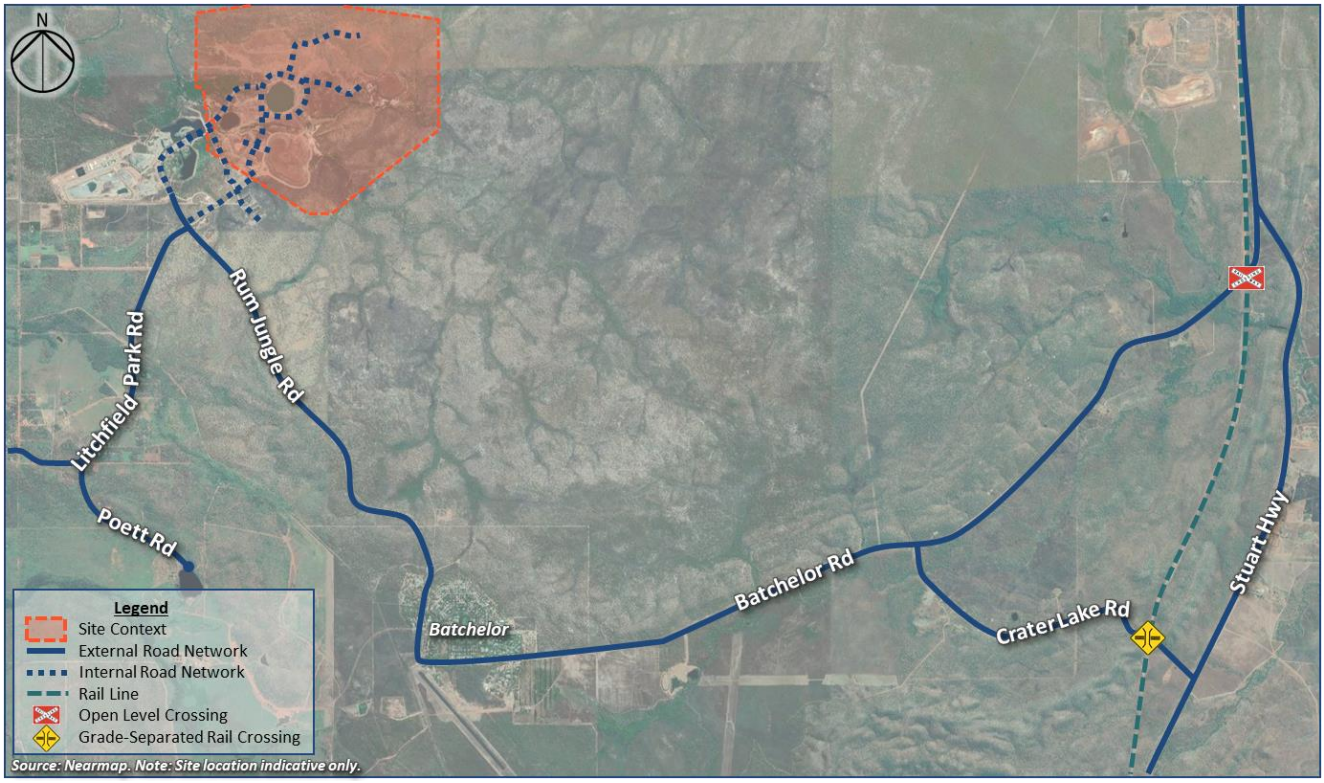


Figure 13 Batchelor Road Open Level Crossing

Figure 14 Crater Lake Road Grade-Separated Crossing

3.8 Batchelor Township

The township of Batchelor is located in the vicinity of the Project, with the proposed haulage roads Batchelor Road and Rum Jungle Road passing through the township. The frontage land uses of these roads as they pass through the town are shown in Figure 15.

Figure 15 Batchelor Township – Frontages to Batchelor Road and Rum Jungle Road

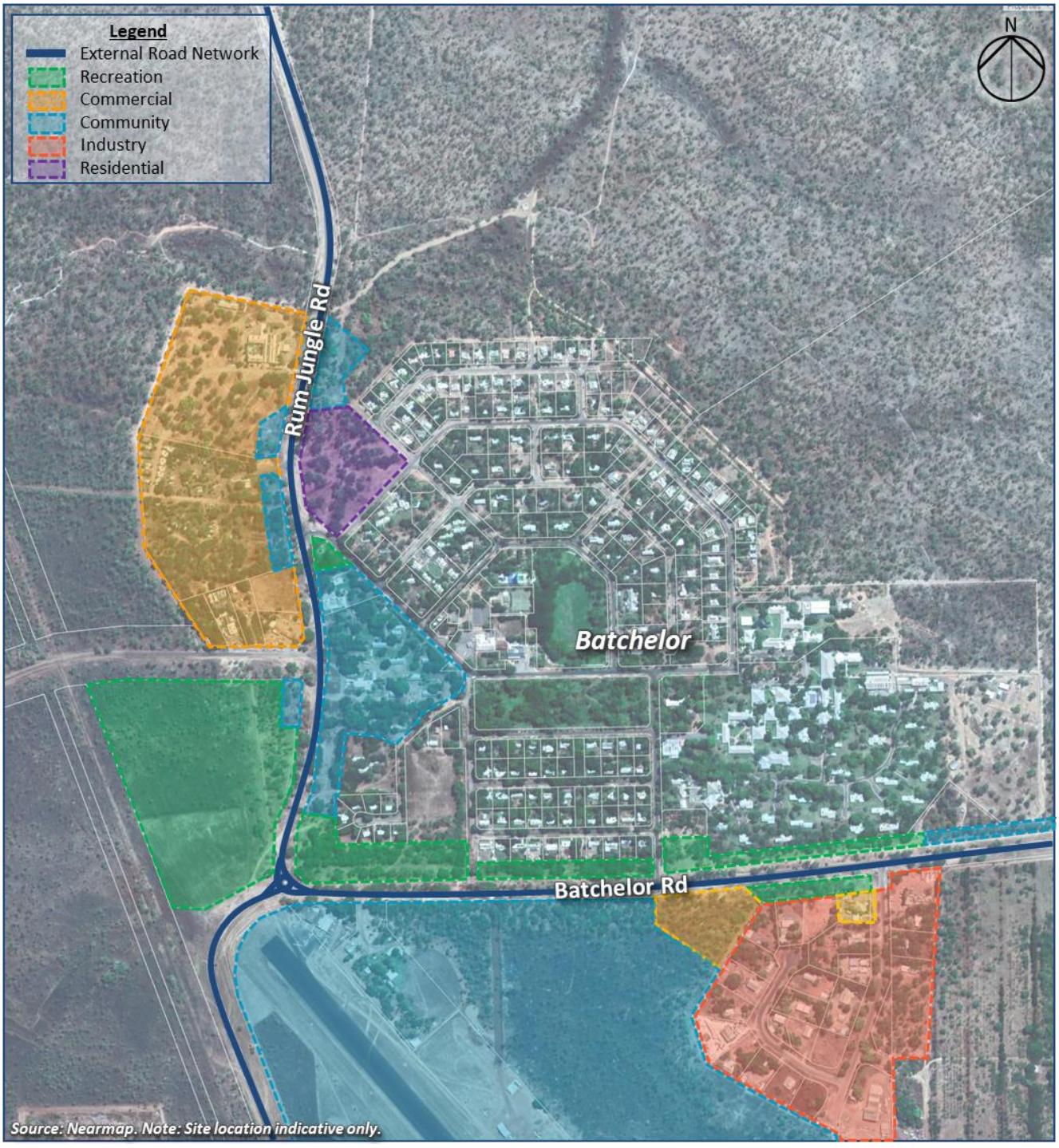


Figure 15 indicates that the existing land uses fronting Rum Jungle Road and Batchelor Road are mostly recreational and community uses, with small pockets of commercial and industrial frontages also. The more sensitive uses within the township such as residential use tend to be located somewhat distant from Rum Jungle Road and Batchelor Road.

4 Project Traffic Demands

The traffic generation of the Project has been forecast based upon the workforce and the proposed haulage of materials to and from the Rum Jungle site to facilitate remediation. The traffic generation estimates presented within this TIA have also considered other consequential road activity as a result of the Project, not just traffic directly associated with material haulage.

The traffic generating activities that have been considered as part of the traffic generation forecasts are as follows:

- Low permeability cover material haulage;
- Growth medium cover material haulage;
- Lime haulage;
- Workforce;
- Fuel deliveries;
- Waste removal;
- Miscellaneous deliveries;
- Equipment deliveries.

4.1 Vehicle Fleet

The vehicle fleet anticipated to be associated with the Project was derived through consultation with the project team and is detailed in Table 9.

Table 9 Project Vehicle Fleet

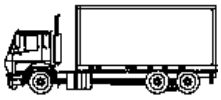
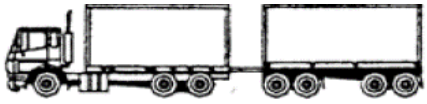
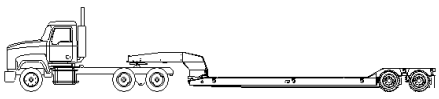
Vehicle	Typical Vehicle Profile	Haulage Material
Private vehicle (Capacity: 1 person)		Workforce
Coach / coaster bus (Capacity: 20 persons)		Workforce
Heavy rigid vehicle (HRV)		Waste removal Miscellaneous deliveries
Truck and dog (Approx. Capacity: 32t or 25 m3)		Low permeability cover material Growth medium cover material Lime
B double (Capacity: 53,000L)		Fuel deliveries
Float (Capacity: 1 equipment)		Equipment deliveries

Table 9 indicates that it has been assumed for the purposes of this assessment that the haulage of material (cover material and lime) will be undertaken by a haulage fleet comprising truck and dogs. It is noted that as is typical practice this assumption is subject to change dependent on the outcomes of the logistics procurement that ultimately occurs for the Project. It is anticipated that in practice the haulage vehicle fleet could potentially include truck and dogs, B-doubles or Performance Based Standards (PBS) A-Doubles (30m). Vehicles larger than this are however likely to be problematic, as the public road network would likely not meet the contemporary design standards. Furthermore, considering that the local road network accommodates some level of tourist activity, the presence of larger trucks may result in increased crash risk if significant road upgrades were not implemented.

For the purposes of the traffic generation estimates presented herein it has been assumed nominally that the haulage fleet will comprise truck and dogs as they have the lowest haulage capacity and therefore their assumed use results in conservative (i.e. high/worst-case) estimates of vehicle generation. In practice, it is foreseeable that haulage will instead be undertaken by larger vehicles such as B-doubles to maximise haulage efficiency.

It is identified that commentary is provided in subsequent sections in relation to the geometric considerations associated with the use of larger vehicle types. The adopted approach is intended to maintain a degree of flexibility for the Project whilst ensuring road authorities have confidence that a conservative assessment has been undertaken.

4.2 Total Traffic Generation

The forecast quantities of material to be hauled to the Project site on the external road network is reported in Section 2.2 of this report. It is however understood that the forecast detailed in Section 2.2 of this report has in fact been incrementally refined since the analysis presented herein was completed and further incremental refinement of the forecast is foreseeable as the Project is delivered.

To account for this, the traffic impact assessment has conservatively assessed slightly higher quantities of material haulage. This adopted approach ensures however that should the material requirements ultimately be slightly higher than currently planned it is unlikely to necessitate update of the assessment presented herein. The assessed values are still higher than the latest updated material quantities provided to SLR and therefore the outcomes of this assessment are still considered to be relevant.

The conservatively high quantities of material that have been adopted for the traffic generation forecasts are as follows:

- Low permeability cover material – 500,000 cubic metres;
- Growth medium cover material – 1,200,000 cubic metres;
- Lime – 300,000 tonnes.

The assessed quantities associated with each traffic generating activity are summarised in Table 10, with the total traffic generation summarised in Table 11.

Table 10 Traffic Generating Activities – Assessed Quantities

Year	Season	Weeks	Cover Material (m^3)		Lime (t)	Fuel (L)	Workforce (per day)	Equipment	Waste (per week)	Miscellaneous (per week)
			Low permeability	Growth medium						
1	Dry	30	30,043	85,376	11,029	2,957,911	49	54	1	1
	Wet	17	24,825	70,547	14,279	1,676,149	49	0	1	1
2	Dry	30	74,070	210,492	43,578	2,974,711	48	0	1	1
	Wet	17	25,455	129,575	21,446	1,685,669	48	0	1	1
3	Dry	30	72,332	216,611	67,707	2,974,711	48	0	1	1
	Wet	17	22,135	72,339	31,445	1,685,669	48	0	1	1
4	Dry	30	59,293	168,499	62,065	2,912,738	48	0	1	1
	Wet	18	22,167	83,310	24,962	1,747,643	48	0	1	1
5	Dry	30	169,680	121,227	19,435	2,907,511	40	0	1	1
	Wet	17	0	42,024	683	1,647,589	40	0	1	1
6	Dry	30	0	0	3,370	1,927,711	36	0	1	1
	Wet	17	0	0	0	1,092,369	36	0	1	1
7	Dry	30	0	0	0	84,000	22	0	1	1
Total	-	**313**	**500,000 m^3**	**1,200,000 m^3**	**300,000 t**	**26,274,380 L**	-	**54**	-	-

Table 11 Total Traffic Generation

Year	Season	Weeks	Cover Material		Lime	Fuel	Workforce	Equipment	Waste	Miscellaneous	Total
			Low permeability	Growth medium							
1	Dry	30	1,220	3,468	345	56	7,350	54	30	30	12,553
	Wet	17	1,009	2,866	446	32	4,165	0	17	17	8,551
2	Dry	30	3,009	8,551	1,362	56	7,200	0	30	30	20,238
	Wet	17	1,034	5,264	670	32	4,080	0	17	17	11,114
3	Dry	30	2,939	8,800	2,116	56	7,200	0	30	30	21,170
	Wet	17	899	2,939	983	32	4,080	0	17	17	8,966
4	Dry	30	2,409	6,845	1,940	55	7,200	0	30	30	18,509
	Wet	18	901	3,384	780	33	4,320	0	18	18	9,454
5	Dry	30	6,893	4,925	607	55	6,000	0	30	30	18,540
	Wet	17	0	1,707	21	31	3,400	0	17	17	5,194
6	Dry	30	0	0	105	36	5,400	0	30	30	5,602
	Wet	17	0	0	0	21	3,060	0	17	17	3,115
7	Dry	30	0	0	0	2	3,300	0	30	30	3,362
Total	-	**313**	**20,313**	**48,750**	**9,375**	**496**	**66,755**	**54**	**313**	**313**	**146,368**

Table 11 indicates that the dry season of the 3rd year is anticipated to generate the highest amount of traffic.

4.3 Peak Daily Traffic Generation

Table 11 indicated that the highest traffic generation is anticipated to occur within the dry season of the 3rd year of the Project.

The peak daily traffic generation of the Project within this season is summarised in Table 12.

Table 12 Forecast Peak Daily Traffic Demands

Project Element	Forecast Daily Return Trips
Low permeability cover material	31
Growth medium cover material	92
Lime	15
Workforce	17
Fuel deliveries	1
Waste removal	1
Miscellaneous deliveries	1
Equipment deliveries	0
Total	**158 daily return trips**

4.4 Traffic Distribution

Table 13 summarises the adopted in / out splits for the traffic generated by the Project.

Table 13 Project Traffic In / Out Split

Project Element	AM Peak		PM Peak	
	In	Out	In	Out
Low permeability cover material	10%	10%	10%	10%
Growth medium cover material	10%	10%	10%	10%
Lime	10%	10%	10%	10%
Workforce [1]	100%	0%	0%	100%
Fuel deliveries [2]	100%	100%	100%	100%
Waste removal [2]	100%	100%	100%	100%
Miscellaneous deliveries [2]	100%	100%	100%	100%
Equipment [2]	100%	100%	100%	100%

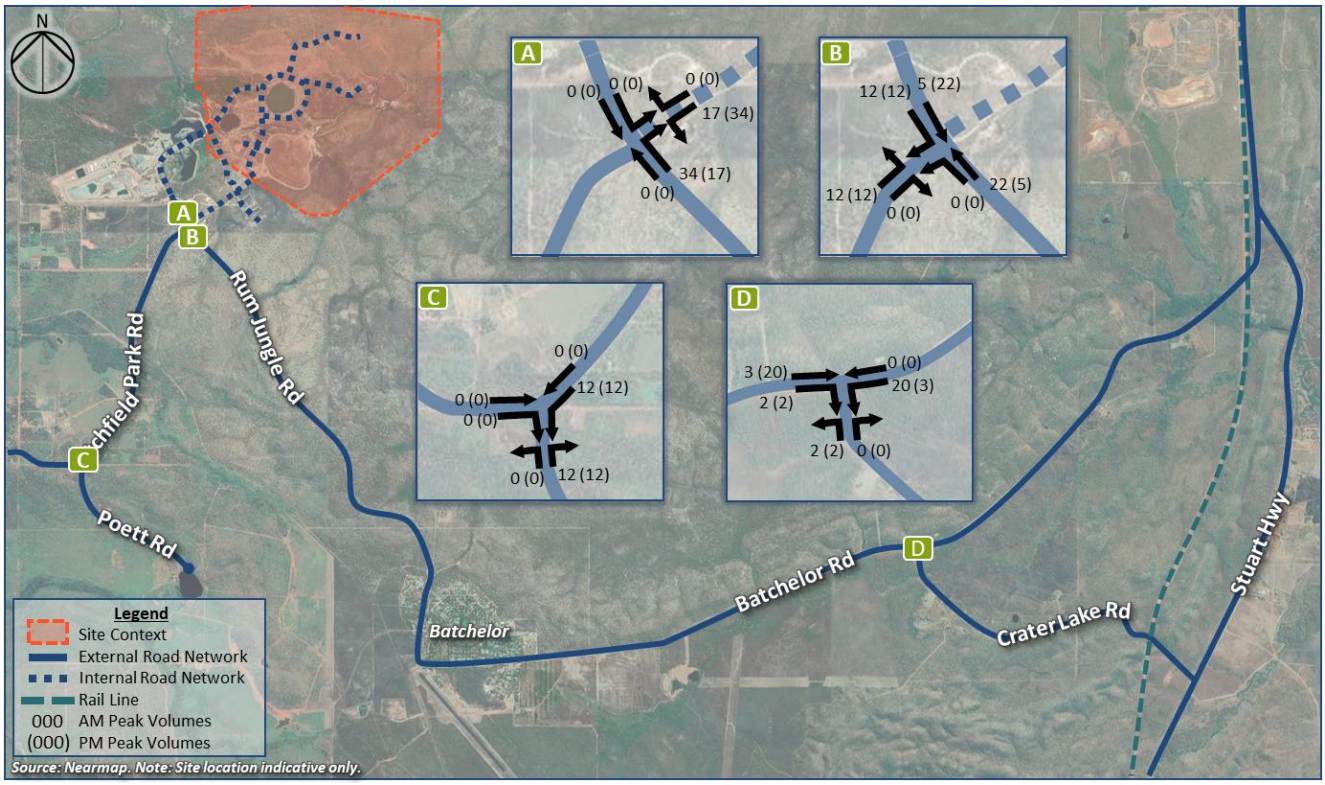
[1] It is likely that some portion of the workforce will arrive and depart outside of the peak periods, and so the adopted split represents a conservative assessment

[2] These movements could occur during either the AM or PM peak and therefore have been assumed to occur in both for this assessment

4.5 Traffic Volumes

Figure 16 illustrates the assessed Project generated traffic demands for the remediation of the Rum Jungle site.

Figure 16 Peak Hour Traffic Volumes



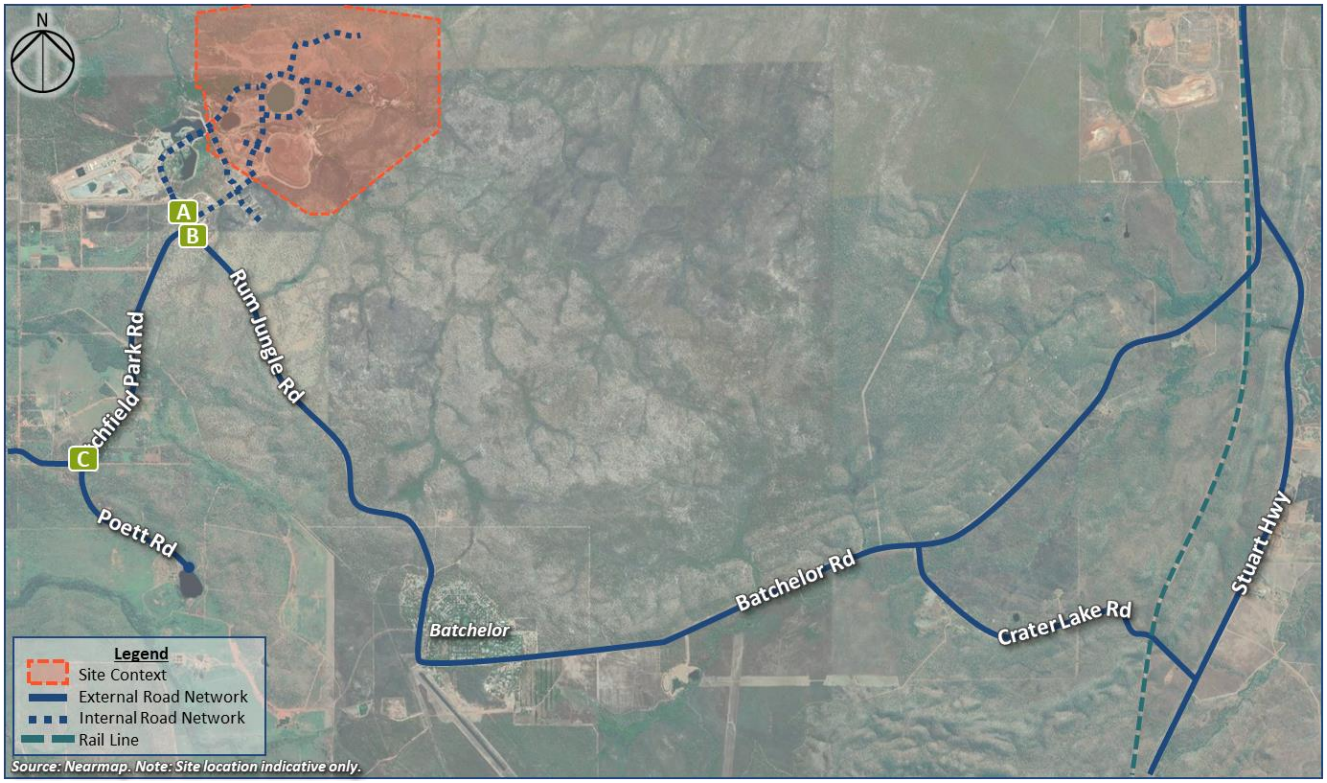
5 Intersection Assessment Scope and Thresholds

5.1 Spatial Scope of Intersection Assessment

A detailed intersection assessment has been completed for all intersections located within proximity to the Project site. The study intersections include the following, as illustrated in Figure 17:

- Intersection A – Rum Jungle Road / Site Access;
- Intersection B – Rum Jungle Road / Litchfield Park Road;
- Intersection C – Litchfield Park Road / Poett Road.

Figure 17 Study Intersections



The following sections detail the methodology adopted for the intersection assessment for the intersections shown in Figure 17. A summary of the intersection assessment is provided in the following sections with a detailed methodology and analysis included at Appendix C.

5.2 Project Design Horizon

Standard traffic assessment practice is to consider a design horizon 10 years after the commencement of the Project's peak output. However, in this case, the Project is proposed to only have a design life of approximately 5 to 7 years, with the later years generating lower amounts of Project-related traffic. Therefore, the design horizon has been assessed as the period with the highest anticipated amount of Project-related traffic generation based on input provided by the project team – Year 3 dry season.

The following design scenarios have been assessed:

- Existing Background;
- Existing Background + Year 3 Dry Season Operational Traffic (i.e. maximum Project traffic).

5.3 Summary of Intersection Assessment

This section presents the summarised outcomes of the technical assessment undertaken to confirm the intersection upgrades required to safely and efficiently accommodate Project generated traffic demands.

5.3.1 Safety Assessment

Table 14 provides a pictorial description of the various turn treatments considered to aid reader interpretation of the assessment. Table 15 identifies the stipulated and recommended intersection treatments for each of the key intersections.

Table 14 Turn Treatment Types

Acronym	Right Turn Treatment	Left Turn Treatment
BAL or **BAR**	 **BAR** (Basic Right Turn)	 **BAL** (Basic Left Turn)
AUL(S) or **CHR(S)**	 **CHR(S)** (Channelised Right Turn (Short))	 **AUL(S)** (Auxiliary Left Turn (Short))
(AUL or **CHL)** or **CHR**	 **CHR** (Channelised Right Turn)	 **CHL** (Channelised Left Turn)  **AUL** (Auxiliary Left Turn)

Table 15 Summary of Safety Assessment Results

Intersection	Stipulated Treatment		Recommended Treatment	
	Left Turn Lane	Right Turn Lane	Left Turn Lane	Right Turn Lane
Intersection A Rum Jungle Road / Site Access	BAL	BAR	BAL	BAR
Intersection B Rum Jungle Road / Litchfield Park Road	BAL	BAR	AUL(S)	BAR
Intersection C Litchfield Park Road / Poett Road	BAL	BAR	AUL(S)	BAR

Table 15 indicates that none of the assessed intersections meet the threshold defined by the industry standard turn warrant assessment tool for the provision of either left turn or right turn lane treatments based on generic application of an industry standard turn warrants assessment. It is however nevertheless SLR's engineering judgement based on a comprehensive understanding of the limitations of the original research informing the development of the industry standard tool that in this instance it would be appropriate to provide the following upgraded treatments:

- **Intersection B – Rum Jungle Road / Litchfield Park Road** – It is proposed that an AUL(s) (short left turn auxiliary lane) treatment be constructed to accommodate vehicles turning left into Litchfield Park Road from Rum Jungle Road. This recommendation is based on the following considerations:
  - It is recognised that the project will generate limited to no usage of the left turn movement and would therefore typically not warrant upgrading the treatment based on a generic assessment. Further the Project will generate a modest increase in the traffic demands traveling through the Rum Jungle Road / Litchfield Park Road intersection which will result in a small risk increase at the intersection that is well below that typically warranting intervention.
  - Notwithstanding this, SLR recommends that the AUL(s) (short left turn auxiliary lane) treatment be implemented as a proportionate response by the Project to address the potential increase in risk associated with Project related traffic transiting through the Rum Jungle Road / Litchfield Park Road intersection and the nearby Rum Jungle Road / Site Access intersection.
  - This recommendation is made as the existing Rum Jungle Road / Litchfield Park Road intersection incorporates a non-conventional arrangement as the predominate movement is the left turn into Litchfield Park Road and the right turn out of Litchfield Park Road. Typically, an intersection would instead be designed to ensure that the predominate movement has priority (i.e. travels through the intersection) to minimise the potential for conflict and preserve the traffic carrying function of the road (i.e. reduce travel times for the majority of traffic travelling through the intersection).
  - It would not be a proportionate response nor is there any nexus for the Project to be required to realign the Rum Jungle Road / Litchfield Park Road intersection to provide priority for the predominate movement. Such works would be costly, would require significant vegetation clearing outside the existing road reserve to facilitate and the further increased risk resulting from the Project related traffic demands is very low.
  - SLR has instead proposed that the Project should implement an AUL(s) (short left turn auxiliary lane) treatment to accommodate vehicles turning left into Litchfield Park Road from Rum Jungle Road, in addition to enhancing directional signage at the intersection. The benefit of implementing these measures is that they will enhance the conspicuousness of the requirement to turn left to travel to Litchfield National Park.
  - The enhanced conspicuousness of the turn will minimise the occurrence of drivers who complete a potentially hazardous late left turn manoeuvre having recognised the need to turn late. In addition, these works will make it easier for drivers who are propped on the Litchfield Park Road approach to identify the turning intent of an approaching vehicle as an approaching vehicle will either be travelling in the through or left turn lane. This will reduce the potential for a propped driver to misjudge the intent of an approaching vehicle and potentially turn in front of a vehicle travelling northbound through the intersection to access for example the Project site.

- The proposed works will provide an ongoing benefit to the community beyond the life of the Project and are therefore considered by SLR to be preferable to other proportionate responses that could instead be implemented such as upgrading the Project access (which is not warranted based upon application of industry standard guidelines nor required in SLR engineering judgement beyond accommodating swept paths).

- **Intersection C – Litchfield Park Road / Poett Road** – It is proposed that an AUL(s) (short left turn auxiliary lane) treatment be constructed to accommodate vehicles turning left into Poett Road from Litchfield Park Road. This recommendation is based on the following considerations:
  - It is recognised that the Project will generate a modest left turn movement demand (in the context of the range typically considered as part of a turn warrants assessment) and that the forecast demands do not warrant upgrading the existing left turn treatment based on the generic industry standard assessment tool.
  - Notwithstanding this, SLR recommends that the AUL(s) (short left turn auxiliary lane) treatment be implemented as a proportionate response by the Project in this specific instance to address the potential increase in risk associated with Project related traffic demands.
  - This engineering view is based on the consideration that the Project related turning demands will disproportionately be associated with heavy vehicles which is not well captured by the industry standard assessment tool. In addition, the presence of tourists who are likely to be unfamiliar with the road conditions is also a consideration in this recommendation as these unfamiliar drivers will be less alert to the presence of the intersection and hence at higher risk of being involved in a major rear end crash that the recommend turn treatment seeks to reduce the potential for.

Design concepts have been prepared and are included at Appendix D.

5.3.2 Sight Distance Assessment

Table 16 identifies the minimum available and required sight distance at each of the key intersections, with Table 17 illustrating the viewing angles at each intersection location.

Table 16 Summary of Sight Distance Assessment

Intersection	Required Sight Distance	Available Sight Distance		Compliant?
		Approach 1	Approach 2	
Intersection A Rum Jungle Road / Site Access	214m	450m[1] plus	214m plus	✓[1]
Intersection B Rum Jungle Road / Litchfield Park Road	214m	214m plus	214m plus	✓

Intersection	Required Sight Distance	Available Sight Distance		Compliant?
		Approach 1	Approach 2	
Intersection C Litchfield Park Road / Poett Road	214m	541m [1] 237m	350m plus	✓

[1] Sight distance measured from an elevated truck drivers eye height (2.4m). It is identified that the presence of a vertical curve to the south reduces the sight distance at lower eye heights.

Table 17 Viewing Ranges – Key Intersections

Intersection	Approach 1	Approach 2
Intersection A Rum Jungle Road / Site Access	South: 	North: 
Intersection B Rum Jungle Road / Litchfield Park Road	North: 	South: 
Intersection C Litchfield Park Road / Poett Road	West: 	East: 

The following points are noted in relation to the sight distance summary presented in Table 16:

- **Intersection A – Rum Jungle Road / Site Access** – there is a vertical crest located to the south of the intersection that constrains the available sight distance for light vehicles exiting the site however the elevated eye height position (i.e. 2.4m) of a truck driver overcomes this constraint. This constraint for light vehicles is not considered to be problematic as exiting vehicles will be turning left out of the site and hence will not conflict with traffic approaching from the south.
- **Intersection B – Rum Jungle Road / Litchfield Park Road** – sight distances are ample in both directions.
- **Intersection C – Litchfield Park Road / Poett Road** – there is a vertical crest located to the west of the intersection that constrains the available sight distance for light vehicles exiting Poett Road however the elevated eye height position of a truck driver overcomes this constraint. This constraint is addressed by the relatively low posted speed limit for a rural road of 80km/h that has been adopted on Litchfield Park Road. Nevertheless, given the rural location it is foreseeable that there may be a diminished level of compliance with this lower than typical posted speed limit by the general public and therefore it would be beneficial to undertake some minor vegetation maintenance to remove the small bushes that have propagated on the inside face of the batter slope to the west as this vegetation will further obstruct sight lines over time. Furthermore, given the foreseeable potential for the general public to exceed the posted speed it is considered appropriate to for the Project to also install advisory signage flagging the presence of the intersection and the potential for trucks to be entering the main line traffic stream.

5.3.3 Capacity Assessment

Table 18 summarises the performance parameters for the worst-case scenario at each key intersection location and the compliance with the assessment criteria.

Table 18 Summary of SIDRA Intersection Assessment

Intersection	DOS Limit	Worst DOS	Critical Delay Limit	Worst Critical Delay	Compliant?
Intersection A Rum Jungle Road / Site Access	0.80	0.03	42 secs	8 secs	✓
Intersection B Rum Jungle Road / Litchfield Park Road	0.80	0.05	42 secs	8 secs	✓
Intersection C Litchfield Park Road / Poett Road	0.80	0.04	42 secs	8 secs	✓

Table 18 indicates that the intersections are expected to perform well within typically acceptable performance thresholds which is to be expected given the low traffic volumes present.

6 Link Assessment

6.1 Relevant Guidelines

The proposed routes are public roads and hence, given the intent for medium term use (i.e. 5 years), their design should accord with relevant public road design guidelines including NT Gov's *Standard Road Cross Section Policy* (Cross Section Policy) and where relevant the more extensive guidance presented within the Austroads design series.

6.1.1 *Standard Road Cross Section Policy* (NT Government)

The Cross Section Policy identifies Rural Arterial and Secondary Roads should be constructed with the following seal widths dependent on the forecast vehicles per day (vpd) technically at a 20-year design horizon:

- Greater than 1,000 vpd - 8.0m seal width including 2 x 3.5m lanes
- Less than 500vpd - 7.0m seal width including 2 x 3.0m lanes

The Cross Section Policy notes that for predicted future traffic volumes of between 500 and 1,000 vpd the required cross-section standard depends on the consideration of the traffic mix (road trains / caravans / buses), topography, seasonal variations (tourism) and environment and should be assessed on a case by case basis. Furthermore, the policy identifies that the decision in regard to sealed versus gravel standard for a particular road will depend on factors such as the proposed use (i.e horticultural) and nearby environment.

6.1.2 Austroads Research Series

Aside from the requirements of NT Gov, the research published within the Austroads research series, which is the association of the Australian and New Zealand road authorities, identifies the following:

- A standard lane width of 3.5 m can 'comfortably' cater for heavy vehicle travel but that rigid-plus-three and A-triples require 3.7 m lanes with additional widening on curves to allow for their additional tracking;
- A minimum shoulder width of 0.5m is typically required to provide lateral support to pavements and to provide an initial recovery area with the shoulder widened on the outside of curves to 1.0m.

In relation to the need to seal shoulders, further research presented within the Austroads design series identifies that unsealed shoulders have been found to cause run-off-road crashes for heavy vehicles in rural areas, with crash rates increasing by approximately 40% where sealed shoulders are not provided.

6.1.3 *Unsealed Road Manual – Guidelines to Good Practice* (ARRB)

The *Unsealed Road Manual – Guidelines to Good Practice* (Unsealed Road Manual) has been prepared by ARRB Group Ltd (ARRB) for practitioners in local government, state road authorities, logging and mining industries and agencies responsible for the maintenance and management of unsealed roads. The Unsealed Road Manual documents the latest management procedures and practices covering both Australian and New Zealand unsealed road networks. This manual is relevant to this assessment as it provides a contemporary standard that specifically details the aspects that should be considered when deciding if a road should be sealed.

In Section 7.7 of the manual, guidance is provided on deciding when to seal a particular road which is summarised as follows:

- According to the manual, it is difficult to justify sealing a road carrying a traffic volume of less than 100 vehicles per day, whereas sealing a road carrying over 250 vehicles per day is probably justified. In between these two values is a 'grey area' where an economic assessment considering other factors may be required to help make the decision of whether or not to seal the road.
- The impact of road dust on adjoining crops and animal health, safety, health of people, and convenience as well as the damage to vehicle moving parts and loss of valuable fines material from the surface should be taken into account when deciding to seal a road.

6.2 Litchfield Park Road

The existing (2018) AADT on Litchfield Park Road is approximately 429 vehicles per day averaged over a year however traffic volumes are highly seasonal ranging from 191 vehicles per day during February to 915 vehicles per day during July.

The traffic demands on Litchfield Park Road with the addition of the anticipated Project traffic demand fall within the '7.0m to 8.0m seal width grey zone' identified in NT Gov's Cross Section Policy, whereby consideration should be given to traffic mix (road trains / caravans / buses) and topography and also consider local issues such as seasonal variations (tourism) and environment.

In added consideration of the Austroad's research series, it is considered that the existing Litchfield Park Road cross-section of approximately 7.5m width would be appropriate for single articulated and B double trucks, but not suitable for larger trucks such as triple or quad trailer trucks. Given that the Project use for Litchfield Park Road is proposed to be for cover material haulage by truck and dogs, no widening or other cross-sectional works aside from maintenance are considered to be required as per this conclusion.

However, if at a later stage the Project vehicle fleet is adjusted for whatever reason and larger trucks are proposed to utilise Litchfield Park Road, it is recommended that the pavement be widened to an absolute minimum of 8.0m and ideally 8.4m.

Additionally, the Project is anticipated to assume responsibility for the maintenance of Litchfield Park Road given the increase in pavement loadings as a result of the Project. A pavement impact assessed is included in Section 7 of this report.

6.3 Poett Road

The future traffic demands on Poett Road are assumed to be almost entirely associated with the Project, and fall within the 'grey zone' when deciding whether or not to seal a road as identified within the Unsealed Road Manual. Therefore, according to the manual, consideration should be given to the traffic mix (road trains / caravans / buses), topography and also consider local issues such as seasonal variations (tourism) and environment.

Duration of Use –The cover material haulage activity on Poett Road associated with the Project is anticipated to occur for a finite period of approximately five years. It is noted that this is much less than the typical 20-30 year design life over which the benefits of implementing road upgrade treatments are typically assumed to accumulate.

Maintenance – The Project is anticipated to assume full responsibility for the maintenance and management of Poett Road for the duration of haulage activity, retaining the road with an unsealed treatment would not place any additional burden on the local road authority. Additionally, the road will be largely unused after the conclusion of haulage activity, so by sealing it, the local road authority would be left with the ongoing maintenance of a sealed road treatment after the Project is completed. It is noted however that sealing of the road would reduce ongoing maintenance works and costs in the short-term during haulage activity and provide greater resilience during the wet season. A pavement impact assessed assuming Poett Road remains unsealed is included in Section 7 of this report.

Route Consistency – The existing unsealed form of Poett Road would likely afford a road environment of a higher standard than the internal circulation roads within the Project and the borrow pit site and therefore will not be completely inconsistent with other components of the haulage route.

Impact on other properties – It is understood that there is a limited number of land holders that utilise Poett Road and that these neighbouring property owners have been engaged with.

Tourism – Whilst Rum Jungle Lake is located at the southern extent of Poett Road it is understood that this locality does not provide an important tourism feature that could be enhanced through the provision of sealed access to provide residual benefit post-completion of haulage activity.

Dust – A review of the adjacent land uses along this section of Poett Road indicates that they are not expected to be particularly sensitive to road dust having a damaging effect on crops, animal health or the health of people, particularly considering the very limited number of properties that are located in this area. It is nevertheless recommended that temporary dust suppression measures should be employed to minimise potential safety risks associated with haulage. It is noted that sealing of the road would however minimise safety impacts associated with dusty driving conditions.

Ultimately, the decision of whether or not to condition sealing of Poett Road rests with the local road authority, however it is believed that there may be grounds to not seal Poett Road based on consideration of traffic volumes, duration of use, maintenance, route consistency, impact on other properties, tourism and dust.

6.4 Rum Jungle Road & Batchelor Road

The existing (2018) AADT on Batchelor Road is approximately 807 vehicles per day averaged over a year however traffic volumes are seasonal ranging from 556 vehicles per day during January to 1,212 vehicles per day during July.

The traffic demands on Rum Jungle Road and Batchelor Road are anticipated to be rather modest, at approximately 35 movements per day during the busiest period of the Project lifespan, with approximately half of these associated with staff movements. Therefore, given the modest heavy vehicle movements associated with the Project on these roads, no specific cross-sectional works are anticipated to be required with the exception of maintenance.

The Project is anticipated to assume responsibility for the maintenance of Rum Jungle Road and Batchelor Road. A pavement impact assessed is included in Section 7 of this report.

Whilst the use of Batchelor Road passes through Batchelor township the modest heavy vehicle traffic volumes are not expected to generate significant amenity impacts that will require infrastructure solutions.

6.5 Crater Lake Road

The traffic demands on Crater Lake Road are anticipated to be rather modest, at approximately 15 return movements per day during the busiest period of the Project lifespan. Therefore, given these modest heavy vehicle movements associated with the Project on this road, no specific cross-sectional works are anticipated to be required with the exception of maintenance.

The Project is anticipated to assume responsibility for the maintenance of Crater Lake Road. A pavement impact assessed is included in Section 7 of this report.

7 Pavement Impact Assessment

SLR has completed a Pavement Impact Assessment (PIA) in accordance with the *Guide to Traffic Impact Assessment Practice Note: Pavement Impact Assessment* (PIA Practice Note) recently issued by the Queensland Government Department of Transport and Main Road's (DTMR). This document has been utilised in the absence of a comparable document specific to the Northern Territory.

It is noted that as is common practice in traffic engineering much of the industry research is initially undertaken by state road authorities with this guidance ultimately adopted by other states over a period of several years. Often there is a degree of co-ordination that occurs via the Austroads body to avoid duplication of research across states. It is also noted that the use of this best practice document is considered appropriate as northern Queensland experiences weather conditions and road maintenance challenges that are comparable to those experienced in the Northern Territory.

The purpose of the PIA is to determine the impact of the additional heavy vehicle traffic associated with the Project on the external road network, and to identify a suitable allowance for maintenance to offset this potential impact.

The PIA Practice Note provides separate methodologies for preparing the assessment for sealed pavements or unsealed pavements. The methodology within the PIA is summarised as follows:

- Determine the pavement impacts of the existing background traffic on the road;
- Determine the pavement impacts of the anticipated development traffic on the road;
- Maintenance contributions must be paid for road sections where the pavement impacts associated with the development traffic exceed 5% of those associated with the existing background traffic.

However, for the purposes of this assessment it has been assumed that a maintenance contribution will be required for all road sections within the pavement impact assessable area regardless of whether or not the development traffic exceeds 5% of the background traffic.

7.1 Pavement Impact Assessable Area

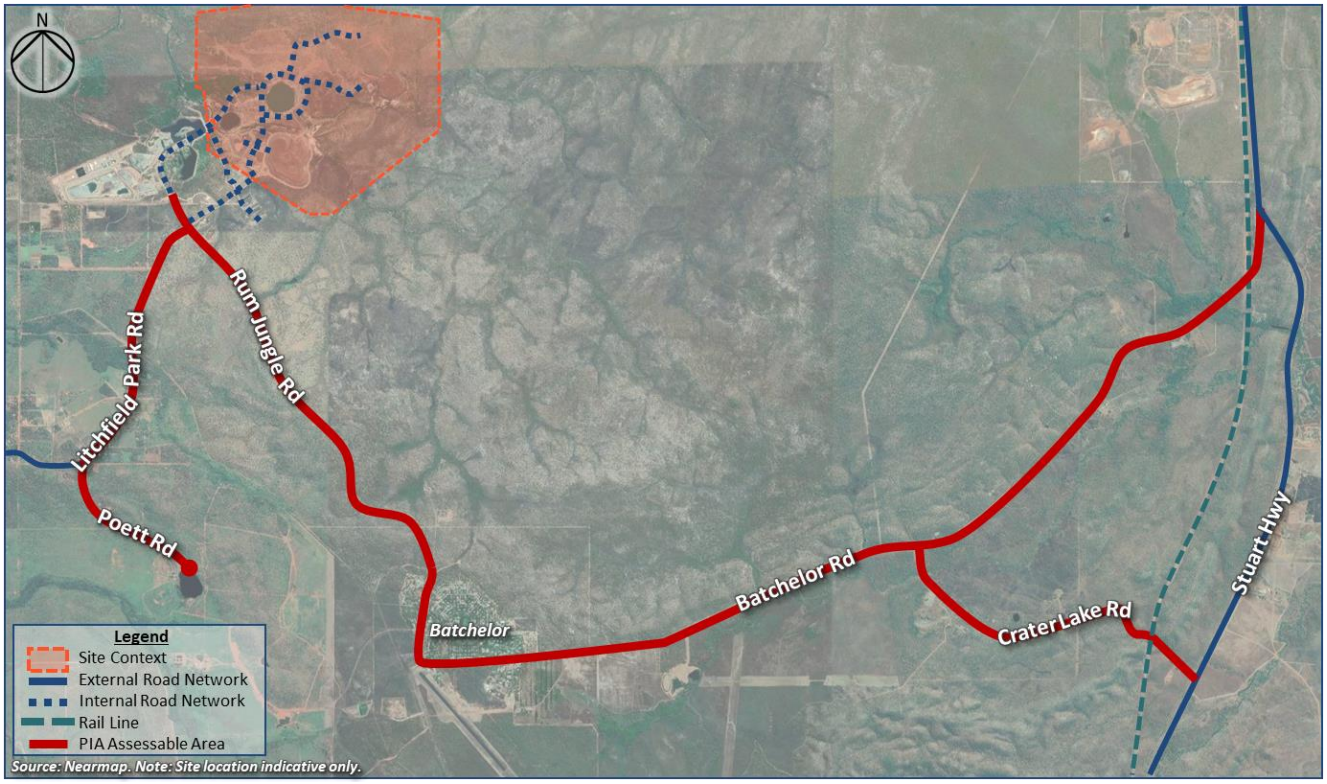
The PIA was prepared for the pavement impact assessable area identified in Table 19 and Figure 18, which includes roads controlled by NT Gov as well as CCGC.

Table 19 Pavement Impact Assessable Area

Jurisdiction	Road Section		Pavement	Length
NT Gov	Rum Jungle Road	between Litchfield Park Road and Batchelor Road	Sealed	~6.6km
	Litchfield Park Road	between Rum Jungle Road and Poett Road	Sealed	~3.4km
	Batchelor Road	between Rum Jungle Road and Crater Lake Road	Sealed	~6.3km
	Batchelor Road	between Crater Lake Road and Stuart Highway	Sealed	~6.3km

Jurisdiction	Road Section		Pavement	Length
CCGC	Crater Lake Road	between Batchelor Road and Stuart Highway	Sealed	~4.3km
	Poett Road	between Litchfield Park Road and Rum Jungle South	Unsealed	~2.0km

Figure 18 Pavement Impact Assessable Area



7.2 Sealed Pavement Impact Assessment Methodology

The following steps have been undertaken in completing the PIA for the sections of the pavement impact assessable areas with sealed pavements:

1. The impact assessable area has been identified, as shown in Figure 18.
2. The development Standard Axle Repetitions (SAR) have been calculated as per the anticipated haulage fleet identified in Table 9 and assuming a granular pavement type.
3. The development SARs have been assigned onto each of the road sections as per the haulage distribution.
4. The contributions for all road sections with development SARs have been calculated assuming the average marginal cost provided within the PIA Practice Note for sealed roads with granular pavement of 13.60 cents / SAR.km.

7.3 Unsealed Pavement Impact Assessment Methodology

The following steps have been undertaken in completing the PIA for the sections of the pavement impact assessable areas with unsealed pavements:

1. As per Step 1 for sealed roads.
2. The development Loaded Units (LU) have been calculated as per the anticipated haulage fleet identified in Table 9.
3. The development LUs have been assigned onto each of the road sections as per the haulage distribution.
4. The contributions for all road sections with development LUs have been calculated assuming the average marginal cost provided within the PIA Practice Note for unsealed roads of 14.84 cents / LU.km.

7.4 Pavement Impact Assessment Summary

The detailed assessment tables for each of these steps are included at Appendix E, with a summary of results presented in Table 20.

Table 20 Pavement Impact Assessment – Maintenance Contributions Summary

Road Name	Section	Authority	Total Development Contributions
Litchfield Park Road	~6.6km	NT Gov	$218,112.64
Poett Road	~3.4km	CCGC	$92,239.88
Rum Jungle Road	~6.3km	NT Gov	$72,821.49
Batchelor Road W	~6.3km	NT Gov	$69,511.42
Batchelor Road E	~4.3km	NT Gov	$14,649.45
Crater Lake Road	~2.0km	CCGC	$37,445.48
Total	**~28.9km**	-	**$504,780.36**

The assessment summarised in Table 20 indicates that it would be appropriate to allow a provisional sum of approximately $500,000 for the maintenance of the public road network over the duration of the project.

8 Other Traffic Considerations

8.1 Tourism

Litchfield National Park is a popular tourist destination and is located west of the Project site accessed via Litchfield Park Road. Tourists accessing Litchfield National Park are likely to be unfamiliar with the local road network. Cognisant of this SLR has made several recommendations which will assist to minimise the potential for conflict between tourists and vehicles associated with the Project.

8.2 School Bus Routes

To minimise the impact of the Project on the local school bus routes, an arrangement could potentially be made to halt material haulage during certain times of the day when school buses are travelling on the surrounding road network. This is not anticipated to substantially increase Project haulage at other times of the day, given that the restrictions would only last 1-2 hours a day total. Any such restrictions would be identified through the future preparation of a Road Use Management Plan.

9 Road Use Management Plan

It is recommended that a Road Use Management Plan or equivalent document be prepared following approval but prior to the substantial commencement of haulage activities.

The purpose of the Road Use Management Plan will be to:

- Summarise and update (where appropriate) the latest condition of the road network and estimates of the Project's traffic generation potential considering the finalised workforce, procurement and logistics arrangements based upon advice from the construction contractor;
- Update (if appropriate) the analysis presented herein where either the underlying road conditions or assumed traffic generating characteristics of the Project have changed;
- Identify any known over-dimension movements and the associated logistics strategy and required approvals; and
- Detail proposed / negotiated impact mitigation strategies, both "soft" strategies (for example, bussing workers, variable message signs / media notices about increased project traffic and road-use management strategies such as avoiding school bus times, fatigue management) and "hard" infrastructure strategies (for example, upgrading an intersection or contributing to maintenance).

A Traffic Management Plan (TMP) will also be required for construction activities on the external road network (e.g. intersection upgrades), and is a separate document to the Road Use Management Plan.

10 Conclusion

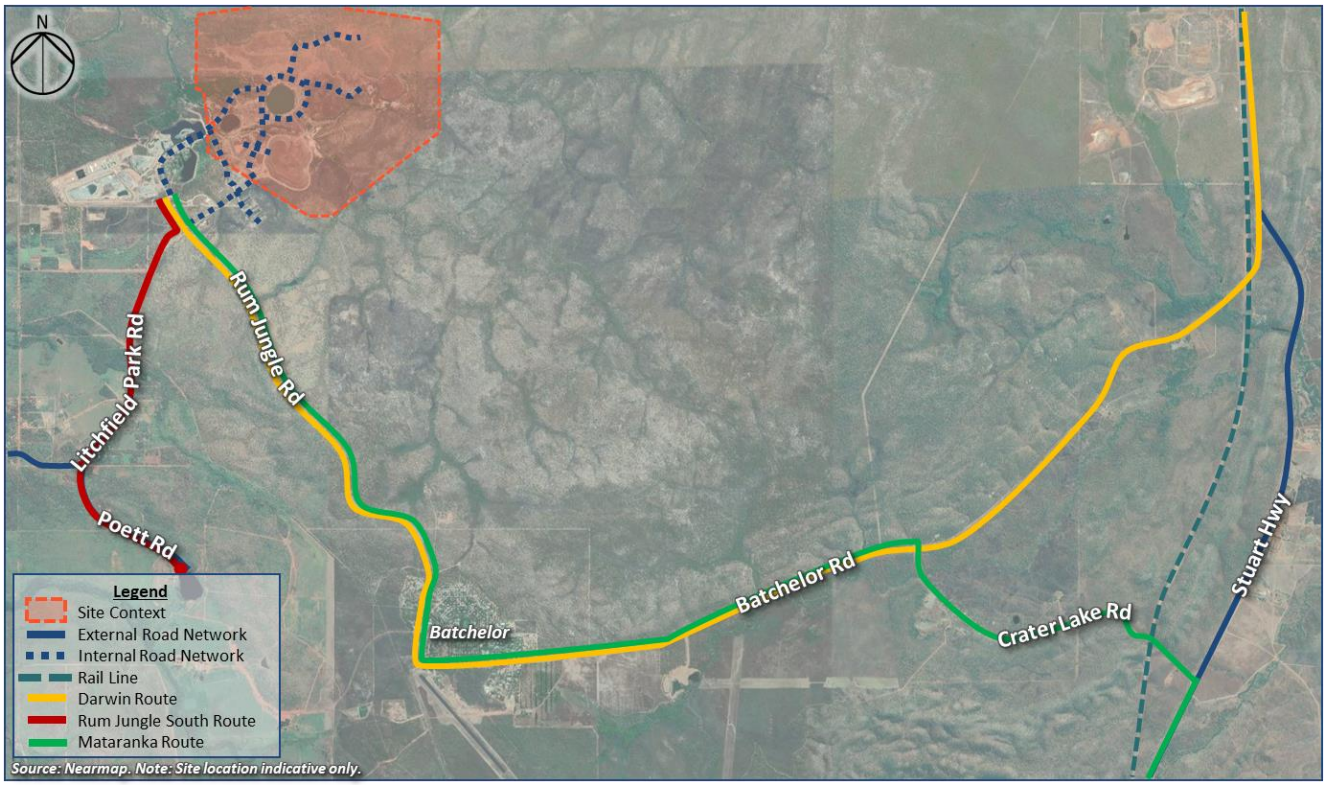
10.1 Context

SLR has been commissioned by the Department of Primary Industry and Resources – Mines Division (DPIR) to provide engineering advice to inform the current cost planning exercise for the potential remediation of the Rum Jungle site (the Project) located approximately 105km south of Darwin within the local government jurisdiction of Coomalie Community Government Council (CCGC).

The objective of the TIA is to identify the potential impacts of the Project on the surrounding road network, and where appropriate, identify management and mitigation strategies.

The Project will consist of several traffic generating activities, with the main components being the haulage of materials from nearby pits to the site. The proposed routes for traffic accessing the site are illustrated in Figure 19.

Figure 19 Proposed Haulage Routes



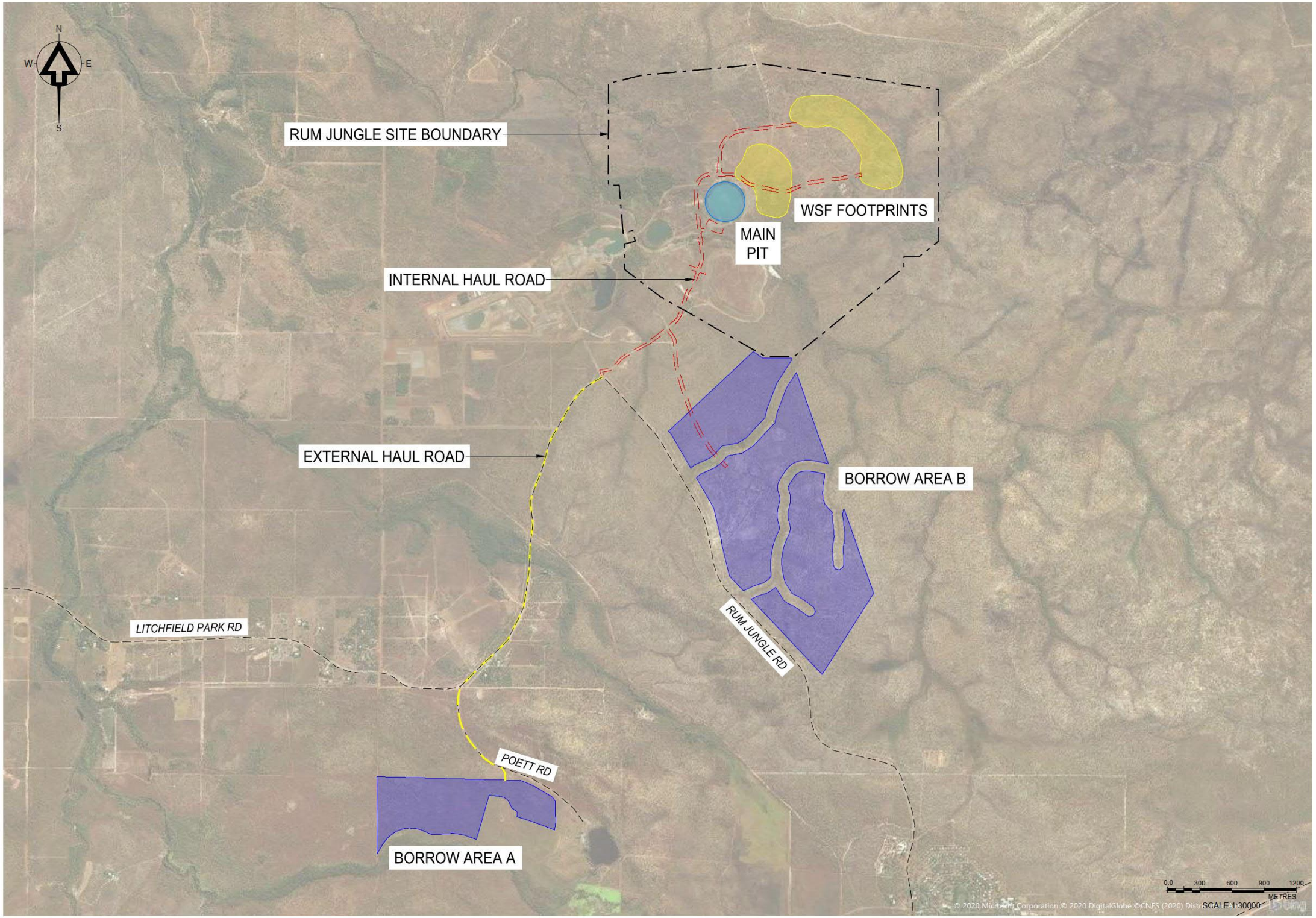
10.2 Recommended Actions

Detailed assessment has been undertaken to establish the transport mitigation strategies recommended to support the traffic demands generated by the Project which include the following:

- Undertake the following intersection upgrade works:
  - Rum Jungle Road / Litchfield Park Road:
    - Construct a short auxiliary left turn lane AUL(S) on the southern approach (Rum Jungle Road).
  - Litchfield Park Road / Poett Road:
    - Construct a short auxiliary left turn lane AUL(S) on the eastern approach (Litchfield Park Road).
- Obtain approval from NHVR to utilise Crater Lake as a haulage route for lime material being sourced from the south on Stuart Highway should the intent be to utilise vehicles longer than 19m.
- Make a provisional allowance of approximately $500,000 for the maintenance of the public road network over the duration of the project.
- Prepare a Road Use Management Plan generally in accordance with the specifications provided in Section 9 and in addition prepare any Traffic Management Plans required to support works undertaken within the public road reserve.

APPENDIX A

Project Plan


N
W
E
S
RUM JUNGLE SITE BOUNDARY
WSF FOOTPRINTS
MAIN PIT
INTERNAL HAUL ROAD
EXTERNAL HAUL ROAD
BORROW AREA B
LITCHFIELD PARK RD
RUM JUNGLE RD
POETT RD
BORROW AREA A
0 0 300 600 900 1200
METRES
SCALE 1:30000
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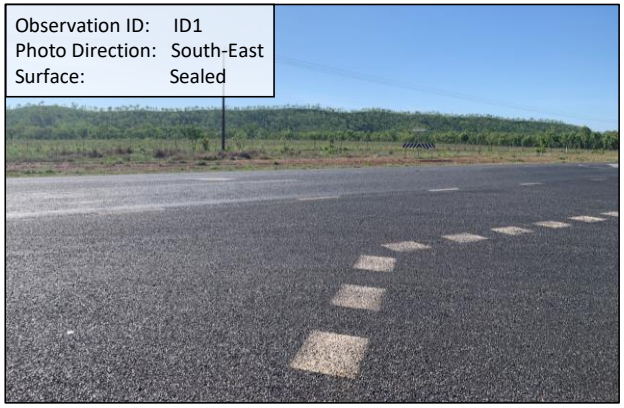
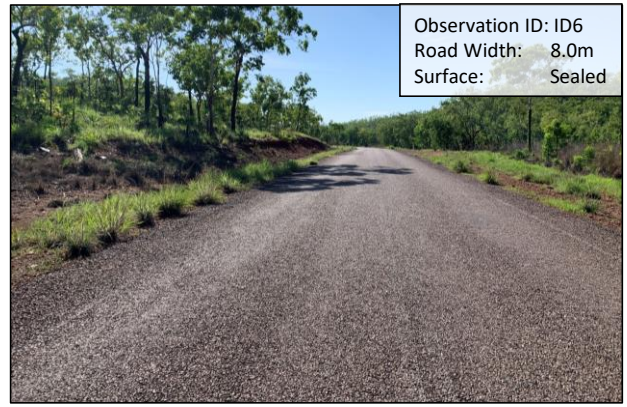
APPENDIX B

Site Inspection Photos





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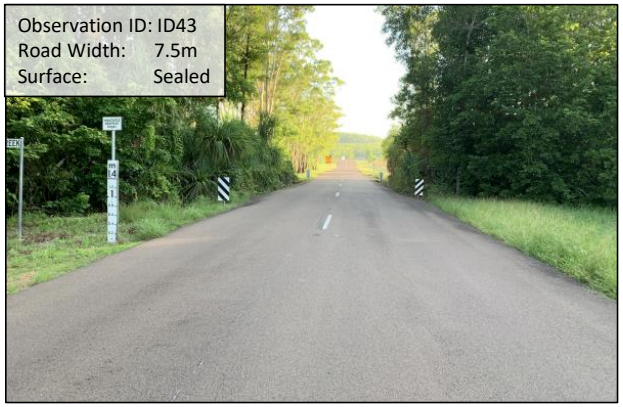

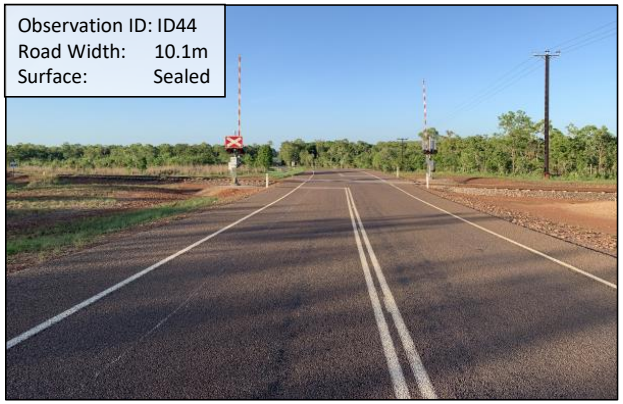

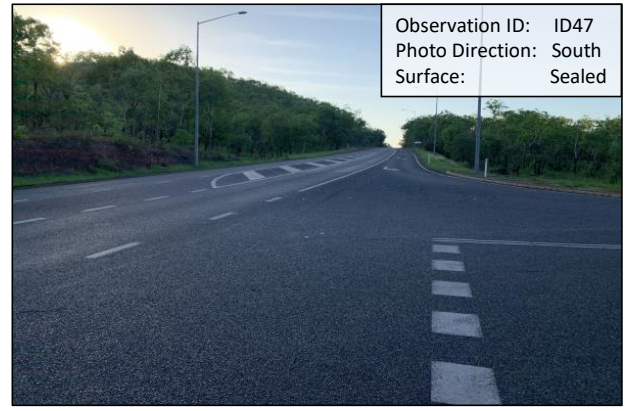

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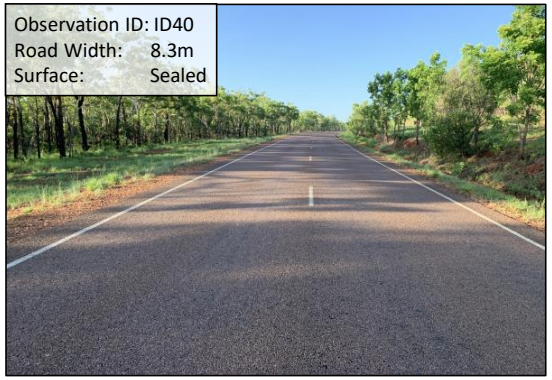

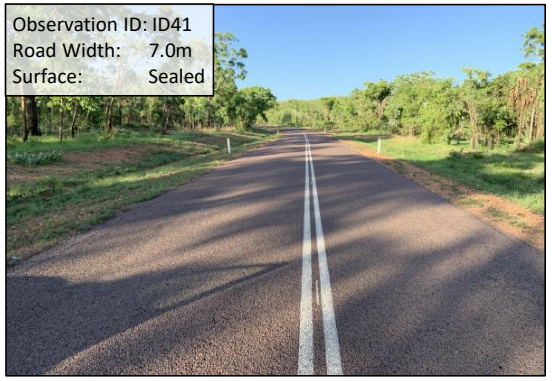

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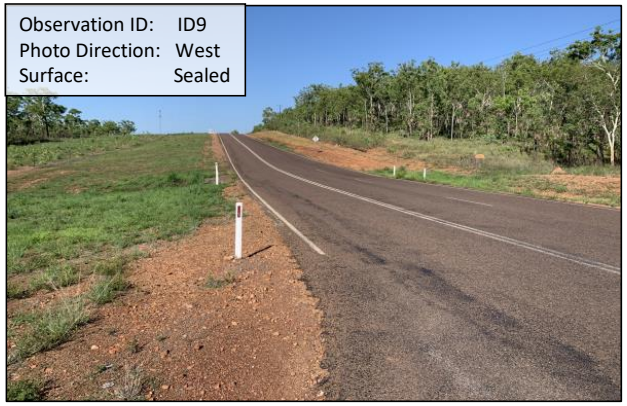

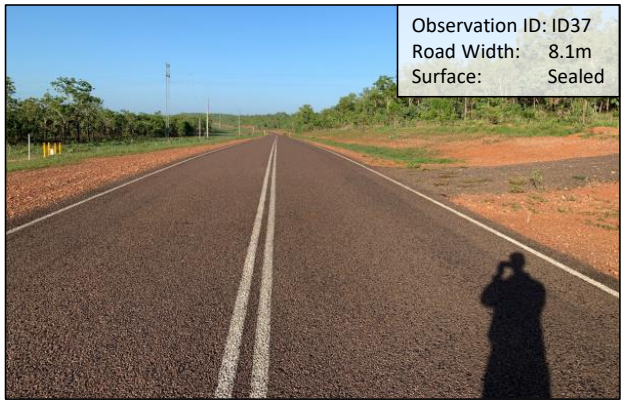

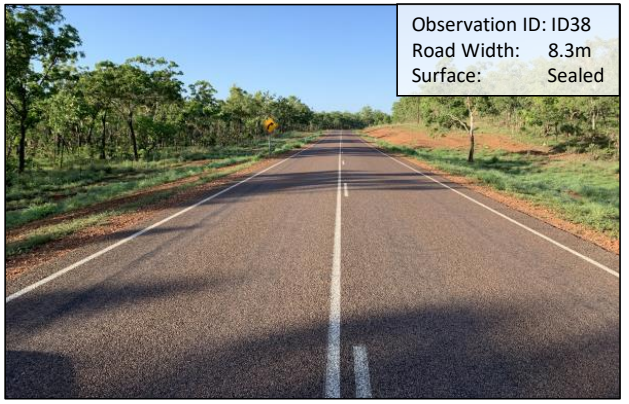

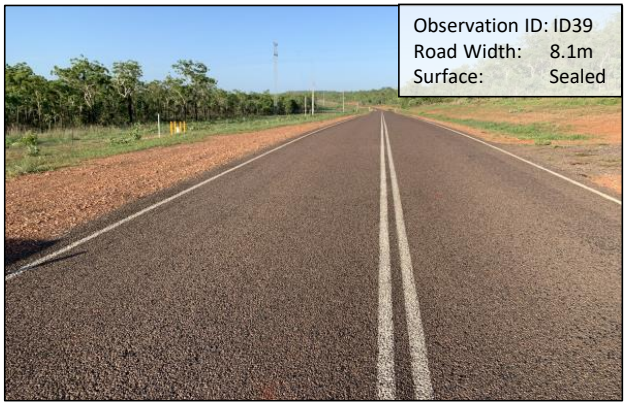

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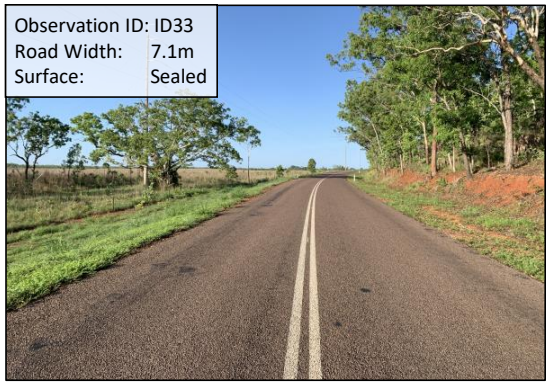

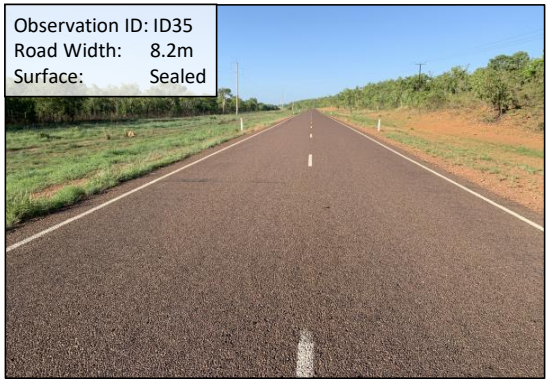

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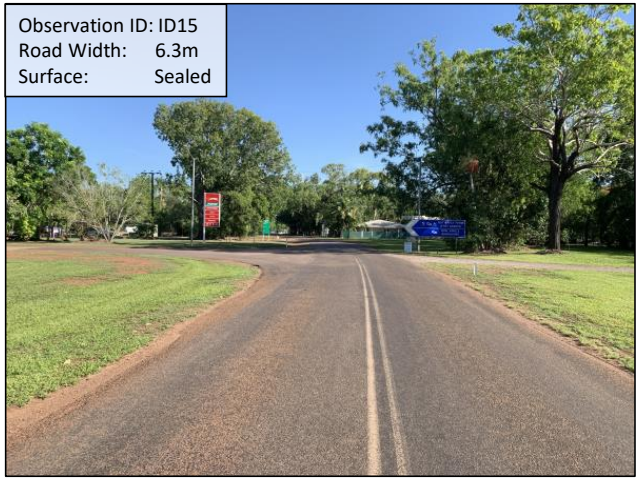

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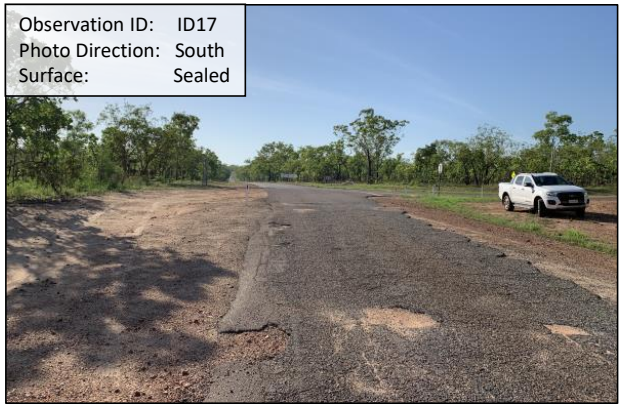

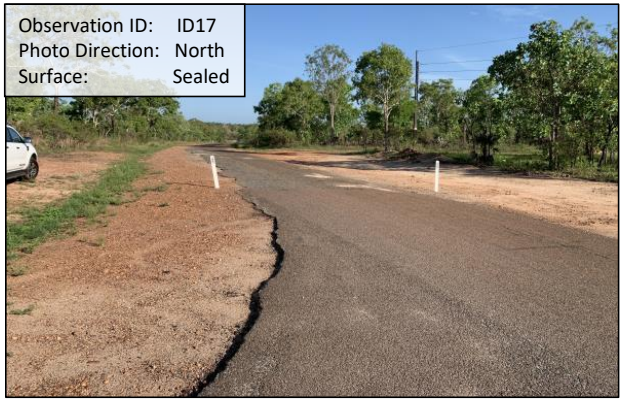

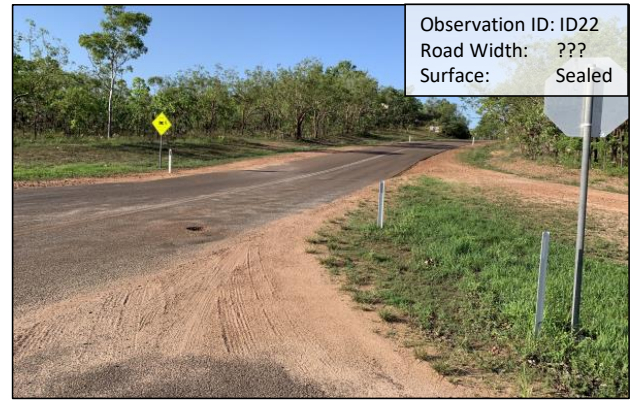

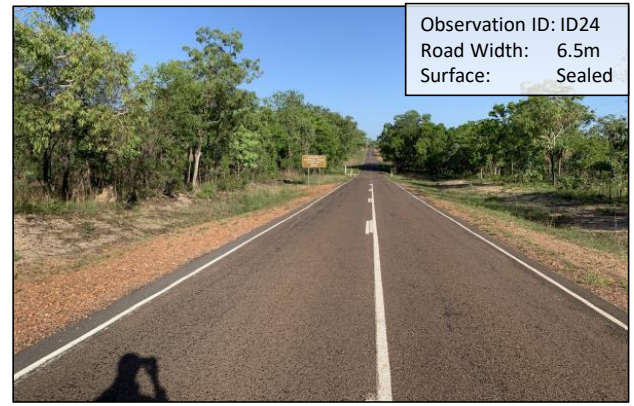

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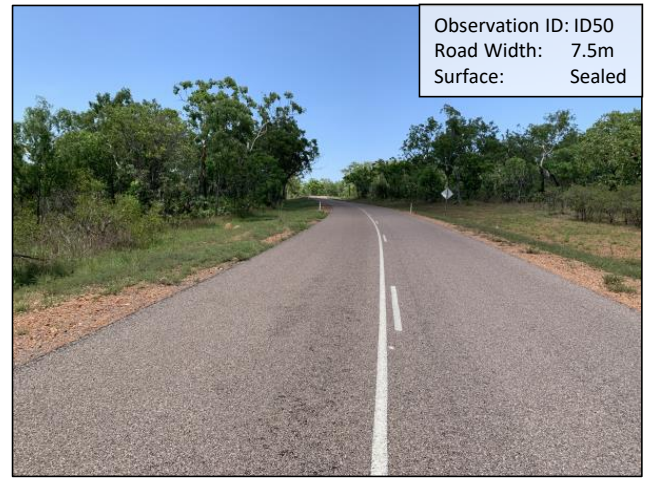

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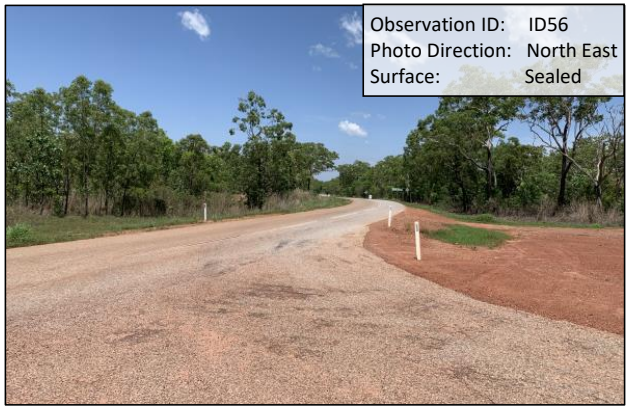

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APPENDIX C

Detailed Intersection Assessment

DETAILED INTERSECTION ASSESSMENT

1 Assessment Methodology

1.1 Safety Assessment

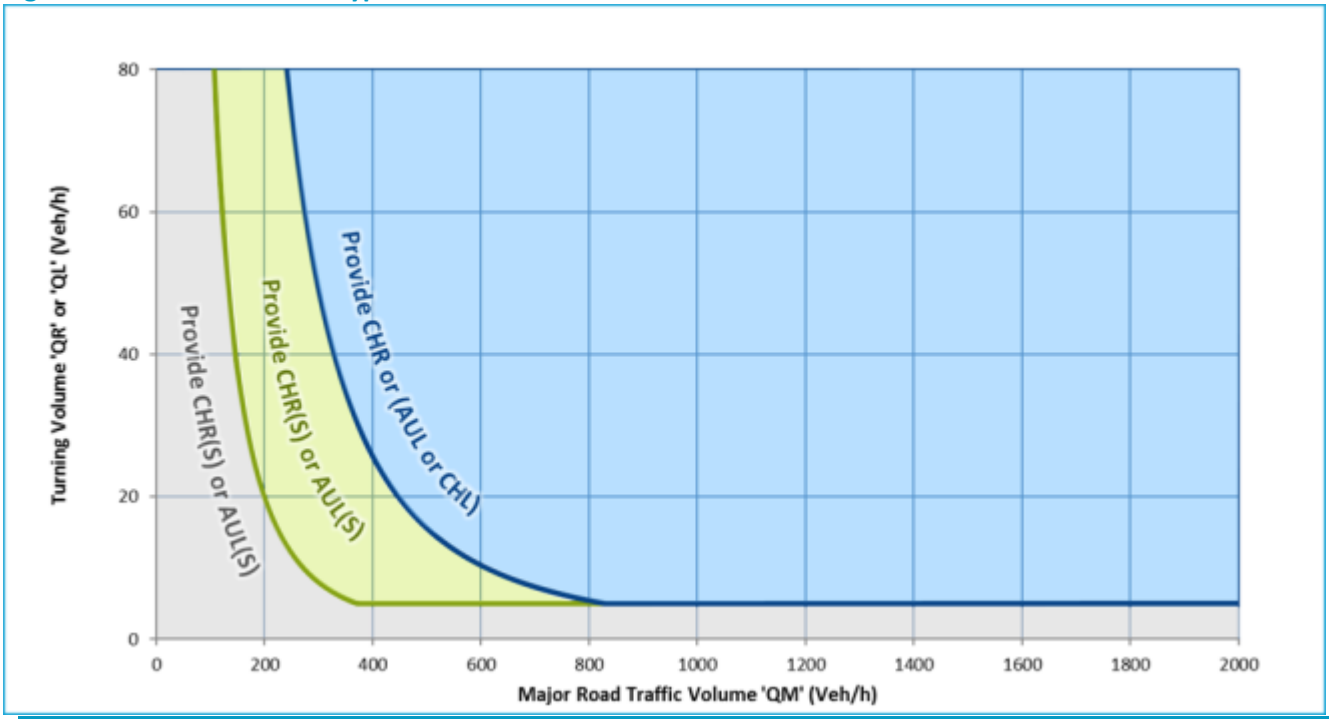
The assessment includes a variety of industry recognised analysis methods that determine the appropriate design requirements for each intersection location based on the anticipated future traffic demands as well as geometric considerations. A turn lane warrant assessment has been undertaken to establish the desirable form of the assessed intersections in accordance with the industry research summarised within *Austroads Guide to Road Design Part 4A*. The warrants provide guidance where turning lanes should be provided based on the design traffic volumes. To aid reader interpretation of the assessment Figure C1 provides a pictorial description of the various turn treatments considered.

As background it is identified that the warrants were produced by establishing the conflicting traffic volumes at which the benefits of providing a higher level of treatment (i.e. the reduction in estimated crash costs) are equal to the additional construction costs associated with providing the higher treatment. The benefits and costs of a higher level treatment were compared to the base case (minimum turn treatments).

Relevant to the assessment presented herein the research assumed the following:

- The warrants are strictly applicable to the construction of intersections on new roads (i.e. greenfield sites). For existing roads application of the warrants as adopted herein is therefore conservative as it tends to over-estimate the benefit ratio of providing higher order treatments; and
- The warrants are intended to be utilised to determine appropriate turn treatments at the intersection of public roads and are not strictly intended to be utilised for private access locations. Their application to private access locations as adopted herein is therefore conservative as it ensures that private accesses are afforded the same standard of safety as provided for public road intersections.

Figure C1 Turn Treatment Types



Acronym	Right Turn Treatment	Left Turn Treatment
BAL or **BAR**	 **BAR** (Basic Right Turn)	 **BAL** (Basic Left Turn)
AUL(S) or **CHR(S)**	 **CHR(S)** (Channelised Right Turn (Short))	 **AUL(S)** (Auxiliary Left Turn (Short))
(AUL or **CHL)** or **CHR**	 **CHR** (Channelised Right Turn)	 **CHL** (Channelised Left Turn)
		 **AUL** (Auxiliary Left Turn)

Source: *Austroads Guide to Road Design Part 4A* (Austroads)

1.2 Sight Distance Assessment

A sight distance assessment has been undertaken in accordance with *Part 4A: Unsignalised and Signalised Intersection* of the *Austroads Guide to Road Design*. Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be provided on the major road at any intersection, providing sufficient distance for a driver of a vehicle on the major road to observe a vehicle on the minor road moving into a collision situation (e.g. in the worst case, stalling across the traffic lanes), and to decelerate to a stop before reaching the collision point. Table C1 identifies the sight distances to and from the subject intersection assessing a reaction time of 2.0 seconds for various design speeds.

Table C1 Safe Intersection Sight Distance Requirements

Design Speed (km/hr)	SISD Requirement (m)
70	151
80	181
90	214
100	248
110	285
120	324

Source: Austroads

1.3 Capacity Assessment

1.3.1 Degree of Saturation Threshold

The study intersections were analysed for each of the traffic demand scenarios using SIDRA Intersection 8.0 (SIDRA). SIDRA is an industry recognised analysis tool used to estimate the capacity and performance of intersections based on input parameters, including geometry and traffic volumes. SIDRA provides an estimate of an intersection's Degree of Saturation (DOS), queues and delays. Part 12 of the Austroads *Guide to Traffic Management* identifies a maximum DOS threshold for each intersection type, which are reproduced in Table C2.

Table C2 Degree of Saturation Capacity Thresholds

Intersection Type	DOS Threshold
Signalised intersections	Less than or equal to 0.90
Roundabouts	Less than or equal to 0.85
Priority controlled intersections	Less than or equal to 0.80

Source: Austroads

DOS values exceeding those presented in Table C2 indicate that an intersection is nearing its practical capacity and upgrade works may be required. Above these threshold values, users of the intersection are likely to experience rapidly increasing delays and queuing.

1.3.2 Critical Delay Threshold

The RMS *Guide to Traffic Generating Developments* states that the average delay statistic for the critical movement provides a better indication of intersection performance and safety for roundabouts and priority-controlled intersections than DOS. A summary of the delay thresholds recommended by the RMS is provided in Table C3.

Table C3 Critical Delay Capacity Thresholds

LOS	Description	Critical Delay (sec/vehicle)
A	Good operation	< 14 sec
B	Acceptable delays and spare capacity	15 - 28 sec
C	Satisfactory	29 - 42 sec
D	Near capacity	43 - 53 sec
E	At capacity, requires other control mode	57 - 60 sec

Source: RMS

2 Intersection A – Rum Jungle Road / Site Access

2.1 Safety Assessment

Figures C2 details the turn warrant assessments undertaken for the Rum Jungle Road / Site Access intersection for all design scenarios. Table C4 identifies the minimum turn treatment to be provided under the results of the turn warrant assessment.

Figure C2 Intersection A – Existing Background + Maximum Project Traffic (AM & PM Peak)

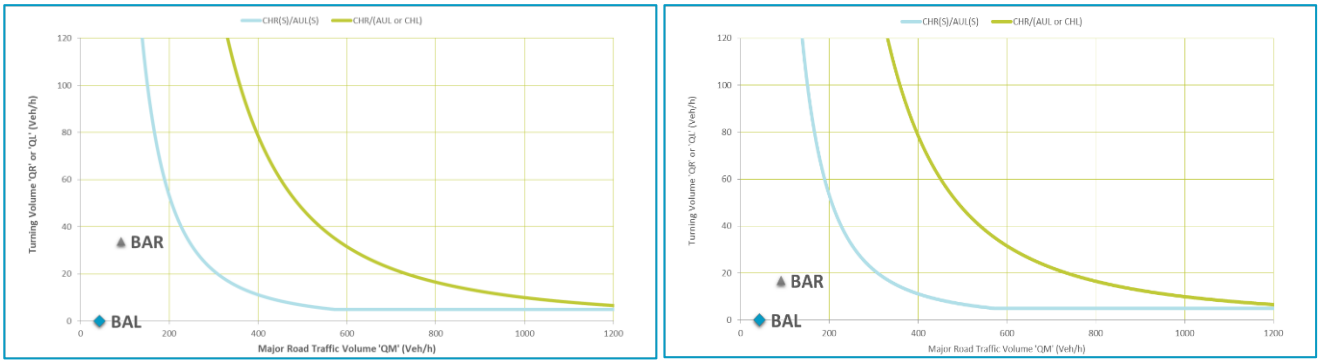


Table C4 Intersection A – Turn Warrant Assessment Results

Scenario	Peak Period	Left Turn Requirement	Right Turn Requirement
Existing Background + Maximum Project Traffic	AM	**BAL**	**BAR**
	PM	**BAL**	**BAR**

2.2 Sight Distance Assessment

Table C5 identifies the sight distances available at the subject intersection.

Table C5 Intersection A – Sight Distance Assessment Results

Desirable Requirement	Measurement to South	Measurement to North
90km/hr	450m+[1]	214m+
		

[1] Sight distance measured from an elevated truck drivers eye height (2.4m). It is identified that the presence of a vertical curve to the south reduces the sight distance at lower eye heights.

The results presented in Table C5 indicate that the existing form of the Rum Jungle Road / Site Access intersection meets the minimum requirements for sight distance defined in *Austroads Guide to Road Design Part 4A*.

There is a vertical crest located to the south of the intersection that constrains the available sight distance for light vehicles exiting the site however the elevated eye height position (i.e. 2.4m) of truck drivers overcomes this constraint. This constraint for light vehicles is not considered to be problematic as exiting vehicles will be turning left out of the site and hence will not conflict with traffic approaching from the south.

2.3 Capacity Assessment

Figure C3 illustrates the existing and assessed form of the Rum Jungle Road / Site Access intersection with the results for this form provided in Table C6.

Figure C3 Intersection A – SIDRA Assessed Intersection Layouts

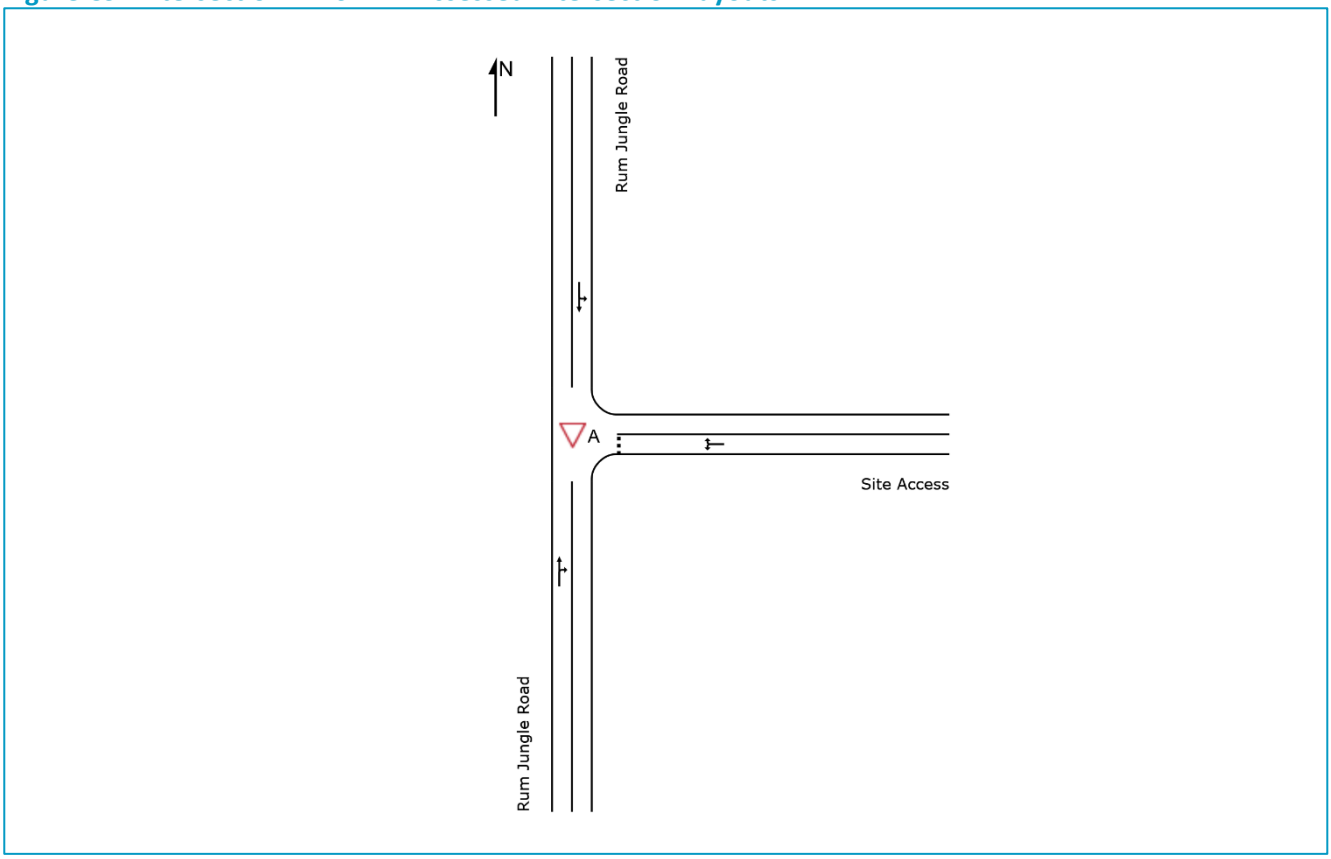


Table C6 Intersection A – SIDRA Results Summary

Scenario	AM Peak			PM Peak		
	DoS	Critical Delay	95th Queue	DoS	Critical Delay	95th Queue
Existing Background + Maximum Project Traffic	0.03	8s	1.5m	0.03	8s	1.5m

Based on the results presented in Table C6, the intersection will perform well within the maximum preferred operational capacity for a priority-controlled intersection (DOS less than 0.80 and acceptable critical delay) for the assessed scenario. No mitigation upgrades are warranted based solely on intersection performance considerations.

3 Intersection B – Rum Jungle Road / Litchfield Park Road

3.1 Safety Assessment

Figures C4 details the turn warrant assessments undertaken for the Rum Jungle Road / Litchfield Park Road intersection for all design scenarios. Table C7 identifies the minimum turn treatment to be provided under the results of the turn warrant assessment.

Figure C4 Intersection B – Existing Background + Maximum Project Traffic (AM & PM Peak)

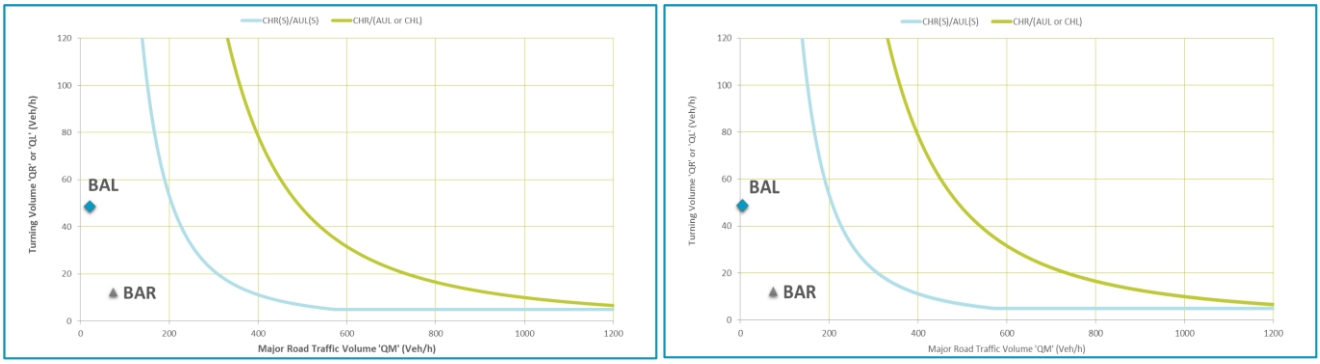


Table C7 Intersection B – Turn Warrant Assessment Results

Scenario	Peak Period	Left Turn Requirement	Right Turn Requirement
Existing Background + Maximum Project Traffic	AM	**BAL**	**BAR**
	PM	**BAL**	**BAR**

3.2 Sight Distance Assessment

Table C8 identifies the sight distances available at the subject intersection.

Table C8 Intersection B – Sight Distance Assessment Results

Desirable Requirement	Measurement to South	Measurement to North
90km/hr	214m+	214m+
		

The results presented in Table C8 indicate that the existing form of the Rum Jungle Road / Site Access intersection meets the minimum requirements for sight distance defined in *Austroads Guide to Road Design Part 4A*.

3.3 Capacity Assessment

Figure C5 illustrates the existing and assessed form of the Rum Jungle Road / Litchfield Park Road intersection with the results for this form provided in Table C9.

Figure C5 Intersection B – Existing and SIDRA Assessed Intersection Layouts

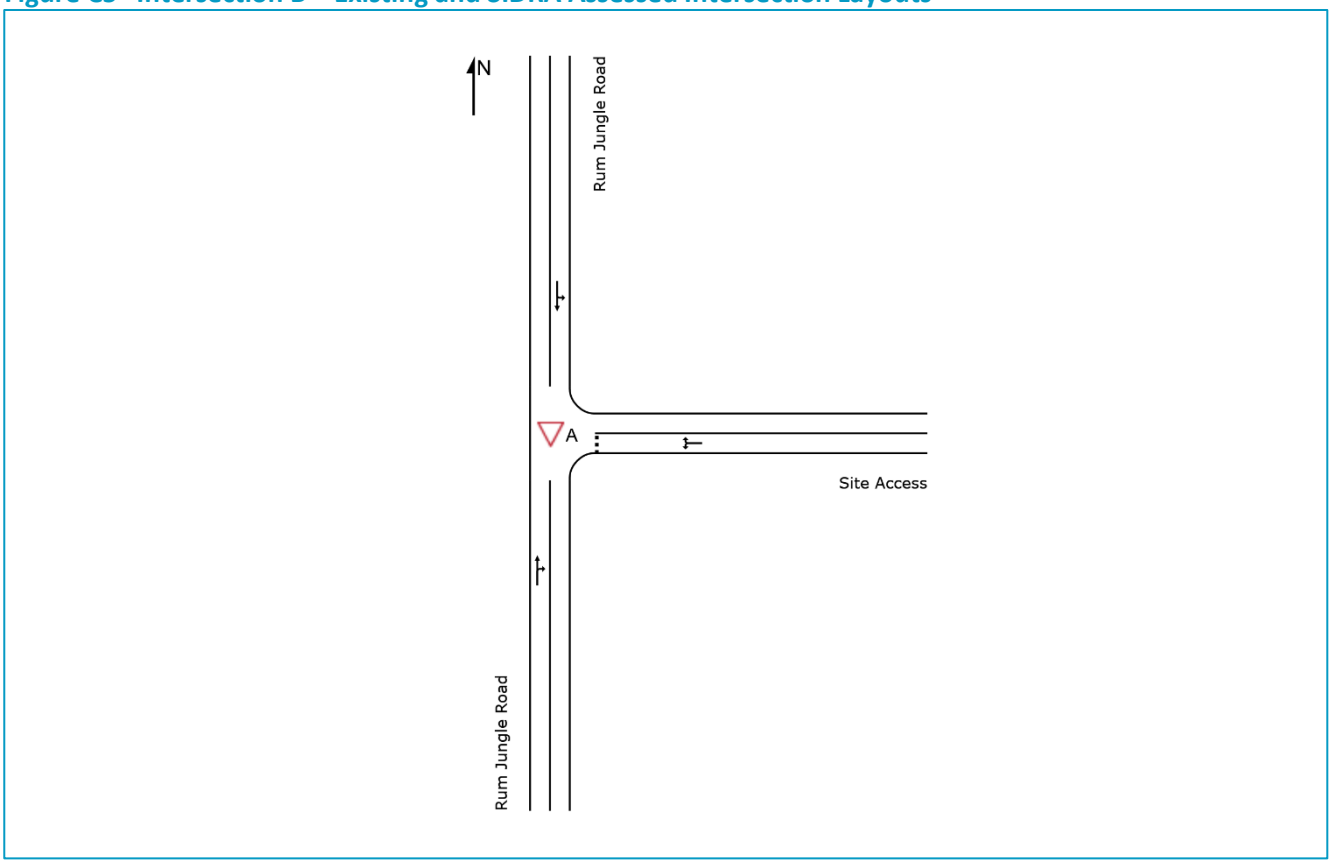


Table C9 Intersection B – SIDRA Results Summary

Scenario	AM Peak			PM Peak		
	DoS	Critical Delay	95th Queue	DoS	Critical Delay	95th Queue
Existing Background + Maximum Project Traffic	0.05	8s	1.3m	0.05	8s	1.3m

Based on the results presented in Table C9, the intersection will perform well within the maximum preferred operational capacity for a priority-controlled intersection (DOS less than 0.80 and acceptable critical delay) for the assessed scenario. No mitigation upgrades are warranted based solely on intersection performance considerations.

4 Intersection C – Litchfield Park Road / Poett Road

4.1 Safety Assessment

Figures C6 details the turn warrant assessments undertaken for the Litchfield Park Road / Poett Road intersection for all design scenarios. Table C10 identifies the minimum turn treatment to be provided under the results of the turn warrant assessment.

Figure C6 Intersection C – Existing Background + Maximum Project Traffic (AM & PM Peak)

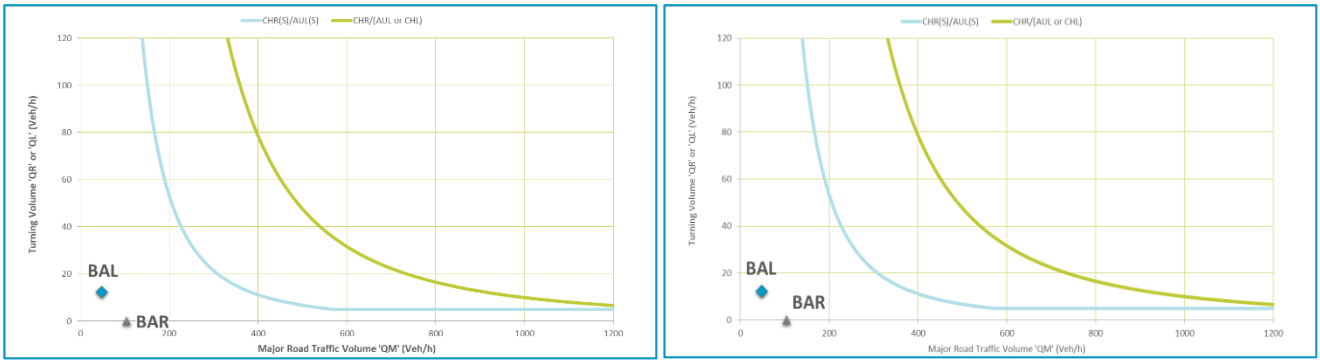


Table C10 Intersection C – Turn Warrant Assessment Results

Scenario	Peak Period	Left Turn Requirement	Right Turn Requirement
Existing Background + Maximum Project Traffic	AM	**BAL**	**BAR**
	PM	**BAL**	**BAR**

4.2 Sight Distance Assessment

Table C11 identifies the sight distances available at the subject intersection.

Table C11 Intersection C – Sight Distance Assessment Results

Desirable Requirement	Measurement to South	Measurement to North
90km/hr	541m[1] 237m	350m+
		

[1] Sight distance measured from an elevated truck drivers eye height (2.4m). It is identified that the presence of a vertical curve to the south reduces the sight distance at lower eye heights.

The results presented in Table C11 indicate that the existing form of the Litchfield Park Road / Poett Road intersection meets the minimum requirements for sight distance defined in *Austroads Guide to Road Design Part 4A*.

There is a vertical crest located to the west of the intersection that constrains the available sight distance for light vehicles exiting Poett Road however the elevated eye height position of truck drivers overcomes this constraint. This constraint is addressed by the relatively low posted speed limit for a rural road of 80km/h that has been adopted on Litchfield Park Road. Nevertheless, given the rural location it is foreseeable that there may be a diminished level of compliance with this lower than typical posted speed limit by the general public and therefore it would be beneficial to undertake some minor vegetation maintenance to remove the small bushes that have propagated on the inside face of the batter slope as this vegetation will further obstruct sight lines over time. Furthermore, given the foreseeable potential for the general public to exceed the posted speed it is considered appropriate to erect advisory signage flagging the presence of the intersection and the potential for trucks to be entering the main line traffic stream.

4.3 Capacity Assessment

Figure C7 illustrates the existing and assessed form of the Litchfield Park Road / Poett Road intersection with the results for this form provided in Table C12.

Figure C7 Intersection C – Existing and SIDRA Assessed Intersection Layouts

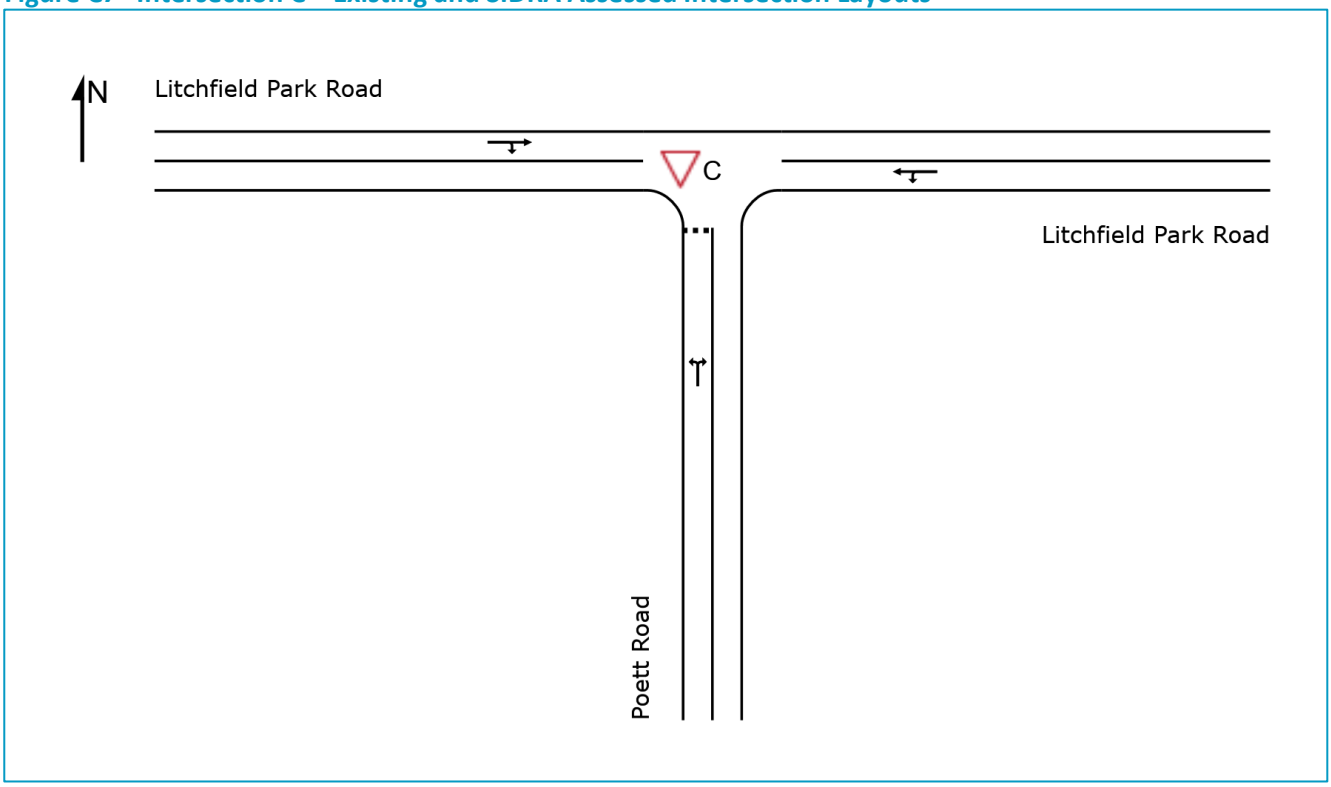


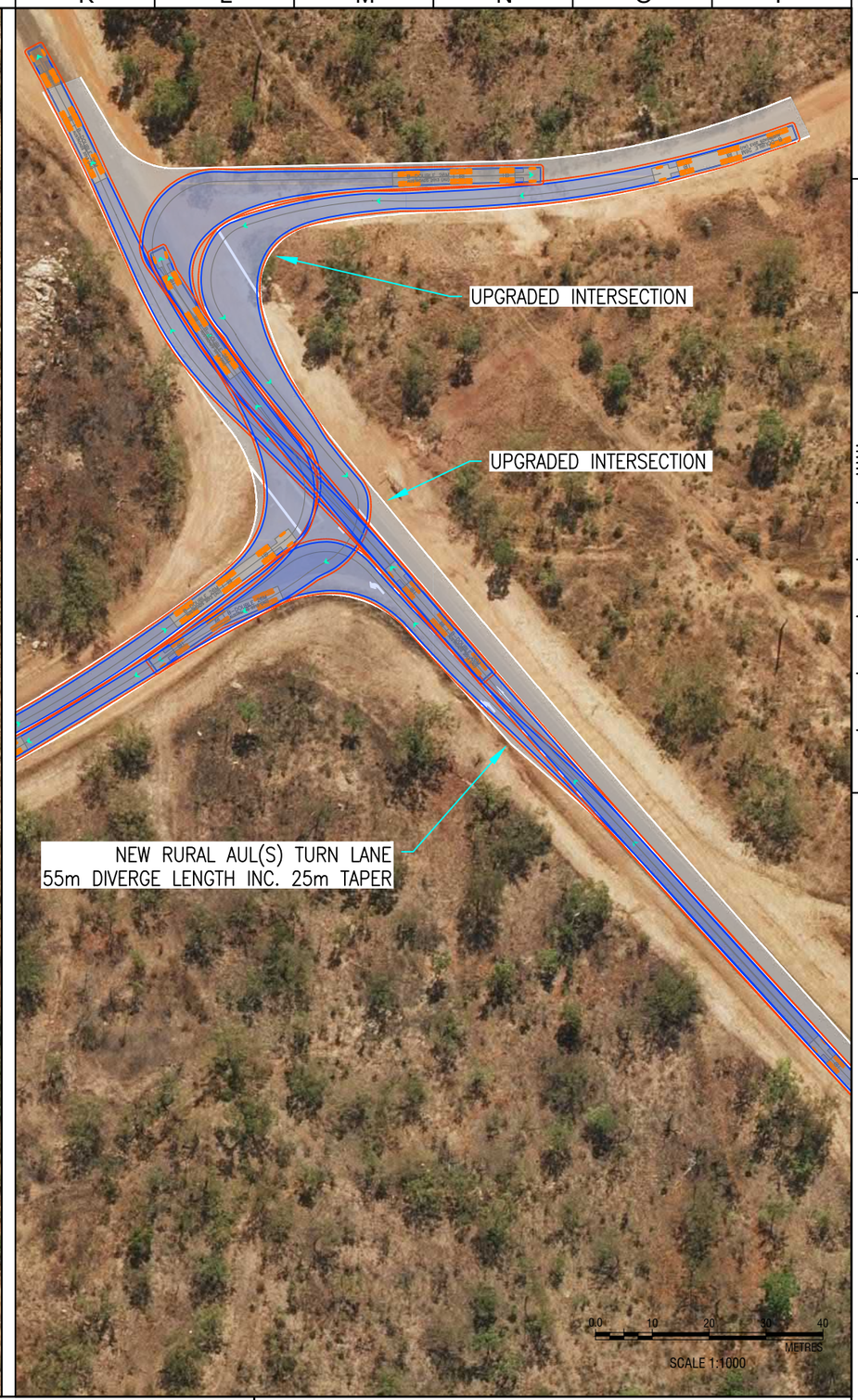
Table C12 Intersection C – SIDRA Results Summary

Scenario	AM Peak			PM Peak		
	DoS	Critical Delay	95th Queue	DoS	Critical Delay	95th Queue
Existing Background + Maximum Project Traffic	0.04	8s	0.4m	0.04	8s	0.4m

Based on the results presented in Table C12, the intersection will perform well within the maximum preferred operational capacity for a priority-controlled intersection (DOS less than 0.80 and acceptable critical delay) for the assessed scenario. No mitigation upgrades are warranted based solely on intersection performance considerations.

APPENDIX D

Intersection Design Concepts



CONSULTANT PROJECT 680.10421

FULL SIZE ON ORIGINAL 0 5 10 20 30 40 50 A3

PLOT DATE 02-Jun-2020 1:10:29 PM

No.	DESCRIPTION	DATE.	INIT.	DEPT/COMP.
-	-	-	-	-

AMENDMENTS

SLR
LEVEL 2, 15 ASTOR TERRACE
SPRING HILL
QUEENSLAND 4000
AUSTRALIA
T: 61 7 3858 4800
F: 61 7 3858 4801
www.slrconsulting.com

DRAWN DM DATE 2/06/2020	CHECKED - DATE -
DESIGNED DM DATE 2/06/2020	CHECKED - DATE -
DESIGN PROJECT LEADER JB DATE 2/06/2020	PROJECT DIRECTOR - DATE -

Northern Territory Government

NORTHERN TERRITORY
RUM JUNGLE
JOB DESCRIPTION

RUM JUNGLE ROAD / LITCHFIELD PARK ROAD INTERSECTION CONCEPT 1

NTG ASSET No:	SLR DRAWING No:	AMENDMANT	SHEET SIZE
-	680.10421.TA.SK01	-	A3

\\au.slr.local\Corporate\Projects-SLR\620-BNE\680-DRW\680.10421 - Rum Jungle\XX TA\03 Acad\680.10421 Road Concepts v0.5.dwg

CONSULTANT PROJECT 680.10421

FULL SIZE ON ORIGINAL 0 5 10 20 30 40 50 A3

PLOT DATE 02-Jun-2020 1:14:53 PM

No.	DESCRIPTION	DATE.	INIT.	DEPT/COMP.
-	-	-	-	-

AMENDMENTS

SLR
LEVEL 2, 15 ASTOR TERRACE
SPRING HILL
QUEENSLAND 4000
AUSTRALIA
T: 61 7 3858 4800
F: 61 7 3858 4801
www.slrconsulting.com

DRAWN DM	DATE 2/06/2020	CHECKED -	DATE -
DESIGNED DM	DATE 2/06/2020	CHECKED -	DATE -
DESIGN PROJECT LEADER JB	DATE 2/06/2020	PROJECT DIRECTOR -	DATE -

Northern Territory Government

NORTHERN TERRITORY
RUM JUNGLE
JOB DESCRIPTION

LITCHFIELD PARK ROAD / POETT ROAD INTERSECTION CONCEPT 1

NTG ASSET No:	SLR DRAWING No:	AMENDMANT	SHEET SIZE
-	680.10421.TA.SK01	-	A3

\\au.slr.local\Corporate\Projects-SLR\620-BNE\680-DRW\680.10421 - Rum Jungle\XX TA\03 Acad\680.10421 Road Concepts v0.5.dwg

APPENDIX E

Pavement Impact Assessment Outputs

SEALED ROADS - Development SAR4s (ESAs)

SLR Road Segment ID	Vehicle class	Loaded			Unloaded			TOTAL_SAR4
		Total Demand	SAR4_PER_VEH	TOTAL_SAR4	Total Demand	SAR4_PER_VEH	TOTAL_SAR4	
Total Traffic	3	2,584	2.98	7,700	2,584	0.54	1,395	9,096
	4	1,038	3.57	3,706	1,038	0.50	519	4,225
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	54	5.61	303	54	0.52	28	331
	9	-	4.93	-	-	0.51	-	-
	10	78,942	6.30	497,335	78,942	0.53	41,839	539,174
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
Total	**Total**	**82,618**	**-**	**509,044**	**82,618**	**-**	**43,782**	**552,826**
A Litchfield Park Road	3	-	2.98	-	-	0.54	-	-
	4	-	3.57	-	-	0.50	-	-
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	-	5.61	-	-	0.52	-	-
	9	-	4.93	-	-	0.51	-	-
	10	69,063	6.30	435,094	69,063	0.53	36,603	471,697
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
A	**Total**	**69,063**	**-**	**435,094**	**69,063**	**-**	**36,603**	**471,697**
C Rum Jungle Road	3	2,584	2.98	7,700	2,584	0.54	1,395	9,096
	4	1,038	3.57	3,706	1,038	0.50	519	4,225
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	54	5.61	303	54	0.52	28	331
	9	-	4.93	-	-	0.51	-	-
	10	9,880	6.30	62,241	9,880	0.53	5,236	67,478
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
C	**Total**	**13,556**	**-**	**73,950**	**13,556**	**-**	**7,179**	**81,129**

Table 3: SAR calculation by Austroads heavy vehicle classification

Austroads vehicle class	3	4	5	6	7	8	9	10	11	12
Legal Loading (t)	15.0	22.5	27.5	24.0	31.5	39.0	42.5	62.5	79.0	115.5
Base Load per SAR4	13.6	19.2	23.0	21.8	27.4	33.0	37.7	56.2	70.0	102.3
Unloaded Axle Group Load (t)	8.5	9.5	12.5	12.5	13.5	14.5	16.0	22.5	27.5	39.0
Unloaded SAR4	0.54	0.50	0.46	0.60	0.56	0.52	0.51	0.53	0.55	0.58
Unloaded SAR5	0.43	0.41	0.37	0.46	0.44	0.41	0.41	0.42	0.43	0.44
Unloaded SAR12	0.11	0.11	0.09	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Loaded Axle Group Load (t)	15.0	22.5	27.5	24.0	31.5	39.0	42.5	62.5	79.0	115.5
Loaded SAR4	2.98	3.57	4.09	4.43	5.02	5.61	4.93	6.30	8.34	11.75
Loaded SAR5	3.29	4.14	4.89	4.88	5.73	6.58	5.61	7.09	9.53	13.45
Loaded SAR12	6.60	12.08	17.07	9.65	15.13	20.61	14.63	17.17	25.71	36.79
Payload (t)	6.5	13.0	15.0	11.5	18.0	24.5	26.5	40.0	51.5	76.5

SEALED ROADS - Development SAR4s (ESAs)

SLR Road Segment ID	Vehicle class	Loaded			Unloaded			TOTAL_SAR4
		Total Demand	SAR4_PER_VEH	TOTAL_SAR4	Total Demand	SAR4_PER_VEH	TOTAL_SAR4	
D Batchelor Road W	3	2,584	2.98	7,700	2,584	0.54	1,395	9,096
	4	1,038	3.57	3,706	1,038	0.50	519	4,225
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	54	5.61	303	54	0.52	28	331
	9	-	4.93	-	-	0.51	-	-
	10	9,880	6.30	62,241	9,880	0.53	5,236	67,478
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
D	**Total**	**13,556**	**-**	**73,950**	**13,556**	**-**	**7,179**	**81,129**
E Batchelor Road E	3	2,584	2.98	7,700	2,584	0.54	1,395	9,096
	4	1,038	3.57	3,706	1,038	0.50	519	4,225
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	54	5.61	303	54	0.52	28	331
	9	-	4.93	-	-	0.51	-	-
	10	505	6.30	3,179	505	0.53	267	3,446
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
E	**Total**	**4,181**	**-**	**14,888**	**4,181**	**-**	**2,210**	**17,098**
F Crater Lake Road	3	-	2.98	-	-	0.54	-	-
	4	-	3.57	-	-	0.50	-	-
	5	-	4.09	-	-	0.46	-	-
	6	-	4.43	-	-	0.60	-	-
	7	-	5.02	-	-	0.56	-	-
	8	-	5.61	-	-	0.52	-	-
	9	-	4.93	-	-	0.51	-	-
	10	9,375	6.30	59,063	9,375	0.53	4,969	64,031
	11	-	8.34	-	-	0.55	-	-
	12	-	11.75	-	-	0.58	-	-
F	**Total**	**9,375**	**-**	**59,063**	**9,375**	**-**	**4,969**	**64,031**

Class	Typical description	Dominant vehicle in each class
Medium (5.5m to 14.5m)		
3	Two axle truck	
4	Three axle truck	
5	Four axle truck	
Long (11.5m to 19.0m)		
6	Three axle articulated	
7	Four axle articulated	
8	Five axle articulated	
9	Six axle articulated (semi-trailer)	
Medium combination (17.5m to 36.5m)		
10	B Double	
11	Double road train	
Large combination (over 33.0m)		
12	Triple road train	

Source: Austroads Guide to Pavement Technology Part 2: Pavement Structure Design, 2008

Figure 3: Austroads vehicle classification system: heavy vehicles

SEALED ROADS - Contribution to offset development impacts

SLR Road Segment ID	SECTION_ID	Road Name	Direction	Load	Section	Length (km)	Pavement type	Load damage exponent	Marginal cost (CENTS_PER_SAR-km)	Vehicle Class	DEVELOPMENT_VOLUMES_Total	SAR_PER_TRIP	DEVELOPMENT_SAR_Total	Development contribution ($)
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	3	-	2.98	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	4	-	3.57	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	5	-	4.09	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	6	-	4.43	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	7	-	5.02	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	8	-	5.61	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	9	-	4.93	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	10	69,063	6.30	435,094	$201,187.35
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	11	-	8.34	-	$0.00
A	S1	Litchfield Park Road	Eastbound	Loaded	0.00 - 3.40	3.40	GN	4	13.60	12	-	11.75	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	3	-	0.54	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	4	-	0.50	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	5	-	0.46	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	6	-	0.60	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	7	-	0.56	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	8	-	0.52	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	9	-	0.51	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	10	69,063	0.53	36,603	$16,925.29
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	11	-	0.55	-	$0.00
A	S2	Litchfield Park Road	Westbound	Unloaded	3.40 - 0.00	3.40	GN	4	13.60	12	-	0.58	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	3	2,584	2.98	7,700	$6,911.94
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	4	1,038	3.57	3,706	$3,326.20
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	5	-	4.09	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	6	-	4.43	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	7	-	5.02	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	8	54	5.61	303	$271.92
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	9	-	4.93	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	10	9,880	6.30	62,241	$55,867.88
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	11	-	8.34	-	$0.00
C	S3	Rum Jungle Road	Northbound	Loaded	0.00 - 6.60	6.60	GN	4	13.60	12	-	11.75	-	$0.00

SEALED ROADS - Contribution to offset development impacts

SLR Road Segment ID	SECTION_ID	Road Name	Direction	Load	Section	Length (km)	Pavement type	Load damage exponent	Marginal cost (CENTS_PER_SAR-km)	Vehicle Class	DEVELOPMENT_VOLUMES_Total	SAR_PER_TRIP	DEVELOPMENT_SAR_Total	Development contribution ($)
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	3	2,584	0.54	1,395	$1,252.50
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	4	1,038	0.50	519	$465.85
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	5	-	0.46	-	$0.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	6	-	0.60	-	$0.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	7	-	0.56	-	$0.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	8	54	0.52	28	$25.20
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	9	-	0.51	-	$0.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	10	9,880	0.53	5,236	$4,700.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	11	-	0.55	-	$0.00
C	S4	Rum Jungle Road	Southbound	Unloaded	6.60 - 0.00	6.60	GN	4	13.60	12	-	0.58	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	3	2,584	0.54	1,395	$1,195.57
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	4	1,038	0.50	519	$444.68
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	5	-	0.46	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	6	-	0.60	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	7	-	0.56	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	8	54	0.52	28	$24.06
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	9	-	0.51	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	10	9,880	0.53	5,236	$4,486.36
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	11	-	0.55	-	$0.00
D	S5	Batchelor Road West	Eastbound	Unloaded	0.00 - 6.30	6.30	GN	4	13.60	12	-	0.58	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	3	2,584	2.98	7,700	$6,597.76
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	4	1,038	3.57	3,706	$3,175.01
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	5	-	4.09	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	6	-	4.43	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	7	-	5.02	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	8	54	5.61	303	$259.56
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	9	-	4.93	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	10	9,880	6.30	62,241	$53,328.43
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	11	-	8.34	-	$0.00
D	S6	Batchelor Road West	Westbound	Loaded	6.30 - 0.00	6.30	GN	4	13.60	12	-	11.75	-	$0.00

SEALED ROADS - Contribution to offset development impacts

SLR Road Segment ID	SECTION_ID	Road Name	Direction	Load	Section	Length (km)	Pavement type	Load damage exponent	Marginal cost (CENTS_PER_SAR-km)	Vehicle Class	DEVELOPMENT _VOLUMES_Total	SAR_PER_TRIP	DEVELOPMENT_SAR _Total	Development contribution ($)
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	3	2,584	0.54	1,395	$1,195.57
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	4	1,038	0.50	519	$444.68
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	5	-	0.46	-	$0.00
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	6	-	0.60	-	$0.00
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	7	-	0.56	-	$0.00
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	8	54	0.52	28	$24.06
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	9	-	0.51	-	$0.00
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	10	505	0.53	267	$229.13
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	11	-	0.55	-	$0.00
E	S7	Batchelor Road East	Eastbound	Unloaded	6.30 - 12.60	6.30	GN	4	13.60	12	-	0.58	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	3	2,584	2.98	7,700	$6,597.76
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	4	1,038	3.57	3,706	$3,175.01
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	5	-	4.09	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	6	-	4.43	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	7	-	5.02	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	8	54	5.61	303	$259.56
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	9	-	4.93	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	10	505	6.30	3,179	$2,723.68
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	11	-	8.34	-	$0.00
E	S8	Batchelor Road East	Westbound	Loaded	12.60 - 6.30	6.30	GN	4	13.60	12	-	11.75	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	3	-	0.54	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	4	-	0.50	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	5	-	0.46	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	6	-	0.60	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	7	-	0.56	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	8	-	0.52	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	9	-	0.51	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	10	9,375	0.53	4,969	$2,905.73
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	11	-	0.55	-	$0.00
F	S9	Crater Lake Road	Eastbound	Unloaded	0.00 - 4.30	4.30	GN	4	13.60	12	-	0.58	-	$0.00

SEALED ROADS - Contribution to offset development impacts

SLR Road Segment ID	SECTION_ID	Road Name	Direction	Load	Section	Length (km)	Pavement type	Load damage exponent	Marginal cost (CENTS_PER_SAR-km)	Vehicle Class	DEVELOPMENT_VOLUMES_Total	SAR_PER_TRIP	DEVELOPMENT_SAR_Total	Development contribution ($)
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	3	-	2.98	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	4	-	3.57	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	5	-	4.09	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	6	-	4.43	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	7	-	5.02	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	8	-	5.61	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	9	-	4.93	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	10	9,375	6.30	59,063	$34,539.75
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	11	-	8.34	-	$0.00
F	S10	Crater Lake Road	Westbound	Loaded	4.30 - 0.00	4.30	GN	4	13.60	12	-	11.75	-	$0.00

Total **$412,540.48**

Table 6: SCR network overview

Type	Length of pavement network	% of network	Average marginal cost	Damage unit
Sealed roads with granular pavement (GN)	24,886 km	82%	13.60 cents / SAR-km	SAR4
Sealed roads with asphaltic concrete pavement (AC)	2,523 km	7%	4.87 cents / SAR-km	SAR5
Sealed roads with cement stabilised pavement (CS)	2,761 km	8%	3.69 cents / SAR-km	SAR12
Sub total	30,171 km	88%	11.94 cents / SAR-km	-
Unsealed roads	4,277 km	12%	14,84 cents / LU-km	LU
Total	34,448 km	100%	-	-

Table 1: Pavement types and load damage exponent

Pavement type		TMR pavement type	Type of damage	Load damage exponent	Damage unit
Granular pavement with thin bituminous surfacing	Granular pavement (GN)	Sprayed seal over flexible pavement, including cement modified and lime stabilised layer types C4 and C5	Overall pavement damage	4	ESA / SAR4
Pavement containing one or more bounded layers	Asphaltic concrete pavement (AC)	Sprayed seal or asphalt over flexible pavement with bitumen stabilised pavement	Fatigue of asphalt	5	SAR5
		Asphalt over flexible pavement, including cement modified and lime stabilised layer types C4 and C5			
	Cement stabilised pavement (CS)	Sprayed seal over semi-rigid / semi-rigid composite pavement	Fatigue of cemented materials	12	SAR12
		Asphalt over semi-rigid / semi-rigid composite pavement			

Source: Austroads Guide to Pavement Technology Part 2: Pavement Structure Design, 2008

Table 3: SAR calculation by Austroads heavy vehicle classification

Austroads vehicle class	3	4	5	6	7	8	9	10	11	12
Legal Loading (t)	15.0	22.5	27.5	24.0	31.5	39.0	42.5	62.5	79.0	115.5
Base Load per SAR4	13.6	19.2	23.0	21.8	27.4	33.0	37.7	56.2	70.0	102.3
Unloaded Axle Group Load (t)	8.5	9.5	12.5	12.5	13.5	14.5	16.0	22.5	27.5	39.0
Unloaded SAR4	0.54	0.50	0.46	0.60	0.56	0.52	0.51	0.53	0.55	0.58
Unloaded SAR5	0.43	0.41	0.37	0.46	0.44	0.41	0.41	0.42	0.43	0.44
Unloaded SAR12	0.11	0.11	0.09	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Loaded Axle Group Load (t)	15.0	22.5	27.5	24.0	31.5	39.0	42.5	62.5	79.0	115.5
Loaded SAR4	2.98	3.57	4.09	4.43	5.02	5.61	4.93	6.30	8.34	11.75
Loaded SAR5	3.29	4.14	4.89	4.88	5.73	6.58	5.61	7.09	9.53	13.45
Loaded SAR12	6.60	12.08	17.07	9.65	15.13	20.61	14.63	17.17	25.71	36.79
Payload (t)	6.5	13.0	15.0	11.5	18.0	24.5	26.5	40.0	51.5	76.5

UNSEALED ROADS - Development LUs

Road Segment	Vehicle class	Loaded		
		Total Demand	LU_PER_VEHICLE	LU_PER_YEAR
Total Traffic	1,2	22,149	1.00	22,149
	3	2,584	1.00	2,584
	4	1,038	1.50	1,557
	5	-	2.00	-
	6	-	1.50	-
	7	-	2.00	-
	8	54	2.50	135
	9	-	3.00	-
	10	78,942	4.50	355,239
	11	-	5.50	-
	12	-	8.00	-
Total	**Total**	**104,767**	**-**	**381,664**
B Poett Road	1,2	-	1.00	
	3	-	1.00	-
	4	-	1.50	-
	5	-	2.00	-
	6	-	1.50	-
	7	-	2.00	-
	8	-	2.50	-
	9	-	3.00	-
	10	69,063	4.50	310,781
	11	-	5.50	-
	12	-	8.00	-
B	**Total**	**69,063**	**-**	**310,781**

Table 4: LU by Austroads heavy vehicle classification

ID	Austroads class	3	4	5	6	7	8	9	10	11	12
[A]	Number of Axles	2	3	4	3	4	5	6	9	11	16
	Loading Units (LU) = (A/2)	1.0	1.5	2.0	1.5	2.0	2.5	3.0	4.5	5.5	8.0

UNSEALED ROADS - Contribution to offset development impacts

SLR Road Segment ID	SECTION_ID	Road Name	Section	Length (km)	Marginal cost (CENTS_PER_LU-km)	DEVELOPMENT _VOLUMES_Total	DEVELOPMENT_ LUs_TOTAL	Development Contributions ($)
B	U1	Poett Road	0.00 - 2.00	2.00	14.84	69,063	310,781	$92,239.88
							Total	**$92,239.88**

Table 6: SCR network overview

Type	Length of pavement network	% of network	Average marginal cost	Damage unit
Sealed roads with granular pavement (GN)	24,886 km	82%	13.60 cents / SAR-km	SAR4
Sealed roads with asphaltic concrete pavement (AC)	2,523 km	7%	4.87 cents / SAR-km	SAR5
Sealed roads with cement stabilised pavement (CS)	2,761 km	8%	3.69 cents / SAR-km	SAR12
Sub total	30,171 km	88%	11.94 cents / SAR-km	-
Unsealed roads	4,277 km	12%	14,84 cents / LU-km	LU
Total	34,448 km	100%	-	-

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