Design Report

Project:	South Western Highway (H009) Kiln Road (SLK10.98) Intersection Realignment and Upgrade 15% 2D Concept Design
Client:	Austral Bricks
Author:	Paul Nguyen
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CONSULTING CIVIL AND TRAFFIC ENGINEERS
1 ST. FLOOR, 908 ALBANY HIGHWAY, EAST VICTORIA PARK WA 6101.
PHONE|+61 8 9355 1300
FACSIMILE| +61 8 9355 1922
EMAIL| admin@ shawmac.com.au

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Version	Prepared By	Reviewed By	Approved By	Date
1	Paul Nguyen	James Bridge	James Bridge	23/10/20

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Contents

1. Introduction 4

1.1. Background 4

1.2. History 5

1.3. Purpose 6

2. Existing Roads 7

2.1. South Western Highway 7

3. Design Data 8

3.1. Proposed Haulage Vehicle 8

3.2. Proposed Haulage Route 8

3.3. Operating Hours 8

3.4. Proposed Traffic Volumes 8

4. Design 10

4.1. Design Drawings 10

4.2. Intersection Design 10

4.3. Sight Distance Assessment 13

4.3.1. Approach Sight Distance 13

4.3.2. Entering Sight Distance 13

4.4. Pavement and Surfacing Design 16

4.5. Vertical Alignment 16

4.6. Drainage Design 16

4.7. Services 17

4.8. Lighting Design 17

4.9. Environmental 17

Figures

Figure 1: Site Location 4

Figure 2: Existing Intersection 5

Figure 3: Existing Cadastral Boundaries 6

Figure 4: South Western Highway Typical Cross Section 7

Figure 5: Example RAV 2 Haulage Vehicles 8

Figure 6: Rural AUL(S) Turn Treatment 11

Figure 7: AUR Turn Treatment 12

Figure 8: ASD Check 13

Figure 9: ESD Check 15

Figure 10: Indicative Drainage Flows 16

Tables

Table 1: Predicted Traffic Volumes 9

Table 2: ESD Requirements 15

1. Introduction

1.1. Background

Austral Bricks are proposing to expand the existing brickworks facility on Kiln Road in Cardup. The site location is shown in **Figure 1**.

Figure 1: Site Location

The site will generate incoming clay trucks and outgoing brick tricks ranging from semi-trailers to Restricted Access Vehicle (RAV) Category 2 truck and dog trailers and pocket road trains. Although Kiln Road and South Western Highway are both approved to carry vehicles up to RAV 4, the existing intersection of these two roads is currently below standard and is it likely that some trucks need to overturn at the intersection.

The existing intersection is shown in **Figure 2**. There is an existing short Auxiliary Left (AUL(S)) turn treatment and there appears to be a Basic Right (BAR) turn treatment at the intersection.

Figure 2: Existing Intersection

1.2. History

A Shawmac Traffic Impact Statement (TIS), Document 1909003-TIS-001 Version 3, was prepared on behalf of Austral Bricks.

The TIS concluded the following:

- 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.

Main Roads WA reviewed the TIS and requested a preliminary intersection design (15% 2D Concept) including the AUR and AUL(S) turn treatments and demonstrating that the intersection could be upgraded without the need for third party land.

The property in the north-east corner of the intersection is currently owned by Austral Bricks. To avoid the need for land acquisition from the property in the south-east corner it is proposed to relocate the intersection towards the north. Austral Bricks has advised that they will cede the land required to accommodate the intersection relocation and upgrade.

The existing cadastral boundaries around the intersection are shown in **Figure 3**.

Figure 3: Existing Cadastral Boundaries

1.3. Purpose

The purpose of this design report is to document the design criteria and assumptions adopted for the 15% concept design of the intersection design.

2. Existing Roads

2.1. South Western Highway

South Western Highway is a broadly north-south aligned road to the west of the site. South Western Highway is a Primary Distributor road under the care and control of Main Roads WA. It is a two-lane rural road with an approximately 11.0m sealed width including 1.5m wide sealed shoulders on both sides. The cross-section of South Western Highway in the vicinity of the site is shown in **Figure 4**.

Figure 4: South Western Highway Typical Cross Section

As per Main Roads WA RAV network mapping tool, South Western Highway allows vehicles up to RAV Category 4 (with concessional loading allowed up to Level 3).

South Western Highway has a 110km/h speed limit which reduces to 80km/h towards the north near Cardup Siding Road and then reduces further to 60km/h north of Pinebrook Road.

Kiln Road also allows vehicles up to RAV category 4 (with no concessional loading). There are no RAV conditions on Great Southern Highway and Kiln Road or at the intersection.

3. Design Data

3.1. Proposed Haulage Vehicle

It is proposed to use RAV 2 truck and dog trailers to delivery clay to the site. Bricks will be delivered from the site using prime mover/semi-trailers and RAV 2 pocket road trains.

Example RAV 2 vehicle combinations are shown in **Figure 5**.

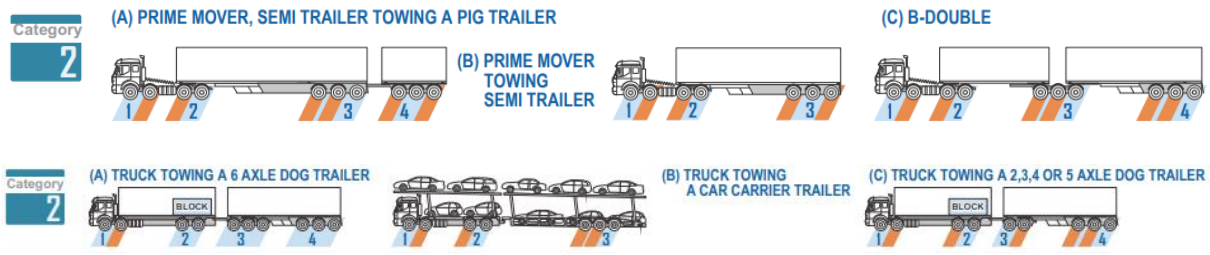


Figure 5: Example RAV 2 Haulage Vehicles

3.2. Proposed Haulage Route

As advised by the client, the majority of vehicle movements generated by the site will be to and from the north (90% from the north). It is noted that half of the truck movements will be unloaded.

3.3. Operating Hours

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.

3.4. Proposed Traffic Volumes

Refer to **Table 1** for the proposed peak hour traffic volumes as discussed previously in the TIS.

Table 1: Predicted Traffic Volumes

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

4. Design

4.1. Design Drawings

The design drawings have been provided along with this report. The list of drawings is provided below:

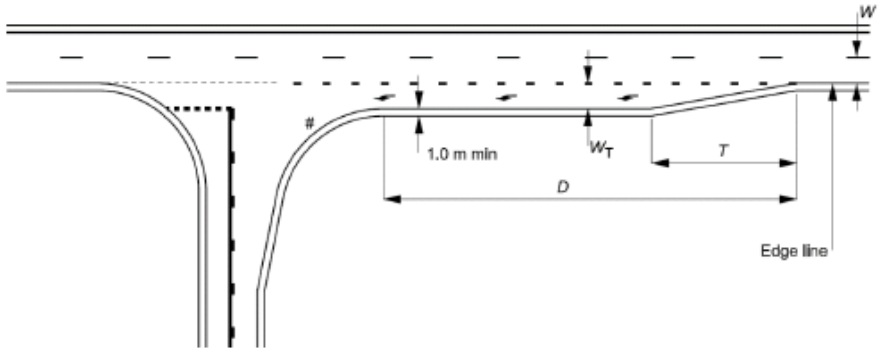
- Locality Plan and Drawing List 2010014-101
- General Arrangement Plan 2010014-201
- Intersection Plan 2010014-202
- Typical Cross Section 2010014-501
- Swept Path 1 of 2 2010014-901
- Swept Path 2 of 2 2010014-902

4.2. Intersection Design

Based on the TIS (Shawmac Document 1909003-TIS-001 Version 3), the intersection warrants a short Auxiliary Left (AUL(S)) and an Auxiliary Right (AUR) turn treatment. The intersection will also need to be wide enough to accommodate the swept path of RAV 2 vehicles.

The AUL(S) treatment has been designed as per Figure 8.3 of Austroads *Guide to Road Design Part 4A*, as shown in **Figure 6**, based on a 110km/hr design speed. The proposed AUL(S) has been extended based on the relocation of the intersection towards the north.

Figure 8.3: Rural AUL(S) treatment with a short left-turn lane



Notes:

- *# For setting out details of the left-turn geometry, use vehicle turning path templates and/or Table 8.2.*
- *Approaches to left-turn slip lanes can create hazardous situations between cyclists and left-turning motor vehicles. Treatments to reduce the number of potential conflicts at left-turn slip lanes are given in AGRD Part 4 (Austroads 2017).*
- *The dimensions of the treatment are defined as follows. Values of D and T are provided in Table 8.2.*

  W = Nominal through lane width (m) (including widening for curves). For a new intersection on an existing road, the width is to be in accordance with the current link strategy.

  W_T = Nominal width of the turn lane (m), including widening for curves based on the design turning vehicle = 3.0 m minimum.

  T = Physical taper length (m) given by Equation 5 being: $T = \frac{0.33VW_T}{3.6}$

  V = Design speed of major road approach (km/h).

Source: Department of Main Roads (2006)[37].

Table 8.2: Dimensions for AUL(S) treatment on major leg

Design speed of major road approach (km/h)	Diverge/deceleration length *D* (m)[1]	Taper length *T* (m)[2]
50	15	15
60	25	15
70	35	20
80	45	20
90	55	25
100	70	30
110	85	30
120	100	35

1 *Based on a 20% reduction in through road speed at the start of the taper and a value of deceleration of 3.5 m/s² (Table 5.2). Adjust for grade using the 'correction to grade', (Table 5.3).*
2 *Based on a turn lane width of 3.0 m.*

Source: Department of Main Roads (2006)[36].

Figure 6: Rural AUL(S) Turn Treatment

The AUR treatment has been designed as per Figure A 47 of Main Roads WA's supplement to Austroads *Guide to Road Design* Part 4 as per **Figure 7**.

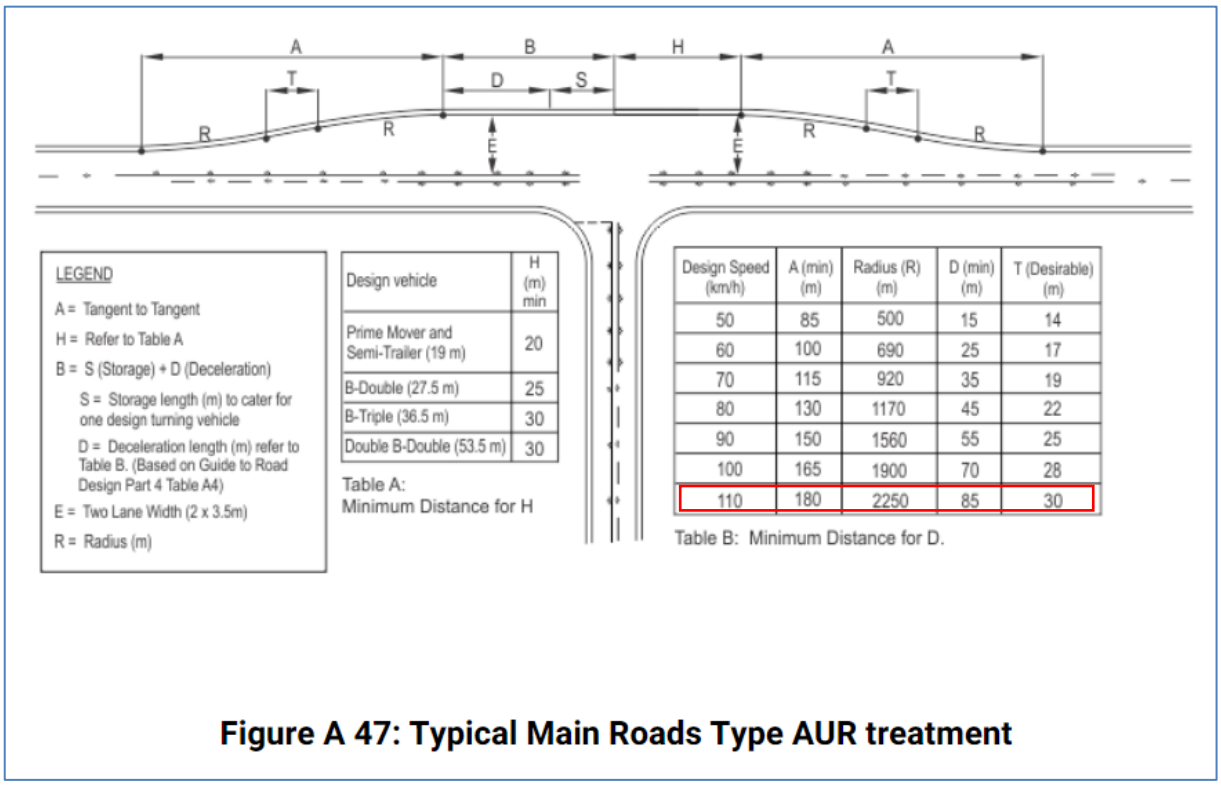


Figure 7: AUR Turn Treatment

As mentioned previously, the intersection will be relocated slightly towards the north to avoid land acquisition from the property in the south-east corner of the intersection.

4.3. Sight Distance Assessment

4.3.1. Approach Sight Distance

The required and available ASD at the relocated intersection has been determined from the Main Roads WA *Standard Restricted Access Vehicle Route Assessment Guidelines*. Based on the 110km/h speed limit (100km/h for trucks) and an approximately 1.5% downgrade towards South Western Highway, the required ASD is 263m. A preliminary check of the concept design indicates that the required ASD is achievable as shown in **Figure 8**.

Figure 8: ASD Check

The available ASD will be checked and maintained during the detailed design stages.

4.3.2. Entering Sight Distance

The required ESD at the intersection has also been determined from the Main Roads WA *Standard Restricted Access Vehicle Route Assessment Guidelines* as detailed in

Table 2. The ESD is measured from the driver's eye height to the top of the opposing vehicle. The approach grades have been estimated from Landgate contours.

Table 2: ESD Requirements

Vehicle Type	Direction	Design Speed (km/h)	Approach Grade	Required ESD (m)
Heavy Vehicles	North	100	1%	247
Heavy Vehicles	South	100	-1%	258

Figure 9 shows that the minimum ESD is achieved horizontally in both directions. There are no significant crests that would impede or restrict the sight distance vertically.

Figure 9: ESD Check

The available ESD will be checked and maintained during the detailed design stages.

4.4. Pavement and Surfacing Design

A geotechnical investigation will need to be undertaken prior to detailed design to determine the required pavement and surfacing design

4.5. Vertical Alignment

The existing intersection is relatively flat. The vertical geometry of the relocated intersection is unlikely to change and will be designed in accordance with the relevant design standards.

4.6. Drainage Design

The drainage design will be completed during the detailed design stages. There is an existing culvert at the intersection under Kiln Road that will need to be removed and replaced to suit the relocated intersection. The indicative culvert layout and drainage flows at the upgraded intersection is shown in **Figure 10**.

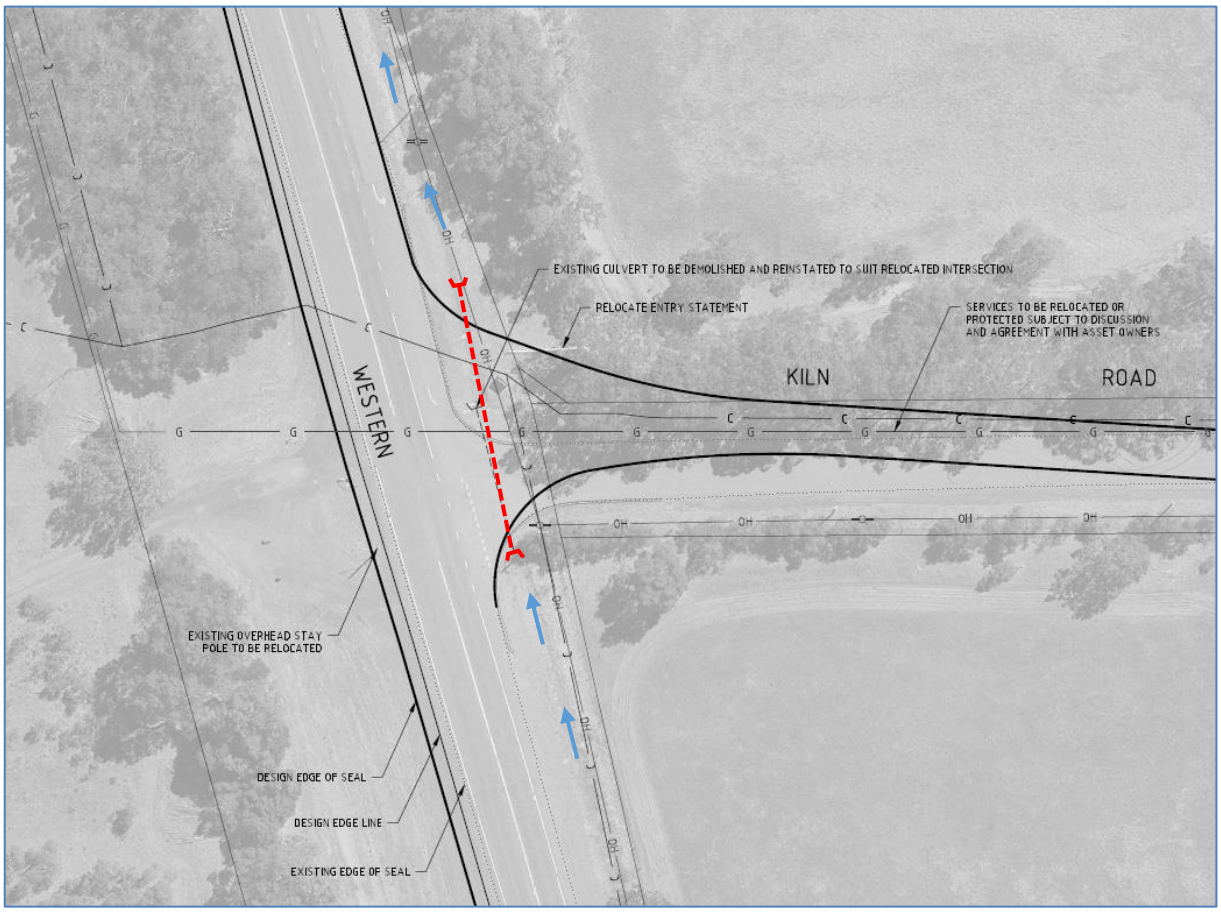


Figure 10: Indicative Drainage Flows

4.7. Services

The existing services have been identified from Dial Before You Dig data, aerial imagery and Google Street View. There is overhead power, high pressure gas and communications infrastructure around the intersection. The intersection upgrade is likely to require relocation or protection (lowering or coating) of the gas and communications infrastructure. Additionally, an existing overhead stay pole on the western side of the intersection will need to be relocated to accommodate the AUR.

Depending on the cost of service relocation/protection, another option involving relocation of the intersection further north may be investigated which may reduce the impacts to the existing services.

The various asset owners will be contacted to discuss the proposed intersection design and any relocation or protection requirements.

4.8. Lighting Design

The proposed intersection is considered an isolated intersection as defined in Main Roads WA Road Lighting Policy and Guidelines, as it is located within an unlit section of South Western Highway.

As per Section 3.8.5 of MRWA Part B: Application & Approval Guidelines isolated intersections generally do not require road lighting unless the intersection:

- Is a Roundabout.
- Is controlled by Traffic Signals.
- Has a median island in the through road, or
- Qualifies for lighting as a Special Case.

The intersection does not meet any of the above-mentioned requirements and therefore, lighting is not considered to be required.

4.9. Environmental

A clearing permit is likely to be required for any vegetation that needs to be removed within the road reserve.