

Red Hill Mining Lease EIS

Road Impact Assessment

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Executive Summary

BM Alliance Coal Operations Pty Ltd (BMA) proposes to convert the existing Red Hill Mining Lease Application (MLA 70421) to enable the continuation of mining operations associated with the existing Goonyella, Riverside and Broadmeadow (GRB) mine complex. Specifically, the mining lease conversion will allow for:

- > An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM)
- > An incremental expansion of the existing Goonyella Riverside Mine (GRM)
- > A future incremental underground expansion option (the Red Hill Mine (RHM)) on the Red Hill Mining Lease.

As part of the Environmental Impact Statement (EIS) Cardno (Qld) Pty Ltd (Cardno) were commissioned to prepare a Road Impact Assessment to document the potential impacts of traffic associated with the Red Hill Mining Lease project components on the safety, efficiency and condition of the road network and, where appropriate, identify mitigation strategies.

This Road Impact Assessment is contained to the potential future GRM incremental expansion and the RHM underground expansion option. This assessment does not include the proposed extension to the BRM, as the extension will not intensify existing activities within BRM, the existing BRM workforce will complete the work associated with the extension and no additional infrastructure is proposed.

The timing for commencement, the rate of development and scale of future production for the GRM incremental expansion and RHM underground expansion option has not been determined and is subject to the owner's approvals. At full production, the future RHM mine has the potential to produce up to 14 million tonnes per annum (mtpa) of high quality hard coking coal over a life of 20 to 25 years. Under this scenario, the potential capacity of the extended complex (GRB mine complex and RHM) would be up to approximately 32.5mtpa. For the purposes of the EIS, the RIA adopts a scenario whereby construction commences in 2020, operations commence in 2022 and the operations continue for approximately 23 years.

Access to the EIS study area is proposed to be achieved via the existing Riverside Access Road access and via a new access point on Red Hill Road. Red Hill Road will also provide connection to the development of an accommodation village to support the proposed workforce. The exact location of the access to the proposed Red Hill accommodation village from Red Hill Road is still to be resolved following detailed engineering investigations.

The construction phase is anticipated to commence in 2020 and be completed by 2024. An estimated 2,000 peak person workforce will be required for the construction phase. BMA has advised that the construction workforce will be up to 100% remote and will be housed in the proposed Red Hill accommodation village. The construction workforce will be transported using buses between the project mine and infrastructure areas, Red Hill accommodation village and Moranbah Airport. A conservative allowance has however also been made for the purposes of traffic modelling within the assessment for some workers to drive to Mackay and beyond. The operation phase is anticipated to commence in 2023 and last until approximately 2044. The operations phase is anticipated to require a 1,500 peak person workforce which will be up to 100% remote and housed in the proposed Red Hill accommodation village. The operation workforce will be transported using buses between the mine and infrastructure areas, Red Hill accommodation village and Moranbah Airport. A conservative allowance has also been made within the assessment for some workers to drive to Mackay and beyond.

An overlap between construction and operational workforces has been also been assessed. BMA advised that there may be an overlap between construction and operation phases, with a workforce of up to 3,000 persons during this overlap period. An accommodation village capacity of 3,000 is proposed to account for this peak workforce arising out of the potential overlap between construction and operation phases.

Historical crash data for the roads north of Moranbah has been reviewed. No clear trends were present within the reviewed data that would indicate the presence of significant existing safety issues. In addition, no fatal crashes were observed.

An intersection scoping assessment was undertaken in accordance with the methodology outlined in the Department of Transport and Main Road's (TMR's) *Guidelines for the Assessment of Road Impacts of Development* (2006). This identified locations where associated traffic has the potential to have a significant impact. Detailed analysis of the performance of the scoped intersections and links was then undertaken to confirm if these road elements would continue to operate within standard performance thresholds at the assessed future design horizon years.

The analysis indicated the following road elements will continue to operate within standard thresholds for all design horizons with allowance for background growth including cumulative impacts:

- > Goonyella Road/Riverside Access Road intersection
- > Goonyella Road/Red Hill Road intersection
- > Goonyella Road (between Red Hill Road and Railway Overpass)
- > Goonyella Road between Riverside Access Road and Red Hill Road
- > Riverside Access Road between Goonyella Road and the EIS study area.

The Goonyella Road/Curtin Street intersection is anticipated to have the potential to be significantly impacted, with the need for an intersection upgrade to accommodate projected traffic. The Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections are likely to warrant upgrading regardless of the RHM underground expansion option and the GRM incremental expansion option proceeding. It is recommended that once the owner's investment decision has been made and prior to the commencement of construction, BMA engage with Isaac Regional Council regarding its plans to upgrade these intersections, and make a proportionate contribution towards the cost of the upgrade works (i.e. not fully fund).

The proponent's obligation towards pavement works has been assessed in accordance with TMR's guidelines. The pavement loading impact has been classified as 'insignificant' and therefore no proponent funded contribution towards pavement maintenance or rehabilitation works is warranted. It is industry standard practice in Queensland to classify the pavement impacts as insignificant where project activities will impact existing conditions by less than 5%.

In summary, the Road Impact Assessment has determined that the project will not generate any traffic impacts on the state-controlled, council-controlled or private road networks that are so significant that they should preclude approval of the EIS. The proponent's commitment to engage with the asset owners (prior to the commencement of construction) and establish proportionate contributions towards road capacity works are anticipated to fully offset all associated traffic impacts.

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1 Introduction

1.1 Road Impact Assessment Context

Cardno (Qld) Pty Ltd (Cardno) has been commissioned by URS Australia Pty Ltd (URS) to prepare the Road Impact Assessment component of the Environmental Impact Statement (EIS) for the Red Hill Mining Lease. The EIS has been prepared on behalf of the mine operator BM Alliance Coal Operations Pty Ltd (BMA). This assessment has been completed with regards to the draft terms of reference (ToR) supplied by BMA August 2013 for the Red Hill Mining Lease.

The Red Hill Mining Lease is located approximately 230 km southwest of Mackay by road. It is connected to Mackay via Riverside Access Road, Goonyella Road, Red Hill Road, Moranbah Access Road and the Peak Downs Highway. Riverside Access Road, Red Hill Road and Goonyella Road also provide connectivity between the existing operations, the Red Hill Mining Lease area and Moranbah, the most significant township in the vicinity of the project. Refer to the locality plans provided in Appendix A.

The proposed project will include the following:

- > The extension of Broadmeadow underground mine (BRM) longwall panels 14, 15, and 16 into MLA70421. Key aspects include:
 - No new mining infrastructure is proposed other than infrastructure required for drainage of incidental mine gas (IMG) to enable safe and efficient mining
 - Management of waste and water produced from drainage of IMG will be integrated with the existing BRM waste and water management systems
 - The mining of the BRM panel extensions is to sustain existing production rates of the BRM mine and will extend the life of mine (LOM) by approximately one year
 - The existing BRM workforce will complete all work associated with the extensions.
- > The incremental expansion of the Goonyella Riverside Mine (GRM). Key aspects include:
 - Underground mining associated with the RHM underground expansion option to target the Goonyella Middle Seam (GMS) on ML 1763
 - A new mine industrial area (MIA)
 - A coal, handling and processing plant (CHPP) adjacent to the Riverside MIA on MLA 1764 and ML 1900 – the Red Hill CHPP will consist of up to three 1,200 tonne per hour modules.
 - Construction of a drift for mine access
 - A conveyor system linking RHM to the Red Hill CHPP
 - Associated coal handling infrastructure and stockpiles
 - A new conveyor linking product coal stockpiles to a new rail load-out facility located on ML 1900
 - Means for providing flood protection to the mine access and MIA, potentially requiring a levee along the west bank of the Isaac River.
- > A potential new Red Hill underground mine expansion option to the east of the GRB mine complex, to target the GMS on MLA 70421. The proposed mine layout consists of a main drive extending approximately west to east with longwall panels ranging to the north and south. Other key aspects include:
 - A network of bores and associated surface infrastructure over the underground mine footprint for mine gas pre-drainage and management of goaf methane drainage to enable the safe extraction of coal
 - A ventilation system for the underground workings
 - A bridge across the Isaac River for all-weather access. This will be located above the main headings, and will also provide a crossing point for other mine related infrastructure including water pipelines and power supply
 - A new accommodation village (Red Hill accommodation village) for the up to 100% remote construction and operational workforces with capacity for up to 3,000 workers
 - Potential production capacity of 14mtpa of high quality hard coking coal over a life of 20 to 25 years.

To inform this Road Impact Assessment, an inspection of the existing road network was undertaken in February 2011. In addition to the inspection, data pertaining to the existing condition of various roads has been sourced from the Department of Transport and Main Roads (TMR) and Isaac Regional Council (IRC). This includes data relating to existing traffic volumes, the existing pavement condition, existing school bus routes and historic crashes, as well as information pertaining to planned future road works. To supplement the information received from the road authorities, traffic counts were also independently undertaken at a number of intersections in May 2013 .

Information pertaining to the traffic generating activities likely to be associated with the GRM incremental expansion and the RHM underground expansion option was sourced from BMA. This Road Impact Assessment addresses the impacts of road-based transport associated with these two project elements. Impacts associated with other transport modes (i.e. rail, air and sea) do not form part of this technical study.

1.2 Road Impact Assessment Methodology

This study has been carried out in accordance with the ToR, specifically utilising TMR's *Guidelines for Assessment of Road Impacts of Development* (2006) which identify the procedure for assessing the road impacts of a development in Queensland. The objective of the assessment documented herein is to identify the impact on the state-controlled, council-controlled and private road networks (open to the public) and, where appropriate, identify mitigation strategies.

The road impacts assessed as part of this study include any significant impacts on the performance of external road links or intersections, pavement loading impacts or road safety impacts. Traffic operation impacts have been assessed up to the ten year design horizon following commencement of the operation phase. Pavement impacts have been assessed during the construction and operation phases (i.e. 2020 to approximately 2044). To identify the road impacts, the following tasks were undertaken:

- > Inspection of the road network including a broad safety assessment of Moranbah Access Road, Goonyella Road, Red Hill Road and Riverside Access Road
- > Collation of data describing the existing road conditions from various road authorities
- > Interrogation of the crash data provided for Goonyella Road, Red Hill Road and Riverside Access Road
- > Review of historic traffic growth patterns and future population projections for the Isaac region
- > Forecast traffic volume growth across the road network in the absence of the proposed activities
- > Source details from the proponent regarding the traffic generating activities likely to be associated with the proposed activities
- > Forecast the likely traffic generation during both its construction phase and operation phase
- > Identify the spatial extents over which associated traffic has the potential to significantly impact network performance
- > Assess the future operation of all intersections and links classified as potentially being significantly impacted by associated traffic
- > Identify strategies to avoid, minimise and mitigate any significant road network performance impacts associated with traffic generation
- > Identify the potential for significant pavement maintenance or rehabilitation impacts associated with traffic generation
- > Identify the potential impact on the existing sustainable transport (i.e. pedestrian, cycle and public transport) infrastructure
- > Identify the regulations and guidelines likely to govern associated project material movements.

The following items which have been identified in the ToR have not been specifically addressed within this Road Impact Assessment:

- > The construction of any related plant and utilities within or impacting on the jurisdiction of any transport authority
- > Likely heavy, oversize and indivisible loads (volume, composition, timing and routes) highlighting any vulnerable bridges and structures along proposed routes.

It is considered that the above items can be conditioned and be better addressed in a Road Use Management Plan following approval of the EIS when the project owners determine to proceed with the project and undertake detailed design, award construction contracts and finalise quantities and logistics. It is therefore anticipated that the proponent would be required to prepare a Road Use Management Plan addressing these items at the detailed design stage.

2 Traffic Context

2.1 Existing Operations

BMA operates the existing GRB mine complex. The GRB mine complex is currently producing at a rate of approximately 14.5 million tonnes per annum (mtpa) based on a life of mine (LOM) of 57 years with an existing approval to increase the rate of mining to a maximum of 18.5 mtpa of product coal.

The existing GRM is an open-cut operation. The existing BRM is a punch longwall underground mine which has been developed off an existing highwall of the open-cut operation. Following processing on-site, the product coal is currently transported by rail to the BMA owned Hay Point Coal Terminal south of Mackay from which it is shipped to overseas markets.

2.2 Project Overview

BMA proposes to expand its current coal mining operations with the development of a new greenfield underground mine called the RHM and associated incremental expansion of GRM. The development of the RHM has the potential to increase BMA's approved production capacity by 14mtpa to approximately 32.5 mtpa.

2.3 Road Realignments

Separate to any planning approvals required, realignment of Red Hill Road may be required to allow for the progression of mining from west to east. The design of any road realignments will be in accordance with the guidelines, standards and thresholds appropriate for the function and use of the roads.

2.4 Site Access

The GRB mine complex currently achieves access to the external road network at three locations: Goonyella Road (to the Goonyella Industrial Area); Riverside Access Road (to the Riverside Industrial Area); and Red Hill Road (to the Broadmeadow Underground Administration Area). The majority of additional traffic will use Red Hill Road. In addition, some increased traffic will be expected on the Riverside Access Road to support the construction and operation of the new Red Hill CHPP, depicted in Appendix A.

2.5 Stock Routes

The stock route alignment will need ongoing management as mining progresses in an easterly direction. BMA has undertaken consultation with the Department of Natural Resources and Mines (NRM) and landowner to agree an appropriate alignment for the stock route. The potential realignments are detailed at Appendix A.

2.6 Red Hill Accommodation Village

Connection to the proposed accommodation village is planned via Red Hill Road, as shown at Appendix A. The exact location of the supporting access to the Red Hill accommodation village is still to be resolved following detailed engineering investigations. The traffic analysis has assumed that all workforce movements will occur to or from this location.

2.7 Network Operation Assessment Scenarios

Traffic volumes and patterns associated with the construction phase will be experienced from 2020 to 2023 while traffic volumes and patterns associated with the operation phase will be experienced from 2022 to approximately 2044. Consistent with typical practice within Queensland, the future performance of the road network has been assessed for the first year of the construction phase, the first year of the operation phase and the ten year design horizon following the commencement of operations. In addition, an overlap scenario during 2023 has been considered where construction is occurring while operations have commenced.

The years adopted for the Road Impact Assessment are therefore:

- > 2013 Traffic survey year (provides validation of road performance models)
- > 2020 First year of construction phase
- > 2023 Overlap scenario (final year of construction phase)
- > 2024 First year of exclusive operations activities phase
- > 2034 Ten year horizon following commencement of operation.

Pavement impacts on the state-controlled road network have been considered for the full potential life of construction and operations between 2020 and approximately 2044. The future performance of the road network is documented in Sections 6 and 7.

3 Existing Road Network

3.1 Peak Downs Highway

The Peak Downs Highway is a state-controlled road which extends approximately 276 km from Mackay to Clermont. It functions as a major link within the IRC area, providing the primary road connection between a number of townships and mines within Central Queensland and the regional hub of Mackay.

The Peak Downs Highway between Nebo and Moranbah Access Road typically comprises a sealed, undivided, two lane cross-section with a seal width of approximately 9 m. The Annual Average Daily Traffic (AADT) volume on the subject section of the Peak Downs Highway is typically in the range of 3,000 vehicles per day (vpd) in the vicinity of Moranbah Access Road. The Peak Downs Highway generally has a posted speed limit of 100 km/h although the limit decreases in proximity to urban areas.

The Peak Downs Highway and other key roads servicing the development are shown in Appendix A.

3.2 Moranbah Access Road

Moranbah Access Road is a council-controlled road. It extends approximately 12 km north from the Peak Downs Highway to its intersection with Mills Avenue in Moranbah, providing the only route between the township and the Peak Downs Highway. Moranbah Access Road is an undivided, sealed, two lane road with sealed shoulders. There are no overtaking lanes on this road. The AADT volume on Moranbah Access Road south of Moranbah typically ranges between 4,800 vpd and 6,000 vpd.

The posted speed limit is generally 100 km/h, although it reduces in proximity to Moranbah.

3.3 Goonyella Road

Goonyella Road extends approximately 26 km north from Mills Avenue in Moranbah to the GRB mine complex providing the only route between the mine and town. Goonyella Road is an undivided, sealed, two lane road with no overtaking lanes. Goonyella Road is a council-controlled road between Mills Avenue and the Railway Overpass (Blair Athol Railway line crossing). North of the railway line, the road is controlled and maintained by BMA.

The posted speed limit is generally 100 km/h although this decreases in proximity to major intersections, the Goonyella Industrial Area and Moranbah.

3.4 Red Hill Road

Red Hill Road is predominately a council-controlled road, however BMA controls and maintains a short section through the mining lease area. It extends approximately 35 km north from its intersection with Goonyella Road to its intersection with Suttor Developmental Road. Between Goonyella Road and the Broadmeadow Mine Access Road, Red Hill Road is an undivided, sealed, two lane road. From the Broadmeadow Mine Access Road north to Suttor Developmental Road, Red Hill Road is unsealed. There are no overtaking lanes on Red Hill Road and in addition, unfenced livestock are present. The posted speed limit is generally 100 km/h.

3.5 School Bus Routes

School bus routes currently use the Peak Downs Highway and Moranbah Access Road to service schools in Moranbah. School start and end times do not however, correspond with the start and end of mine shifts (i.e. the peak traffic generation period) and the volumes of goods deliveries during school bus times is typically relatively low and not expected to significantly impact on the safety and operations of the school bus routes.

3.6 Road Crash History

Crash data has been obtained from the TMR for the following time periods dependant on crash severity:

- > Fatal: 1 January 2006 to 30 April 2013
- > Hospitalisation: 1 January 2006 to 31 December 2012
- > Non serious crashes: 1 January 2006 to 31 December 2010

The location and severity of the crashes north of Moranbah is summarised at Appendix B. Due to mining activity north of Moranbah, there have been changes to the alignment of various roads over time, including Goonyella Road. Some of the data received from TMR misidentified crash locations on the former alignment of Goonyella Road and Red Hill Road. Advice from TMR officers was to estimate the crash location based upon the existing alignment of Goonyella Road and Red Hill Road and the crash description.,

Table 3-1 provides a summary of the severity of crashes for the road network in the vicinity of EIS study area as depicted in Appendix B.

Table 3-1 Summary of Crash Statistics

| Crash Severity | Number of Crashes | % |
|---|-------------------|-------------|
| Fatal (1 Jan 06 to 30 Apr 2013) | 0 | 0% |
| Hospitalisation (1 Jan 06 to 31 Dec 12) | 5 | 28% |
| Medical treatment (1 Jan 06 to 31 Dec 10) | 5 | 28% |
| Minor injury (1 Jan 06 to 31 Dec 10) | 3 | 16% |
| Property damage (1 Jan 06 to 31 Dec 10) | 5 | 28% |
| TOTAL | 18 | 100% |

3.7 Road Network Planning

TMR's *Queensland Transport and Roads Investment Program 2012-2013 to 2015-2016* (QTRIP) has allocated \$24 million over the next financial year to improvements to roadside delineation along the Peak Downs Highway between Clermont and Nebo.

An upgrade of the Peak Downs Highway/Moranbah Access Road intersection to include a "seagull treatment" (where separate lanes for both right and left turns are provided) is understood to be close to completion at the time of report preparation. This treatment provides additional capacity for the right turn movement out of Moranbah Access Road.

Cardno is not aware of any formalised planning undertaken by IRC in relation to the upgrade of either Goonyella Road/Curtin Street or Goonyella Road/Moranbah Access Road/Mills Avenue intersections, the future operation of which is documented later in this report.

4 Historic and Future Background Traffic Volumes

4.1 Existing Traffic Volumes

Surveys of existing intersection traffic volumes were undertaken by Austraffic during June 2013. Survey data is included in Appendix C.

4.2 Traffic Growth Forecast

Various data sources were considered when forecasting likely baseline traffic growth over the assessment period. The review included consideration of data detailing historic traffic growth as well as consideration of population predictions for Moranbah Statistical Area (Level 2 - ASGS Code 312011341) (OESR 2011a, b) as documented in Table 4-1.

Table 4-1 Moranbah Statistical Area Population Projections

| Series | Rate | Time Span | Source |
|--------------------------------------|------|----------------------|------------|
| Projected FTE population | 8.4% | 7 years (2011-2018) | OESR 2011a |
| Projected population – medium series | 3.6% | 20 years (2011-2031) | OESR 2011b |

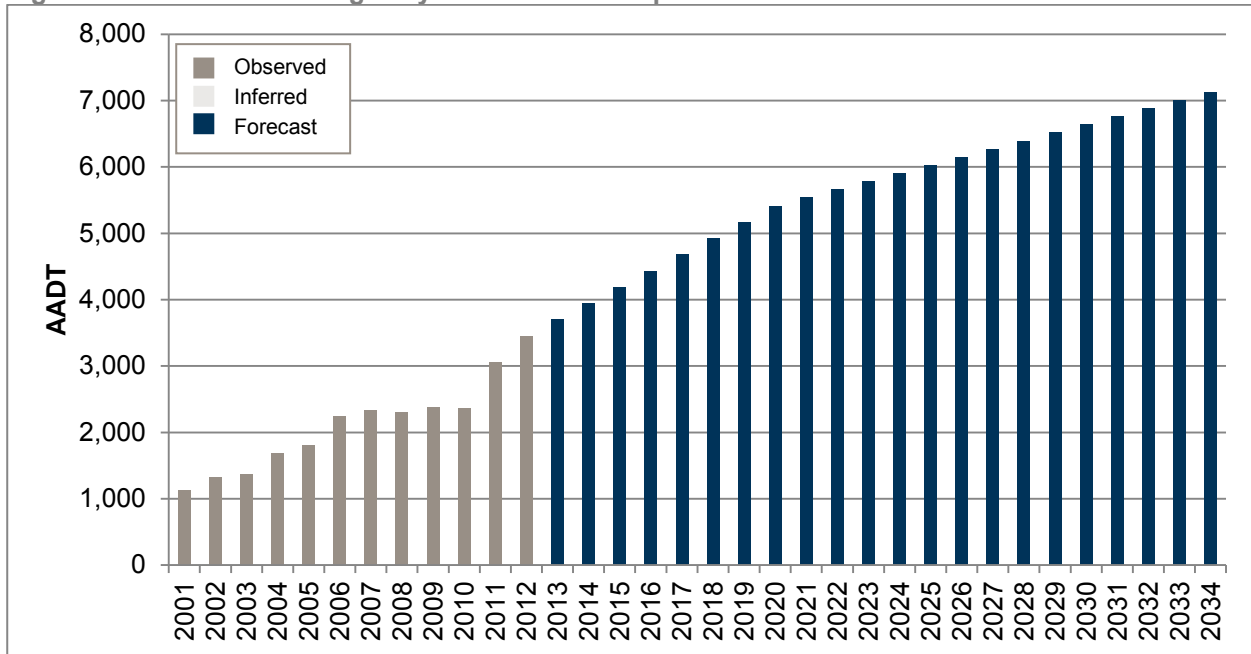
Furthermore the traffic assessments prepared for other nearby projects were considered including Isaac Plains South (previously known as Integrated Isaac Plains Project), Eagle Downs, Caval Ridge and Grosvenor.

Table 4-2 summarises the baseline traffic growth rates adopted by Cardno based upon review of the various summarised data sources. The adopted growth rates compared to historical observed traffic growth on each road is shown in Figures 4-1 and 4-2.

Table 4-2 Adopted Traffic Growth Rates

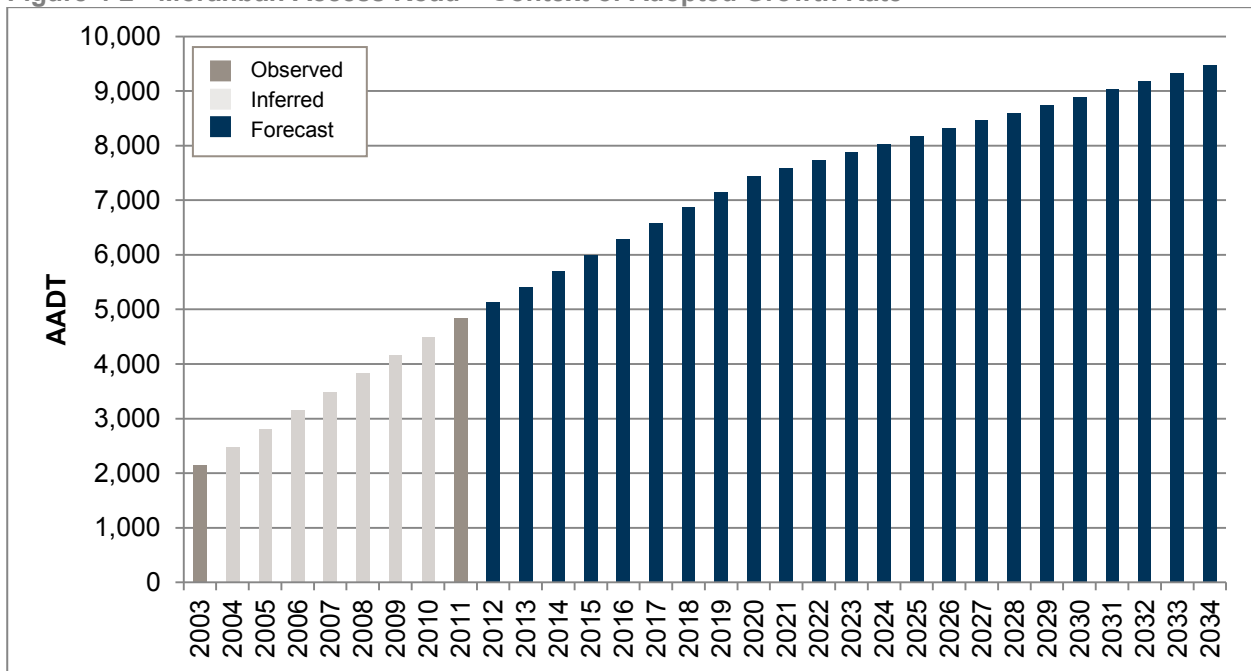
| Road | Rate | Time Span | Rate | Time Span |
|---|------|--------------|------|--------------|
| Peak Downs Highway | 8% | 2012 to 2020 | 4% | 2020 to 2034 |
| Moranbah Access Road and Goonyella Road (Mills Avenue to Curtin Street) | 6% | 2012 to 2020 | 3% | 2020 to 2034 |
| Goonyella Road (north of Curtin Street) | 1% | 2012 to 2020 | 1% | 2020 to 2034 |

Figure 4-1 Peak Downs Highway – Context of Adopted Growth Rate



Source: TMR (2013)

Figure 4-2 Moranbah Access Road – Context of Adopted Growth Rate



Source: IRC (2012)

5 Project Traffic Generation

The additional traffic generation has been forecast separately for both the construction phase and the operation phase. The additional traffic generated by the two phases is documented in Sections 5.1 and 5.2 respectively.

5.1 Construction Phase Traffic Generation

The construction phase is anticipated to commence in 2020 and be completed by the end of 2023. Most construction activities will occur 24 hours per day, seven days per week across two shifts daily of 12 hours duration each.

Activities undertaken during the three general stages of construction are planned to include:

- > Site preparation including the removal of existing structures, establishment of power supplies and the construction of a site office, emergency facilities and gas drainage infrastructure.
- > Provision of supporting civil works including earthworks, drainage installation, road re-alignment and construction, trenching and laying of reticulated services, ramps and hardstand construction.
- > Construction of MIA buildings and the Red Hill CHPP. Where practical and cost-effective, these facilities will consist of modularised units.

5.1.1 Construction Phase Workforce Movements

A peak construction workforce of up to 2,000 persons will be required during the construction phase based on current assumptions. BMA has advised that the construction workforce will be up to 100% remote, likely working a three weeks-on/one week-off roster and will be accommodated at the purpose built Red Hill accommodation village. Based on the assessed shift and rostering arrangements, approximately 37.5% of the construction phase workforce will be working onsite at any time, resulting in approximately 750 personnel arriving and 750 personnel departing the EIS study area at shift change-over.

While BMA has advised that the majority of the workforce will arrive via Moranbah Airport, allowance has been made for an estimated 75% of the construction workforce to transit through Moranbah Airport at the start and end of the three weeks-on/one week-off roster while 25% are assumed to transit through Mackay. Based on the assessed roster, it is assumed that 71 personnel arrive and 71 personnel depart the Red Hill accommodation village each day. Those travelling via Moranbah Airport have been assumed to utilise chartered bus services (20 person occupancy) to travel between the Red Hill accommodation village and Moranbah Airport. Those travelling to Mackay or beyond have been assumed to use light vehicles (single-occupant). Table 5-1 summarises the trips estimated for construction phase workforce movements.

Table 5-1 Construction Phase Project Workforce Movements

| Trip Type | One-way Trips per Peak Hour | |
|--|--------------------------------|-------------------------------------|
| | Buses (20 person occupancy) | Light Vehicles (Single Occupant) |
| Red Hill accommodation village ↔ EIS study area <i>Start/end shift trips</i> | 76 | - |
| Red Hill accommodation village ↔ Moranbah Airport <i>Start/end roster trips</i> | 6 | - |
| Red Hill accommodation village ↔ Mackay <i>Start/end roster trips</i> | - | 18 |
| Total | 82 | 18 |

For traffic modelling purposes, a factor of safety allowance has been made for a nominal 75 trips each way during peak hour from Moranbah to the EIS study area during the construction phase. It is stressed that this factor of safety allowance has been made for traffic modelling purposes only.

5.1.2 Construction Phase Material Movements

The quantum of traffic movements associated with the delivery and removal of materials and wastes during the construction phase has been forecast. This is based on the material quantity estimates and origins supplied by BMA and their design team. Table 5-2 summarises the additional daily material movements to and from the EIS study area during the 28 month construction phase used for design purposes.

Table 5-2 Construction Phase Material Movements

| Movement Origin/Destination | Daily Return Trips |
|-----------------------------|--------------------|
| Mackay | 2 |
| Moranbah | 17 |
| Total | 19 |

The assessed project material demands as forecast by the design team are summarised in Appendix D.

For the operational assessment, a nominal allowance has been made for ten trips during the morning (AM) and afternoon (PM) peak hour. It is anticipated that the majority of deliveries would occur outside peak times, so this nominal allowance caters for any deliveries that may occur during peak times.

5.2 Operation Phase Traffic Generation

The operation phase is anticipated to commence in 2023 and continue until approximately 2044. The majority of traffic movements generated during this phase are anticipated to be associated with workforce movements and material deliveries.

5.2.1 Operation Phase Workforce Movements

A total operation workforce of 1,500 persons beyond the existing workforce associated with the existing operation of the mine will be required based on current assumptions. BMA has advised that the additional operation workforce will be up to 100% remote, working a seven days-on/seven days-off roster and will be accommodated at a purpose built Red Hill accommodation village. Based on the assessed shift and rostering arrangements, approximately 25% of the operation phase workforce will be working onsite at any time, resulting in approximately 375 personnel arriving and 375 personnel departing the EIS study area at shift change-over.

While BMA has advised that the majority of the workforce will arrive via Moranbah Airport, allowance has been made for an estimated 75% of the construction workforce to transit through Moranbah Airport at the start and end of the assessed seven days-on/seven days-off roster while 25% are assumed to transit through Mackay. Based on the assessed roster, it is assumed that 107 personnel arrive and 107 personnel depart the Red Hill accommodation village each day. Those travelling via Moranbah Airport have been assumed to utilise chartered bus services (20 person occupancy) to travel between the Red Hill accommodation village and Moranbah Airport. Those travelling to Mackay or beyond have been assumed to use light vehicles (single-occupant).

Table 5-3 Operation Phase Project Workforce Movements

| Trip Type | One-way Trips per Peak Hour | |
|--|--------------------------------|-------------------------------------|
| | Buses (20 person Occupancy) | Light Vehicles (Single Occupant) |
| Red Hill accommodation village ↔ EIS study area <i>Start/end shift trips</i> | 38 | - |
| Red Hill accommodation village ↔ Moranbah Airport <i>Start/end roster trips</i> | 8 | - |
| Red Hill accommodation village ↔ Mackay <i>Start/end roster trips</i> | - | 27 |
| Total | 46 | 27 |

For traffic modelling purposes, a factor of safety allowance has been made for a nominal 75 trips each way during peak hour from Moranbah to the EIS study area during the construction phase. It is stressed that this factor of safety allowance has been made traffic modelling purposes only.

5.2.2 Operation Phase Material Movements

The quantum of traffic movements associated with the delivery and removal of materials and wastes during the operation phase has been forecast based on the material quantity estimates and origins supplied by BMA and their design team. Table 5-4 summarises the average additional daily material movements to and from the EIS study area during the operation phase between 2023 and approximately 2044.

Table 5-4 Operation Phase Material Movements

| Movement Origin/Destination | Daily Return Trips |
|-----------------------------|--------------------|
| Mackay | 2 |
| Moranbah | 1 |
| Total | 3 |

The assessed project material demands as forecast by the design team are summarised at Appendix D.

For the operational assessment, a nominal allowance has been made for ten trips during the AM and PM peak hour. It is anticipated that the majority of deliveries would occur outside peak times, so this nominal allowance caters for any deliveries that may occur during peak times.

5.3 Overlap Scenario

Based on advice from BMA, an overlap scenario has also been considered where the construction workforce overlaps with operations staff as operation activities start to commence and construction activities ramp down. For the purposes of the traffic assessment, the overlap scenario has been assumed to include the 2,000 peak construction workforce as well as 1,000 persons from the operations workforce. This results in a potential overlap workforce of 3,000.

5.4 Assessment Volumes

Traffic volume forecasts for 2022, 2023, 2024 and 2034 with and without project traffic are shown at Appendix C.

6 Network Performance Assessment

A link level of service (LOS) assessment has been undertaken on the key road sections of Goonyella Road north of the rail overpass and Riverside Access Road. This assessment has been undertaken in accordance with the Austroads (1988) Guide to Traffic Engineering Practice Part 2: Roadway Capacity manual. The assessed road sections represent those that are rural in nature and are hence dictated by the LOS of the road link rather than the associated intersections.

In accordance with the guide, the level of service has been determined for each assessed link section based on design peak hour volumes. Typically, LOS C is the worst accepted level for rural roads not affected by recreational peaks. The adopted threshold limits for LOS are shown in Table 6-1, while Table 6-2 shows a summary of the LOS assessment for each of the assessment scenarios. The vehicles per hour volumes include both light and heavy vehicles.

Table 6-1 Level of Service Thresholds

| LOS | LOS Description | Peak Hour Traffic Volumes (vph) |
|-----|--|---------------------------------|
| A | Free flow conditions where drivers are unaffected by the presence of others in the traffic stream. | < 241 |
| B | Stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. | < 480 |
| C | Stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre. | < 793 |
| D | Close to the limit of stable flow and is approaching unstable flow. Drivers are severely restricted to select their speed and manoeuvre. | < 1,347 |
| E | Traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre. | < 2,285 |
| F | Forced flow. Traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs. | ≥ 2,285 |

Table 6-2 Level of Service Assessment Results Summary

| Road | Section | Survey | 2020 BKG | 2023 BKG | 2024 BKG | 2034 BKG |
|-----------------------|---------------------------------------|--------|--------------|----------------|------------|------------|
| Goonyella Road | Red Hill Road - Railway Overpass | B | B | C | C | C |
| Goonyella Road | Riverside Access Road - Red Hill Road | B | B | B | B | B |
| Riverside Access Road | Goonyella Road - Mine | B | B | B | B | B |
| Road | Section | | 2020 + Const | 2023 + Overlap | 2024 + Ops | 2034 + Ops |
| Goonyella Road | Red Hill Road - Railway Overpass | - | C | C | C | C |
| Goonyella Road | Riverside Access Road - Red Hill Road | - | B | B | B | B |
| Riverside Access Road | Goonyella Road - Mine | - | B | B | B | B |

Note: 'BKG' = Background; 'Const' = Construction; and 'Ops' = Operations

The results presented in Table 6-2 indicate that Goonyella Road, from the EIS study area to Red Hill Road, operates appropriately (i.e. LOS C and better) for all assessed scenarios.

7 Intersection Design and Operation

A traffic operation assessment has been undertaken to determine the impact of the GRM incremental expansion and the RHM underground expansion option on the performance of the state, council and privately controlled intersections.

7.1 Assessment Traffic Volumes

For the purposes of this assessment, it has conservatively been assumed that the road network peak periods and project's peak traffic generation periods will coincide. This assumption is conservative and provides TMR and IRC assurance that, irrespective of eventual shift times adopted, the performance of the road network should be no worse than that reported herein.

7.2 Intersection Assessment Scope

TMR's (2006) *Guidelines for the Assessment of Road Impacts of Development* states that traffic operations need to be considered for all state-controlled assets where the construction or operation traffic generated by a proposed development equals or exceeds 5% of the existing AADT, for any intersection movement or mid-block volume. This stipulated methodology has also been utilised to determine the assessment scope for council-controlled assets consistent with the advice historically provided by IRC officers.

In accordance with the scoping guidelines, the impact on the following intersections has been considered:

- > Goonyella Road/Riverside Access Road intersection
- > Goonyella Road/Red Hill Road intersection
- > Goonyella Road/Curtin Street intersection
- > Goonyella Road/Moranbah Access Road/Mills Avenue intersection
- > Peak Downs Highway/Moranbah Access Road intersection

This assessment scope includes all major intersections at which construction or mining operation phases are anticipated to increase any movement volume by 5% or more beyond existing (2013) survey volumes. The use of existing volumes as opposed to future background volumes to define the extent of investigations ensures that the assessment scope is independent of the assumed background growth rate. The use of existing volumes for scoping is also consistent with TMR's assessment guidelines. The scoping assessment is summarised at Appendix C.

Traffic conditions have been assessed for the years:

- > 2013 Traffic survey year (provides validation of road performance models)
- > 2020 First year of construction phase
- > 2023 Overlap scenario (final year of construction phase)
- > 2024 First year of exclusive operations activities phase
- > 2034 Ten year horizon following commencement of operations

For all assessment years, analysis has been completed both with and without project associated traffic scenarios. This is so the marginal impact on the safe and efficient operation of the state and council-controlled road networks can be determined.

7.3 Intersection Operation Performance Thresholds

The traffic operation of each study intersection has been analysed with and without projected traffic using SIDRA Intersection 5.1 (referred to herein as SIDRA). This program is a micro-analytical traffic evaluation tool that estimates the capacity, and in turn, the performance of intersections based on input parameters, including geometry and traffic volumes. As an output, SIDRA provides estimates of an intersection's degree of saturation (DOS), queues and delays.

In the Guidelines for Assessment of Road Impacts of Development (2006), TMR defines the following standard DOS thresholds:

- > Priority-controlled intersections 0.80
- > Roundabouts 0.85
- > Signalised intersections 0.90.

The TMR guidelines note that a DOS exceeding these values indicates that an intersection is nearing its practical capacity and upgrade works may be required. Above these threshold values, users of the intersection are likely to experience rapidly increasing delays and queuing.

7.4 Intersection Operation Assessment

7.4.1 Goonyella Road/Riverside Access Road Intersection

The Goonyella Road/Riverside Access Road intersection is currently a priority-controlled T-intersection with a formalised right turn bay on the northern Goonyella Road approach. Figure 7-1 to Figure 7-3 show each leg of the existing intersection.

Figure 7-1 Goonyella Road/Riverside Access Road Intersection: Northern Goonyella Road Approach – Looking North



Figure 7-2 Goonyella Road/Riverside Access Road Intersection: Southern Goonyella Road Approach - Looking South



Figure 7-3 Goonyella Road/Riverside Access Road Intersection: Western Riverside Access Road Approach - Looking West



Intersection Operation

Figure 7-4 shows the existing intersection form as output by SIDRA with summary results provided in Table 7-1

Figure 7-4 Goonyella Road/Riverside Access Road Intersection: Assessed SIDRA Layout – Existing Form

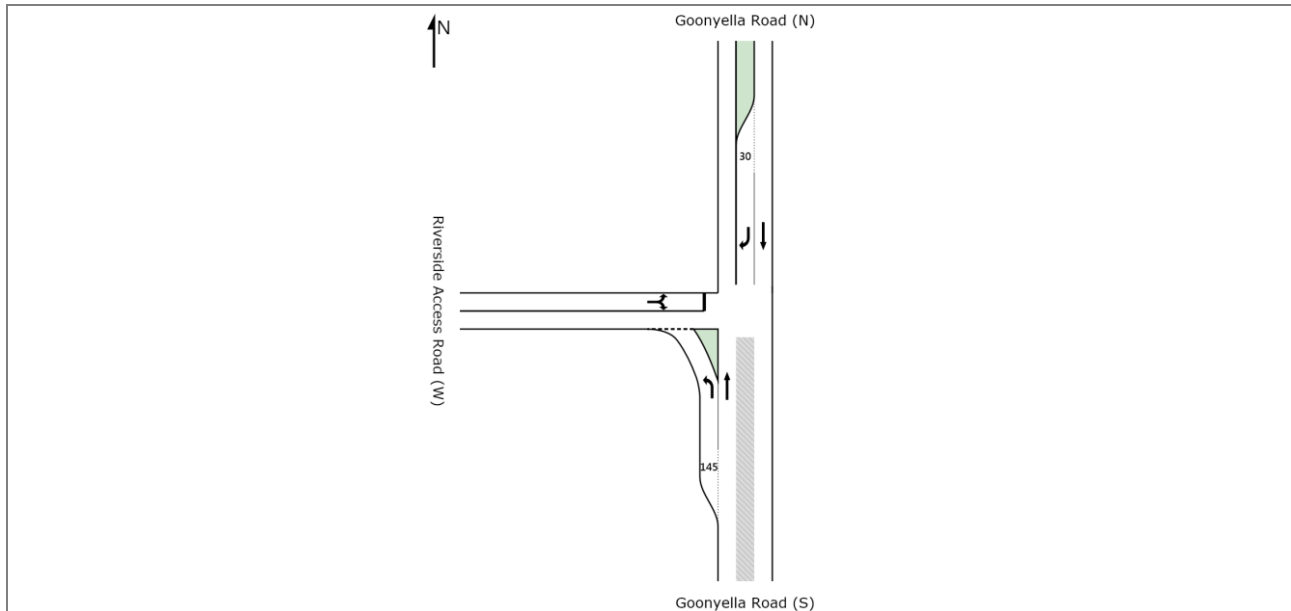


Table 7-1 Goonyella Road/Riverside Access Road Intersection: SIDRA Analysis Summary - Existing Form

| Scenarios | AM Peak | | | PM Peak | | |
|------------------------------|---------|----------------|-----------------------------|---------|----------------|-----------------------------|
| | DOS | Critical Delay | 95 th %ile Queue | DOS | Critical Delay | 95 th %ile Queue |
| 2013 Survey | 0.25 | 14 | 8 | 0.23 | 14 | 7 |
| 2020 Without Project | 0.26 | 14 | 9 | 0.25 | 14 | 7 |
| 2023 Without Project | 0.27 | 14 | 9 | 0.26 | 14 | 8 |
| 2024 Without Project | 0.28 | 14 | 9 | 0.26 | 14 | 8 |
| 2034 Without Project | 0.30 | 14 | 11 | 0.29 | 14 | 9 |
| 2020 With Construction Phase | 0.27 | 14 | 9 | 0.26 | 14 | 8 |
| 2023 With Overlap | 0.28 | 14 | 10 | 0.27 | 14 | 8 |
| 2024 With Operation Phase | 0.28 | 14 | 10 | 0.27 | 14 | 8 |
| 2034 With Operation Phase | 0.31 | 14 | 11 | 0.30 | 14 | 9 |

The summarised SIDRA analysis results presented in Table 7-1 indicate that the subject intersection will perform acceptably at all design horizons irrespective of the RHM underground expansion option and associated GRM incremental expansion proceeding. No intersection upgrades are therefore warranted based on capacity considerations.

7.4.2 Goonyella Road/Red Hill Road Intersection

The Goonyella Road/Red Hill Road intersection is a priority-controlled intersection with a formalised right turn lane on the southern Goonyella Road approach. Figure 7-5 to Figure 7-7 show each leg of the existing intersection.

Figure 7-5 Goonyella Road/Red Hill Road Intersection: Northern Goonyella Road Approach - Looking North



Figure 7-6 Goonyella Road/Red Hill Road Intersection: Eastern Red Hill Road Approach - Looking East



Figure 7-7 Goonyella Road/Red Hill Road Intersection: Southern Goonyella Road Approach - Looking South



Intersection Operation

Figure 7-8 shows the existing intersection form as output by SIDRA with summary results provided in Table 7-2.

Figure 7-8 Goonyella Road/Red Hill Road Intersection: Assessed SIDRA Layout – Existing Form

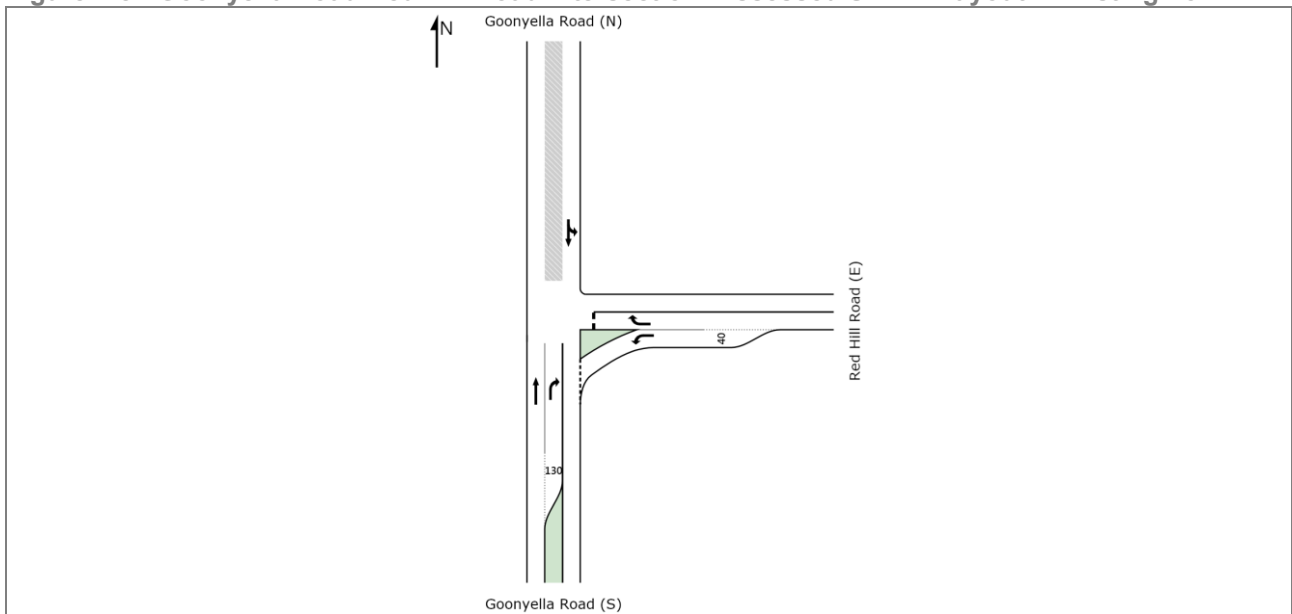


Table 7-2 Goonyella Road/Red Hill Road Intersection: SIDRA Analysis Summary – Existing Form

| Scenarios | AM Peak | | | PM Peak | | |
|------------------------------|---------|----------------|-----------------------------|---------|----------------|-----------------------------|
| | DOS | Critical Delay | 95 th %ile Queue | DOS | Critical Delay | 95 th %ile Queue |
| 2013 Survey | 0.18 | 14 | 3 | 0.12 | 13 | 3 |
| 2020 Without Project | 0.19 | 14 | 3 | 0.13 | 13 | 4 |
| 2023 Without Project | 0.20 | 15 | 3 | 0.13 | 13 | 4 |
| 2024 Without Project | 0.20 | 15 | 3 | 0.13 | 13 | 4 |
| 2034 Without Project | 0.22 | 15 | 3 | 0.14 | 13 | 4 |
| 2020 With Construction Phase | 0.20 | 16 | 5 | 0.22 | 14 | 7 |
| 2023 With Overlap | 0.20 | 16 | 5 | 0.22 | 14 | 7 |
| 2024 With Operation Phase | 0.20 | 16 | 5 | 0.23 | 14 | 7 |
| 2034 With Operation Phase | 0.22 | 17 | 6 | 0.24 | 14 | 8 |

The summarised SIDRA analysis results presented in Table 7-2 indicate that the subject intersection will perform acceptably at all design horizons irrespective of the RHM underground expansion option and associated GRM incremental expansion proceeding. No intersection upgrades are therefore warranted based on capacity considerations.

7.4.3 Goonyella Road/Curtin Street Intersection

The Goonyella Road/Curtin Street intersection is a priority-controlled T-intersection with a formalised right turn bay on the southern Goonyella Road approach.

Curtin Street functions as a northern access point between Moranbah town centre and Goonyella Road via Belyando Avenue. Vehicle demands at this intersection are currently moderate. It is anticipated however, that this intersection will become increasingly utilised, as the alternative Mills Avenue/Goonyella Road/Moranbah Access Road intersection becomes increasingly busier with expected traffic growth. Figure 7-9 to Figure 7-11 show each leg of the existing intersection.

Figure 7-9 Goonyella Road/Curtin Street Intersection: Northern Goonyella Road Approach - Looking North



Figure 7-10 Goonyella Road/Curtin Street Intersection: Eastern Curtin Street Approach - Looking East



Figure 7-11 Goonyella Road/Curtin Street Intersection: Southern Goonyella Road Approach - Looking South



Intersection Operation

Figure 7-12 shows the existing intersection form as output by SIDRA with summary results provided in Table 7-3.

Figure 7-12 Goonyella Road/Curtin Street Intersection: Assessed SIDRA Layout – Existing Form

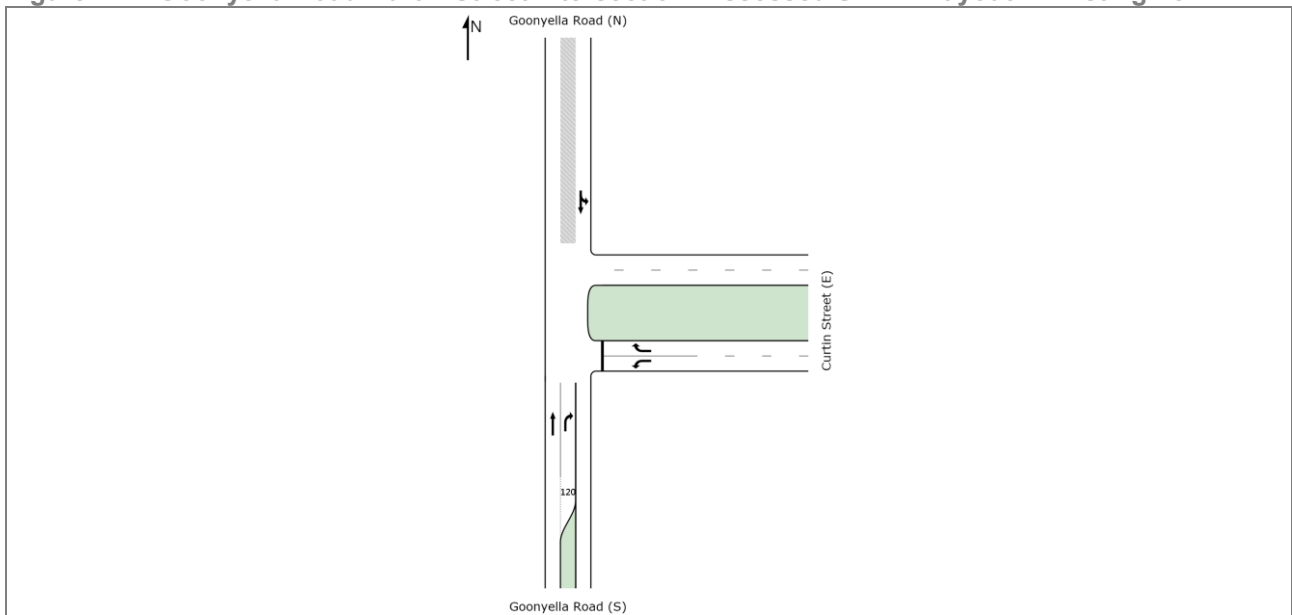


Table 7-3 Goonyella Road/Curtin Street Intersection: SIDRA Analysis Summary – Existing Form

| Scenarios | AM Peak | | | PM Peak | | |
|------------------------------|---------|----------------|-----------------------------|---------|----------------|-----------------------------|
| | DOS | Critical Delay | 95 th %ile Queue | DOS | Critical Delay | 95 th %ile Queue |
| 2013 Survey | 0.54 | 19 | 25 | 0.30 | 17 | 9 |
| 2020 Without Project | 0.62 | 21 | 30 | 0.38 | 23 | 11 |
| 2023 Without Project | 0.65 | 21 | 33 | 0.41 | 24 | 13 |
| 2024 Without Project | 0.66 | 22 | 35 | 0.42 | 25 | 13 |
| 2034 Without Project | 0.77 | 26 | 48 | 0.54 | 30 | 18 |
| 2020 With Construction Phase | 0.83 | 33 | 53 | 0.53 | 32 | 16 |
| 2023 With Overlap | 0.88 | 37 | 61 | 0.58 | 34 | 19 |
| 2024 With Operation Phase | 0.91 | 42 | 70 | 0.61 | 36 | 20 |
| 2034 With Operation Phase | 1.07 | 81 | 141 | 0.79 | 52 | 30 |

The analysis results presented in Table 7-3 indicate that the RHM underground expansion option and associated GRM incremental expansion is likely to have significant impacts on the Goonyella Road/Curtin Street intersection as modelling indicates it will perform outside the typically accepted performance threshold.

A potential upgrade solution has therefore been assessed incorporating signalisation of the intersection. Figure 7-13 shows the potential signalised intersection form with the corresponding SIDRA results documented at Table 7-4. This form demonstrates that there is a potential intersection layout that can accommodate the projected traffic.

Figure 7-13 Goonyella Road/Curtin Street Intersection: Intersection Layout – Upgraded Form

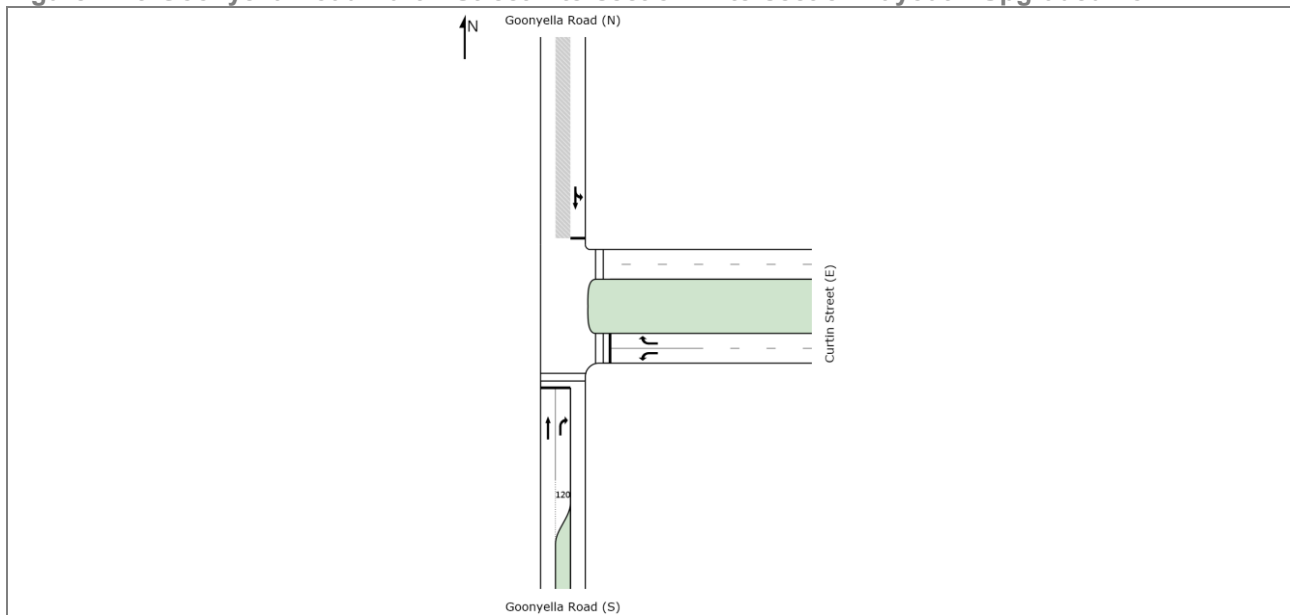


Table 7-4 Goonyella Road/Curtin Street Intersection: SIDRA Analysis Summary – Upgraded Form

| Scenarios | AM Peak | | | PM Peak | | |
|---------------------------|---------|---------------|-----------------------------|---------|---------------|-----------------------------|
| | DOS | Average Delay | 95 th %ile Queue | DOS | Average Delay | 95 th %ile Queue |
| 2034 With Operation Phase | 0.74 | 21 sec | 94m | 0.81 | 34 sec | 255m |

The results presented in Table 7-4 indicate that the potential signalised form will perform within the typically adopted DOS performance thresholds for signalised intersections (i.e. DOS less than 0.90) for the worst case scenario.

Given the timing for delivery of the RHM underground expansion option and associated GRM incremental expansion is not yet known, it would be unreasonable to condition the implementation of an upgrade at the time of approval. It would instead be reasonable for the proponent to commit to engaging with IRC and determining a proportionate contribution towards upgrade costs prior to the commencement of construction, once the owners have made a decision to proceed with the project

It is also noted that the intersection forms part of the trunk road network and therefore it is anticipated that IRC, through its headworks charges scheme, already has an established mechanism for funding the upgrade of this intersection. The timing for consultation with IRC regarding their proposed upgrade solution and any contribution by the proponent would need to occur prior to the commencement of construction, once the project owners have made a commitment to proceed with the project, determined the proposed staging and finalised its proposed workforce numbers and associated traffic volumes in line with the final staging for execution determined by the project owners.

7.4.4 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection

The Goonyella Road/Moranbah Access Road/Mills Avenue intersection is a priority-controlled T-intersection with a formalised right turn bay on the southern Goonyella Road approach. The projected traffic will generate additional through and turning traffic at this intersection. Figure 7-14 to Figure 7-16 show each leg of the existing intersection.

Figure 7-14 Goonyella Road/Moranbah Access Road Intersection: Northern Goonyella Road Approach - Looking North



Figure 7-15 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection: Eastern Mills Avenue Approach - Looking East



Figure 7-16 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection: Southern Moranbah Access Road Approach - Looking South



Intersection Operation

Figure 7-17 shows the existing intersection form as output by SIDRA with summary results provided in Table 7-5.

Figure 7-17 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection: Assessed SIDRA Layout – Existing Form

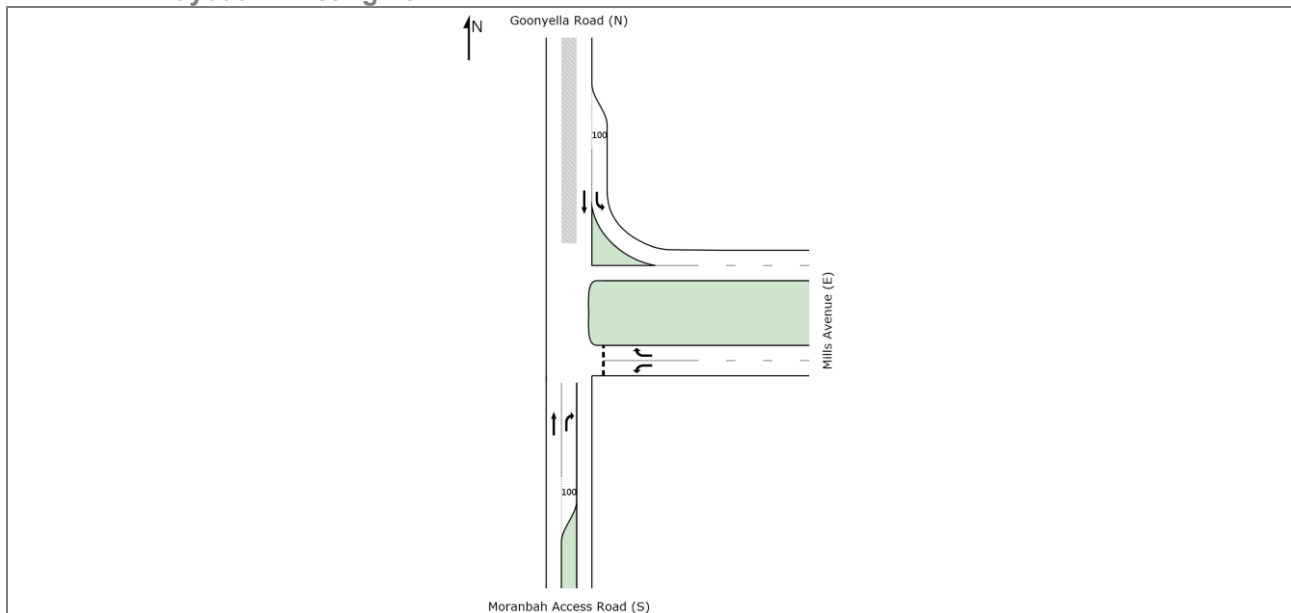


Table 7-5 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection: SIDRA Analysis Summary – Existing Form

| Scenarios | DOS | AM Peak | | DOS | PM Peak | |
|------------------------------|------|----------------|----------------------------|------|----------------|----------------------------|
| | | Critical Delay | 95 th %le Queue | | Critical Delay | 95 th %le Queue |
| 2013 Survey | 0.44 | 14 sec | 17m | 0.36 | 21 sec | 14m |
| 2020 Without Project | 0.82 | 26 sec | 55m | 0.92 | 72 sec | 42m |
| 2023 Without Project | 0.93 | 37 sec | 84m | 1.14 | 140 sec | 85m |
| 2024 Without Project | 0.97 | 43 sec | 99m | 1.23 | 175 sec | 105m |
| 2034 Without Project | 1.42 | 219 sec | 385m | 2.57 | 786 sec | 309m |
| 2020 With Construction Phase | 1.14 | 97 sec | 208m | 1.71 | 371 sec | 256m |
| 2023 With Overlap | 1.27 | 152 sec | 301m | 2.08 | 542 sec | 324m |
| 2024 With Operation Phase | 1.35 | 186 sec | 350m | 2.29 | 640 sec | 355m |
| 2034 With Operation Phase | 1.94 | 452 sec | 681m | 4.46 | 1,642 sec | 556m |

The analysis results presented in Table 7-5 indicate that irrespective of the RHM underground expansion option and associated GRM incremental expansion proceeding the Goonyella Road/Moranbah Access Road/Mills Avenue intersection will perform outside the typically accepted performance threshold (i.e. DOS less than 0.80) .

A potential upgrade solution has therefore been assessed incorporating signalisation of the intersection. Figure 7-18 shows the potential upgraded intersection form with SIDRA results documented at Table 7-6.

Figure 7-18 Goonyella Road/Moranbah Access Road/Mills Avenue Intersection: Assessed SIDRA Layout – Potential Upgrade Form

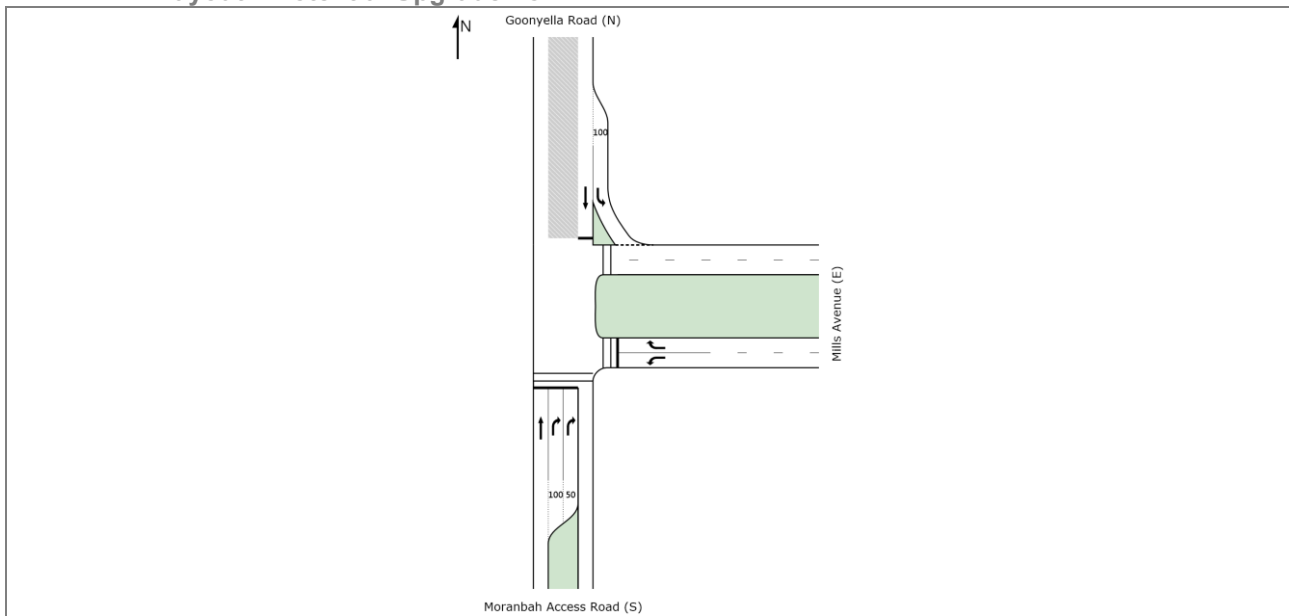


Table 7-6 Goonyella Rd/Moranbah Access Rd/Mills Av Intersection: SIDRA Analysis Summary – Potential Upgrade Form

| Scenarios | AM Peak | | | PM Peak | | |
|---------------------------|---------|---------------|----------------------------|---------|---------------|----------------------------|
| | DOS | Average Delay | 95 th %le Queue | DOS | Average Delay | 95 th %le Queue |
| 2034 With Operation Phase | 0.83 | 42 sec | 286m | 0.83 | 30 sec | 147m |

The results presented in Table 7-6 indicate that the potential signalised form will perform within the typically adopted DOS performance thresholds for signalised intersections (i.e. DOS less than 0.90) for the worst case scenario.

The Goonyella Road/Moranbah Access Road/Mills Avenue intersection may require upgrading irrespective of the RHM underground expansion option and associated GRM incremental expansion proceeding. As such, it would be unreasonable to condition the implementation of an upgrade as the requirement for the upgrade is not a direct result of traffic associated with the RHM underground expansion option and associated GRM incremental expansion. It would instead be reasonable for the proponent to commit to engaging with IRC and determining a proportionate contribution towards upgrade costs consistent with the extent of intersection capacity consumed by the projected project traffic.

Again, it is stressed that the analysis indicates that the identified intersection upgrade is likely to be required even in the absence of the RHM underground expansion option and associated GRM incremental expansion proceeding. It is therefore reasonable for the proponent to make a proportionate contribution towards upgrade costs (i.e. not fully fund) once the project owners have determined that the project will proceed and have determined the final staging for execution. Furthermore, the intersection forms part of the trunk road network and therefore it is anticipated that IRC, through its headworks charges scheme, already has an established mechanism for funding the upgrade of this intersection. Consultation with IRC regarding their proposed upgrade solution for the intersection should occur. The timing for consultation with IRC regarding their proposed upgrade solution and any contribution by the proponent would need to occur prior to the commencement of construction. This will happen after the project owners have made a commitment to proceed with the project, determined the proposed staging and finalised the proposed workforce numbers and associated traffic volumes in line with the final staging for execution.

7.4.5 Peak Downs Highway/Moranbah Access Road Intersection

The Peak Downs Highway/Moranbah Access Road intersection is understood to have been or about to be upgraded to a seagull T-intersection with formalised right and left turn bays on the Peak Downs Highway and an acceleration lane for right turning traffic. The intersection form assessed is consistent with plans supplied by TMR for the upgrade.

Intersection Operation

Figure 7-19 shows the existing intersection form as output by SIDRA with summary results provided in Table 7-7.

Figure 7-19 Peak Downs Highway/Moranbah Access Road Intersection: Assessed SIDRA Layout – Existing Form

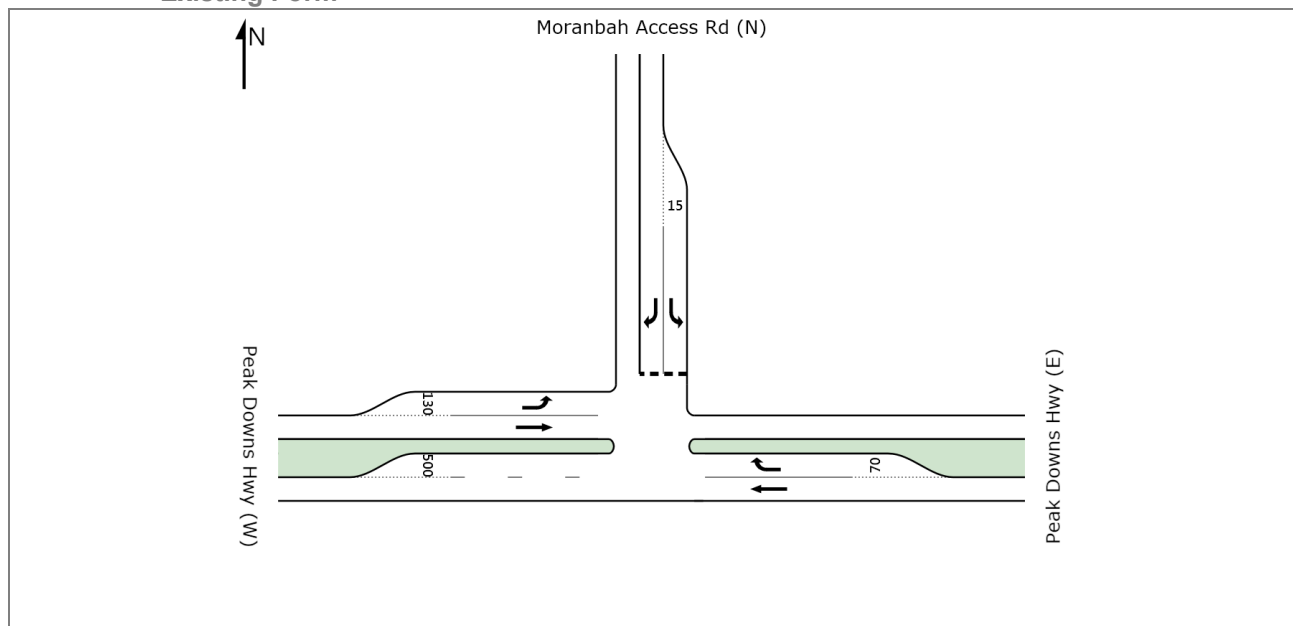


Table 7-7 Peak Downs Highway/Moranbah Access Road Intersection: SIDRA Analysis Summary – Existing Form

| Scenarios | AM Peak | | | PM Peak | | |
|------------------------------|---------|----------------|----------------------------|---------|----------------|----------------------------|
| | DOS | Critical Delay | 95 th %le Queue | DOS | Critical Delay | 95 th %le Queue |
| 2013 Survey | 0.48 | 14 | 19 | 0.25 | 18 | 8 |
| 2020 Without Project | 0.70 | 17 | 69 | 0.45 | 22 | 20 |
| 2023 Without Project | 0.75 | 18 | 89 | 0.51 | 24 | 23 |
| 2024 Without Project | 0.77 | 18 | 97 | 0.53 | 25 | 25 |
| 2034 Without Project | 0.95 | 30 | 246 | 0.82 | 39 | 54 |
| 2020 With Construction Phase | 0.72 | 17 | 73 | 0.48 | 23 | 22 |
| 2023 With Overlap | 0.77 | 19 | 94 | 0.54 | 25 | 26 |
| 2024 With Operation Phase | 0.79 | 20 | 105 | 0.58 | 26 | 29 |
| 2034 With Operation Phase | 0.97 | 36 | 269 | 0.88 | 44 | 68 |

The analysis results presented in Table 7-7 indicate that irrespective of the RHM underground expansion option and associated GRM incremental expansion proceeding, the Peak Downs Highway/Moranbah Access Road Intersection will perform outside the typically accepted performance threshold (i.e. DOS less than 0.80)

A potential upgrade solution has therefore been assessed incorporating an upgrade to a roundabout. Figure 7-20 shows the potential upgraded intersection form with SIDRA results documented at Table 7-8.

Figure 7-20 Peak Downs Highway/Moranbah Access Road Intersection: Assessed SIDRA Layout – Potential Upgrade Form

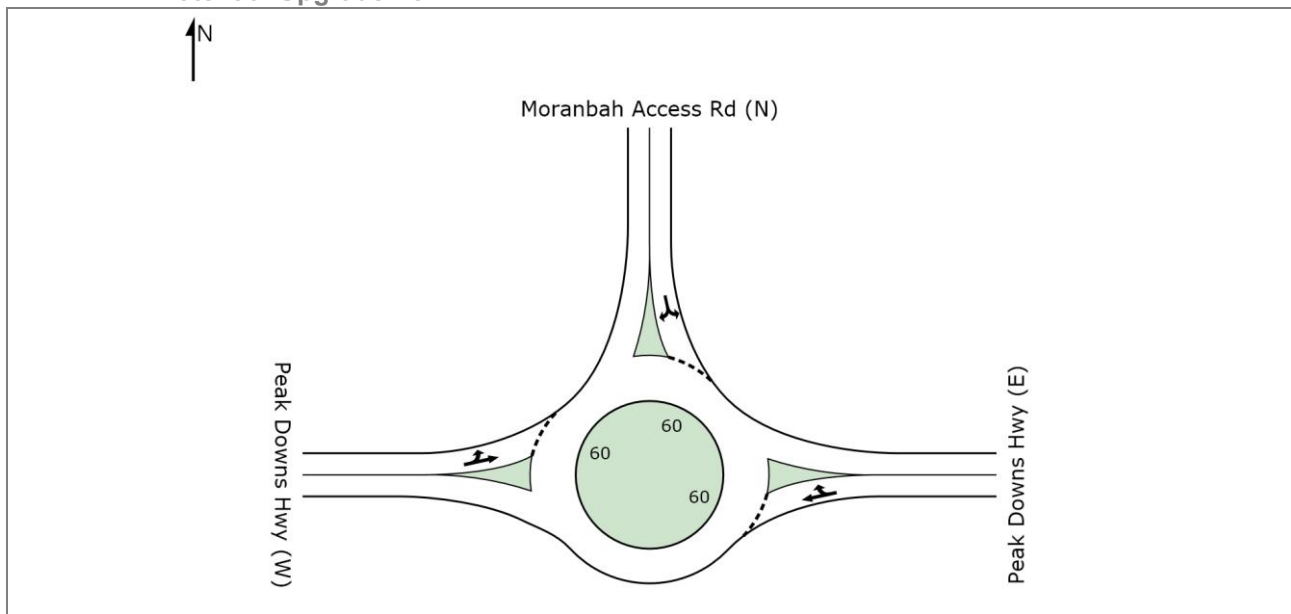


Table 7-8 Peak Downs Highway/Moranbah Access Road Intersection: SIDRA Analysis Summary – Potential Upgrade Form

| Scenarios | AM Peak | | | PM Peak | | |
|---------------------------|---------|----------------|----------------------------|---------|----------------|----------------------------|
| | DOS | Critical Delay | 95 th %le Queue | DOS | Critical Delay | 95 th %le Queue |
| 2034 With Operation Phase | 0.70 | 23 sec | 73m | 0.78 | 20 sec | 100m |

The results presented in Table 7-8 indicate that the potential roundabout form will perform within the typically adopted DOS performance thresholds for a roundabout (i.e. DOS less than 0.85) for the worst case scenario.

The Goonyella Road/Moranbah Access Road/Mills Avenue intersection is likely to require upgrading irrespective of the RHM underground expansion option and associated GRM incremental expansion. As such, it would be unreasonable to condition the implementation of an upgrade as the requirement for the upgrade is not a direct result of traffic associated with the RHM underground expansion option and associated GRM incremental expansion. It would instead be reasonable for the proponent to commit to engaging with TMR and determining a proportionate contribution towards upgrade costs consistent with the extent of intersection capacity consumed by the projected project traffic.

Again, it is stressed that the analysis indicates that the identified intersection upgrade is likely to be required even in the absence of the RHM underground expansion option and associated GRM incremental expansion proceeding. It is therefore reasonable for the proponent to make a proportionate contribution towards upgrade costs (i.e. not fully fund). Given the uncertain timeframe for the delivery, the proponent should be conditioned to undertake reassessment in consultation with TMR following a decision to proceed with the RHM underground expansion option and associated GRM incremental expansion.

7.4.6 Red Hill Accommodation Village Access

As identified in Section 2.4, an accommodation village is planned with connection to be provided via Red Hill Road. The exact location of the supporting access to the Red Hill accommodation village is still to be resolved following detailed engineering investigations. Irrespective of the location ultimately selected the Red Hill accommodation village access intersection should include a channelised right turn treatment and auxiliary left turn treatment in accordance with the TMR (2006b) *Road Planning and Design Manual*. The proposed access form will provide an appropriate level of safety and capacity given likely traffic volumes.

8 Pavement Impact Assessment

8.1 Pavement Impact Assessment Scoping

The spatial extent of the pavement impact assessment undertaken for the state-controlled road network has been defined in accordance with the scoping methodology outlined in TMR's (2006) Guidelines for Assessment of Road Impacts of Development. That is, all surrounding state-controlled roads have been considered to identify any road sections where the proposed increase in traffic activity may result in an increase of 5% or more beyond existing ESA levels. Cardno has considered the construction, operations and construction phases with respect to heavy vehicle movements.

The proponent's obligation towards routine maintenance of the state-controlled road network has been calculated based on the percentage increase in ESAs on each road segment as a result of the likely increased haulage activity.

The results presented at Table 8-1 indicate that the increased haulage activity will not have an impact, classified as significant, on maintenance activities on the state-controlled road network. That is, while associated traffic will slightly increase the need for pavement maintenance works on the state-controlled road network this increase is forecast to be less than 5% on any road section and therefore does not warrant a proponent contribution for any sections.

Table 8-1 Maintenance Impacts Summary – Peak Downs Highway

| Road | Direction | Section | Construction Impact (%) | Operation Impact (%) | Overlap Impact (%) |
|------|-----------|---|-------------------------|----------------------|--------------------|
| 33A | G | Moranbah Access Road to Nebo Shire Boundary | 0.3% | 0.4% | 0.6% |
| | A | Nebo Shire Boundary to Moranbah Access Road | 1.6% | 1.4% | 2.5% |
| 33A | G | Nebo Shire Boundary to East of Coppabella | 0.3% | 0.4% | 0.6% |
| | A | East of Coppabella to Nebo Shire Boundary | 1.6% | 1.4% | 2.5% |
| 33A | G | East of Coppabella to Fitzroy Dev Road | 0.3% | 0.3% | 0.5% |
| | A | Fitzroy Dev Road to East of Coppabella | 1.5% | 1.3% | 2.4% |
| 33A | G | Fitzroy Dev Road to Oxford Downs | 0.3% | 0.3% | 0.5% |
| | A | Oxford Downs to Fitzroy Dev Road | 1.3% | 1.2% | 2.1% |
| 33A | G | Oxford Downs to Reynolds Street | 0.3% | 0.3% | 0.5% |
| | A | Reynolds Street to Oxford Downs | 1.5% | 1.3% | 2.3% |

It is noted that reassessment may potentially be warranted should the estimated material movements change significantly.

9 Cumulative Impacts

The baseline traffic conditions assessed in Section 7 of the report include allowance for high background growth between 2013 and 2020. As previously identified in Section 4.2, the adopted growth rate includes allowance for traffic generated by other known projects in the vicinity of the EIS study area. The results presented in Section 7 of this report therefore account for the potential cumulative impacts of the identified projects proposed within the vicinity of Moranbah. The previously reported results therefore enable TMR and IRC to make an informed assessment regarding the likely future operation of the road network assuming the identified projects proposed in the vicinity of Moranbah proceed (i.e. enable an assessment of the cumulative traffic impacts of the identified projects).

10 Sustainable Transport

Sustainable transport incorporates travel modes other than private vehicles including public transport, pedestrian and cyclist modes.

10.1 Existing Infrastructure

In the vicinity of the EIS study area, the majority of sustainable transport infrastructure, including pedestrian paths, is located within the Moranbah urban area. There is also an off-road path on the eastern side of Goonyella Road that provides a connection between the Moranbah urban areas with the riverfront area, approximately one kilometre south of the town.

There is currently no public transport provision within Moranbah. There are passenger bus services that travel between Mackay and Emerald that stop in Moranbah, which are operated by Paradise Coaches and Greyhound Australia. Paradise Coaches services operate daily, with Greyhound Australia providing services four days a week. Each company operates one service in each direction (i.e. to and from Mackay).

10.2 Sustainable Transport Planning

A review of IRC and regional planning documents identified the following sustainable transport vision, goals and strategies:

- > Develop an integrated system of bicycle and pedestrian paths within urban centres to encourage the use of public transport, walking and cycling
- > Provide for and encourage greater use of pedestrian and cycling transport systems, including more bicycle end of trip facilities within the region
- > Identify, develop and manage environmentally sustainable pedestrian and cycle recreation trails in environmental and natural resource management programs and plans.

The IRC does not appear to have any specific sustainable transport plans for areas outside of the urban Moranbah area that will be affected.

10.3 Project Impacts

The RHM underground expansion option and associated GRM incremental expansion are not anticipated to significantly increase demands on the existing pedestrian and cyclist infrastructure, nor is it likely to warrant the provision of additional public transport infrastructure such as bus stops. A proponent contribution towards such infrastructure is therefore considered unwarranted.

11 Haulage of Goods and Materials

The state government has a number of regulations and guidelines that apply to the movement of goods and materials by road. Key documents and legislative requirements that will apply to the transport of materials, goods and equipment are discussed in the following sections.

It is the responsibility of the haulage operator to obtain the necessary permits for the movement of equipment and materials.

11.1 Transport Operations (Road Use Management) Act 1995

The Transport Operations (Road Use Management – Mass, Dimensions and Loading) Regulation 2005, which is part of the Transport Operations (Road Use Management) Act 1995, outlines the maximum allowable dimensions for vehicles using the public road network without the need of any permits. These dimensions include the width, height, length and mass of vehicles and trailers.

If the vehicles being used to transport goods, materials and equipment to and from the mine comply with the limits detailed in this regulation, then no permits will be required. If however, any of these criteria (width, height, mass or length) exceed the allowable maximum, then a permit will need to be obtained from the TMR.

The permit may detail information including:

- > Times, roads and maximum speeds that the vehicle or type of vehicle is allowed to be driven
- > The maximum permissible dimensions for the vehicle or type of vehicle (including load)
- > The maximum permissible mass of the vehicle, the type of vehicle or part of the vehicle with the load
- > Requirements for pilot vehicles or escort vehicles and when they are required
- > Any necessary vehicle modifications
- > Any other matters relevant to the safe movement of vehicles.

The permit may also be subject to conditions that relate to the payment of costs for the repair and rehabilitation of road transport infrastructure. This may be required to be paid up-front as a bond, which may be returned following the completion of haulage.

11.2 Queensland Government Guidelines

The Queensland Government has developed a number of Guidelines that identify alternative means of complying with the Transport Operations (Road Use Management) Act 1995. In addition to these guidelines, the TMR also issue Information Bulletins which outline key features of the various guidelines.

Some of the relevant guidelines that may be applicable include:

- > Form Number 4: Guideline for Excess Dimension – Vehicles Carrying Indivisible Articles and Special Purpose Vehicles in Queensland;
- > Form Number 6: Guideline for Excess Dimension –Special Purpose Vehicles and Vehicles Carrying Indivisible Articles Requiring Pilots/Escorts;
- > Form Number 10: Guideline for Higher Mass Limits for Vehicles with Road Friendly Suspensions in Queensland; and
- > Form Number 11: Guideline for Operation of Excess Mass – Special Purpose Vehicles to 40 tonnes and Vehicles Carrying an Indivisible Item to 59.5 tonnes.

If the criteria detailed in the applicable guidelines are able to be achieved, then additional permits are not required for the haulage of materials, equipment and goods.

12 Conclusion

In accordance with the TMR's *Guidelines for the Assessment of Road Impacts of Development*, an intersection scoping assessment was undertaken to identify locations where associated traffic has the potential to have an impact classified as significant. Detailed analysis of the performance of the scoped intersections and links was then undertaken to confirm if these road elements would continue to operate within standard performance thresholds at the assessed future design horizon years.

The analysis indicated the following road elements will continue to operate within standard thresholds for all design horizon years:

- > Goonyella Road/Riverside Access Road intersection
- > Goonyella Road/Red Hill Road intersection
- > Goonyella Road (between Red Hill Road and Railway Overpass)
- > Goonyella Road between Riverside Access Road and Red Hill Road
- > Riverside Access Road between Goonyella Road and the EIS study area.

The analysis indicates that the Goonyella Road/Curtin Street, Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections will have the potential to be impacted by the project and operate outside typically accepted performance thresholds.

Goonyella Road/Curtin Street is anticipated to have the potential to be significantly impacted by the RHM underground expansion option and associated GRM incremental expansion, with the potential for an intersection upgrade to accommodate traffic. The Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections are likely to warrant upgrading regardless of the RHM underground expansion option and associated GRM incremental expansion. It is recommended that BMA engage with IRC and TMR regarding its potential plans to upgrade these intersections and make a proportionate contribution towards the cost of the upgrade works (i.e. not fully fund). The timing for consultation with TMR and IRC regarding their proposed upgrade solution and any contribution would need to occur prior to the commencement of construction once the project owners have made a commitment to proceed with the project, determined the proposed staging and finalised its proposed workforce numbers and associated traffic volumes.

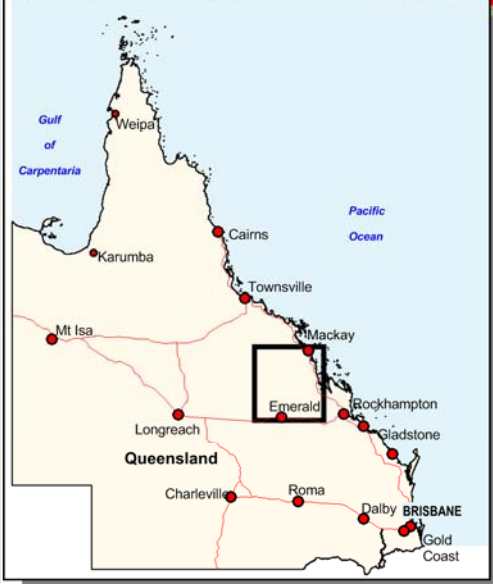
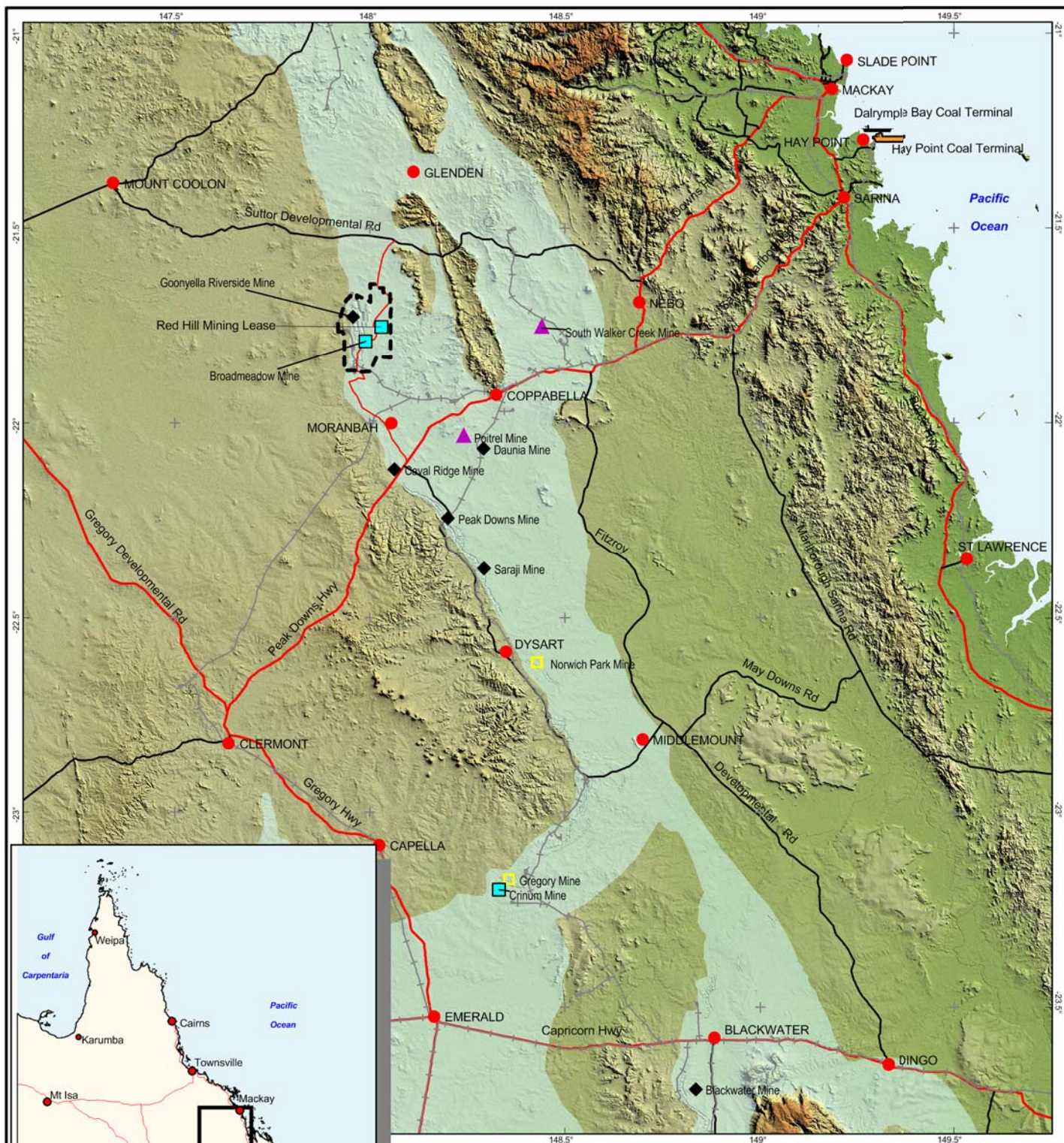
The proponent's obligation towards pavement works has been assessed in accordance with the TMR guidelines. The pavement loading impact has been classified as 'insignificant' and therefore no proponent funded contribution towards pavement maintenance or rehabilitation works is warranted. It is industry standard practice in Queensland to classify the pavement impacts of a project as insignificant where the project will impact existing conditions by less than 5%. It is noted that reassessment may potentially be warranted should the estimated material movements change significantly.

It is identified that certain items not covered by this RIA, but required under the TOR, are able to be conditioned and are better addressed in a Road Use Management Plan following approval of the EIS when the project owners determine to proceed with the project and undertake detailed design, award construction contracts and finalise quantities and logistics. It is therefore anticipated that the proponent would be required to prepare a Road Use Management Plan addressing these items at the detailed design stage.

In summary, the Road Impact Assessment has identified that the RHM underground expansion option and associated GRM incremental expansion will not generate any traffic impacts on the state-controlled, council-controlled or private road networks that are so significant that they should preclude approval of the EIS. The proponent's commitment to engage with the asset owners (prior to the commencement of construction), establish proportionate contributions towards road capacity works and prepare Road Use Management Plans are anticipated to fully offset all significant associated traffic impacts.

Road Impact Assessment

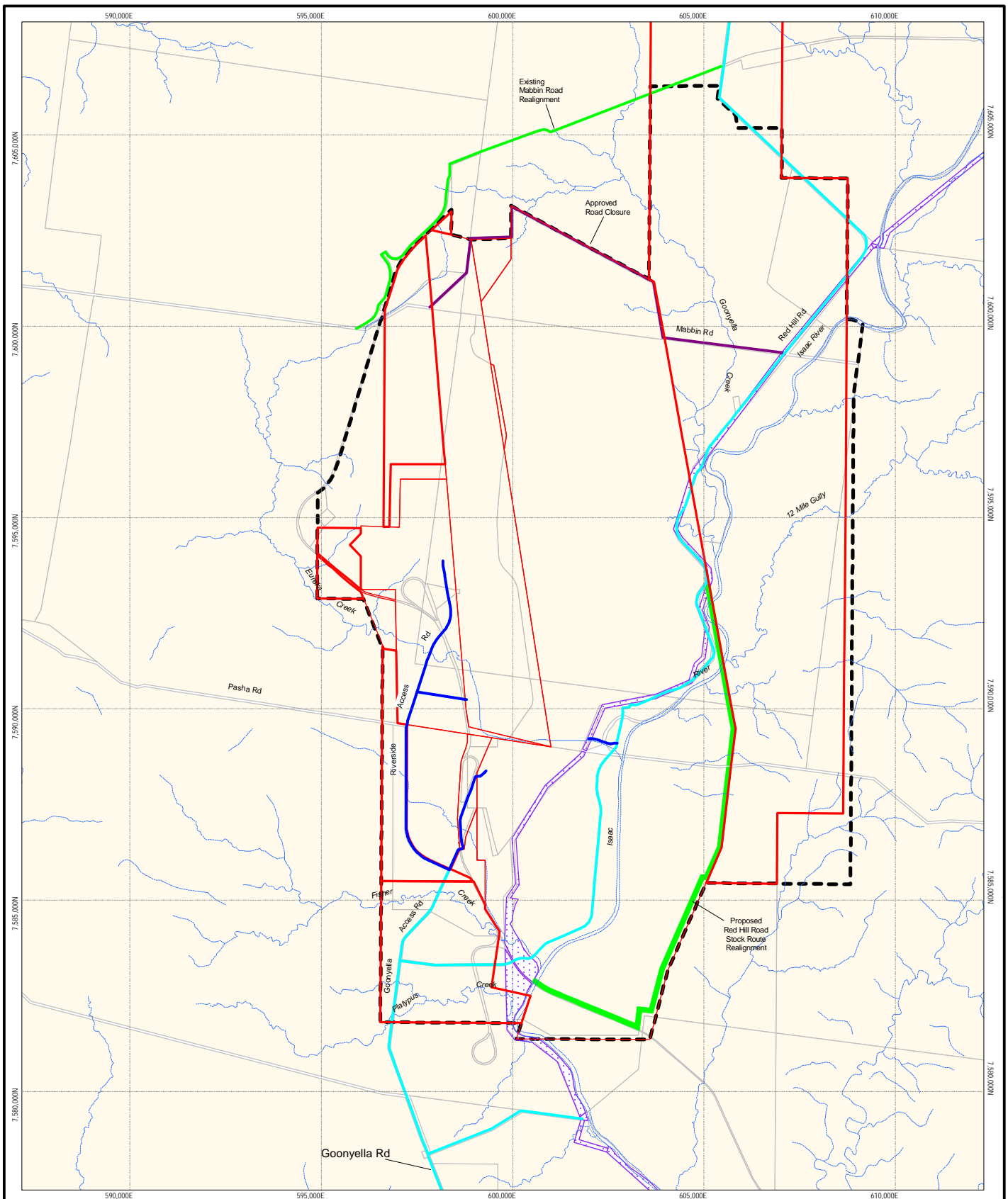
APPENDIX A
PROJECT MAPS



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| | | | |
|------------|--|-------------------------------|--|
| Client | Project RED HILL MINING LEASE ROAD IMPACT ASSESSMENT | Title LOCALITY PLAN | |
| | Drawn: VH Approved: JB Date: 26-11-2013 Job No: CEB06179 File No: URS42627136-g-2088c.wor | Figure: A1 | |



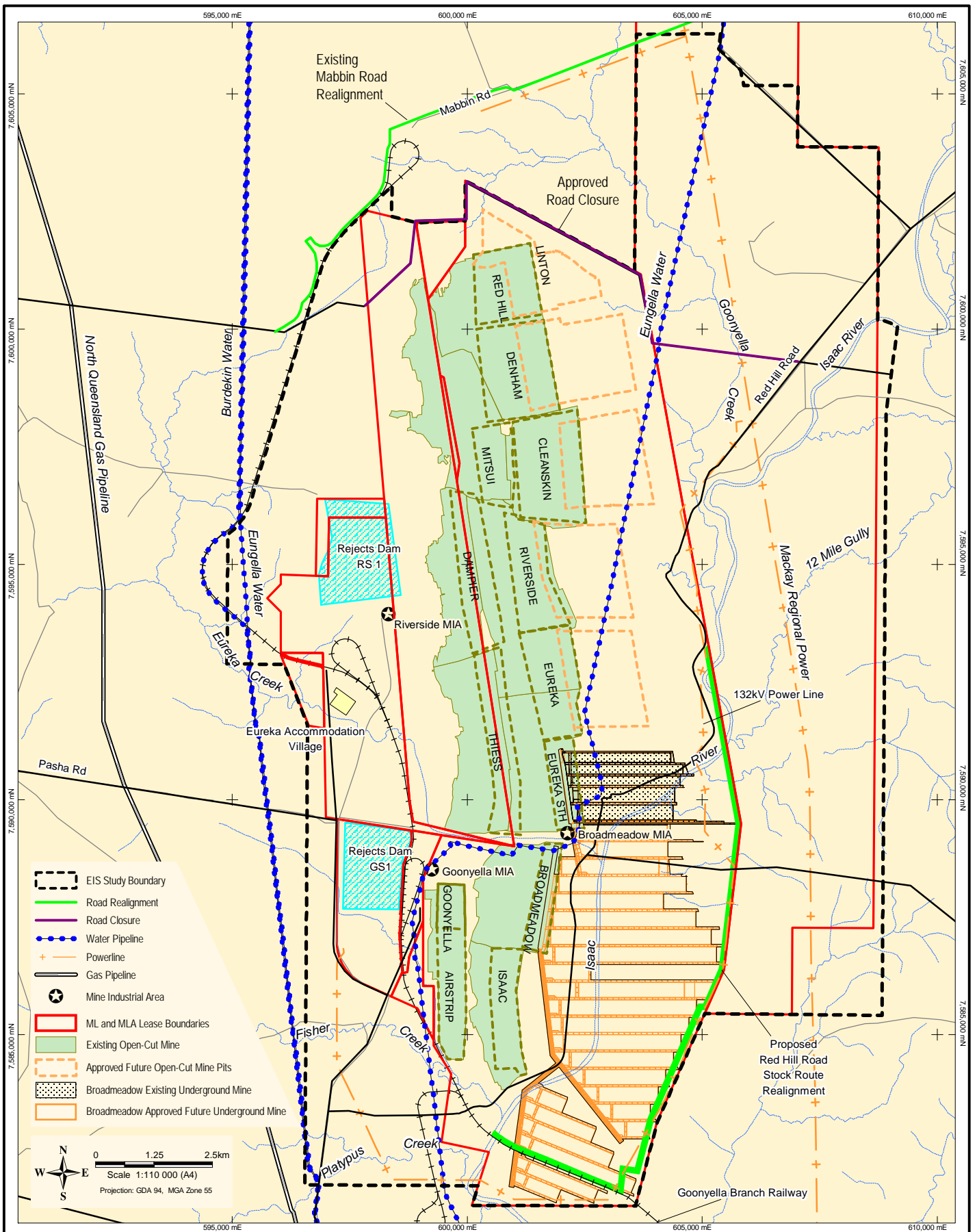
0 1.25 2.5km
 Scale 1:140 000 (A4)
 Datum: GDA84, MGA Zone 55

- EIS Study Boundary
- ML & MLA Lease Boundary
- Existing Stockroute (U831)
- Realignments
- Road Closure
- Mine Access Road (BMA)
- Constructed Roads

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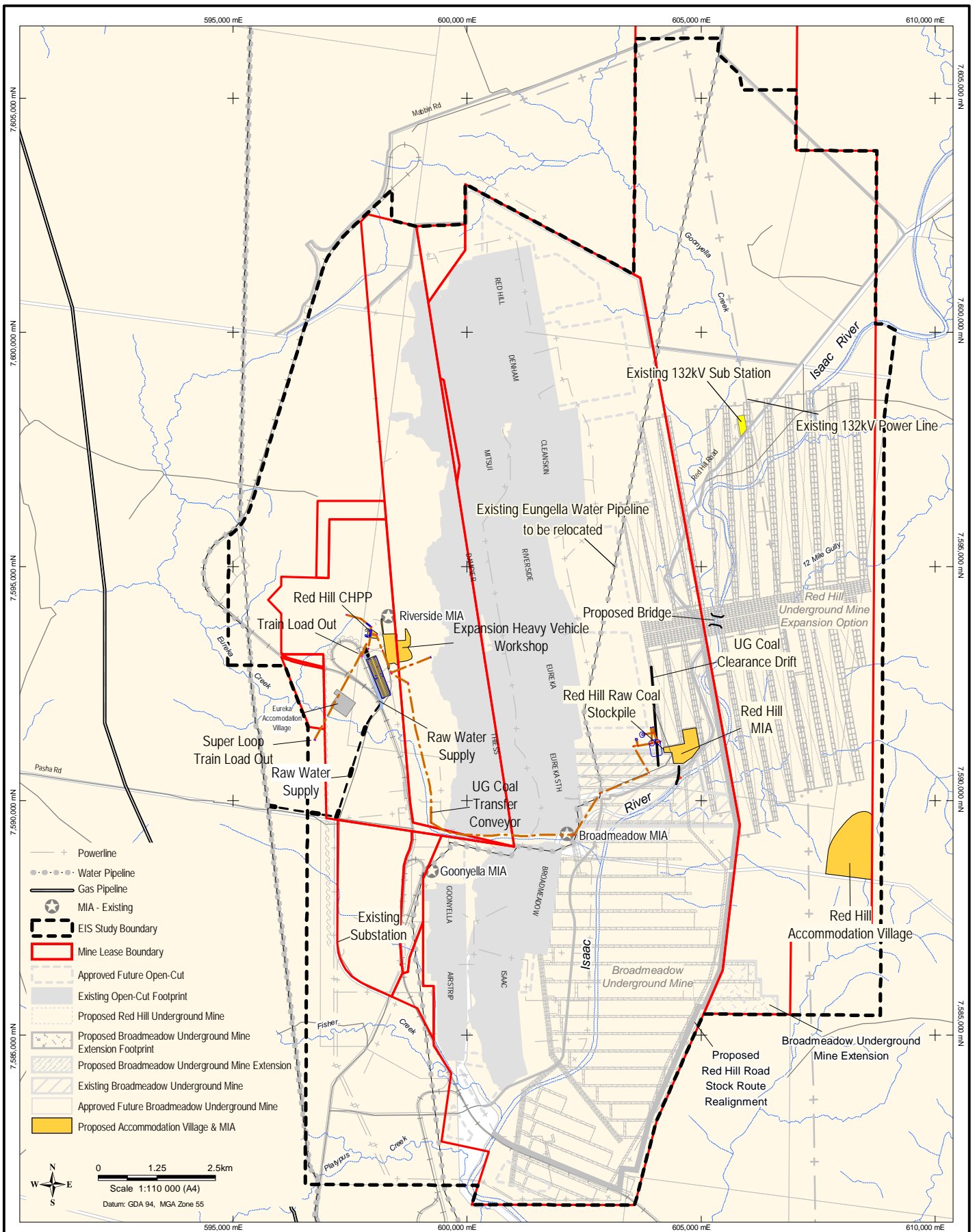
| | | | | | | | | | | |
|-------------------------|--|---|--------------|------------------|-------------------------|--|---|---|--------|----|
| Client | Project <p style="text-align: center;">RED HILL MINING LEASE ROAD IMPACT ASSESSMENT</p> | Title <p style="text-align: center;">TRANSPORT AND ACCESS</p> | | | | | | | | |
| | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Drawn: VH</td> <td style="width: 33%;">Approved: JB</td> <td style="width: 33%;">Date: 23-08-2013</td> </tr> <tr> <td colspan="2">Job No: CEB06179</td> <td>File No: URS 42627136-g-2089.wor</td> </tr> </table> | Drawn: VH | Approved: JB | Date: 23-08-2013 | Job No: CEB06179 | | File No: URS 42627136-g-2089.wor | Figure: A2 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">Rev: A</td> <td style="width: 20%; text-align: center;">A4</td> </tr> </table> | Rev: A | A4 |
| Drawn: VH | Approved: JB | Date: 23-08-2013 | | | | | | | | |
| Job No: CEB06179 | | File No: URS 42627136-g-2089.wor | | | | | | | | |
| Rev: A | A4 | | | | | | | | | |



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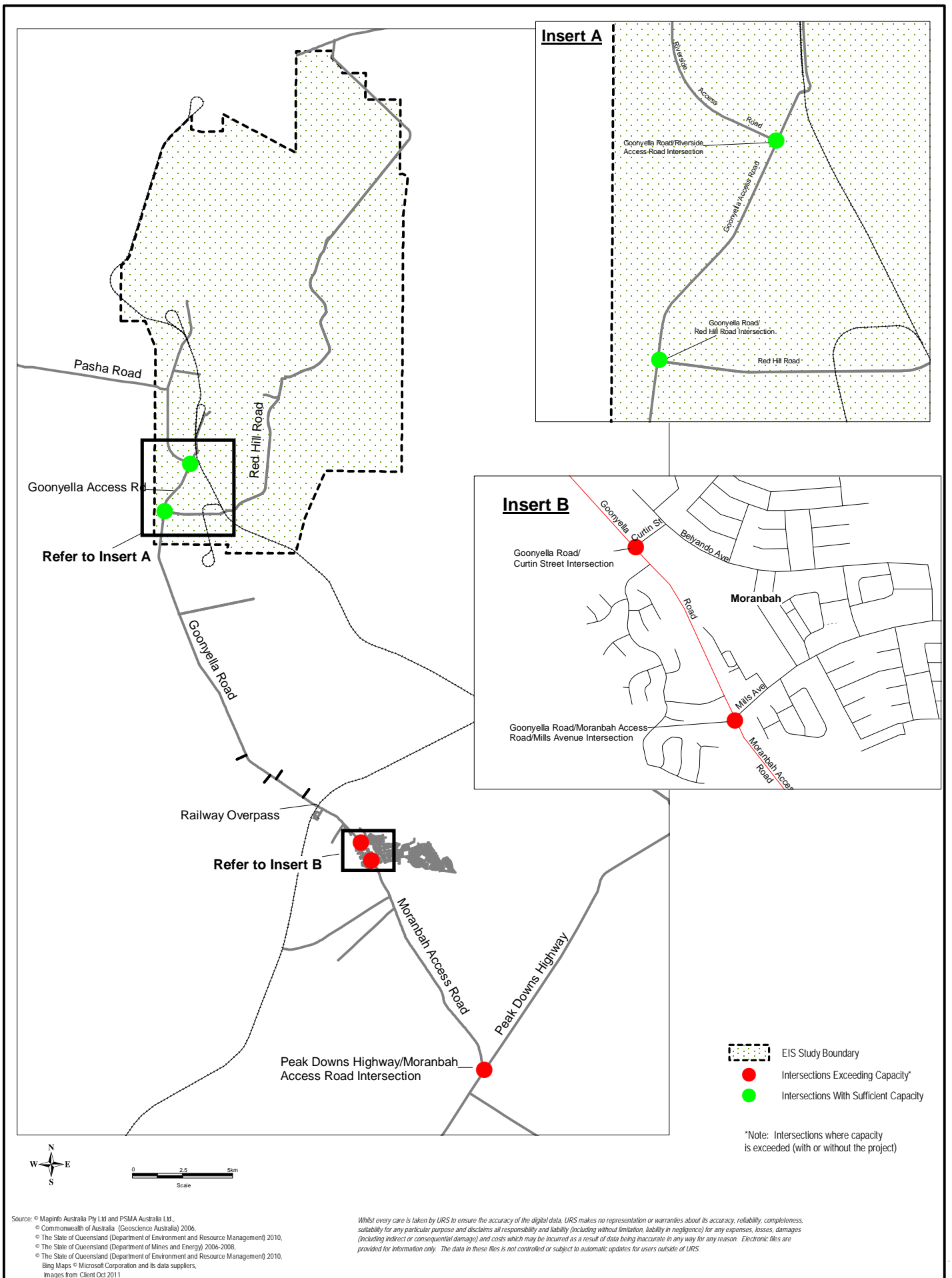
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|------------|---|--|---------------------------------------|
| Client | Project RED HILL MINING LEASE ROAD IMPACT ASSESSMENT | Title EXISTING OPERATIONS | |
| | Drawn: VH Job No: CEB06179 | Approved: JB File No: URS 42627136-g-2090.wor | Date: 21-06-2012 Figure: A3 |



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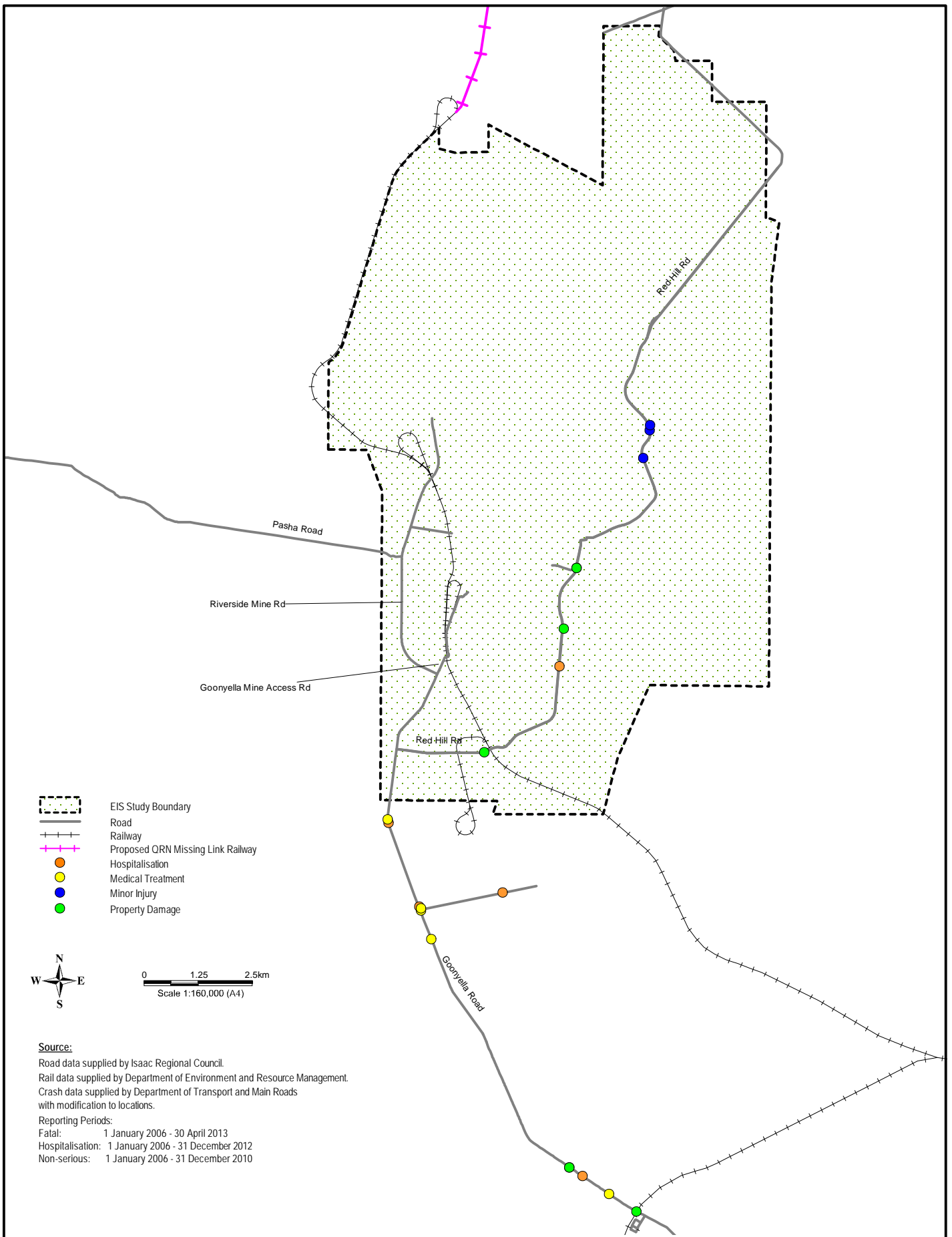
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| Client   | Project RED HILL MINING LEASE ROAD IMPACT ASSESSMENT | Title PROPOSED INFRASTRUCTURE EXPANSION COMPONENTS |
| | Drawn: VH Approved: GC Date: 21-06-2013 Job No: CEB06179 File No: URS 42627136-g-2091.wor | Figure: A4 |



| | | | | |
|------------|--|-------------------------|---|-------------------|
| Client | Project RED HILL MINING LEASE ROAD IMPACT ASSESSMENT | | Title INTERSECTION AND ROAD LOCATIONS | |
| | Drawn: VH | Approved: GC | Date: 29-07-2013 | Figure: A5 |
| | | Job No: CEB06179 | File No: URS 42627136-g-2192.wor | |

Road Impact Assessment

APPENDIX B
CRASH DATA





Source:

Road data supplied by Isaac Regional Council.
 Rail data supplied by Department of Environment and Resource Management.
 Crash data supplied by Department of Transport and Main Roads with modification to locations.
 Reporting Periods:
 Fatal: 1 January 2006 - 30 April 2013
 Hospitalisation: 1 January 2006 - 31 December 2012
 Non-serious: 1 January 2006 - 31 December 2010

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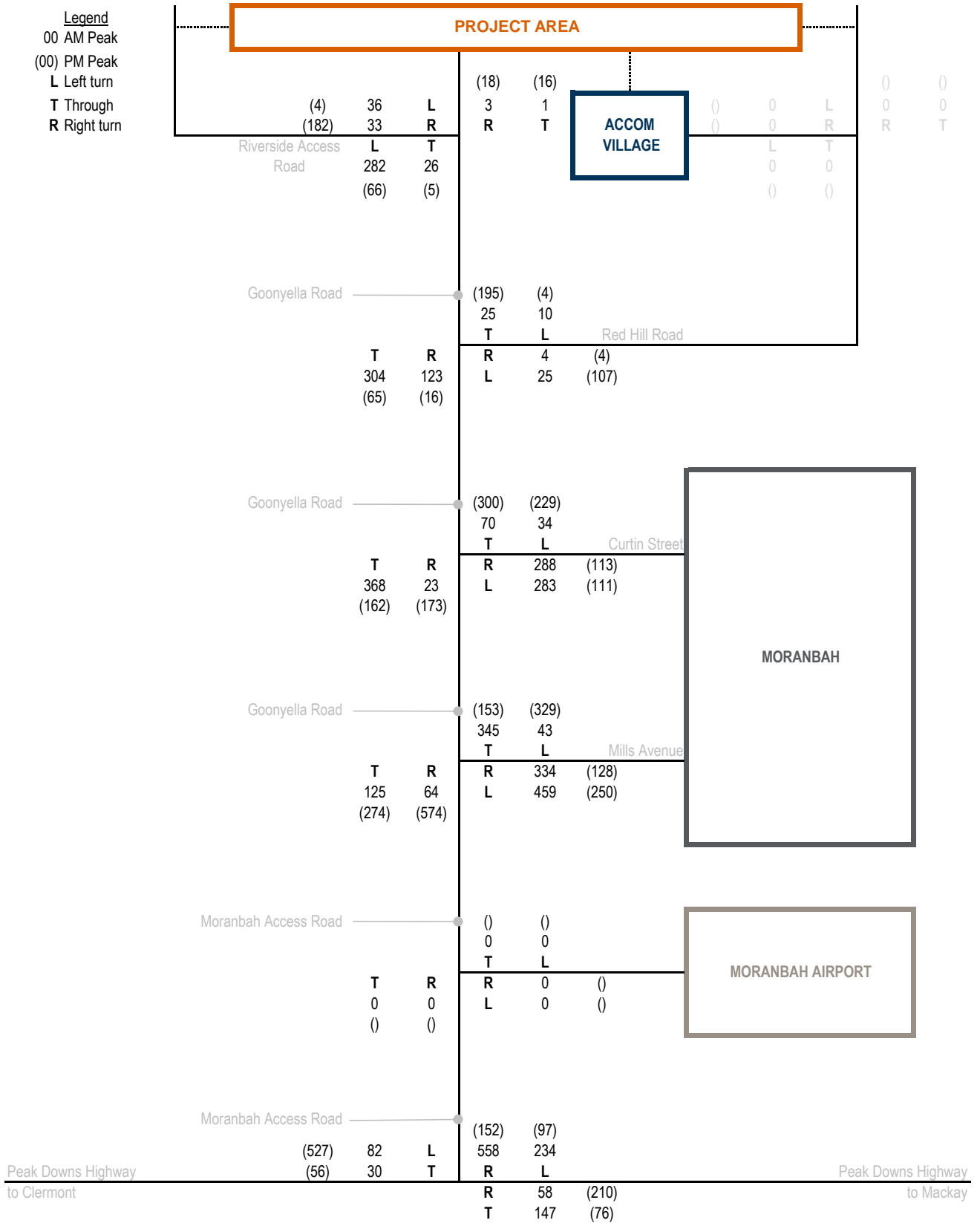
| | | | | |
|---|---|---|---|---------------------------------------|
| Client  | Project RED HILL MINING LEASE ROAD IMPACT ASSESSMENT | | Title ROAD CRASHES NORTH OF MORANBAH JANUARY 2006 - JUNE 2013 | |
| |  | Drawn: VH/RG Job No: CEB06179 | Approved: JB File No: URS 42627136-g-2221.wor | Date: 29-07-2013 Figure: B1 |

Road Impact Assessment

APPENDIX C
ASSESSMENT TRAFFIC VOLUMES

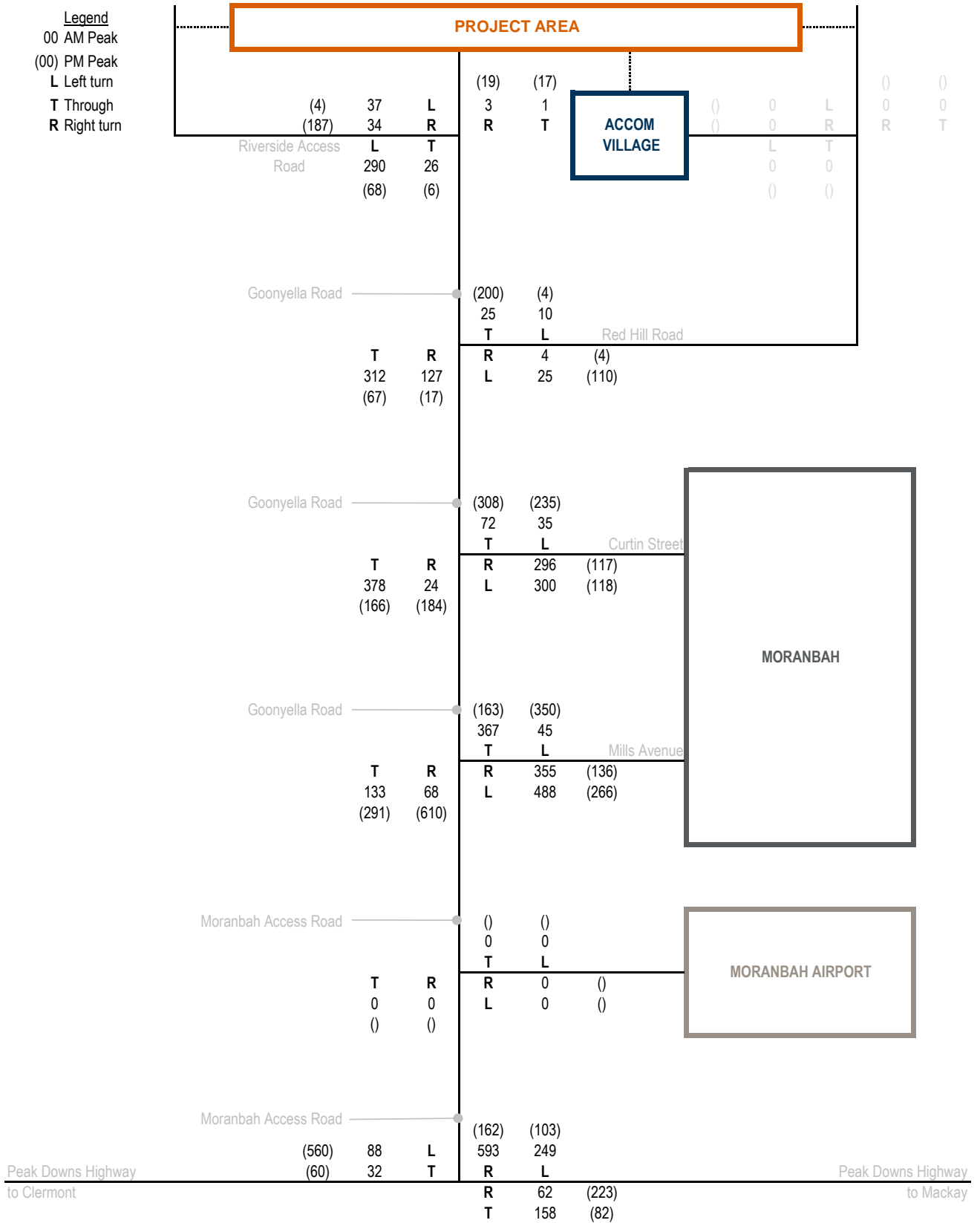
2020 Background

- Legend
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



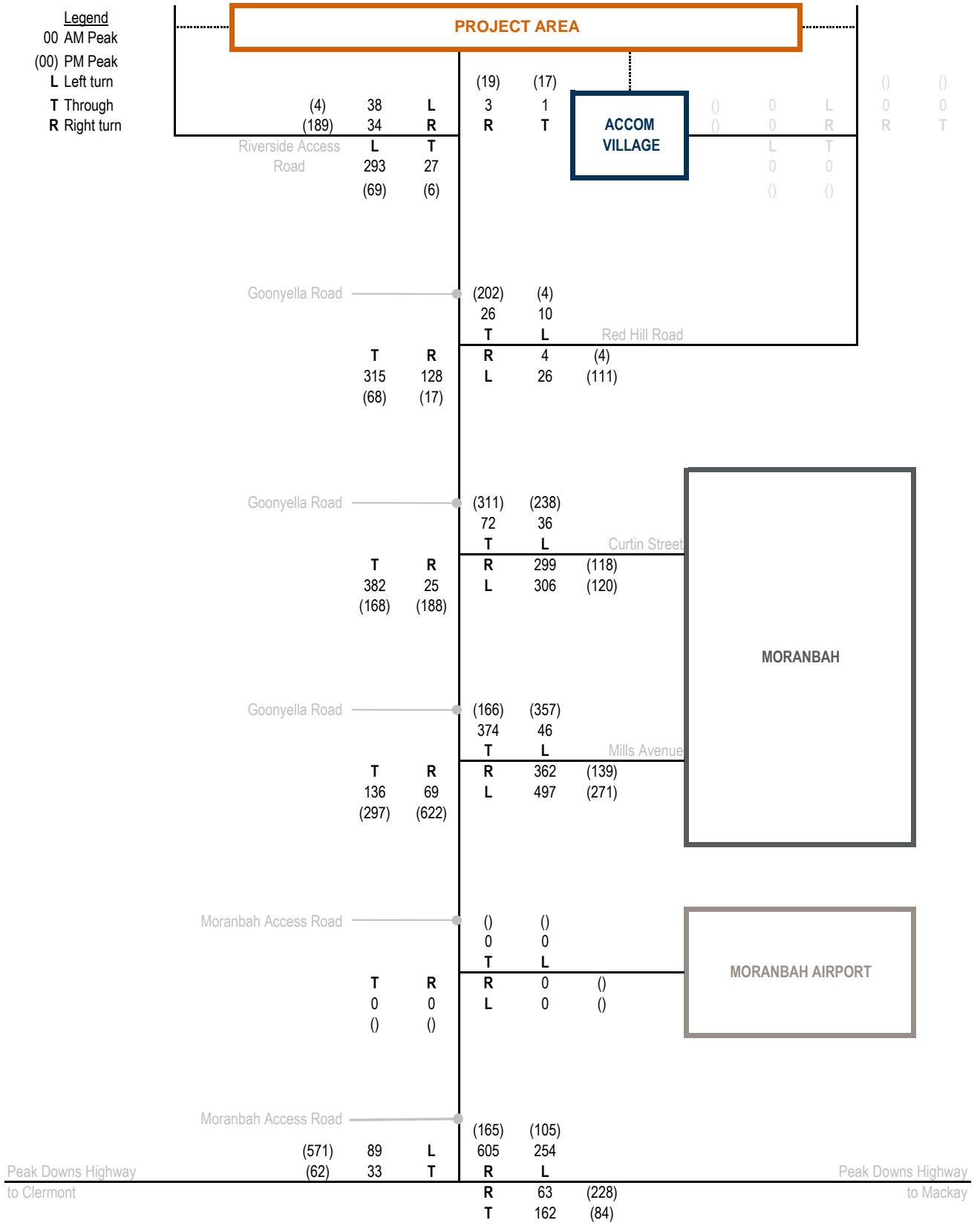
2023 Background

- Legend
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



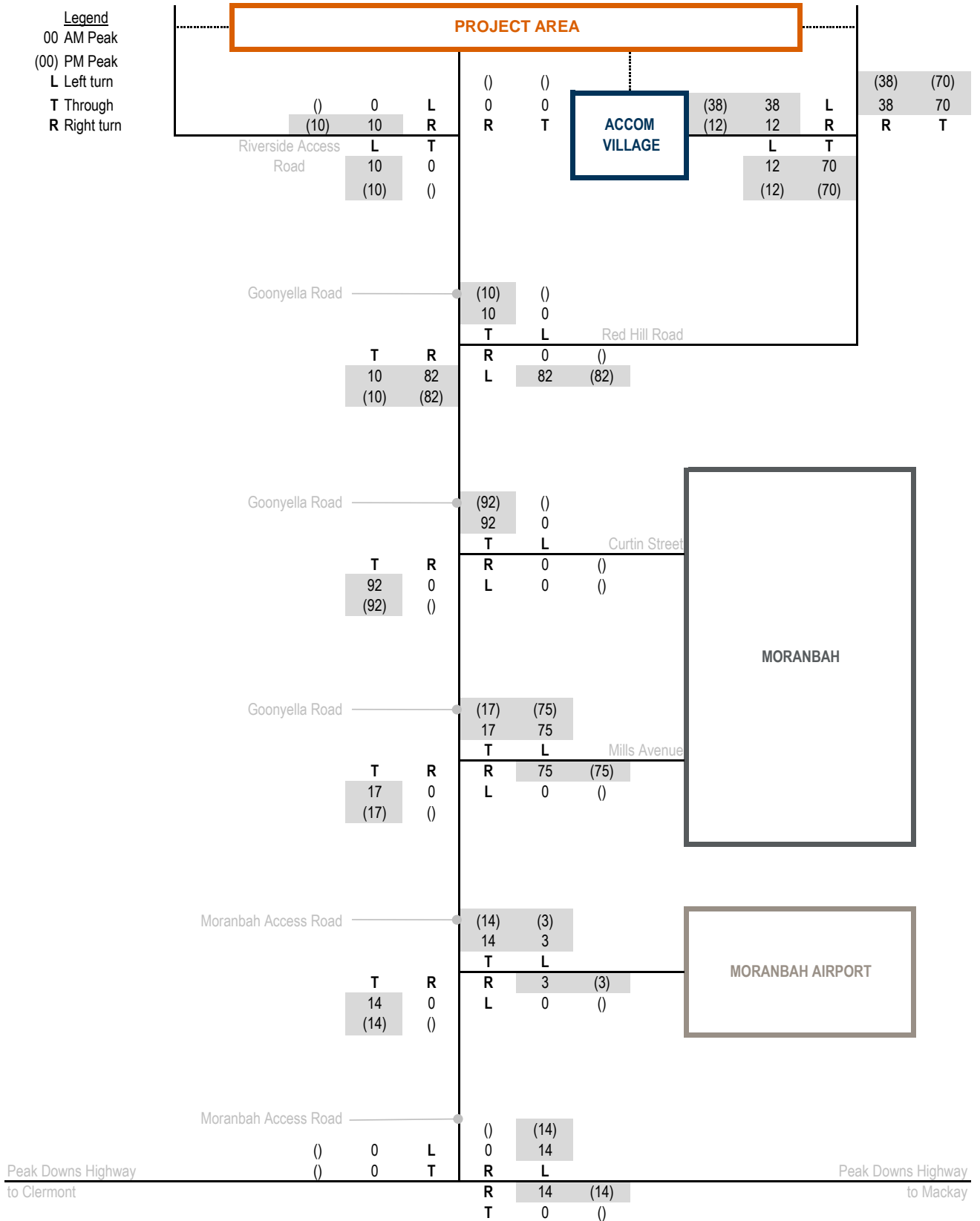
2024 Background

- Legend
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



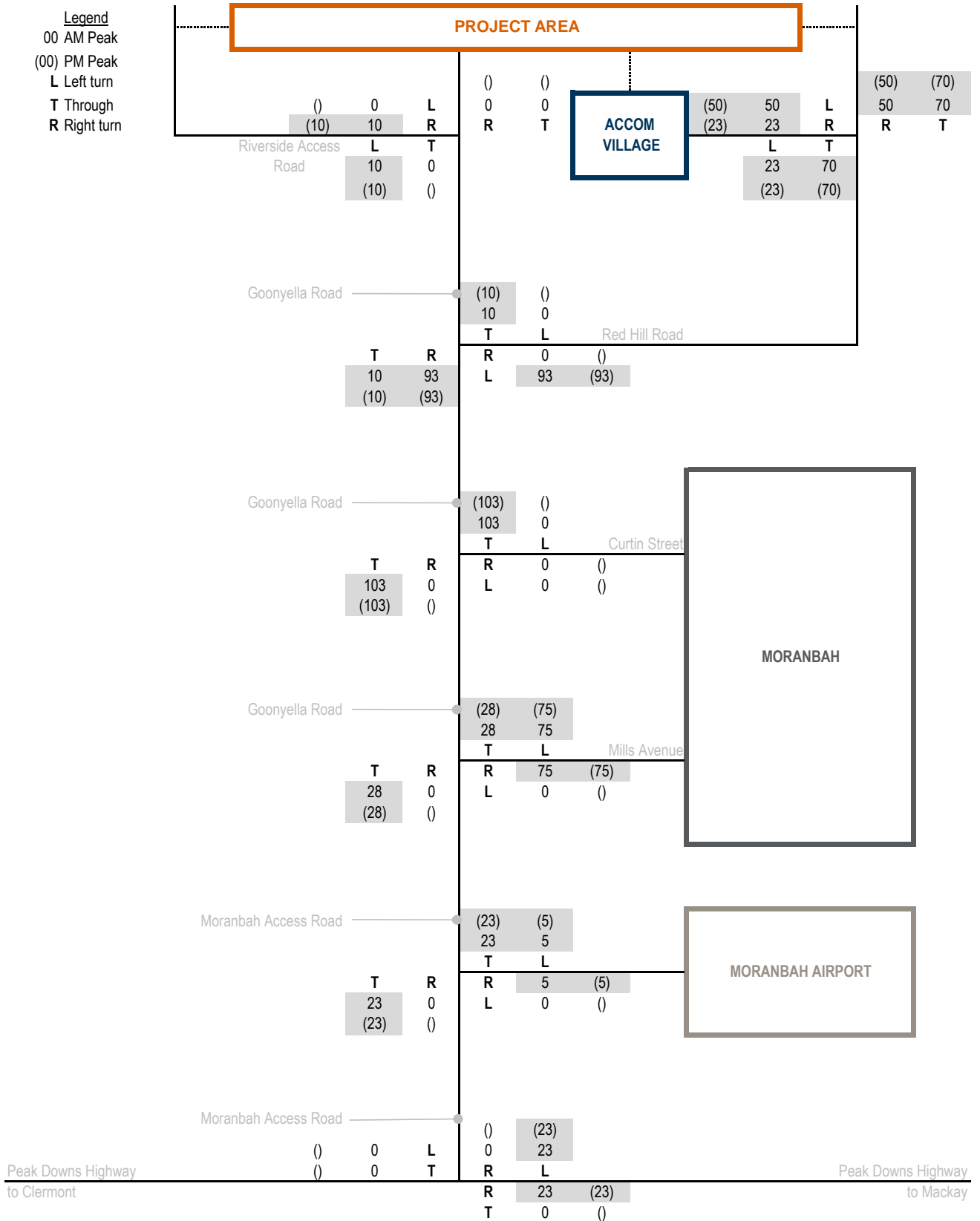
Construction Phase - All Trips

- Legend**
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



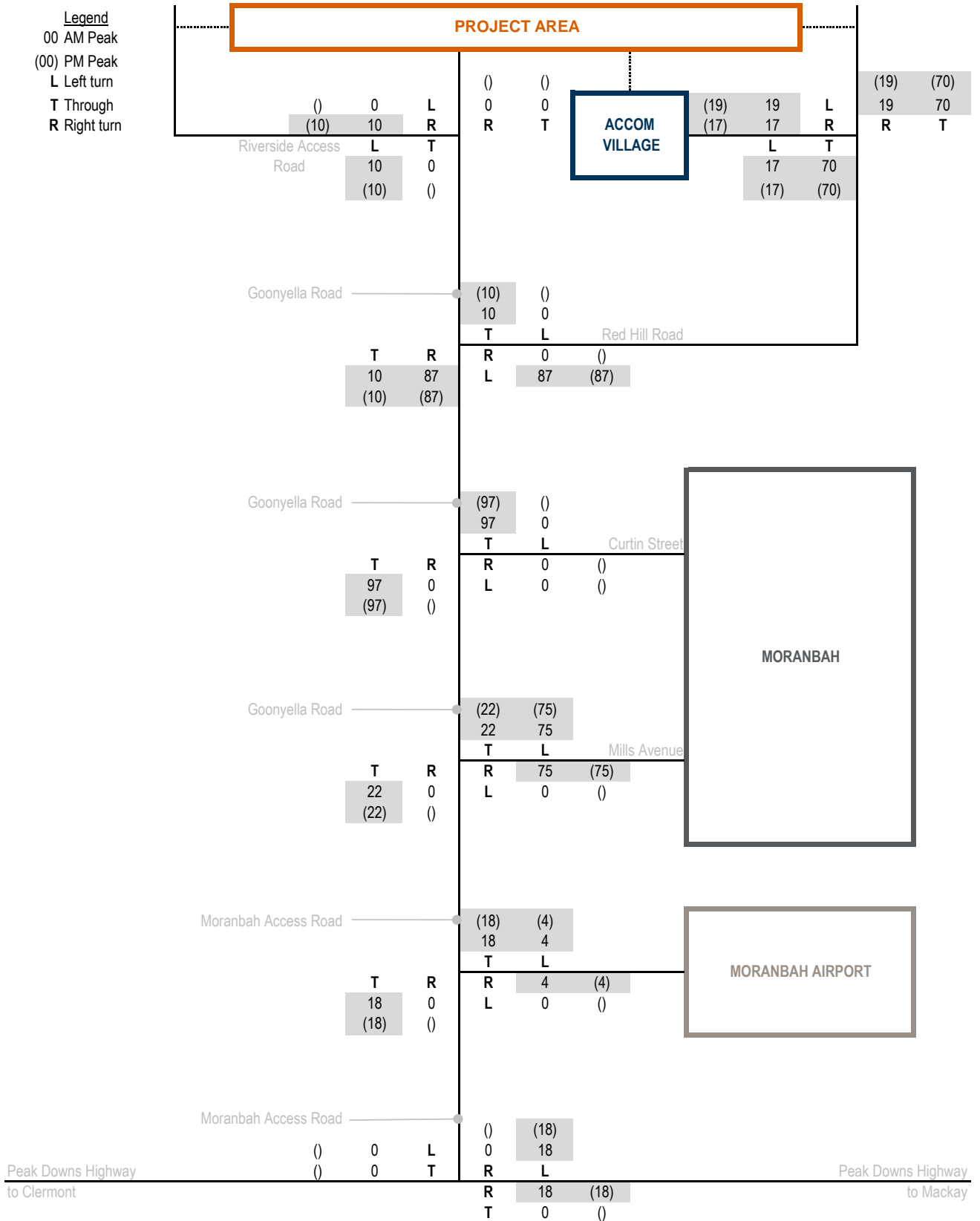
Overlap Phase - All Trips

- Legend**
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



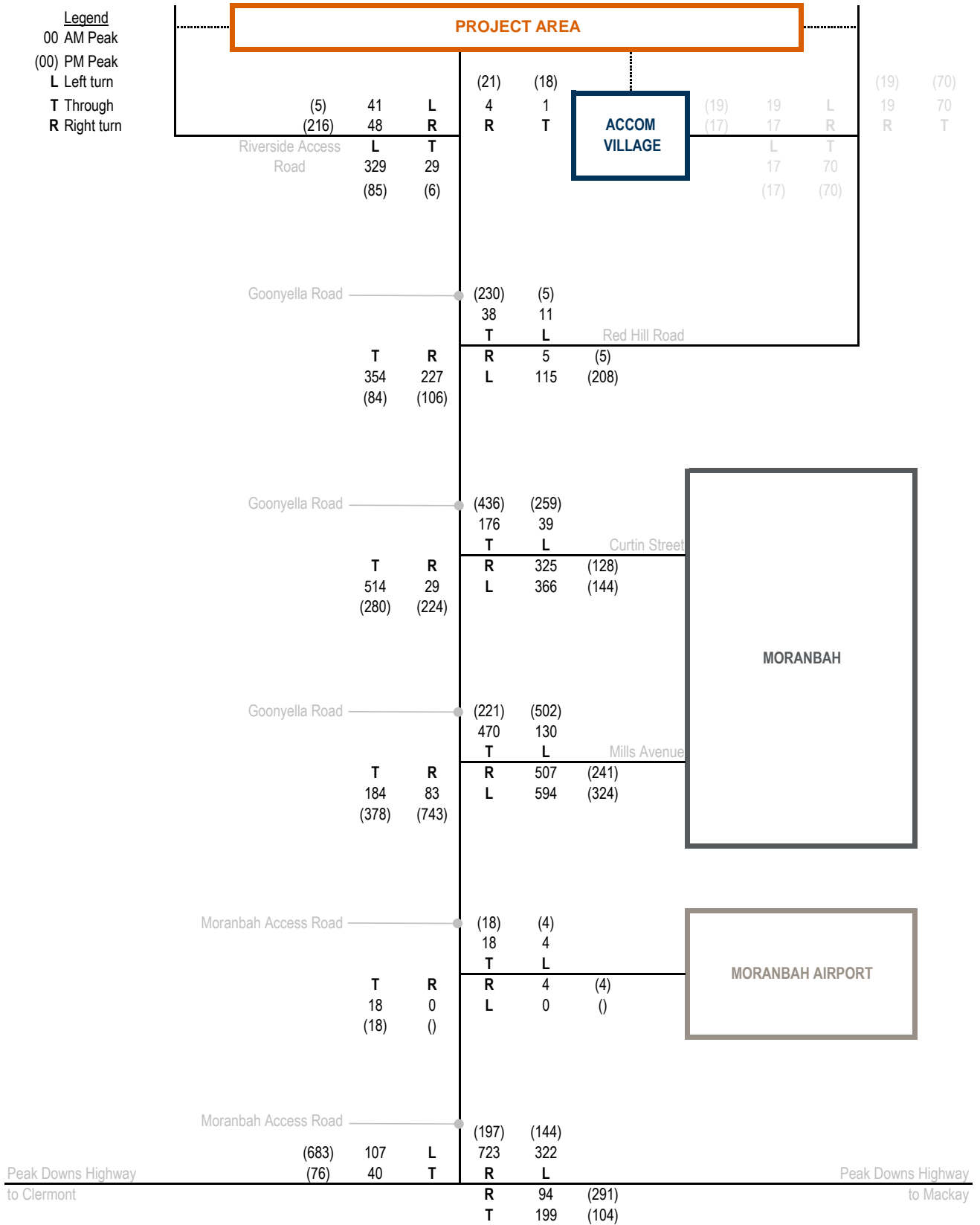
Operation Phase - All Trips

- Legend**
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



2034 Background + Operations

- Legend**
 00 AM Peak
 (00) PM Peak
 L Left turn
 T Through
 R Right turn



Road Impact Assessment

APPENDIX D
CONSTRUCTION AND OPERATION
ASSUMPTIONS

Table 1 - Broad Project Assumptions

| Item | Value |
|---------------------|------------|
| Output Increase | 14.0 MT/pa |
| Construction Start | 2020 |
| Construction Period | 4.0 years |
| Operation Start | 2022 |
| Operation Period | 23.0 |

Table 2 - Project Construction Assumptions (Total Construction Period)

| Item | Origin or Destination | Quantity (Total Construction Period) | Delivery Vehicle | Assumed Load Size | Total Construction Period Deliveries | Average Deliveries/PA during Construction Period | |
|-----------------------------|---|--------------------------------------|------------------|--------------------------|--------------------------------------|--|----------------------------|
| Inputs | Building Materials and Fuel | Mackay | 40,087 t | Single Articulated | 25 t | 1603 deliveries | 401 deliveries/pa |
| | Base and Sub-base materials | Moranbah | 939,000 t | 27m B-Double | 50 t | 18,780 deliveries | 4,695 deliveries/pa |
| | Concrete | Moranbah | 60,480 t | Concrete Transit Vehicle | 12 t | 5,040 deliveries | 1,260 deliveries/pa |
| | Prefabricated Buildings - Offices | Mackay | 600 t | Single Articulated | 10 t | 60 deliveries | 15 deliveries/pa |
| | Structural Steel | Mackay | 8,909 t | Single Articulated | 20 t | 445 deliveries | 111 deliveries/pa |
| | Mechanical Steel | Mackay | 2,100 t | Single Articulated | 20 t | 105 deliveries | 26 deliveries/pa |
| | Pipe work - Steel | Mackay | 1,410 t | Single Articulated | 20 t | 71 deliveries | 18 deliveries/pa |
| | Pipe work - Steel with Lining | Mackay | 2,103 t | Single Articulated | 20 t | 105 deliveries | 26 deliveries/pa |
| | Pipe work - PE | Mackay | 2,204 t | Single Articulated | 20 t | 110 deliveries | 28 deliveries/pa |
| | Electrical Reticulation Cable | Mackay | 341 t | Single Articulated | 20 t | 17 deliveries | 04 deliveries/pa |
| | Electrical Reticulation - (Poles 208 No.) | Mackay | 1,782 t | Single Articulated | 20 t | 35 deliveries | 09 deliveries/pa |
| | Conveyor Belts | Mackay | 858 t | Single Articulated | 20 t | 43 deliveries | 11 deliveries/pa |
| | Rotating Equipment -Pumps & Compressors | Mackay | 3,564 t | Single Articulated | 20 t | 70 deliveries | 18 deliveries/pa |
| | Process Equipment | Mackay | 1,527 t | Single Articulated | 20 t | 30 deliveries | 08 deliveries/pa |
| | Other Equipment | Mackay | 3,055 t | Single Articulated | 20 t | 60 deliveries | 15 deliveries/pa |
| | Asphalt | Mackay | 1,527 t | Single Articulated | 20 t | 76 deliveries | 19 deliveries/pa |
| | Bulk Bitumen - Polymer Modified | Mackay | 718 t | Single Articulated | 20 t | 36 deliveries | 09 deliveries/pa |
| | Miscellaneous | Mackay | 546 t | Single Unit Truck | 5t | 109 deliveries | 27 deliveries/pa |
| | Total | - | ~1,070,810 | - | - | 26,796 deliveries | 6,699 deliveries/pa |
| Outputs | Waste (Oil + Sludge, Hydraulic Fluid, metal, etc) | Mackay | 71 t | Single Articulated | 10 t | 7 deliveries | 2 deliveries/pa |
| | General and Recyclable Waste | Moranbah | 4182 t | Single Articulated | 10 t | 418 deliveries | 105 deliveries/pa |
| | Septic | Moranbah | m³ | Single Articulated | 20 m³ | 0 deliveries | 0 deliveries/pa |
| | Total | - | ~4,253 | - | - | 425 deliveries | 106 deliveries/pa |
| Total Input / Output | - | ~1,075,063 | - | - | 27,221 deliveries | 6,805 deliveries/pa | |

Table 3 - Project Operation Assumptions (Annual Assumptions)

| Item | Origin or Destination | Quantity (Annual) | Delivery Vehicle | Assumed Load Size | Deliveries Per Annum | Deliveries/Average Day | |
|-----------------------------|---|-------------------|------------------|--------------------|--------------------------|---------------------------------|---------------------------------|
| Inputs | Fuel & Additives | Mackay | 3,536 t | Tri - Semi | 34 t | 104 deliveries | 0 deliveries/pa |
| | Explosives | Moranbah | 00 t | Single Articulated | 20 t | 0 deliveries | 0 deliveries/pa |
| | General freight | Mackay | 10,400 t | Single Articulated | 20 t | 520 deliveries | 1 deliveries/pa |
| | Oil | Mackay | 90 t | 27m B-Double | 30,000 l | 3 deliveries | 0 deliveries/pa |
| | Total | | ~13,936 | | | 627 deliveries/pa | 2 deliveries/average day |
| Outputs | Waste (Oil + Sludge, Hydraulic Fluid, metal, Filters) | Mackay | 1,040 t | Single Articulated | 20 t | 52 deliveries | 0 deliveries/pa |
| | General and Recyclable Waste | Moranbah | 560 t | Single Articulated | 20 t | 28 deliveries | 0 deliveries/pa |
| | Septic | Moranbah | 00 t | Single Articulated | 20 m³ | 0 deliveries | 0 deliveries/pa |
| | Total | | ~1,600 | | | 80 deliveries/pa | 1 deliveries/average day |
| Total Input / Output | | ~15,536 | | | 707 deliveries/pa | 3 deliveries/average day | |

Road Impact Assessment

APPENDIX E
BIBLIOGRAPHY

In undertaking this road impact assessment the following material has been reviewed:

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APPENDIX F
GLOSSARY OF TERMS

| Term | Definition |
|--------------------------------------|---|
| 95%ile Queue | The length of vehicles in a queue that is exceeded only 5% of the time. A typical design parameter for intersections to estimate turning bay lengths. |
| Access | The location where vehicles move between private property and the public road network. |
| Annual Average Daily Traffic (AADT) | The volume of traffic over a day as averaged from a complete years' worth of traffic counts. |
| Austroroads | The association of Australian and New Zealand road transport and traffic authorities that aims to promote improved road transport outcomes and produces nationally accepted guidelines. |
| Average Daily Traffic (ADT) | The volume of traffic over a day as averaged from an incomplete year's worth of traffic counts. |
| Background Traffic | The expected volume of traffic at a particular point without the addition of the traffic associated with the Project under consideration. |
| Chainage | The distance in kilometres along a road from a defined starting point. |
| Crash Data | Recorded road crashes along a particular section of public road. |
| Critical delay | The highest average traffic delay experienced by any traffic movement at an intersection. |
| Critical Movement | In the context of critical traffic delays intersections, it is the traffic movement which experiences the highest average delay of any of the movements at that intersection. |
| Degree of Saturation (DOS) | The ratio of the number of vehicles requiring entry to an intersection in a specified period to the number which could enter if an approach was fully saturated (i.e. at capacity) during that period. |
| Department of Main Roads (DMR) | The former Queensland Government body responsible for operating and maintaining the state-controlled road network, now part of the Department of Transport and Main Roads. |
| Equivalent Standard Axles | The number of standard axle loads that are equivalent in damaging effect on a pavement to a given vehicle or axle loading. |
| External Road Network | The road network outside the direct control and ownership of a development project. The external road network is usually controlled by either the Department of Transport and Main Roads or a local council. |
| Growth Rate | The annual percentage change in the number of vehicles passing a given point on a road. |
| Heavy Vehicles | A heavy vehicle is defined as any vehicle with three or more axles or with dual tyres on the rear axle. |
| High entry angle left turn treatment | A left turn intersection treatment where the terminating road intersects at an angle close to 90° (generally between 70° and 110°). This treatment produces optimal sight angles. |
| Intersection Capacity | The maximum sustainable traffic flow rate at which vehicles can reasonably be expected to traverse a point or uniform segment of a lane or roadway under given roadway, geometric, traffic, environmental and control conditions; usually expressed as vehicles per hour. |
| Intersection Movement | A traffic path through an intersection with a discrete origin and destination. |
| Level of Service (LOS) | A qualitative measure describing traffic operational conditions within a traffic stream, and their perception by motorists and/or passengers. These conditions are generally described in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. |
| Light Vehicles | A light vehicle is defined as any vehicle with two axles and without dual tyres on the rear axle. |
| Mid-Block | The section of road between intersections. |
| Network Peak | The period usually hour long during which traffic volumes on the road network are at the highest level. |
| Pavement Impact | Pavements are designed to carry a pre-determined level of traffic load, measured in ESAs, after which the pavement is likely to require structural improvements. New developments can generate increased heavy vehicle traffic which may adversely impact the structure or condition of a pavement. |

| Term | Definition |
|----------------------------------|---|
| Pavement Markings | Any painted lines, raised pavement markers, traffic domes and the like placed on the road to direct and control the movement or parking of traffic. |
| Peak Period | Typically the one hour period that has the highest traffic demands. |
| Priority-Controlled Intersection | An intersection where the movement of vehicles is controlled by road rules and traffic control devices as opposed to traffic signals or a roundabout |
| Protected acceleration lane | An intersection treatment where left turning vehicles typically accelerate to the design speed of the intersecting road prior to completing a merge manoeuvre. |
| Right turn bay | A lane allocated for use exclusively by right turning vehicles. |
| Road Impact Assessment (RIA) | A study of a development project's impact on the efficiency and safety of the road network. Impacts may result from the presence of the development and the movement of vehicles to and from the development during its construction and operation. |
| Road and Traffic Authority (RTA) | The State Road Authority in New South Wales which is the State Government Agency responsible for the state road network. |
| Roundabout | A channelised intersection at which all traffic moves clockwise around a central traffic island. |
| Seagull Intersection | An intersection where a triangular island is used to separate turning traffic from through traffic in the same carriageway. |
| Seal Width | The width of the carriageway sealed to protect and waterproof the underlying pavement inclusive of sealed shoulders. |
| Sensitivity Analysis | Testing the relative change in a calculation based on a range of values for an input parameter. |
| SIDRA | Traffic analysis software developed by SIDRA SOLUTIONS which provides estimates of capacity and performance statistics for isolated intersections. |
| Signalised Intersection | An intersection at which the movement of vehicles and pedestrians is generally controlled by traffic signals. |
| State-Controlled Road | A road declared to be controlled by the Department of Transport and Main Roads, including all AusLink National Roads in Queensland. |
| Traffic Volumes | Typically the number of vehicles passing a given point during a specified period of time. |