Specialist Consultant Studies Compendium

Gunlake Quarries
Gunlake Quarry Project

ENVIRONMENTAL ASSESSMENT

VOLUME II

Part 1
Christopher Hallam and Associates Pty Ltd
Transport Study of Proposed Gunlake Quarry, Brayton Road, Marulan

Part 2
SEEC Morse McVey
Managing Soil and Water. Proposed Gunlake Quarry and Haul Road, Brayton Road, Marulan

Part 3
Larry Cook and Associates Pty Ltd
Groundwater Impact Assessment. Gunlake Quarry Brayton Road via Marulan

February 2008

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GUNLAKE QUARRIES

TRANSPORT STUDY OF PROPOSED GUNLAKE QUARRY, BRAYTON ROAD, MARULAN

FEBRUARY 2008

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1.0 INTRODUCTION

Gunlake Quarries propose to develop a hard rock quarry on Brayton Road, Marulan. This study has been undertaken to assess the traffic and transport implications of the quarry, as part of the Environmental Assessment of the proposal. This study report is set out as follows:

- Section 2 reviews the current situation in regard to the road network and traffic flows;
- Section 3 discusses road design standards, to provide a basis for assessing any roadwork improvements for the quarry traffic;
- Section 4 sets out our assessment of the traffic implications of the proposal, covering traffic generation, transport route assessment, alternative transport routes and recommended improvement works;
- Section 5 summarises the recommended roadworks programme, briefly commenting on the environmental implications of the works, and of road pavement issues, and
- Section 6 sets out the conclusions.

2.0 CURRENT SITUATION

2.1 Road Network

Figure 1 shows the Locality Plan, indicating the Site location and the proposed transport haul routes. As is further discussed in Section 4, the proposed Stage 1 haul route is along Brayton Road, from the Site to the Marulan Hume Highway interchange to access this Highway. The Stage 2 haul route will utilise a new road connecting Brayton Road with Red Hills Road, and thence to its junction with the Hume Highway.

Brayton Road, Site to Marulan

At the Site access, Brayton Road has a sealed width of 5.7 m, and with a speed limit of 100 km/hr. The alignment is typical of a relatively lowly used country road, with flat sections interspersed with some rolling hills. Brayton Road generally maintains this width until the access to Johnniefelds Quarry is reached, when the road widens out, maintaining a wider carriageway width until it meets a T-junction on the outskirts of Marulan, where Brayton Road makes a right-angle bend to the East and Stoney Creek Road continues to the South. Stoney Creek Road is relatively short, ending at the Main Southern Railway Line. Stoney Creek Road has residential uses on each side.

Table 2.1 sets out an inventory of the transport route along Brayton Road from the junction with Stoney Creek Road, Marulan, to the Site.

TABLE 2.1 Transport Route Inventory, Brayton Road, from Stoney Creek Road, Marulan, to the Quarry Site

Chainage	Nearest Property	Sealed Width (m)	Comments
0.0	78-84	7.2	4 houses on west side, vacant east side
0.1		6.7	Start of 100 km/hr speed zone
0.6		7.1	Concrete bridge, 7.1 m to edges of kerbs on bridge; no centreline
0.9		12.7	Widens on approach to Merino Road, then narrows after junction
1.2		7.2	After Merino Road junction
1.6	#268	7.2	Joarimin Creek Road
1.8		6.9	Driveway on left
2.1		7.3	Culvert
2.2	Near 355	7.5	Minor culvert
2.9	#394	7.7	
3.1	#415	7.5	Bridge/culvert
		7.3	Minor culvert
3.7	#484	9.5	Johnniefelds Quarry access, recently upgraded
4.0		5.7	Older pavement west of Johnniefelds Quarry
4.5		5.7	
4.7	#575		Driveway on northern side of bend
5.0		5.7	
5.6		5.6	Minor crest
6.1	#715	5.7	At site entrance

Brayton Road thus has a sealed width generally over 7 m between Stoney Creek Road and the entrance to the Johnniefelds Quarry, The road pavement in part of this section has been recently upgraded, with the sealed width reducing to 5.7 m between Johnniefelds and the Site.

Brayton Road through Marulan

Between its junction with Stoney Creek Road and George Street, Brayton Road travels through an urban residential section of Marulan, generally with dwellings on each side. Just east of Stoney Creek Road the carriageway width is 11.8 m. Then, for a section approximately 400 m long, the carriageway slightly reduces to 10.0 m wide, with no kerbs/gutter on the northern side and a roll kerb on the southern side. A gutter is provided on the northern side, just west of Wollondilly Street, with the carriageway reducing slightly to 9.6 m. For the 400 m west of Wollondilly Street, there is no residential development along the southern side. The road pavement in this section has been recently upgraded. Between Wollondilly Street and George Street, there are kerbs/gutters on both sides, with a carriageway width of 11.0 m.

George Street, Marulan

George Street (the old Hume Highway) extends from the Highway Service Centre south of the town, past the Portland Avenue roundabout, which has access off the current Hume Highway, through the Marulan town centre to Brayton Road. George Street has kerbside parking on both sides, plus travel lanes. As well as shops, there is a school on George Street. North of Brayton Road, George Street becomes a cul-de-sac, after passing the disused truck checking stations.

Hume Highway Interchange

The eastern extension of Brayton Road passes under the Hume Highway, as part of the Marulan Interchange. The underpass has one travel lane per direction. Southbound traffic on the Highway offloads near the truck checking station and travels under the Highway to access Brayton Road and Marulan. Traffic from Marulan and Brayton Road wishing to travel south uses this underpass to access the southbound load ramp on the eastern side of the Highway. Traffic from Marulan wishing to travel north turns left off Brayton Road onto the load ramp on the western side of the Highway.

Northbound traffic on the Highway cannot offload to Brayton Road. Traffic wishing to make this movement needs to offload at Portland Avenue.
The at-grade interchange of the Highway with Portland Avenue provides left-turn deceleration and acceleration lanes on the Highway to cater for left turns into and out of Portland Avenue. There is a right turn bay with a deceleration lane in the median for the right turn from the Highway North into Portland Avenue. There is also an acceleration lane in the median to assist vehicles turning right out of Portland Avenue. The median is wide enough to shelter these right turning vehicles, prior to acceleration and merging with southbound traffic. Sight distance at this intersection is good.

Just west of this intersection there is a roundabout on Portland Avenue, with George Street (from Marulan town) and the Old Hume Highway (from the highway service centre) forming a junction with Portland Avenue. This is a large roundabout designed for large heavy vehicles.

Red Hills Road

The existing junction of Red Hills Road with the Hume Highway allows for all movements, at-grade, with a 65 m long right turn lane in the Highway median for southbound vehicles wishing to turn right into Red Hills Road. For the 110 km/hr design speed on the Highway, this deceleration and right turn lane is substandard in its length. Vehicles can turn right out of Red Hills Road. The median width provides some scope for a driver making this manoeuvre to first cross the northbound traffic before entering the southbound traffic, but it does not constitute seagull chanellisation. There are no left-turn lanes for the movements into or out of Red Hills Road. Sight distance is very good.

There is a Truck Parking Area just south of Red Hills Road, on the Highway. The entrance to this area is approximately 400m south of the junction of Red Hills Rd and the Hume Highway.

Red Hills Road approaches the Highway junction via a sharp turn adjacent to a property access. Red Hills Road has a sealed width of 8.1 m at this point. Table 2.2 sets out an inventory of Red Hills Road from its junction with the Highway to the location where the proposed new By-Pass road will join it.

TABLE 2.2 Transport Route Inventory, Red Hills Road west of Hume Highway

Chainage (km)	Sealed Width (m)	Comment
0.0	8.1	At Highway
0.1	5.7	Gate to "Pinelodge"
	5.7	Culvert
	5.7	Bend, 25km/hr advisory speed
0.4	6.9	
0.85	6.6	Crest
1.1	6.6	
1.4	6.5	Bend to North, where proposed By-Pass road to join

The carriageway and alignment of Red Hills Road is designed for local access use.

2.2 Traffic Flows

Current traffic flows in the Marulan area were collected over the seven day period Friday 25th to Thursday 31st May 2007, using automatic counters at four locations. Full survey results are reproduced in Appendix A. In addition, previous traffic counts in the area have been collated.

Brayton Road

Table 2.3 sets out the current flows on Brayton Road, south of the access to the Johnniefelds Quarry, in terms of total flows, and with heavy vehicles also shown. This section of road will be the primary haul route from the quarry, initially all the way to Marulan, and ultimately just to the proposed new By-Pass road.

TABLE 2.3 Daily Traffic Flows on Brayton Road South of Johnniefelds Quarry 25-31 May 2007 (vehicles/day)

Day	Northbound	Southbound	Total	Rigid Class 3-5	Articulated Class 6-13
Monday	164	176	340	60	46
Tuesday	218	220	438	90	77
Wednesday	181	179	360	47	50
Thursday	209	210	419	69	60
Friday	223	220	443	76	51
Saturday	174	157	331	33	17
Sunday	122	163	285	28	4
Avg Daily	184	189	373	58	44

Table 2.3 indicates that current average daily traffic flows are relatively low, at 373 veh/day. However the proportion of heavy vehicles is high, with 27% overall, including 15% Rigid Trucks (Class 3-5) and 12% Articulated Trucks (Class 6-13). The heavy vehicle numbers reduce on the weekend, particularly on Sunday.

The weekly 85%ile northbound speed was 90 km/hr while the weekly 85%ile southbound speed was 102 km/hr. The speed limit is 100 km/hr.

Table 2.4 sets out the average hourly flows over the week, including a breakdown of Rigid Trucks and Articulated Trucks.

TABLE 2.4 Average Hourly Traffic Flows on Brayton Road South of Johnniefelds Road 25-31 May 2007 (vehicles/hour)

	Northbound			Southbound			Total		
Period	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**
0-1am	0	0	1	0	0	0	0	0	1
1-2	0	0	1	0	0	1	0	0	2
2-3	0	0	0	0	0	0	0	0	0
3-4	0	0	1	0	0	1	0	0	2
4-5	0	0	1	0	0	2	0	0	3
5-6	0	1	5	0	0	2	0	1	7
6-7	1	2	7	0	2	8	1	4	15
7-8	2	2	15	4	1	14	6	3	29
8-9	2	4	16	5	3	20	7	7	36
9-10	1	2	13	3	2	16	4	4	29
10-11	1	2	13	4	3	18	5	5	31
11-12	2	2	14	4	3	15	6	5	29
12-1p	1	2	12	3	2	12	4	4	24
1-2pm	1	1	12	2	2	12	3	3	24
2-3	2	2	14	4	2	14	6	4	28
3-4	1	1	13	5	2	17	6	3	30
4-5	0	0	12	4	1	18	4	1	30
5-6	0	0	11	1	0	9	1	0	20
6-7	0	0	7	0	0	4	0	0	11
7-8	1	0	6	1	0	3	2	0	9
8-9	0	0	4	0	0	1	0	0	5
9-10	0	0	4	0	0	0	0	0	4
10-11	0	0	3	0	0	1	0	0	4
11-12	0	0	2	0	0	1	0	0	3

The hourly flows are not strongly peaked. The highest morning flows were 36 veh/hr in the 8.00-9.00am, with the highest afternoon flows of 30 veh/hr in 3.00-4.00pm and 4.00-5.00pm. These flows are of a very low order.

Brayton Road continues into Marulan. During the Stage 1 , this section of Brayton Road will be used by all quarry trucks. In Stage 2 it will only be used for trucks travelling to the South. The daily traffic flows on Brayton Road east of Wollondilly Street, Marulan, were as shown in Table 2.5.

TABLE 2.5 Daily Traffic Flows on Brayton Road East of Wollondilly Street, Marulan 25-31 May 2007 (vehicles/day)

Day	Eastbound	Westbound	Total	Rigid Class 3-5	Articulated Class 6-13
Monday	424	406	830	45	85
Tuesday	452	438	890	68	79
Wednesday	481	444	925	53	55
Thursday	453	440	893	55	63
Friday	472	445	917	72	63
Saturday	448	412	860	22	20
Sunday	358	378	736	13	6
Avg Daily	441	423	864	47	53

Within the township, the daily traffic flows are still only moderate, well within usual environmental capacity limits for local residential streets. However the numbers of heavy vehicles are higher than typical in residential streets. The overall percentage of heavy vehicles is 11.6%, of which 6.1% is articulated vehicles.

Over the week, the eastbound 85%ile travel speed was 56 km/hr while the westbound 85%ile speed was 60 km/hr.

Table 2.6 shows the average hourly flows.

TABLE 2.6 Average Hourly Traffic Flows on Brayton Road East of Wollondilly Street, Marulan 25-31 May 2007 (veh/hr)

	Eastbound			Westbound			Total		
Period	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**
0-1am	0	0	3	0	0	1	0	0	4
1-2	0	0	2	0	0	1	0	0	3
2-3	0	0	1	0	0	1	0	0	2
3-4	0	0	1	0	0	2	0	0	3
4-5	0	0	1	0	0	4	0	0	5
5-6	0	1	6	0	1	11	0	2	17
6-7	0	2	8	0	2	23	0	4	31
7-8	3	2	21	2	2	33	5	4	54
8-9	2	4	22	3	4	41	5	8	63
9-10	1	2	26	2	2	33	3	4	59
10-11	2	3	31	1	3	36	3	6	67
11-12	2	2	29	2	4	30	4	6	59
12-1p	2	3	34	1	3	27	3	6	61
1-2pm	2	1	28	2	2	25	4	3	53
2-3	1	2	32	3	2	26	4	4	58
3-4	3	1	36	3	2	30	6	3	66
4-5	2	0	42	2	0	35	4	0	77
5-6	1	1	44	1	0	24	2	1	68
6-7	0	0	24	0	0	15	0	0	39
7-8	1	0	16	0	0	9	1	0	25
8-9	0	0	11	0	0	6	0	0	17
9-10	0	0	11	0	0	3	0	0	14
10-11	0	0	6	0	0	3	0	0	9
11-12	0	0	5	0	0	2	0	0	7

There is no strong peak hour trend in the flows. The highest flow in the morning was 67 veh/hr in the 10.00-11.00am period, while the highest flow in the afternoon was 77 veh/hr in the 4.00-5.00pm period. Heavy vehicle movements are concentrated in the daytime period of 7.00am to 5.00pm.

George Street

George Street will be used by quarry trucks arriving from the Highway South during stage 1 only. Southbound trucks leaving the quarry will travel directly to the Highway at the Marulan Interchange.

Intersection turning movement counts were undertaken in February 2005 by Transport & Urban Planning, as part of their *Traffic and Transport Impact Assessment* for the proposed Lynwood Quarry. Table 2.7 sets out these peak period flows immediately north of the Portland Avenue roundabout.

TABLE 2.7 Peak Hour Flows on George Street North of Portland Avenue, Friday 11 February 2005

	Northbound		Southbound		Total	
Period	**Heavy**	**Total**	**Heavy**	**Total**	**Heavy**	**Total**
6.30-7.30am	6	36	9	22	15	58
8-9am	9	34	5	27	14	61
12-1pm	12	64	4	34	16	98
5.30-6.30pm	0	37	3	31	3	68

The peak hourly flows in Table 2.7 are moderate for the main street access into a town centre.

Hume Highway Interchanges

Relatively minor truck movements will utilise the interchange at Brayton Road, adjacent to the RTA truck checking station. Table 2.8 shows the current daily traffic flows on the underpass at this interchange.

TABLE 2.8 Daily Traffic Flows on Brayton Road Interchange Underpass 25-31 May 2007 (vehicles/day)

Day	**Eastbound**	**Westbound**	**Total**	**Rigid Class 3-5**	**Artic Class 6-13**
Monday	356	168	524	30	54
Tuesday	396	176	572	40	63
Wednesday	378	152	530	39	31
Thursday	327	176	503	35	42
Friday	426	184	610	32	39
Saturday	408	146	554	22	17
Sunday	338	121	459	12	4
Avg Daily	375	160	535	30	36

The eastbound flows are generally at least double the westbound flows. The total two-way flows of 535 veh/day are relatively low for a highway interchange. The overall proportion of heavy vehicles is 12%.

Table 2.9 shows the average hourly traffic flows on the underpass.

TABLE 2.9 Average Hourly Traffic Flows on Brayton Road at Interchange Underpass 25-31 May 2007 (vehicles/hour)

	Eastbound			Westbound			Total		
Period	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**
0-1am	0	0	2	0	0	1	0	0	3
1-2am	0	0	1	0	0	0	0	0	1
2-3	1	0	1	0	0	0	1	0	1
3-4	1	0	2	0	0	1	1	0	3
4-5	0	0	3	0	0	2	0	0	5
5-6	0	0	2	0	0	5	0	0	7
6-7	0	2	8	0	1	9	0	3	17
7-8	2	1	16	1	1	13	3	2	29
8-9	1	1	28	1	2	16	2	3	44
9-10	2	1	31	0	2	14	2	3	45
10-11	3	2	27	1	1	13	4	3	40
11-12	1	2	28	0	1	11	1	3	39
12-1p	2	2	26	0	1	11	2	3	37
1-2pm	1	1	23	0	1	10	1	2	33
2-3	1	2	29	1	1	10	2	3	39
3-4	2	1	33	2	1	11	4	2	44
4-5	2	1	37	0	0	11	2	1	48
5-6	1	2	32	0	0	6	1	2	38
6-7	0	0	21	0	0	4	0	0	25
7-8	0	1	12	0	0	4	0	1	16
8-9	0	0	6	0	1	3	0	1	9
9-10	0	1	5	0	0	2	0	1	7
10-11	0	0	2	0	0	3	0	0	5
11-12	0	0	2	0	0	1	0	0	3

The hourly flows are relatively low for a highway interchange, with two-way flows of less than 50 veh/hr. The eastbound flows predominate, following from the daily trends.

The construction of a roundabout is proposed at the intersection of George Street and Brayton Road for southbound trucks on the Highway to make a U-turn and return north onto the highway to make a left turn into Red Hills Road.

Red Hills Road

As is further discussed, a new By-Pass road is proposed to link Brayton Road with Red Hills Road. Red Hills Road currently carries very low traffic flows, as shown by the current daily flows shown in Table 2.10.

TABLE 2.10 Daily Traffic Flows on Red Hills Road West of Hume Highway 25-31 May 2007 (vehicles/day)

Day	Eastbound	Westbound	Total	Rigid Class 3-5	Articulated Class 6-13
Monday	25	25	50	6	0
Tuesday	47	47	94	13	6
Wednesday	46	49	95	16	2
Thursday	32	34	66	3	4
Friday	38	32	70	4	0
Saturday	29	21	50	5	2
Sunday	14	20	34	2	2
Avg Daily	33	32	65	7	2

These daily traffic flows are very low, albeit with some heavy vehicle activity. As would be expected, the average hourly flows are very low, as indicated in Table 2.11.

TABLE 2.11 Average Hourly Traffic Flows on Red Hills Road West of Hume Highway 25-31 May 2007 (vehicles/hour)

	Eastbound			Westbound			Total		
Period	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**	**Rigid**	**Artic**	**Total**
0-1am	0	0	1	0	0	0	0	0	1
1-2am	0	0	0	0	0	0	0	0	0
2-3	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0	0
4-5	0	0	0	0	0	0	0	0	0
5-6	0	0	0	0	0	0	0	0	0
6-7	0	0	2	0	0	0	0	0	2
7-8	1	0	3	0	0	1	1	0	4
8-9	0	0	4	0	0	5	0	0	9
9-10	0	0	3	0	0	3	0	0	6
10-11	0	0	2	0	0	3	0	0	5
11-12	0	0	2	0	0	2	0	0	4
12-1	1	0	2	0	0	2	1	0	4
1-2pm	0	0	2	1	0	2	1	0	4
2-3pm	0	0	2	1	0	2	1	0	4
3-4	0	0	3	0	0	2	0	0	5
4-5	0	0	4	1	0	5	1	0	9
5-6	0	0	1	0	0	3	0	0	4
6-7	0	0	1	0	0	1	0	0	2
7-8	0	0	1	0	0	0	0	0	1
8-9	0	0	1	0	0	0	0	0	1
9-10	0	0	1	0	0	0	0	0	1
10-11	0	0	0	0	0	0	0	0	0
11-12	0	0	0	0	0	0	0	0	0

The “peak” hour flows were 9 veh/hr in the periods 8.00-9.00am and 4.00-5.00pm.

3.0 ROAD DESIGN STANDARDS

In reviewing the proposed transport routes, reference will be made to several guidelines, as set out below.

"Road Design Guide"

The Roads & Traffic Authority's *"Road Design Guide"* is the primary road design reference for NSW roads. Tables 3.2-4 and 3.3-1 are reproduced below, setting out the recommended lane and shoulder widths for different traffic flows.

TABLE 3.2-4 Lane Widths Two Lane Two Way Rural Roads

AADT (vehicles/day)	***No. of Lanes***	***Lane Width (m)***
1-150	*1*	*3.5*
150-500	*2*	*3.0*
500-2000	*2*	*3.0-3.5*
> 2000	*2*	*3.5*

Where the intended design speed through mountainous terrain will be in excess of 80 km/hr, or 100 km/hr in undulating terrain, or where there is a predominantly high percentage of heavy vehicles (20% for 500 AADT and 5% for 2000 AADT), a lane width of 3.5 m is desirable.

TABLE 3.3-1 Shoulder Widths for Two Lane Two Way Rural Roads

AADT (vehicles/day)	***Shoulder Width (m)***
1-500	*1.0-1.5*
500-1000	*1.0-2.0*
Over 1000	*2.0-3.0*
Adjacent to barrier lines	*3.0*

Shoulders should be sealed to a width of 0.5 m from the edge of the sealed lane, when the predicted AADT is less than 2000, and 1m when the predicted AADT is greater than 2000.

Table 3.11-2 of the Roads & Traffic Authority's *"Road Design Guide",* sets out recommended bridge carriageway widths, from kerb to kerb, for non-Highway roads. For daily traffic flows of 100-500 veh/day, a 6.0 m road plus two 1.0 m shoulders is recommended, for a total width of 8.0 m. For daily traffic flows of 500-1000 veh/day, a 6.5 m road plus two 1.0 m shoulders is recommended, for a total width of 8.5 m.

Section 4.7.4 of the *Road Design Guide* deals with sight distance requirements at intersections. Drivers approaching an intersection need to be able to see intersection

geometry and pavement markings. For this, the *approach sight distance* from a driver eye height of 1.15 m (in a car) to the pavement level is required. For design speeds of 80 km/hr and 100 km/hr the approach sight distance on level terrain is
100 m and 150 m.

The *safe intersection sight distance* (SISD) should also be provided, this being to allow adequate sight between an approaching vehicle on the major road seeing a vehicle on the side road about to cross or join the major road. This is measured from car driver eye height to car driver eye height. For design speeds of 80, 100 and 110 km/hr the SISD is 160 m, 225 m and 295 m respectively. Note that on the measurement of sight distances, while a driver's eye height is taken to be 1.15 m, the eye height of the driver of a truck + dog rig, as measured on a quarry truck, is 2.45 m, or over double the eye height of a car driver. This gives a truck driver better sight distance where there is a constraint with the vertical alignment, plus an enhanced ability to see over vegetation on the inside of corners.

The *Road Design Guide* defines carriageway as:

> *"That portion of a road or bridge used by vehicles, (inclusive of shoulders and auxiliary lanes)."*

"Route Assessment Guidelines for Restricted Access Vehicles"

This publication by the Roads & Traffic Authority was prepared for assessing proposed transport routes by over-dimension vehicles, including B-doubles. These guidelines provide an insight into road cross-sectional considerations of the RTA when assessing the movement of 25 m long articulated vehicles. In summary, for total traffic flows of less than 500 veh/day, a total road formation width of 7.0 m, including shoulders, is recommended for straight sections. For 500-2000 veh/day, lane widths of 3.0 m each and shoulder widths of 1.0 m each are recommended. For daily flows of up to 6,000 veh/day, the lane width remains at 3.0 m. This is less than the 3.5 m lane widths recommended in the *Road Design Guide* for flows over 2,000 veh/day.

These *Guidelines* do not recommend any minimum horizontal or vertical geometry standards. They do not mention any minimum bridge widths, but do comment that the structural capacity of bridges might need to be checked.

Goulburn Mulwaree Council Draft Development Control Plan Provisions for Heavy Vehicle Generating Development

Goulburn Mulwaree Council has recently drafted planning provisions for heavy vehicle generating development, to be incorporated in to the consolidated Development Control Plan currently being formulated. In terms of the upgrading of haulage routes, the Draft standards are:

- 7 m wide carriageways in rural areas
- 6 m wide carriageways in village areas
- 1 m wide shoulder with 500mm seal
- 8 m wide culverts and bridges (i.e. from barrier to barrier)

- Replacement of road with dense grade asphaltic concrete or stone mastic asphalt in village areas
- Possible intersection upgrades

Goulburn Mulwaree Council Pavement Design for Brayton Road-Marulan

Goulburn Mulwaree Council has recently reconstructed Brayton Road for a length of 1200 m, from the access to the Readymix Johnniefelds Quarry, towards Marulan. The document *Pavement Design, Brayton Road – Marulan, 2006-2007 Pavement Rehabilitation Program,* sets out the specifications for the road standards considered appropriate by Council. These standards and specifications were based on *"an AADT of 550, with a large volume of heavy vehicles using the Readymix Quarry"*. They noted:

> *"The existing **formation width** varies between 8 m and 9m and the objective is to widen the formation width to **9.0m.***
>
> *The existing **seal width** also varies between 6m and 7m and the objective is to seal to **7.0m."***
>
> *"Both sections [Chainage 0m to 600m and 600m to 1200m] will be constructed with a 9m wide formation and a 7m wide two coat seal (14mm/7mm) finish."*

As noted in the definition on the RTA *Road Design Guide,* the carriageway includes the shoulder used by vehicles. The 7m wide carriageway stated in the Councils Draft DCP Provisions for Heavy Vehicle Generating Development thus includes sealed sections of the road shoulder. Taking these sections to be 0.5m on each side, the sealed width is thus 0.5 + 6.0 + 0.5 = 7.0m. This is the sealed width implemented on Brayton Road, and hence the Draft DCP Provisions and the "as constructed" works are consistent.

"Guide to Traffic Generating Developments"

The Roads & Traffic Authority's *Guide to Traffic Generating Developments* provides general advice on the traffic impact assessment of proposed developments. For assessing the peak period operation of intersections, this *Guide* makes recommendations for varying levels of service. These are reproduced in Table 3.1 below.

TABLE 3.1 Level of Service Criteria for Intersections

Level of Service	Average Delay Per Vehicle (secs/veh)	Traffic Signals, Roundabouts	Give Way & Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with Acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near Capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays; roundabouts require other control mode	At capacity, needs other control mode
F	Over 70	Over capacity	Over capacity

The RTA *Guide* also recommends performance standards for the *environmental capacity* of residential streets. These have been developed for application on any residential streets in the State, and hence are applicable to streets such as Brayton Road, Marulan. They have been developed taking into account issues such as pedestrian safety in crossing the road, traffic noise, road hierarchy design and surveyed perceptions of traffic annoyance. They are based on peak hour flows because these can specifically be correlated with traffic gaps for pedestrians crossing the road. Table 3.2 reproduces these standards.

TABLE 3.2 Environmental Capacity Performance Standards on Residential Streets

Road class	Road type	Max. Speed (km/hr)	Max.peak hour flow (veh/hr)
Local	Access way	25	100
	Street	40	200 environmental goal
		40	300 maximum
Collector	Street	50	300 environmental goal
		50	500 maximum

4.0 TRAFFIC IMPLICATIONS OF PROPOSED QUARRY

4.1 Description

The Site of the proposed quarry is located approximately 8km northwest of Marulan, as shown on Figure 1. Current access to the Site is via Brayton Road, a two lane sealed road servicing existing quarry operations and communities west of Marulan and beyond. The Site has extensive reserves of quarry material and has an expected life of over 100 years. Approval is sought for an initial period of 30 years.

The quarry is proposed to operate as a conventional open-cut hard rock quarry and will produce 500,000 tonnes per annum of saleable product.

The quarry will provide employment for approximately 45 personnel, comprising 20 quarry personnel and 25 haulage operators.

4.2 Traffic Generation and Transport Routes

Two stages of operation are proposed:

Stage 1: An average of 25 truck movements per day, with a peak no greater than 50% more than that average.
Stage 2: Over the average 25 truck movements, increasing over time to an estimated 100 truck movements per day

In addition to the truck movements, there will be staff commuting movements. With 20 staff on the Site, and conservatively assuming every staff member drives, there will be 40 light vehicle movements each day by staff by Stage 2. There will also be occasional visitor movements plus deliveries.

For Stage 1, material will be transported by articulated semi-trailer and truck-and-dog rigs, with three or four-axle dogs. For Stage 2, while the current assessment has been based on the same vehicle types, consideration will be given to the used of B-Doubles. If proposed, a separate application will be made for the haul route to be approved as a B-Double route.

Stage 1

<u>Route</u>
The haulage route for this Stage will utilise existing roads:

- New access from the Site to Brayton Road
- Brayton Road, through northern edge of Marulan, to the Hume Highway interchange near RTA Checking Station, most trucks will use this interchange.
- Trucks arriving from the Highway South will off-load near Highway Service Centre and travel northbound through Marulan town centre, to access Brayton Road.

Hours of Haulage

The proposed haulage hours for Stage 1 are 9pm Sunday to 6pm Saturday. (After construction of the by-pass route, being Stage 2, there will be no haulage through Marulan outside the hours of 6.00am to 6.00pm Monday to Saturday)

Taking the daily average truck movements of 25, there will be an average of 1.04 truck movements each hour on Brayton Road.

The distribution of haulage of material is estimated to be 80% to the Highway North and 20% to the Highway South. For the trucks returning from the Highway South, these will be 25/2 x 20% = 2.5/day, say up to 3 movements each day through the town centre.

Site Access

The Site access onto Brayton Road will be constructed prior to the haulage of quarry material in Stage 1. This access will be near the current site access. To maximise sight distance, some clearing of roadside vegetation is proposed.

Stage 2

Route

For Stage 2, with truck movements exceeding the average of 25/day, a new By-Pass road is proposed to be constructed, from Brayton Road to Red Hills Road, along an unformed Crown Road. The starting point on Brayton Road will be through land owned by Gunlake Quarries, at a location to be selected to maximise sight distances to/from Brayton Road. This route will join Red Hills Road at the point where it makes a right-angle turn to the North. Where Red Hills Road joins the Hume Highway, quarry trucks will only make left turns. It is proposed to dedicate this new By-Pass road to Council, as a public road.

For unladen quarry trucks arriving from the Highway North, they will proceed southbound along the Highway and off-load at the Marulan Truck checking station. At this interchange, they will make a U-turn manoeuvre at the proposed roundabout at the intersection of George Street and Brayton Road , to return northbound along the Highway prior to making a left-turn into Red Hills Road.

Hours of Haulage

Stage 2 will have an estimated 100 truck movements each day. The hours of haulage will be from 9.00pm Sunday to 6.00pm Saturday. These hours will apply to the main route, via Red Hills Road. For haulage to the Highway South, the hours 6.00am to 6.00pm Monday to Saturday will apply. Trucks from the Highway South will turn left from the Highway into Red Hills Road. For the estimated 100 truck movements each day, based on the anticipated 80% North and 20% South split, the daily and average hourly movements will be:

Movement	Movement/Day	Movement/Hour
From North, U-turn at proposed roundabout, left turn to Red Hills Rd	40	1.7
To North, via left turn from Red Hills Road to Highway	40	1.7
From South, via left turn into Red	10	0.4
To South, via Brayton Road	10	0.4

Road and Intersection Upgrades

Improvements to Brayton Road are further discussed in Sections 4.4 and 4.5.

Construction of a roundabout at the intersection of George Street and Brayton Road as discussed in section 4.6.

The intersection of Red Hills Rd and the Hume Highway will be upgraded as discussed in Section 4.7

A new junction will be constructed where the new haul route meets Brayton Road and where the quarry access meets Brayton Road. The construction design will be based on current and projected traffic flows. The design is discussed in Section 4.7.

We recommend that all haul roads be signposted with an 80 km/hr speed limit, for trucks and buses. A similar restriction applies on South Marulan Road, at South Marulan. While we accept that this recommendation is subject to the consent of the RTA, we recommend it to improve traffic safety. The relative distances of the haul routes are not long, with the distance from the Site to the new By-Pass road being approximately 4.0 km, with a further 1.5 km to the 60 km/hr restriction in Marulan. The total distance along the proposed By-Pass road and Red Hills Road is approximately 3.0 km.

4.3 Alternative Transport Routes

The primary transport route, as proposed for Stage 1 operations, is via Brayton Road from the Site through to the existing Hume Highway interchange at Marulan. This utilises existing road infrastructure.

The Stage 2 operations will generate an estimated 100 truck movements in total each day. The proposed hours are 9pm Sunday to 6pm Saturday . For this level of operation, the amenity implications for dwellings fronting Brayton Road within Marulan could be significantly adverse. Consequently, the new By-Pass road to connect Brayton Road with Red Hills Road has been proposed. This Stage 2 proposal will require an intersection upgrade at the Red Hills Road Hume Hwy intersection.

The approved Lynwood Quarry further to the South will provide a new grade-separated interchange at the junction of the Highway with Marulan South Road and with the proposed

Lynwood Quarry haul road. The latter will be a private road. The timing of the construction of this interchange is not known.

Trucks from the proposed Gunlake Quarry do not have access to the Lynwood Quarry private haul road and hence to the new interchange.

The Lynwood Quarry includes a provision for a rail loading balloon loop on the southern side of the Main Southern Railway, west of Marulan. This loop and associated infrastructure will not be able to be accessed off the public road network. At present, Stoney Creek Road ends at the railway lines within Marulan. Stoney Creek Road south of Brayton Road is a local residential street, with dwellings on both sides, and is not suitable as a haul road.

Further road access options on the northern outskirts of Marulan were investigated. However, the relevant land was not available for sale, and hence this option is not available.

An option was developed for a U-turn facility at the Highway interchange adjacent to the RTA truck checking station, east of Brayton Road. A design was developed following initial feedback from the Roads & Traffic Authority. However, the Authority did not approve the proposed layout.

Another option was for trucks in Stage 2 to turn right into Portland Avenue off the Hume Highway, make a U-turn at the existing roundabout at Portland Avenue/George Street and then return to the Highway via a left turn, to travel northbound to Red Hills Road, where they would turn left into Red Hills Road and then to the quarry. This movement would average 40/day, or up to 2 trucks/hour.

Approaching Portland Avenue from the Highway North, there is a deceleration lane in the median and a protected right turn bay. There is very good visibility towards approaching northbound vehicles. The driver would take a gap in northbound traffic and cross the two northbound lanes. After making a U-turn, the driver would turn left back onto the Highway and use the existing acceleration lane.

The Roads & Traffic Authority (RTA) and Council expressed concern about the safety of the Highway/Portland Avenue intersection, given its accident history, and have not ruled out closing the median at this intersection. The implications of closing this intersection have not been fully investigated by the RTA or Council

The RTA have provided the accident history at this intersection for the most recent five year period. It showed five accidents as follows:

20/4/2002	Van eastbound from Portland, across Highway, hit northbound car
28/4/2002	Car eastbound from Portland, turning right onto Highway, hit northbound station wagon
18/12/2005	Truck westbound from eastern service road, turning right onto Highway, hit northbound car
18/3/2006	Car eastbound from Portland, hit southbound car
21/7/06	15 m north of Portland, northbound station wagon hit northbound car while merging lanes

There were no accidents involving vehicles making a right turn from the Highway North into Portland Avenue.

If the median was closed, four out of these five accidents would not occur. If the Portland Avenue approach had channelisation to prevent cross and right turn movements, only allowing left turn movements, and if similar channelisation was provided on the service road on the eastern side, the same four accidents would not occur.

In summary, this transport route option is an alternative, or at the least a short term option, with the RTA being able to prevent all of the accidents that have occurred right at the intersection over the last five years.

4.4 Brayton Road Junctions

Table 2.4 shows the average hourly traffic flows on Brayton Road south of Johnniefelds Quarry. This table indicates very low traffic flows, with nominal peaks at 8.00-9.0am and 3.00-4.00pm. The weekday flows are marginally higher than the average weekly flows. Table 4.1 shows these average weekday peak hour flows.

TABLE 4.1 Average Weekday Peak Hour Flows on Brayton Road South of Johnniefelds Quarry, 25-31 May 2007

Peak Hour	Northbound	Southbound	Total
8.00-9.00am	18	24	42
3.00-4.00pm	15	17	32

For Stage 1, with an average of 25 truck movements per day, the average hourly truck movement will be one per hour. Clearly with this level of flow overlayed onto the current peak hour flows there will be no traffic capacity issues at the Site access intersection or at the Brayton Road/Stoney Creek Road intersection.

For Stage 2, hourly truck movements between the Site and the new By-Pass road junction will be 2 truck movements per hour in each direction. Again, overlayed on the current "peak" hour flows, there will be no traffic capacity issues. These are average truck flows. A peak hour might see up to a 50% increase, or 3 truck movements per hour, which again will be insignificant in traffic capacity terms. The despatch of laden trucks will be determined by the loading capacity at the quarry.

The key issue with the Brayton Road junctions is traffic safety. At the Site access intersection, taking the hourly flows in Table 4.1 as the starting point, and adding a left turn into the Site of 2 veh/hr and a right turn out of the Site of 2 veh/hr, Figure 4.5.12 of the RTA's *Road Design Guide* indicates that a Type BAL treatment would be adequate for the left turn. With no right turn truck movements into the quarry, no special treatment is needed for this right turn. Figure 4.5.12 does make the comment that *"Use of Types "AU" and "CH" is preferred on high speed and/or heavy vehicle routes to enhance safety"*. While the threshold for a Type AUL treatment is significantly above the current traffic flow levels, to be conservatively safe, a Type AUL treatment is recommended.

As is discussed in Section 4.5, and at the request of council as per their letter to the Department dated 17 July 2007, we have adopted the Councils Draft DCP Provisions for Heavy Vehicle Generating Development for a sealed width between the Site and the Johnniefelds quarry of 7.0 m. For the auxiliary left turn into the quarry, we recommend a lane width of 3.25 m. As recommended in Section 4.2, an 80 km/hr speed limit for trucks (and buses) would be appropriate, to enhance traffic safety. With this speed and left turn lane width, the diverge length (Td) would be 72 m. This would be adequate for a vehicle to stop from 80km/hr at a "desirable maximum" deceleration rate of 3.5 m/s2 (Table 4.8.3 of *Road Design Guide*). As suggested in the *Road Design Guide*, the initial taper will be 20 m, with the parallel section of lane then 52 m long. The quarry site driveway will have an initial sealed width of 7.0 m. Figure 3 shows the schematic layout of this junction. No widening is proposed of the carriageway of Brayton Road west of the Site, because quarry traffic will not use this section of road, with the possible exception of an employee commuting to work. With the level of current traffic and the level of right turn movement out of the quarry site, any auxiliary acceleration lane would not be justified.

With the level of eastbound peak hour flow at the Site access – 24veh/hr in morning peak hour and 17 veh/hr in afternoon peak hour – and with no traffic likely to be arriving at the Site from Brayton Road West, no additional treatment is proposed for the eastbound approach.

Should the RTA decide to <u>not</u> improve traffic safety through the imposition of an 80 km/hr speed limit for trucks and buses, the deceleration length would be increased accordingly. Again, we recommend this 80 km/hr speed limit for trucks. It would only apply over relatively short lengths – 6.0 km from the Site to Marulan, and is identical to the existing restrictions on South Marulan Road.

At the Site access, there is currently some vegetation within the road reserve to the west of the Site that affects sight distance. We recommend that this roadside vegetation be cut back to maintain sight lines.

At the junction of Brayton Road with the new By-Pass road (Figure 5), the same traffic conditions will apply as for the Site access junction, with the exception that the through movements along Brayton Road will be reversed. These movements are of a very low order. For the same reasons, we recommend a Type AUL treatment, with a 72 m long auxiliary left turn lane. The location of this junction will be designed to maximise sight distances in both directions. Roadside vegetation may be trimmed as required to maintain sight lines. Again, the length of left turn lane would increase if the truck speed limit was not imposed.

With this junction, the westbound peak hour flows on Brayton Road are very low, at 18 veh/hr in the morning and 15 veh/hr in the afternoon. With the construction of the new By-Pass road, there might be a low flow making a right turn into the By-Pass road. Since this will be a public road intersection, we recommend that this westbound approach have a BAR treatment, with shoulder widening opposite the By-Pass road, to provide better safety for passing through traffic.

4.5 Brayton Road Route

For Stage 1, the transport route will be along the length of Brayton Road, from the Site, into Marulan township and onto the Highway interchange, with trucks from the Highway South using George Street to connect with Brayton Road. This will see an average of 25 truck movements each day, with an average of about one truck movement each hour.

For Stage 2, the main transport route will be along Brayton Road from the Site to the By-Pass road, with 100 truck movements along this section, averaging 4 truck movements each hour over any 24 hour period. Trucks travelling to south will continue to use Brayton Rd at an average of 25 movements per day for the life of the quarry but the hours will be between 6am and 6pm Monday to Saturday only.

Brayton Road: Site to Stoney Creek Road

Looking first at the issue of carriageway widths, Section 3 provides an indication of road design standards for varying levels of traffic flow. Table 2.1 provides road inventory details. Table 4.2 repeats Table 2.3, showing current daily traffic flows, plus the Stage 1 and Stage 2 additional traffic flows.

TABLE 4.2 Daily Traffic Flows on Brayton Road South of Johnniefelds Quarry (vehicles/day)

Day	Light	Rigid Truck Class 3-5	Articulated Class 6-13	Total Traffic
Monday	234	60	46	340
Tuesday	271	90	77	438
Wednesday	263	47	50	360
Thursday	290	69	60	419
Friday	316	76	51	443
Saturday	281	33	17	331
Sunday	253	28	4	285
Avg Weekly	271	58	44	373
Stage 1	+10	-	+25	408
Stage 2	+40	-	+100	513

Stage 1 would see about 400 vehicles per day, including 58 rigid trucks and 69 articulated trucks. If assessment is based on the RTA *Road Design Guide*, while the flow is less than 500 veh/day, the heavy vehicle numbers would make lane widths of 3.5 m "desirable". The criterion of truck numbers in the *Road Design Guide* is 20% heavy for 500 veh/day or 5% heavy for 2000 veh/day, both of which equate to 100 trucks per day. However this criterion is already reached, with the current average daily traffic of 373 veh/day including 102 trucks. With Stage 2, the average daily flows would just exceed 500 veh/day, with total truck numbers of 202 trucks.

The existing Johnniefelds quarry is clearly adding to the current heavy vehicle numbers. The proposed quarry will increase these numbers.

The RTA's *Route Assessment Guidelines for Restricted Access Vehicles* only recommends lane widths of 3.0 m, for flows of up to 6,000 veh/day.

Goulburn Mulwaree Council has developed its own road design guidelines, for its roads. Brayton Road and Red Hills Road are fully under the control of Council. The Councils Draft DCP Provisions for Heavy Vehicle Generating Development and the specifications for the reconstruction works on Brayton Road south of the Johnniefelds Quarry are consistent – for the observed daily flows over 500 veh/day and large numbers of quarry trucks, Council recommend a sealed width of 7.0m. This sealed width includes two 3.0 m lanes plus 0.5m of sealed shoulder on each side. This specification has been adopted for this assessment of Council roads.

Looking at the inventory of the road – Table 2.1 – we have considered the haul routes in five sections, with the recommended upgrades for each section set out in Table 4.3, where the sections are:

- Section A Site to Johnniefelds Quarry access
- Section B Johnniefelds Quarry access to new By-Pass road junction
- Section C Brayton Rd (New By-Pass road junction to Marulan interchange)

- Section D New By-Pass road, Brayton Road to Red Hills Road
- Section E Red Hills Road to the Hume Highway

TABLE 4.3 Proposed Roadworks

Stage	Section A	Section B	Section C	Section D	Section E
1	7.0 m total seal	No Change	No change	-	-
2	7.0 m total seal	No Change	No change	7.0 m total seal	7.0m total seal

Much of Section B has recently been reconstructed by Council

In regard to traffic noise impacts along Brayton Road, these can be reviewed through reference to the current hourly flows shown on Table 2.4, with Stage 1 adding about one truck each hour of the day. For Stage 2, for the section between the Site and the new By-Pass road, there will be an additional three truck movements each hour of the day.

On the issue of auxiliary lanes for overtaking, the Roads & Traffic Authority's *Road Design Guide* recommends that these only be considered for lengths greater than 500m, where the grade exceeds 4.5%. Table 3.2-6 of this *Guide* sets out Minimum Volume Warrants for Selected Road Improvement Options. The lowest category is for *Auxiliary lanes on 10% of length.* For "rolling" terrain (BCR = 1) the minimum AADT is 1400 veh/day. The respective lengths of haul route and the maximum daily flows with the quarry in operation are:

Haul Route Section	Length (km)	Future AADT
Brayton Rd Site to By-Pass road	4.5	513 veh/day
Brayton Rd By-Pass road to Marulan	1.5	408 veh/day
New By-Pass road	2.0	80 veh/day
Red Hills Rd east By-Pass road	1.4	145 veh/day

Based on these figures, there is no warrant for auxiliary lanes for overtaking.

Brayton Road: Stoney Creek Road to Hume Highway Interchange

The daily traffic flows would increase as set out in Table 4.4 below. For the staff commuter movements, these have been assumed to split with other routes, such as Stoney Creek Road and the new By-Pass road. In addition, some of these commuter trips are likely to be currently occurring, as workers travel to other job locations.

TABLE 4.4 Daily Traffic Flows on Brayton Road East of Wollondilly Street (vehicles/day)

Day	Light	Rigid Truck Class 3-5	Articulated Class 6-13	Total Vehicles
Monday	700	45	85	830
Tuesday	743	68	79	890
Wednesday	817	53	55	925
Thursday	775	55	63	893
Friday	782	72	63	917
Saturday	818	22	20	860
Sunday	717	13	6	736
Avg Weekly	764	47	53	864
Stage 1 and 2	+20	-	+25	909

The additional 25 truck movements each day in Stage 1 would increase the total heavy vehicle movements to approximately 125 movements each day, with the articulated truck movements increasing from 53 to 78 movements each day. The total traffic flows would not increase substantially. Stage 2 would see no further increase in truck traffic and in total traffic along this route. With the current satisfactory carriageway widths in this section of Brayton Road, with a minimum of 9.6 m available, no road upgrading will be required. This width allows for overtaking, but on flat terrain, subject to an urban speed limit, this is not an important issue.

The increased truck traffic in Stage 1 might potentially impact on amenity through traffic noise. The base hourly traffic flows set out in Table 2.6 can be used to assess such impacts, adding an average of one truck movement each hour.

In traffic engineering terms, assessment of the potential impacts on amenity through traffic noise can be assessed through reference to environmental capacity criteria. Table 3.2 sets out the RTA guidelines. Looking at the current hourly traffic flows in Table 2.6, the current maximum hourly flow is 77 veh/hr. Between 6.00am and 6.00pm the Stage 1 hourly flows will increase by about one truck each hour. Table 4.5 sets out the current and projected average hourly flows between 6.00am and 6.00pm, with the additional one truck per hour indicated. Table 4.5 also allows for an additional 20 car movements by staff, as shown in brackets under the Total.

TABLE 4.5 Average Hourly Traffic Flows in Brayton Road East of Wollondilly Street (vehicles/hour)

Period	Rigid Truck Class 3-5	Articulated Class 6-13	Total +Truck (+Car)
6-7am	0	4 +1	31 +1 (+3)
7-8am	5	4 +1	54 +1 (+4)
8-9am	5	8 +1	63 +1 (+3)
9-10am	3	4 +1	59 +1
10-11am	3	6 +1	67 +1
11-12noon	4	6 +1	59 +1
12-1pm	3	6 +1	61 +1
1-2pm	4	3 +1	53 +1
2-3pm	4	4 +1	58 +1
3-4pm	6	3 +1	66 +1 (+3)
4-5pm	4	0 +1	77 +1 (+4)
5-6pm	2	1 +1	68 +1 (+3)

Table 4.5 indicates that the highest peak hourly flow will increase from 77 to 82 veh/hr, in the afternoon. The highest morning flow will be 68 veh/hr. In terms of the environmental capacity thresholds set out in Table 3.2, where the environmental goal for a local residential street is 200 veh/hr, the situation will be very satisfactory.

George Street

The Stage 1 operation will see 2-3 trucks each day travel from the Highway South, left into Portland Avenue, right into George Street and along George Street to Brayton Road. This movement will not occur in Stage 2, when any trucks arriving from the Highway South will continue on the freeway pass the truck checking station and turn left into Red Hills Road. Table 2.7 indicated that George Street immediately north of Portland Avenue carries 60-100 vehicles/hour in peak periods, with up to 15 truck movements in an hour. The additional truck movements would have an insignificant impact.

4.6 George Street/Brayton Road Intersection

During Stage 1, with an average of 25 truck movements each day, no changes are proposed to the existing Hume Highway interchanges at Marulan.

For Stage 2, when daily truck movements exceed the average of 25 movements per day, the current proposal is to construct a new roundabout at the junction of Brayton Road and George Street, Marulan, just west of the Marulan Highway interchange adjacent to the RTA truck checking stations. A schematic layout is shown on Figure 2. This will allow southbound vehicles to offload from the Highway, pass under the Highway towards Brayton Road, make a U-turn at the roundabout and return to the Highway via the left-turn onload ramp. The existing priority controls on the Brayton Road/George Street junction would simply be

replaced by a roundabout, requiring all vehicles to slow down. This would provide net safety benefits.

Traffic flows through this junction are relatively low. Table 2.5 indicates that the average daily traffic flows on Brayton Road west of George Street (east of Wollondilly Street) are 420-440 veh/day in each direction. Table 2.6 indicates peak hour flows of 30-40 veh/hr eastbound and about 35 veh/hr westbound.

On the underpass under the Highway, Table 2.8 indicates current average daily flows of 375 veh/day eastbound (travelling to the Highway South) and 160 veh/day westbound (travelling from the Highway North). Peak hour flows are 30-40 veh/hr eastbound and 10-15 veh/hr westbound.

A manual traffic count undertaken on Monday 6th August 2007 in the period 6.00am-12.00noon found peak hour flows of 26 veh/hr making the left-turn northbound load movement, 18 veh/hr travelling eastbound under the Highway to continue to the Highway South and 20 veh/hr offloading from the Highway North to travel westbound under the Highway into Marulan.

With all peak hour movements either into or out of the Brayton Road/George Street junction less than 50 veh/hr, there are no traffic capacity issues, either with the current priority control or with a one-lane roundabout. The roundabout will be designed to provide for large articulated trucks to turn. It will need to be constructed prior to the introduction of Stage 2 traffic movements.

The Stage 2 traffic operations will see an additional 2 trucks per hour making the U-turn. A noise analysis has found that these movements would not have a significant impact on adjoining properties.

Should any future urban development occur on George Street north of Brayton Road, this roundabout will provide road network benefits.
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Stage 1 Access

During Stage 1, there will be an average of 10 truck movements each day travelling eastbound on Brayton Road and turning left onto the northbound onload ramp, an average of 10 truck movements travelling southbound on the Highway, offloading at the Brayton Road interchange and heading westbound along Brayton Road, and 2-3 truck movements each day heading eastbound under the Highway and joining the southbound load ramp to travel to the Highway South. With these movements of less than one per hour added to the current flows, there clearly will not be any road or interchange capacity issues. This interchange has ample spare capacity for these movements.

Stage 2 Access

In this Stage there will be up to 40 truck movements each day, or up to 2 trucks/hour making a U-turn at the proposed roundabout at the intersection of Brayton Road and George Street to return to the Highway northbound, to enable them to turn left into Red Hills Road. Up to 1 truck/hour (10 truck movements per day, over 6am-6pm) would travel eastbound along Brayton Road, to turn southbound onto the Highway at this northern interchange adjacent to the RTA truck checking station. For the peak hours of 8-9am and 4-5pm, the current and projected flows at this northern interchange, from Table 2.9, would be:

Brayton Road Interchange Underpass

Direction	**Hour**	**Current**	**Projected**
Eastbound	8-9am	28	29
	4-5pm	37	38
Westbound	8-9am	16	16
	4-5pm	11	11

The additional traffic at this northern interchange will have minimal effect, with high levels of service remaining.

The construction of the proposed roundabout at Brayton road and George Street will remove the need for any vehicles to make a right turn from the Highway North into Red Hills Road. Hence, with the option to upgrade the Highway/Red Hills Road junction to allow left turn movements by quarry trucks, the low volume of general traffic making this right turn now could simply use these existing roads to return to Red Hills Road or continue along Brayton Rd and use the new By-Pass road to Red Hills Road.

4.7 Red Hills Road Transport Route

Hume Highway/Red Hills Road Junction

Prior to truck movements exceeding the average of 25 movements each day, the Stage 2 haulage route will be constructed to provide a link between Brayton Road and Red Hills Road, and with the junction of Red Hills Road and the Hume Highway upgraded. This new By-Pass road is proposed to be a public road.

Traffic Flows

The current traffic flows in Red Hills Road just west of its junction with the Hume Highway were discussed in Section 2.2. Table 4.9 summarises the daily traffic flows.

TABLE 4.9 Daily Traffic Flows on Red Hills Road West of Hume Highway 25th May-1st June 2007 (vehicles/day)

Day	Eastbound	Westbound	Total	Class 3-5	Class 6-13
Monday	25	25	50	6	0
Tuesday	47	47	94	13	6
Wednesday	46	49	95	16	2
Thursday	32	34	66	3	4
Friday	38	32	70	4	0
Saturday	29	21	50	5	2
Sunday	14	20	34	2	2
Avg Daily	33	32	65	7	2

Table 4.9 indicates that current traffic flows on Red Hills Road are very low, with an average daily traffic flow of 65 veh/day, relatively evenly split per direction. There are some heavy vehicle movements, mainly rigid vehicles (Class 3-5).

Table 4.10 sets out the peak hourly flows, as averaged over Monday to Friday.

TABLE 4.10 Weekday Peak Hour Flows on Red Hills Road West of Hume Highway, 25th May-1st June 2007 (vehicles/hour)

Period	Eastbound	Westbound	Total
7-8am	3	1	4
8-9am	4	6	10
9-10am	3	4	7
3-4pm	4	1	5
4-5pm	5	6	11
5-6pm	1	3	4

Table 4.10 indicates very low current hourly flows in Red Hills Road.

Table 4.11 shows the daily traffic flows on the Hume Highway north of South Marulan Road, in February 2005. (Source: *Environmental Impact Statement, Proposed Lynwood Quarry, Marulan,* May 2005.)

TABLE 4.11 Daily Traffic Flows on Hume Highway, South Marulan 15-21 February 2005 (vehicles/day)

Day	Northbound	Southbound	Total
Monday	7911	9620	17,531
Tuesday	7862	8200	16,062
Wednesday	8414	8375	16,789
Thursday	9454	8966	18,420
Friday	13,051	11,619	24,670
Saturday	9931	9467	19,398
Sunday	12,196	12,572	24,768
Avg Daily Traffic	9831	9831	19,662

In terms of peak hour flows on the Highway, the Lynwood Quarry EIS also provides details of hourly flows. From the above Table, Highway traffic flows are highest on the Friday. Table 4.12 sets out the peak hourly flows on Friday 18 February 2005.

TABLE 4.12 Peak Hour Traffic Flows on Hume Highway, South Marulan Friday 18 February 2005 (vehicles/hour)

Period	Northbound Total (Heavy vehicles)	Southbound Total (Heavy vehicles)
7.00-8.00am	365 (136)	405 (81)
8.00-9.00am	448 (137)	562 (85)
9.00-10.00am	596 (148)	660 (94)
3.00-4.00pm	1081 (114)	865 (145)
4.00-5.00pm	1210 (84)	855 (123)
5.00-6.00pm	1169 (96)	942 (120)

Stage 2 Access

The proposed Stage 2 access arrangements would see an average of 2 trucks/hour turning left from the Highway into Red Hills Road, and 2 trucks/hour turning left from Red Hills Road onto the Highway. The current peak hour two-way movement on Red Hills Road is about 10 veh/hr. These movements are split between left and right turns at the Highway junction. The RTA have advised that if Red Hills Road is to be used as a quarry truck haul route then they would require the Highway median at the junction to be closed to physically prevent right turn movements. At present there is a right-turn bay some 65 m long in the median.
The junction of Red Hills Road is perpendicular to the Hume Highway. To the south is part of the Old Hume Highway which is currently being used as a Truck Parking Area. The

entrance to this area is approximately 400m south of the current Red Hills Rd/Hume Highway intersection. The Highway has two travel lanes per direction. Along the western side the constructed road shoulder is about 3.0 m wide. The speed limit on the Highway is 110 km/hr.

To better consider the issue of the Truck Parking Area, and at the same time provide additional data on turning movements at the Highway/Red Hills Road junction, traffic counts were undertaken on 6th August 2007 between 6.00am and 12.00 noon. Table 4.13 sets out the results.

TABLE 4.13 Weekday Hourly Use of Truck Parking Area and Turning Movements at Red Hills Road/Highway Junction – 8 August 2007

Period	RT to Red Hills	LT to Red Hills	LT from Red Hills	RT from Red Hills	Into Truck Area	Out of Truck Area
6-7am	0	1	0	0	5	6
7-8am	2	1	0	0	4	6
8-9am	5	2	1	1	4	4
9-10am	1	1	0	0	6	4
10-11am	1	0	1	0	4	5
11-12n	1	0	2	2	4	4
Total	10	5	4	3	27	29

RT: Right-turn LT: Left-turn

Table 4.13 shows that the use of the Truck Area is relatively low in traffic generation terms, with an average of 5 trucks per hour using this area. The average movement of 5 trucks/hr is an average of one truck every 12 minutes. This Truck Parking Area does not have an acceleration or deceleration lane, drivers either simply slow down in the road shoulder or in the kerbside lane However, due to the entrance of this area being approximately 400m from the proposed new intersection, there would be no conflict between trucks entering the Truck Parking Area and trucks turning left into Red Hills Road. Trucks wishing to exit the truck parking area could enter the shoulder south of the proposed deceleration lane and merge with northbound traffic. Vehicles making a left turn into Red Hills Road would have priority over trucks pulling out of the Truck Parking Area.

The provision of a deceleration lane for trucks wishing to turn left into Red Hills Road would have a net positive impact on traffic safety by providing a wider area for trucks exiting the Truck Parking Area to accelerate when rejoining northbound traffic.

Figure 4 shows the proposed concept design of the new Red Hills Rd/ Hume Highway interchange. The Figure 4 design is overlaid on a survey plan of the current junction layout. The location of this intersection is positioned to maximise sight distance as well as being close to a slight crest on the highway to maximise deceleration and acceleration to and from the junction.

The RTA has recommended an acceleration lane for traffic turning left from Red Hills Road into the Highway. We note that such a lane has not been provided for the egress from the Truck Parking Area south of Red Hills Road, where the volume of trucks observed leaving

this area – about 4-6 each hour – is higher than the projected average hourly number of quarry trucks turning left from Red Hills Road into the Highway – 40 trucks over 24 hours, averaging less than 2 truck movements each hour.

For the left turn entry to Red Hills Road an auxiliary deceleration lane is proposed, some 140 m long, and 3.5 m wide. This will require minor road widening. This meets the requirements of the RTA's *Road Design Guide*. Hence this will provide an adequate length for deceleration. As noted, there is a Truck Parking Area south of the junction. With the relative volume of quarry truck movements, less than 2 trucks per hour, and the Truck Parking Area activity, as set out above the level of cross-over, if any, will be very low and the proposed works would provide a net positive impact on traffic safety

In terms of consistency of approach on at-grade intersections along the Hume Highway in the Marulan area, we note that there have recently been intersection safety upgrades at the Highway junctions with Carrick Road and with Towrang Road. Seagull-channelisation has been provided at these junctions, plus left-turn deceleration lanes into the side streets. We understand that at Carrick Road, there is a left-turn deceleration lane, plus an acceleration lane in the median for traffic turning right out of Carrick Road, this being 300 m long. No acceleration lane has been provided for traffic turning left out of Carrick Road. A similar design has been provided at the Towrang Road intersection.

A 1998 ADT traffic count at Carrick Road showed 98 veh/day, a figure greater than the existing figure in Red Hills Road of 65 veh/day, with the latter figure projected to increase to about 140 veh/day with the quarry traffic. Existing left turn movements out of Carrick Road were 0-3 veh/hr in the peak hours in a count undertaken in April 2003, while on Towrang Road the equivalent left turn flows were 2-3 veh/hr. The current left turn flows out of Red Hills Road are 0-2 veh/hr, which will increase by
+2 veh/hr with the proposed quarry. At the Towrang Road and Carrick Road junctions, the RTA quite correctly placed greater importance on the acceleration lane to enable vehicles merging with the "fast" lane to get up to speed before the merge.

Impact of Closure of Highway Median

The closure of the Highway median will have a minor impact on local traffic. The current average daily traffic on Red Hills Road is 65 veh/day. Table 4.13 shows that on the day surveyed, over the 6.00am to 12.00noon period the total two-way movement in Red Hills Road was 22 veh/6 hr, with a right-turn into Red Hills Road totalling 10 vehicles and a right-turn out of Red Hills Road totalling 3 vehicles. In proportion with the average daily flow of 65 veh/day, approximately 35 veh/day would be likely to be disadvantaged by the closure. This closure would achieve a public safety benefit. For vehicles currently turning right into Red Hills Road from the Highway South, they could continue southbound to the Marulan Interchange and travel along Brayton Rd to the new By-Pass road to connect to Red Hills Road. This facility can easily accommodate this level of diversion. For vehicles turning right from Red Hills Road into the Highway southbound, they could use the new By-Pass road to travel to Brayton Road and thence down to Marulan, and to the Highway South if that is their destination. In summary, about 35 vehicle movements each day would be required to make a short diversion. The public safety benefits in removing right turn movements to and from the Highway, clearly out way any impacts associated with these closures.

Construction of the By-pass road to connect Brayton Road and Red Hills Road has historically been recognised by Council and some residents as a worthwhile improvement to the local road network.
The Report dated 24th August 2000 by Mulwaree Shire Council Director of Environmental Services favours a connection to Brayton Road from Red Hills Road *as it connects the Uringalla Estate and future 1(b) land north of Marulan to the town and provides better social and commercial connection with the town and can proceed, as the area develops, from Section 94 Contributions*. The Mulwaree Shire Council-Director of Environmental Services Report-on Building, Planning, Health and General dated 17th December 1998 describes this as a suitable option as it:

- *Reduces highway usage,*
- *Reduces the potential for accidents at a further highway access;*
- *Provides easy access to Marulan for Uringalla residents;*
- *Provides a good road along the north and west of the Urban Investigation Zone; and*
- *Supports the further development of Marulan to supply the daily needs of local residents.*

The reports also refers to letters from neighbours supporting this access to Brayton Rd.

Highway Junction

The proposed junction layout has been assessed using the aaSIDRA program, for the Friday peak hours of 9.00-10.00am and 4.00-5.00pm, with the addition of 2 truck movements each hour turning left into Red Hills Road and left out of Red Hills Road. The only movement delayed is the left turn out of Red Hills Road. Assuming that the northbound Highway flow is evenly split between its two travel lanes and that the traffic entering the Highway travels into the kerbside lane, the predicted average delays for this left turn movement are:

Period	**Delay (secs/veh)**	**Level of Service**
9.00-10.00am	14.5	A
4.00-5.00pm	18.5	B

These are satisfactory levels of delay. They are not sensitive to whether it is one truck every 30 minutes or one truck every 20 or 15 minutes, if truck movements were more peaked than the average.

Red Hills Road Route

Table 4.9 indicates that the current average daily traffic flows on Red Hills Road are 65 veh/day, including 7 rigid truck and 2 articulated truck movement. Stage 2 would see an estimated 80 truck movements each day, taking the total daily movement to 145 veh/hr, substantially less than 500 veh/day.

Table 2.2 shows an inventory of the current condition of Red Hills Road. The narrow carriageway widths close to the Highway intersection will be resolved with the proposed intersection design. From the chainage point approximately 400m west of the current Highway junction, the sealed width varies between 6.9 and 6.5 m, prior to where the new By-Pass road will intersect. Based on the RTA's *Road Design Guide*, for a daily traffic flow of up to 500 veh/day, a 6.0 m sealed width plus shoulder sealing of 0.5 m on each side is recommended, for a total sealed width of 7.0 m. For situations with 500 veh/day including 20% trucks (100 trucks) a lane width of 3.5 m is "desirable", leading to a total sealed width of 8.0 m. The RTA's guidelines for B-double routes recommend a total sealed formation width of 7.0 m for flows of up to 500 veh/day. More relevant is the Councils Draft DCP Provisions for Heavy Vehicle Generating Development, for Council roads, where a total carriageway width of 7.0m, including sealed shoulders, is recommended for rural roads.

Minor carriageway widening will be required to provide 7.0 m of seal.

New By-Pass Route

For the new by-pass route to connect Brayton Road with Red Hills Road, the projected traffic flow is 80 articulated trucks each day, plus some light traffic movements associated with staff commuting, or traffic diverted due to the median closure of the Highway at the Red Hills Road junction. A sealed width of 7.0 m is recommended, including the 0.5m seal on each shoulder.

5.0 RECOMMENDED ROADWORKS PROGRAMME

5.1 Programme

Stage 1

1.1 Construct site access intersection on Brayton Road – see Figure 3

1.2 Brayton Road from the Site to the Johnniefelds Quarry access (2.4 km) to provide 2 x 3.0 m lanes plus 2 x 1.0 m shoulders, each with 0.5 m of seal

Stage 2

2.1 Construct intersection of new By-Pass road with Brayton Road – see Figure 5

2.2 Construct new By-Pass road from Brayton Road to Red Hills Road to provide 2 x 3.0 m lanes plus 2 x 1.0 m shoulders, each with 0.5 m of seal

2.3 Upgrade Red Hills Road from the By-Pass road to the Hume Highway intersection, to provide 2 x 3.0 m lanes plus 2 x 1.0 m shoulders, each with 0.5 m of seal

2.4 Reconstruct intersection of Hume Highway with Red Hills Road – see Figure 4

2.5 Construct roundabout at the intersection of Brayton Road and George Street

5.2 Section 94 Contribution.

The Mulwaree Section 94 Contributions Plan (CP) 2003 makes provision for a levy for road upgrades and maintenance in relation to Extractive Industries. The quarry proposes to transport up to 125,000 tonnes per annum at Stage 1, increasing over time to 500,000 tonnes per annum at Stage 2.

In Stage 1, the laden trucks will travel along Brayton Road from the Site to the Hume Highway Interchange at Marulan. In Stage 2, the laden trucks will travel along Brayton Road to the new By-Pass road and then along Red Hills Road to the Hume Highway.

The levy will be calculated directly from the Gunlake Quarry sales and transport records and a quarterly return will be submitted to Council. Gunlake proposes a levy of 16 cents per tonne of product sold and hauled from the Site, adjusted in accordance with the Consumer Price Index for Sydney as published by the Australian Bureau of Statistics, effective from the date of project approval.

The Contribution Plan Section 3.9.6 Extractive Industries provides for the levy to meet *expenditure to maintain, repair and where necessary reconstruct the roads*, and further *is appropriate for new construction, maintenance and rebuilding of any road that is used by quarry traffic.* As shown in 5.1, Gunlake proposes in Stage 1 to carry out the necessary upgrading of Brayton Road at its cost upfront, and in Stage 2 to fully construct the new by-pass road, upgrade Red Hills Road where necessary, and ultimately construct the new roundabout all at its own cost upfront. Accordingly it is proposed that the payment of the levy would be off set against the costs of the upgrading and the new road construction in each case when completed. Gunlake will provide an audited statement of these costs to Council and the quarterly return showing the amount of the offset.

6.0 CONCLUSIONS

1. The proposed development is a quarry, located off Brayton Road about 8km north-west of Marulan. Ultimate production levels in Stage 2 are expected to be 500,000 tonnes per annum, with an estimated 100 truck movements each day. During Stage 1, the truck haulage route is proposed along Brayton Road from the Site to the Hume Highway Interchange at Marulan.

2. For the higher truck movements in Stage 2, it is proposed to construct a new By-Pass road to connect Brayton Road with Red Hills Road, and thence through to the Hume Highway. For Stage 1 operations, the Site access intersection will be constructed on Brayton Road. In addition, Brayton Road will be widened to a total seal of 7.0 m between the Site and the access into the Johnniefelds Quarry.

3. Stage 2 will require the construction of the By-Pass road – 7.0 m including shoulder seals – and its junction with Brayton Road, plus the Hume Highway works and the roundabout at the intersection of Brayton Road and George Street. At the Red Hills Road/Highway junction, the median will be closed to prohibit any right turns and a deceleration lane constructed for left turn movements into Red Hills Road.

4. Gunlake proposes to close the existing median at the existing Red Hills Road/Hume Highway junction and seeks an agreement with RTA to contribute to the cost of these works as there is clearly a public safety benefit due to these proposed works.

   In addition Gunlake proposes to construct the new intersection with Red Hills Road and the Hume Highway and seeks an agreement that future non-residential developments contribute to the capital cost of this work as there is clearly a benefit to be gained to those users. This could be achieved through a condition of consent for future developments to reimbursement Gunlake a percentage of this cost or by sharing the cost at the time of construction.

Locality Plan Figure 1

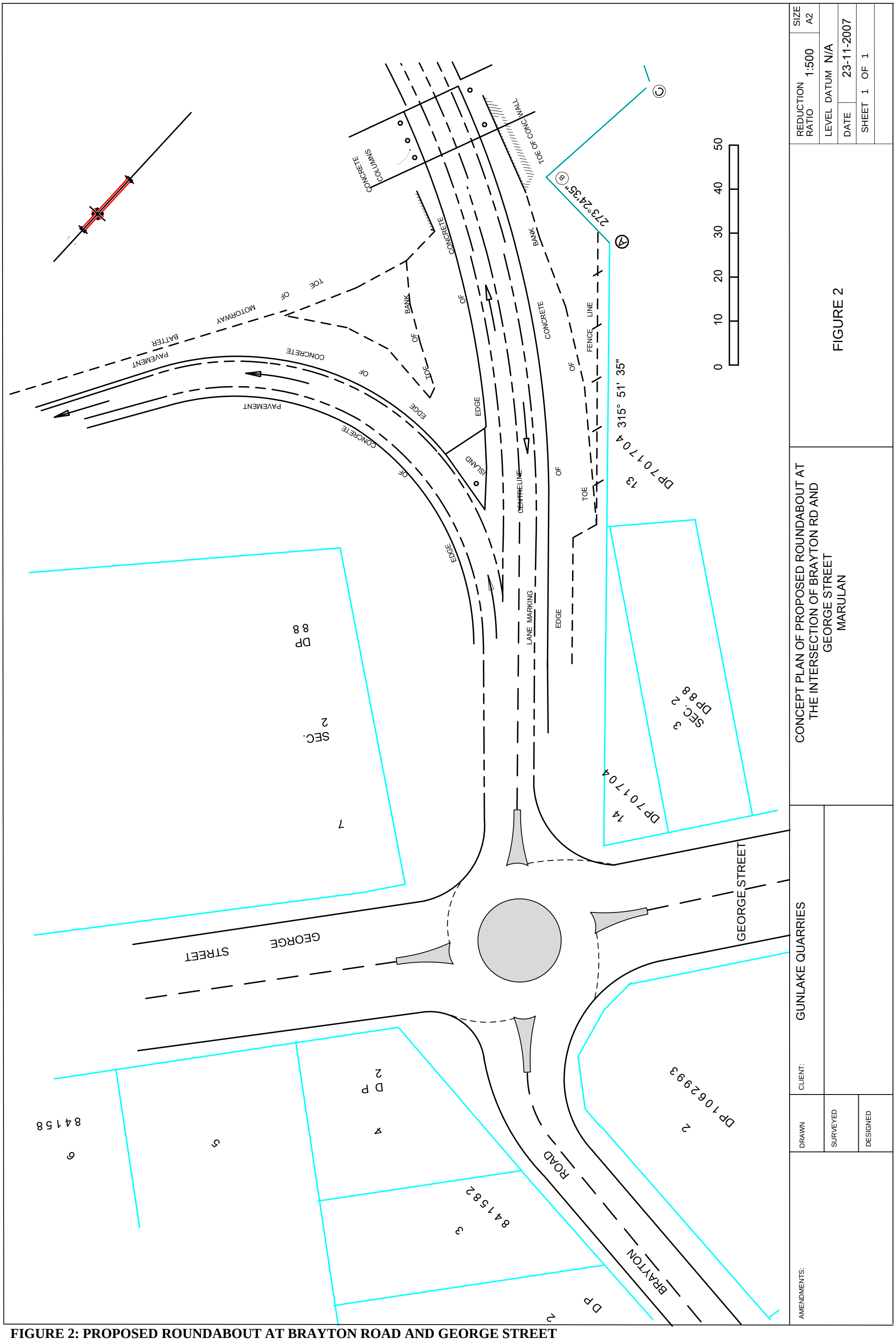


FIGURE 2

CONCEPT PLAN OF PROPOSED ROUNDABOUT AT THE INTERSECTION OF BRAYTON RD AND GEORGE STREET
MARULAN

GUNLAKE QUARRIES

REDUCTION RATIO	1:500
LEVEL DATUM	N/A
DATE	23-11-2007
SHEET	1 OF 1
SIZE	A2

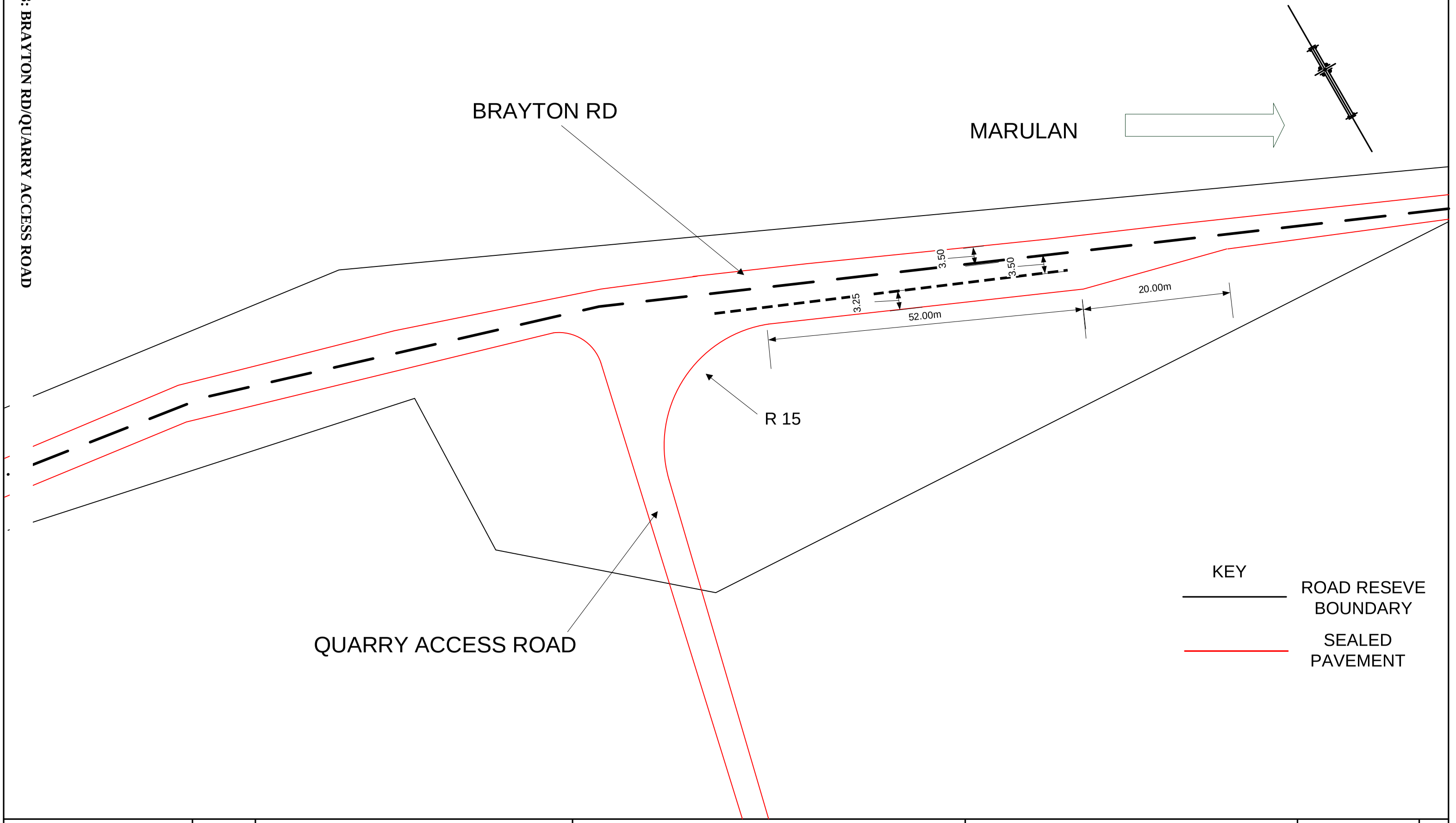
CLIENT:

DRAWN | SURVEYED | DESIGNED

AMENDMENTS:

FIGURE 2: PROPOSED ROUNDABOUT AT BRAYTON ROAD AND GEORGE STREET

FIGURE 3: BRAYTON RD/QUARRY ACCESS ROAD



AMENDMENTS:

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GUNLAKE QUARRIES

TITLE:

PROPOSED INTERSECTION OF BRAYTON RD AND THE QUARRY ACCESS ROAD

FIGURE 3

REDUCTION RATIO

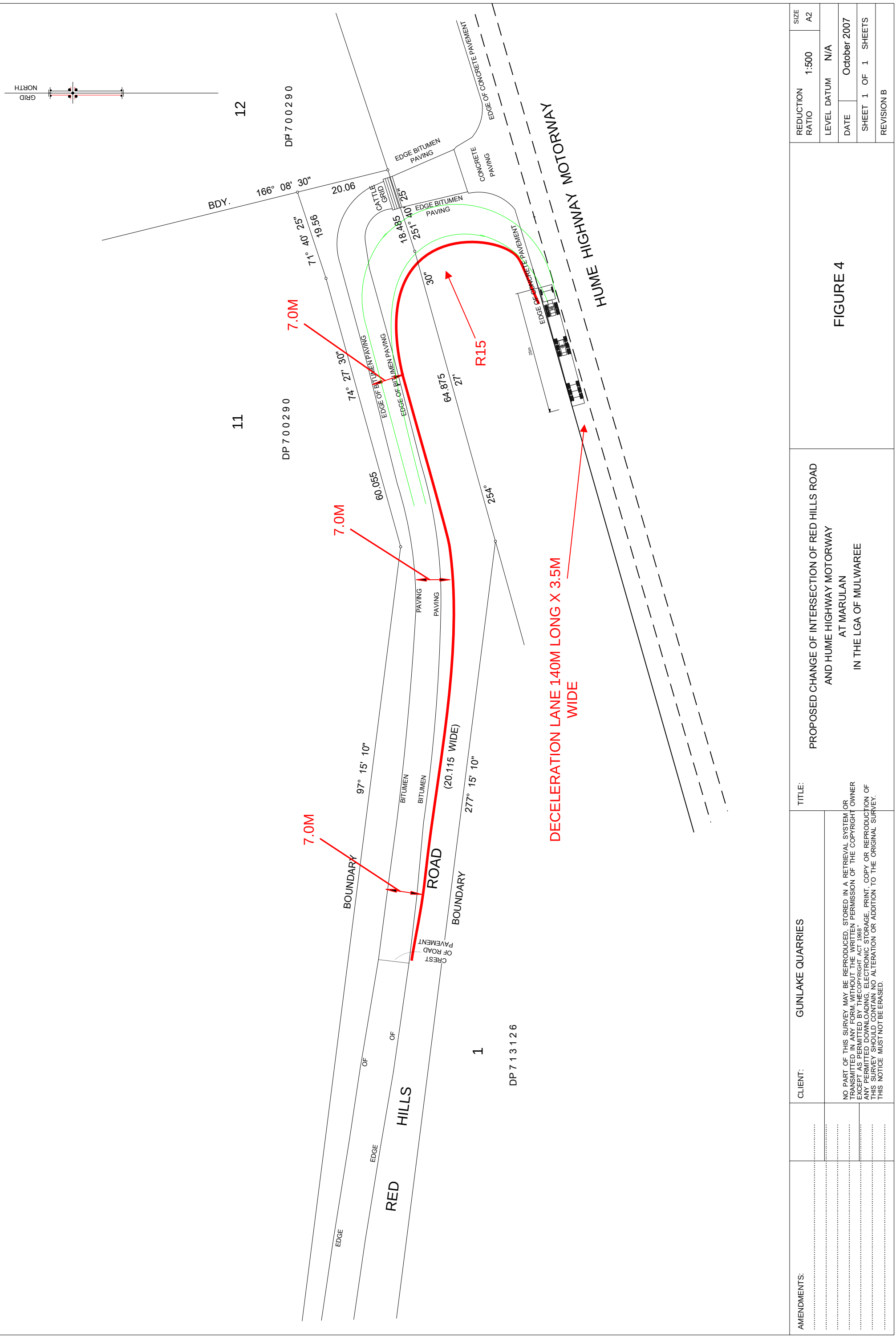
SIZE

LEVEL DATUM N/A

DATE NOVEMBER 2007

SHEET 1 OF 1 SHEETS

REFERENCE No.



REDUCTION RATIO 1:500 | SIZE A2
LEVEL DATUM N/A
DATE October 2007
SHEET 1 OF 1 SHEETS
REVISION B

FIGURE 4

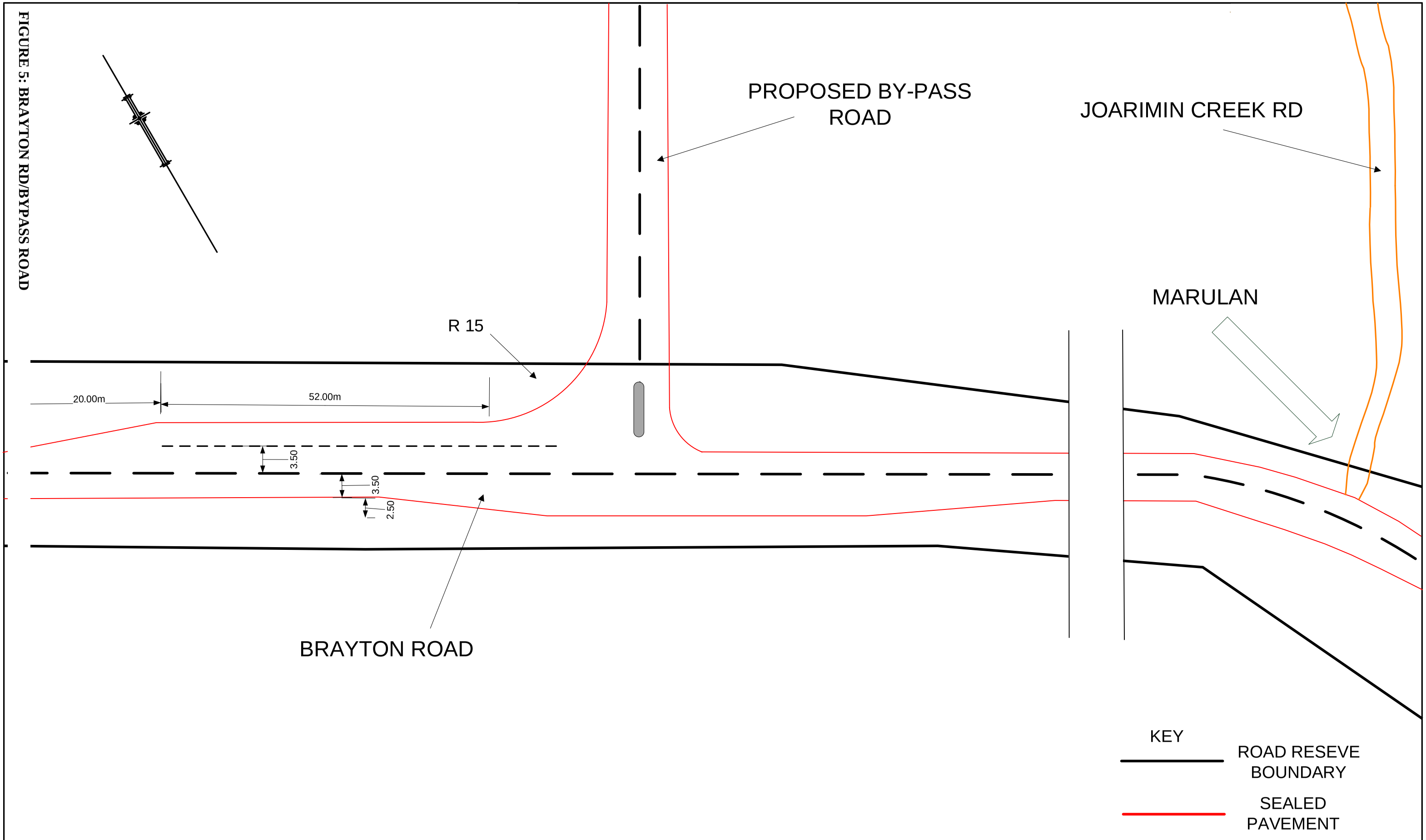
TITLE: PROPOSED CHANGE OF INTERSECTION OF RED HILLS ROAD AND HUME HIGHWAY MOTORWAY AT MARULAN IN THE LGA OF MULWAREE

CLIENT: GUNLAKE QUARRIES

AMENDMENTS:

FIGURE 4:HUMEHWY/RED HILLS RD INTERSECTION

FIGURE 5: BRAYTON RD/BYPASS ROAD



AMENDMENTS:

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GUNLAKE QUARRIES

TITLE:

PROPOSED INTERSECTION OF BRAYTON RD AND THE PROPOSED BY-PASS ROAD

FIGURE 5

REDUCTION RATIO

SIZE

LEVEL DATUM N/A

DATE OCTOBER 2007

SHEET 1 OF 1 SHEETS

REFERENCE No.

Count Number	**1665**	Ref : **CHAL**	Directory Ref : **Google Map**
Street	**BRAYTON ROAD, MARULAN : From HUME HIGHWAY to GEORGE STREET : EAST BOUND**		
Location	At Underpass of Hume Highway off-ramp (under highway), East of northbound load ramp		*Carriageway*

TOTAL COUNT MATRIX

Start Date	25-MAY-07
Start Time	1200
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	67
Weekly 85th Percentile Speed	78
Five Day AADT	377
Seven Day AADT	376

	MON *28TH*	TUE *29TH*	WED *30TH*	THU *31ST*	FRI *1ST / 25TH*	SAT *26TH*	SUN *27TH*	5 Day Total	5 Day Average	7 Day Total	7 Day Average
Midnight - 1am	3	0	0	2	4	3	3	**9**	**2**	**15**	**2**
1am - 2am	0	0	0	0	0	1	3	**0**	**0**	**4**	**1**
2am - 3am	0	2	0	1	1	1	3	**4**	**1**	**8**	**1**
3am - 4am	2	0	3	1	1	2	2	**7**	**1**	**11**	**2**
4am - 5am	3	2	3	4	3	2	2	**15**	**3**	**19**	**3**
5am - 6am	1	6	1	4	1	1	1	**13**	**3**	**15**	**2**
6am - 7am	6	7	10	7	8	10	5	**38**	**8**	**53**	**8**
7am - 8am	14	21	14	16	19	18	11	**84**	**17**	**113**	**16**
8am - 9am	28	31	35	31	29	26	14	**154**	**31**	**194**	**28**
9am - 10am	24	35	29	30	30	48	18	**148**	**30**	**214**	**31**
10am - 11am	21	28	21	18	31	47	21	**119**	**24**	**187**	**27**
11am - Midday	21	24	29	20	36	29	35	**130**	**26**	**194**	**28**
Midday - 1pm	22	26	18	17	27	37	35	**110**	**22**	**182**	**26**
1pm - 2pm	23	20	17	17	21	31	34	**98**	**20**	**163**	**23**
2pm - 3pm	36	27	25	25	29	34	29	**142**	**28**	**205**	**29**
3pm - 4pm	28	37	27	32	40	39	27	**164**	**33**	**230**	**33**
4pm - 5pm	41	47	46	36	33	20	33	**203**	**41**	**256**	**37**
5pm - 6pm	41	34	38	27	44	18	23	**184**	**37**	**225**	**32**
6pm - 7pm	14	27	26	16	30	22	13	**113**	**23**	**148**	**21**
7pm - 8pm	10	8	15	13	18	11	9	**64**	**13**	**84**	**12**
8pm - 9pm	9	4	6	3	10	2	10	**32**	**6**	**44**	**6**
9pm - 10pm	4	5	8	2	8	2	5	**27**	**5**	**34**	**5**
10pm - 11pm	2	4	3	2	3	3	0	**14**	**3**	**17**	**2**
11pm - Midnight	3	1	4	3	0	1	2	**11**	**2**	**14**	**2**
Total	**356**	**396**	**378**	**327**	**426**	**408**	**338**	**1883**	**376**	**2629**	**375**

 CFE Information Technologies

Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

Count Number	**1665**	Ref :	**CHAL**	Directory Ref :	**Google Map**
Street	**BRAYTON ROAD, MARULAN : From GEORGE STREET to HUME HIGHWAY : WEST BOUND**				
Location	At Underpass of Hume Highway off-ramp (under highway), East of northbound load ramp				*Carriageway*

TOTAL COUNT MATRIX

Start Date	25-MAY-07
Start Time	1200
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	62
Weekly 85th Percentile Speed	71
Five Day AADT	171
Seven Day AADT	160

	MON	TUE	WED	THU	FRI	SAT	SUN	5 Day		7 Day	
	28TH	*29TH*	*30TH*	*31ST*	*1ST / 25TH*	*26TH*	*27TH*	Total	Average	Total	Average
Midnight - 1am	0	2	0	0	0	3	0	2	0	5	1
1am - 2am	0	1	0	0	0	1	0	1	0	2	0
2am - 3am	1	1	0	1	0	0	0	3	1	3	0
3am - 4am	1	1	1	2	1	1	0	6	1	7	1
4am - 5am	2	2	2	3	4	2	0	13	3	15	2
5am - 6am	6	5	6	5	4	5	3	26	5	34	5
6am - 7am	11	7	12	9	10	8	4	49	10	61	9
7am - 8am	18	15	13	14	22	5	3	82	16	90	13
8am - 9am	20	27	19	17	13	9	5	96	19	110	16
9am - 10am	15	21	14	14	13	12	11	77	15	100	14
10am - 11am	16	10	9	17	12	15	12	64	13	91	13
11am - Midday	14	11	8	14	14	10	7	61	12	78	11
Midday - 1pm	10	11	10	11	12	12	10	54	11	76	11
1pm - 2pm	7	8	8	12	13	10	12	48	10	70	10
2pm - 3pm	11	9	10	17	9	10	6	56	11	72	10
3pm - 4pm	13	16	6	4	19	10	11	58	12	79	11
4pm - 5pm	7	9	9	13	10	12	14	48	10	74	11
5pm - 6pm	2	8	6	5	5	8	6	26	5	40	6
6pm - 7pm	3	2	3	6	5	5	5	19	4	29	4
7pm - 8pm	4	4	2	2	7	1	5	19	4	25	4
8pm - 9pm	4	1	4	6	4	3	1	19	4	23	3
9pm - 10pm	2	0	6	1	2	1	1	11	2	13	2
10pm - 11pm	1	3	3	3	3	3	5	13	3	21	3
11pm - Midnight	0	2	1	0	2	0	0	5	1	5	1
Total	**168**	**176**	**152**	**176**	**184**	**146**	**121**	**856**	**171**	**1123**	**160**

 CFE Information Technologies

Data displayed has been compiled from pneumatic traffic count processes and is subject to the documented limitations

Count Number	**1662**	Ref : **CHAL**	Directory Ref : **Google Map**
Street	**RED HILLS ROAD, MARULAN : From WOLLUMBI ROAD to DAVIES ROAD : EAST BOUND**		
Location	West of Hume Highway and Wollumbi Road, west of first driveway, House No. , ELP		*Carriageway*

TOTAL COUNT MATRIX

Start Date	25-MAY-07
Start Time	1400
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	66
Weekly 85th Percentile Speed	80
Five Day AADT	38
Seven Day AADT	33

	MON *28TH*	TUE *29TH*	WED *30TH*	THU *31ST*	FRI *1ST / 25TH*	SAT *26TH*	SUN *27TH*	5 Day Total	5 Day Average	7 Day Total	7 Day Average
Midnight - 1am	0	0	0	0	0	0	1	**0**	**0**	**1**	**0**
1am - 2am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
2am - 3am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
3am - 4am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
4am - 5am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
5am - 6am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
6am - 7am	3	2	2	3	3	0	0	**13**	**3**	**13**	**2**
7am - 8am	4	3	3	3	4	1	2	**17**	**3**	**20**	**3**
8am - 9am	2	7	6	5	2	1	2	**22**	**4**	**25**	**4**
9am - 10am	2	4	2	2	4	6	0	**14**	**3**	**20**	**3**
10am - 11am	1	3	3	2	3	3	1	**12**	**2**	**16**	**2**
11am - Midday	1	2	1	2	2	3	2	**8**	**2**	**13**	**2**
Midday - 1pm	0	4	7	1		2	0	**12**	**2**	**14**	**2**
1pm - 2pm	1	2	6	2	1	1	0	**12**	**2**	**13**	**2**
2pm - 3pm	3	4	3	0	1	3	1	**11**	**2**	**15**	**2**
3pm - 4pm	3	4	3	5	4	3	2	**19**	**4**	**24**	**3**
4pm - 5pm	0	6	5	4	10	2	1	**25**	**5**	**28**	**4**
5pm - 6pm	1	2	1	0	2	1	0	**6**	**1**	**7**	**1**
6pm - 7pm	1	2	0	0	1	1	0	**4**	**1**	**5**	**1**
7pm - 8pm	2	1	2	1	0	1	0	**6**	**1**	**7**	**1**
8pm - 9pm	1	1	0	0	1	0	1	**3**	**1**	**4**	**1**
9pm - 10pm	0	0	2	1	0	0	1	**3**	**1**	**4**	**1**
10pm - 11pm	0	0	0	1	0	1	0	**1**	**0**	**2**	**0**
11pm - Midnight	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
Total	**25**	**47**	**46**	**32**	**38**	**29**	**14**	**188**	**37**	**231**	**33**

Count Number	**1662**	Ref : **CHAL**	Directory Ref : **Google Map**
Street	**RED HILLS ROAD, MARULAN : From DAVIES ROAD to WOLLUMBI ROAD : WEST BOUND**		
Location	West of Hume Highway and Wollumbi Road, west of first driveway, House No. , ELP		*Carriageway*

TOTAL COUNT MATRIX

Start Date	25-MAY-07
Start Time	1400
Duration	7 DAYS
Interval	1 HOUR

Weekly 50th Percentile Speed	74
Weekly 85th Percentile Speed	85
Five Day AADT	37
Seven Day AADT	33

	MON *28TH*	TUE *29TH*	WED *30TH*	THU *31ST*	FRI *1ST / 25TH*	SAT *26TH*	SUN *27TH*	5 Day Total	5 Day Average	7 Day Total	7 Day Average
Midnight - 1am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
1am - 2am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
2am - 3am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
3am - 4am	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
4am - 5am	0	0	0	1	0	0	0	**1**	**0**	**1**	**0**
5am - 6am	1	0	0	0	0	0	0	**1**	**0**	**1**	**0**
6am - 7am	0	0	0	0	0	1	1	**0**	**0**	**2**	**0**
7am - 8am	1	1	1	2	1	0	0	**6**	**1**	**6**	**1**
8am - 9am	5	8	5	7	4	2	1	**29**	**6**	**32**	**5**
9am - 10am	1	6	6	3	5	1	1	**21**	**4**	**23**	**3**
10am - 11am	1	5	6	3	4	0	1	**19**	**4**	**20**	**3**
11am - Midday	3	3	3	2	2	0	2	**13**	**3**	**15**	**2**
Midday - 1pm	3	3	4	1		2	4	**11**	**2**	**17**	**3**
1pm - 2pm	1	4	5	4	0	2	1	**14**	**3**	**17**	**2**
2pm - 3pm	1	4	6	1	0	2	0	**12**	**2**	**14**	**2**
3pm - 4pm	1	1	3	0	1	4	4	**6**	**1**	**14**	**2**
4pm - 5pm	3	4	4	7	10	3	4	**28**	**6**	**35**	**5**
5pm - 6pm	3	6	4	2	2	2	0	**17**	**3**	**19**	**3**
6pm - 7pm	1	2	2	1	2	0	0	**8**	**2**	**8**	**1**
7pm - 8pm	0	0	0	0	1	0	0	**1**	**0**	**1**	**0**
8pm - 9pm	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
9pm - 10pm	0	0	0	0	0	1	1	**0**	**0**	**2**	**0**
10pm - 11pm	0	0	0	0	0	1	0	**0**	**0**	**1**	**0**
11pm - Midnight	0	0	0	0	0	0	0	**0**	**0**	**0**	**0**
Total	**25**	**47**	**49**	**34**	**32**	**21**	**20**	**187**	**37**	**228**	**32**