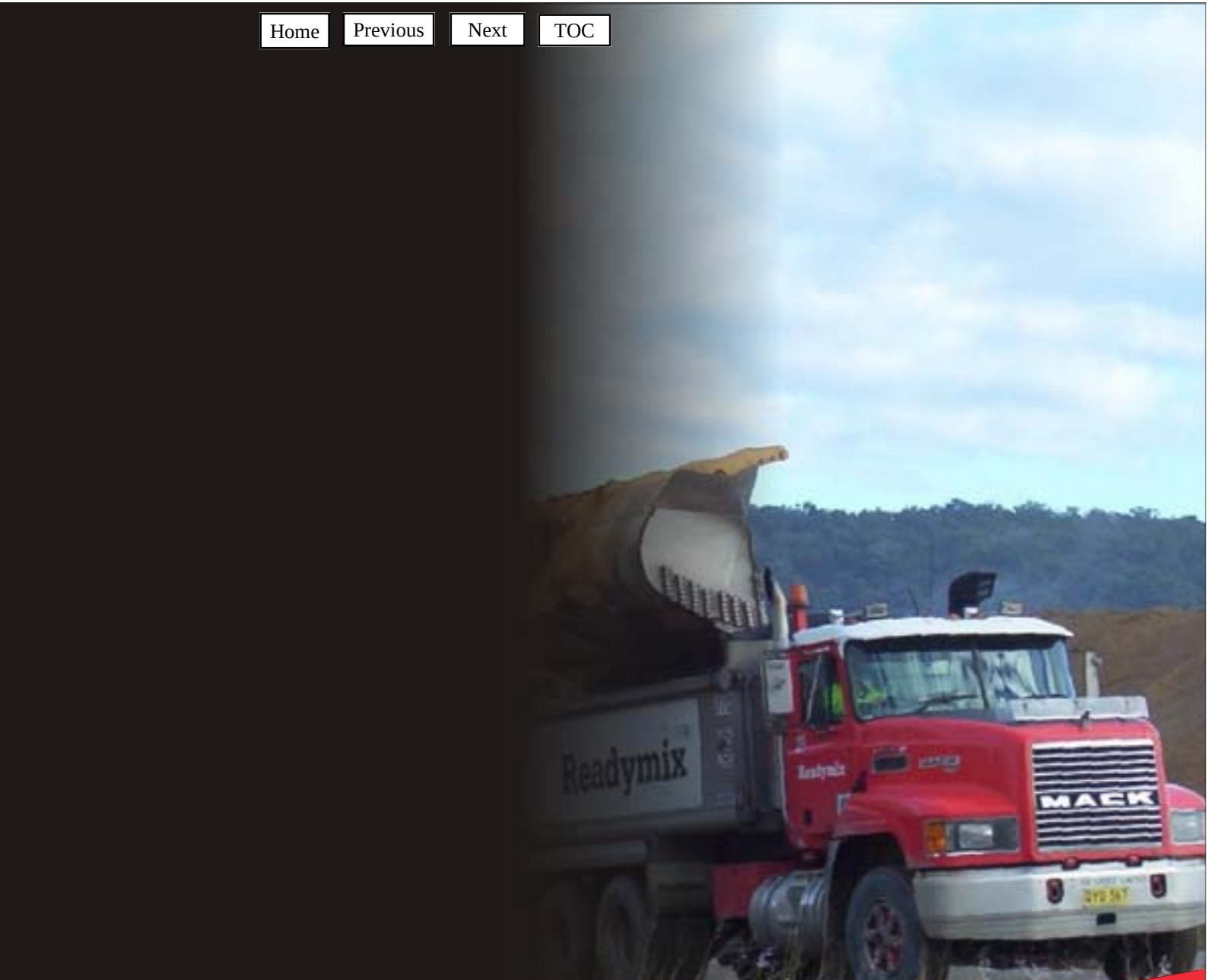

APPENDIX 6

Traffic Assessment

TRAFFIC & TRANSPORT IMPACT ASSESSMENT

FOR

PROPOSED LYNWOOD QUARRY

NEAR

MARULAN

Ref. 24181r

April, 2005

Prepared By

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EXECUTIVE SUMMARY

Introduction

This report documents the assessment of traffic and transport impacts of the proposed Lynwood Quarry west of Marulan.

Quarry Proposal

Readymix Holdings Pty Limited (Readymix) is seeking approval to develop and operate a quarry west of Marulan. The proposal is to operate the Quarry for an initial approval period of 30 years and produce up to 5 million tonnes per annum (Mtpa) of quarry product.

As part of the proposal, a rail balloon loop will be built to transport up to 5 Mtpa of quarry product to Sydney. Up to 1.5 Mtpa of quarry product may be transported by road to local and regional markets.

As part of the proposal, a new dedicated road will be built between the Hume Highway and the Quarry. This dedicated road will be connected to the Hume Highway with a full grade separated interchange at the existing South Marulan Road intersection. The provision of a grade separated intersection at this location will replace the unsatisfactory at grade intersection with South Marulan Road as well as cater for traffic generated by the Quarry.

The proposed hours of operation for the Quarry including road transport are 24 hours, seven (7) days per week.

After the Quarry becomes operational approximately 115 persons including contractors are expected to work at / from the Quarry in various shifts over the day. The day time shift, which generally occurs between 7.00 am and 6.00 pm, will be the busiest shift.

The construction phase for the Quarry and the associated infrastructure is expected to be approximately 24 months. Construction hours will be 7.00 am to 6.00 pm Monday to Friday and 7.00 am to 1.00 pm Saturday.

The construction workforce during the 24 month period will range from approximately 20 to 140 persons each day, with the maximum number of 140 persons required for about 5 months of the construction period. For the majority of the construction period between 90 and 120 people will be involved in construction activities on any day.

During the construction phase of the Quarry and the associated infrastructure, the principal road access to the Quarry site will be via the existing Marulan township at grade intersection with the Hume Highway (at Portland Avenue) and then via Portland Avenue and Wilson Drive to the site. This route passes through the industrial area of Marulan.

Readymix will contribute to the upgrade of the Portland Avenue / Wilson Drive route prior to the construction phase in order to ensure an appropriate road standard for construction traffic. At the completion of the construction phase, Readymix will

contribute to the repair of any damage to the route, as determined by pre and post construction road inspections of the road pavements.

Assessment of Existing Conditions

The existing traffic conditions on the road network at Marulan have been examined as part of this assessment.

A high level of traffic management has been provided along the Hume Highway with dual 2 lane carriageways and appropriate intersection treatments by way of additional turning and/or diverging / merging lanes for vehicles entering and leaving the Highway.

While the Highway carries significant traffic volumes (AADT of 19,662 (two way) with 22% heavy vehicles and average (5 day) of 18,694 vpd with 28% heavy vehicles), there is adequate road capacity to easily accommodate this level of traffic.

The existing traffic management at the at grade intersection of the Hume Highway and Portland Avenue is satisfactory. The Roads and Traffic Authority is proposing minor changes at this intersection to restrict cross movements to and from the adjacent service station.

These works will improve potential road safety at the intersection. Traffic modelling for the AM, business and PM peak hours indicates the intersection operates at a good Level of Service (A/B) with acceptable delays to the minor movements using the intersection.

Portland Avenue and Wilson Drive are Council roads and carry relatively low traffic volumes. Portland Avenue west of George Street has an AADT volume of 421 vehicles (per day), of which 12% are heavy vehicles. The weekday (5 day) average volume is 453 vpd. Wilson Drive south of the industrial area has an AADT volume of 119 vehicles (per day) with 17% heavy vehicles. The weekday (5 day) average volume is 116 vpd.

An assessment of existing traffic conditions along the Portland Avenue / Wilson Drive route, including the intersections, indicates that the traffic conditions are good and consistent with Level of Service A operation. While there are some sections of narrow and damaged pavement along the route, Readymix is proposing to contribute to improvement works in Portland Avenue and Wilson Drive prior to the commencement of the construction phase.

Pedestrian activity in Portland Avenue and Wilson Drive is minimal.

Assessment of Traffic Impacts of the Proposed Quarry

Operational Phase

The Quarry will generate some 570 vehicle trips on an average day of product transportation with 285 inbound and 285 outbound trips. Heavy vehicles will comprise 340 vehicle trips of this total.

Product truck movements are likely to number 20 truck movements per hour (i.e. 10 in / 10 out) on an average day with an estimated 324 product truck movements per day (162 in / 162 out) on an average day.

The increase in traffic volumes using the Hume Highway on an average weekday due to the proposed quarry represent some 3.1% of total vehicles and 6.5% of heavy vehicles. The increase in total traffic and heavy vehicles using the Hume Highway due to the proposal is small in real terms and the Highway has sufficient road capacity to easily absorb the traffic increases.

Over the life of the Quarry, it is expected that transportation levels of the product trucks may be higher than 20 truck movements per hour (10 in / 10 out) on busy days.

An assessment of the proposed interchange at South Marulan Road with the Quarry operating at higher road transportation levels (100 product movements per hour, 50 in / 50 out) indicates that the interchange and the Hume Highway will easily accommodate this level of traffic without any noticeable change / impact on capacity.

The proposed interchange on the Hume Highway will address the current unsatisfactory nature of the existing intersection and in addition, will provide a safe and adequate intersection for quarry traffic and other traffic using this intersection.

Construction Phase

During the busiest 5 months of construction, traffic volumes associated with the Quarry will increase traffic volumes in Portland Avenue / Wilson Drive by a total of 270 vehicles per day (135 in / 135 out). Heavy vehicles are expected to average 36 vehicle trips per day (18 in / 18 out).

The highest hourly volumes using the road network will occur at the start and finish times which is 7am and 6pm.

An assessment of the additional traffic volumes using the Portland Avenue / Wilson Drive route, including the intersections, indicates that the additional traffic volumes will have minimal impacts on the road network and intersections and traffic conditions will remain satisfactory.

The additional traffic will have minimal impacts on the adjoining land uses along the route which are industrial. As pedestrian activity in Portland Avenue and in Wilson Drive is minimal, the additional traffic is not expected to adversely impact on pedestrians.

As noted previously, Readymix is proposing to contribute to the upgrade of the Portland Avenue / Wilson Drive construction route, which will improve conditions along the route and enhance potential road safety.

At the completion of the construction phase, Readymix will cease to use the route for access to the Quarry and will contribute to the repair of any pavement damage along the route, as determined by pre and post construction inspections of the road pavements.

Proposed Interchange Intersection with Hume Highway

As noted above, this intersection will replace the existing unsatisfactory intersection at South Marulan Road and will provide a safe and adequate intersection for quarry traffic and other traffic using the intersection.

While Readymix will construct this intersection as part of this proposal, it seeks an agreement that other industrial users of the intersection will also contribute to the cost of the intersection. This could be achieved through the inclusion of consent conditions on future development consents.

Conclusions

In concluding, the traffic impacts associated with the proposed Quarry are considered to be minimal and traffic conditions on the road network will remain satisfactory during the construction period and after the Quarry becomes operational.

1.0 INTRODUCTION

Readymix Holdings Pty Ltd (Readymix) is seeking development approval for a major quarry located approximately 2 kilometres west of Marulan, northeast of Goulburn NSW. The project area occupies approximately 1000 hectares adjacent to the Hume Highway and is dissected by the Main Southern Railway (refer to **Figure 1**).

The Quarry will produce up to 5 million tonnes per annum (Mtpa) of product, up to 1.5 Mtpa of which may be transported by road to local and regional markets in any one year.

This report has been prepared as part of the Environmental Impact Statement to assess the traffic impacts associated with the Quarry's road based transportation and the traffic impacts during the construction period of the Quarry.

The remaining sections of this report address the following:

- Section 2 describes the proposal.
- Section 3 examines the existing traffic conditions on the road network.
- Section 4 evaluates the traffic impacts of the proposed Quarry, including during the construction period; and
- Section 5 provides conclusions.

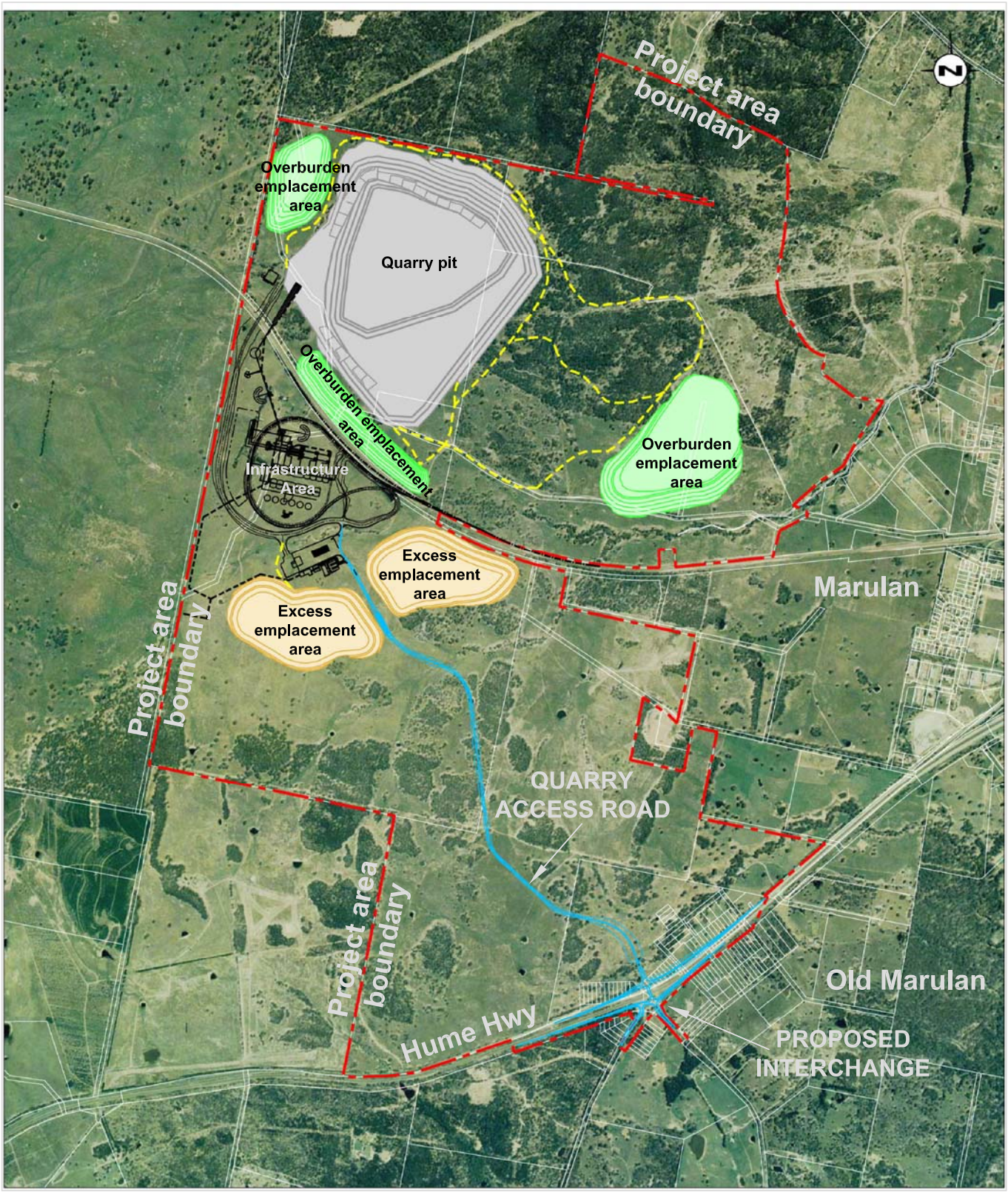

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FIGURE 1
LYNWOOD QUARRY
SITE LOCATION AND PROPOSAL
JOB NO.24181

2.0 PROPOSAL

2.1 Operational Phase

2.1.1 Quarry Proposal

The proposal is to develop and operate the Quarry west of Marulan on the subject site. Readymix is seeking approval to operate the Quarry for an initial period of 30 years and produce up to 5 Mtpa of quarry product.

The proposal will include a rail balloon loop which will transport up to 5 Mtpa of quarry product to Sydney.

Up to 1.5 Mtpa of quarry product may be transported by road to local and regional markets.

As part of the proposal a new dedicated road will be built between the Hume Highway and the Quarry. This dedicated road will be connected to the Hume Highway with a full grade separated interchange at the existing South Marulan Road intersection.

The concept design for the proposed interchange is shown in **Figure 2**. The main features of the interchange are:

- Off and on ramps for both directions of travel on the Hume Highway together with deceleration and acceleration lanes for diverging and merging manoeuvres.

- Elevated at grade intersections at the top of the ramps, with suitable road connections to South Marulan Road and Jerrara Road.

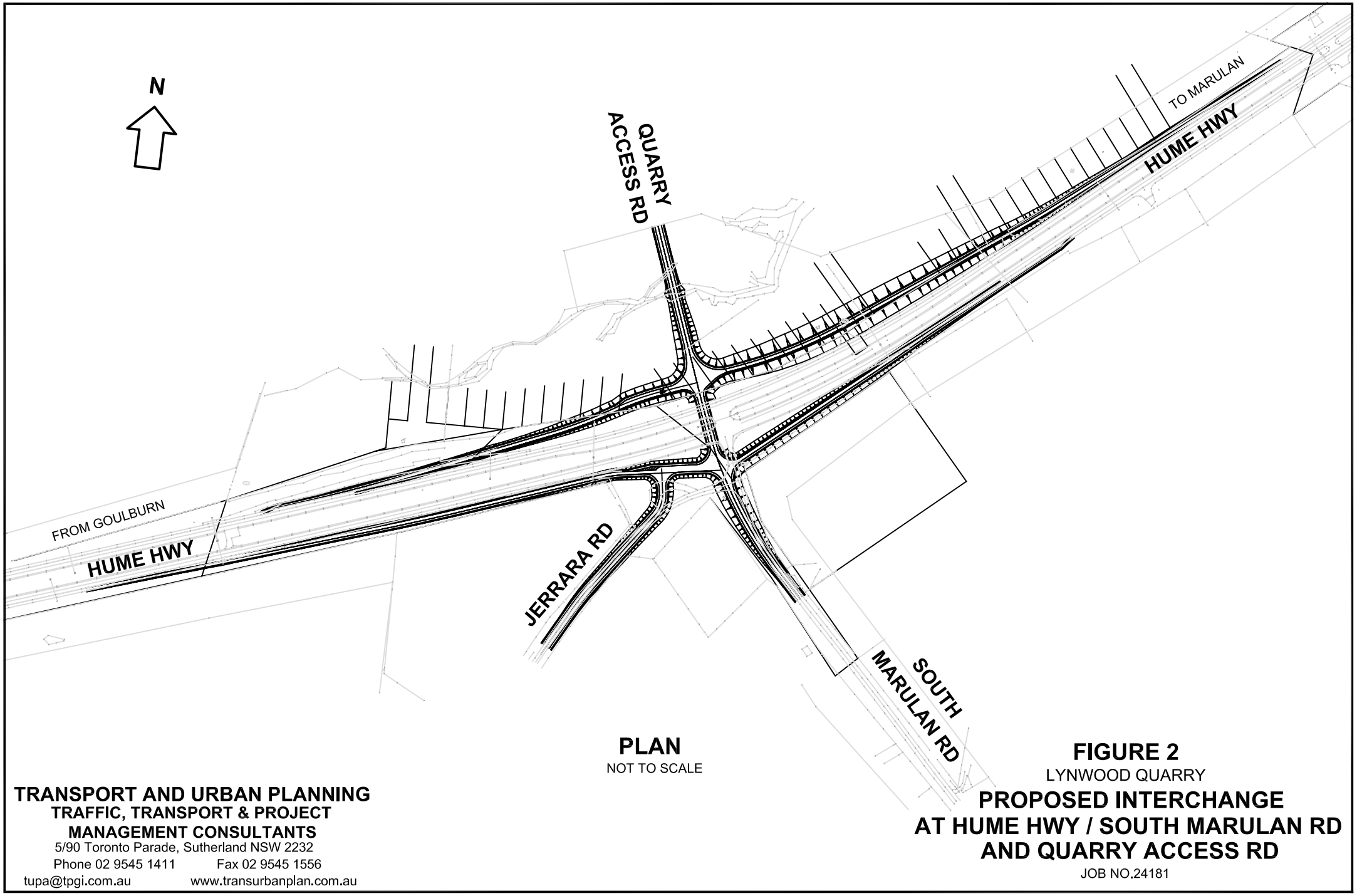
The proposed interchange will be designed to suit Roads & Traffic Authority (RTA) and Austroad Standards and will address the current unsatisfactory nature of the existing intersection. In addition, it will provide a safe and adequate intersection for quarry traffic and other traffic using the intersection.

2.1.2 Hours of Operation

The proposed hours of operation for the Quarry including road transport are 24 hours, seven (7) days per week.

2.1.3 Workforce

Approximately 115 persons including contractors are expected to work at / from the Quarry in various shifts over the day. The day time shift, which generally occurs between 7.00 am and 6.00 pm, will be the busiest shift.



PLAN
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FIGURE 2
LYNWOOD QUARRY
PROPOSED INTERCHANGE AT HUME HWY / SOUTH MARULAN RD AND QUARRY ACCESS RD
JOB NO.24181

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2.1.4 Product Transport by Road

Readymix proposes that up to 1.5 Mtpa of quarry product may be transported by road, resulting in 162 loads per day on an average day (i.e. 162 truck movements in / 162 truck movements out).

Most trucks used for product transportation will be rigid trucks with dog trailers, although some semi trailers and B Doubles will also be used. The average load is expected to be 32 tonne.

All product trucks will use the dedicated quarry road and the interchange with the Hume Highway. Initially, the majority of product trucks are expected to travel north east towards Sydney with a small proportion to travel south west towards Goulburn / Canberra. In time Readymix expects that the proportion travelling to the south / west may increase.

2.1.5 Employee and Other Trips

It is expected that all employees / contractors will use motor vehicles as their principal transport to and from the Quarry. Allowing for some sharing of motor vehicles based on 1.2 persons per car, employee trips per day are estimated to be 95 in / 95 out. All employee vehicle trips will be light vehicle trips.

Other trips to the Quarry are assumed to include:

- Average of 10 couriers per day, which will be light vehicle trips;
- 10 maintenance vehicles per day, which will be a mixture of light and heavy vehicles;
- Up to 5 visitors per day, which will be light vehicles;
- 4 delivery vehicles per week for fuel and other quarry supplies, which will be heavy vehicles, plus 2 bulk deliveries per day (heavy vehicles); and
- 6 hire equipment deliveries every 3 months, which will be heavy vehicles.

2.2 Construction Phase

2.2.1 Timing and Hours of Operation

The construction phase for the Quarry and the associated infrastructure is expected to be approximately 24 months.

Construction hours will be 7.00 am to 6.00 pm Monday to Friday and 7.00 am to 1.00 pm Saturday.

2.2.2 Workforce

The construction workforce during the 24 month period will range from approximately 20 up to approximately 140 persons each day, with the maximum number of 140 persons required for about 5 months of the construction period. For the majority of the construction period between 90 and 120 people will be involved in the construction on any day.

2.2.3 Construction Road Routes

The principal road access to the Quarry site will be via the existing Marulan township at grade intersection with the Hume Highway (at Portland Avenue) and then via Portland Avenue and Wilson Drive to the site.

During the early stage of the construction Stoney Creek Road will be used by a small number of vehicles to access the Quarry site, north of the Main Southern Railway. Stoney Creek Road will be the only way to access this portion of the site, until the rail bridge is completed. Once the bridge over the rail line is completed, the Stoney Creek Road route will not be used as a construction access route. Vehicles using Stoney Creek Road will access this road from Brayton Road and not via the rail level crossing on Portland Avenue / Stoney Creek Road.

2.2.4 Construction Traffic

The construction traffic will include:

- Employees / contractors work trips estimated between 16-117 vehicles per day (assuming vehicle occupancy of 1.2 persons)[1];

- Up to 125 truck deliveries a month during the busiest periods of construction with an average of 4-5 truck deliveries per day.

In addition, Readymix is seeking approval to export excess excavated and crushed material from the site during the construction period with up to 13 truck loads per day (i.e. 13 truck movements in / 13 truck movements out) on a 5 day per week basis.

[1] Readymix has advised that, based on previous projects, vehicle occupancies during the construction phase will be in the order of 1.5 to 2.0 persons per vehicle. However, to ensure a worst case or conservative assessment is undertaken, a lower vehicle occupancy of 1.2 persons per vehicle has been adopted

3.0 EXISTING TRAFFIC CONDITIONS

3.1 Principal Road Network

The principal road network that will provide access to the proposed Lynwood Quarry and form the main transport routes following the commissioning of the Quarry include:

- Hume Highway, which is a State Road and National Route under the control of the RTA;

- A dedicated 2 lane Quarry Road which will be constructed between the Quarry processing area and the Hume Highway. It is proposed that a full grade separated intersection will be provided with the Hume Highway at the existing South Marulan Road intersection.

During the construction phase, the principal access roads will include:

- Hume Highway (State Road);
- Portland Avenue / Wilson Drive route between the Hume Highway and the Quarry site (Council Road).

Figure 3 shows the principal road network for the proposal.

3.2 Description and Assessment of Existing Roads

3.2.1 Hume Highway

The Hume Highway is a high standard 4 lane divided road with dual carriageways. The Highway is the main road corridor between Sydney and Melbourne / the ACT, as well as servicing those towns / communities in south western NSW.

In the Marulan area the Hume Highway provides 2 through lanes in each direction plus additional turning and/or diverging / merging lanes at intersections for vehicles entering or leaving the Highway.

The speed limit on this section of the Hume Highway is 110km/h. A high level of traffic management is provided in the Hume Highway including wide shoulders, delineation and signage.

The principal intersections along the Hume Highway at Marulan include:

- A grade separated interchange at the northern end of Marulan that provides the main access to the township including access to George Street.

- An at grade intersection at Portland Avenue, which includes left and right turn lanes (acceleration and deceleration lanes) for turns to and from the Hume Highway.

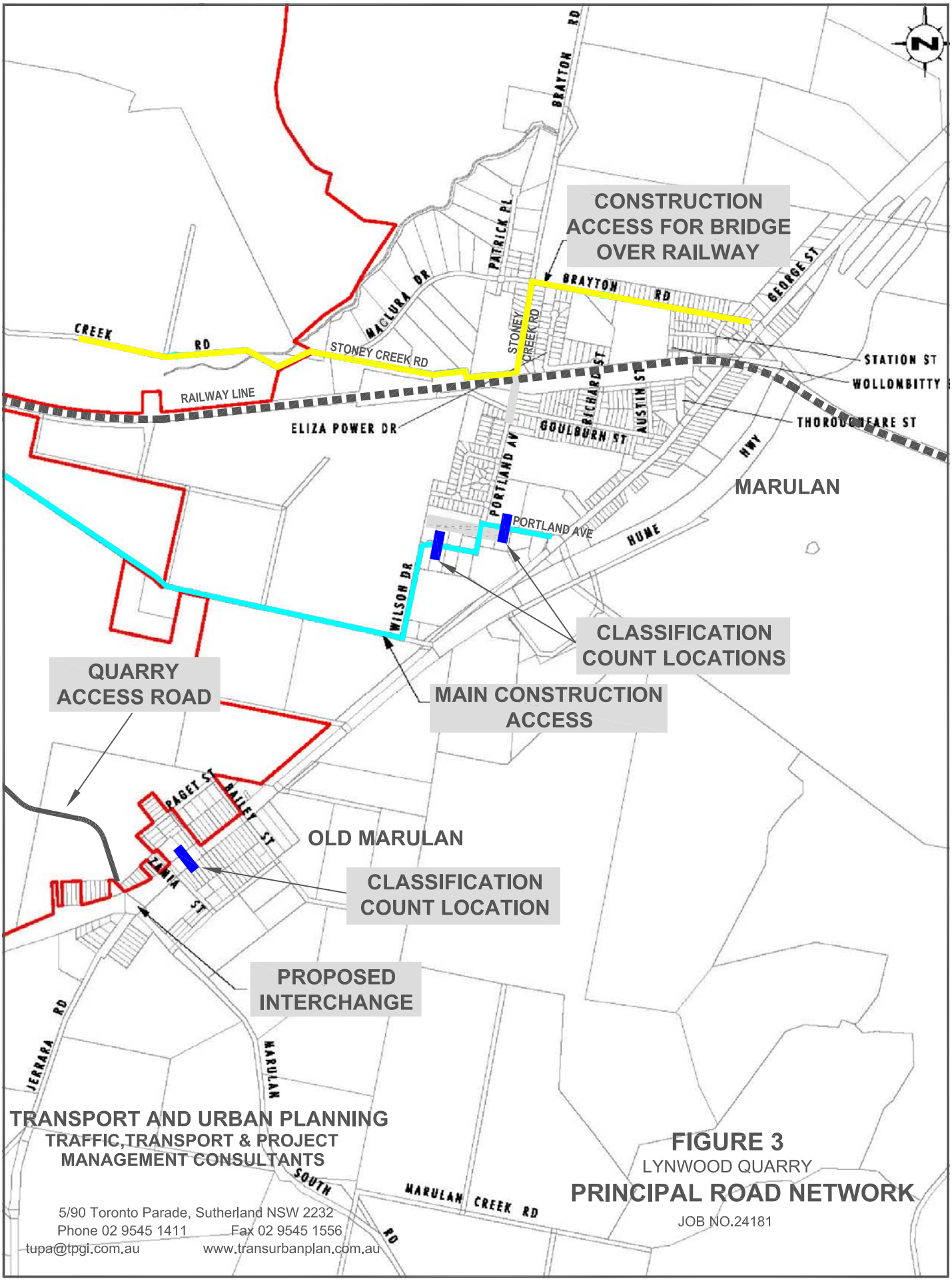

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FIGURE 3
LYNWOOD QUARRY
PRINCIPAL ROAD NETWORK
JOB NO.24181

- An at grade intersection at South Marulan Road which provides minimum turning lanes. This intersection provides access to South Marulan and Bungonia and is used by heavy vehicles.

3.2.2 Portland Avenue / Wilson Drive Route

This route as measured between the Hume Highway and the Quarry site's boundary is approximately 2.2km long and passes through the industrial area of Marulan.

The route provides for 2 lanes of traffic (single lane in each direction) on a road pavement that varies between 5.6 metres and 6.4 metres. For most sections of the route a pavement width of 6.0 metres is maintained together with gravel shoulders between 0.5 and 2.0 metres wide. However, there are several sections with narrower road pavement and broken edges, as well as small sections of poor pavement in Portland Avenue and in Wilson Drive. No kerb and gutter is provided along the route. The speed limit along the route is 50km/h.

The horizontal alignment of the route in Wilson Drive changes direction several times with 90 degree bends connecting straight sections. There is minimal delineation along the road. The route is relatively flat in the eastern part, with relatively modest grades on several sections in the western part of the route.

Principal intersections along the route include:

- Portland Avenue / George Street intersection which is a cross intersection adjacent to the Hume Highway controlled by a roundabout;

- Portland Avenue / Wilson Drive intersection which is a T junction intersection.

The land uses served by Portland Avenue and Wilson Drive are predominantly industrial as well as several rural properties and Marulan's waste management facility, which is located at the northern end of Wilson Drive, adjacent to the site entrance.

3.2.3 Intersections

The intersections in Marulan that will be used by construction traffic during the construction period include:

- Hume Highway / Portland Avenue intersection;
- Portland Avenue / George Street intersection;
- Portland Avenue / Wilson Drive.

Hume Highway / Portland Avenue Intersection

Portland Avenue forms a T junction with the Hume Highway. The intersection's geometry includes:

- 2 lane dual carriageways separated by a wide median which provides a holding area for traffic crossing the carriageways (i.e. right turn traffic);

- a right turn bay (deceleration lane) and acceleration lane in the Highway to cater for right turn movements into and out of Portland Avenue;

- left turn deceleration and acceleration lanes in the Highway to cater for left turn into and out of Portland Avenue

- 2 lanes in Portland Avenue.

Sight distance at the intersection is good and easily meets the Austroad requirements for safe stopping sight distance for the vehicle operating speeds at the intersection.

The intersection caters for traffic exiting the service centre located south west of Portland Avenue, as well as traffic generated in Marulan (Portland Avenue and George Street). **Figure 4** shows the current road geometry at the intersection.

It is understood that the RTA is proposing changes at the intersection to prevent vehicles crossing from Portland Avenue into the service station, on the south eastern side of the intersection (i.e. opposite Portland Avenue). These changes will improve road safety at the intersection.

Portland Avenue / George Street Intersection

This intersection is a cross junction intersection and is located some 50 metres west of the northeast bound carriageway of the Hume Highway (refer to **Figure 4**).

Traffic management includes roundabout control of the intersection and street lighting.

Sight distance at the intersection is good in all approaches and meets Austroad requirements for the vehicle operating speeds at the intersection.

The intersection caters for traffic exiting the service centre to the southwest, as well as traffic generated in Marulan.

Portland Avenue / Wilson Drive

This intersection is a minor T junction intersection with priority control on the eastern arm of Portland Avenue.

Sight distance at the intersection is good and meets Austroad requirements for safe stopping sight distance for the vehicle operating speeds at the intersection.

The intersection principally caters for traffic generated by the industrial area in Marulan, as well as the waste management facility and carries relatively low traffic volumes.

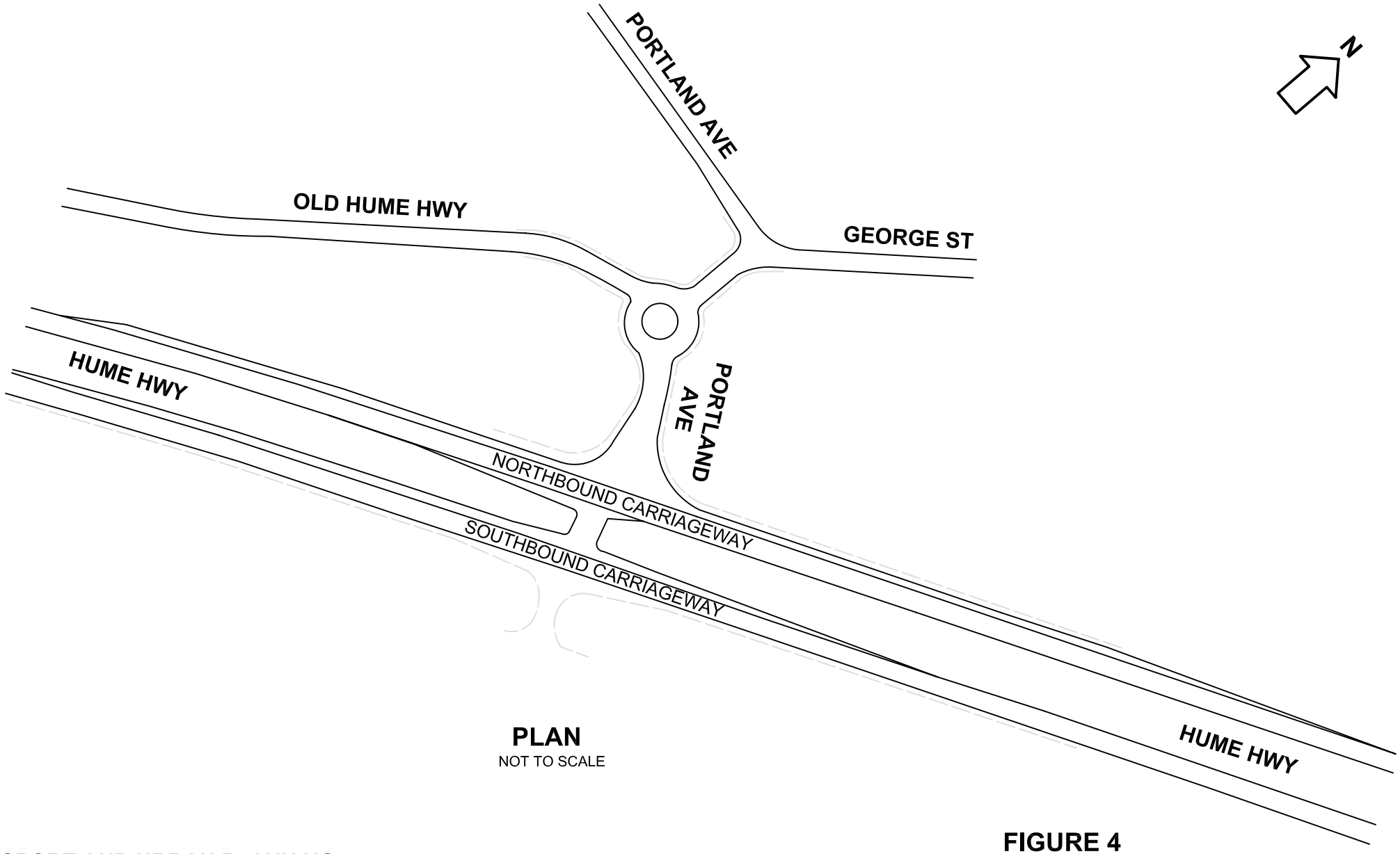

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FIGURE 4
LYNWOOD QUARRY
HUME HWY / PORTLAND AVE AND PORTLAND AVE / GEORGE ST INTERSECTIONS
JOB NO.24181

3.2.4 Stoney Creek Road

Stoney Creek Road provides an alternative route onto the quarry site. Stoney Creek Road connects to Brayton Road at its northern end. The section between Brayton Road and Portland Avenue is a sealed road pavement providing a single lane of travel in each direction. West of Portland Avenue, Stoney Creek Road is a gravel road of varying road width which generally provides sufficient room for 2 vehicles.

Stoney Creek Road forms a 90 degree junction intersection with Portland Avenue just north of the rail level crossing. Sight distance at the intersection is satisfactory and meets Austroad requirements for safe stopping sight distance for the estimated vehicle operating speeds at the intersection.

Stoney Creek Road's role during the construction period will be relatively minor (i.e. small number of employee and delivery trips for several months). Its use will be managed with all vehicles accessing Stoney Creek Road via Brayton Road. Once the Quarry is operational Stoney Creek Road will not be used to access the Quarry.

3.3 Existing Traffic Conditions on the Road Network

3.3.1 Traffic Volumes

Traffic volumes using the principal road network in Marulan were collected as part of this assessment. This included daily volume and vehicle classification counts on the Hume Highway, Portland Avenue and Wilson Drive and peak hour intersection counts at the major intersections of Hume Highway / Portland Avenue and Portland Avenue / George Street. **Figure 3** shows the traffic count locations. Traffic counts were not collected for the Portland Avenue / Wilson Drive intersection due to the low traffic volumes that use this intersection, which are generally less than 50 vehicles per hour (vph).

3.3.2 Daily Traffic Volumes

The volume and classification counts were undertaken between 15 and 21 February 2005.

Tables 3.1 and 3.2 show the traffic volumes using the Hume Highway north east of South Marulan Road. Reference to Tables 3.1 and 3.2 shows that the Highway on a typical weekday (5 day average) carries two way traffic volumes of 18,694 vehicles, of which 28% are heavy vehicles (Austroad Classes 3-12). Friday and Sunday carry the highest traffic volumes (24,670 – 24,768 vpd) resulting in a 7 day (AADT) average volume of 19,662 vehicles of which 22% are heavy vehicles.

While traffic flows in each direction of the Highway are consistent throughout the day, traffic conditions are good with spare capacity.

TABLE 3.1

HUME HIGHWAY AT SOUTH MARULAN
DAILY TRAFFIC VOLUMES

Direction of Travel	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	5 Day Average (Weekday)	7 Day Average (AADT)
Northeast	7,911	7,862	8,414	9,454	13,051	9,931	12,196	9,338	9,831
Southwest	9,620	8,200	8,375	8,966	11,619	9,467	12,572	9,356	9,831
Total	**17,531**	**16,062**	**16,789**	**18,420**	**24,670**	**19,398**	**24,768**	**18,694**	**19,662**

Source: Traffic Counts 15-21 February 2005

TABLE 3.2

HUME HIGHWAY AT SOUTH MARULAN
VEHICLE CLASSIFICATIONS FOR 5 DAY AVERAGE AND 7 DAY AVERAGE

Direction of Travel	5 Day Average (Weekday)			7 Day Average (AADT)		
	Light [1]	Heavy [2]	Total	Light [1]	Heavy [2]	Total
Northeast	6,742	2,596	9,338	7,594	2,237	9,831
Southwest	6,733	2,623	9,356	7,672	2,159	9,831
Total	**13,475**	**5,219**	**18,694**	**15,266**	**4,396**	**19,662**
%	**72%**	**28%**	**100%**	**78%**	**22%**	**100%**

[1] Light Vehicles – Austroads 1 and 2 vehicle classification
[2] Heavy Vehicles – Austroads 3-12 vehicle classification

Source: Traffic Counts 15-21 February 2005

Tables 3.3, 3.4 and 3.5 show the daily two way traffic volumes and vehicle classifications using Portland Avenue, west of George Street.

Reference to Tables 3.3 and 3.4 shows that typical weekday volumes (5 day average) are 453 vehicles per day of which 14% are heavy vehicles. Typical 7 day average (AADT) two way traffic volumes in Portland Avenue are 421 vehicles per day.

Table 3.5 shows the hourly traffic volumes in Portland Avenue for a typical week day and 7 day average day.

These traffic volumes represent light traffic conditions in Portland Avenue and are consistent with Level of Service A road conditions.

TABLE 3.3

PORTLAND AVENUE WEST OF GEORGE STREET
DAILY (TWO WAY) TRAFFIC VOLUMES

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	5 Day Average (Weekday)	7 Day Average (AADT)
Total	**431**	**419**	**485**	**446**	**488**	**398**	**29**	**453**	**421**

Source: Traffic Counts 15-21 February 2005

TABLE 3.4

PORTLAND AVENUE WEST OF GEORGE STREET VEHICLE CLASSIFICATIONS FOR 5 DAY AVERAGE AND 7 DAY AVERAGE

	5 Day Average (Weekday)			7 Day Average (AADT)		
	Light [1]	**Heavy [2]**	**Total**	**Light [1]**	**Heavy [2]**	**Total**
Total Two Way Volumes	389	64	453	371	50	421
%	**86%**	**14%**	**100%**	**88%**	**12%**	**100%**

[1] Light Vehicles – Austroads 1 and 2 vehicle classification
[2] Heavy Vehicles – Austroads 3-12 vehicle classification
Source: Traffic Counts 15-21 February 2005

TABLE 3.5

PORTLAND AVENUE HOURLY TRAFFIC VOLUMES

Time	**5 Day Average (Weekday)**			**7 Day Average (AADT)**		
	East	**West**	**Total**	**East**	**West**	**Total**
Midnight – 1am	2	0	2	2	0	2
1am – 2am	1	0	1	1	0	1
2am – 3am	0	0	0	0	0	0
3am – 4am	0	1	1	0	1	1
4am – 5am	1	1	2	1	1	2
5am – 6am	4	4	8	3	3	6
6am – 7am	6	15	21	5	12	17
7am – 8am	11	13	24	10	12	22
8am – 9am	14	18	32	13	15	28
9am – 10am	17	19	36	15	17	32
10am -11am	14	19	32	15	18	33
11am – Midday	12	14	26	13	15	28
Midday – 1pm	14	13	27	16	12	28
1pm – 2pm	14	13	27	14	13	27
2pm – 3pm	13	16	29	13	15	28
3pm – 4pm	25	22	47	21	18	39
4pm – 5pm	24	19	43	21	17	38
5pm – 6pm	19	13	32	17	12	29
6pm – 7pm	15	9	24	13	7	20
7pm – 8pm	8	7	15	8	8	16
8pm – 9pm	5	5	10	5	5	10
9pm -10pm	6	2	8	6	2	8
10pm – 11pm	3	1	4	3	1	4
11pm – Midnight	1	1	2	1	1	2
Total	**229**	**225**	**453**	**216**	**205**	**421**

Source: Traffic Counts 15-21 February 2005

Tables 3.6, 3.7 and 3.8 show the traffic volumes using Wilson Drive adjacent to the western end of the industrial area.

Reference to Tables 3.6 and 3.7 shows that typical weekday (5 day average) and 7 day average two way traffic volumes are in the order of 116-119 vehicles per day. Heavy vehicles comprise 20%-21% of these vehicles.

Table 3.8 shows the hourly traffic volumes in Wilson Drive for a typical week day and 7 day average day.

These traffic volumes represent very light traffic conditions in Wilson Drive consistent with Level of Service A road conditions.

TABLE 3.6

WILSON DRIVE SOUTH OF INDUSTRIAL AREA
DAILY (TWO WAY) TRAFFIC VOLUMES

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	5 Day Average (Weekday)	7 Day Average (AADT)
Total Two Way Volumes	**85**	**95**	**119**	**133**	**151**	**150**	**100**	**116**	**119**

Source: Traffic Counts 15-21 February 2005-03-01

TABLE 3.7

WILSON DRIVE SOUTH OF INDUSTRIAL AREA
VEHICLE CLASSIFICATIONS FOR 5 DAY AVERAGE
AND 7 DAY AVERAGE

Total Two Way Volumes	5 Day Average (Weekday)			7 Day Average (AADT)		
	Light [1]	Heavy [2]	Total	Light [1]	Heavy [2]	Total
	96	20	116	98	21	119
Percentage	83%	17%	100%	83%	17%	100%

[1] Light Vehicles – Austroads 1 and 2 vehicle classification
[2] Heavy Vehicles – Austroads 3-12 vehicle classification

Source: Traffic Counts 15-21 February 2005

TABLE 3.8

WILSON DRIVE
HOURLY TRAFFIC VOLUMES

Time	5 Day Average (Weekday)			7 Day Average (AADT)		
	East	West	Total	East	West	Total
Midnight – 1am	0	0	0	0	0	0
1am – 2am	0	0	0	0	0	0
2am – 3am	0	0	0	0	0	0
3am – 4am	0	0	0	0	0	0
4am – 5am	0	0	0	0	0	0
5am – 6am	0	2	2	0	2	2
6am – 7am	3	3	6	2	2	4
7am – 8am	3	3	6	2	3	5
8am – 9am	5	5	10	4	5	9
9am – 10am	4	6	10	3	5	8
10am -11am	4	4	8	5	5	10
11am – Midday	5	5	10	6	6	12
Midday – 1pm	4	6	10	4	6	10
1pm – 2pm	4	5	9	4	5	9
2pm – 3pm	4	4	8	5	5	10
3pm – 4pm	4	5	9	3	5	8
4pm – 5pm	6	5	11	6	5	11
5pm – 6pm	3	3	6	3	3	6
6pm – 7pm	2	2	4	2	3	5
7pm – 8pm	1	1	2	2	2	4
8pm – 9pm	1	2	3	2	2	4
9pm -10pm	0	2	2	0	2	2
10pm – 11pm	0	0	0	0	0	0
11pm – Midnight	0	0	0	0	0	0
Total	**53**	**63**	**116**	**53**	**66**	**119**

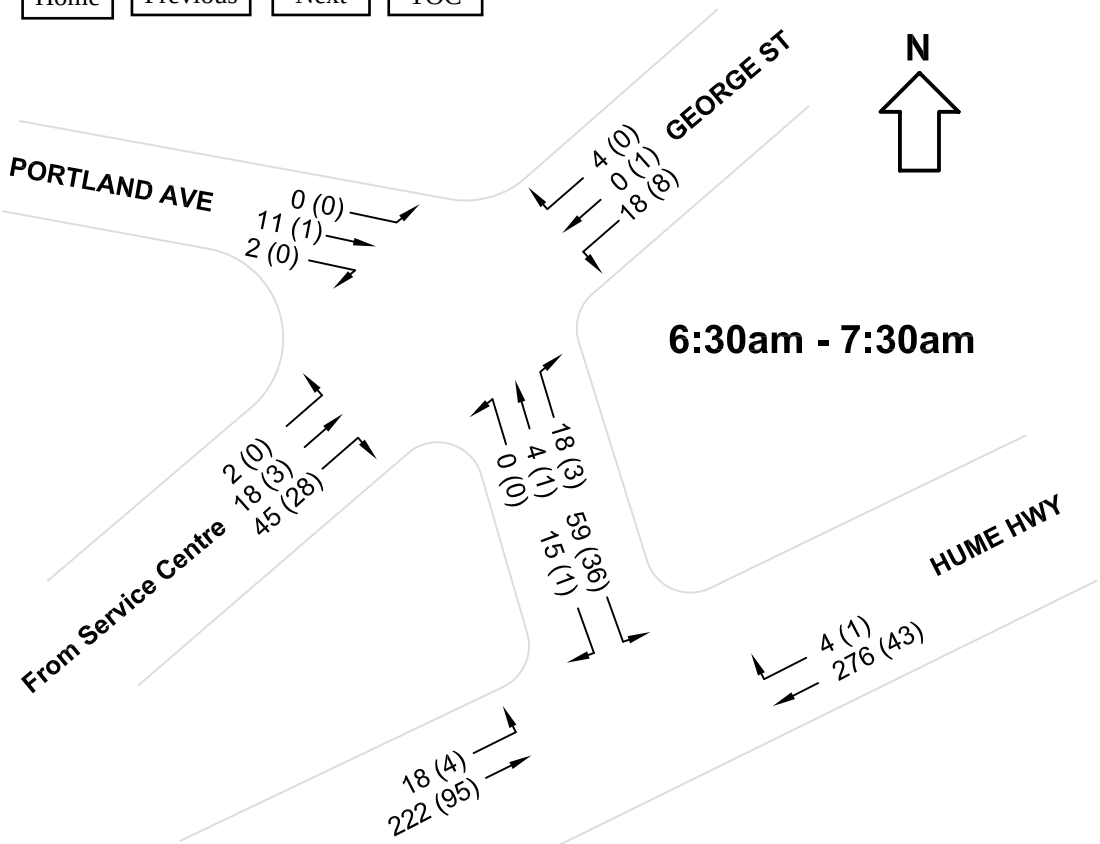
Source: Traffic Counts 15-21 February 2005

3.3.3 Intersection Traffic Volumes and Operating Conditions

Intersection turning volume counts were undertaken at the intersections of Hume Highway / South Marulan Road, Hume Highway / Portland Avenue and Portland Avenue / George Street on Friday 11 February 2005.

Figures 5 and 6 show the traffic volumes using the Portland Avenue intersection during the AM peak hour (8.00 am to 9.00 am), midday period (12 noon to 1.00 pm) and PM peak hour (5.30 pm to 6.30 pm). The 6.30 am to 7.30 am period is also shown, as this period would coincide with the majority of workers arriving at the proposed quarry site during the construction phase.

Figure 7 shows the traffic volumes using the Hume Highway / South Marulan Road intersection during the AM, midday and PM peak hour periods. It should be noted that PM peak hour occurred between 3.30 pm – 4.30 pm at this intersection.



LEGEND

10 - TOTAL VEHICLES PER HOUR
(10) - HEAVY VEHICLES PER HOUR

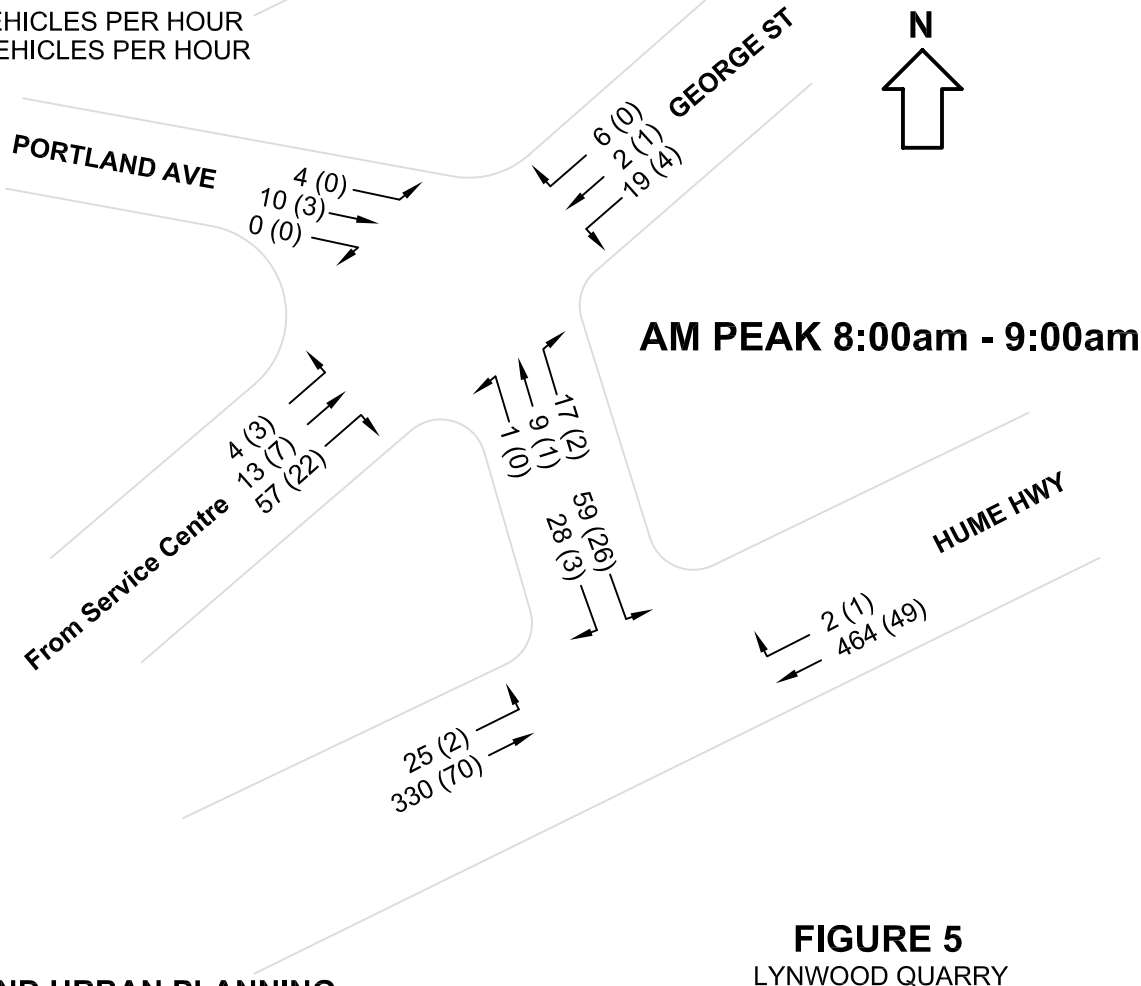


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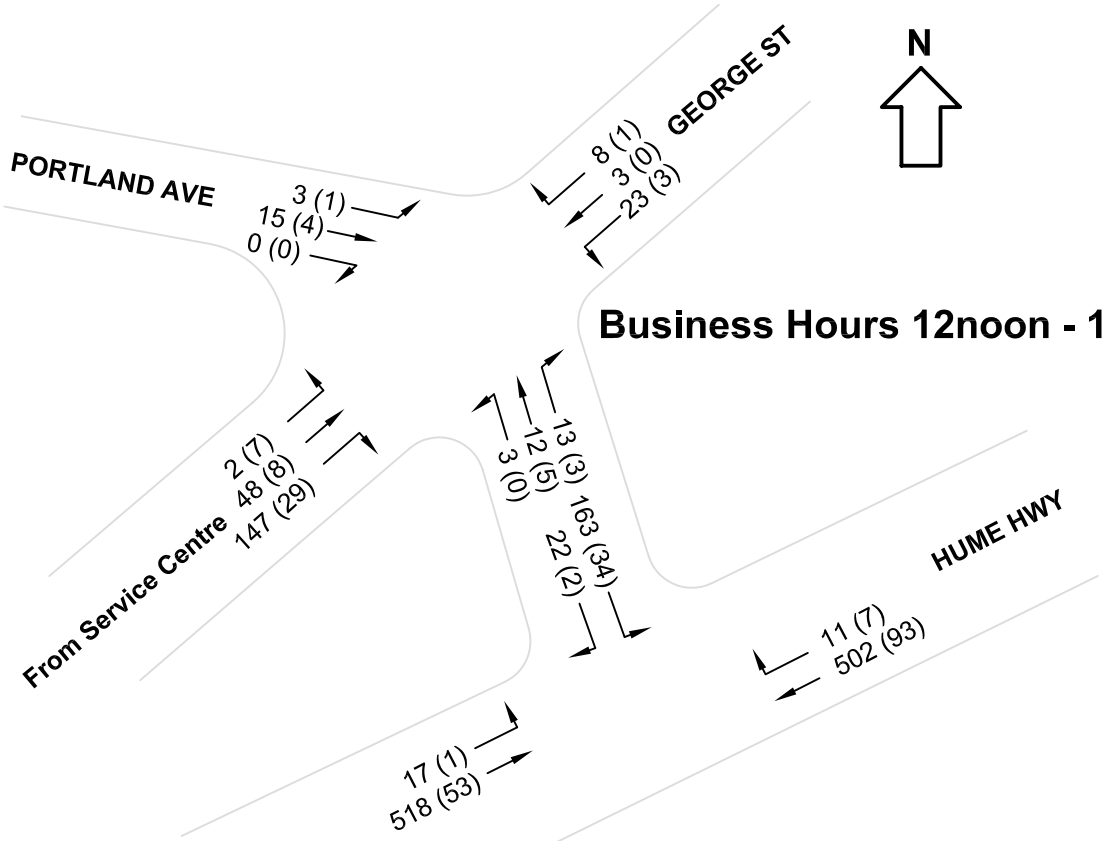
FIGURE 5
LYNWOOD QUARRY
AM PEAK HOUR VOLUMES AT HUME HWY / PORTLAND RD AND GEORGE ST
JOB NO.24181



LEGEND

10 - TOTAL VEHICLES PER HOUR
(10) - HEAVY VEHICLES PER HOUR

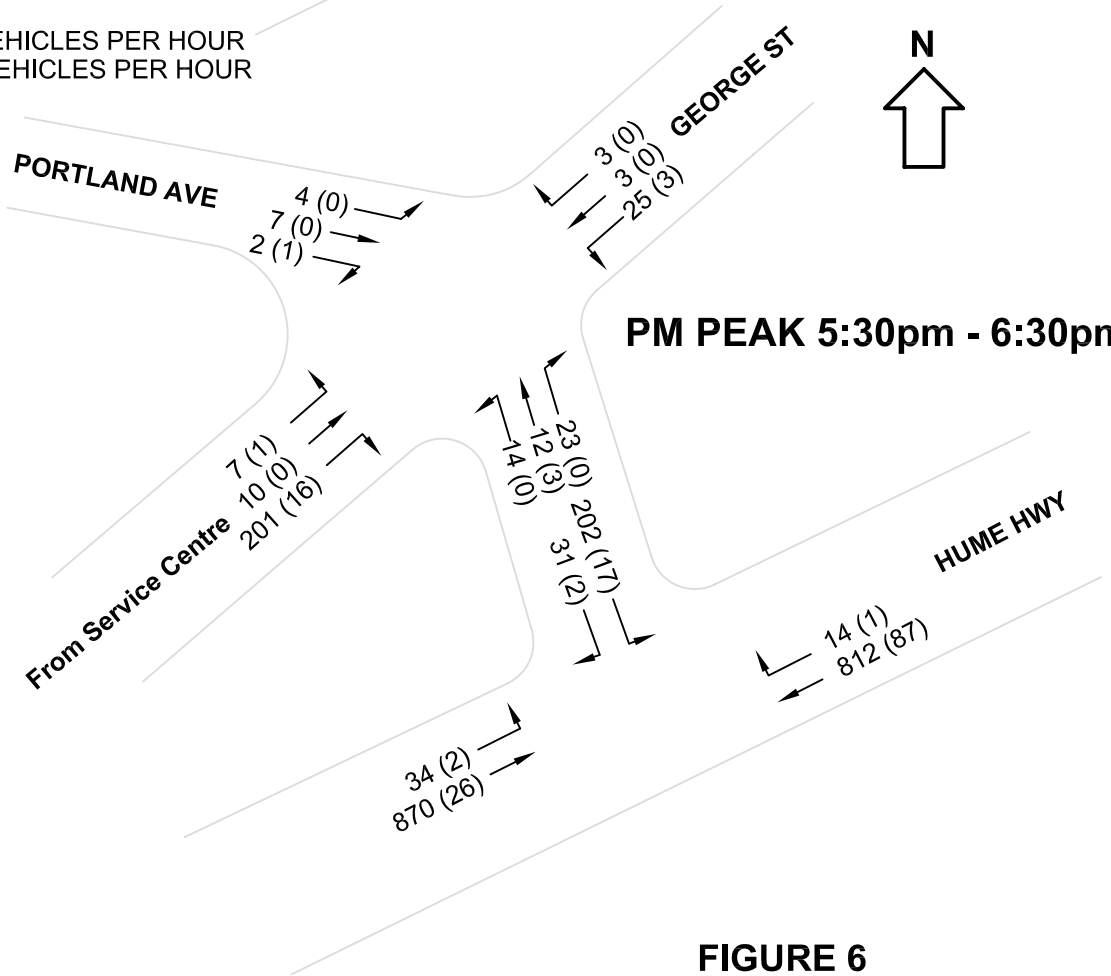


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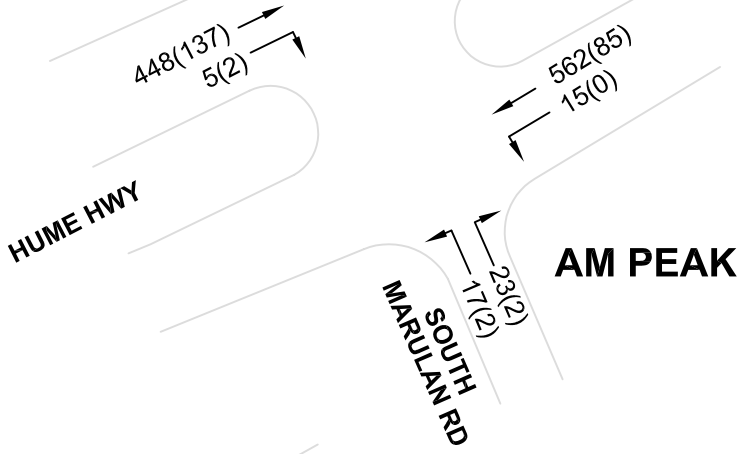
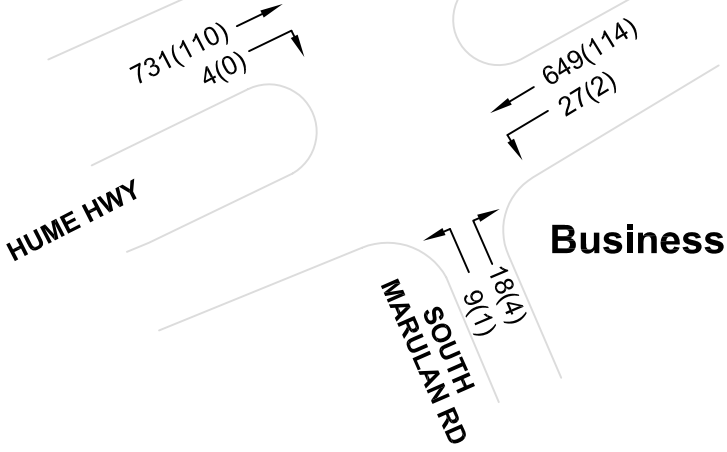
FIGURE 6
LYNWOOD QUARRY
BUSINESS AND PM PEAK HOUR VOLUMES AT HUME HWY / PORTLAND RD AND GEORGE ST
JOB NO.24181

LEGEND

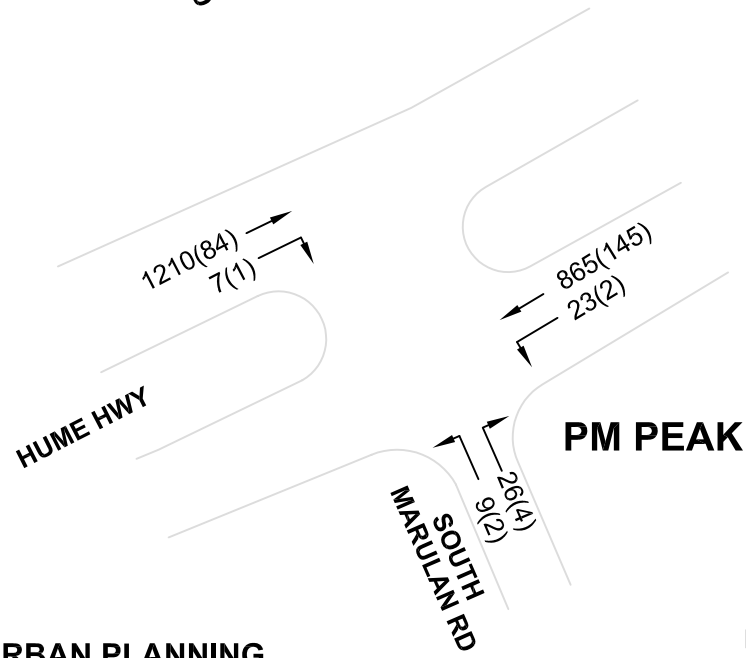
10 - TOTAL VEHICLES PER HOUR
(10) - HEAVY VEHICLES PER HOUR



AM PEAK 8am - 9am



Business Hours 12noon - 1pm



PM PEAK 3:30pm - 4:30pm

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FIGURE 7
LYNWOOD QUARRY
PEAK HOUR VOLUMES AT HUME HWY AND SOUTH MARULAN ROAD
JOB NO.24181

Hume Highway / Portland Avenue Intersection

The PM peak hour has the highest traffic volumes using the Hume Highway intersection and represents the busiest period of the day.

The major turning movement from Portland Avenue at all times is the left turn into the Highway to travel northeast. The majority of this traffic is generated by the service centre, southwest of the intersection.

The right and left turn movements from the Hume Highway are very light with the right turn movement numbering between 2 and 14 vehicles per hour and the left turn numbering between 17 and 34 vehicles per hour during these periods.

The right turn out of Portland Avenue into the Hume Highway is also relatively light numbering between 15-31 vehicles per hour during the same periods.

Portland Avenue / George Street Intersection

The Portland Avenue / George Street intersection carries relatively light traffic volumes (as compared to the Hume Highway intersection) with the major movement being the right turn out of the western arm of George Street to Portland Avenue.

Hume Highway / South Marulan Road

Traffic volumes turning into and out of this intersection are relatively light with the largest movements being the left turn out of the Hume Highway which numbers between 15-27vph and the right turn movement into the Hume Highway from South Marulan Road which numbers between 18-26vph.

The existing layout at this intersection does not meet the current RTA standards with the treatment of the left and right turns for vehicles turning into and out of Hume Highway. In this regard turning lanes in the Hume Highway are of minimal length and do not meet the standards for deceleration and acceleration lengths for vehicles leaving or entering the Hume Highway. As the intersection is at grade, potential conflicts occur when vehicles enter the Hume Highway from South Marulan Road.

Traffic Modelling

To assess the traffic conditions and operational performance of these intersections during the peak hour periods, traffic modelling has been undertaken using the software package INTANAL.

INTANAL assesses the operational performance of intersections under traffic signal, roundabout or sign control. Criteria for interpreting INTANAL modelling results are reproduced in **Appendix 1**. The best criteria for assessing intersections controlled by priority or sign control are Level of Service (LS), Degree of Saturation (DS), Average Vehicle Delay (AVD) and Highest Movement Delay (HMD). The desirable design criteria for intersections is a Level of Service C or better. See **Appendix 1** for Criteria for Interpreting Results of Intanal Analysis.

Hume Highway / Portland Avenue and George Street / Portland Avenue

The modelling has been undertaken using the existing geometry and traffic controls at the intersections together with the traffic volumes shown in **Figures 5 and 6**. Allowance has been made for the number of heavy vehicles at the intersections.

The results of the traffic modelling are shown in Tables 3.9 and 3.10.

Reference to Table 3.9 (Hume Highway / Portland Avenue) shows that this intersection generally operates with a Level of Service A/B operation. The Highest Movement Delay is to the right turn out of Portland Avenue which ranges between 12-19 seconds per vehicle and is considered acceptable. The current level of service at the intersection which is Level of Service A/B operation, represents good to satisfactory traffic conditions.

Reference to Table 3.10 (Portland Avenue / George Street) shows that this intersection operates at a Level of Service A operation with low vehicle delays which represents good traffic conditions.

TABLE 3.9

INTANAL ANALYSIS FOR HUME HIGHWAY / PORTLAND AVENUE

Criteria	AM Peak*	PM Peak	Business Peak
LS	A (A)	B	B
AVD	10.2 (9.8)	14.0	11.9
HMD	13.1 (12.6)	19.2	15.3

**Results in brackets represents the 6.30-7.30am period.*

Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds

TABLE 3.10

INTANAL ANALYSIS FOR PORTLAND AVENUE / GEORGE STREET

Criteria	AM	PM	Business
LS	A	A	A
AVD	4.3	4.2	4.5
HMD	5.9	6.4	7.0

Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds

Portland Avenue / Wilson Drive

Traffic conditions at the intersection of Portland Avenue / Wilson Drive are good with minimal delay, due to the low traffic volumes that use this intersection.

Hume Highway / South Marulan Road

INTANAL analysis has also been undertaken for the intersection of Hume Highway / South Marulan Road using the existing geometry and traffic controls at the intersection and the traffic volumes shown in **Figure 7**, with allowances for heavy vehicles.

The results of the modelling are shown in Table 3.11 and indicate that the intersection operates with a Level of Service B operation and that delays at the intersection are satisfactory. However as noted above, the existing geometry at the intersection is inadequate and traffic conditions at the intersection are considered to be unsatisfactory by the RTA.

TABLE 3.11

INTANAL ANALYSIS FOR HUME HIGHWAY / SOUTH MARULAN ROAD

Criteria	AM Peak	PM Peak	Business Peak
LS	B	B	B
AVD	12.5	15.2	12.3
HMD	15.9	20.7	17.2

Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds

3.4 Road Safety

Five year accident statistics from July 1999 to June 2004 for the area were obtained from the RTA.

A review of this data indicates that:

- 2 (casualty) accidents occurred at the intersection of Hume Highway / Portland Avenue;
- 5 accidents (non casualty) occurred at the intersection of Hume Highway / South Marulan Road;
- there were no reported accidents in the section of Portland Avenue and/or Wilson Drive that form the proposed construction access route.

The 2 accidents at the Hume Highway / Portland Avenue intersection were right angle accidents. As noted previously, the RTA is proposing changes at this intersection to

prevent vehicles crossing between Portland Avenue and the service station on the south eastern corner of the intersection.

The 5 accidents at the Hume Highway / South Marulan Road intersection were a combination of right angle accidents (2), rear end (2) and run off the road accidents (1).

3.5 Pedestrian Issues

There are no footpaths in the Hume Highway and there was no observed pedestrian activity at the Hume Highway / Portland Avenue intersection and the Portland Avenue / George Street intersection on the days of the traffic counts and during the site inspections at Marulan.

Pedestrian activity in Portland Avenue between George Street and Wilson Drive was also observed to be minimal.

Similarly, there was no observed pedestrian activity in Wilson Drive.

3.6 Summary of Existing Traffic Conditions

The assessment of the existing road network, including the intersections, indicates that traffic conditions are satisfactory to good with adequate road and intersection capacity and acceptable vehicle delays at intersections.

While accident levels are not considered to be unsatisfactory, improvement works are planned by the RTA for the intersection of Hume Highway / Portland Avenue.

The intersection of Hume Highway / South Marulan Road has a higher number of accidents which in part could be due to the inadequate geometry that exists at the intersection.

4.0 ASSESSMENT OF TRAFFIC IMPACTS

4.1 Operational Phase

4.1.1 Proposed Grade Separated Intersection at South Marulan Road

As part of the proposal Readymix will construct a dedicated Quarry Access Road to the Hume Highway together with a grade separated interchange (with the Hume Highway) at South Marulan Road. This will provide the principal access to the Quarry to and from the Hume Highway.

Readymix accepts that a grade separated intersection will be required to cater for safe access to and from the Hume Highway for traffic generated by the Quarry and accepts the responsibility for funding its construction as part of the proposal.

The decision to provide the interchange at the South Marulan Road intersection was made following discussions with the RTA who indicated its preference to replace the existing unsatisfactory at grade intersection at this location.

The proposed grade separated intersection at this location will provide a safe intersection for quarry traffic to enter and leave the Hume Highway. In addition it will also provide a safe intersection for existing and future traffic accessing South Marulan Road and Jerrara Road to and from the Hume Highway.

South Marulan Road and Jerrara Road are used by a range of vehicles from the communities served by these roads, including trucks from other industrial users.

These other industrial users will benefit from the provision of a safe intersection at the Hume Highway which will be provided as part of the Readymix proposal. Readymix considers that any future industrial users of this intersection should also be required to contribute to the cost of the intersection. This could be achieved through the inclusion of suitable consent conditions on future development consents.

4.1.2 Traffic Generation

The traffic generation during the operational phase of the Quarry includes:

- 162 truck loads of product material on an average day (162 in / 162 out movements) which is likely to be the equivalent of 10 truck loads per hour (10 in / 10 out) on most haulage days.
- 95 employee / contractor trips per day (95 in / 95 out).
- 15 courier / visitor trips per day (15 in / 15 out).
- 10 maintenance trips per day (10 in / 10 out).
- Some 3 deliveries per day (3 in / 3 out).
- 6 hire equipment deliveries every 3 months.

All of this traffic will arrive and depart the Quarry via the Hume Highway using the proposed interchange and the Quarry Access Road.

4.1.3 Traffic Impacts

Based on the above, the Quarry will generate some 570 trips on an average day of production with 285 inbound and 285 outbound trips.

These trips will be spread over the full day with the highest traffic generation occurring between 6.00 am and 7.00 am with an estimated 58 work trips arriving at the Quarry, plus 10 product trucks leaving the Quarry.

Other busy periods will be the 5.30 pm – 6.30 pm period with an estimated 40 work trips leaving the Quarry plus 10 product trucks arriving back at the Quarry.

The product truck trips are expected to average approximately 10 loads an hour (i.e. 10 in / 10 out trips), although the Quarry facility has a significantly higher capacity than this. However, there are practical considerations that would inhibit the product transportation levels from operating at the processing plant's capacity for periods longer than 1 to 2 hours at any time.

For the purpose of examining a worst case in terms of product truck numbers a figure of up to 50 truck loads per hour is feasible in terms of sales (50 in / 50 out) at a future date over the life of the Quarry. This level of traffic generation could typically occur on any weekday between 7.00 am and 5.00 pm.

Impact on the Hume Highway

As noted above the Quarry will generate a total of 570 vpd on an average day of production, of which 340 vehicle trips will be heavy vehicles.

In terms of traffic impacts on the Hume Highway the additional traffic will have minimal impacts.

The Hume Highway at Marulan carries some 18,694 vpd on an average weekday, of which 5,219 are heavy vehicles. The proposed quarry traffic (total of 570 vehicles with 340 heavy vehicles per day) will represent an increase of 3.1% in total vehicles using the Hume Highway. The increase in heavy vehicles due to the proposal is 6.5%.

The increase in total traffic and heavy vehicles using the Hume Highway due to the proposal are small in real terms and the Highway has sufficient available capacity to absorb the traffic increases.

Table 4.1 shows the hourly volumes on each carriageway of the Hume Highway as recorded on Friday 18 February. Friday is the heaviest weekday in terms of traffic volumes using the Hume Highway. Friday's traffic volume on this particular day (21/2/2005) was a total of 24,670 vehicles which was 32% higher than the average weekday volume (5 day average) and 27% higher than the 7 day average (AADT).

The Hume Highway has a theoretical capacity in each direction of travel (i.e. each carriageway) of 3,600 equivalent passenger car units (pcu's) per hour.

As can be seen from Table 4.1, the Highway traffic volumes in each direction of travel is considerably less than 3,600 passenger car units per hour. Even after allowing for the number of heavy vehicles in the traffic stream, each carriageway has considerable spare capacity and can easily accommodate the 20 truck movements per hour (10 return truck loads) associated with the Quarry.

If the Quarry is operating at higher transportation levels and product truck numbers increase to 50 product truck loads per hour (i.e. 50 in / 50 out) at some future time, the Hume Highway and the proposed interchange will continue to easily accommodate this level of traffic without any noticeable change / impact on capacity.

As noted previously, the grade separated interchange will be designed in accordance with RTA and Austroad Standards with appropriate deceleration and acceleration lanes for vehicles to exit and enter the Hume Highway.

TABLE 4.1

HOURLY VOLUMES IN HUME HIGHWAY
ON FRIDAY 18 FEBRUARY, 2005

Time	North East	South West
Midnight – 1am	141 (90)	131 (90)
1am – 2am	118 (89)	60 (48)
2am – 3am	150 (123)	73 (53)
3am – 4am	178 (161)	66 (46)
4am – 5am	223 (176)	77 (34)
5am – 6am	199 (108)	143 (57)
6am – 7am	277 (114)	252 (68)
7am – 8am	365 (136)	405 (81)
8am – 9am	448 (137)	562 (85)
9am – 10am	596 (148)	660 (94)
10am -11am	684 (122)	585 (114)
11am – Midday	765 (104)	698 (135)
Midday – 1pm	731 (110)	649 (114)
1pm – 2pm	830 (105)	731 (140)
2pm – 3pm	980 (113)	817 (148)
3pm – 4pm	1,081 (114)	865 (145)
4pm – 5pm	1,210 (84)	855 (123)
5pm – 6pm	1,169 (96)	942 (120)
6pm – 7pm	1,029 (67)	850 (127)
7pm – 8pm	745 (76)	681 (138)
8pm – 9pm	483 (47)	579 (109)
9pm -10pm	346 (59)	419 (115)
10pm – 11pm	179 (44)	305 (113)
11pm – Midnight	124 (34)	214 (113)
Total	**13,051 (2,477)**	**11,619 (2,420)**

Source: Traffic Counts 15-21 February, 2005

Where: 141 total volumes
(90) heavy vehicles

Impact on Proposed Interchange Intersection with Hume Highway

For the purpose of examining the proposed interchange intersection, the future sales projection of 50 truck loads per hour (50 trucks in / 50 trucks out) has been adopted.

Whilst the employee start and finish times have a slightly higher traffic generation the traffic generation at these times will be light vehicles, which have less impacts than the product trucks.

Figures 8A, 8B & 8C show projected traffic volumes at the grade separated interchange intersection associated with a maximum hour of 50 product trucks. It has been assumed that 80% will be travelling to and from the northeast and 20% travelling to and from the southwest.

Also shown are the existing turning volumes to and from South Marulan Road and Jerarra Road in the AM (7.30-8.30am), PM (3.30-4.30pm) and Business Hour Peak (12pm – 1pm) at this intersection.

To examine the operational capacity of the interchange intersection, the software package INTANAL has been used. The modelling has assumed the maximum hour of product transportation for the Quarry together with the existing volumes at the South Marulan Road intersection.

The modelling results are shown in Table 4.2 and reveal that both the interchange intersections will operate at a good level of service (Level of Service A) with low vehicle delays with the Quarry in place.

TABLE 4.2

INTANAL ANALYSIS FOR NORTHBOUND OFF AND ON RAMPS / QUARRY ACCESS ROAD / SOUTH MARULAN ROAD INTERSECTION DURING MAXIMUM HOUR

Criteria	AM Peak	PM Peak	Business Peak
LS	A	A	A
AVD	2.9	2.7	2.8
HMD	5.4	5.4	5.4

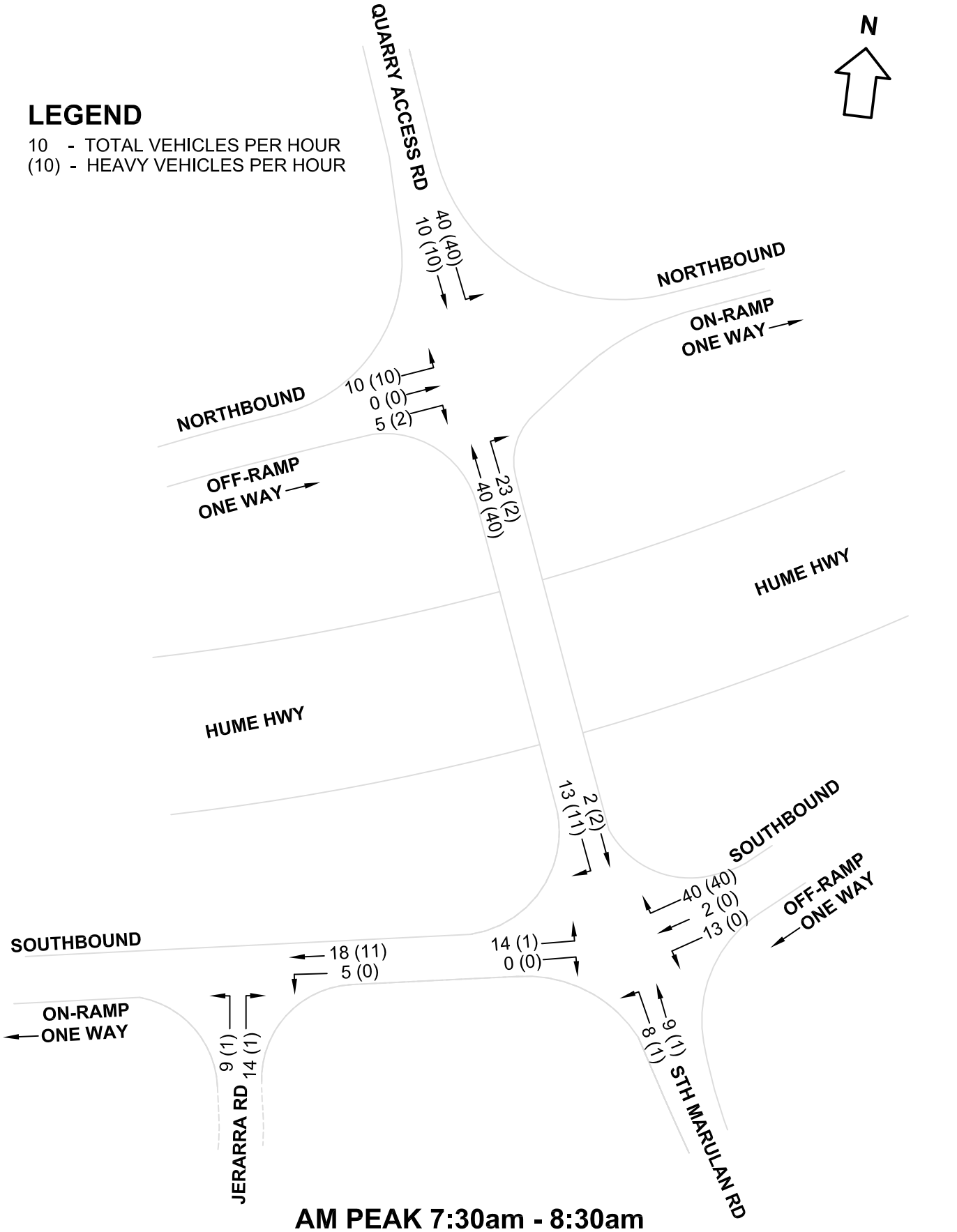

FIGURE 8A

LYNWOOD QUARRY

QUARRY MAXIMUM HOUR TRUCK VOLUMES AT INTERCHANGE INTERSECTIONS AM PEAK

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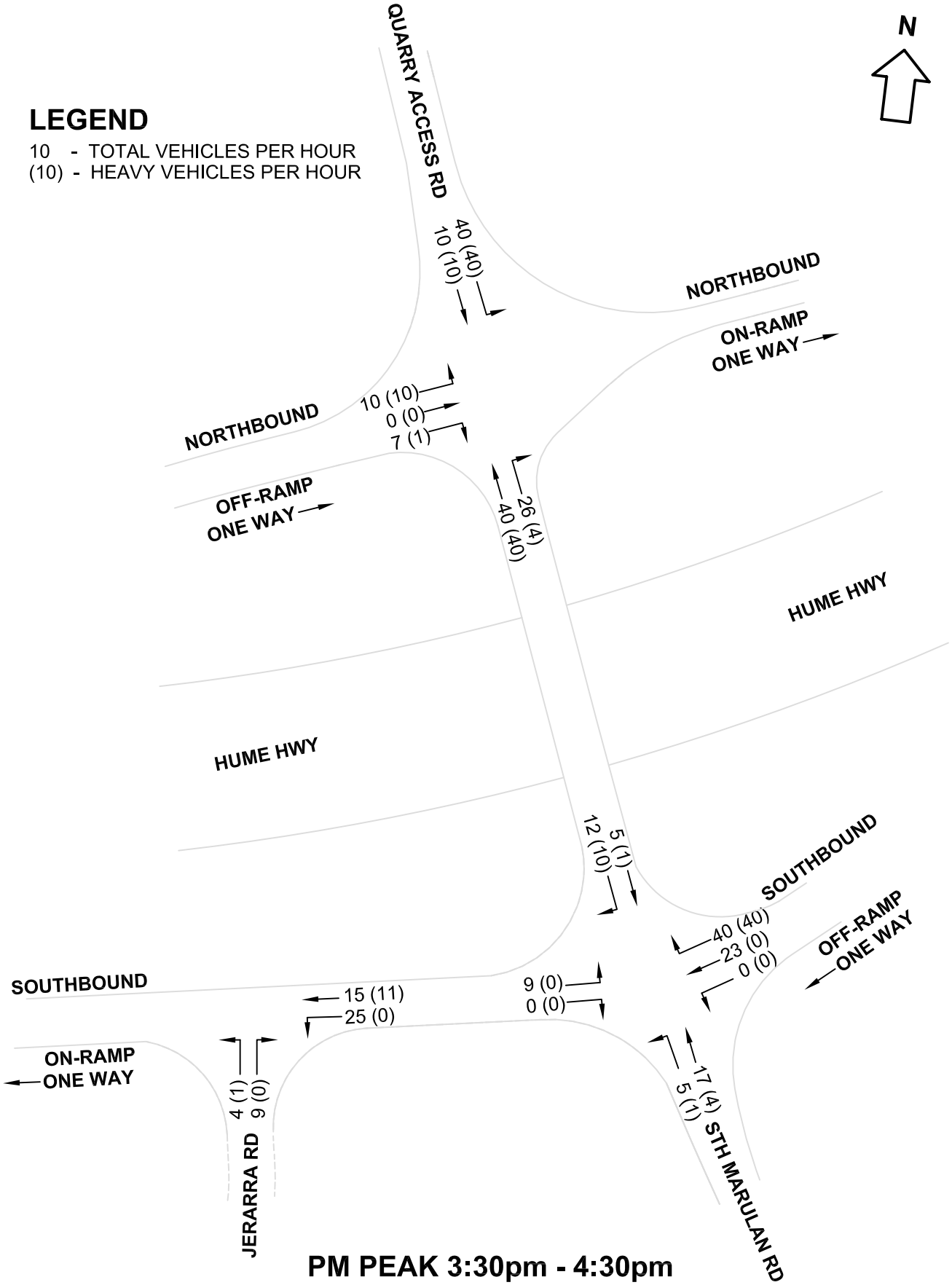

FIGURE 8B

LYNWOOD QUARRY

QUARRY MAXIMUM HOUR TRUCK VOLUMES AT INTERCHANGE INTERSECTIONS PM PEAK

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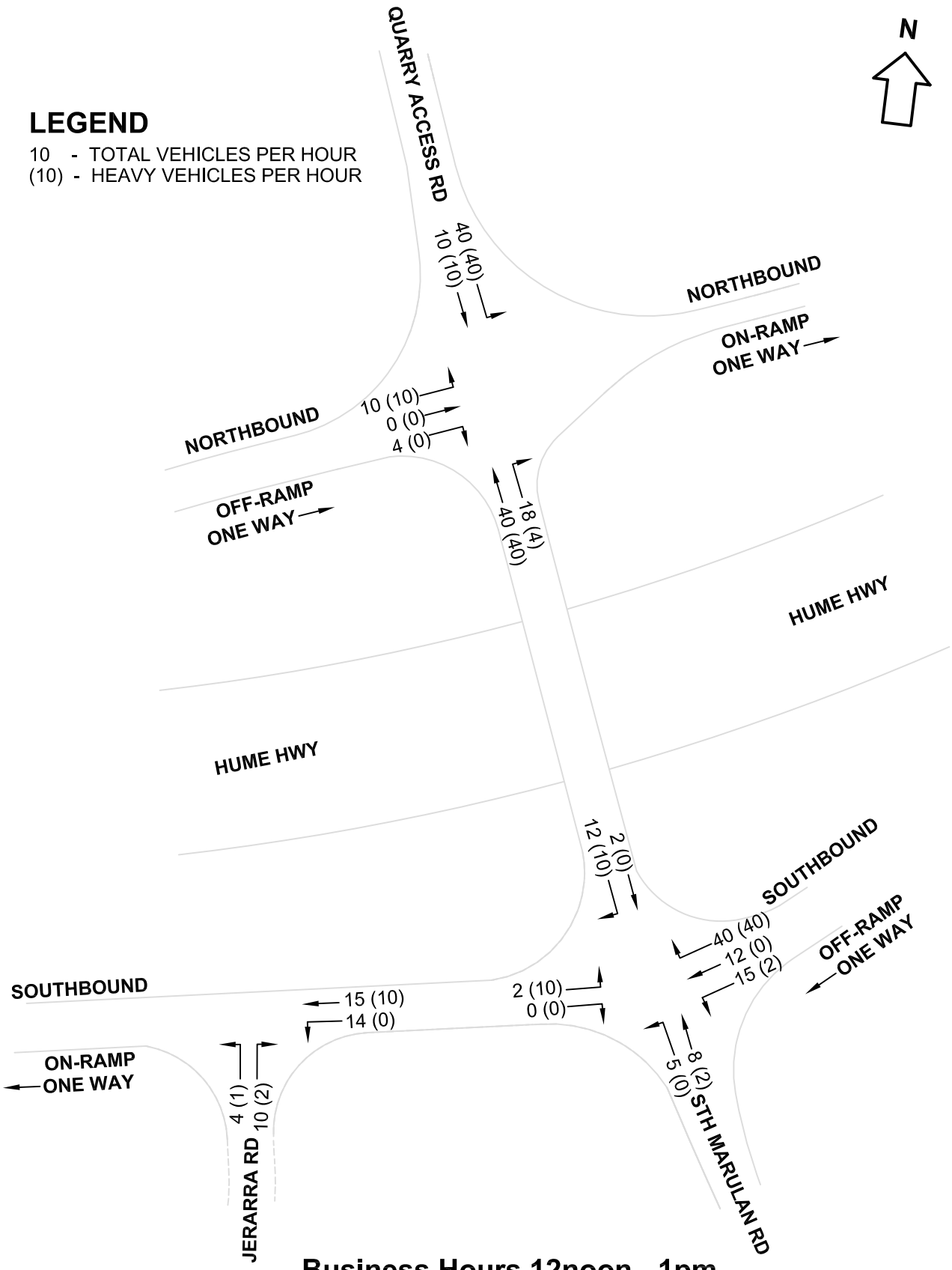

Business Hours 12noon - 1pm

FIGURE 8C

LYNWOOD QUARRY

QUARRY MAXIMUM HOUR TRUCK VOLUMES AT INTERCHANGE INTERSECTIONS BUSINESS HOURS

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INTANAL ANALYSIS FOR SOUTHBOUND OFF AND ON RAMPS / QUARRY ACCESS ROAD / SOUTH MARULAN ROAD INTERSECTION DURING MAXIMUM HOUR

Criteria	AM	PM	Business
LS	A	A	A
AVD	4.8	5.0	4.8
HMD	6.4	6.4	6.4

Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds

4.1.4 Summary

In summary, the assessment of the traffic impacts associated with the Quarry indicates that these impacts will be small and traffic conditions on the Hume Highway will continue to be satisfactory. The proposed interchange on the Hume Highway will provide a high level of road safety and adequate road and intersection capacity for vehicles generated by the Quarry to enter and leave the Hume Highway. In addition, the interchange will replace an existing unsatisfactory at grade intersection with South Marulan Road.

4.2 Construction Phase

4.2.1 Traffic Generation

The traffic generation during the construction phase includes:

- 13 truck loads of excess excavated material per day (13 in / 13 out movements);
- An average 4-5 truck deliveries to the Quarry per day (4-5 in / 4-5 out movements); and
- Up to 117 work trips by employees / contractors per day during the busiest 5 months of construction (117 in / 117 out trips).

4.2.2 Traffic Impacts on Intersections

The largest traffic impacts associated with the construction phase on the adjacent intersections will occur at those times that coincide with the start and finish times at the Quarry which are 7.00 am and 6.00 pm

Readymix expects that the majority of the workforce will either be housed in Marulan or Goulburn and for the purposes of this assessment it is assumed that 20% will be based in Marulan and 80% in Goulburn.

The AM peak period 6.30 am – 7.30 am will be the most concentrated peak in terms of workforce trips and where it would be expected that most, if not all work trips will occur between 6.30 am and 7.30 am.

It is expected that workers and contractors will start leaving the site from 3.30 pm with approximately 40-50% of the workforce staying to 6.00 pm.

For the purpose of this assessment it has been assumed that 80% of the workforce will leave the site between 5.30 pm and 6.30 pm. This figure is higher than what is expected to occur, however represents a conservative or worst case.

Figure 9 shows the traffic volumes associated with the workforce trips during the 6.30 am – 7.30 am and 5.30 pm – 6.30 pm periods assigned to the road network approaching the Portland Avenue / Hume Highway intersection, based on the traffic assignment outlined above.

In the AM peak hour 94 vehicle trips will arrive from Goulburn via the Hume Highway / Portland Avenue intersection with 23 vehicle trips from Marulan.

In the PM peak hour 75 vehicle trips will travel back to Goulburn via the Hume Highway / Portland Avenue intersection with 19 vehicles travelling to Marulan.

To assess the impacts that this additional construction traffic will have on the intersections of the Hume Highway / Portland Avenue and Portland Avenue / George Street, the software package INTANAL has been used.

The modelling has been undertaken with the additional traffic volumes as shown in **Figure 9** overlaid on the base AM and PM peak hour volumes. Tables 4.3 and 4.4 show the traffic modelling results for the two intersections.

Reference to Table 4.3 which shows the modelling results for Hume Highway / Portland Road, indicates that the intersection will continue to operate at good to satisfactory Level of Service with a A/B operation and acceptable vehicle delays. The increase in vehicle delays for the minor movements at the intersection due to the construction traffic will be about 1 second per vehicle, which indicates that the impacts are minor.

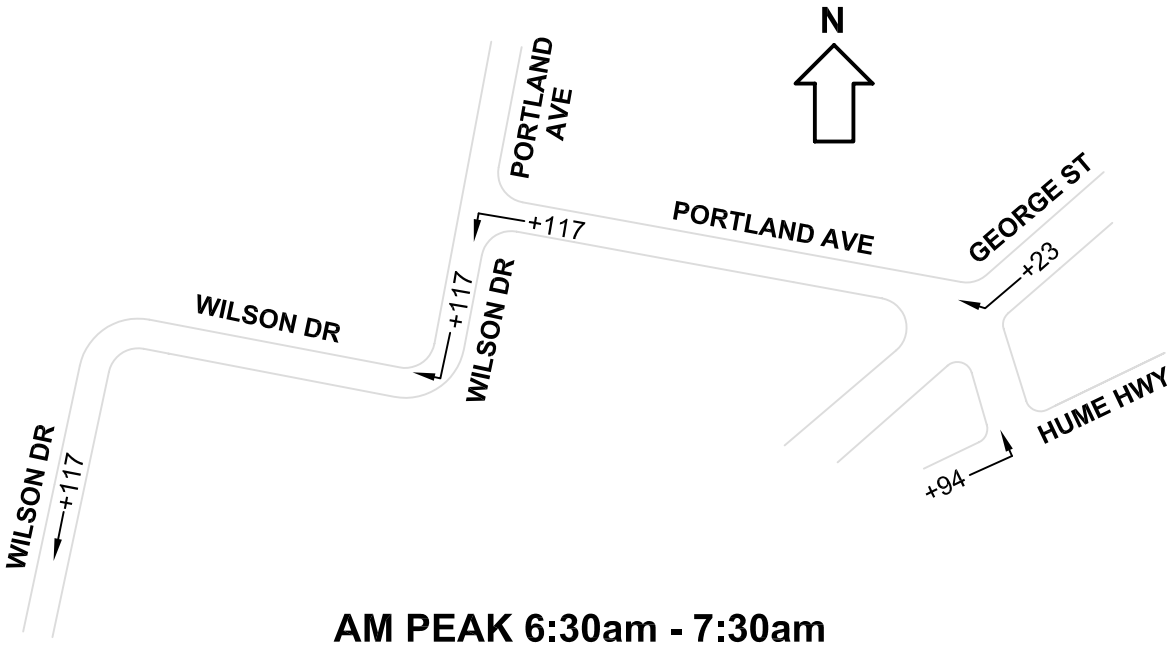
Reference to Table 4.4 which shows the results for Portland Avenue / George Street, indicates that the construction traffic will have minimal impacts and this intersection will continue to operate a good level of service (Level of Service A) with low vehicle delays.

TABLE 4.3

INTANAL ANALYSIS FOR HUME HIGHWAY / PORTLAND AVENUE

Criteria	Existing		Proposal	
	AM Peak	PM Peak	AM Peak	PM Peak
LS	A	B	B	B
AVD	9.1	14.0	9.1	15.3
HMD	12.6	19.2	12.6	20.2

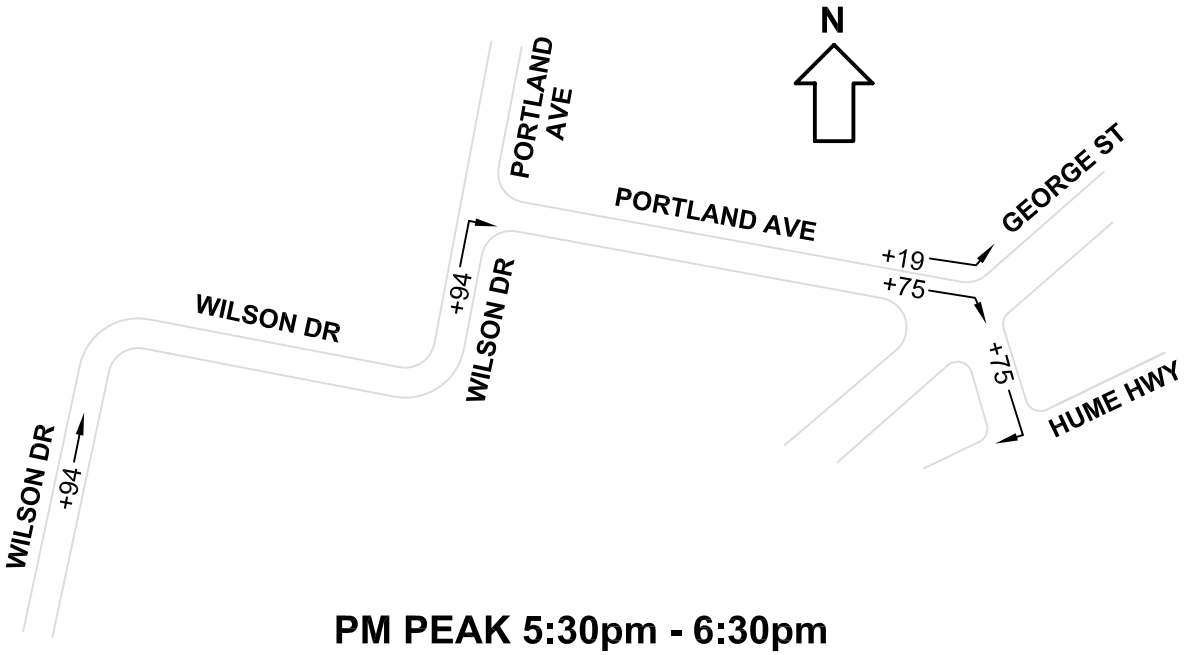
Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds



AM PEAK 6:30am - 7:30am

LEGEND

+10 - ADDITIONAL VEHICLES PER HOUR



PM PEAK 5:30pm - 6:30pm

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FIGURE 9
LYNWOOD QUARRY
PEAK HOUR CONSTRUCTION VOLUMES
JOB NO.24181

TABLE 4.4

INTANAL ANALYSIS FOR PORTLAND AVENUE / GEORGE STREET

Criteria	Existing		Proposal	
	AM Peak	PM Peak	AM Peak	PM Peak
LS	A	A	A	A
AVD	4.3	4.2	4.3	4.3
HMD	5.9	6.4	5.9	7.0

Where:
LS Level of Service
AVD Average Vehicle Delay in seconds
HMD Highest Movement Delay in seconds

The additional traffic using the intersection of Portland Avenue / Wilson Drive will also have minimal traffic impacts due to the overall low volumes at the intersection and the intersection will continue to operate at a good service level with minimal delays.

4.2.3 Additional Volumes Using the Road Network

During the 5 busiest months of construction, traffic volumes associated with the Quarry will increase traffic in the Portland Avenue / Wilson Drive route by a total of approximately 270 vehicles per day consisting of:

- 234 light vehicles per day (117 trips in / 117 trips out); and
- 36 heavy vehicles per day (18 trips in / 18 trips out).

Total two way traffic volumes in Portland Avenue will increase from the existing 7 day average volume (AADT) of 421 vehicles per day to an estimated 691 vehicles per day.

Total two way traffic volumes will increase in Wilson Drive from the existing 7 day average volume (AADT) of 119 vehicles to an estimated 389 vehicles per day.

These roads can easily absorb the increases in traffic volumes. However, there will be a need to widen the road pavement to address the existing narrow sections of road pavement and provide curve improvement works and improved delineation along the route. These works are detailed in the following section.

As the construction access route passes through the industrial area of Marulan there will be minimal impacts on these land uses from the construction traffic.

4.2.4 Improvement Works for Construction Phase

Figure 10 shows the recommended remedial works along the Portland Avenue / Wilson Drive route, which include:

- Pavement repairs and increased radius for the left turn from Portland Avenue into Wilson Drive.

- Pavement repairs and widening on curves in Wilson Drive.
- The maintenance of minimum pavement width of 6.2 metres plus 1.0 metre shoulders on the straight sections in Portland Avenue and Wilson Drive.
- Provision of delineation along the route; and
- Regular maintenance of western section of Wilson Drive to remove tree debris from road pavement.

Table 4.5 shows the lane widths for rural roads as defined by the RTA Road Design Guide and Austroads. These lane width standards have been used to determine the lane width requirements for these routes. Either the RTA standard or Austroad standard could be applied. Transport and Urban Planning's recommendation for the remedial works are based on the Austroad Standard.

Portland Avenue will carry an estimated 691vpd and Wilson Drive will carry an estimated 389vpd during the busiest 5 months of construction.

Reference to Table 4.5 shows that the RTA standard would require a 6.0 metre wide road pavement (2 x 3.0 metre wide lanes) and Austroads a 6.2 metre wide road pavement (2 x 3.1 metre wide lanes) for roads carrying those traffic volumes.

Following the construction phase and the opening of the dedicated Quarry Access Road and new interchange, Readymix will contribute to the repair of any pavement damage to the Portland Avenue / Wilson Drive construction route based on pre and post inspections of the road pavements.

TABLE 4.5

LANE WIDTHS FOR RURAL ROADS

RTA STANDARD			
AADT	**No. of Lanes**	**Lane Width (metres)**	**Total Width (metres)**
1-150	1	3.5	3.5
150-500	2	3.0	6.0
500-2,000	2	3.0-3.5	6.0-7.0
>2,000	2	3.5	7.0.

AUSTROAD STANDARD			
AADT	**No. of Lanes**	**Lane Width (metres)**	**Total Width (metres)**
1-150	1	3.5	3.5
150-500	2	3.1	6.2
500-1,000	2	3.1-3.5	6.2-7.0
1,000-3,000	2	3.5	7.0
>3,000	2	3.5	7.0

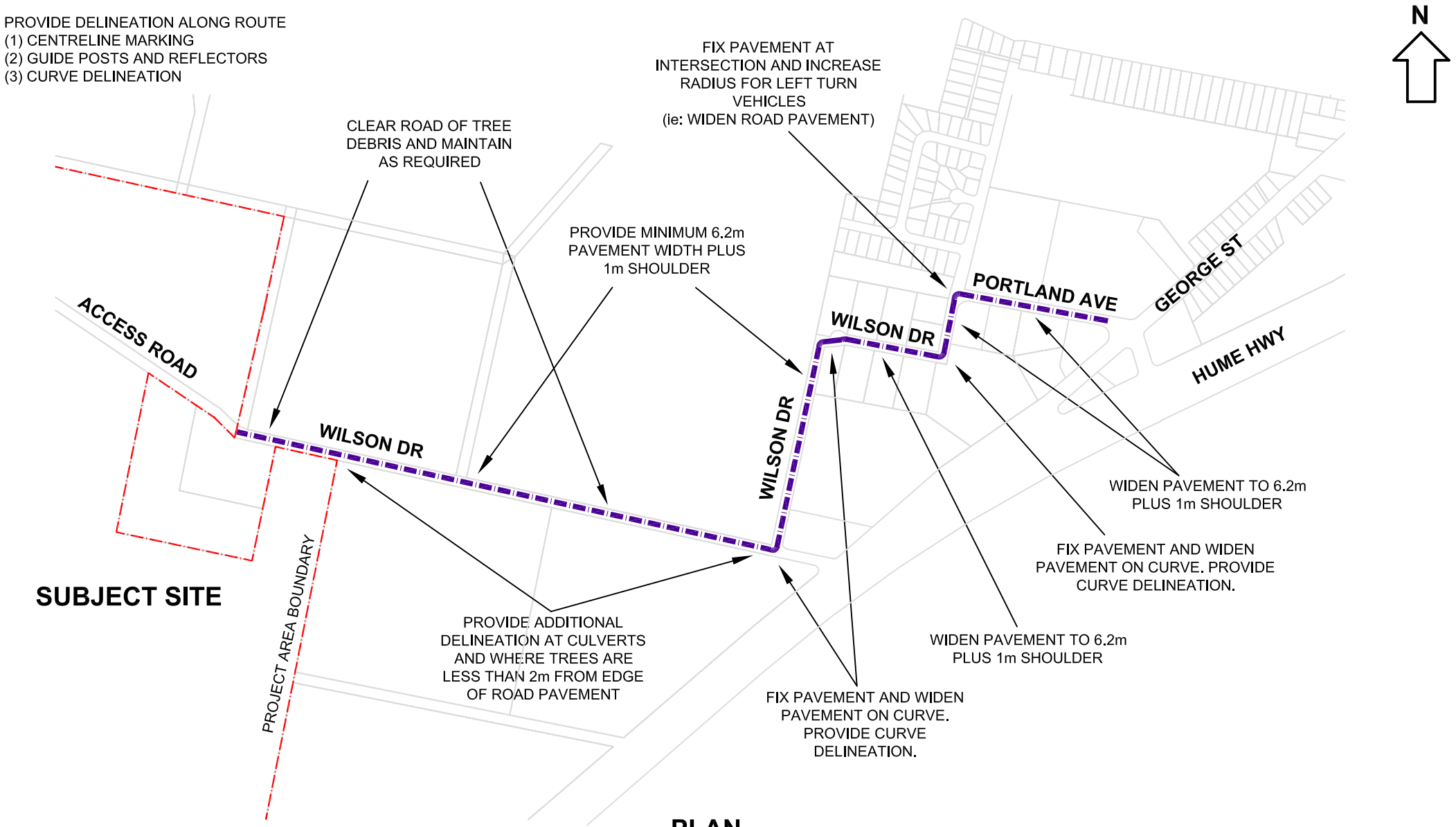

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FIGURE 10
LYNWOOD QUARRY
RECOMMENDED WORKS FOR CONSTRUCTION ACCESS ROUTE
JOB NO.24181

4.2.5 Stoney Creek Road

The use of Stoney Creek Road during the construction phase will be restricted to up to 10 construction worker vehicle trips per day (i.e. 10 trips in / 10 trips out) during the early months of construction and up to 10 heavy vehicle movements (10 trips in / 10 trips out) over that period. Large heavy vehicle movements using Stoney Creek Road would do so under escort. Once the bridge over the rail line is completed Stoney Creek Road will not be used as a construction access route. Vehicles using Stoney Creek Road will access the road via Brayton Road and not via the rail level crossing on Portland Avenue / Stoney Creek Road. This small number of vehicles using Stoney Creek Road would have minimal impacts on the road.

4.2.6 Pedestrian Issues

The additional traffic using Portland Avenue and Wilson Drive associated with the construction of the Quarry is not expected to have any detrimental impact on pedestrians. As previously noted, pedestrian activity in Portland Avenue and Wilson Drive is minimal and conditions for pedestrians are expected to remain unchanged during the construction period.

4.2.7 Summary

In summary, the assessment of the traffic impacts during the construction period of the Quarry indicates that the impacts will be acceptable and that traffic conditions on the road network will be satisfactory during the construction period.

5.0 CONCLUSIONS

This report documents the assessment of the traffic and transport impacts of the proposed Lynwood Quarry west of Marulan.

The proposal incorporates a rail balloon loop which will transport up to 5.0 Mtpa of quarry product to Sydney.

Up to 1.5 Mtpa of quarry product may be transported by road to local and regional markets.

As part of the proposal, a new dedicated road will be built between the Hume Highway and the Quarry. This dedicated road will be connected to the Hume Highway with a full grade separated interchange at the existing South Marulan Road intersection. This will replace the existing unsatisfactory at grade intersection at this location and will provide a safe and adequate intersection for quarry traffic and other traffic using this intersection. While Readymix will construct the intersection as part of its proposal, it is seeking an agreement that other industrial users will contribute to the cost of the intersection. This could be achieved through the inclusion of consent conditions on future development consents.

Once operational, the Quarry will generate some 570 vehicles trips (285 inbound and 285 outbound trips) on the average day of sales / transportation with heavy vehicles comprising 340 vehicle trips (180 in / 180 out).

An assessment of the traffic impacts associated with the Quarry indicates that these impacts will be small and traffic conditions on the Hume Highway will continue to be satisfactory. The proposed interchange on the Hume Highway will provide a high level of road safety and adequate road and intersection capacity for vehicles generated by the Quarry to enter and leave the Hume Highway.

During the construction phase of the Quarry and its associated infrastructure, the Portland Avenue / Wilson Drive route will be used as the principal construction access route. Readymix is proposing to provide road and pavement improvements along this route consistent with current Austroad standards.

Up to a total of 270 vehicles per day (135 inbound and 135 outbound vehicle trips) are expected to use this route during the busiest periods of construction, including some 36 heavy vehicles per day (18 in / 18 out).

An assessment of the traffic impacts for the busiest periods during construction indicates that traffic conditions along the Portland Avenue / Wilson Drive route, including at the principal intersections, will remain satisfactory.

As the construction access route passes through the industrial area of Marulan there will be minimal impacts on the township of Marulan. The impacts on pedestrians in Portland Avenue and Wilson Drive is also assessed to be minimal.

At the completion of the construction period, Readymix will cease to use this route for vehicle access to the Quarry and will contribute to the repair of any pavement damage along the route based on pre and post inspections of the road pavement.

APPENDIX 1

CRITERIA FOR INTERPRETING RESULTS OF INTANAL ANALYSIS

I. Level of Service (LS)

LS	Traffic Signals and Roundabouts	Average Vehicle Delay in Seconds
A	Good	0-14
B	Good with minimal delays and spare capacity	15-28
C	Satisfactory with spare capacity	29-42
D	Satisfactory but operating near capacity	43-56
E	At capacity and incidents will cause excessive delays	57-60
F	Unsatisfactory and requires additional capacity	>70

LS	Give Way and Stop Signs	Highest Movement Delay (in Seconds)
A	Good	0-14
B	Acceptable delays and spare capacity	15-28
C	Satisfactory	29-42
D	Near capacity and accident study required	43-56
E	At capacity and requires other Control Delays Mode	57-60
F	Unsatisfactory and requires other Control Mode	>70

2. Average Vehicle Delay (AVD)

The AVD provides a measure of the operational performance of an intersection. For intersections controlled by traffic signals or a roundabout, satisfactory intersection performance is achieved where:

- the TOTAL average delay of the intersection is less than 70 secs; and
- no individual movement through the intersection experiences a delay greater than 120 secs.

For intersections controlled by GIVE WAY or STOP signs, satisfactory intersection performance is achieved where no individual movement (Highest Movement Delay) through the intersection experiences a delay greater than 40 secs.

3. Highest Movement Delay (HMD)

Highest Movement Delay is the Highest average delay for any movement at an intersection. It is useful for determining the delay for minor movements at intersections controlled by Stop/Give Way signs or roundabouts.

4. Total Delay

Total Delay is the intersections total delay expressed in vehicle hours per hour, ie. the sum of all delay which occurs at an intersection, during the modelled period, which in most cases is a one-hour of the modelled peak.

Some caution is required in interpreting Total Delay as Total Delay will always increase with the traffic volumes.

Also, for intersections controlled by STOP or GIVE WAY control, only the minor movements such as the turning movements from the major road and the movements out of the minor road face delays. For this reason total delay for intersections controlled by STOP or GIVE WAY signs tend to be lower than for intersections controlled by traffic signals. In this situation Level of Service and Degree of Saturation are better performance measures, particularly when assessing if another form of control is required.

Total Delay should be used to assist in comparing the likely improvements to be gained in terms of overall delay for geometric improvements, control and operation for roundabouts and traffic signals.

Therefore its main use should be for comparing different/competing design improvements for the same intersection which is controlled by either roundabouts or traffic signals.

5. Degree of Saturation (DS)

The DS is another measure of the operational performance of individual intersections. DS is calculated for all movements at the intersection. The DS displayed is usually the highest DS for any single movement at the intersection during the period modelled.

For intersections controlled by traffic signals[2] both queue length and delay increase rapidly as DS approaches 1, and it is usual to attempt to keep DS to less than 0.9. Values of DS in the order of 0.7 generally represent satisfactory intersection operation. When DS exceeds 0.9 queues can be anticipated.

At lower cycle lengths a DS around 0.9 can be acceptable as are small increases in DS between different designs.

For intersections controlled by a roundabout or GIVE WAY or STOP signs, satisfactory intersection operation is indicated by a DS of 0.8 or less.

6. Average Vehicle Cost or Total $ Cost per Vehicle (AVC)

This is calculated as Total Cost / Total Vehicles using the intersection and represents the Average Vehicle Cost. It is useful in comparing different design scenarios which may have increased traffic volumes for some scenarios, as it calculates the average cost per vehicle.

It should be used for examining the operation of traffic signal and roundabouts.

There is no threshold for determining what is an acceptable average cost, however this cost increases significantly as an intersection becomes over saturated. i.e. level of service E & F.

[2] The values of DS for intersections under traffic signal control are only valid for cycle length of 120 seconds

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