



Transport Impact Statement

Project:	Cardup Development
Client:	Austral Bricks WA Pty Ltd c/o Land Insights
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1. Introduction

Shawmac has been engaged by Land Insights on behalf of Austral Bricks WA Pty Ltd to undertake a transport impact assessment of the proposed expansion of the existing brickworks facility in Cardup on South Western Highway.

The City of Serpentine-Jarrahdale policy *PLN 5.1 - Highway Development* applies to all developments adjacent to Primary Distributor Roads including South Western Highway. The City has therefore requested that the transport impact of the proposed development on the highway is assessed to satisfy the objectives of the policy which are as follows:

- To encourage the uninterrupted movement of traffic.
- To minimise conflicts between traffic passing, entering or leaving a property.
- To minimise conflicts between pedestrians and motor vehicles.

The format of the assessment is generally in accordance with a Transport Impact Statement as per the Western Australian Planning Commission's (WAPC) *Transport Impact Assessment Guidelines for Developments: Volume 4 – Individual Developments (2016)* and includes the following:

- Assessment of existing and future traffic generation from the site.
- Review of existing and forecast traffic flows on the surrounding road network.
- Assignment of predicted traffic flows onto the road network.
- Review of relevant crash history on the surrounding road network.
- Assessment of traffic impacts to South Western Highway.

1.1. Site Location

The site is located on 69 Kiln Road, Cardup as shown in **Figure 1**. An aerial photo of the site is shown in **Figure 2**.

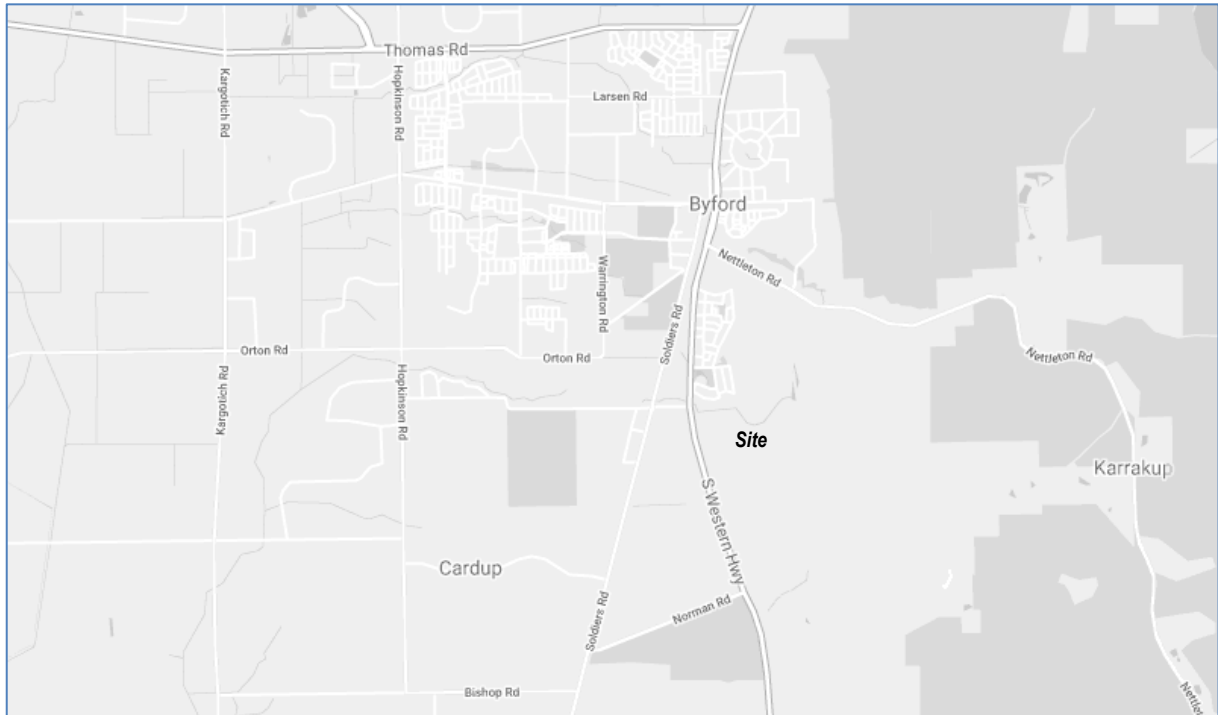


Figure 1: Site Location



Figure 2: Aerial Photo of Site (March 2020)

2. Existing Situation

2.1. Site and Surrounding Land Use

The site is currently used as a brickworks as it has been for an extended period of time. Material is transported to the site and the bricks are made on the site. The land immediately surrounding the site is mostly rural, with residential developments further north of the site.

2.2. Road Network

The site is accessed from South Western Highway then onto Kiln Road.

South Western Highway is a Primary Distributor Road controlled by Main Roads Western Australia (MRWA). It is constructed as an unkerbed, two-lane, undivided road adjacent to the site, with a left-turning lane into Kiln Road. South Western Highway has a speed limit of 110km/h in the close vicinity to Kiln Road.

Kiln Road is classified as an Access Road and is constructed as an unkerbed, two-lane, undivided road. Kiln Road intersects with South Western Highway, with all the movements in and out allowable at the intersection. According to the MRWA Road Information Mapping System, Kiln Road has a 110km/h speed limit that applies outside of the built-up areas.

2.3. RAV Network

South Western Highway and Kiln Road adjacent to the site has a Restricted Access Vehicle (RAV) network 4 status.

2.4. Traffic Volumes

The latest available traffic data for South Western Highway was sourced from MRWA as summarised in **Table 1**.

Table 1: South Western Highway Traffic Data

Road and Location	Average Weekday Traffic	AM Peak Hour (8AM to 9AM)	PM Peak Hour (3PM to 4PM)	Heavy Vehicles	Date
South Western Highway - South of Kiln Road	6,710 vpd 3,288 northbound 3,422 southbound	463 vph 264 northbound 199 southbound	579 vph 275 northbound 304 southbound	22.5%	2017/18

3. Proposed Development

It is proposed to continue to use the site for the same brickworks activities, with the existing operations to be expanded further.

4. Vehicle Access and Parking

Vehicle access to the site will be the same as the existing arrangement.

The main crossovers are located on Kiln Road on the southern boundary of the site, with the access to the parking located in the same vicinity of the crossovers.

The access and parking arrangement are illustrated in **Figure 3**.



Figure 3: Vehicle Access and Parking Arrangement

5. Hours of Operation

The clay delivery times are expected to be made five days a week between 7:00am and 5:00pm, with Saturday morning from 7:00am to 12:00pm.

Brick deliveries from the site will occur on weekdays between 5:00 a.m. and 4:00 p.m. Brick plant staff typically arrive at 5:00 a.m. and leave at 4:45 p.m. and then night shift staff arrive at 5:00 p.m. and leave at 5:00 a.m.

6. Daily Traffic Volumes and Vehicle Types

6.1. Site Traffic Movements

The expected traffic movements for the site have been provided by Austral Bricks, as outlined in **Table 2**.

Table 2: Site Traffic Movement Summary

Truck Type	Yearly Throughput	Truck Capacity	Yearly Loads	Yearly Movements	Operation Days/Hours	Frequency	Days Per Year	Daily Movements	AM Peak / PM Peak	Direction
Clay Trucks RAV 2 Truck and Dog Trailers	432,000	44T	9,818	19,636	5 days per week 7am to 5pm Saturday 7am to 12pm	8 months per year	240	82	8 / 8	All North
Brick Trucks Prime Mover and Semi-Trailer RAV 2 Pocket Road Trains	324,000	44T	7,364	14,728	Weekdays 5am to 4pm	Year Round	260	58	5 / 5	90% North / 10% South
Light Vehicles (Staff and Sales Centre)								50	25 in / 25 out	90% North / 10% South

6.2. Background Traffic

Kiln Road is a no through road and the only other traffic generators are approximately 10 rural residential properties. It has been estimated that these properties would generate eight daily movements per property with a total of 80 daily movements as outlined in **Table 3**.

Table 3: Background Traffic Movement Summary

Truck Type	Daily Movements	AM Peak / PM Peak	Direction
Residential Vehicles (Estimated 8 daily movements per residence)	80	8 / 8	90% North / 10% South

6.3. Intersection Capacity Assessment

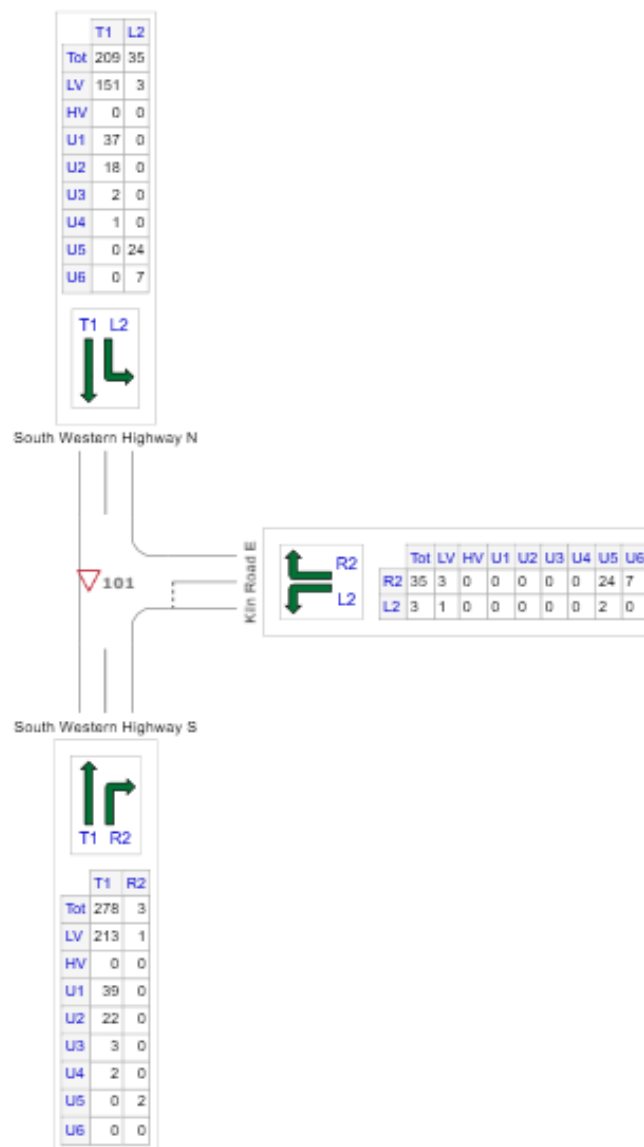
The morning peak hour (8:00 a.m. to 9:00 a.m.) and afternoon peak hour (3:00 p.m. to 4:00 p.m.) has been assessed at the South Western Highway and Kiln Road intersection using SIDRA Intersection 8.0 in accordance with the MRWA Operational Modelling Guidelines.

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

- Degree of Saturation is a measure of how much physical capacity is being used with reference to the full capability of the particular movement, approach, or overall intersection. A DoS of 1.0 equates to full theoretical capacity although in some instances this level is exceeded in practice. SIDRA uses maximum acceptable DoS of 0.90 for signalised intersections for its Design Life analysis. Design engineers typically set a maximum DoS threshold of 0.95 for new intersection layouts or modifications.
- Average Delay reports the average delay per vehicle in seconds experienced by all vehicles in a particular lane, approach, or for the intersection as a whole. For severely congested intersections the average delay begins to climb exponentially.
- Queue Length measures the length of approach queues. In this document we have reported queue length in terms of the length of queue at the 95th percentile (the maximum queue length that will not be exceeded for 95 percent of the time). Queue lengths provide a useful indication of the impact of signals on network performance. It also enables the traffic engineer to consider the likely impact of queues blocking back and impacting on upstream intersections and accesses.

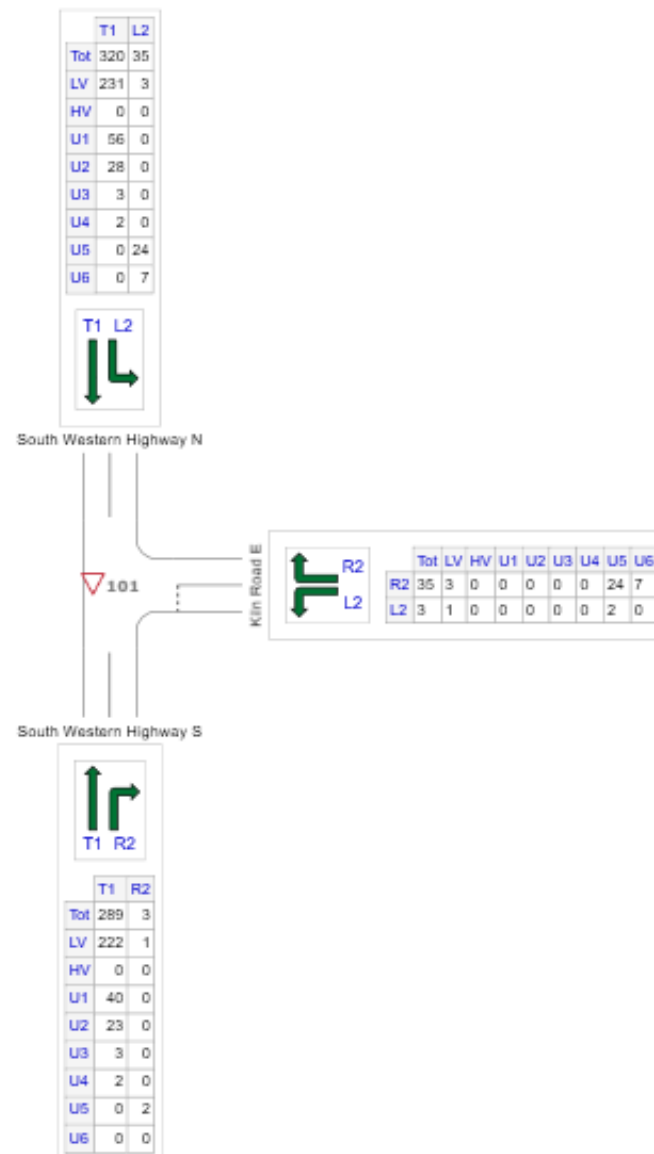
Level of Service is a combined appreciation of queuing incidence and delay time incurred, producing an alphanumeric ranking of A through F. A LoS of A indicates an excellent level of service whereby drivers delay is at a minimum and they clear the intersection at each change of signals or soon after arrival with little if any queuing. Values of B through D are acceptable in normal traffic conditions. Whilst values of E and F are typically considered undesirable, within central business district areas with significant vehicular and pedestrian numbers, corresponding delays/queues are unavoidable and hence, are generally accepted by road users.

The peak hour flows along South Western Highway were taken from MRWA data. During the peak hour, the site is estimated to generate 8 clay truck deliveries (4 in and 4 out) and 5 brick deliveries (rounded to 3 in and 3 out). For simplicity, the clay and brick trucks are assumed to be distributed 100% along South Western Highway. The input volumes are shown in **Figure 4** and **Figure 5** and the results are shown in **Figure 6** and **Figure 7**.



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)	2-5 (U1)	6-9 (U2)	10 (U3)	11 (U4)	LV - Site (U5)	HV - Site (U6)
S: South Western Highway S	281	214	0	39	22	3	2	2	0
E: Kiln Road E	38	4	0	0	0	0	0	26	7
N: South Western Highway N	244	155	0	37	18	2	1	24	7
Total	563	373	0	75	40	4	3	53	15

Figure 4: South Western Highway – Kiln Road Intersection AM Distribution



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)	2-5 (U1)	6-9 (U2)	10 (U3)	11 (U4)	LV - Site (U5)	HV - Site (U6)
S: South Western Highway S	293	223	0	40	23	3	2	2	0
E: Kiln Road E	38	4	0	0	0	0	0	26	7
N: South Western Highway N	355	235	0	56	28	3	2	24	7
Total	685	462	0	97	51	5	4	53	15

Figure 5: South Western Highway – Kiln Road Intersection PM Distribution

MOVEMENT SUMMARY

Site: 101 [South Western Highway - Kiln Road - AM Peak]

Give-way / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: South Western Highway S												
2	T1	278	23.4	0.178	0.0	LOS A	0.0	0.3	0.01	0.01	0.01	109.4
3	R2	3	0.0	0.178	9.2	LOS A	0.0	0.3	0.01	0.01	0.01	83.9
Approach		281	23.1	0.178	0.1	NA	0.0	0.3	0.01	0.01	0.01	109.0
East: Kiln Road E												
4	L2	3	0.0	0.048	8.9	LOS A	0.2	1.9	0.47	0.74	0.47	67.7
6	R2	35	21.2	0.048	11.6	LOS B	0.2	1.9	0.47	0.74	0.47	64.1
Approach		38	19.4	0.048	11.4	LOS B	0.2	1.9	0.47	0.74	0.47	64.4
North: South Western Highway N												
7	L2	35	21.2	0.029	8.8	LOS A	0.0	0.0	0.00	0.67	0.00	67.1
8	T1	209	27.7	0.150	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.9
Approach		244	26.8	0.150	1.3	NA	0.0	0.0	0.00	0.10	0.00	100.7
All Vehicles		563	24.5	0.178	1.4	NA	0.2	1.9	0.04	0.09	0.04	100.7

Figure 6: South Western Highway – Kiln Road Intersection AM Peak SIDRA Results

MOVEMENT SUMMARY

Site: 101 [South Western Highway - Kiln Road - PM Peak]

Give-way / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: South Western Highway S												
2	T1	289	23.4	0.186	0.0	LOS A	0.0	0.3	0.01	0.01	0.01	109.4
3	R2	3	0.0	0.186	10.2	LOS B	0.0	0.3	0.01	0.01	0.01	83.9
Approach		293	23.1	0.186	0.2	NA	0.0	0.3	0.01	0.01	0.01	109.0
East: Kiln Road E												
4	L2	3	0.0	0.057	9.5	LOS A	0.2	2.2	0.53	0.79	0.53	66.5
6	R2	35	21.2	0.057	12.7	LOS B	0.2	2.2	0.53	0.79	0.53	63.0
Approach		38	19.4	0.057	12.4	LOS B	0.2	2.2	0.53	0.79	0.53	63.3
North: South Western Highway N												
7	L2	35	21.2	0.029	8.8	LOS A	0.0	0.0	0.00	0.67	0.00	67.1
8	T1	320	27.7	0.228	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.8
Approach		355	27.1	0.228	0.9	NA	0.0	0.0	0.00	0.07	0.00	103.3
All Vehicles		685	25.0	0.228	1.2	NA	0.2	2.2	0.04	0.08	0.04	102.0

Figure 7: South Western Highway – Kiln Road Intersection PM Peak SIDRA Results

The results indicate that the intersection will operate at an acceptable level with all measures of performance within typically accepted values.

6.4. Intersection Capacity – 10 years after Opening

A secondary analysis has been undertaken to assess the access capacity 10 years after commencing operations (assumed to be the year 2030 after the development commences in 2020) to assess the impact of general traffic growth. Historical traffic counts for South Western Highway indicate an annual growth rate between 2 and 5%. The through traffic volumes along South Western Highway were increased by 5% per year to 2030 to be conservative.

The results of the assessment are shown in **Figure 8** and **Figure 9**. The results show that the access intersection would still perform within capacity 10 years after commencement.

It is noted that Tonkin Highway is planned for extension from Thomas Road through to South Western Highway, south of Mundijong. The extension will be a four-lane dual carriageway with intersection upgrades at Thomas Road, Orton Road, Mundijong Road and South Western Highway. The project is currently in planning and construction is estimated to be completed in late 2023. It is likely that some of the existing traffic along South Western Highway will transfer to Tonkin Highway which would increase the capacity of the South Western Highway / Kiln Road intersection.

MOVEMENT SUMMARY

Site: 101 [South Western Highway - Kiln Road - AM Peak 2030]

Give-way / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: South Western Highway S												
2	T1	500	23.6	0.321	0.0	LOS A	0.1	0.5	0.01	0.00	0.01	109.6
3	R2	3	0.0	0.321	11.5	LOS B	0.1	0.5	0.01	0.00	0.01	84.0
Approach		503	23.4	0.321	0.1	NA	0.1	0.5	0.01	0.00	0.01	109.4
East: Kiln Road E												
4	L2	3	0.0	0.087	9.8	LOS A	0.3	3.2	0.69	0.88	0.69	62.8
6	R2	35	21.2	0.087	16.2	LOS C	0.3	3.2	0.69	0.88	0.69	59.7
Approach		38	19.4	0.087	15.7	LOS C	0.3	3.2	0.69	0.88	0.69	59.9
North: South Western Highway N												
7	L2	35	21.2	0.029	8.8	LOS A	0.0	0.0	0.00	0.67	0.00	67.1
8	T1	378	27.9	0.271	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	109.7
Approach		413	27.3	0.271	0.8	NA	0.0	0.0	0.00	0.06	0.00	104.1
All Vehicles		954	24.9	0.321	1.0	NA	0.3	3.2	0.03	0.06	0.03	103.7

Figure 8: South Western Highway – Kiln Road Intersection AM Peak SIDRA Results – 2030

MOVEMENT SUMMARY

Site: 101 [South Western Highway - Kiln Road - PM Peak 2030]

Give-way / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: South Western Highway S												
2	T1	519	23.5	0.335	0.1	LOS A	0.1	0.8	0.02	0.00	0.02	109.3
3	R2	3	0.0	0.335	15.0	LOS B	0.1	0.8	0.02	0.00	0.02	83.8
Approach		522	23.4	0.335	0.2	NA	0.1	0.8	0.02	0.00	0.02	109.1
East: Kiln Road E												
4	L2	3	0.0	0.126	11.4	LOS B	0.4	4.5	0.80	0.93	0.80	58.6
6	R2	35	21.2	0.126	20.6	LOS C	0.4	4.5	0.80	0.93	0.80	55.8
Approach		38	19.4	0.126	19.8	LOS C	0.4	4.5	0.80	0.93	0.80	56.1
North: South Western Highway N												
7	L2	35	21.2	0.029	8.8	LOS A	0.0	0.0	0.00	0.67	0.00	67.1
8	T1	576	27.8	0.411	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	109.5
Approach		611	27.4	0.411	0.6	NA	0.0	0.0	0.00	0.04	0.00	105.7
All Vehicles		1171	25.4	0.411	1.0	NA	0.4	4.5	0.03	0.05	0.04	104.1

Figure 9: South Western Highway – Kiln Road Intersection PM Peak SIDRA Results - 2030

6.5. Auxiliary Lanes

The requirement for turning treatments at the access was calculated using the Intersection Warrants calculator provided in Main Roads WA *Supplement to Austroads Guide to Road Design - Part 4 A.8*. The Intersection Warrants calculator has modified the Austroads warrants equation to account for the high percentage of heavy vehicles on Western Australian Roads.

The through and turning volumes were calculated as per Austroads GTM Part 6 – 2017 as shown in **Figure 10**. The volumes from **Table 1** and **Table 2** were used for this assessment, with the results of the assessment summarised in **Figure 11**.

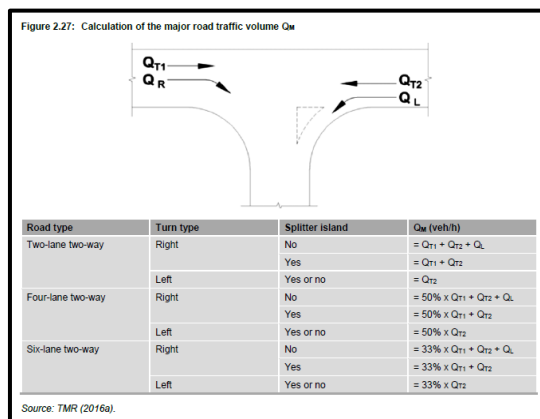


Figure 10: Calculation of the Major Road Traffic Volume Q_m

INTERSECTION WARRANTS

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

DESIGN SPEED = 120km/h
 SPLITTER ISLAND YES / NO = No
 DUAL CARRIAGEWAY YES / NO = No

MOVEMENT	COUNT (v/h)	HV (%)
Q _{T1}	278	23.4
Q _R	3	0
Q _{T2}	209	27.7
Q _L	35	21.2

RIGHT TURN ASSESSMENT

Q_m = 522
 % HV = 24.974
 x = 1.18
 TREATMENT = BAR

LEFT TURN ASSESSMENT

Q_m = 209
 % HV = 27.700
 x = 1.42
 TREATMENT = AUL(S)

AM Peak

INTERSECTION WARRANTS

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

DESIGN SPEED = 120km/h
 SPLITTER ISLAND YES / NO = No
 DUAL CARRIAGEWAY YES / NO = No

MOVEMENT	COUNT (v/h)	HV (%)
Q _{T1}	289	23.4
Q _R	3	0
Q _{T2}	320	27.7
Q _L	35	21.2

RIGHT TURN ASSESSMENT

Q_m = 644
 % HV = 25.417
 x = 1.44
 TREATMENT = BAR

LEFT TURN ASSESSMENT

Q_m = 320
 % HV = 27.700
 x = 2.09
 TREATMENT = AUL(S)

PM Peak

Figure 11: Warrants for Turn Treatments on Major Roads at Unsignalised Intersections

The required treatments, as calculated according to Main Roads WA standards, are a short Auxiliary Left (AUL) and a Basic Right (BAR) turn treatment.

It has been noted by Main Roads WA that the assessment result for the right turn is very sensitive to a small increase in right turn movements and so an Auxiliary Right (AUR) turn treatment is justified at this intersection. An example layout of an AUR and AUL treatment is shown in Figure 12.

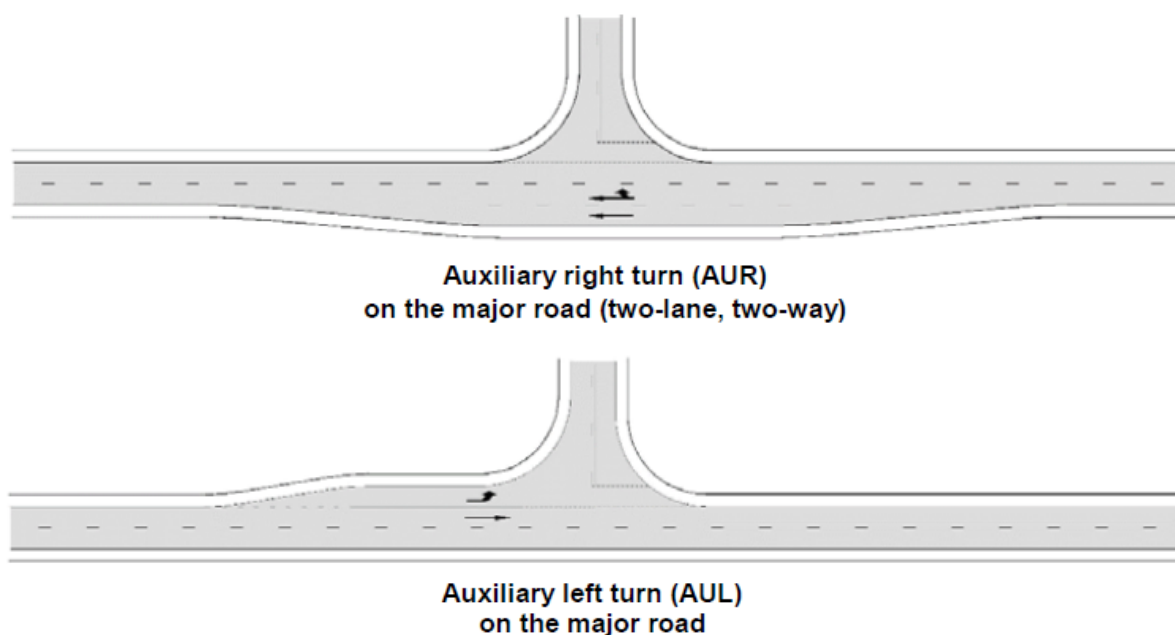


Figure 12: Rural Auxiliary Right (AUR) and Auxiliary Left (AUL) Turn Treatments

7. Traffic Management on Frontage Streets

7.1. Road Width and Number of Lanes

The cross section and geometry of the frontage streets are summarised in **Table 4**.

Table 4: Frontage Road Cross Section and Geometry

Road and Location	Number of Lanes	Cross Section
South Western Highway	2	Unkerbed single carriageway Typically 10m sealed width (4 - 4.5m traffic lanes) Wide unsealed shoulders
Kiln Road	2	Unkerbed single carriageway Typically 7m pavement (3.5m lanes)

7.2. Parking Provision and Restrictions

There are an estimated 60 parking bays available at the southern side of the site.

7.3. Posted Traffic Speed

The posted speed limit along South Western Highway is 110 km/h in the vicinity of Kiln Road.

7.4. Intersections

As mentioned previously, Kiln Road intersects South Western Highway with all movements allowable in and out. The intersection operates under give-way control and provides a left-turn lane into Kiln Road.

7.5. Access

Property access is at the southern side of the site on Kiln Road which connects onto South Western Highway.

8. Swept Path Analysis

A preliminary swept path analysis has been undertaken using the Main Roads WA RAV 2 vehicle template (27.5m B-double with an 18m turning circle) at the South Western Highway – Kiln Road intersection as shown in **Figure 13**. Although both South Western Highway and Kiln Road are RAV 4 approved roads, the existing intersection layout does not allow the lane-correct movement for RAV2-4 vehicles and the intersection will need to be widened.



Figure 13: South Western Highway – Kiln Road Intersection Swept Path

The land in the north-east corner of the intersection is owned by Austral Bricks and so it is possible to relocate the intersection and turn treatments towards the north to avoid the need to acquire land from other landowners to the south. A section of Kiln Road could be realigned into the Austral Bricks land and the required land ceded to the Shire and Main Road WA. A preliminary concept design for the intersection relocation and upgrade is being prepared for submission to MRWA.

9. Sight Distance

The proposed crossovers have been assessed for entering sight distance (ESD) in accordance with Australian Standard AS 2890.1-2004 *Parking Facilities - Off-street car parking* (AS2890.1). Figure 3.2 of AS2890.1, shown as **Figure 14**, outlines the minimum required ESD for access driveways based on the approach speed of vehicles on the frontage road.

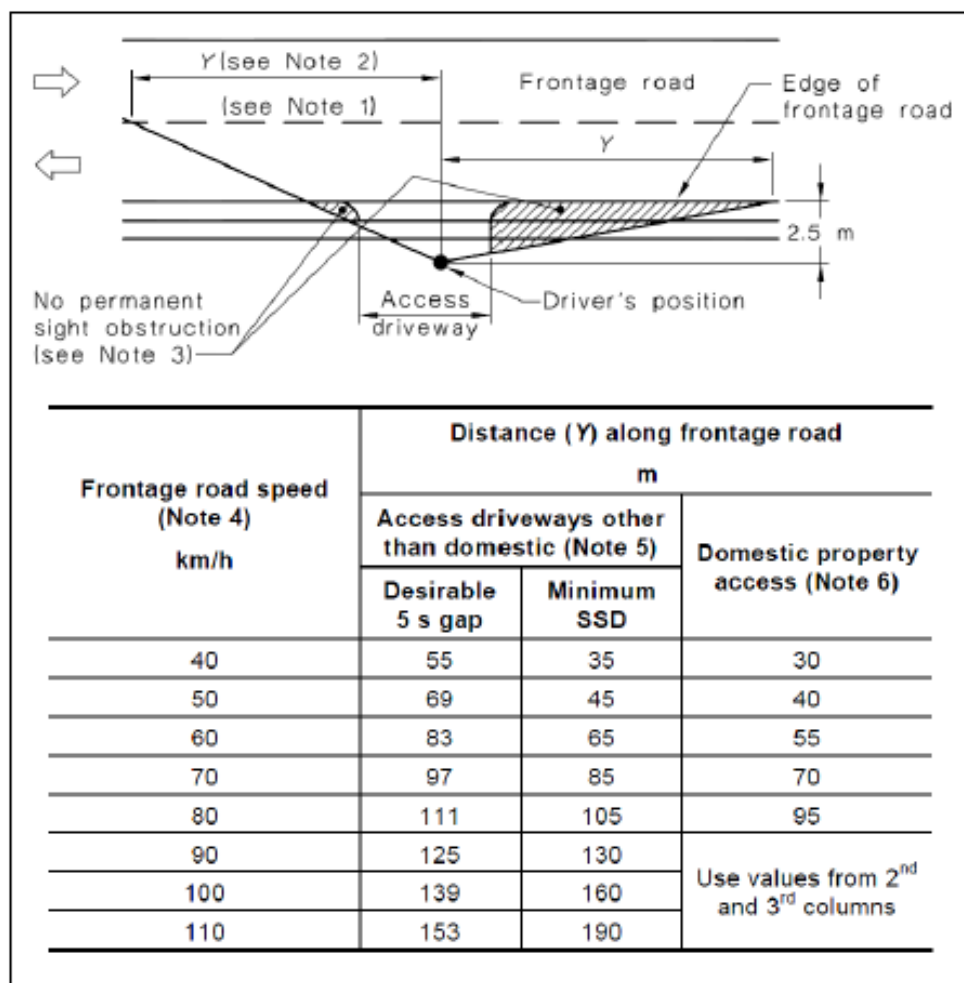


Figure 14: AS2890.1 Access Sight Distance Requirements

Based on the frontage road speed of 110 km/h, the minimum required sight distance is 190 metres. A desktop review of the available sight distance from each of the exit crossovers using the latest aerial imagery and Google Street view concludes that in order to achieve the minimum 190 metres of sight distance, some pruning of the vegetation along Kiln Road may be required as shown in **Figure 15** and **Figure 16**. However, due to the length and geometry of Kiln Road it is unlikely that vehicles would be travelling at 110km/h and so the actual ESD required would be less and so pruning is not considered to be essential.

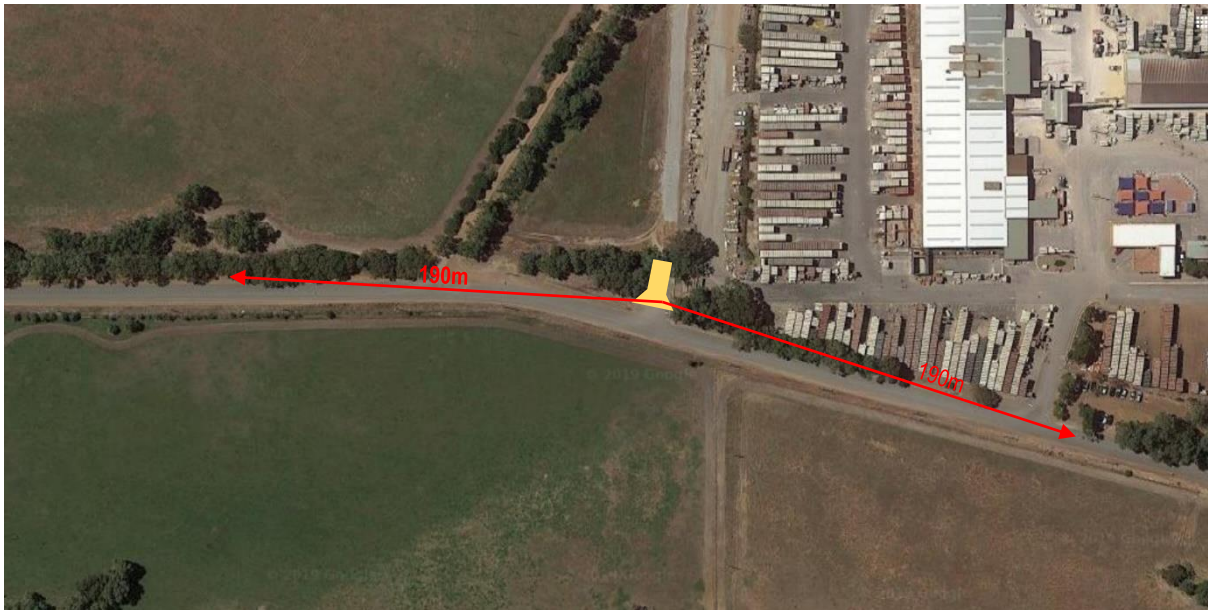


Figure 15: AS2890.1 Access Sight Distance Assessment



Figure 16: AS2890.1 Access Sight Distance Assessment

10. Public Transport Access

There are no public transport routes in close vicinity to the site. The public transport demand of the site is likely to be low and therefore the existing services are considered to be adequate.

11. Pedestrian / Cycle Access

There is no pedestrian / cycle access in the vicinity of the site, with demand expected to be low based on the proposed site use.

12. Site Specific or Safety Issues

12.1. Crash History

Detailed crash statistics for the entire length of Kiln Road between January 2015 and December 2019 were obtained from the MRWA *Reporting Centre*. One incident was recorded in the vicinity of the site over the period of five years. The crash was recorded at the intersection of South Western Highway and Kiln Road, which involved an out of control utility vehicle colliding with an SEC pole.

The crash history of the surrounding road network indicates a relatively low number of crashes for the amount traffic volume near the site. As the volume of traffic generated by the proposed development will not increase significantly, the development is not expected to increase the risk profile on South Western Highway and Kiln Road intersection or Kiln Road accesses.

13. Conclusion

An assessment of the proposed expansion of the existing brickworks facility in Cardup concluded that the proposed development would not have unacceptable adverse impact on the surrounding road network including South Western Highway intersection.

A peak hour capacity analysis of the South Western Highway / Kiln Road intersection under the peak traffic scenario indicates that the intersection would perform at a satisfactory level.

A swept path assessment indicates that the intersection would need to be upgraded to accommodate the turning movement of the proposed trucks. The peak hour traffic at the intersection also warrant the provision of an Auxiliary Right (AUR) and a short Auxiliary Left (AUL(S)) turn treatment.