APPENDIX M: TRAFFIC IMPACT ASSESSMENT

Traffic Impact Assessment

Project:	Lamb Creek Iron Ore Project Great Northern Highway Intersection Design
Client:	Mineral Resources
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Doc No:	2105001-TIA-001
Revision:	B

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Document Status: Issued for MRWA Review

Revision	Prepared By	Reviewed By	Approved By	Issue	Date
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A	Keli Li	R. Needham	R. Needham	MRWA Review	27-05-21

Disclaimer

File Reference: Y:\Jobs Active 2021\CE - Roads and Drainage\MRL - Lamb Creek GNH Intersection_2105001\3. Documents\3.6 TIA\2105001-TIA-001_A.docx

Contents

Figures

Tables

Glossary of Terms

Abbreviations

AADT	Annual Average Daily Traffic
ASD	Approach Sight Distance
AWT	Average Weekly Traffic
BAL	Basic Left Turn Treatment
BAR	Basic Right Turn Treatment
AUL	Auxiliary Left Turn Treatment
AUR	Auxiliary Right Turn Treatment
CHL	Channelised Left Turn Treatment
CHR	Channelised Right Turn Treatment
ESD	Entering Sight Distance
Km	Kilometre
Km/h	Kilometres per Hour
MRWA	Main Roads Western Australia
RAV	Restricted Access Vehicle
SISD	Safe Intersection Sight Distance
SLK	Straight Line Kilometre
TIS	Traffic Impact Statement
TIA	Traffic Impact Assessment
Vpd	Vehicles per Day
Vph	Vehicles per Hour

1. Introduction

1.1. Background

Mineral Resources (MRL) are seeking to progress their Lamb Creek Iron Ore Project which is located approximately 128km NW of Newman in the Shire of East Pilbara.

The project will involve the haulage of iron ore at 10mtpa (Million Tonnes Per Annum) rate from the site using Great Northern Highway (GNH) to Port Hedland for a period of 4 years. To facilitate the haulage movements a new intersection will be required onto GNH south of the existing railway level crossing at SLK 1295.21. The exact preferred location of the intersection is yet to be confirmed and will be depended on the recommendation of this assessment

Refer to **Figure 1** for the proposed intersection location. An aerial view is also provided in **Figure 2**.

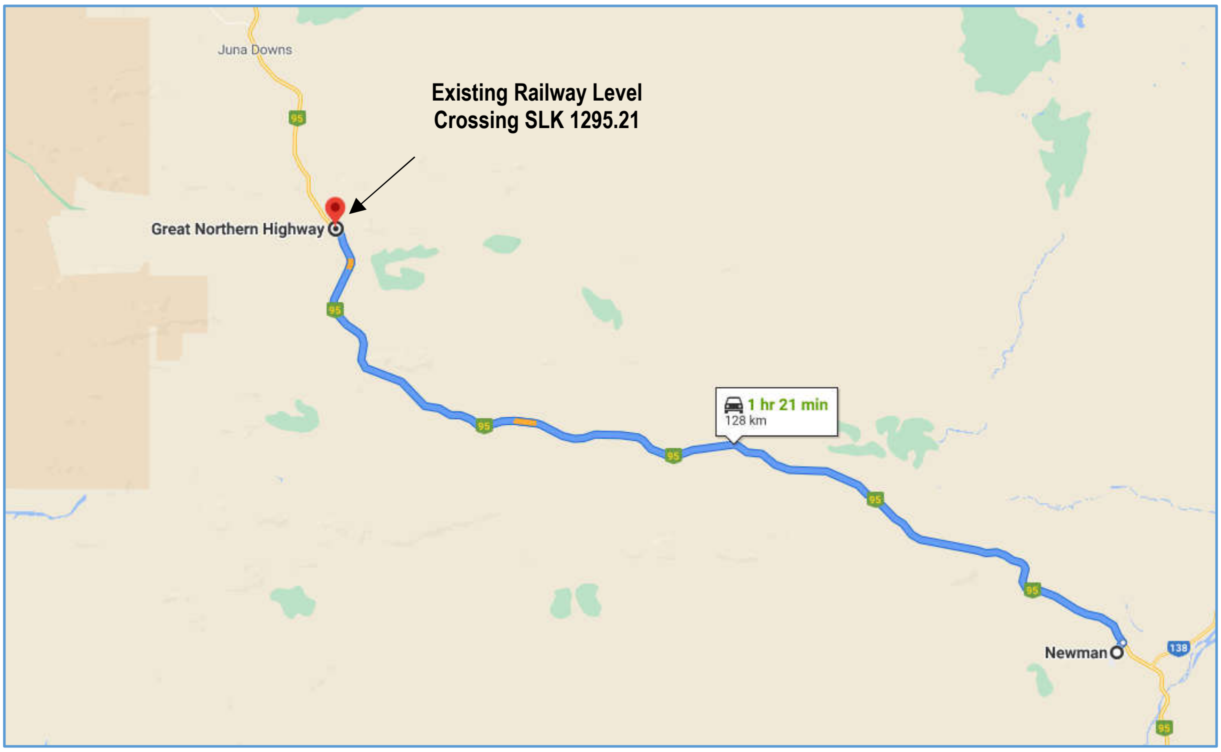


Figure 1: Proposed Intersection Location

Figure 2: Aerial View

Shawmac has been engaged by MRL to undertake a Transport Impact Assessment for the proposed haulage and construction operations. The Transport Impact Assessment has been undertaken in accordance with the Western Australian Planning Commission's (WAPC) Transport Impact Assessment Guidelines for Developments: Volume 4 – Individual Developments (2016). The assessment includes:

- Collection of background data including traffic counts and crash data.
- Details of the proposed transportation of ore as provided by the client. This includes the proposed yields, operating hours and periods, vehicle numbers types and loads.
- Assessment of the proposed access onto Great Northern Highway in accordance with MRWA and Austroads guidelines with regards to safety, sight distance requirements, geometry and interaction with non-site traffic.
- Assessment of the development impact on the immediately adjacent road network at the subject intersection.
- Review of any site-specific safety issues associated with the proposal.

- Assessment of the proposed crossing in relation to the MRWA RAV Assessment Guidelines.

2. Existing Situation

2.1. Road Network

GNH is defined as a Primary Distributor. The layout and hierarchy of the existing road network according to the Main Roads WA Road Information Mapping System is shown in **Figure 3**.

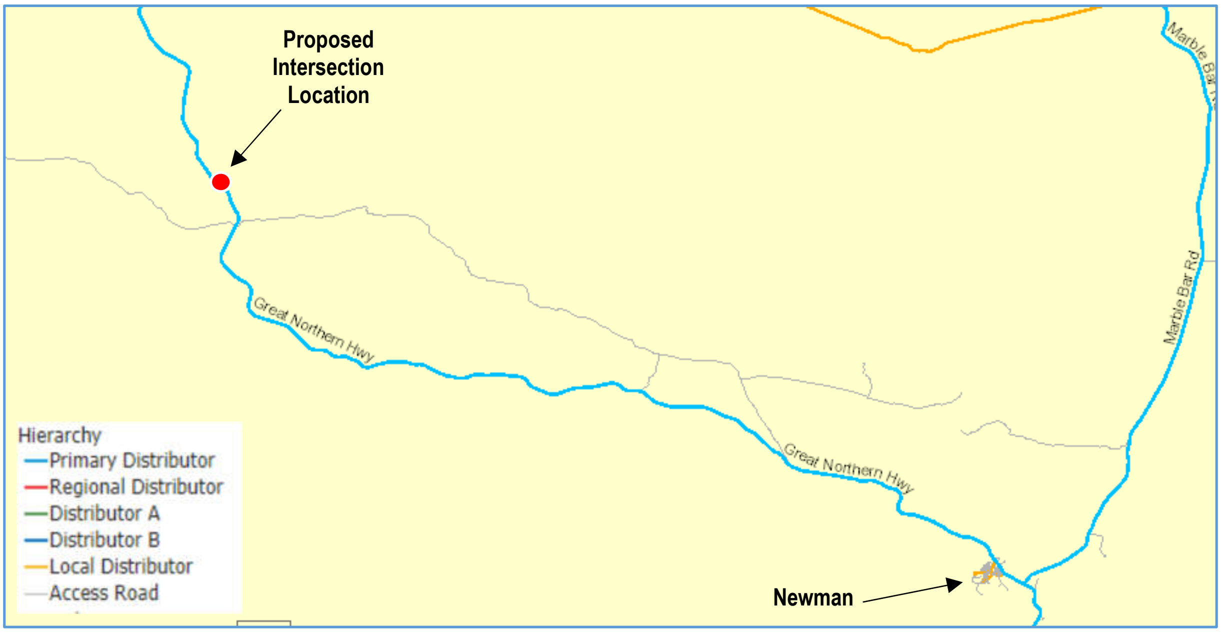


Figure 3: Adjacent Road Network

2.2. Carriageway Width and Cross Section

The carriageway and configuration of GNH is summarised in **Table 1**.

Table 1: Road Configuration

Road and Location	Road Type	Cross Section	Carriageway Width (Approx.)	Sealed Pavement Width (Approx.)
Great Northern Highway	Primary Distributor	Two-lane single carriageway	10.0m	8.0m

2.3. Traffic Volumes

The nearest traffic count data for Great Northern Highway according to MRWA Trafficmap is at the count site South of Karijini Drive (SLK 1314.60). The traffic counts data from this count site recorded a steady 12% increase over the 3-year period from 2018/19 to 2020/21. This growth rate has been used to estimate the 2025 background traffic volumes. For conservatism and simplification, the assessment considers a hypothetical peak hour consisting of the worst-case AM and PM volumes combined (i.e. the peak AM and PM volumes occur at the same time).

Detailed traffic count data is attached in **Appendix A** and a summary of this information is provided in **Table 2** and **Table 3**.

Table 2: Daily Traffic Volumes

Road / Direction	Location	Daily Volume (2020/21)	Estimated Daily (2025/26)	Data Source
Great Northern Highway NB	South of Karijini Drive	397	701	MRWA 20/21
Great Northern Highway SB	South of Karijini Drive	381	673	MRWA 20/21

Table 3: Peak Hour Traffic Volumes

Road / Direction	Location	2020/21		Estimated 2025/26		Assessment Peak
		AM Peak	PM Peak	AM Peak	PM Peak	
Great Northern Highway NB	South of Karijini Drive	39	35	**69**	62	69
Great Northern Highway SB	South of Karijini Drive	30	36	53	**64**	64

2.4. RAV Status

As per MRWA HVS network mapping tool:

- Great Northern Highway is categorised under Tandem Drive RAV 10.3 network and Tri Drive 5.3 network without any conditions.

Figure 4 shows the Tandem Drive RAV 10.3 network for the road network in the local vicinity.

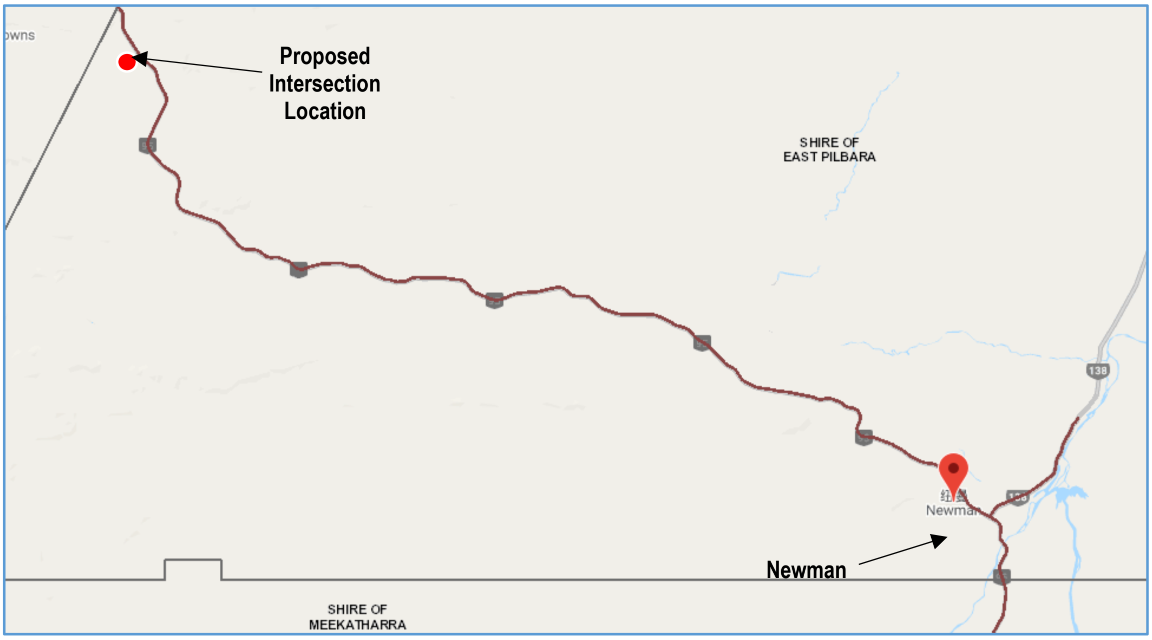


Figure 4: Tandem Drive RAV Network

2.5. Speed Limit

As per MRWA's Road Information Mapping System, Great Northern Highway is operating under a 110km/h speed limit and the speed limit transitions into 80km/hr between approximately 360m south of the existing railway level crossing and 400m north of the crossing.

The speed limit of the adjacent road network is shown below in **Figure 5**.

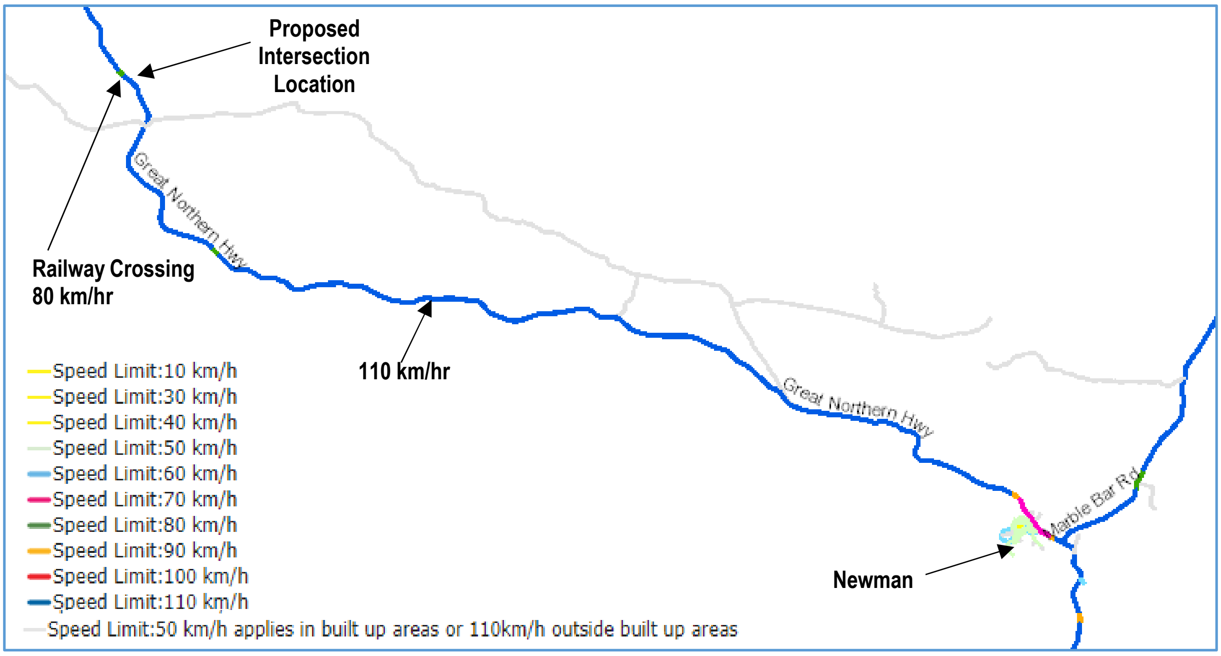


Figure 5: Speed Zoning

2.6. Crash History

Crash data for GNH in the vicinity of the proposed intersection (3,000m to south of the railway level crossing) was sourced from MRWA Crash Analysis Reporting System (CARS) for the 5-year period ending 31/12/2020. The report is summarised in **Table 4**.

Table 4: Crash History

Location	Number of Crashes	MR Nature and Location	Severity
Great Northern Highway SLK 1295.21 – 1292.21	0	N/A	N/A

2.7. Changes to Surrounding Transport Networks

It is understood that the Wonmunna Iron Ore is also proposed by Mineral Resources which proposes a new intersection at SLK 1250.92 of Great Northern Highway. This project proposes haulage of 10mtpa iron ore for 5 years to and from Port Hedland. This means there will be 230 unloaded truck movements per day travelling south passing the new Lamb Creek intersection, and 230 loaded truck movements per day travelling north across the new Lamb Creek intersection. For this assessment, the 2025 background traffic volume takes into account the traffic generation of the Wonmunna Iron Ore project as summarised in **Table 5** below.

Table 5: Background Traffic Volume with Wonmuna Project

Road / Direction	2025 Daily	2025 Assessment Peak	2025 Daily with Wonmunna	2025 Assessment Peak Wonmunna
Great Northern Highway NB	701	69	1161	84
Great Northern Highway SB	673	64	1133	79

We are not aware of any other potential changes to the surrounding transport networks.

3. Transport Logistics

3.1. Proposed Development

It is proposed to extract and deliver iron ore at 10mtpa from the Lamb Creek site to Port Hedland.

The intersection is to be located at the south of the existing railway level crossing at SLK 1295.21, however the exact preferred location of the intersection is yet to be confirmed and will be depended on the recommendation of this assessment.

3.2. Haulage Route

Loaded trucks will travel north and head to Port Hedland. Unloaded trucks will travel in the opposite direction.

3.3. Operating Hours

Haulage operations will occur 24 hours a day and 7 days a week. There is no strictly defined peak period, however it has been assumed that some bunching of vehicles will occur during the peak hour of the road network, as discussed in **Section 3.5**.

3.4. Proposed Haulage Vehicle

It is proposed to use 60m long PBS quad road train with 120t payload. The same vehicles are currently being utilised for MRL's Iron Valley Project and will also be used for MRL's Wonmunna project.

For the purpose of intersection design, in accordance with MRWA's supplement Guide to Road Design Part 4, a Tri-Drive Double B-Double Road Train with 22m turning radius has been used. Refer **Figure 6** for typical configurations of design vehicle.

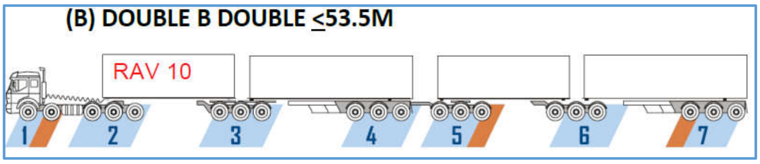


Figure 6: Design Vehicle

3.5. Projected Traffic Generation

It has been advised that the proposed 10 mtpa (Million Tonnes Per Annum) rate will require 228 haulage vehicle movements per day. This means 228 unloaded truck movements turning into, and 228 loaded truck movements turning out of the proposed intersection. The daily truck movements will generally be evenly distributed over the 24-hour operating period, however to account for some bunching over the peak period around shift changes as previously discussed, 15 vph inbound and 15 vph outbound have been assumed for the purpose of peak hour assessment.

Considering the location of the site, light vehicle movements are assumed to be to and from Newman. It has been advised that the site would generate 50 vehicle movements in each direction during shift change. For conservatism, it is assumed that shift change aligns with the existing morning peak hour.

It is also expected to have service vehicles coming to the site from both directions, however the number of movements is expected to be low and infrequent, it is assumed that there will be 5 service vehicles to and from the proposed site from each direction and these movements will occur outside of peak period (shift change).

4. Traffic Impact Assessment

4.1. Assessment Years

The development is assessed based on network condition on 2025 (i.e. the last year of the projects life).

4.2. Impact on Roads

4.2.1. Road Minimum Widths

The sealed widths of Great Northern Highway were checked against the rural road minimum widths in accordance with Appendix A of the MRWA RAV assessment guideline. The comparison is shown below in **Table 6**.

Table 6: Rural Road Minimum Width

Road	Location	2025 Background AADT	Proposed AADT**	Speed (RAV) (km/hr)	RAV Status	Required Minimum Seal Width (m)	Existing Seal Width (m)
GNH	North of Proposed Intersection	1,490	2,299	100	RAV 10	8.0	8.0
GNH	South of Proposed Intersection	1,490	1,943	100	RAV 10	8.0	8.0

As shown above, the existing road seal widths comply with the minimum requirements.

4.2.2. Road Safety

The crash history of the adjacent road network (as previously outlined in **Section 2.6**) does not suggest any particular safety issues (there have been no crashes recorded) in the existing road network. The additional traffic movements generated by the operation is not considered to increase the likelihood of crashes to unacceptable levels.

4.3. Intersection Assessment

4.3.1. General

A review of the reasonable intersection range (3 km south of the existing railway crossing at SLK 1295.21) indicates that the major driver of the intersection locations would be the length of a potential acceleration lane and the constraint of the existing rail line. In essence, this means that the acceleration lane will need to terminate an appropriate distance from the rail crossing and the intersection location would then be set to the south, based on the acceleration lane length, and subject to that location having the appropriate Safe Intersection Sight Distance (SISD) available.

4.3.2. Intersection Volumes

For the purpose of capacity assessment and auxiliary lane assessment, the with-development peak hour (worst-case) volumes based on 2025 projected traffic volumes are shown in **Figure 7**.

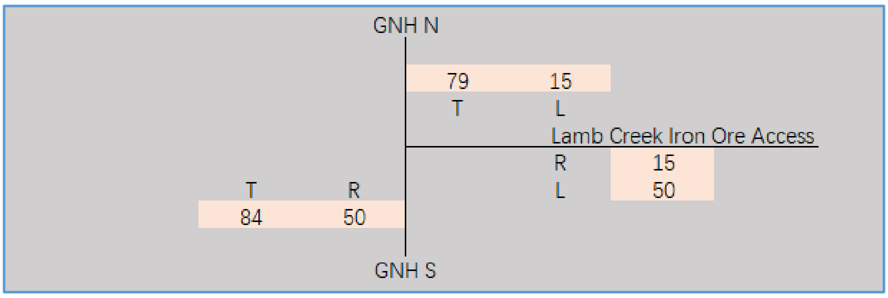


Figure 7: Intersection Volumes

4.3.3. Intersection Capacity

SIDRA Intersection 9 has been used to assess the worst-case peak hour capacity and performance of the proposed intersection off Great Northern Highway.

SIDRA is a commonly used intersection modelling tool used by traffic engineers for all types of intersections. Outputs for four standard measures of operational performance can be obtained, being Degree of Saturation (DoS), Average Delay, Queue Length, and Level of Service (LoS).

- Degree of Saturation is a measure of how much physical capacity is being used with reference to the full capability of the particular movement, approach, or overall intersection. A DoS of 1.0 equates to full theoretical capacity although in some instances this level is exceeded in practice. Design engineers typically set a maximum DoS threshold of 0.95 for new intersection layouts or modifications.
- Average Delay reports the average delay per vehicle in seconds experienced by all vehicles in a particular lane, approach, or for the intersection as a whole. For severely congested intersections the average delay begins to climb exponentially.

- Queue Length measures the length of approach queues. In this document we have reported queue length in terms of the length of queue at the 95th percentile (the maximum queue length that will not be exceeded for 95 percent of the time). Queue lengths provide a useful indication of the impact of signals on network performance. It also enables the traffic engineer to consider the likely impact of queues blocking back and impacting on upstream intersections and accesses.
- Level of Service is a combined appreciation of queuing incidence and delay time incurred, producing an alphanumeric ranking of A through F. A LoS of A indicates an excellent level of service whereby drivers delay is at a minimum and they clear the intersection at each change of signals or soon after arrival with little if any queuing. Values of B through D are acceptable in normal traffic conditions. Whilst values of E and F are typically considered undesirable, within central business district areas with significant vehicular and pedestrian numbers, delays/queues are unavoidable and hence, are generally accepted by road users.

In accordance with Main Roads Operational Modelling Guidelines, the gap acceptance factor, opposing vehicle factor as well as other heavy vehicle parameters were set as shown in **Table 7**. Vehicle Mass for the haulage truck has been assumed to be equivalent to Austroads Class 12 truck.

Table 7: Vehicle Parameter Settings

Vehicle Type	Average Mass (kg)	Maximum Power (kW)	Length (m)	Queue Space (m)	PCE	Gap Acceptance Factor and Opposing Vehicle Factor
Light Vehicle (Austroads Class 1)	1,600	120	4.85	7.35	1	1
Austroads Class 2-5	15,000	160	12.5	15.0	2	1.5
Austroads Class 6-9	42,500	350	19.0	21.5	3	2
Austroads Class 10	67,000	450	27.5	30.0	4	2.5
Austroads Class 11	85,000	450	36.5	39.0	4	2.5
Austroads Class 12	147,500	450	53.5	56.0	9	4.5

The intersection has been modelled based on three layouts, which are:

- Proposed intersection layout – With development traffic; and
- Acceleration Lane Layout – With development traffic and a 900m long acceleration lane towards the north.

The modelling layouts are shown in **Figure 8**.

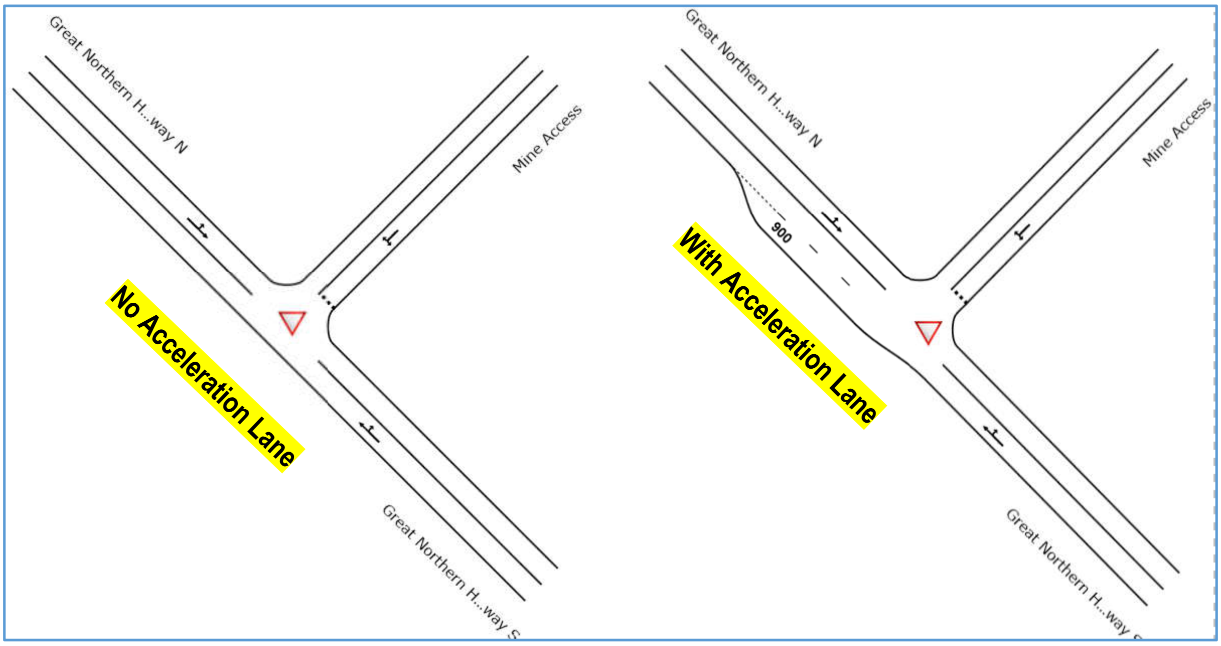


Figure 8: Assessment Intersection Layouts

The results of the assessment are summarised in **Table 8** and included as **Appendix B – SIDRA Output**.

Table 8: SIDRA Outputs – Great Northern Highway / Access Road

Scenario	Assessment Period	Worst DoS	Queue Distance (m)	Average Delay (s)	Worst Delay (s)	LoS Through Movements	LoS Turning Movements
Proposed Layout With Development	Peak Hour	0.243	5.5	4.1	13.2	A	B
Acceleration Lane Layout With Development	Peak Hour	0.243	5.5	3.7	13.2	A	B

The results indicate the intersection would perform with acceptable degree of saturation, queue distance and delay under both scenarios and the addition of an acceleration lane will have minimal impact on the capacity of this intersection.

4.3.4. Acceleration Lane

The RAV guidelines provides the following advice with regards to acceleration lanes:

> *To assist in ensuring network performance levels are maintained, the assessor needs to identify if the acceleration lanes and turn pockets are present at intersections and the length of these treatments. Capturing this information in the assessment will assist in determining if network improvements are necessary, in consultation with the road manager.*

Note 11 on the MRWA T-Intersection guideline drawing (201431-0002) provides the following advice with regards to acceleration lanes:

Provide 900m long acceleration lane (or lanes) when the AADT on the through road exceeds 600 with at least 2 road trains per hour on the terminating leg.

AGRD04 notes that:

There are no simple numerical warrants for the provision of acceleration lanes. However, an auxiliary lane may be added on the departure side of a left turn or right turn if traffic is unable to join safely and/or efficiently with the adjacent through traffic flow by selecting a gap in the traffic stream.

Acceleration lanes may be provided at major intersections depending on traffic analysis. However, they are usually provided only where:

- *insufficient gaps exist for vehicles to enter a traffic stream.*
- *turning volumes are high (e.g. > 300 vph).*
- *the observation angle falls below the requirements of the minimum gap sight distance model (for example, inside of horizontal curves).*
- *heavy vehicles pulling into the traffic stream would cause excessive slowing of major road vehicles.*

The requirement for acceleration lanes has been assessed against the Austroads and Main Roads WA guidelines as detailed in **Table 9**.

Table 9: Acceleration Lane Warrants

Note	Assessment
MRWA – To assist in ensuring network performance levels are maintained, the assessor needs to identify if the acceleration lanes and turn pockets are present at intersections and the length of these treatments. Capturing this information in the assessment will assist in determining if network improvements are necessary, in consultation with the road manager.	A SIDRA assessment of the intersection indicates satisfactory network performance without an acceleration lane.
MRWA - Provide 900m long acceleration lane (or lanes) when the AADT on the through road exceeds 600 with at least 2 road trains per hour on the terminating leg.	The AADT on the through road (GNH) exceeds 600 and it is expected to have 15 road trains (Class 12) per hour on the terminating to enter GNH during peak hour. Therefore, the requirements to provide for a 900m acceleration lane have been met. NOTE: As this drawing is a guideline only, the requirement of an acceleration lane is to be considered (when considering all other aspects) and is technically not mandatory.
Austroads - Acceleration lanes may be provided at major intersections depending on traffic analysis. However, they are usually provided only where: • *Insufficient gaps exist for vehicles to enter a traffic stream.*	Traffic analysis (SIDRA) indicates that the intersection would operate at an acceptable level without the provision of an acceleration lane. The development is expected to generate a maximum of 30 additional truck movements (15 left out / 15 right in) through the intersection per hour and the background northbound traffic during peak hour is 84 vehicles per hour which equates to about 1.5 vehicles per minute.
Austroads continued: • *Turning volumes are high (e.g. > 300 vph).*	Turning volumes at the intersection during the peak hour is expected to be <300 vph.
Austroads continued: • *The observation angle falls below the requirements of the minimum gap sight distance model (for example, inside of horizontal curves).*	The intersection will be designed with adequate sight distances and acceptable observation angle.
Austroads continued: • *Heavy vehicles pulling into the traffic stream would cause excessive slowing of major road vehicles.*	The number of road trains turning right onto GNH is assumed to be 15 vehicles during the peak hour. The peak hour northbound traffic volumes along GNH is approximately 84vph which equates to about 1.5 vehicles per minute. Coming out of the intersection in the loaded direction, there is a slight downgrade for northbound traffic. The downgrade can assist loaded vehicles to pick up speed quicker, however it is not considered significant enough to discourage light vehicles to attempt overtaking loaded RAV 10 vehicles. Therefore, it is expected that a haulage truck turning right onto GNH, during the peak hour, will impact northbound vehicles.

Based on the above assessment, an acceleration lane is considered to be warranted by the proposed haulage traffic at this intersection. This takes into consideration of the relatively high background traffic volume, speed limit on Great Northern Highway and the number of loaded vehicles turning onto Great Northern Highway.

4.3.5. Intersection Location

As an acceleration lane is warranted towards the north of the mine access road, the addition of an acceleration lane will likely affect the existing railway level crossing if the gap between the mine access road and the railway is not sufficient to contain a northbound acceleration lane. Modifications to the railway crossing itself is not likely to be feasible due to substantial cost and interruption to rail operations. Therefore, the mine access road location must be chosen at a location which will not affect the railway crossing.

The intersection location has been recommended based on the considerations outlined in **Table 10** below.

Table 10: Intersection Location Considerations

Item	Assessment
Acceleration Lane Length	Based on the acceleration lane assessment an 900m long acceleration lane is considered required. Although this represents the minimum acceptable length, a significantly longer acceleration lane is not preferred as this would require the intersection to be located within the horizontal curve which commences approximately 1.9km south of the rail crossing. As per the MRWA guideline drawing 201431-0002 and Austroads Guide to Road Design Part 3 Section 9.92, the complete length (inclusion of swept path widening section, merge taper length) from the centreline of the mine access road would be approximately 1,200m.
Existing Signage and minimum gap between signage	As per AS 1742.2 Appendix D, where it is necessary to convey two different messages at one location, separate signs located a minimum of 0.6V metres apart should be used. With 110 km/hr through road speed, the minimum gap between two signages is 66m. A desktop review indicates the railway level crossing is controlled by boom gates with advanced flashing signals. The signals are located 210m away from the railway stop line and there are speed signs located 160 south of the flashing signals. To avoid driver confusion, specifically the potential for drivers to fail to perceive the rail advanced flashing warning signage or speed zone signage as they concentrate on merging, the merge taper needs to terminate before these signs. It is therefore recommended to have 100m gap between the end of merge taper and the speed signs (i.e., 70m from the end of the 30m run out area). **The access road intersection will then need to be at least 1300m south of the speed signs at SLK 1293.53 (or 1,665 south of the railway stop line).**
Approach Sight Distance Towards the Railway	If the acceleration lane is proposed before the railway level crossing, it is also considered necessary to assess if the driver of a loaded RAV-10 vehicle will be able to decelerate and stop at the holding line of the level crossing after noticed the flashing signal just before the signal location. This is assessed based on the Approach Sight Distance as per Austroads Guide to Road Design Part 4A Equation 2. The Approach Sight Distance (ASD) is required to ensure that drivers of trucks and light vehicles approaching the intersection from the minor road at the 85th percentile operating speed are able to see the intersection and stop at the holding line. This is assessed based on the following parameters: • A reaction time of 4.0 seconds for heavy vehicles; • 80 km/hr speed limit approach the railway; • Deceleration coefficients of 0.26 for heavy vehicles; • Driver eye height is 2.4m for trucks. • As no survey is available, a conservative 5% downgrade is assumed Based on the above parameters, the minimum required distance is 209m and the 210m gap between the stop line and the flashing signal is acceptable.

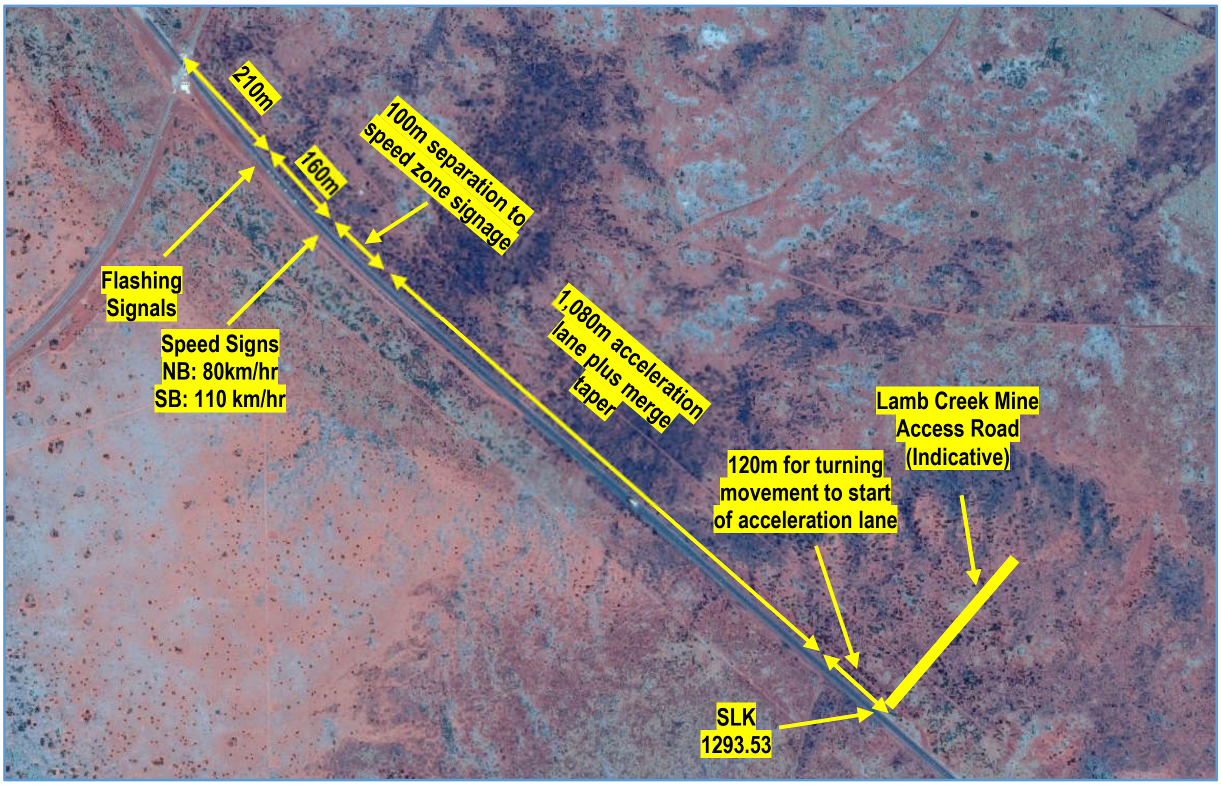


Figure 9: Minimum Gap for Addition of Acceleration Lane

Based on the above assessment, the Safe Intersection Sight Distance, Entering Sight Distance and the access road Approach Sight Distance is assessed based on SLK 1293.53 of Great Northern Highway. The continuation sight distance is assessed 900m northwest of the intersection location.

4.3.6. Safe Intersection Sight Distance

The Safe Intersection Sight Distance (SISD) is the minimum distance which should be provided on the major road at any intersection. SISD provides sufficient distance for a driver of a vehicle on the major road to observe a vehicle on a minor road approach 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.

The SISD is assessed based on the following parameters:

- An observation time of 3 seconds as per Austroads Part 3;
- A reaction time of 2.5 seconds;
- Deceleration coefficients for the purpose of SISD calculations are 0.36 for light vehicles and 0.26 for heavy vehicles; and
- Driver eye height is 2.4m for trucks and 1.1m for cars.

The results are summarised in **Table 11**. The line-of-sight street view at the intersection location are shown in **Figure 10** and **Figure 11**. The measurement of the SISD is shown in **Figure 12**.

Figure 10: Looking North

Figure 11: Looking South

Figure 12: Sight Distance Measurement

Table 11: SISD at Proposed Intersection Location

Location	Vehicle Type	Design Speed (km/h) (NB / SB)	Coefficient of Deceleration	Decision Time (s)	Longitudinal Grade (NB / SB)*	Required SISD for NB / SB Traffic (m)	Available SISD (m) NB	Available SISD (m) SB
Great Northern Highway SLK 1293.53	Trucks	100 / 100	0.26	3.0+2.5	-2.0% / 2.0%	317 / 293	900+	500+
	Cars	110 / 110	0.36	3.0+2.5	-2.0% / 2.0%	307 / 293	900+	500+

*Positive for through traffic travelling uphill and negative for through traffic travelling downhill. Grades are conservative estimates based on google earth only.

As shown, the SISD are sufficient to achieve minimum requirements in accordance with the Austroads Guide to Road Design Part 4A.

4.3.7. Entering Sight Distance

The Entering Sight Distance (ESD) is the minimum distance for driver of a RAV, entering a through road, having appropriate sight distance to see a sufficient gap in oncoming traffic that will allow a RAV, with greater length and lower acceleration capacity, to clear the intersection safely.

The ESD is assessed based on the following parameters in accordance with MRWA's Standard RAV Route Assessment Guidelines:

- A reaction time of 4 seconds, and
- Deceleration coefficient of 0.28;

The Entering Sight Distance (ESD) for existing and proposed access locations has been assessed in accordance with RAV Route Assessment Guideline (updated November 2019). A comparison of available and required ESD for RAV vehicles are summarised in **Table 12**.

Table 12: RAV Vehicle Entering Sight Distance

Location	Design Speed (km/h) (NB / SB)	Coefficient of Deceleration	Reaction Time (s)	Longitudinal Grade (NB / SB)*	Required SISD for NB / SB Traffic (m)	Available ESD (m)	
						NB	SB
Great Northern Highway SLK 1293.53	100 / 100	0.28	4	2.0% / -2.0%	281 / 305	900+	500+

*Positive for through traffic travelling uphill and negative for through traffic travelling downhill. Grades are conservative estimates based on google earth only.

As shown, the ESD are sufficient to achieve minimum requirements in accordance with the MRWA RAV Assessment Guideline.

4.3.8. Approach Sight Distances

The Approach Sight Distance (ASD) is required to ensure that drivers of trucks and light vehicles approaching the intersection from the minor road at the 85th percentile operating speed are able to see the intersection and stop at the holding line.

The ASD is assessed based on the following parameters:

- A reaction time of 2.5 seconds for light vehicles and 4.0 seconds for heavy vehicles;
- Deceleration coefficients for the purpose of SISD calculations are 0.362 for light vehicles and 0.26 for heavy vehicles; and
- Driver eye height is 2.4m for trucks and 1.1m for cars.

The natural terrain from the intersection location (SLK 1293.53) is shown in **Figure 13.** The required and available ASD at the intersection has been determined from Austroads Part 4A Equation 2 as summarised in **Table 13**.

Figure 13: Approach Sight Line Towards Northeast

Table 13: Approach Sight Distance

Location	Vehicle Type	Design Speed (km/h)	Coefficient of Deceleration	Reaction Time (s)	Longitudinal Grade*	Required ASD (m)
Great Northern Highway SLK 1293.53	Trucks	60	0.26	4.0	-2.0%	126
	Cars	60	0.362	2.5	-2.0%	83

*Positive for traffic travelling uphill and negative for through traffic travelling downhill. Grades are estimates only.

Assuming the approaching grade is -2% (downhill) towards the intersection, the required ASD's are 126m for trucks and 83m for cars. The ASD requirements need to be further confirmed in the detailed design stage.

4.3.9. Continuation Sight Distance

The Continuation Sight Distance is required to ensure that drivers of trucks and light vehicles reaching the end of acceleration lane are able to observe the road environment ahead of them and be able to decelerate and stop if obstruction is observed.

The minimum required Continuation Sight Distance as per MRWA Supplement to Austroad GTRD Part 3 is 2x stopping sight distance from the start of the merge as shown below in **Figure 14**. The required Continuation Sight Distance is calculated as shown in **Table 11**.

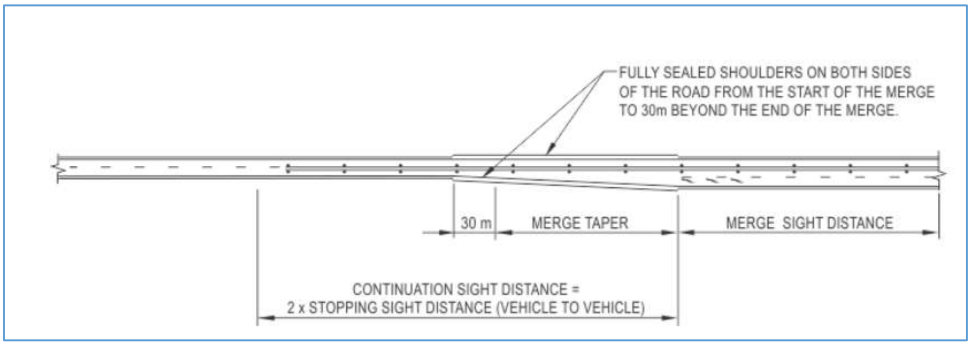


Figure 14: Continuation Sight Distance

A review of Google street view at CH 1294.43 (approximate start of merge taper) indicates the sight distance is available to a point approximately half-way between the railway line and the flashing signal and is measured at approximately 564m as shown in **Figure 15** and **Figure 16**. This is above the minimum requirement of 466m as calculated in **Table 11**.

Figure 15: Continuation Sight Distance Street View

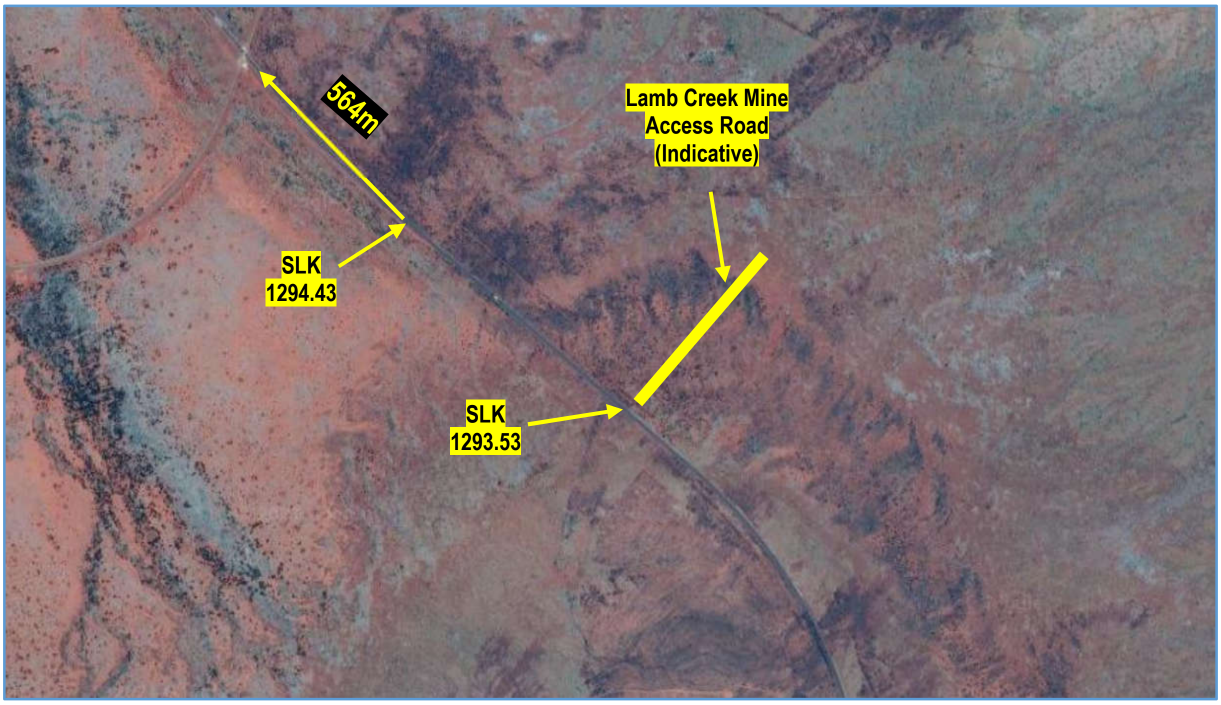


Figure 16: Continuation Sight Distance Measurement

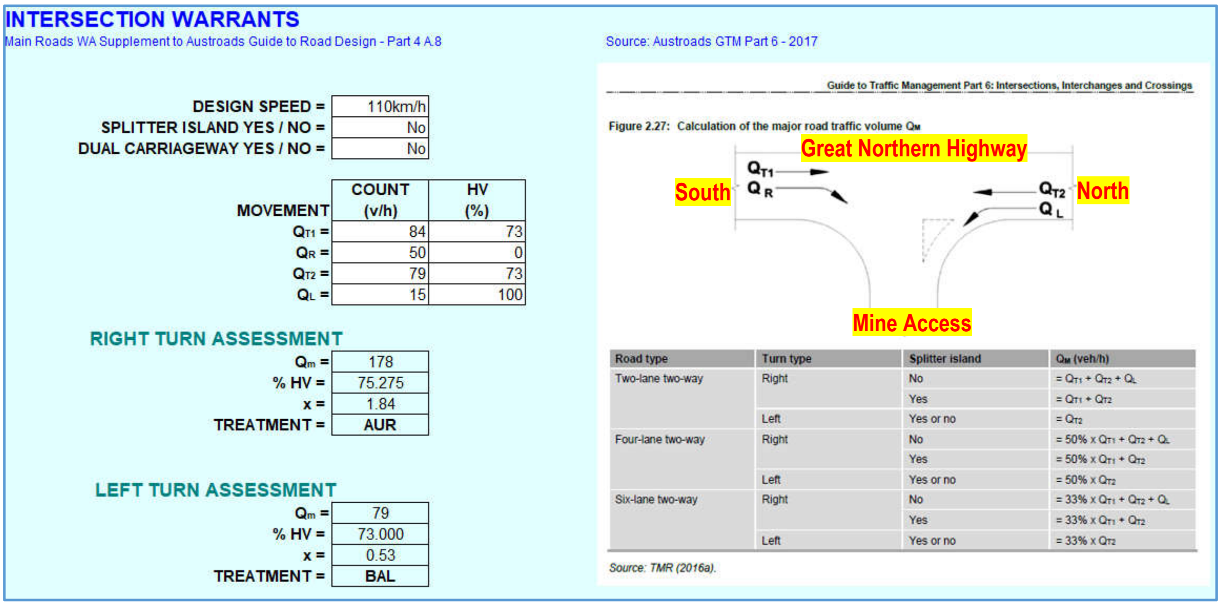
Table 14: Continuation Sight Distance

Location	Vehicle Type	Design Speed (km/h)	Coefficient of Deceleration	Reaction Time (s)	Longitudinal Grade (NB / SB)*	Required SSD (m)	Required Continuation Sight Distance (m)	Available Continuation Sight Distance (m)
Great Northern Highway SLK 1294.43	Trucks	100	0.26	2.5	-2.0%	233	466	564
	Cars	110	0.36	2.5	-2.0%	216	432	564

*Positive for through traffic travelling uphill and negative for through traffic travelling downhill. Grades are conservative estimates based on google earth only.

4.3.10. Auxiliary Lanes

The requirement for turning treatments was calculated using the Intersection Warrants calculator provided in Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A.8. The results of the assessment are shown in **Figure 17**.



INTERSECTION WARRANTS
Main Roads WA Supplement to Austroads Guide to Road Design - Part 4 A.8

DESIGN SPEED =	110km/h
SPLITTER ISLAND YES / NO =	No
DUAL CARRIAGEWAY YES / NO =	No

MOVEMENT	COUNT (v/h)	HV (%)
Q_{T1} =	84	73
Q_R =	50	0
Q_{T2} =	79	73
Q_L =	15	100

RIGHT TURN ASSESSMENT

Q_m =	178
% HV =	75.275
x =	1.84
TREATMENT =	AUR

LEFT TURN ASSESSMENT

Q_m =	79
% HV =	73.000
x =	0.53
TREATMENT =	BAL

Source: Austroads GTM Part 6 - 2017

Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings

Figure 2.27: Calculation of the major road traffic volume Q_M

Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$
Four-lane two-way	Right	No	$= 50\% \times Q_{T1} + Q_{T2} + Q_L$
		Yes	$= 50\% \times Q_{T1} + Q_{T2}$
	Left	Yes or no	$= 50\% \times Q_{T2}$
Six-lane two-way	Right	No	$= 33\% \times Q_{T1} + Q_{T2} + Q_L$
		Yes	$= 33\% \times Q_{T1} + Q_{T2}$
	Left	Yes or no	$= 33\% \times Q_{T2}$

Source: TMR (2016a).

Figure 17: Warrants for Turn Treatments on Major Roads at Unsignalised Intersections

As shown, the required left-turn and right turn treatments for the proposed intersection are a Basic Left Turn (BAL) and Auxiliary Right Turn (AUR) treatment. BAL turn treatments features a widened shoulder on the major road which allows turning vehicles to move further off the through carriageway making it easier for vehicles to pass. The AUR turn treatment features an added short section of traffic lane on the left side of major road which allows through vehicles to pass to the left of right-turning vehicles.

In this instance, notwithstanding the warrants calculator, it is recommended to design the intersection with Auxiliary Left Turn (AUL) treatment and a Channelised Right Turn (CHR) treatment.

The AUL and CHR treatment (refer to Figure 8.6 and Figure 7.8 of Austroad Guide to Road Design Part 4A) on the major road both feature construction of indented left/right turn lane minimising the impact of the slow turning vehicles on through traffic.

The decision takes into consideration that there is and will be a high proportion of road trains in the through road, a BAL and AUR treatment would generally require traffic braking in the through lane and it can be difficult for a road train to safely make the shift around a stopped/slow turning vehicle.

4.3.11. Proposed Intersection Layout

The concept layout of the proposed intersection at Great Northern Highway SLK 1293.53 is attached in **Appendix C – Concept Intersection Layout.**

5. Site Specific Issues

5.1. Existing Floodway

The proposed acceleration lane will be located through an existing floodway approximately 450m in length. Although this is not considered to be a safety issue provided adequate delineation and warning signage is in place, it will present an engineering design challenge and add to costs, particularly for the cement stabilised pavement required.

6. Conclusions

This TIA has concluded the following:

- A conservative estimate of the peak traffic generation of 15 loaded and 15 unloaded haulage vehicles in addition to 100 LV movements (50 in each direction to and from Newman) per hour can be accommodated within the capacity of the existing road network.
- The additional traffic generated by the site is not considered likely to increase the likelihood of crashes to unacceptable levels.
- The proposed intersection can operate at acceptable levels of service.
- Great Northern Highway has the appropriate RAV network for proposed operation at present.
- Based on the predicted traffic volume, the mine access road intersection is required to have Basic Left-turn treatment (BAL) and Auxiliary Right Turn (AUR) treatment. In this instance, Auxiliary left turn (AUL) treatment and Channelised Right-Turn (CHR) treatment is recommended to improve safety. Further, in accordance with MRWA requirements, the seal should be extended for 100m or to the road reserve boundary, whichever the greater, into the mine access road.
- A 900m (minimum) acceleration lane is considered warranted towards north of the mine access road intersection.
- The mine access road intersection is recommended to be located at approximately SLK1293.53.

Appendix A – Traffic Counts

SITE 8564

Hourly Volume

2020/21
Monday to Friday

Great Northern Hwy (H006)

South of Karijini Dr (SLK 1314.60)

	All Vehicles NB	All Vehicles SB	All Vehicles Both	Heavy Vehicles NB	Heavy Vehicles SB	Heavy Vehicles Both	%
00:00	1	0	1	1	0	1	100.0
01:00	0	2	2	0	1	1	50.0
02:00	1	0	1	0	0	0	0.0
03:00	1	0	1	0	0	0	0.0
04:00	3	4	7	2	3	5	71.4
05:00	6	8	14	4	5	9	64.3
06:00	16	18	34	10	12	22	64.7
07:00	24	19	43	15	12	27	62.8
08:00	31	24	55	21	15	36	65.5
09:00	29	29	58	19	18	37	63.8
10:00	33	26	59	20	16	36	61.0
11:00	35	28	63	21	18	39	61.9
12:00	33	31	64	19	19	38	59.4
13:00	33	33	66	19	20	39	59.1
14:00	32	33	65	19	19	38	58.5
15:00	29	31	60	18	19	37	61.7
16:00	27	27	54	17	17	34	63.0
17:00	21	23	44	15	15	30	68.2
18:00	14	16	30	10	12	22	73.3
19:00	9	9	18	7	7	14	77.8
20:00	8	9	17	6	7	13	76.5
21:00	5	6	11	4	5	9	81.8
22:00	3	4	7	2	3	5	71.4
23:00	3	1	4	2	1	3	75.0
TOTAL	397	381	778	251	244	495	63.6

Peak Statistics

		All Vehicles NB	All Vehicles SB	All Vehicles Both	Heavy Vehicles NB	Heavy Vehicles SB	Heavy Vehicles Both
AM	TIME	10:45	10:30	11:30	09:15	10:30	09:15
	VOL	36	30	64	23	20	40
PM	TIME	14:15	13:30	13:30	14:15	13:30	13:30
	VOL	35	36	70	22	24	45

Vehicle Type

2020/21
Monday to Friday

Great Northern Hwy (H006)

South of Karijini Dr (SLK 1314.60)

	Austroads Classification Scheme 1994													
	1	2	3	4	5	6	7	8	9	10	11	12	Heavy	Total
N	129	17	67	12	7	3	3	4	22	11	53	69	251	397
%	32.5	4.3	16.9	3.0	1.8	0.8	0.8	1.0	5.5	2.8	13.4	17.4	63.2	
S	125	12	61	11	6	3	3	3	22	12	55	68	244	381
%	32.8	3.1	16.0	2.9	1.6	0.8	0.8	0.8	5.8	3.1	14.4	17.8	64.0	
NS	254	29	128	23	13	6	6	7	44	23	108	137	495	778
%	32.6	3.7	16.5	3.0	1.7	0.8	0.8	0.9	5.7	3.0	13.9	17.6	63.6	

Appendix B – SIDRA Output

MOVEMENT SUMMARY

▽ **Site: [2025 GEH / MAR - With Dev (Site Folder: General)]**

Site Category: -
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Great Northern Highway S														
2	T1	84	62	84	73.8	0.162	0.7	LOS A	0.3	5.5	0.19	0.31	0.19	90.2
3	R2	50	0	50	0.0	0.162	8.5	LOS A	0.3	5.5	0.19	0.31	0.19	65.4
Approach		134	62	134	46.3	0.162	3.6	NA	0.3	5.5	0.19	0.31	0.19	79.1
NorthEast: Mine Access														
4	L2	50	0	50	0.0	0.074	6.0	LOS A	0.2	4.5	0.26	0.59	0.26	59.7
6	R2	15	15	15	100.0	0.074	13.2	LOS B	0.2	4.5	0.26	0.59	0.26	35.6
Approach		65	15	65	23.1	0.074	7.6	LOS A	0.2	4.5	0.26	0.59	0.26	51.6
NorthWest: Great Northern Highway N														
7	L2	15	15	15	100.0	0.243	13.0	LOS B	0.0	0.0	0.00	0.11	0.00	37.8
8	T1	78	57	78	73.1	0.243	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	90.8
Approach		93	72	93	77.4	0.243	2.2	NA	0.0	0.0	0.00	0.11	0.00	74.1
All Vehicles		292	149	292	51.0	0.243	4.1	NA	0.3	5.5	0.14	0.31	0.14	69.3

MOVEMENT SUMMARY

▽ **Site: [2025 GEH / MAR - With Dev + Accerleration (Site Folder: General)]**

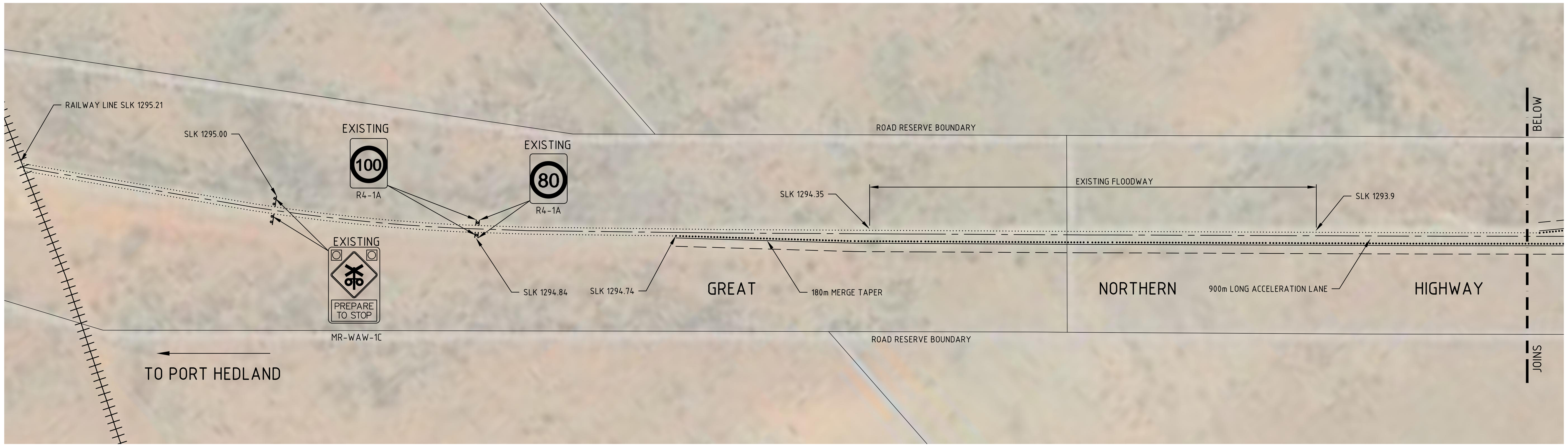
Site Category: -
Give-Way (Two-Way)

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Great Northern Highway S														
2	T1	84	62	84	73.8	0.162	0.8	LOS A	0.3	5.5	0.19	0.28	0.19	75.2
3	R2	50	0	50	0.0	0.162	6.1	LOS A	0.3	5.5	0.19	0.28	0.19	57.2
Approach		134	62	134	46.3	0.162	2.8	NA	0.3	5.5	0.19	0.28	0.19	67.3
NorthEast: Mine Access														
4	L2	50	0	50	0.0	0.074	6.0	LOS A	0.2	4.5	0.26	0.59	0.26	59.7
6	R2	15	15	15	100.0	0.074	13.2	LOS B	0.2	4.5	0.26	0.59	0.26	35.6
Approach		65	15	65	23.1	0.074	7.6	LOS A	0.2	4.5	0.26	0.59	0.26	51.6
NorthWest: Great Northern Highway N														
7	L2	15	15	15	100.0	0.243	13.0	LOS B	0.0	0.0	0.00	0.11	0.00	37.8
8	T1	78	57	78	73.1	0.243	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	90.8
Approach		93	72	93	77.4	0.243	2.2	NA	0.0	0.0	0.00	0.11	0.00	74.1
All Vehicles		292	149	292	51.0	0.243	3.7	NA	0.3	5.5	0.14	0.30	0.14	64.8

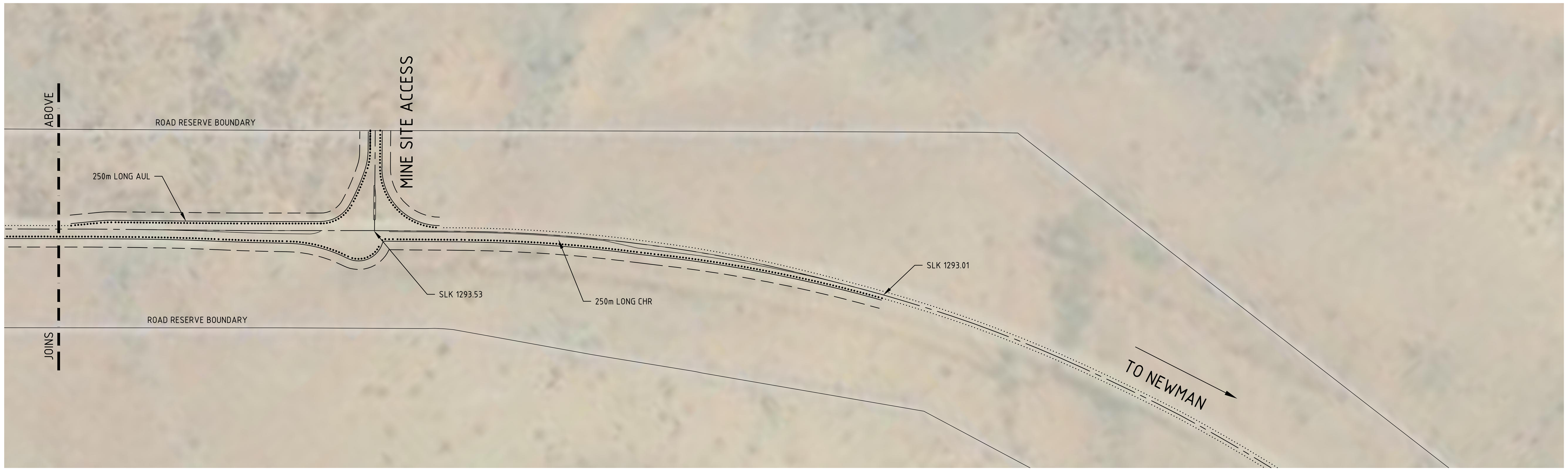
Appendix C – Concept Intersection Layout

NOTES:

1. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS NOTED OTHERWISE
2. DIMENSIONS ARE APPROXIMATE ONLY AND LAYOUT IS NOT SPATIALLY CORRECT



PLAN
1:2500



PLAN CONT.
1:2500

SCALE 1:2500

LEGEND

- EXISTING CADASTRAL BOUNDARY
- EXISTING EDGE OF SEAL
- DESIGN EDGE OF SEAL
- DESIGN EDGE OF SHOULDER
- INDICATIVE CLEARING EXTENT

REV	DATE	REVISION DESCRIPTION	CHK	APP	DRG No.	REFERENCE DRAWING TITLE
A	18.05.21	ISSUED FOR COMMENT	RN	RN		

CLIENT: MINERAL RESOURCES

SCALE @A1 HORIZ: 1:2500 VERT:

PROJ. DATUM HORIZONTAL: N/A VERTICAL: N/A

LOCAL AUTHORITY: SHIRE OF EAST PILBARA

SHAWMAC

INFORMATION ONLY

PROJECT INFORMATION	
DESIGNED BY:	RN
DRAWN BY:	JG
PROJECT No.	2105001
PROJ. MANAGER	RN

MINERAL RESOURCES
LAMB CREEK GREAT NORTHERN HIGWAY INTERSECTION
CONCEPTUAL OVERALL GENERAL ARRANGEMENT

DRAWING NUMBER: 2105001-SK-007 REV. A

A1

FILE REF: Y:\Jobs Active 2021\CE - Roads and Drainage\MRL - Lamb Creek GNH Intersection_2105001\4. Drawings\4.5 Sketches\2105001-SK-005 to 007

LAST SAVED BY: Jgonzales DATE: 18 May 2021 4:10 PM

APPENDIX N: BANJIMA LETTER OF SUPPORT

22 November 2024

Carl Paton
Senior Environmental Advisor
Mineral Resources
20 Walters Drive
Osborne Park
WA 6017

Dear Carl

RE: MINERAL RESOURCES LIMITED/PROCESS MINERAL INTERNATIONAL - LAMB CREEK IRON ORE PROJECT

I refer to the proposed Lamb Creek Iron Ore Project (**Proposal**) which we understand will be referred under s38 *of the Environmental Protection Act 1986* by Process Minerals International (**PMI**), a wholly owned subsidiary of Mineral Resources Limited (**MRL**).

This letter is provided conditionally (see 'Conditional Support' below) on the basis of a request made by MRL to the Banjima Native Title Aboriginal Corporation (**BNTAC**) seeking support for the Proposal. This letter is being made available for MRL to provide to the Environmental Protection Agency, or other departments as required.

The Proposal is located on land the subject of Banjima People Native Title Determination (WAD6096/1998). BNTAC holds this native title in trust on behalf of the Banjima People and is the Registered Native Title Body Corporate for the Banjima people and Common Law Holders.

BNTAC acknowledges that MRL has undertaken detailed engagement and consultation with the Banjima People on the Proposal. This consultation has occurred via the BNTAC 'MRL Heritage Environment Reference Committee' (**MHERC**), led by nominated members of the Banjima People, and has considered the impact of the Proposal on important heritage and cultural values.

BNTAC acknowledges MRL has altered the Proposal's design and management controls in response to feedback from the MHERC. BNTAC also acknowledges MRL's commitment to ongoing engagement through the construction, operations and closure phases of the Proposal.

<u>Conditional Support</u>

BNTAC and the MHERC are satisfied with the level of engagement to this point in the life of the Proposal and support the Proposal subject to the following:

1. No landfills are constructed on-site, and all imported materials and waste are removed from the site;
2. The pit is backfilled to a minimum of 5m above the pre-mining water table to prevent the creation of pit lakes;

3. There is minimal loss of visual amenity and no visibility of the pit from the Mine Access Road, to be defined in the Mine Closure Plan and agreed with by Banjima;
4. There is no ex-pit storage of mineralised waste;
5. Rehabilitation of the upper benches of the pit to support visual amenity is undertaken at closure;
6. Rehabilitation of the overburden storage dump to support visual amenity and restoration to a reference ecosystem as agreed within the Mine Closure Plan;
7. There is no permanent groundwater contamination and no permanent land use restrictions resulting from such contamination attributable to the proposal;
8. MRL must work collaboratively with Banjima to identify regional benefits for the re-use of topsoil and overburden materials; and
9. The access road must be paved with asphalt to reduce dust.

BNTAC's support is preliminary and subject to formal approval of the Mine Closure Plan for both Lamb Creek and Phil's Creek mines prior to commencement of any extraction activities relating to the Proposal.

Yours sincerely,

Mark Gregson
General Manager – Native Title
Banjima Native Title Aboriginal Corporation

APPENDIX O: GREENHOUSE GAS EMISSIONS CALCULATIONS

LAMB CREEK IRON ORE PROJECT

GREENHOUSE GAS ASSESSMENT TECHNICAL REPORT

Version 1.2

Prepared by **Greenbase Pty Ltd**

On behalf of **Mineral Resources Limited**

Prepared August 2024

Print Date: 13/08/2024

Disclaimer

This document has been prepared for the exclusive use of Mineral Resources Limited on the basis of instructions, information and data supplied by Mineral Resources Limited. No warranty or guarantee, whether express or implied, is made by Greenbase Pty Ltd with respect to the completeness or accuracy of any aspect of this document and no party, other than Mineral Resources Limited, is authorised to or should place any reliance whatsoever on the whole or any part or parts of the document. Greenbase Pty Ltd does not undertake or accept any responsibility or liability in any way whatsoever to any person or entity in respect of the whole or any part or parts of this document, or any errors in or omissions from it, whether arising from negligence or any other basis in law whatsoever.

Rounding of Amounts

All CO_2-e and energy amounts included in this document have been rounded to the nearest Tonne and GJ respectively, except when rounding would result in a zero.

Prepared by:

Greenbase Pty Ltd

Level 2, 41 St Georges Terrace, Perth WA 6000

PO Box Z5451, St Georges Terrace WA 6831

Telephone 08 9322 9966

Website www.greenbase.com.au

Table 1 Document History

Ver.	Date Completed	Details	Name	Status
1.2	13/08/2024	Finalised	Greenbase (H. Ko)	Final
	13/08/2024	Reviewed and provided feedback and made a few minor changes in wording	MinRes (C. Paton)	Reviewed
	12/08/2024	Updated according to comments from MinRes	Greenbase (H. Ko)	Update
1.1	05/08/2024	Updated according to comments and finalised	Greenbase (H. Ko)	Final
	02/08/2024	Reviewed	Greenbase (L. Orozco)	Reviewed
	01/08/2024	Updated emissions from road haulage to be Scope 1 emissions	Greenbase (H. Ko)	Update
1.0	02/06/2023	Updated according to MinRes comments and finalised	Greenbase (H. Ko)	Final
	31/05/2023	MinRes review – comments provided	MinRes (C. Paton; K. Hodgson)	Reviewed
0.4	22/05/2023	Updated according to MinRes comments	Greenbase (H. Ko)	Draft
	05/05/2023	MinRes review – comments provided	MinRes (C. Paton; K. Hodgson)	Reviewed
0.3	11/04/2023	Added emissions based on maximum/ nameplate capacity	Greenbase (H. Ko)	Draft
0.2	04/05/2023	Greenbase internal review	Greenbase (H. Ko)	Draft
0.1	30/03/2023	Initial document prepared	Greenbase (C. Mesquita; K. Bajracharya)	Draft

Table of Contents

Table of Tables

Table of Figures

1 Summary

Mineral Resources Limited (MinRes) is the proponent for the Lamb Creek Iron Ore Project (LCIOP), located 130 kilometres (km) northwest of Newman in Western Australia (WA).

The proposed LCIOP encompasses a 10 million tonne per annum (Mtpa) iron ore mine with the construction of a multi-stage crushing and screening process plant, and associated infrastructure including offices, water pipelines, storage and equipment areas, power generation and village accommodation. The actual designed/expected throughput of this project is 8 Mtpa and the Life of Mine (LOM) is expected to be 5 years.

This greenhouse gas (GHG) assessment has been prepared to support the *Environment Protection Act 1986* (EP Act) Section 38 referral. This assessment has been prepared according to the requirements outlined in the Environmental Protection Authority (EPA)'s Environmental Factor Guideline for Greenhouse Gas Emissions (EPA, 2023). The estimated GHG emissions and energy consumption and production from the LCIOP have been calculated in this assessment.

Two scenarios have been considered in the assessment:

- Scenario 1 (Base): Electricity generated using diesel generators, no emissions reduction,
- Scenario 2: Electricity generated using diesel generators complimented with a solar photovoltaic (PV) system (1.7 megawatt (MW)), installed post the construction phase.

The estimates have also been calculated at a maximum nameplate/nominal throughput capacity of 10 Mtpa and the planned production designed capacity of 8 Mtpa. Based on these assessments, the emissions from the LCIOP are expecting to exceed 100,000 tonnes carbon dioxide equivalent (tCO_2-e) throughout the LOM under all scenarios. As a result, the LCIOP requires a GHG Environmental Management Plan in accordance with Part IV of the EP Act.

In Scenario 1 where no emissions reduction strategies are proposed, the total Scope 1 emissions over the LOM have been estimated to be 851,564 tCO_2-e based on the planned production designed capacity of 8 Mtpa. The average Scope 1 emissions are estimated to be 170,313 tCO_2-e annually. When at maximum capacity of 10 Mtpa, the estimated Scope 1 emissions would be 1,322,832 tCO_2-e, with an average of 264,566 tCO_2-e annually.

Under Scenario 2 when a solar PV system is implemented, the estimated total Scope 1 emissions over the LOM are 842,417 tCO_2-e, with an average annual emissions of 168,483 tCO_2-e based on the planned production designed capacity of 8 Mtpa. When operating at the maximum capacity of 10 Mtpa, the estimated Scope 1 emissions would be 1,313,685 tCO_2-e, with an average annual emissions of 262,737 tCO_2-e.

Scope 3 emissions were examined in this assessment with key emission sources identified as purchased goods and services, capital goods, fuel and energy related activities, upstream and downstream transportation and distribution, processing of sold products and end-of-life treatments of sold products. Under Scenario 1, the total estimated Scope 3 emissions for these sources over the LOM are estimated at 41,179,075 tCO_2-e, with average Scope 3 emissions estimated at 8,235,815 tCO_2-e annually based on the planned production designed capacity of 8 Mtpa. When at maximum capacity of 10 Mtpa, the estimated Scope 3 emissions would be 65,624,405 tCO_2-e with an average of 13,124,881 tCO_2-e annually.

In Scenario 2, the total estimated Scope 3 emissions over the LOM are 41,176,821 tCO_2-e . The average Scope 3 emissions during full production based on the planned production designed capacity of 8 Mtpa are estimated to be 8,235,364 tCO_2-e annually. When operating at maximum capacity of 10 Mtpa, the estimated Scope 3 emissions would be 65,622,151 tCO_2-e with an average Scope 3 emissions of 13,124,430 tCO_2-e annually.

The energy consumption sources identified are fuel and electricity consumption; electricity production is recognised as the source of energy production. Under Scenario 1, the total estimated energy consumption and production of the LCIOP over the LOM are 11,054,397 GJ and 194,143 GJ respectively based on the planned production designed capacity of 8 Mtpa. In Scenario 2, the total estimated energy consumption over the LOM is 10,924,092 GJ, considering the reduced fuel consumption when a solar PV system is installed, based on the planned production designed capacity of 8 Mtpa. The estimated energy production remains the same at 194,143 GJ reflecting the electricity generated as part of the project.

Overall, the average GHG emission intensity for the project was estimated as 0.02807 tCO_2-e/tonne of iron ore produced based on Scope 1 GHG emissions and the forecasted iron ore production in the base scenario with the planned production designed capacity of 8 Mtpa.

2 Introduction

2.1 Background

The proposed LCIOP is an open pit iron ore mine located approximately 130 km northwest of Newman, in East Pilbara, WA. The maximum design capacity throughput of this project is 10 Mtpa. It is expected to run for over 3 to 5 years and expected to produce 8 Mtpa of crushed and screened iron ore.

This GHG assessment has been prepared to support the Section 38 referral under the EPA Act. The estimated GHG emissions, energy consumption and production from the LCIOP, and their likely contribution to regional, state, and national emissions have been calculated in this assessment.

A summary of the project details is outlined in Table 2.

Table 2 Project Summary Table

Project Name	Lamb Creek Iron Ore Project
Proponent Name	Mineral Resources Limited
Relevant Environmental Documents	N/A
Key Environmental factor and objective	Factor: Greenhouse Gas Emissions EPA Environmental Objective: To maintain air quality and minimise emissions so that environmental values are protected. (EPA, 2023)
Proposed commencement date of the Project	Q2 2025 (Calendar Year; CY)

2.2 Lamb Creek Iron Ore Project

The LCIOP includes an open pit mine, a private haul road, a multi-staged crushing and screening process plant and associated mine infrastructure including offices, power generation and village accommodation.

The iron ore product generated from the mine will be transported to Port Hedland for export via the aforementioned private haul road (16 km) and the Great Northern Highway (GNH) (320 km).

The location of the project and proposed development envelope are shown in Figure 1.

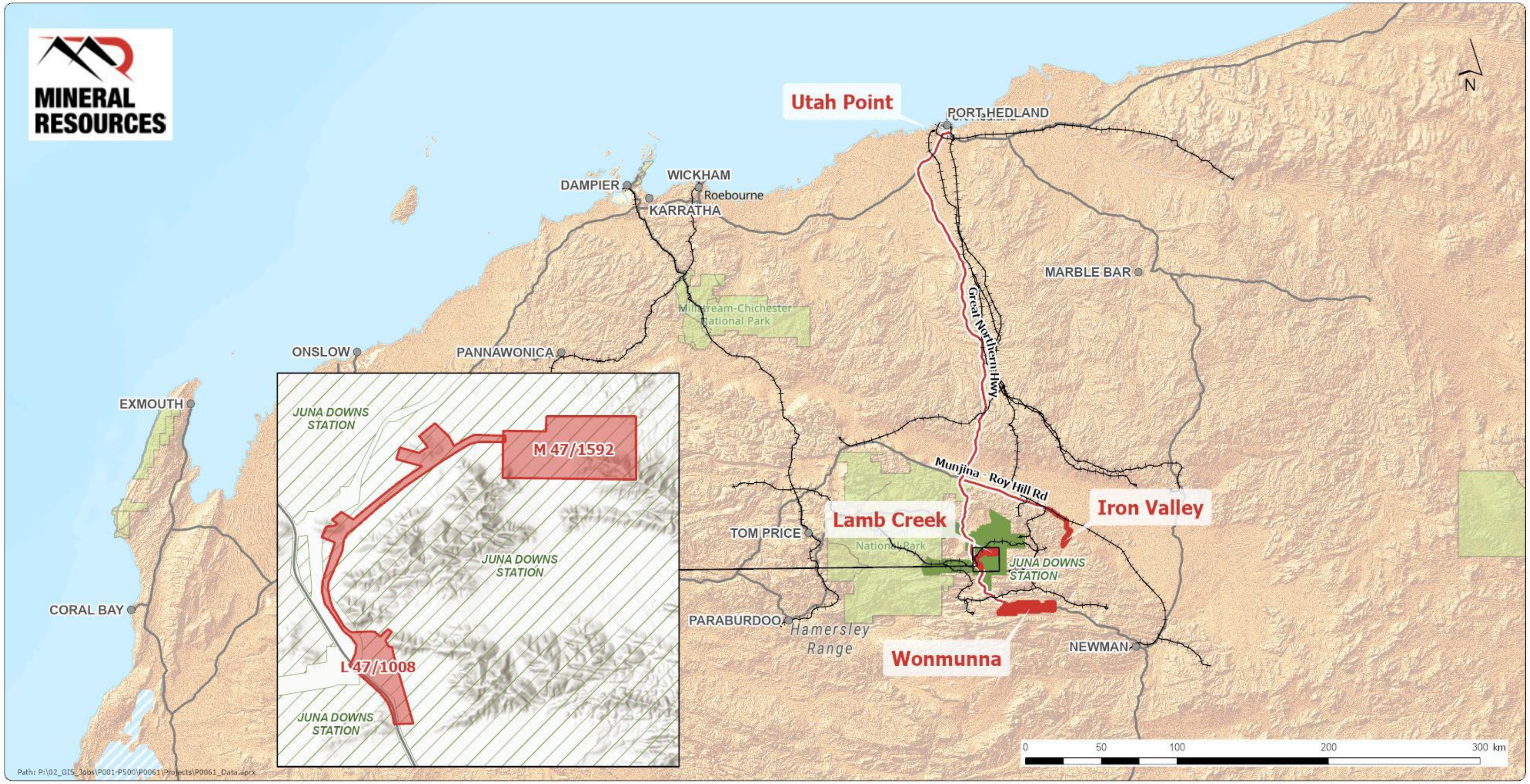


Figure 1 Location of the LCIOP (Source: MinRes)

2.3 Australian GHG Landscape

Australian resources are nationally and globally significant from an economic and GHG perspective (Denis-Ryan *et al*, 2020). To manage Australia's contribution to global GHG's, several frameworks, agreements and policies have been put in place in recent times. The history and key points of these strategies, which underpin the basis of Australian GHG reporting, are discussed below.

The United Nations Framework Convention on Climate Change (UNFCCC) came into force in 1994 with the aim of stabilising GHG concentrations and preventing dangerous human interference with the climate system (UNFCCC, 2021). Australia, along with over 190 other countries, is a member of this Convention and submits regular reports detailing its annual and quarterly emissions, progress towards targets, projections, and mitigation actions to fulfill its reporting obligations to the UNFCCC.

Australia is also a signatory to the Kyoto Protocol, ratified in December 2007, and the Paris Agreement, ratified in November 2016. Under the Paris Agreement, Australia has committed to reducing emissions by 26-28% below 2005 levels by 2030. In June 2022, Australia updated its Nationally Determined Contribution (NDC), committing to reduce greenhouse gas emissions to 43% below 2005 levels by 2030. The revised 2030 commitment is both a single-year target to reduce emissions to 43% below 2005 levels by 2030 and a multi-year emissions budget from 2021-2030 (DCCEEW, 2022b). The purpose of the Paris Agreement is to restrict global warming to 'well below' 2^oC above pre-industrial levels, with a goal of 1.5^oC. The Agreement states that, in order to achieve the 1.5^oC, global emissions will need to reach net zero in the second half of the century.

The National Greenhouse and Energy Reporting (NGER) scheme, established by the *National Greenhouse and Energy Reporting Act 2007* (NGER Act), is Australia's national framework under which companies are required to report their GHG emissions and energy consumption and production. The objectives of the NGER scheme include informing government policy and helping to meet Australia's international reporting obligations.

In October 2021, Australia set a national net-zero target. Alongside this, each state and territory has set their own net-zero target. Additionally, many Australian businesses have pledged net-zero targets. WA is committed to achieving net-zero emissions by 2050 as outlined in the Western Australian Climate Policy (Government of Western Australia, 2020).

To further align with national and state goals of reducing and managing GHG emissions, the Government of Western Australia published the Greenhouse Gas Emissions Policy for Major Projects (State Emissions Policy) in August 2019. This Policy aims to inform the decision-making process for Environmental Impact Assessments (EIA) assessed by the EPA. Under the Policy, projects with significant GHG emissions (over 100,000 t CO_2-e of Scope 1 emissions per year) are required to demonstrate their ability to contribute to Western Australia's net-zero target. The Environmental Greenhouse Gas Emissions Guideline (EPA, 2023) has been prepared to further inform the EIA process.

According to recent government reports, Australia's emissions for the year to March 2022 were 487 million tCO_2-e (DCCEEW, 2022a). This represents an increase of 1.5% compared to the previous year but a 21.6% decrease compared to the 2005 baseline year outlined in the Paris Agreement. As shown in Figure 2, Australia's emissions recorded in the last thirty years peaked in 2007 and have since been following a downward trend.

Key factors driving Australia's long-term emission trends outlined by The Department of Climate Change, Energy, the Environment and Water (DCCEEW) in its recent quarterly report (DCCEEW, 2022a) include:

- Ongoing reductions in emissions from electricity,
- Increased transport emissions reflecting a continuing recovery from the impacts of COVID restrictions on movement,
- Increased emissions from stationary energy (excluding electricity), agriculture, and fugitive emissions.

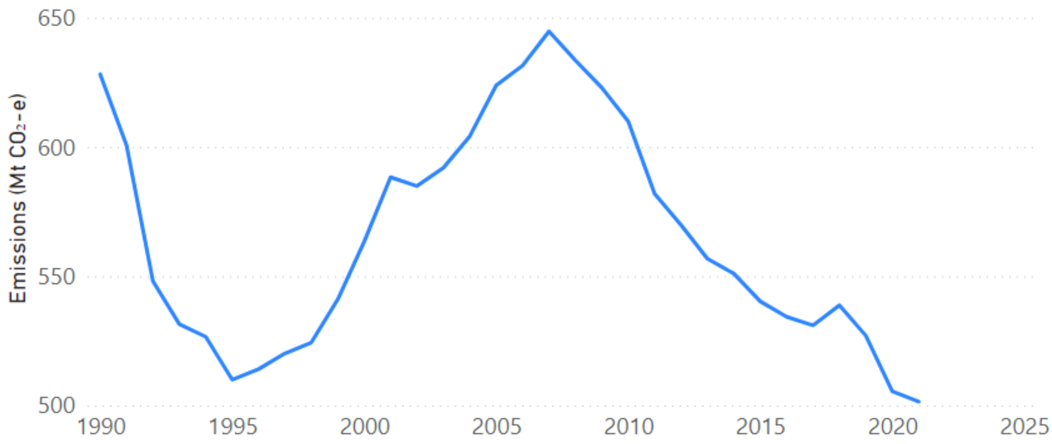


Figure 2 Australia's Annual Emissions Over Time (DISER, 2022)

2.4 Applicable Environmental Factors

The EPA considers two environmental factors in relation to air, namely Air Quality and Greenhouse Gas Emissions. The objective of each of these environmental factors are outlined below:

- Air Quality - to maintain air quality and minimise emissions (from point sources) so that environmental values are protected.
- Greenhouse Gas Emissions - to reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.

The EPA has also published guidelines on each of these environmental factors, namely the *Air Quality Environmental Factor Guideline* (EPA, 2020a) and *Greenhouse Gas Emissions Environmental Factor Guideline* (EPA, 2023b).

This GHG assessment has been prepared to assist MinRes in meeting the objective of the EPA's Greenhouse Gas Emissions Environmental Factor Guideline (EPA, 2023b), and will not directly address the Air Quality Environmental Factor Guideline (EPA, 2020a).

The GHGs included in the Greenhouse Gas Emissions Environmental Factor Guideline are covered by the UNFCCC's Reporting Guidelines on Annual Inventories and are listed below:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Sulphur hexafluoride (SF_6)

- Hydro fluorocarbons (HFCs)
- Perfluorocarbons (PFCs).

The main GHG emissions associated with the LCIOP are CO_2, CH_4 and N_2O.

3 GHG and Energy Inventory

3.1 Activities Affecting Key Environmental Factors

The key infrastructure and principal activities to be undertaken by the LCIOP have been identified and outlined below:

- Open mining pits,
- Processing plant (crushing and screening),
- Power Station (Diesel generators),
- Material Loading and haulage, and
- Other mine services area including explosives facilities, landfill, water treatment plant, bulk fuel storage facility, workshop and washdown bay etc.

3.2 GHG Emissions and Energy Sources

GHG emissions can include both *direct* and *indirect* emissions, i.e. Scope 1, Scope 2 and Scope 3 emissions. Identified emission, energy production and energy consumption sources from the LCIOP are discussed below.

3.2.1 Scope 1 GHG Emissions

Scope 1 GHG emissions are *direct* emissions from sources within the boundary of the facility or organisation, e.g., fuel combusted on site. The Scope 1 emissions estimate boundary of the LCIOP includes all activities conducted at the open pit mine, private haul road, multi-staged crushing and screening process plant and associated mine infrastructure including offices, power generation and village accommodation. The roads connecting to Port Hedland for export, via private haul road (16 km) and the Great Northern Highway (GNH) (320 km) are also included in the proposed project for purposes of including emissions from road haulage of iron ore to the port.

The significant sources of Scope 1 GHG emissions resulting from the activities identified from the project are as follows:

- Diesel consumption by the power station (electricity purposes),
- Diesel consumption by the mining fleet, support equipment and other vehicles for mining operations and land clearing (non-transport purposes),
- Diesel consumption for construction,
- Diesel consumption for road haulage, include the haulage of ore from the project to the port via the 336km haul road (16 km from the mine to GNH intersection + 320 km from GNH to the port), and
- Land clearing (lost carbon sink).

The mine plan and expected throughput of 8 Mtpa, was used as the basis to calculate the diesel consumption of each emission source. When estimating the amount of diesel required for power generators, an average energy consumption of 1.4 kilowatt hour (kWh)/tonne was applied. This is based on operating experience/data sourced from MinRes' other operational sites with similar crushing and screening facilities. The heat rate of the power generators was assumed to be 10,500 kilojoules (kJ)/kWh.

The fleet units for onsite loading, hauling and ancillary were determined based on amount of material to be moved on site. Diesel consumption for each unit was calculated based on its operating hours and fuel consumption rate from plant and operating data.

Two scenarios have been considered for the project:

- Scenario 1 (Base): Electricity generated using diesel generators, no emissions reduction,
- Scenario 2: Electricity generated using diesel generators complimented with a solar PV system (1.7 MW) installed post the construction phase.

The estimates have also been calculated at a maximum nameplate/nominal throughput capacity of 10 Mtpa. To estimate the electricity generation and diesel combustion required under the maximum nameplate conditions of 10 Mtpa, the average fuel consumption rate from the 8 Mtpa condition was used as the basis.

3.2.2 Scope 2 GHG Emissions

Scope 2 GHG emissions are *indirect* emissions from the consumption of purchased electricity, steam or heat produced by another organisation.

No Scope 2 emissions are expected from purchased electricity as all electricity will be generated from the onsite power station.

3.2.3 Scope 3 GHG Emissions

Scope 3 GHG emissions are all other *indirect* emissions that are of a consequence of an organisation's activities but are not from sources owned or controlled by the organisation, e.g., the emissions associated with the extraction, refinement, and delivery of diesel to site.

The GHG Protocol (2011) divides Scope 3 GHG emissions into two groups, depending on the financial transactions of the company:

- Upstream indirect GHG emissions related to purchased or acquired goods and services,
- Downstream indirect GHG emissions related to sold goods and services.

Scope 3 GHG emissions are further split into 15 categories to provide a systematic framework for companies to quantify, manage and reduce emissions across their corporate value chain. To avoid double counting emissions, the categories are designed to be mutually exclusive. Table 3 outlines all Scope 3 categories, their relevancy to the project and indicates those included in the GHG assessment. A full list and description of the Scope 3 categories as well as definitions of relevancy are outlined in Appendix A.

Table 3 Scope 3 GHG Emissions Categories (GHG Protocol, 2011)

Category	Relevancy	Included/Excluded in Assessment
1. Purchased goods and services	**Material and directly influenced by the company; should be calculated.**	**Included**

Category	Relevancy	Included/Excluded in Assessment
2. Capital goods	**Material and directly influenced by the company; should be calculated.**	**Included** **(included in '1. Purchased goods and services' since separation of data is challenging)**
3. Fuel- and energy-related activities **(Not included in scope 1 or scope 2)**	**Not material but is directly influenced by the company; should be calculated.**	**Included**
4. Upstream transportation and distribution	Material and directly influenced by the company; should be calculated.	N/A (The haulage of ore from the project to the port via the 336km haul road (16 km from the mine to GNH intersection + 320 km from GNH to the port) has been included as Scope 1)
5. Waste generated in operations	Not material.	Excluded
6. Business travel	Not material.	Excluded
7. Employee commuting	Not material.	Excluded
8. Upstream leased assets	Not applicable	Excluded
9. Downstream transportation and distribution	**Material and directly influenced by the company; should be calculated.** **Include the shipment of the ore from the Port to oversea**	**Included**
10. Processing of sold products	**Material and directly influenced by the company; should be calculated.**	**Included**
11. Use of sold products	Not applicable, iron ore is an intermediate product and any emissions associated with its 'use' is calculated in the processing of sold products category.	Excluded
12. End-of-life treatment of sold products	**Immaterial, but calculated as the data required for the emissions estimates is available.**	**Included**

Category	Relevancy	Included/Excluded in Assessment
13. Downstream leased assets	Not applicable, no assets are leased to other companies that are not accounted for in either Scope 1, 2 or other Scope 3 categories.	Excluded
14. Franchises	Not applicable, there are no franchised operations.	Excluded
15. Investments	Not applicable, any investments would come under the larger corporate group and not the site itself.	Excluded

3.2.4 Energy Production and Consumption

According to the *National Greenhouse and Energy Reporting Regulation 2018* (NGER Regulation), energy production is the extraction of energy from natural resources for final consumption, or the manufacture of energy by conversion of energy from one form to another form. Energy consumption means the use or disposal of energy from the operation of the facility.

The significant sources of energy production and consumption identified from the project are as follows:

- Electricity production from the power station,
- Electricity consumption for the processing plant and other infrastructure,
- Diesel consumption during land clearing,
- Diesel consumption during construction,
- Diesel consumption by the mining fleet, haulage fleet, generators, support equipment and other vehicles, and
- Diesel consumption from road haulage.

3.3 Limitations and Exclusions

The following emissions and energy sources have been excluded from the assessment as they were deemed either minor sources or no use was identified (exclusions from the Scope 3 are outlined in Table 3):

- Oils and greases,
- Sulphur Hexafluoride (SF_6),
- Hydro fluorocarbons (HFCs) and Perfluorocarbons (PFCs),
- Other minor fuel sources (e.g. ULP), and
- Wastewater treatment plant (WWTP).

Other exclusions are noted below:

- Exploration activities,

- Explosives used for mining. There are no factors/methods included in the National Greenhouse Accounts Factors (2023) or the NGER Determination to calculate emissions from explosives.

Whilst the estimates in this assessment have been calculated using the best available information, it should be noted that potential for technology change (implementation of best available technology) and updates to costing over the project LOM may result in adjustments to emission estimates.

3.4 GHG Emissions and Energy Methodology

3.4.1 Scope 1 GHG Emissions

Fuel Consumption

For emission calculations, fuel use is split into two categories, namely non-transport, and electricity, based on the associated activities.

Scope 1 GHG estimates from fuel consumption have been prepared using methods and emissions factors from the *National Greenhouse and Energy Reporting (Measurement) Determination 2008 (*NGER Determination), as applicable to 2022-23 financial year (FY2023) reporting. The emission factors applied to calculations are shown in Table 4. The emission factors are provided in carbon dioxide equivalents (CO_2-e), and therefore include the global warming potential (GWP) of each gas.

Table 4 GHG Emission Factors applied to the LCIOP

Emission/Energy Source	Energy Content Factor	Emission Factor ($kgCO_2$-e/GJ)			
		CO_2	**CH_4**	**N_2O**	**Total**
GWP		1	28	265	
Diesel (Non-transport/Electricity)	38.6 GJ/kL	69.9	0.1	0.2	70.20

Land Clearing

Lost carbon sink emissions associated with land clearing have been calculated using the Full Carbon Accounting Model (FullCAM) guidelines produced by the Department of Climate Change, Energy, the Environment and Water (DCCEEW, 2020) and methodology outlined in *Carbon Credits (Carbon Farming Initiative—Avoided Clearing of Native Regrowth) Methodology Determination 2015* (CER, 2018). The process involves determining the carbon mass for an area and converting it to carbon dioxide emissions (Scope 1 emissions) when the land is cleared.

The carbon mass (tonnes of carbon per hectare) is calculated using the project location (latitude/longitude coordinates) and taking consideration of the vegetation type at the areas. The maximum carbon mass of trees per hectare and the associated forest debris carbon mass per hectare have been utilised in the calculations. Other baseline settings used in the FullCAM calculations were set up in accordance with the FullCAM Guidelines (DCCEEW, 2020).

Emissions have been calculated for Mallee & Acacia Woodlands, Open Woodlands and Grasslands assuming all vegetation will be completely lost upon land clearing and converted to carbon dioxide emissions. Estimate emissions have been spread over the LOM to reflect progressive nature of clearing as follows:

- 50% year 1
- 35% year 2
- 15% year 3.

3.4.2 Scope 3 GHG Emissions

To calculate Scope 3 GHG emissions, the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011) has been consulted and the GHG Protocol Technical Guidance for Calculating Scope 3 Emissions (2013) referenced where required.

The two main methods of quantifying Scope 3 GHG emissions are direct measurement and calculation. Direct measurement involves monitoring, mass balance or stoichiometry to quantify emissions, while calculation uses an emission factor and activity data to calculate emissions. Due to the difficulty in direct measurement generally the calculation method is used, as such the general formula for calculating emissions is outlined below:

$$GHG\ Emissions = Activity\ Data\ x\ Emisssion\ Factor$$

A variety of emission factor sources were used, including but not limited to:

- National Greenhouse Accounts Factors (2023),
- UK Conversion Factors (2022), and
- Various scientific studies.

When estimating the Scope 3 emissions, fuel-based or goods and distance-based methods are considered the most appropriate options. These methods involve tracking the amount of fuel or goods used and the distance they travel, respectively. However, in cases where the necessary data is not available, spent-data methods are used. Spent-data methods involve estimating Scope 3 emissions based on the expenditure involved for a given activity.

For Categories 1 and 2, spent-data methods are used to estimate the associated Scope 3 emissions. While spent-data methods may not be as accurate as fuel-based or goods and distance-based methods, they still provide a useful estimate for calculating the Scope 3 emissions when necessary data is not available.

3.4.3 Energy Production and Consumption

Energy estimates from fuel consumption, electricity production and consumption have been prepared using methods and energy contents from the NGER Determination. It is assumed that all electricity produced will be consumed on site. The emission and energy factors applied to fuel consumption are shown in Table 5.

Table 5 Energy Content Factors applied to the LCIOP

Emission/Energy Source	Energy Content Factor
Diesel Consumption	38.6 GJ/kL
Electricity Consumption	0.0036 GJ/kWh

3.4.4 Renewable Energy

There are plans underway to install a 1.7 MW solar PV with the goal of offsetting approximately 23% of the power demand currently met by diesel generators. Electricity generated by the 1.7 MW solar photovoltaic system was estimated assuming the average peak sunlight per day is 5 hours in 365 days.

3.5 GHG Emissions and Energy Estimates

3.5.1 Scope 1 GHG Emissions

Fuel Combustion

GHG emissions have been estimated for the LCIOP activities over the expected LOM based on the maximum nameplate/nominal throughput capacity of 10 Mtpa and the planned production design capacity of 8 Mtpa. The key inputs used to calculate the Scope 1 GHG emissions associated with the project are outlined in Table 6 and Table 7.

Table 6 Key Project Inputs (Based on the expected production throughput of 8 Mtpa)

Input	Value (over LOM)
LOM – construction + operation	5 Years Construction: Year 1 Operation: Year 1 – Year 5
Total Material Mined	Total: 56,015,509 Tonnes Ore: 31,374,018 Tonnes Waste: 24,641,491 Tonnes
Total Iron Ore Produced	30,333,262 Tonnes
Power Source (Electricity Generation)	On-site diesel generators & solar PV system
Total Electricity Generation	53,929 MWh
Total Diesel Consumption	
- **Scenario 1 (Base)**	59,398 kL
- **Scenario 1 (Base) – Include fuel used for haulage**	281,354 kL
- **Scenario 2**	56,022 kL
- **Scenario 2– Include fuel used for haulage**	277,978 kL

Table 7 Key Project Inputs (Based on the maximum capacity throughput of 10 Mtpa)

Input	Value (over LOM)
Total Iron Ore Produced	10,000,000 Tonnes
Total Electricity Generation	88,893 MWH (17,779 MWh per annum)
Total Diesel Consumption	

Input	Value (over LOM)
- **Scenario 1 (Base)**	95,964 kL
- **Scenario 1 (Base) – Include fuel used for haulage**	454,881 kL
- **Scenario 2**	92,588 kL
- **Scenario 2– Include fuel used for haulage**	451,505 kL

The estimated Scope 1 emissions from fuel combustion by source, are outlined in Table 8. A summary of the annual estimates is shown in Appendix B.

Table 8 Estimated Scope 1 Emissions associated with Fuel Usage

		Expected Throughput (8 Mtpa)		Maximum Throughput (10 Mtpa)	
Scenario	**Sources**	**Emissions over LOM (tCO_2-e)**	**Average Annual Emissions (tCO_2-e/year)**	**Emissions over LOM (tCO_2-e)**	**Average Annual Emissions (tCO_2-e/year)**
Scenario 1 (Base)	Diesel combustion (Electricity)	39,751	7,950	65,523	13,105
	Diesel combustion (non-transport)	121,201	24,240	194,511	38,902
	Diesel combustion (Transport)	603,152	120,630	975,336	195,067
	Total	**764,103**	**152,821**	**1,235,371**	**247,074**
Scenario 2	Diesel combustion (Electricity)	30,603	6,121	56,376	11,275
	Diesel combustion (non-transport)	121,201	24,240	194,511	38,902
	Diesel combustion (Transport)	603,152	120,630	975,336	195,067
	Total	**754,956**	**150,991**	**1,226,224**	**245,245**

Land Clearing

The inputs applied to the LCIOP land clearing calculations are shown in Table 9. Input data was entered into the FullCAM simulation model producing an estimated maximum carbon biomass for the project area (Table 10). Emission factors from clearing different vegetation types have been calculated from this carbon biomass via the Carbon Credits Methodology (CER, 2018).

Table 9 Land Clearing Input Data the LCIOP

Input	Value
Project Location Coordinates	-22.81 North; 118.87 East
Cleared Area	661 ha
- **Open Woodland**	378 ha
- **Mallee & Acacia woodlands**	249 ha
- **Grasslands**	25 ha
Other Baseline Settings	As outlined in FullCAM guidelines

Table 10 Estimated Carbon Biomass and Emission Factor for Land Clearing

Vegetation Type	Item	Value
Mallee & Acacia Woodlands	Carbon mass of trees per hectare	23.54
	Carbon mass of forest debris per hectare	12.60
	Emission Factor (tCO_2-e/ha)	36.15
Open Woodlands	Carbon mass of trees per hectare	23.54
	Carbon mass of forest debris per hectare	12.60
	Emission Factor (tCO_2-e/ha)	36.15
Grasslands	Carbon mass of trees per hectare	23.54
	Carbon mass of forest debris per hectare	11.69
	Emission Factor (tCO_2-e/ha)	35.23

The estimated Scope 1 emissions generated from land clearing activities was 87,461 tCO_2-e (with an average of 17,492 tCO_2-e/year) over the LOM (loss of carbon sink). The resulting emissions from the proposed area to be cleared and applying the above emission factor are outlined in Table 11.

Refer to Appendix C for a complete breakdown of the emissions calculations.

Table 11 Estimated Scope 1 Emissions Associated with Land Clearing (loss of carbon sink)

Area (ha)	Emissions Over LOM (tCO_2-e)	Annual Emission (tCO_2-e/year)
661	87,461	17,492

Total Scope 1 GHG Emissions

The emissions from fuel consumption and land clearing have been combined to provide an overall estimate of Scope 1 emissions for Scenario 1 and Scenario 2 for planned production design capacity of 8 Mtpa and maximum nameplate/nominal throughput capacity of 10 Mtpa (Table 12). The estimated emissions over the LOM of the projects are also showed in Figure 3 & Figure 4 for Scenario 1 and Figure 5 & Figure 6 for Scenario 2.

The emissions reduction from the 1.7 MW solar PV system is estimated to be around 9,147 tCO_2-e over the LOM. Calculations and resulting emission estimates are provided in further detail in Appendix B below.

Table 12 Estimated Scope 1 Emissions by Source over LOM

		Expected Throughput (8 Mtpa)		Maximum Throughput (10 Mtpa)	
Scenario	Category	Emissions over LOM (tCO_2-e)	Average Annual Emissions (tCO_2-e/year)	Emissions over LOM (tCO_2-e)	Average Annual Emissions (tCO_2-e/year)
Scenario 1 (Base)	Fuel Combustion (Electricity)	39,751	7,950	65,523	13,105
	Fuel Combustion (Non-transport)	121,201	24,240	194,511	38,902
	Fuel Combustion (Transport)	603,152	120,630	975,336	195,067
	Land Clearing	87,461	17,492	87,461	17,492
	Total	**851,564**	**170,313**	**1,322,832**	**264,566**
Scenario 2	Fuel Combustion (Electricity)	30,603	6,121	56,376	11,275
	Fuel Combustion (Non-transport)	121,201	24,240	194,511	38,902
	Fuel Combustion (Transport)	603,152	120,630	975,336	195,067
	Land Clearing	87,461	17,492	87,461	17,492
	Total	**842,417**	**168,483**	**1,313,685**	**262,737**

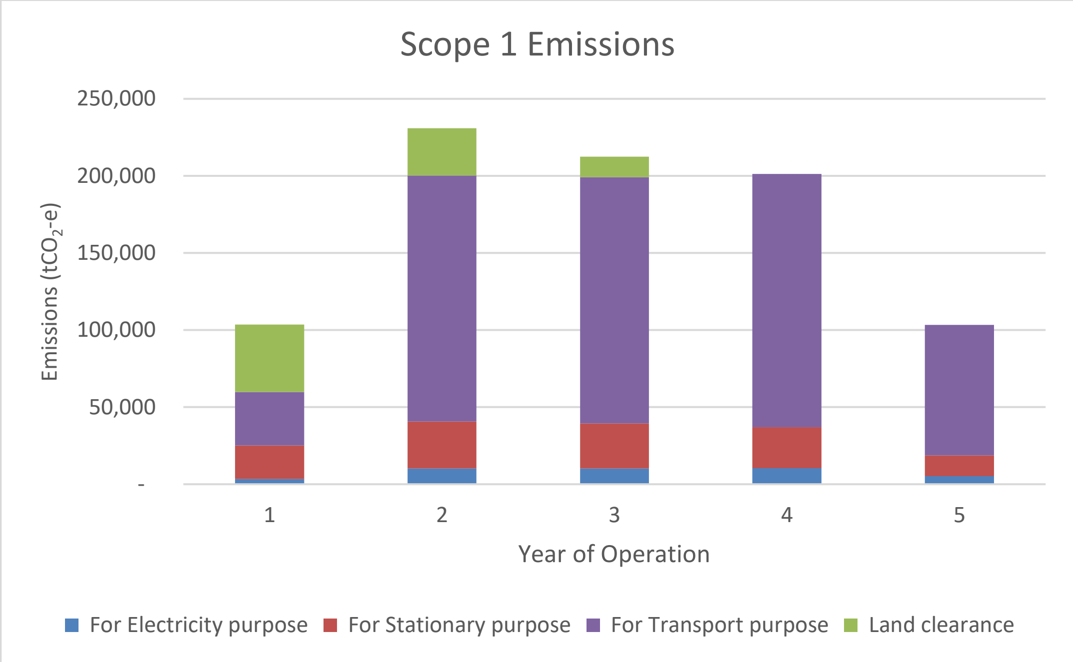


Figure 3 Estimated Scope 1 Emissions by Source over LOM (Scenario 1 – planned production design capacity 8 Mtpa)

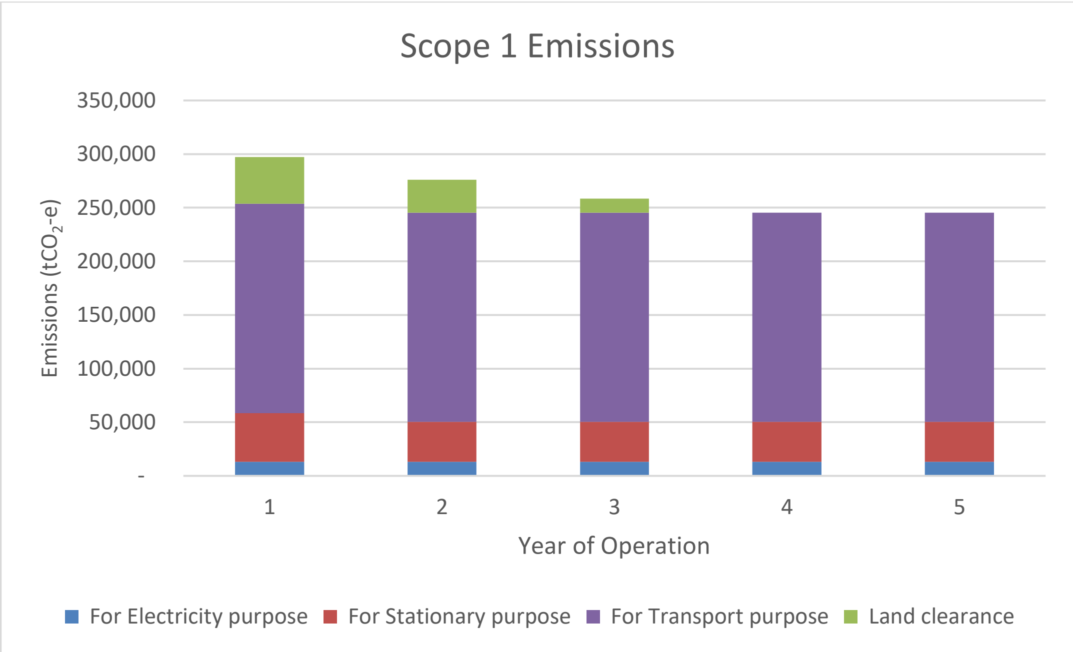


Figure 4 Estimated Scope 1 Emissions by Source over LOM (Scenario 1 – maximum nameplate/nominal throughput capacity of 10 Mtpa)

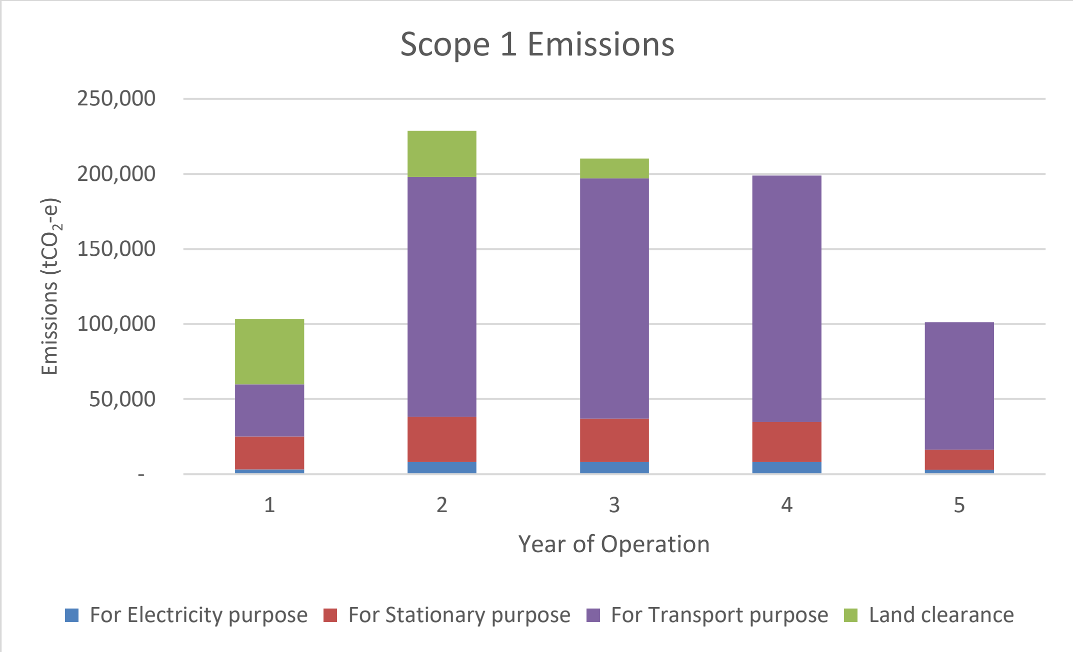


Figure 5 Estimated Scope 1 Emissions by Source over LOM (Scenario 2 – planned production design capacity 8 Mtpa)

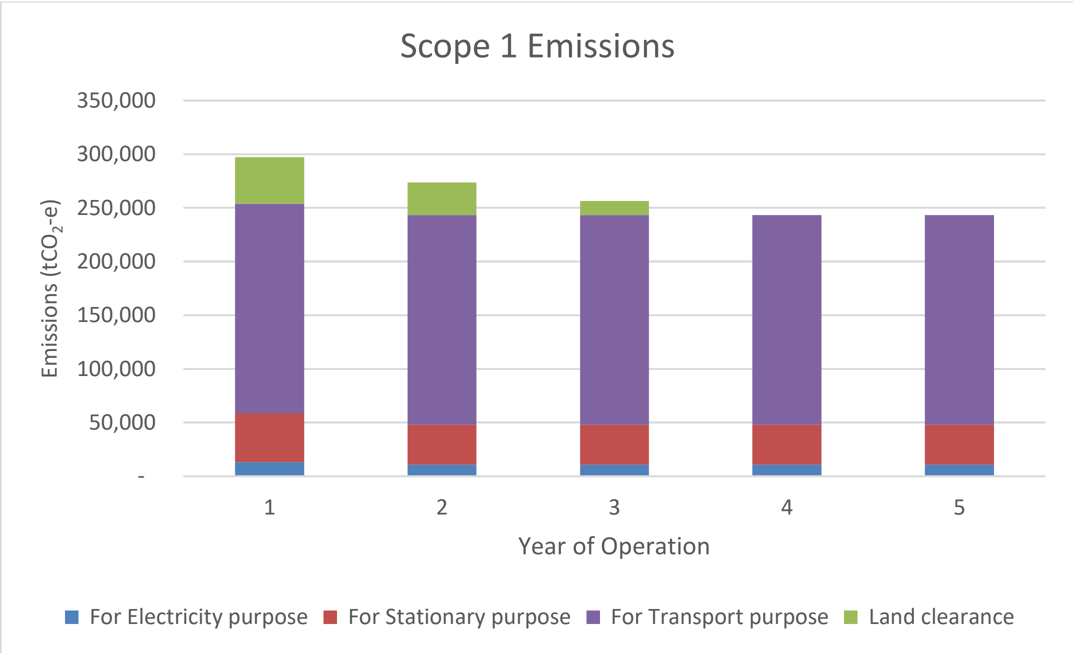


Figure 6 Estimated Scope 1 Emissions by Source over LOM (Scenario 2 – maximum nameplate/nominal throughput capacity of 10 Mtpa)

3.5.2 Scope 3 GHG Emissions

Seven categories of Scope 3 GHG emissions were determined and included for the LCIOP as specified in Section 3.2.3. These being:

- Purchased goods and services,
- Capital goods,
- Fuel and energy related activities,
- Downstream transportation and distribution,
- Processing of sold products, and
- End-of-life treatment of sold products.

Emissions from capital goods were assessed, however due to the limited breakdown on spending it has been included into the purchased goods and services category.

The Scope 3 results shown in Table 13 were estimated based on the maximum nameplate/nominal throughput capacity of 10 Mtpa and the planned production design capacity of 8 Mtpa. It shows that of the seven categories, emissions from processing of sold products was the highest contributor making up about 96% of the Scope 3 GHG emissions. These emissions relate to the processing of iron ore for steel production. The average Scope 3 emissions per annum are showed in Table 14.

A summary of the annual estimates is shown in Appendix D.

Table 13 Estimated Scope 3 Emissions over LOM

Scenario	Category	Expected Throughput (8 Mtpa) Emissions over LOM (tCO_2-e)	Maximum Throughput (10 Mtpa) Emissions over LOM (tCO_2-e)
Scenario 1 (Base)	Purchased Goods and Services (including Capital Goods)	85,481	85,481
	Fuel and Energy Related Activities	187,882	303,760
	Downstream Transportation and Distribution	716,954	1,143,376
	Processing of Sold Products	39,803,743	63,477,778
	End-of-life Treatment of Sold Products	385,014	614,009
	Total	**41,179,075**	**65,624,405**
Scenario 2	Purchased Goods and Services (including Capital Goods)	85,481	85,481
	Fuel and Energy Related Activities	185,628	301,506

	Downstream Transportation and Distribution	716,954	1,143,376
	Processing of Sold Products	39,803,743	63,477,778
	End-of-life Treatment of Sold Products	385,014	614,009
	Total	**41,176,821**	**65,622,151**

Table 14 Average Scope 3 Emissions per Annum

Scenario	Category	Expected Throughput (8 Mtpa) Average Emissions (tCO_2-e/ year)	Maximum Throughput (10 Mtpa) Average Emissions (tCO_2-e/ year)
Scenario 1 (Base)	Purchased Goods and Services (including Capital Goods)	17,096	17,096
	Fuel and Energy Related Activities	37,576	60,752
	Downstream Transportation and Distribution	143,391	228,675
	Processing of Sold Products	7,960,749	12,695,556
	End-of-life Treatment of Sold Products	77,003	122,802
	Total	**8,235,815**	**13,124,881**
Scenario 2	Purchased Goods and Services (including Capital Goods)	17,096	17,096
	Fuel and Energy Related Activities	37,126	60,301
	Downstream Transportation and Distribution	143,391	228,675
	Processing of Sold Products	7,960,749	12,695,556
	End-of-life Treatment of Sold Products	77,003	122,802
	Total	**8,235,364**	**13,124,430**

3.5.3 Energy Production and Consumption

The LCIOP energy consumption is associated with fuel and electricity consumption onsite. Energy production is associated with electricity production from the onsite power station. The key inputs outlined in Table 6 have been utilised to estimate the energy consumption and production.

The estimated energy production and consumption for the LCIOP over LOM by source and scenario based on maximum nameplate/nominal throughput capacity of 10 Mtpa and the planned production design capacity of 8 Mtpa are outlined in

Table 15.

Refer to Appendix B for a summary of the annual estimates.

Table 15 Estimated Energy Production and Consumption by Source over LOM

		Expected Throughput (8 Mtpa)	Maximum Throughput (10 Mtpa)
Scenario	**Sources**	**Energy Production & Consumption Over LOM (GJ)**	
Scenario 1 (Base)	Electricity production	194,143	320,016
	Electricity consumption	194,143	320,016
	Diesel consumption (Include road haulage)	10,860,254	17,558,408
	Total	**11,054,397**	**17,878,425**
Scenario 2	Electricity production	194,143	320,016
	Electricity consumption	194,143	320,016
	Diesel consumption (Include road haulage)	10,729,949	17,428,103
	Total	**10,924,092**	**17,748,120**

4 Benchmark Assessment

4.1 Contribution of the LCIOP GHG emissions

Total estimated emissions of Australia from the Department of Climate Change, Energy, the Environment and Water for the year to March 2022 was 487 million tCO_2-e (DCCEEW, 2022a). The Clean Energy Regulator (CER) has also published the annual NGER data for FY2022 in March 2023. For the FY2022, registered corporations reported a total of 310 million tCO_2-e of Scope 1 GHG emissions and 84 million tCO_2-e of Scope 2 GHG emissions (CER, 2023a). There were 27.5% of Scope 1 GHG emissions contributed from WA and 30.3% of emissions were derived from mining industry (CER, 2023a).

To provide a perspective on the project's likely impact, Scope 1 GHG emission estimates of the LCIOP have been compared against regional, state and national emission estimates and displayed in Table 16.

Table 16 Estimated Impact of the LCIOP Scope 1 GHG Emissions

Location	FY2022 Scope 1 GHG Emissions (Million tCO_2-e)	% Contribution from the Project[d]
Pilbara Region[a] (excluding offshore)	34	0.50 %
Western Australia[b]	69	0.25%
Australia[c]	310	0.05 %

a) Source from FY2022 Safeguard published data & FY2022 Electricity sector emissions and generation data (CER, 2023b). Only includes facilities reporting to safeguard and electricity generators that provide electricity to the grid. The real figure is likely to be higher as it will include other sources such as smaller mining and processing facilities, road rail and air transport, and agriculture.
b) Source from Clean Energy Regulator (CER, 2023a). Only corporations that trip the NGER reporting thresholds are required to be registered and reported to the NGER Scheme.
c) Source from Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2022 (DCCEEW, 2022a).
d) LCIOP % contribution based on annual average emissions under base Scenario, 8 Mtpa.

4.2 Emission Intensity

Emissions intensity was estimated based on production forecasted data and estimated emissions. Emission intensity is calculated by:

$$Emission\ intensity = \frac{Scope\ 1\ emissions}{Iron\ ore\ produced}$$

The Average emission intensity estimated for the LCIOP is 0.02807 tCO_2-e/tonnes iron ore produced, based on the planned production design capacity of 8 Mtpa.

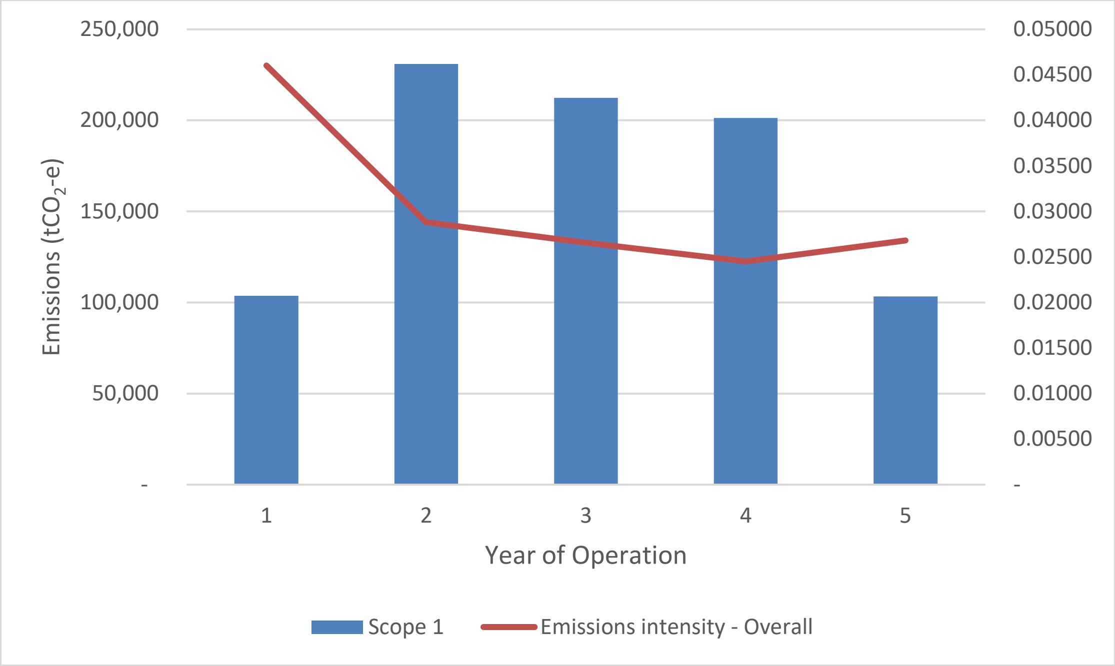


Figure 7 Emission intensities and Scope 1 emissions estimates of the LCIOP over LOM (Scenario 1 – planned production design capacity 8 Mtpa)

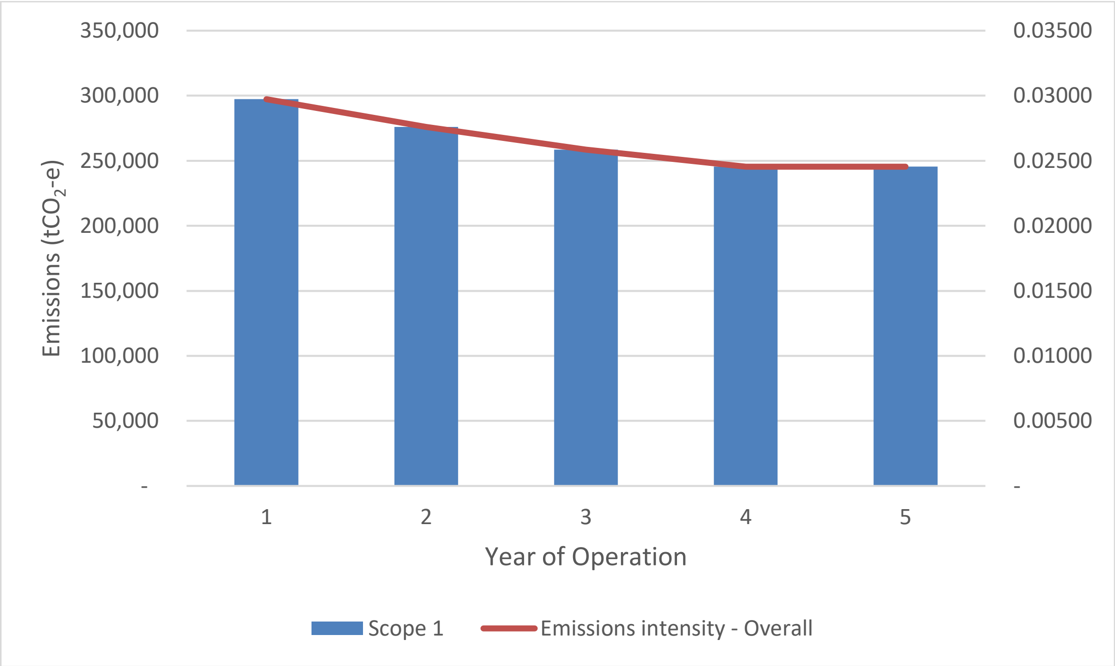


Figure 8 Emission intensities and Scope 1 emissions estimates of the LCIOP over LOM (Scenario 1 – maximum nameplate/nominal throughput capacity of 10 Mtpa)

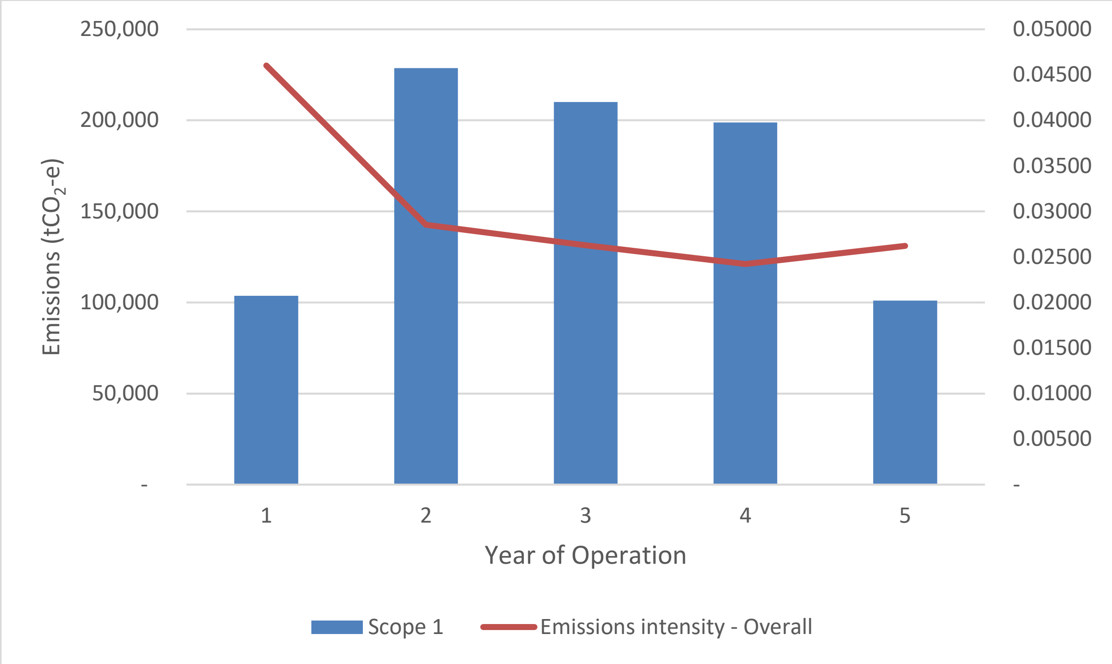


Figure 9 Emission intensities and Scope 1 emissions estimates of the LCIOP over LOM (Scenario 2 – planned production design capacity 8 Mtpa)

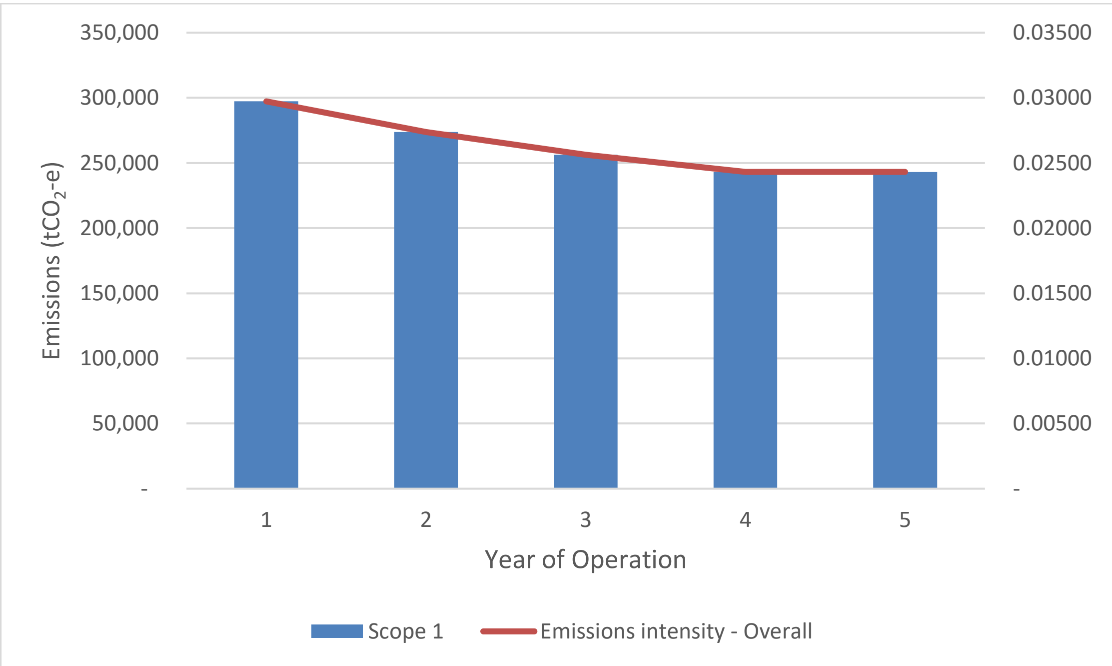


Figure 10 Emission intensities and Scope 1 emissions estimates of the LCIOP over LOM (Scenario 2 – maximum nameplate/nominal throughput capacity of 10 Mtpa)

Figure 7 and Figure 8 outline the emissions intensities and the Scope 1 emissions estimates of the LCIOP over the LOM, based on the Scenario 1, the maximum nameplate/nominal throughput capacity of 10 Mtpa and the planned production design capacity of 8 Mtpa. Figure 9 and Figure 10 show the emission intensities and Scope 1 emissions estimates of Scenario 2 for both throughput capacities.

The emission intensity is expected to be high during the first operations year mainly due to the low production rates, as the facility will still be in construction and operations start-up phase (commissioning). Emissions intensities are expected to decrease when the production rate increases. A summary of the annual estimates is provided in Appendix B.

The estimated emission intensity of the LCIOP was compared with the other iron ore mines that have:

- Similar annual production,
- Are in the same region (Pilbara), and
- Hematite as the primary target ore (as opposed to magnetite)

The estimated emissions intensity of the LCIOP was also compared with other existing MinRes' iron ore projects, including Koolyanobbing, Iron Valley and Wonmunna . The GHG emission intensities benchmarking comparison for the project is outlined in Table 17.

Table 17 GHG Emission Intensities Benchmark

Project	Ore Production (tonnes/year)	Total Scope 1 + 2 Emissions (tCO_2-e /year)	Scope 1 + 2 Emissions Intensity (tCO_2/t ore)	Source(s) and notes
MinRes Lamb Creek Iron Ore Project				
Planned average throughput during LOM (Scenario 1 – 8 Mtpa)	6,066,652	170,313	0.02807	From this assessment
Highest production throughput during LOM (Scenario 1 – 8 Mtpa)	8,211,719	201,219	0.02450	From this assessment
Maximum nameplate (Scenario 1 – 10 Mtpa)	10,000,000	264,566	0.02646	From this assessment
Planned average throughput during LOM with Solar PV system (Scenario 2 – 8 Mtpa)	6,066,652	168,483	0.02777	From this assessment
Highest production throughput during LOM with Solar PV system (Scenario 2 – 8 Mtpa)	8,211,719	198,932	0.02423	From this assessment
Maximum nameplate with Solar PV system (Scenario 2 – 10 Mtpa)	10,000,000	262,737	0.02627	From this assessment
Other projects[a]				
Rio Tinto West Angelas[b]	35,000,000	369,032	0.0105	Public environmental review document EPA Assessment No. 2132 (Rio Tinto, 2018) Including 315,825 tCO2-e scope 1 and 53,207 tCO2-e scope 2 emissions
Roy Hill Iron Ore Mine[b]	59,100,000	733,000	0.0124	Greenhouse Gas Management Plan (Roy Hill, 2020)
Mount Gibson Extension Hill[c]	3,200,000	56,927	0.0178	2019 Mount Gibson Annual Report, 2019 NGER published data

Project	Ore Production (tonnes/year)	Total Scope 1 + 2 Emissions (tCO_2-e /year)	Scope 1 + 2 Emissions Intensity (tCO_2/t ore)	Source(s) and notes
BHP Jimblebar	50,673,195	414,000	0.0082	Jimblebar Optimisation Project: Jimblebar Iron Ore Mine Revised Proposal
McPhee Creek Iron Ore (excluding transport)	10,000,000	56,711	0.0057	McPhee Creek Iron Ore Mine Greenhouse Gas Assessment (Roy Hill Holdings, 2022)
MinRes Iron Valley Operations[d]	4,317,428	55,342	0.013	MRL NGER FY2022 report and data
MinRes Wonmunna Mine Operations[d]	4,698,589	40,932	0.0087	MRL NGER FY2022 report and data
MinRes Koolyanobbing Mine Operations[d]	6,721,607	131,693	0.020	MRL NGER FY2022 report and data

a) MinRes has no oversight on the methodology used to calculate the emissions from other projects.
b) Life of Mine project averages
c) This emissions include emissions from Koolan Island associated with mining of small quantity (400,000t) of non-beneficiated ore.
d) Haulage activities are not included in the NGER reporting as Scope 1 emissions; therefore emission intensities listed do not include haulage activities for the listed MinRes facilities.

4.2.1 Safeguard Mechanism Production Variables & Default Emission Intensities

Table 18 compares the estimated emission intensities of the LCIOP with the default emission intensities specified in the Safeguard Mechanism Rules. Further details on the Safeguard Mechanism Rules can be found in Section 4.3.2 below.

The LCIOP is subject to the following Safeguard Mechanism production variables:

- Iron Ore - Production Variable from Schedule 2, Part 14 of the Safeguard Mechanism Rule.
- Electricity Generation - Production variable from Schedule 2, Part 26 of the Safeguard Mechanism Rule

Table 18 Safeguard Mechanism Production Variables & Default Comparison

Scenario	Items	Emission Intensities	
		Iron Ore (tCO_2/t ore)	Electricity (tCO_2/MWh)
Default	Default from Safeguard Mechanism Rules	0.00476	0.539
Scenario 1 (Base)	Planned average throughput during LOM (8 Mtpa)	0.00373	0.737
	Highest production throughput during LOM (8 Mtpa)	0.00324	0.737
	Maximum nameplate (10 Mtpa)	0.00373	0.737
Scenario 2	Planned average throughput during LOM (8 Mtpa)	0.00373	0.567
	Highest production throughput during LOM (8 Mtpa)	0.00324	0.577
	Maximum nameplate (10 Mtpa)	0.00373	0.634

4.3 GHG Monitoring and Reporting

4.3.1 National Greenhouse and Energy Reporting (NGER)

The NGER scheme is a Commonwealth initiative, introduced in 2007, to provide data and accounting in relation to GHG emissions and energy consumption and production.

Under the NGER scheme, corporations that exceed the corporate or facility thresholds need to report annually to the CER (Table 19).

Table 19 Key NGER Thresholds

Level	GHG Emissions	Energy Consumed / Produced
Facility	25,000 tCO_2-e	100,000 GJ
Corporate	50,000 tCO_2-e	200,000 GJ

The controlling corporation (as defined in the *NGER Act)* of this project is likely to be MinRes. It is expected that this company will have to include the GHG emissions, energy consumption and energy production from this project in their NGER report.

4.3.2 Safeguard Mechanism

Starting on 1 July 2016, the Australian Government introduced a Safeguard Mechanism under section 22XS of the NGER Act. As a consequence, responsible emitters controlling facilities which emit 100,000 tCO_2-e (Default Baseline) or more of scope 1 GHG emissions will be required to meet the safeguard requirements, including keeping the facility's net emissions at or below a set baseline emissions level.

Section 22XB of the NGER Act requires that the responsible emitter report annual covered emissions to enable a comparison against a baseline determined by the CER.

In the event of the reported annual emissions being below the baseline, the Safeguard facility would become eligible for Safeguard Mechanism Credits (SMC) under the new reform which could be used for compliance purposes. However, should the emissions be above the baseline; the responsible emitter will be required to 'make good' the excess emissions by surrendering carbon credit units or alternatively be liable to a substantial penalty.

With the highest forecast annual Scope 1 GHG emissions of 40,696 tCO_2-e (Scenario 1, excluded land clearance emissions* and road haulage activities^ based on the planned production throughput of 8 Mtpa), the LCIOP is not likely to exceed the default baseline of 100,000 tCO_2-e when it is in operation.

*Emissions from land clearance are not required to be included for NGER and Safeguard Mechanism.
^ Road haulage from the mine to the port will be conducted by contractor that is not under the overall control of MinRes. Therefore, emissions from the haulage activities will not be reported as Scope 1 emissions for NGER and Safeguard Mechanism.

4.4 Adaptive Management and Management Plan Review

In line with the concept of adaptive management, it is recommended that mitigation and management strategies be reviewed and updated (where appropriate) in response to triggers such as:

- Introduction of a new process or activity that has the potential to alter existing GHG emissions,
- Changes to relevant State or Commonwealth legislation, policy or guidelines,
- Introduction of new GHG reduction technologies,
- Technical review of implemented emissions monitoring,
- Relevant audit findings,
- EPA and decision-making authorities' comments during the Environmental approval process, or
- Update or implementation of an operating licence issued under Part V of the EP Act.

5 Glossary

Terms	Definitions
CO_2-e	Carbon dioxide equivalence, the amount of the gas multiplied by a value specified in the regulations in relation to that kind of greenhouse gas.
Determination	The NGER Determination 2008
Downstream emissions	Indirect GHG emissions related to sold goods and services
EPA	Western Australian Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
Facility	Is a single enterprise that undertakes an activity, or a series of activities that involve greenhouse gas emissions, the production of energy or the consumption of energy.
GHG	All greenhouse gases mentioned in the NGER Act
Non-transport	Includes purposes for which fuel is combusted that do not involve transport energy purposes, see Sections 2.20, and 2.42 of the Determination.
PER	Public Environmental Review
Regulations	The NGER Regulations 2008
Safeguard Mechanism Rules	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015
Scope 1	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.
Scope 2	Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.
Scope 3	Indirect emissions of greenhouse gas, that are not included in scope 2, that occur in the value chain of the reporting company.
Transport	Includes purposes for which fuel is combusted for transport by vehicles registered for road use, rail transport, marine navigation, and air transport, see Sections 2.20, and 2.42 of the Determination
Upstream emissions	Indirect GHG emissions related to purchased or acquired goods and services

Appendix A Scope 3 Emission Categories and Relevancy

Category	Description
1. Purchased goods and services	All emissions from the production of products and services purchased or acquired by the reporting company in the reporting period. *Example: The emissions associated with the extraction, production and transportation (between suppliers) of copper that is purchased by the reporting company to create bronze.*
2. Capital goods	All upstream emissions from the production of capital goods purchased by the company in the reporting period. *Example: Emissions associated with the production of excavators used by the reporting company.*
3. Fuel- and energy-related activities (Not included in scope 1 or scope 2)	All emissions related to the production (extraction, processing, transport etc.) of fuel and energy purchased by the reporting company, that are not included in the company's scope 1 and scope 2 emissions. *Example: The emissions from extracting crude oil, processing it to form diesel and transporting it to a site run by the reporting company.*
4. Upstream transportation and distribution	All emissions resulting from the transportation and distribution of purchased products, between a company's tier 1 suppliers and its own operations, in vehicles not owned by the reporting company, as well as any third-party transportation and distribution services purchased by the reporting company between a company's own facilities. *Example: Emissions from transportation of purchased copper between the supplier and the reporting company's bronze manufactoring facility.*
5. Waste generated in operations	All emissions from third-party treatment and disposal of waste that is generated by the company in the reporting period. *Example: Waste sent from the reporting company's site facilities for recycling, disposal at landfills, incineration, composting, etc.*
6. Business travel	All emissions from the transportation of employees for business-related activities in vehicles owned or operated by third-parties. *Example: Flights to business conferences and meeting suppliers.*
7. Employee commuting	All emissions from the transportation of employees between their homes and worksites. *Examples: FIFO and DIDO to site.*
8. Upstream leased assets	All emissions from the operation of leased assets that are not included in the company's scope 1 and 2 emissions inventory. *Example: Emissions from leased cars, offices and buildings.*
9. Downstream transportation and distribution	All emissions from third-party transport and distribution of the company's sold products in the reporting period. *Example: Emissions from third-party marine transportation of iron ore sold by the reporting company to be processed by another company.*
10. Processing of sold products	All emissions from processing of sold intermediate products by third-parties, subsequent to the sale of the product by the reporting company. *Example: Emissions from processing of iron ore sold by the reporting company to create steel.*

Category	Description
11. Use of sold products	All emissions from the use of goods and services sold by the reporting company in the reporting period. *Example: Emissions from the combustion of diesel, produced by the reporting company, as fuel for cars.*
12. End-of-life treatment of sold products	All emissions from the waste disposal or treatment of products sold by the company in the reporting period, at the end of their life. *Example: Emissions from recycling of metal cans sold by the reporting company.*
13. Downstream leased assets	All emissions from the operation of assets owned by the company and leased to third-parties in the reporting period, if they are not included in the company's scope 1 and scope 2 emissions. *Example: Emissions from electricity used in offices/buildings leased by the reporting company to other operations.*
14. Franchises	All emissions from the operation of franchises, by franchisees, not included in the franchisor's scope 1 and scope 2 emissions. *Example: Emissions from operations associated with a company's trademark.*
15. Investments	All emissions associated with operating the reporting company's investments in the reporting period. *Example: Emissions associated with a mine a company has a financial investment in but not operational control.*

Criteria	Description
Size	They contribute significantly to the company's total anticipated scope 3 emissions.
Influence	There are potential emissions reductions that could be undertaken or influenced by the company.
Risk	They contribute to the company's risk exposure (e.g., climate change related risks such as financial, regulatory, supply chain, product and customer, litigation, and reputational risks).
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, investors, or civil society).
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by the reporting company that are typically performed in-house by other companies in the reporting company's sector.
Sector guidance	They have been identified as significant by sector-specific guidance.
Other	They meet any additional criteria for determining relevance developed by the company or industry sector.

Source: GHG Protocol (2011)

Appendix B Fuel and Energy Calculations

Scenario 1 (Base Scenario, Planned Production Design Capacity 8 Mtpa) – No Emission Reduction

ITEM N°	ITEM	VALUE	UNITS	NOTE	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
SUMMARY										
1 -	Scenario 1: Total Emissions (Base Scenario, Planned production - design capacity 8 MTpa)									
1a	Scope 1	851,564	tCO2-e		=sum(1g:1k)	103,615	230,935	212,391	201,219	103,404
1b	Scope 2	-	tCO2-e		No electricity expected to be purchased for the project	-	-	-	-	-
1c	Total of Scope 1 & Scope 2	851,564	tCO2-e		=1a+1b	103,615	230,935	212,391	201,219	103,404
1d	Energy production	194,143	GJ		=14c	16,141	50,478	50,307	51,274	25,943
1e	Energy consumption	11,054,397	GJ		=20f	867,786	2,897,628	2,882,474	2,910,999	1,495,510
1f	Scope 3	41,179,075	tCO2-e		=39f	2,215,024	10,827,170	10,965,726	11,114,740	6,056,417
1g	Diesel Combustion (Electricity)	39,751	tCO_2-e		=8c	3,305	10,335	10,300	10,498	5,312
1h	Diesel Combustion (Construction)	8,129	tCO_2-e		=10c	8,129	-	-	-	-
1i	Diesel Combustion (Mining Operation and Land Clearing)	113,072	tCO_2-e		=12c	13,721	30,361	29,088	26,576	13,326
1j	Diesel Combustion (Road Haulage)	603,152	tCO_2-e		=3d	34,729	159,627	159,884	164,145	84,767
1k	Land clearance	87,461	tCO_2-e		=34i	43,731	30,611	13,119	-	-
1l	Average Diesel Combustion (Electricity)	7,950	tCO_2-e/yr		=1g÷5 years					
1m	Average Diesel Combustion (Construction)	1,626	tCO_2-e/yr		=1h÷5 years					
1n	Average Diesel Combustion (Mining Operation and Land Clearing)	22,614	tCO_2-e/yr		=1i÷5 years					
1o	Average Diesel Combustion (Road Haulage)	120,630	tCO_2-e/yr		=1j÷5 years					
1p	Average Land clearance	17,492	tCO_2-e/yr		=1k÷5 years					
1q	For Electricity purpose	39,751	tCO_2-e		=1g	3,305	10,335	10,300	10,498	5,312
1r	For Stationary purpose	121,201	tCO_2-e		=1h+1i	21,850	30,361	29,088	26,576	13,326
1s	For Transport purpose	603,152	tCO_2-e		=1j	34,729	159,627	159,884	164,145	84,767
1t	Land clearance	87,461	tCO_2-e		=1k	43,731	30,611	13,119	-	-
1u	Average Scope 1 emissions	170,313	tCO_2-e/yr		=1a÷5 years					
1v	Average Scope 3 emissions	8,235,815	tCO_2-e/yr		=1f÷5 years					
1w	Average Energy production	38,829	GJ/yr		=1d÷5 years					
1x	Average Energy consumption	2,210,879	GJ/yr		=1e÷5 years					
1y	Total Diesel	281,354	kL		=45a	22,063	73,760	73,372	74,086	38,072
1z	Total Electricity Generation	53,929	MWh		=6d÷1,000	4,484	14,022	13,974	14,243	7,206
1aa	Total Iron Ore Product - Planned	30,333,262	Tonnes		=5f	2,251,367	8,012,376	7,998,726	8,211,719	3,859,074
1ab	Emissions intensity - Overall	0.02807	tCO_2-e/tonnes iron ore produced		=1a÷1aa	0.04602	0.02882	0.02655	0.02450	0.02680
1ac	Emissions intensity - Iron Ore Production	0.00373	tCO_2-e/tonnes iron ore produced		=1i÷1aa	0.00609	0.00379	0.00364	0.00324	0.00345
1ad	Emissions intensity - Electricity	0.73710	tCO_2-e/MWh		=1g÷1z	0.73710	0.73710	0.73710	0.73710	0.73710

Scenario 1 (Base Scenario, Maximum Nameplate/Nominal Capacity Throughput 10 Mtpa) – No Emission Reduction

ITEM N°	ITEM	VALUE	UNITS	NOTE	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Maximum nameplate/nominal capacity - 10 Mtpa										
1ae	Scope 1	1,322,832	tCO2-e		=sum(1ak:1ao)	297,308	276,060	258,568	245,448	245,448
1af	Scope 2	-	tCO2-e		No electricity expected to be purchased for the project	-	-	-	-	-
1ag	Total of Scope 1 & Scope 2	1,322,832	tCO2-e		=1ae+1af	297,308	276,060	258,568	245,448	245,448
1ah	Energy production	320,016	GJ		=28c	64,003	64,003	64,003	64,003	64,003
1ai	Energy consumption	17,878,425	GJ		=33f	3,668,325	3,552,525	3,552,525	3,552,525	3,552,525
1aj	Scope 3	65,624,405	tCO2-e		=40f	13,156,917	13,121,496	13,116,794	13,121,814	13,107,384
1ak	Diesel Combustion (Electricity)	65,523	tCO_2-e		=4a	13,105	13,105	13,105	13,105	13,105
1al	Diesel Combustion (Construction)	8,129	tCO_2-e		=4b	8,129	-	-	-	-
1am	Diesel Combustion (Mining Operation and Land Clearing)	186,382	tCO_2-e		=4c	37,276	37,276	37,276	37,276	37,276
1an	Diesel Combustion (Road Haulage)	975,336	tCO_2-e		=4d	195,067	195,067	195,067	195,067	195,067
1ao	Land clearance	87,461	tCO_2-e		=34i	43,731	30,611	13,119	-	-
1ap	Average Diesel Combustion (Electricity)	13,105	tCO_2-e/yr		=1ak÷5 years					
1aq	Average Diesel Combustion (Construction)	1,626	tCO_2-e/yr		=1al÷5 years					
1ar	Average Diesel Combustion (Mining Operation and Land Clearing)	37,276	tCO_2-e/yr		=1am÷5 years					
1as	Average Diesel Combustion (Road Haulage)	195,067	tCO_2-e/yr		=1an÷5 years					
1at	Average Land clearance	17,492	tCO_2-e/yr		=1ao÷5 years					
1au	For Electricity purpose	65,523	tCO_2-e		=1ak	13,105	13,105	13,105	13,105	13,105
1av	For Stationary purpose	194,511	tCO_2-e		=1al+1am	45,406	37,276	37,276	37,276	37,276
1aw	For Transport purpose	975,336	tCO_2-e		=1an	195,067	195,067	195,067	195,067	195,067
1ax	Land clearance	87,461	tCO_2-e		=1ao	43,731	30,611	13,119	-	-
1ay	Average Scope 1 emissions	264,566	tCO_2-e/yr		=1ae÷5 years					
1az	Average Scope 3 emissions	13,124,881	tCO_2-e/yr		=1aj÷5 years					
1ba	Average Energy production	64,003	GJ/yr		=1ah÷5 years					
1bb	Average Energy consumption	3,575,685	GJ/yr		=1ai÷5 years					
1bc	Total Diesel	454,881	kL		=49e	93,376	90,376	90,376	90,376	90,376
1bd	Total Electricity Generation	88,893	MWh		=22b÷1,000	17,779	17,779	17,779	17,779	17,779
1be	Total Iron Ore Product - Maximum	50,000,000	Tonnes		=21	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
1bf	Emissions intensity - Overall	0.02646	tCO_2-e/tonnes iron ore produced		=1ae÷1be	0.02973	0.02761	0.02586	0.02454	0.02454
1bg	Emissions intensity - Iron Ore Production	0.00373	tCO_2-e/tonnes iron ore produced		=1am÷1be	0.00373	0.00373	0.00373	0.00373	0.00373
1bh	Emissions intensity - Electricity	0.73710	tCO_2-e/MWh		=1ak÷1bd	0.73710	0.73710	0.73710	0.73710	0.73710

Scenario 2 (Planned Production Design Capacity 8 Mtpa) – Solar PV System (1.7 MW)

ITEM N°	ITEM	VALUE	UNITS	NOTE	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
2 -	Scenario 2: Total Emissions (with Solar Farm, Planned production - design capacity 8 MTpa)									
2a	Scope 1	842,417	tCO2-e		=sum(2g:2k)	103,615	228,648	210,105	198,932	101,118
2b	Scope 2	-	tCO2-e		No electricity expected to be purchased for the project	-	-	-	-	-
2c	Total of Scope 1 & Scope 2	842,417	tCO2-e		=2a+2b	103,615	228,648	210,105	198,932	101,118
2d	Energy production	194,143	GJ		=66c	16,141	50,478	50,307	51,274	25,943
2e	Energy consumption	10,924,092	GJ		=72f	867,786	2,865,052	2,849,898	2,878,422	1,462,934
2f	Scope 3	41,176,821	tCO2-e		=87f	2,215,024	10,826,606	10,965,162	11,114,176	6,055,853
2g	Diesel Combustion (Electricity)	30,603	tCO$_2$-e		=60c	3,305	8,048	8,014	8,211	3,025
2h	Diesel Combustion (Construction)	8,129	tCO$_2$-e		=62c	8,129	-	-	-	-
2i	Diesel Combustion (Mining Operation and Land Clearing)	113,072	tCO$_2$-e		=64c	13,721	30,361	29,088	26,576	13,326
2j	Diesel Combustion (Road Haulage)	603,152	tCO$_2$-e		=53d	34,729	159,627	159,884	164,145	84,767
2k	Land clearance	87,461	tCO$_2$-e		=34i	43,731	30,611	13,119	-	-
2l	Average Diesel Combustion (Electricity)	6,121	tCO$_2$-e/yr		=2g÷5 years					
2m	Average Diesel Combustion (Construction)	1,626	tCO2-e/yr		=2h÷5 years					
2n	Average Diesel Combustion (Mining Operation and Land Clearing)	22,614	tCO$_2$-e/yr		=2i÷5 years					
2o	Average Diesel Combustion (Road Haulage)	120,630	tCO$_2$-e/yr		=2j÷5 years					
2p	Average Land clearance	17,492	tCO$_2$-e/yr		=2k÷5 years					
2q	For Electricity purpose	30,603	tCO$_2$-e		=2g	3,305	8,048	8,014	8,211	3,025
2r	For Stationary purpose	121,201	tCO$_2$-e		=2h+2i	21,850	30,361	29,088	26,576	13,326
2s	For Transport purpose	603,152	tCO$_2$-e		=2j	34,729	159,627	159,884	164,145	84,767
2t	Land clearance	87,461	tCO$_2$-e		=2k	43,731	30,611	13,119	-	-
2u	Average Scope 1 emissions	168,483	tCO$_2$-e/yr		=2a÷5 years					
2v	Average Scope 3 emissions	8,235,364	tCO$_2$-e/yr		=2f÷5 years					
2w	Average Energy production	38,829	GJ/yr		=2d÷5 years					
2x	Average Energy consumption	2,184,818	GJ/yr		=2e÷5 years					
2y	Total Diesel	277,978	kL		=93a	22,063	72,916	72,528	73,242	37,228
2z	Total Electricity Generation	53,929	MWh		=56d÷1,000	4,484	14,022	13,974	14,243	7,206
2aa	Total Iron Ore Product - Planned	30,333,262	Tonnes		=55f	2,251,367	8,012,376	7,998,726	8,211,719	3,859,074
2ab	Emissions intensity - Overall	0.02777	tCO$_2$-e/tonnes iron ore produced		=2a÷2aa	0.04602	0.02854	0.02627	0.02423	0.02620
2ac	Emissions intensity - Iron Ore Production	0.00373	tCO$_2$-e/tonnes iron ore produced		=2b÷2aa	0.00609	0.00379	0.00364	0.00324	0.00345
2ad	Emissions intensity - Electricity	0.56748	tCO$_2$-e/MWh		=2g÷2z	0.73710	0.57400	0.57345	0.57654	0.41977

Scenario 2 (Maximum Nameplate/Nominal Capacity Throughput 10 Mtpa) – Solar PV System (1.7 MW)

ITEM N°	ITEM	VALUE	UNITS	NOTE	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Maximum nameplate/nominal capacity - 10 Mtpa										
2ae	Scope 1	1,313,685	tCO2-e		=sum(2ak:2ao)	297,308	273,773	256,281	243,162	243,162
2af	Scope 2	-	tCO2-e		No electricity expected to be purchased for the project	-	-	-	-	-
2ag	Total of Scope 1 & Scope 2	1,313,685	tCO2-e		=2ae+2af	297,308	273,773	256,281	243,162	243,162
2ah	Energy production	320,016	GJ		=81c	64,003	64,003	64,003	64,003	64,003
2ai	Energy consumption	17,748,120	GJ		=86f	3,668,325	3,519,949	3,519,949	3,519,949	3,519,949
2aj	Scope 3	65,622,151	tCO2-e		=88f	13,156,917	13,120,933	13,116,230	13,121,250	13,106,820
2ak	Diesel Combustion (Electricity)	56,376	tCO$_2$-e		=54a	13,105	10,818	10,818	10,818	10,818
2al	Diesel Combustion (Construction)	8,129	tCO$_2$-e		=54b	8,129	-	-	-	-
2am	Diesel Combustion (Mining Operation and Land Clearing)	186,382	tCO$_2$-e		=54c	37,276	37,276	37,276	37,276	37,276
2an	Diesel Combustion (Road Haulage)	975,336	tCO$_2$-e		=54d	195,067	195,067	195,067	195,067	195,067
2ao	Land clearance	87,461	tCO$_2$-e		=35f	43,731	30,611	13,119	-	-
2ap	Average Diesel Combustion (Electricity)	11,275	tCO$_2$-e/yr		=2ak÷5 years					
2aq	Average Diesel Combustion (Construction)	1,626	tCO2-e/yr		=2al÷5 years					
2ar	Average Diesel Combustion (Mining Operation and Land Clearing)	37,276	tCO$_2$-e/yr		=2am÷5 years					
2as	Average Diesel Combustion (Road Haulage)	195,067	tCO$_2$-e/yr		=2an÷5 years					
2at	Average Land clearance	17,492	tCO$_2$-e/yr		=2ao÷5 years					
2au	For Electricity purpose	56,376	tCO$_2$-e		=2ak	13,105	10,818	10,818	10,818	10,818
2av	For Stationary purpose	194,511	tCO$_2$-e		=2am+2al	45,406	37,276	37,276	37,276	37,276
2aw	For Transport purpose	975,336	tCO$_2$-e		=2an	195,067	195,067	195,067	195,067	195,067
2ax	Land clearance	87,461	tCO$_2$-e		=2ao	43,731	30,611	13,119	-	-
2ay	Average Scope 1 emissions	262,737	tCO$_2$-e/yr		=2ae÷5 years					
2az	Average Scope 3 emissions	13,124,430	tCO$_2$-e/yr		=2af÷5 years					
2ba	Average Energy production	64,003	GJ/yr		=2ah÷5 years					
2bb	Average Energy consumption	3,549,624	GJ/yr		=2ai÷5 years					
2bc	Total Diesel	451,505	kL		=97e	93,376	89,532	89,532	89,532	89,532
2bd	Total Electricity Generation	88,893	MWh		=74b÷1,000	17,779	17,779	17,779	17,779	17,779
2be	Total Iron Ore Product - Planned	50,000,000	Tonnes		=73	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000
2bf	Emissions intensity - Overall	0.02627	tCO$_2$-e/tonnes iron ore produced		=2ae÷2be	0.02973	0.02738	0.02563	0.02432	0.02432
2bg	Emissions intensity - Iron Ore Production	0.00373	tCO$_2$-e/tonnes iron ore produced		=2am÷2be	0.00373	0.00373	0.00373	0.00373	0.00373
2bh	Emissions intensity - Electricity	0.63420	tCO$_2$-e/MWh		=2ak÷2bd	0.73710	0.60847	0.60847	0.60847	0.60847

Appendix C Land Clearing Calculations

Land Clearing – Lost Carbon Sink

ITEM N°	ITEM	VALUE	UNITS	NOTE	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
SUMMARY										
30 –	Summary									
30a	- Land Clearing Emissions - Acacia Woodlands	16,489.22	tCO2-e		= 31m					
30b	- Land Clearing Emissions - Mallee Woodlands	16,489.22	tCO2-e		= 32m					
30c	- Land Clearing Emissions - Open Woodlands	51,255.64	tCO2-e		= 33m					
30d	- Land Clearing Emissions - Grasslands	3,226.95	tCO2-e		= 34m					
30e	- Total Land Clearing Emissions	87,461	tCO2-e		= SUM(30a:30d)					
30f	- Year 1 %	50%	%		GHG Emission Estimate Memo for Lamb Creek					
30g	- Year 2 %	35%	%		GHG Emission Estimate Memo for Lamb Creek					
30h	- Year 3 %	15%	%		GHG Emission Estimate Memo for Lamb Creek					
30i	**Total Land Clearing GHG Emissions (Lost carbon sink):**	**87,461**	**tCO_2-e**		***Spread over the LOM***	**43,731**	**30,611**	**13,119**	**-**	**-**

Appendix D Scope 3 Calculations

Scenario 1 (Base Scenario) – No Emission Reduction

ITEM N°	ITEM	VALUE	UNITS	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
SUMMARY									
Planned/expected operational throughput - 8 MTpa									
39 -	Total Scope 3 Emissions								
39a	- Capital Goods/Purchased Goods and Services	85,481	tCO_2-e	=44c	47,530	14,112	9,410	14,430	-
39b	- Fuel and Energy Related Activities	187,882	tCO_2-e	=45e	14,733	49,256	48,996	49,473	25,424
39c	- Downstream Transportation and Distribution	716,954	tCO_2-e	=46i	37,731	188,657	191,173	193,688	105,705
39d	- Processing of Sold Products	39,803,743	tCO_2-e	=47f	2,094,767	10,473,833	10,613,484	10,753,136	5,868,523
39e	- End-of-life Treatment of Sold Products	385,014	tCO_2-e	=48c	20,262	101,311	102,662	104,013	56,765
39f	**Total Scope 3 Emissions:**	**41,179,075**	**tCO_2-e**	=sum(39a:39e)	**2,215,024**	**10,827,170**	**10,965,726**	**11,114,740**	**6,056,417**
Maximum nameplate/nominal capacity - 10 Mtpa									
40 -	Total Scope 3 Emissions								
40a	- Capital Goods/Purchased Goods and Services	85,481	tCO_2-e	=39a	47,530	14,112	9,410	14,430	-
40b	- Fuel and Energy Related Activities	303,760	tCO_2-e	=49i	62,355	60,351	60,351	60,351	60,351
40c	- Downstream Transportation and Distribution	1,143,376	tCO_2-e	=50i	228,675	228,675	228,675	228,675	228,675
40d	- Processing of Sold Products	63,477,778	tCO_2-e	=51f	12,695,556	12,695,556	12,695,556	12,695,556	12,695,556
40e	- End-of-life Treatment of Sold Products	614,009	tCO_2-e	=52c	122,802	122,802	122,802	122,802	122,802
40f	**Total Scope 3 Emissions:**	**65,624,405**	**tCO_2-e**	=sum(40a:40e)	**13,156,917**	**13,121,496**	**13,116,794**	**13,121,814**	**13,107,384**

Scenario 2 – Solar PV System (1.7 MW)

ITEM N°	ITEM	VALUE	UNITS	COMMENT	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
SUMMARY									
Planned/expected operational throughput - 8 MTpa									
87 -	Total Scope 3 Emissions								
87a	- Capital Goods/Purchased Goods and Services	85,481	tCO_2-e	=92c	47,530	14,112	9,410	14,430	-
87b	- Fuel and Energy Related Activities	185,628	tCO_2-e	=93e	14,733	48,692	48,433	48,910	24,860
87c	- Downstream Transportation and Distribution	716,954	tCO_2-e	=94i	37,731	188,657	191,173	193,688	105,705
87d	- Processing of Sold Products	39,803,743	tCO_2-e	=95f	2,094,767	10,473,833	10,613,484	10,753,136	5,868,523
87e	- End-of-life Treatment of Sold Products	385,014	tCO_2-e	=96c	20,262	101,311	102,662	104,013	56,765
87f	**Total Scope 3 Emissions:**	**41,176,821**	**tCO_2-e**	=sum(87a:87e)	**2,215,024**	**10,826,606**	**10,965,162**	**11,114,176**	**6,055,853**
Maximum nameplate/nominal capacity - 10 Mtpa									
88 -	Total Scope 3 Emissions per Annum								
88a	- Capital Goods/Purchased Goods and Services	85,481	tCO_2-e	=87a	47,530	14,112	9,410	14,430	-
88b	- Fuel and Energy Related Activities	301,506	tCO_2-e	=97i	62,355	59,788	59,788	59,788	59,788
88c	- Downstream Transportation and Distribution	1,143,376	tCO_2-e	=50i	228,675	228,675	228,675	228,675	228,675
88d	- Processing of Sold Products	63,477,778	tCO_2-e	=40d	12,695,556	12,695,556	12,695,556	12,695,556	12,695,556
88e	- End-of-life Treatment of Sold Products	614,009	tCO_2-e	=40e	122,802	122,802	122,802	122,802	122,802
88f	**Total Scope 3 Emissions per Annum:**	**65,622,151**	**tCO_2-e**	=sum(88a:88e)	**13,156,917**	**13,120,933**	**13,116,230**	**13,121,250**	**13,106,820**

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