AECOM

Mint Interchange

Land Development Agency/ Economic Development Directorate

21 December 2012

Mint Interchange

Pre-Feasibility Study Report

Pre-Feasibility Study Report

Prepared for

Land Development Agency/ Economic Development Directorate

Prepared by

AECOM Australia Pty Ltd

Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia

T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com

ABN 20 093 846 925

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0	14 Dec 2012	Pre-feasibility Design Report	Jane Peters Associate Director	
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Executive Summary

The Land Development Agency (LDA)/ Economic Development Directorate (EDD) engaged AECOM in August 2012 to investigate and test options for the reconfiguration of the existing grade-separated at Cotter road, Adelaide Avenue and Yarra Glen as part of the Canberra Brickworks precinct at Yarralumla. For the purpose of this report, the new interchange is named the "Mint Interchange".

The prefeasibility study for the interchange tested the geometry in terms of the required traffic, bus, cyclist and pedestrian movements, road design standards, and existing physical constraints.

The interchange location and geometry and is based on the configuration previously proposed by AECOM with connections to Denison Street and Cotter Road.

The elements of the project investigated consist of:

- A realigned dual carriageway Cotter Road along the location shown on the Canberra Brickworks Masterplan.
- An interchange at the junction of Cotter Road and Adelaide Avenue/Yarra Glen.
- On and off-ramps connecting the interchange to Adelaide Avenue and Yarra Glen accommodating all movements.
- A new bus stop within Adelaide Avenue median.
- Provision of on-road cycle lanes and consideration for off-road paths in the vicinity of the project.
- A four way intersection on Cotter Road to Brickworks and North Curtin development areas.
- A T intersection between Deakin Link and Denison Street.
- Relocation of the City-Woden off-road cycle path to suit the reconfigured road system including the provision of an underpass beneath Deakin Link.

There are concurrent studies/ projects adjacent to the project site and these projects are:

- Brickworks Development by LDA/EDD
- Potential future Development of Block 5 Section 121 (North Curtin Horse Paddock) by National Capital Authority (NCA)
- Adelaide Avenue Bus Stops Feasibility Study by Environment and Sustainable Development Directorate (ESDD)
- Molonglo Arterial Roads Feasibility Study by EDD.
- Cotter Road Stage 1 Works (Tuggeranong Parkway to Lady Denman Drive) by Roads ACT.

Traffic modelling exercises were undertaken on the various intersection layouts considered as part of this pre-feasibility study. Primarily the analysis focused on:

- Mint Interchange;
- Denison/Deakin Link; and
- Cotter Road/Brickworks access.

The analysis of the various intersection layouts concluded that all the proposed intersection layout are feasible at this stage of the study based on the projected 2031 traffic volumes provided by the ACT Government.

The investigations relating to services included were primarily made using the ACTMAPi data, Dial-Before-You-Dig information and aerial photos.

Some realignment of the both the northbound and southbound carriageways of Adelaide Avenue/Yarra Glen will be required to establish the on and off-ramps connecting to the roundabout. The ramps will need to be flanked by reinforced earth (or similar) retaining walls to minimise bridge spans and the footprint of the interchange given the relatively constrained area; the need to avoid intrusion into the Mint Oval; and to provide space for the a proposed bus station to be located within the median to the north of the proposed interchange.

LDA/EDD requested for a retaining wall option is explored to contain the extent of earthworks and thus reducing the road reserve width at the northern corner of the interchange, adjacent to Brickworks development. This option is shown on all layout options included in Appendix B.

Options study has developed a range of conceptual options for the treating the interchange including:

- Elevated roundabout treatment with no median ramp accessing median bus stop on Adelaide Avenue.
- Single Point Diamond Interchange.
- Diverging Diamond Interchange

Discussion with Environment and Sustainable Development Directorate (ESDD) in September 2012 indicated Cotter Road is unlikely to be identified as a public transport rapid route, therefore busses accessing Mint Interchange and onto Cotter Road would most probably be a low frequency busses or express services during peak hours only. Therefore the location of bus stops for this route could be located off-line from the proposed median crossover bus stops on Adelaide Avenue. Bus stops, adjacent to this median bus stop, are therefore proposed on the verge sides of Adelaide Avenue for busses accessing Cotter Road.

Two possible bus stop locations included in this study are:

- Median crossover bus stop on Adelaide Avenue at Kent/Novar overpass with bus stops located in close proximity in the verges of Adelaide Avenue
- Median crossover bus stop on Adelaide Avenue between Kent/Novar overpass and the Mint Interchange with bus stops located in close proximity in the verges of Adelaide Avenue

There are warrants for safety barriers in the project in the vicinity of large trees proposed along Cotter Road west (between Brickworks access/Cotter Road intersection and the interchange), in the vicinity of the interchange and in the vicinity of the median crossover bus stop on Adelaide Avenue.

There is a high voltage overhead power line along the southern side of Cotter Road that crosses Adelaide Avenue towards Deakin. The Deakin Link has the potential to impact on the large diameter gas main and the existing watermain located on the eastern and western sides of Denison Street respectively whilst at Kent Street there are a number of communication assets which will be potentially impacted by the new intersection arrangements.

No environmental impact assessments have been made as part of the study. These assessments will need to be carried out as and when the designs are further developed. Notwithstanding, there are impacts on the existing pine copses at the location of the interchange, the Kent Street works and the Deakin Link.

Impacts on the Mint Oval are minimised through the use of retaining walls along the southern side of the Cotter road east extension. However, the existing toilet block within the Mint Oval will need to be relocated.

Based on a number of discussions with the LDA/ EDD and a number of possible combinations of the different type of interchange arrangement and bus stop locations have been considered in an attempt to determine the road reserve boundary on the Brickworks development side. These combinations have been reduced to four possible

layouts. It should be noted that other combinations of the interchange type and bus stop locations may be possible, however, not explored in this study.

- Layout Option 1 - Elevated Roundabout Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass
- Layout Option 2 - Single Point Diamond Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)
- Layout Option 3 - Elevated Roundabout Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)
- Layout Option 4 – Diverging Diamond Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass

The layouts for Option 1 to 3 on Cotter Road require a wider road reserve of 55 m compared to 48 m for Option 4. For the purpose of showing the possible boundary on Brickworks side, a wider road reserve boundary of 55 m is adopted. In the vicinity of the interchange, the layout of Option 4 is adopted to set the boundary on the northern quadrant as Option 4 provided a wider footprint in the vicinity of the northern facing ramps.

LDA/EDD requested to explore construction of retaining wall on this northern quadrant in order to reduce the extent of fill embankment into the Brickworks Development. With retaining wall option, an easement of approximately 5 m from the retaining wall is proposed for maintenance access. The retaining wall option would appear to have the minimal impact to the Brickworks development compared to the fill embankment option.

Based on the typical section included in Appendix B , a verge with of 13 m has been adopted to show the road reserve boundary notionally adjacent to North Curtin Horse Paddock Boundary.

The works can be staged into three stages with construction of the single point diamond interchange and diverging diamond interchange option be undertaken in one stage. With the elevated roundabout interchange option, the southern bridge of the roundabout will be the initial construction with Cotter Road westbound traffic deviated onto the bridge whilst the existing Cotter Road flyover is demolished to allow for the construction of the northern bridge of the roundabout.

An assessment of probable costs for each layout options have been undertaken with a list of assumptions included in Section 11.0. A summary of the probable costs is tabulated below.

Layout Option	Cotter road	Denison street	Interchange	Adelaide Avenue	**Total cost**
1	$21,500,000.00	$13,300,000.00	$20,400,000.00	$38,800,000.00	**$94,000,000.00**
2	$21,500,000.00	$13,300,000.00	$30,700,000.00	$38,800,000.00	**$104,300,000.00**
3	$21,500,000.00	$13,300,000.00	$20,400,000.00	$38,800,000.00	**$94,000,000.00**
4	$20,400,000.00	$13,200,000.00	$19,900,000.00	$30,300,000.00	**$83,800,000.00**

1.0 Introduction

1.1 Background

The Land Development Agency (LDA)/ Economic Development Directorate (EDD) engaged AECOM in August 2012 to investigate and test options for the reconfiguration of the existing grade-separated interchange at Cotter Road, Adelaide Avenue and Yarra Glen as part of the further investigations for the Canberra Brickworks precinct at Yarralumla.

The interchange is located at the junction of Cotter Road and Adelaide Avenue/Yarra Glen road systems. For the purposes of nomenclature this report uses the following:

- The name 'Mint Interchange' where the actual interchange location is referred to.
- Deakin Link for the works on Cotter Road East between the interchange and Denison Street.
- Cotter Road West for the works west of the interchange.
- Cotter Road/ Brickworks Access for the future four way intersection closer to the western end of the project site near Dunrossil Drive.

The prefeasibility study for the interchange tested the geometry in terms of the required traffic, bus and pedestrian movements, road design standards, and existing physical constraints.

The interchange location and geometry is based broadly on the configuration previously proposed by AECOM in the Yarralumla Interchange, Concept Design Report in 2011 with connections to Denison Street and Cotter Road.

1.2 Previous Studies

SMEC produced a schematic interchange arrangement in May 2011 as part of Canberra Brickworks and Environs Planning Strategy: Traffic, Transport and Infrastructure study.

In February 2011, LDA engaged AECOM to investigate and test the proposed interchange at the intersection of Cotter Road and Adelaide Avenue/Yarra Glen as part of the development of the Canberra Brickworks precinct as shown in Figure 1.

The works included:

- A revised alignment of Cotter Road west of the proposed interchange;
- Connection of Cotter Road to Denison Street (Deakin Link);
- Elevated roundabout as the single point interchange with Adelaide Avenue/Yarra Glen;
- New on and off-ramps connecting the elevated roundabout to Adelaide Avenue/Yarra Glen
- Demolition of the existing Cotter Road flyover;
- A potential bus stop located in the Adelaide Avenue median north of the interchange with a ramped bridge connection to the between the bus stop and the interchange for bus access;
- Removal of the existing Cotter Road on-ramp to Adelaide Avenue;
- Adjustments to the City – Woden off-road cyclepath; and
- A revised layout for the intersection of Kent Street/Denison Street and the Adelaide Avenue southbound off-ramp.

The location of the interchange is determined based on the following constraints:

- Minimise the impacts on the Mint Oval.

- Minimise the impacts on the Brickworks Development.

The elevated roundabout interchange arrangement provided flexibility in incorporating direct median ramps for bus access from the interchange to the bus stop located in the median of Adelaide Avenue but concerns were raised on the safety of such an arrangement if combined with the median crossover bus stop on Adelaide Avenue as proposed in the Adelaide Avenue Bus Stops Feasibility Study project.

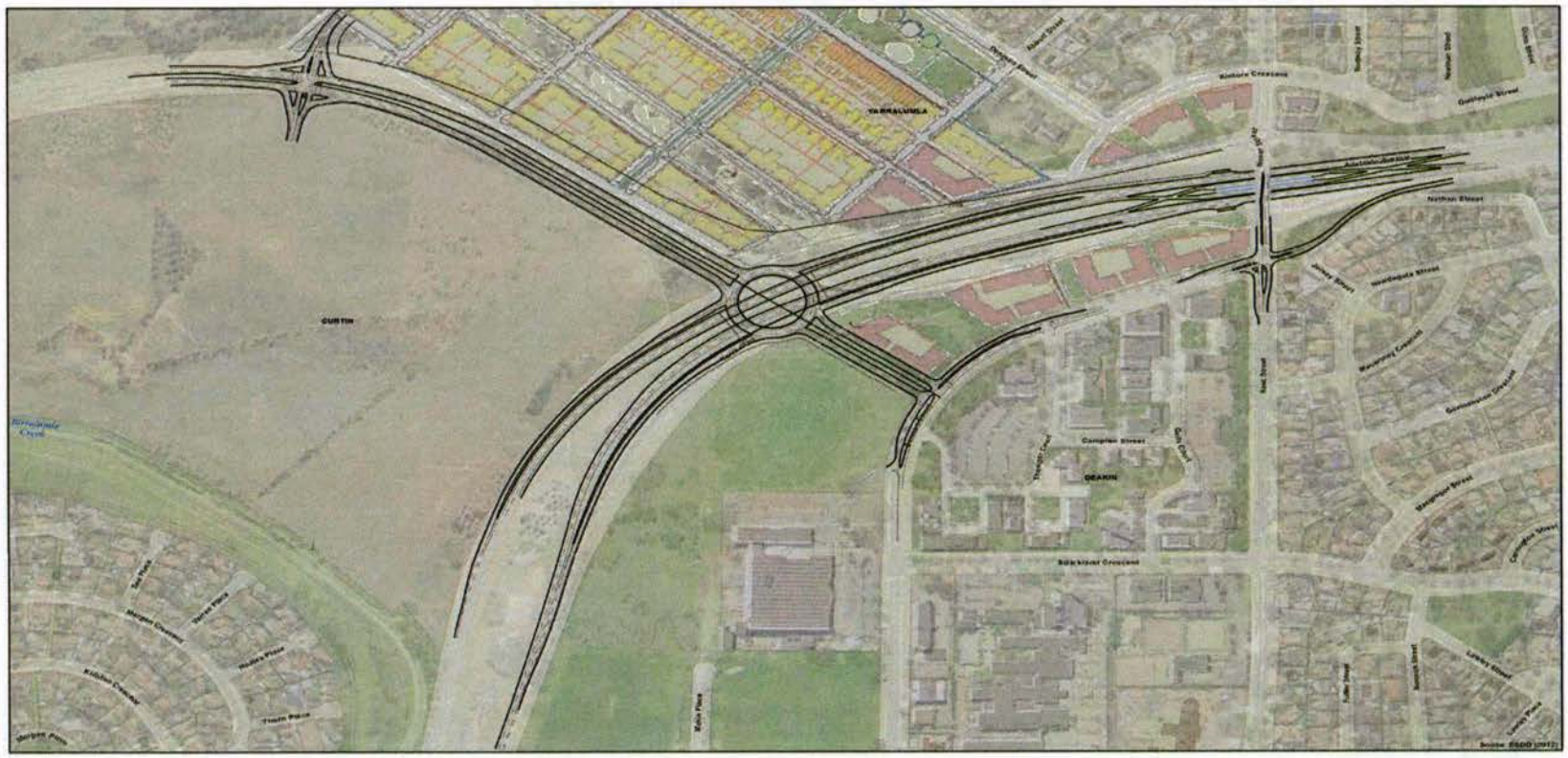

Figure 1 Study Area

2.0 Description of the Works

2.1 Objectives

The objective of this study is to develop and assess four layout options for the reconfiguration of the existing grade separated interchange at the intersection of the intersection of Cotter Road and Adelaide Avenue/Yarra Glen, adopting the following criteria:

- Allowance for all traffic movements;
- Canberra Brickworks, Yarralumla site and environs redevelopment layout;
- Minimise impacts on the Mint Playing Field;
- Minimises land take and disruption to existing utilities and roads;
- Meets road design needs;
- Incorporate public transport needs including bus stops on Adelaide Avenue; and
- Provides opportunities to stage the works.

2.2 Scope of works

The scope of work for this study is to develop a range of conceptual options for the interchange and linking roads taking into account previous traffic studies and concepts developed for the interchange.

The elements of the project investigated consist of:

- A realigned dual carriageway Cotter Road along the location shown on the Canberra Brickworks Masterplan.
- A grade separated interchange at the junction of Cotter Road and Adelaide Avenue/Yarra Glen.
- On and off-ramps connecting the interchange to Adelaide Avenue and Yarra Glen accommodating all movements.
- A new bus stop within Adelaide Avenue median.
- Provision of on-road cycle lanes and consideration for off-road paths in the vicinity of the project.
- A four way intersection on Cotter Road to Brickworks and North Curtin development areas.
- A T intersection where the Deakin Link meets Denison Street.
- Relocation of the City-Woden off-road cycle path to suit the reconfigured road system including the provision of an underpass beneath Deakin Link.

3.0 Concurrent Studies/ Projects

3.1 Brickworks Development

The Brickworks Development is a current project of the LDA/ EDD. The study area for the Brickworks development is located between the old Canberra Brickworks and the intersection of Cotter Road with Adelaide Avenue/Yarra Glen in Yarralumla and Deakin. SMEC provided future traffic volumes from their strategic transport model, developed for the Canberra Brickworks study. These volumes were adopted in AECOM's Concept Design Report for the interchange in May 2011.

It should be highlighted that these traffic volumes did not include the future development of Molonglo which is part of recent study and further discussed in Section 3.4 below.

3.2 Potential Future Development of Block 5 Section 121 (North Curtin Horse Paddock)

The National Capital Authority (NCA) undertook Public Consultation late in 2011 on potential locations for new Diplomatic estates. The North Curtin Horse Paddock has been identified as one of the potential site for this development. At this stage, no further information is available regarding the proposal.

3.3 Adelaide Avenue Bus Stops Feasibility Study

The main objective of the Adelaide Avenue Bus Stops Feasibility study is to determine the feasibility of establishing bus stops along the Adelaide Avenue – Yarra Glen corridor. SMEC is the design consultant undertaking this study for ESDD.

Kent/Novar Street has been identified as one of the location of the possible bus stops along the Adelaide Avenue. A number of possible bus stop design options explored and the one considered in this prefeasibility study is the median crossover bus platform design option.

3.4 Molonglo Arterial Roads Feasibility Study

In 2012, SMEC was engaged to undertake the Molonglo Arterial Road Feasibility Study on behalf of the ACT Shared Services Procurement (SSP).

The traffic modelling from this study included traffic projections on the external network imposed by the Molonglo development and it was intended to be used for an assessment of the Mint Interchange and other intersection capacity included as part of this prefeasibility study. SMEC highlighted, however, that the future development of Brickworks has not being included in this traffic modelling.

Further discussions regarding the adopted traffic figures are discussed in Section 4.0.

3.5 Cotter Road Stage 1 Works

The Cotter Road Stage 1 works was designed by SMEC for Roads ACT and is currently under construction. The works area is extended from Yarralumla Creek Bridge including signalisation of Lady Denman intersection. The western end of this pre-feasibility study will connect to the future works of Cotter Road Stage 1 works east of the Lady Denman Intersection.

4.0 Traffic Analysis

Traffic modelling exercises were undertaken on the various intersection layouts considered as part of this pre-feasibility study. Primarily the analysis focused on:

- Mint Interchange – three different layouts;
- Denison/Deakin Link – two different layouts; and
- Cotter Road/Brickworks access – two different layouts.

The analysis has indicated the following key conclusions that should be considered further at the feasibility stage of the project:

- The analysis undertaken by AECOM indicates that all the intersection layouts tested, apart from a priority intersection layout at the Deakin Link/ Denison intersection, are feasible at this stage of the study based on the projected 2031 traffic volumes provided by the ACT Government;
- Of all the intersection layouts tested, the roundabout layouts offer the most efficient solution for the general traffic movements in terms of minimising delay and queuing at the intersections;
- Whilst the roundabouts offer the best solution for traffic, they do not offer the best solution to facilitate the movements of pedestrian and cyclist along the corridor and given the pedestrian and cycle demands are unknown at present its difficult to suggest a roundabout is the best solution;
- Whilst the signalised layouts do not operate as efficiently as the roundabout options they do operate at a satisfactory LoS and they all offer signalised and controlled pedestrian crossing facilities; and
- In all modelling exercises all intersections operated with minimum delay and queuing during the AM peak period, whilst the PM peak experienced greater delays and queuing as a result of conflicting movements.

Following the conclusion of the modelling exercise undertaken by AECOM the following recommendations are outlined for further consideration and to facilitate the development of a brief for the feasibility study by EDD:

- All intersections have been analysed in isolation and no corridor assessment has been completed – In order to fully understand the operation of the corridor and the interaction between the intersections along the corridor it is recommended that a Micro-simulation model of the network should be developed;
- The impact of the brickworks development has not been fully assessed as part of this pre-feasibility study and the micro-simulation should include the brickworks development to assess the impacts of any rat running
- There is an ambition to develop a transport interchange in the median of Adelaide Avenue by ESDD which will provide a segregated busway link to the City Centre, therefore, as part of the micro simulation assessment consideration should be given to the inclusion of the bus interchange within the model and a comprehensive assessment of pedestrian and cycle interaction with vehicles – the micro simulation package chosen for this assessment should have the ability to assess and capture this interaction; and
- Consideration of the urban form / environment across the area to assist with the development of a bus interchange and the promotion of the walking and cycling linkages between the areas of the Brickworks and Deakin – this is important in promoting the bus as a mode of transport for local residents and workers and will assist in local traffic reduction and congestion along Adelaide Avenue

A copy of the Intersection Modelling Report which outlines the base data and modelling methodology that were utilised to analyse the various layouts under consideration is included in the Appendix A.

5.0 Road Design

5.1 Existing Conditions

Presently Cotter Road intersects with Adelaide Avenue/Yarra Glen in a half-trumpet configuration with Cotter Road westbound passing over Adelaide Avenue/Yarra Glen. Cotter Road, Yarra Glen and Yarralumla Interchange are arterial roads with 80 km/h posted speed limit.

The Cotter Road westbound carriage exits Adelaide Avenue immediately west of the Kent Street/Novar Street overpass as a single lane off-ramp as a 3.5 m wide traffic lane and a 2.0 m wide shoulder/on-road cycle lane.

The existing Cotter Road flyover has the following characteristics:

- Length: 99.3 m consisting of 3 spans measuring approximately 43 m (west span) 17 m (centre span) and 39 m (east span)
- Width: 6.5 m between kerbs with 1.2 m wide flanking kerbs containing guardrail and handrails.
- Geometry: 373.3 m radius left-hand curve.
- Superelevation: 6%.
- Linemarking; 4.0 m traffic lane and 2.5 m wide shoulder/on-road cycle lane.
- Superstructure: Prestressed box girder

The eastbound on-ramp is 5.5 m wide with a 3.5 m wide traffic lane and a 2.0 m wide shoulder/on-road cycle lane. The on-ramp joins Adelaide Avenue between the Cotter road flyover and the Kent Street/Novar Street overpass.

West of the flyover the median separating the westbound and eastbound carriageways varies up to 100 m in width.

5.2 Design Criteria and Assumptions

5.2.1 Design Criteria

The following criteria adopted for the design of the interchange:

- Adelaide Avenue/Yarra Glen: 90 km/h (signposted speed: 80 km/h)
- Cotter Road (west): 90 km/h (signposted speed: 80 km/h)
- Roundabout: 35 to 40 km/h (within 60 km/h zone)
- Cotter Road (east); 60 km/h (default speed limit: 50 km/h)
- Denison Street: 60 km/h (default speed limit: 50 km/h)
- Reaction time of 2.0 seconds.

5.2.2 Design Guidelines

The following design guidelines were consulted during the development of the designs:

- ACT Government Design Standards for Urban Infrastructure.
- ACTEW Water Supply and Sewerage Standards.
- AUSTROADS – Part 3: Geometric Design.
- AUSTROADS – Part 4A Unsignalised and Signalised Intersections.
- AUSTROADS – Part 4C Interchanges.
- AUSTROADS – Part 6A Pedestrian and Cycle Paths.

- RTA – Road Design Guide.
- SAA – AS 5100 Bridge Design Code.
- ACTPLA - ACT Bus Passenger Station Design Guidelines.

5.2.3 Assumptions

The proposed interchange concepts have been developed using ACTMAPi 1 m contour/cadastral data.

A search of ACTPLA plan room microfilm records had limited success with some details of the existing Cotter Road flyover and Kent Street overpass but little information on the original road construction carried out in late 1960s/early 1970s.

Hence the investigations were primarily made using the ACTMAPi data, Dial-Before-You- Dig information and aerial photos.

Detailed surveys will be required for the designs to be developed further than these concepts.

5.3 Horizontal Alignment

5.3.1 Cotter Road

The alignment of Cotter Road has been determined from the Canberra Brickworks Masterplan. There is a requirement to minimise the impact on the Mint Playing Field, hence the southern boundary of the Deakin Link is set to meet this requirement.

The existing toilet block will be impacted by the proposal and will require relocation.

5.3.2 Adelaide Avenue/Yarra Glen

The southbound carriageway is realigned into the median to provide space for the southbound on-ramp to be clear of the Mint Playing Field. The southern connection to the existing carriageway to provide this arrangement will extend approximately 700 m south of the interchange whilst the northern connection rejoins the existing carriageway approximately midway between the existing Cotter Road flyover and Kent/Novar Streets.

The northbound carriageway is also realigned to the west over a length of approximately 850 m to create the adequate space for the bridge ramp from the elevated roundabout to the proposed median bus station.

The northbound off-ramp and southbound on-ramps extend approximately 530 m and 600 m respectively south of the interchange, the length influenced by the grade of Yarra Glen falling towards the south.

The northbound on-ramp and southbound off-ramps extend approximately 300 m north of the interchange, the length influenced by the grade of Adelaide Avenue rising towards the north. LDA/EDD requested for the extent of pavement reconstruction on Adelaide Avenue and Yarra Glen between the ramps to be minimised. This request is further explored in the discussions of reservation corridors for interchange options in Section 6.0.

The distance between the Yarrulumla Interchange southbound on-ramp and the Carruthers Street off-ramp noses is 630 m and 780 m for the Carruthers Street northbound on-ramp and the Cotter Road off-ramp, which is less than the 900 m recommended by AUSTROADS design guidelines. However the recommended 4 seconds minimum travel time between the end of the off-ramp taper and the start of the exit ramp taper on both the southbound and northbound carriageways is 300 m which equates to a 13 second travel time. Whilst meeting this minimum criteria the weave condition would need further analysed in the detailed design phase.

5.4 Vertical Alignment

5.4.1 Cotter Road

The eastbound vertical alignment departs the existing Cotter Road immediately west of Dunrossil Drive on a down gradient varying between 1.5% and 1.9%, rising to 3 % prior to crossing over Adelaide Avenue/Yarra Glen via 125 m and 160 m long vertical curve followed by down-grades varying between 3% and 5% to Denison Street.

The clearance over Adelaide Avenue/Yarra glen has been adopted at 5.4 m with an additional 2.5 m allowance for structural depth for the bridge, crossfalls, etc for this concept design phase. Further investigations are required when the design progresses to the next phase considering actual road levels on Adelaide Avenue and the desired clearance given the present clearances at the Kent/Novar Street and Carruthers Street bridges which are 4.7 m.

Adopting a 4.7 m minimum clearance at the bridges would:

- Reduce ramp lengths.
- Increase the distance between the ramps at the Carruthers Street and Cotter Road interchanges.
- Reduced heights and lengths of reinforced earth retaining walls.
- Limit the use of the bridges for high vehicles

5.4.2 Mint Interchange Ramps

Gradients on the ramps vary with the maximum grade being 6%.

5.4.3 Retaining Walls

Reinforced earth retaining walls are proposed in the inner or Adelaide Avenue/Yarra Glen face of all ramps. To reduce the impacts on the Mint Playing Fields and the City to Woden off-road cyclepath, a reinforced earth wall is required to retain the proposed interchange along the southern face of the Deakin Link to Denison Street. Retaining walls are also proposed adjacent the proposed bus stops on the verge of Adelaide Avenue.

The other areas, batter sloping of 4H:1V is assumed to match with the existing levels in either cut or fill conditions.

LDA/EDD requested for a retaining wall option is explored to contain the extent of earthworks and thus reducing the road reserve width at the northern corner of the interchange, adjacent to Brickworks development. This option is shown on all layout options included in Appendix B.

5.5 Typical Cross Sections

The proposed cross sections are as follows and included in Appendix B.

5.5.1 Cotter Road West (between Cotter Road/ Brickworks access intersection and the interchange)

Dual carriageway with each carriageway containing:

- 2 x 3.5 m wide traffic lanes
- 2.0 m wide on-road cycling lane/shoulder
- 12.2 m wide southern verge and 10.0m wide northern verge.

5.5.2 Cotter Road East (between Deakin Link and the interchange)

Dual carriageway with each carriageway containing:

- 2 x 3.5 m wide traffic lanes
- 1.5 m wide on-road cycling lane/shoulder

- 6.0 m wide verge

5.5.3 Adelaide Avenue and Yarra Glen

Dual carriageway with each carriageway containing:

- 2 x 3.5 m wide traffic lanes
- 1 x 3.5 m wide bus lane
- 2 m wide on-road cycling lane/shoulder
- 0.5 m wide right-hand shoulder
- A minimum of 10.0 m wide median to avoid the requirements of safety barriers based on no hazards such as trees is located in the median.

5.5.4 Cotter Road Off and On-ramps

- 3.5 m wide traffic lanes widening to 2 x 3.5 m wide lanes adjacent to the roundabout.
- 2.0 m wide on-road cycling lane/shoulder.
- 1.5 m wide right-hand verge.
- 6 m wide left-hand verge where shared path is proposed. 4.5m wide elsewhere.

5.6 Interchange

The options study has developed a range of conceptual options for the treating the interchange including:

- Elevated roundabout treatment with no median ramp accessing median bus stop on Adelaide Avenue.
- Single Point Diamond Interchange.
- Diverging Diamond Interchange

5.6.1 Elevated Roundabout Interchange

There is no alteration to the geometry of the elevated roundabout interchange proposed in 2011. The key parameters are:

- The roundabout has an 80 m diameter central island.
- 2 x 4.1 m wide traffic lanes.
- 3 m wide inside shoulder.
- 1.5 m wide on-road cycle lane shoulder.
- 2.5 m wide pedestrian/off-road cycle path.
- A median ramp accessing median bus stop on Adelaide Avenue has been deleted – refer to Section 5.8

5.6.2 Single Point Diamond Interchange

A Single-Point Urban Interchange (SPUI), as a modification of the diamond interchange with single four phase signal operation providing increased efficiency and capacity when compared to a standard diamond interchange with separated signals each with three phases. Refer diagram.

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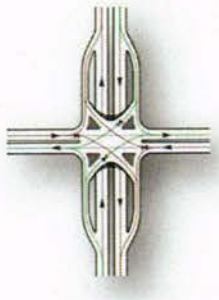
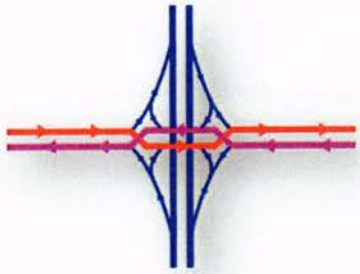


5.6.3 Diverging Diamond Interchange

This type of interchange is used widely in the United States. Whilst not used in the ACT to date, it is proposed on a project in Western Australia. The arrangement suits:

- The relatively wide median;
- The need to minimise the impacts on the existing alignment and pavements of Adelaide Avenue/Yarra Glen.

This configuration allows for two-phase operation at all signalised intersections within the interchange. This is a significant improvement in safety, since no right-turns must clear opposing traffic and all movements are discrete, with most controlled by traffic signals. Additionally, the design can improve the efficiency of an interchange, as the lost time for various phases in the cycle can be redistributed as green time; there are only two clearance intervals. Refer diagram.



5.7 Intersections

5.7.1 Cotter Road/ Brickworks Access

The intersection of Cotter Road West and Denison Street will be a signal controlled four-way intersection. The signalisation of the intersection has been documented as this arrangement would provide a safer pedestrian access at the intersection.

The following parameters are considered in determining the possible location of this intersection:

- The estimated traffic queues on Cotter Road; and
- The location and access to the Local Street from the intersection.
- The minimal level difference between the existing ground and the preliminary control line.

5.7.2 Deakin Link/Denison Street

The intersection of Cotter Road East and Denison Street will be a signal controlled T intersection.

Widening of the existing carriageway of Denison Street is required to provide a central median for signal columns and left-turn and right-turn lanes.

5.7.3 Kent Street/Adelaide Avenue Off-Ramp and Denison Street/Kent Street Intersections

Given the sub-standard separation of these two intersections it was proposed in the Concept design Stage to create a combined intersection by realigning Denison Street to align with the Adelaide Avenue off-ramp. The realigned Denison Street rejoins the existing Denison Street near the Giles Court intersection.

It is noted that the intersection crossing angle exceeds the normal 70° required by design guidelines by approximately 5°. This angle is fixed by the angle of the existing Adelaide Avenue off-ramp intersection with Kent Street.

The revised alignment will impact on the existing long-stay carpark located opposite the Geilis Court intersection located in Block 4 Section 65.

LDA/EDD requested AECOM to assess the possibility of realigning the Adelaide Avenue off-ramp with the current alignment of Denison to minimise the impact of Block 4 Section 65 Deakin. It appears that shifting the intersection to further south, aligning with the current alignment of Denison Street is possible. The likely impacts of this proposal are:

- Removal of rows of trees which appear to be acting as visual screens between the residences along the north eastern side parallel with the ramp.
- A possible increase in traffic noise as the ramp is proposed to be realigned closer to the existing residences.
- Impacts to existing utilities. Discussions with asset authorities would be required in the next stage of design.

It is recommended that the extent of impacts of this proposal is to be assessed further in the next stage of design.

5.8 Public Transport

5.8.1 Deakin to Molonglo Bus Route

Discussion with Environment and Sustainable Development Directorate (ESDD) in September 2012 indicated Cotter Road is unlikely to be identified as a public transport rapid route, therefore busses accessing Mint Interchange and onto Cotter Road would most probably be a low frequency busses and/ or buses operating during peak periods only. Therefore the location of bus stops for this route could be located off-line from the proposed median crossover bus stops on Adelaide Avenue. Bus stops, adjacent to this median bus stop, are therefore proposed on the verge sides of Adelaide Avenue for busses accessing onto Cotter Road. A standard indented bus stop details is proposed at these stops.

5.8.2 Median crossover bus stop on Adelaide Avenue at Kent/ Novar overpass

As discussed in Section 3.3 the Kent/Novar bridge has been identified as one of the bus stops on Adelaide Avenue as part of Adelaide Avenue Bus Stops Feasibility Study. It is anticipated that this stop would be utilised for the Civic to Woden bus route.

The Deakin to Molonglo bus stops in the vicinity of Kent/Novar overpass are proposed to be situated west of the overpass to minimise impacts on the existing overpass structure.

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5.8.3 Median crossover bus stop on Adelaide Avenue between Kent/ Novar overpass and Mint Interchange

An alternative location to the Kent/Novar bus stop is proposed. This alternative location is utilising the proposed bus stop in the Concept Design study in 2011 and it is located approximately mid-way between the Kent/ Novar overpass and Mint Interchange. Pedestrian footbridge is required to provide access to these bus stops. AECOM was requested to adopt the similar median crossover bus stop arrangement similar to Kent/Novar bus stop.

The key features of this median crossover bus stop are:

- 2 x 3.5 m bus lanes.
- 6.0 m wide median platform.
- Barriers between the bus lanes and Adelaide Avenue carriageway.

5.9 Safety Barriers

Warrants of safety barriers in the project have been established in the vicinity of large trees proposed along Cotter Road west (between Cotter Road/ Brickworks access intersection and the interchange), in the vicinity of the interchange and in the vicinity of the median crossover bus stop on Adelaide Avenue. Note that there is no available planting proposals elsewhere in the vicinity of the project to assess the warrant of safety barriers.

The following assumptions are adopted for clear zone assessment on Cotter Road and local street within Brickworks development:

- Cotter Road: minimum 7.5 m wide clear zone
  - → Design speed of 90 km/h for 80 km/h posted speed
  - → Design traffic is more than 6,000 vehicle per day
  - → 6H:1V or flatter batter slope
- Local Street : minimum 3.5 m wide clear zone
  - → Design speed of 60 km/h for 50 km/h posted speed
  - → Design traffic is between 750 to 150 vehicle per day
  - → 6H:1V or flatter batter slope

At this stage, the type and size of trees are unknown. It is understood that these trees proposed are large size trees and will be located within the clear zone widths specified in Austroads Part 6, Roadside Design, Safety and Barriers, 2009.

It is suggested for the trees in the 13 m wide median between the two carriageways of Cotter Road be offset to avoid requirements of barriers on both sides of the median. If barriers are provided on both sides of the median, the median width can be reduced to 6m. Refer to the typical section drawings included in the appendices.

5.10 Cyclists and Pedestrians

5.10.1 On-road cycle lane

The following provision of on-road cycle lanes is provided:

- A 2.0 m wide lane through the 80 km/h (posted speed) on Cotter Road west.
- A 1.5 m wide lane through the 50 km/h (posted speed) on the interchange, Deakin Link, Denison Street and Dunrossil Street.

5.10.2 Off-road paths

The off-road path is realigned near the Cotter Road East to provide an underpass on a more oblique angle than the existing 45°skew.

A 2.5 m wide off-road path is included along the following sections:

- Cotter Road east
- Cotter Road west
- Dunrossil Street

1.5 m wide paths have been included between the interchange and the proposed bus stops on Adelaide Avenue and adjacent to the development blocks.

As noted in Section 5.8, a footbridge overpass is proposed a the location where bus stops are proposed in between Kent/ Novar overpass and the interchange.

6.0 Road Reservation Corridors for Interchange Options

The road reserve boundary on the Brickworks development side is based on a number of discussions with the LDA/ EDD and a number of combinations of the different type of interchange arrangement and bus stop locations. These combinations have been reduced to four possible layouts. It should be noted that other combinations of the interchange type and bus stop locations may be possible, however, not explored in this study.

6.1 Layout Options

The four possible layouts generate two possible road reservation widths of 55 m and 48 mon Cotter Road adjacent to Brickworks development and they are included in Appendix B. These layouts are:

- Layout Option 1 - Elevated Roundabout Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass
- Layout Option 2 - Single Point Diamond Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)
- Layout Option 3 - Elevated Roundabout Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)
- Layout Option 4 – Diverging Diamond Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass

6.2 Brickworks Development Boundary

6.2.1 Road Reserve Boundary Adjacent to Realigned Cotter Road

The estimated total road reserve width mid-section on Cotter Road adjacent to Brickworks Development for Layout Option 1 to 3 is in the order of 55 m excluding the Local Street within Brickworks development. This road reserve width assessment is based on the following assumptions. Note that these assumptions, especially relating to services, will require discussions and confirmation with the relevant services authorities in the next stage of design.

- A 13m wide verge adjacent to North Curtin Horse Paddock development which consists of the following features:
    - → A provision of 5 m wide for future trunk utilities including a shared trench for telecommunications and a shared trench for gas and electrical.
    - → A typical arrangement for telecommunication shared trench is as follows:
        - o 4 x 100 mm diameter conduit for Telstra
        - o 2 x 100 mm diameter conduit for ICON
        - o 2 x 100 mm diameter conduit for NBNCo
        - o 2 x 100 mm diameter conduit for TransACT
        - o 2 x 100 mm diameter conduit for Optus
    - → A typical arrangement for gas and electrical shared trench is as follows:
        - o 225 mm diameter conduit for Gas
        - o 4 x 125 mm diameter conduit Electrical
    - → 2.5 m wide off-road path.
    - → 1.5 m wide clearance from the tree trunk to the edge of the off-road path.
    - → Future large trees in all verges and medians.

- → Minimum setback from the road reserve boundary to the building will be determined by the type and size of the large trees proposed in the verge.
- 9 m wide Cotter Road westbound.
- 13 m wide median between Cotter Road westbound and eastbound carriageway based on the following assumptions:
  - → Creating the boulevard effect.
  - → Future trees are offset to one side of the carriageway with barriers on one side of the median, to minimise the requirements of safety barriers on both sides of the median.
- 9 m wide Cotter Road eastbound.
- 11 m median between Cotter Road eastbound and future Local Street within Brickworks development based on the following assumptions regarding the future trees in this median:
  - → Trees located outside the clear zones
  - → Trees would have less than 1 m wide trunk diameter.
  - → Trees will be planted in a later stage and would have 1.5 m wide clearance to the edge of the off-road path adjacent to Cotter Road.

The estimated total road reserve width mid-section on Cotter Road adjacent to Brickworks Development for Layout Option 4 in this option is in the order of 48 m excluding the Local Street within Brickworks development. The difference between this option and the rest of the options is in the width of the median between Cotter Road westbound and eastbound carriageway is reduced to 6 m wide due to the following reasons:

- This option of interchange has a smaller footprint.
- Considering the location of Cotter Road/ Brickworks access and the required turning lanes at this intersection, a constant width of median from the interchange to the intersection is proposed.
- This option will require barriers on both sides of the median as the proposed large trees will be located within the clear zone for Cotter Road traffic.
- The location of the ramps are located further away from Adelaide Avenue, therefore, retaining some of Adelaide Avenue existing pavement is possible and incorporated in the documentation.

The typical section for the above layout options were provided to LDA/EDD and agreed that for the purpose of showing the possible boundary on Brickworks side, the wider road reserve boundary of 55 m is adopted.

6.2.2 Road Boundary Adjacent to Adelaide Avenue on-ramp

In the vicinity of the interchange, the layout of Option 4 provided a wider footprint in the vicinity of the northern facing ramps and has lesser impacts on the existing pavement on Adelaide Avenue. Thus, the layout of Option 4 has been adopted to set the boundary on the northern quadrant.

LDA/EDD requested to explore construction of a retaining wall on this northern quadrant in order to reduce the extent of fill embankment into the Brickworks Development. With retaining wall option, an easement of approximately 5 m from the retaining wall is proposed for maintenance access. The retaining wall option would appear to have the minimal impact to the Brickworks development compared to the fill embankment option.

6.3 North Curtin Horse Paddock Boundary

Based on the typical section included in Appendix B , a verge with of 13 m has been adopted to show the road reserve boundary notionally adjacent to North Curtin Horse Paddock Boundary.

7.0 Bridgeworks

Barriers and throw screens of the preferred option are assumed to be detailed in the next stage of design.

7.1 Elevated Roundabout Interchange Option

The Mint Interchange "Elevated Roundabout" included in Layout Option 1 and 3 contains two bridges, namely the southern bridge and the northern bridge.

7.1.1 Southern Bridge

The southern bridge consists of a two span voided slab superstructure supported on a central pier and reinforced soil walled abutment. The overall length of the bridge measured along the control line is 48 m consisting of a 21 m and 27 m span, the vertical clearance under the bridge over the proposed dual carriageways is a minimum of 5.4 m. The superstructure is curved in plan to match the road geometry. The deck is 17.7 m wide, made up to two 4.1 m traffic lanes shoulders catering for on road cycling and sight distances and a separated 3 m wide footpath. Twin rail plus half height concrete medium performance traffic barriers are provided on the inside edge of the carriageway and between the carriageway and the footpath. A pedestrian railing and safety screen is provided on the outside edge of the footpath.

The superstructure consists of a slender 1050 mm deep post tensioned voided slab with 1500 mm cantilevers. The pier consists of a single 1500 mm diameter column supported on a pilecap and four 900 mm diameter bored piles. The abutments consist of a simple headstock supported on bored piles. The embankment fill is supported by a reinforced soil wall running parallel to the proposed realignment of the Yarra Glen dual carriageways.

The bridge will be constructed using cast insitu methods. The vertical clearance over the dual carriageways of the Yarra Glen provides adequate headroom to place falsework over the existing traffic to construct the bridge. Adequate room is available in the median to safely construct the central pier.

7.1.2 Northern Bridge

The northern bridge is similar to the southern bridge in configuration consisting of two span curved voided slab bridge. The bridge has a length measured along the control line of 46.6 m consisting of two approximately equal spans. The vertical clearance under the bridge over the proposed realignment of the Yarra Glen dual carriageways is a minimum of 7.9 m. The superstructure is curved in plan to match the road geometry. The deck is 14.2 m wide, made up to two 4.1 m traffic lanes plus shoulders accommodating on road cycling and sight distance requirements. Twin rail plus half height concrete medium performance traffic barriers are provided on both edges of the carriageway.

The superstructure consists of a slender 1050 mm deep post tensioned voided slab with 1500 mm cantilevers. The central pier consists of a single 1500 mm diameter column supported on a pilecap and four 900 mm diameter bored piles. The abutments consist of a simple headstock supported on bored piles. The embankment fill is supported by a reinforced soil wall running parallel to the proposed realignment of the Yarra Glen dual carriageways

7.1.3 Staging

The northern bridge alignment clashes with the existing Cotter Road Flyover. Therefore the southern bridge will need to be constructed first with the flyover traffic temporarily diverted onto the southern bridge. The flyover can then be demolished and the new northern bridge constructed over the Yarra Glenn dual carriageways in a similar manner to the southern bridge.

7.2 Single Point Diamond Interchange Arrangement

The Mint Interchange "Single Point Diamond Interchange" included in Layout Option 2 contains one large bridge.

The bridge consists of a two span super T arrangement supported on a central blade wall pier. The length of the bridge is 45 m consisting of two approximately equal spans. The width of the deck is 80 m to accommodate the required turning movements of the interchange. To reduce the overall width of the bridge, small triangular flares are provided on the four corners.

The superstructure consists of 1200 mm deep precast super T girders with a 200 mm thick insitu deck slab. The pier consists of a blade wall section supported on 900 mm diameter bored piles. The abutments consist of a simple headstock supported on bored piles. The embankment fill is supported by a reinforced soil wall running parallel to the proposed realignment of the Yarra Glen dual carriageways

The bridge can be built utilizing conventional methods with the precast girder being placed by crane during overnight road possessions. The remainder of the deck can be completed without impacting the Yarra Glen carriageway. There is adequate room in the existing median to safely construct the central pier.

The interchange bridge is to the south and clear of the existing Cotter Road Flyover that will be demolished after the construction of the new interchange.

7.3 Diverging Diamond Interchange Arrangement

The Mint Interchange "Diverging Diamond Interchange" included in Layout Option 4 contains a single two span bridge.

The bridge consists of a two span super T arrangement supported on a central blade wall pier. The length of the bridge is 45 m consisting of two approximately equal spans. The width of the deck is 35 m to accommodate the required lane configuration of the interchange. The bridge cross section accommodates 4 traffic lanes, a wide median and shared path on the south western side.

The superstructure consists of 1200 mm deep precast super T girders with a 200 mm thick insitu deck slab. The pier consists of a blade wall section supported on 900 mm diameter bored piles. The abutments consist of a simple headstock supported on bored piles. The embankment fill is supported by a reinforced soil wall running parallel to the proposed realignment of the Yarra Glen dual carriageways. Median performance barriers and throw screens are provided on both edges of the bridge.

The bridge can be built utilizing conventional methods with the precast girder being placed by crane during overnight road possessions. The remainder of the deck can be completed without impacting the Yarra Glen carriageway. There is adequate room in the existing median to safely construct the central pier.

The interchange bridge is to the south and clear of the existing Cotter Road Flyover that will be demolished after the construction of the new interchange.

8.0 Public Utilities

The existing public utilities discussed in this section are based on the , Dial-Before-You- Dig information.

The existing public utilities impacted by the proposed works include:

8.1 Stormwater Drainage

This infrastructure is limited to the road reserve and it is predominately related to road surface drainage and its collector system.

Adjustments will be required to this infrastructure to suit the new arrangements for the interchange and associated works.

8.2 Sewerage

Sewer connection to the Mint Playing fields toilet block from the network near Denison Street.

The Cotter Road East extension will impact on the existing toilet block requiring its relocation and the consequent adjustment of the sewer connection.

8.3 Water Supply

Water connection to the Mint Playing fields toilet block from the network near Denison Street.

The Cotter Road East extension will impact on the existing toilet block requiring its relocation and the consequent adjustment of the water supply connection.

Existing150 mm diameter water mains at the Cotter Road/Denison Street and the Kent Street/Denison Street revised intersection arrangements will be impacted by the proposed works.

8.4 Electrical

Mint Interchange/Denison Street

ActewAGL's infrastructure in the area is limited to street lighting along the Adelaide Avenue and a high voltage overhead power line which crosses Adelaide Avenue from Deakin to the southern side of the Cotter Road.

The new interchange will require the relocation of the overhead power line between Denison Street and the Lady Denman Drive intersection.

Street lighting will require adjustment and extension to suit the new interchange layout.

Kent Street/Adelaide Avenue Off-Ramp and Denison Street/Kent Street Intersections

ActewAGL's infrastructure in the area is limited to street lighting along Kent Street/Novar Street and Denison Street and a high voltage overhead power line which crosses Adelaide Avenue from Deakin to Yarralumla immediately west of the Kent Street/Novar Street bridge.

The revised intersection will require the relocation of the high voltage overhead power line and street lighting to suit the new interchange layout.

8.5 Communications

Telstra

Telstra has optic fibre cables crossing Adelaide Avenue immediately east of the Kent Street/Novar Street bridge and along Kent Street, Novar Street (east side) and Denison Street (south side).

There is a cable crossing beneath existing Cotter Road, in close proximity of the proposed four way intersection of Brickworks development and Cotter Road. There is communication running both sides of the verge west of the crossing and on the northern verge east of the crossing.

Those cables located in Kent Street and the proposed four way intersection of Brickworks development and Cotter Road will potentially be impacted by the intersection modifications.

No cables are indicated on Telstra's asset mapping within the area of the Mint Interchange.

Optus

Optus cabling as indicated on their asset mapping appears to be located with Telstra's assets along Kent street and Novar Street.

ICON

There is an existing ICON that runs across North Curtin Horse Paddock, continues along the southern verge of Cotter Road and crosses Cotter Road towards the Brickworks development site. ICON indicated that there would be future assets proposed as part of the development in North Curtin Horse Paddock. These assets are included in the appendices.

The assessment of impacts to the existing ICON assets, considering future assets, will need to be undertaken in the next stage of design.

AAPT

There is an AAPT/ PWT asset that runs west along Cotter Road, west of Lady Denman Drive intersection. This run continues south east and across Yarra Glen closer to the southern end of the project site. The affected asset on Yarra Glen would most likely be within the project site. It is anticipated that minor design level alteration in this area as works are matching with the existing pavement. Therefore, no allowance of protection nor relocation for this asset has been made.

TransACT

TransACT has cables located along the western side of Kent Street which cross Adelaide Avenue immediately west of the Kent Street/Novar Street bridge to Yarralumla.

8.6 Gas

A 350 mm diameter steel main is located along the Adelaide Avenue off-ramp to Kent Street and along the southern side of Denison Street.

It appears from ActewAGL's asset drawings that a 63 mm diameter PE connects to the 350 mm diameter steel main via a 110mm PE and crosses Adelaide Avenue to the west side of Novar Street. The 110 mm diameter PE main continues south, crossing Kent Street south of Denison Street/ Kent Street intersection and continues along eastern verge along Kent Street.

The gas mains within the vicinity of the Adelaide Avenue off-ramp/Kent Street/Denison Street intersection modifications will potentially be impacted by the intersection modifications.

The 350 mm diameter steel main in Denison Street will need to be considered in the development of the designs for the Cotter Road East intersection with Denison Street.

9.0 Other Matters

9.1 Environmental Impacts

No environmental impact assessments have been undertaken for this feasibility study. These studies will need to be undertaken at a design development stage.

Observations on site indicate that the primary vegetation disturbance will be remnant pine copses in all areas of the works.

There are scattered individual Lombardy poplar trees located on the northern edge of the Mint Oval which will also be impacted by the proposal.

9.2 Impacts on Public Facilities

Measures have been undertaken to minimise the impacts on the Mint Oval of the Cotter Road East extension to Denison Street through the use of a reinforced earth retaining wall along the northern side of the oval.

However, the existing toilet block will be required to be demolished and re-built clear of the Cotter Road East roadworks. The opportunity should be taken to reconstruct the toilet block closer to Denison Street to make the facility more accessible and secure for users.

9.3 Noise Impacts

No studies have been undertaken to assess the impacts of noise resulting from changes to the infrastructure and hence should be considered as the design are further developed.

10.0 Construction Staging

The preliminary proposal for construction sequence for any of the options is similar to staging documented in the Concept Design, 2011:

10.1 Stage 1

- Temporarily relocate City – Woden off-road cyclepath clear of Cotter Road East works and southbound carriageway side track which will require encroachment into the northern and western flank of the Mint Oval.
- Construct:
  - → Widened pavement on Adelaide Avenue, clear of the existing ramps.
  - → South facing ramps, southbound ramp partially.
  - → For the elevated roundabout interchange option, construct the southern roundabout bridge.
  - → For the Single Point Diamond or Diverging Diamond Interchange, the bridge structure can be constructed fully as part of this stage.
  - → Cotter Road West.
  - → Deakin Link including City-Woden cycleway underpass.
  - → Cotter Road East/Denison intersection.
  - → Kent Street/ Denison Street/ Adelaide Avenue off-ramp revised intersection.
  - → Temporary connection for Cotter Road off-ramp to future interchange.
- Maintain existing traffic conditions on Cotter Road flyover and eastbound Cotter Road to Adelaide Avenue on-ramp.

10.2 Stage 2

- Connect Cotter Road off-ramp to the interchange, via Denison Street and deviate Cotter Road traffic to southern leg of roundabout.
- Deviate city bound traffic from Cotter Road onto Dudley Street for the elevated roundabout option and onto the interchange and Denison Street for the Single Point Diamond or Diverging Diamond Interchange option.
- Deviate southbound Adelaide Avenue traffic to new pavement on Adelaide Avenue.
- Demolish existing Cotter Road flyover.
- Construct:
  - → North facing reinforced earth retaining walls.
  - → North facing ramps.
  - → Northern roundabout bridge.
  - → Complete southbound on-ramp
- Maintain existing traffic conditions on Cotter Road flyover and eastbound Cotter Road to Adelaide Avenue on-ramp.

10.3 Stage 3

- Full operation of the interchange
- Construction of works that can be included as part of this stage are:
  - → New median located bus station
  - → Pedestrian footbridge is this option is opted.

11.0 Assessment of Probable Construction Costs

The general assumptions of the assessment of the probable costs are:

1. Allowances are made on the following items:
   - → 15% for Design Management Fees.
   - → 40% for contingencies.
   - → $350,000 to relocate the existing high voltage overhead power line along Cotter Road West and $100,000 along Deakin Link.
   - → $1,125,000 for the demolition of the existing Cotter Road flyover.
   - → $875,000 for the construction of City-Woden off-road cycle path underpass.
2. No allowance of the following items:
   - → Removal of unsuitable material.
   - → Relocation and/ protection of existing services except electrical services.
   - → The construction of local road adjacent to Cotter Road West.
   - → Installation of the shared trenches, local services and plantings shown in the typical cross section.
   - → Installation of bus stops and shelters in the median of Adelaide Avenue or the connecting bridge link from Deakin to Yarralumla.
   - → Installation of bus stops and shelters on the verge of Adelaide Avenue.
   - → Realignment of Kent Street/ Adelaide Avenue off-ramp.
3. Preliminaries are assumed to be in the order of 10% of the estimated construction costs.
4. Landscaping works are assumed to be in the order of 5% of the estimated construction costs.
5. Streetlighting on Adelaide Avenue is assumed to be relocated.
6. The estimation of construction costs are based on the following:
   - → Bridge construction is based on per m^2 of bridge area of similar structure:
     - o $3,500 per m2 of bridge area for an elevated roundabout interchange option.
     - o $2,600 per m2 of bridge area for a single point diamond interchange option.
     - o $2,800 per m2 of bridge area for a diverging diamond interchange option.
   - → Pavement construction is based on $300 per m^2 of pavement area and a full depth asphalt pavement composition is assumed.
   - → Extends from western link into the Brickworks (including the intersection) to Denison Street and Adelaide Avenue/Yarra Glen ramps and off-road cycle path adjustments.

Table 1:Probable of Costs – Summary

Layout Options	Cotter Road	Denison Street	Interchange	Adelaide Avenue	**Total cost**
Layout Option 1 – Elevated Roundabout Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass	$21,500,000.00	$13,300,000.00	$20,400,000.00	$38,800,000.00	**$94,000,000.00**
Layout Option 2 - Single Point Diamond Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)	$21,500,000.00	$13,300,000.00	$30,700,000.00	$38,800,000.00	**$104,300,000.00**
Layout Option 3 - Elevated Roundabout Interchange with Median Bus Station and Bus Stops on the Verge of Adelaide Avenue (approximately half way between Kent/ Novar overpass and the proposed interchange)	$21,500,000.00	$13,300,000.00	$20,400,000.00	$38,800,000.00	**$94,000,000.00**
Layout Option 4 - Diverging Diamond Interchange with Kent/Novar Median Bus stop and Bus Stops on the Verge of Adelaide Avenue west of Kent/Novar overpass	$20,400,000.00	$13,200,000.00	$19,900,000.00	$30,300,000.00	**$83,800,000.00**

LDA/ EDD requested for the items such as pavement and bridges to be tabulated. It should be noted that the rates included in the estimation of probable construction costs do not include contingency, design management fee and GST.

Table 2: Estimated quantities of some key items

Item	Rate/ m^2	Layout Option 1		Layout Option 2		Layout Option 3		Layout Option 4	
		Quantity	Total	Quantity	Total	Quantity	Total	Quantity	Total
Pavement (Area)	$300	62,700	$18,810,000	63,400	$19,020,000	62,500	$18,750,000	60,300	$18,090,000
Bridge - Elevated Roundabout (Area)	$3,500	1,400	$4,900,000	-	-	1,400	$4,900,000	-	-
Bridge - Single Point Diamond (Area)	$2,600	-	-	3,600	$9,400,000	-	-	-	-
Bridge - Diverging Diamond (Area)	$2,800	-	-	-	-	-	-	1,600	$4,500,000
Retaining walls (Area)	$700	6,900	$4,830,000	6,900	$4,830,000	6,900	$4,830,000	4,000	$2,800,000

LDA/EDD requested AECOM to explore the possible installation costs of additional retaining walls on each quadrant of the interchange attempting to minimise the footprint of the earthworks and maximising the developable area in each quadrant. Refer to Section 6.0 for the discussions on the road reserve boundary within the study area. These probable costs are tabulated below and the assumptions of these costs are:

- Additional retaining walls are applicable to any of the options.
- No contingency, Design Management Fees nor GST is included in the costs.
- Rates are based on per m2 area of retaining wall.
- Area of retaining wall is based on the average height and the assumption of possible length of retaining wall for each quadrant is included in the table.

Table 3: Estimated quantities of some key items excluding contingency, GST and Design Management Fees

Item	Rate/m2	Face area of walls	Total
Additional retaining wall to contained earthworks on Brickworks development side from Cotter Road/ Brickworks access to Kent/ Novar Street overpass (north eastern quadrant). Assume that the average height of the retaining wall is in the order of 3.5m and about 750m long (m2)	$700	2,700	$1,890,000
Additional retaining wall to contained earthworks on Block 1 Section 75 (south eastern quadrant). Assume that the average height of the retaining wall is in the order of 3m and about 450m long (m2)	$700	1,400	$980,000
No additional retaining wall to contained earthworks on the Mint side (south western quadrant) as retaining wall is already proposed.	$700	-	-
Additional retaining wall to contained earthworks on North Curtin Horse Paddock (north western quadrant). Assume that the average height of the retaining wall is in the order of 3.5m and about 600m long (m2)	$700	2,100	$1,470,000

Appendix A

Traffic Report

AECOM

Mint Interchange

Land Development Agency/ Economic Development Directorate

21 December 2012

Pre-Feasibility Study

Intersection Modelling Results

Pre-Feasibility Study

Intersection Modelling Results

Prepared for

Land Development Agency/ Economic Development Directorate

Prepared by

AECOM Australia Pty Ltd
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

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AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

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Quality Information

Document Pre-Feasibility Study

Ref 60276240

Date 21 December 2012

Prepared by Rhys Davies

Reviewed by Tim Rampton

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	14-Dec-2012	Pre-Feasibility Design Report	Jane Peters Associate Director	
1	18-Dec-2012	Pre-Feasibility Design Report Final	Jane Peters Associate Director	

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Executive Summary

AECOM were engaged by the LDA as part of the pre-feasibility Mint Interchange Study to undertake a comprehensive traffic assessment for the following intersections:

- Cotter Road / Yarra Glen / Adelaide Avenue Interchange;
- Deakin Link / Denison Street; and
- Cotter Road / Brickworks Access.

None of the intersections considered as part of this analysis were existing and therefore numerous layouts and configurations were tested to optimise performance and efficiency. This section of the report outlines the base data and modelling methodology that were utilised to analyse the various layouts under consideration.

The analysis of the various intersection layouts indicated the following conclusions:

- The analysis undertaken by AECOM indicates that all the intersection layouts tested, apart from a priority intersection layout at the Deakin Link/ Denison intersection, are feasible at this stage of the study based on the projected 2031 traffic volumes provided by the ACT Government and its consultant SMEC;
- Of all the intersection layouts tested, the roundabout layouts offer the most efficient solution for the general traffic movements in terms of minimising delay and queuing at the intersections;
- Whilst the roundabouts offer the best solution for traffic, they do not offer the best solution to facilitate the movements of pedestrian and cyclist along the corridor and given the pedestrian and cycle demands are unknown at present its difficult to suggest a roundabout is the best solution;
- Whilst the signalised layouts do not operate as efficiently as the roundabout options they do operate at a satisfactory LoS and they all offer signalised and controlled pedestrian crossing facilities; and
- In all modelling exercises all intersections operated with minimum delay and queuing during the AM peak period, whilst the PM peak experienced greater delays and queuing as a result of conflicting movements.

As part of the work undertaken by AECOM a number of recommendations have been developed to facilitate the development of a brief for the feasibility stage of the project, the recommendations include:

- All intersections have been analysed in isolation and no corridor assessment has been completed – In order to fully understand the operation of the corridor and the interaction between the intersections along the corridor it is recommended that a Micro-simulation model of the network should be developed;
- The impact of the brickworks development has not been fully assessed as part of this study and the micro-simulation should include the brickworks development to assess the impacts of any rat running
- There is an ambition to develop a transport interchange in the median of Adelaide Avenue which will provide a segregated busway link to the City Centre. Therefore, as part of the micro simulation assessment consideration should be given to the inclusion of the bus interchange within the model and a comprehensive assessment of pedestrian and cycle interaction with vehicles – the micro simulation package chosen for this assessment should have the ability to assess and capture this interaction; and
- Consideration of the urban form / environment across the area to assist with the development of a bus interchange and the promotion of the walking and cycling linkages between the areas of the Brickworks and Deakin – this is important in promoting the bus as a mode of transport for local residents and workers and will assist in local traffic reduction and congestion along Adelaide Avenue

1.0 Introduction

The Land Development Agency (LDA)/ Economic Development Directorate (EDD) engaged AECOM in August 2012 to investigate and test options for the reconfiguration of the existing grade-separated interchange at Cotter Road, Adelaide Avenue and Yarra Glen as part of the Canberra Brickworks precinct at Yarralumla.

The interchange is located at the junction of Cotter Road and Adelaide Avenue/Yarra Glen road systems. For the purposes of nomenclature this report uses the following:

- The name 'Mint Interchange' when the actual interchange location is referred to.
- Deakin Link for the works on Cotter Road East between the interchange and Denison Street.
- Cotter Road West for the works west of the interchange.
- Brickworks access/ Cotter Road for the future four way intersection closer to the western end of the project site.

The prefeasibility study for the interchange tested the geometry in terms of the required traffic, bus and pedestrian movements, road design standards, and existing physical constraints.

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2.0 Data Collection and Methodology

2.1 Introduction

For the purpose of this study, intersection analysis was undertaken on the following intersections:

- Cotter Road / Yarra Glen / Adelaide Avenue Interchange;
- Deakin Link / Denison Street; and
- Cotter Road / Brickworks Access.

None of the intersections considered as part of this analysis were existing and therefore numerous layouts and configurations were tested to optimise performance and efficiency. This section of the report outlines the base data and modelling methodology that were utilised to analyse the various layouts under consideration.

2.2 Data Collection

2.2.1 EMME/2 and Paramics

The ACT strategic EMME/2 transport model was the primary source of traffic data for the 2031 future year analysis. The most recent EMME/2 model includes:

- The future Mint Interchange;
- The Duplication of Cotter Road; and
- The future Deakin Link / Denison Street intersection.

The current EMME/2 model does not include any of the future Brickworks development and associated land use and therefore does not include the future access arrangements. However, SMEC, as part of their analysis for the future Brickworks development, have developed a Paramics traffic model which included the future access arrangements and associated traffic flows.

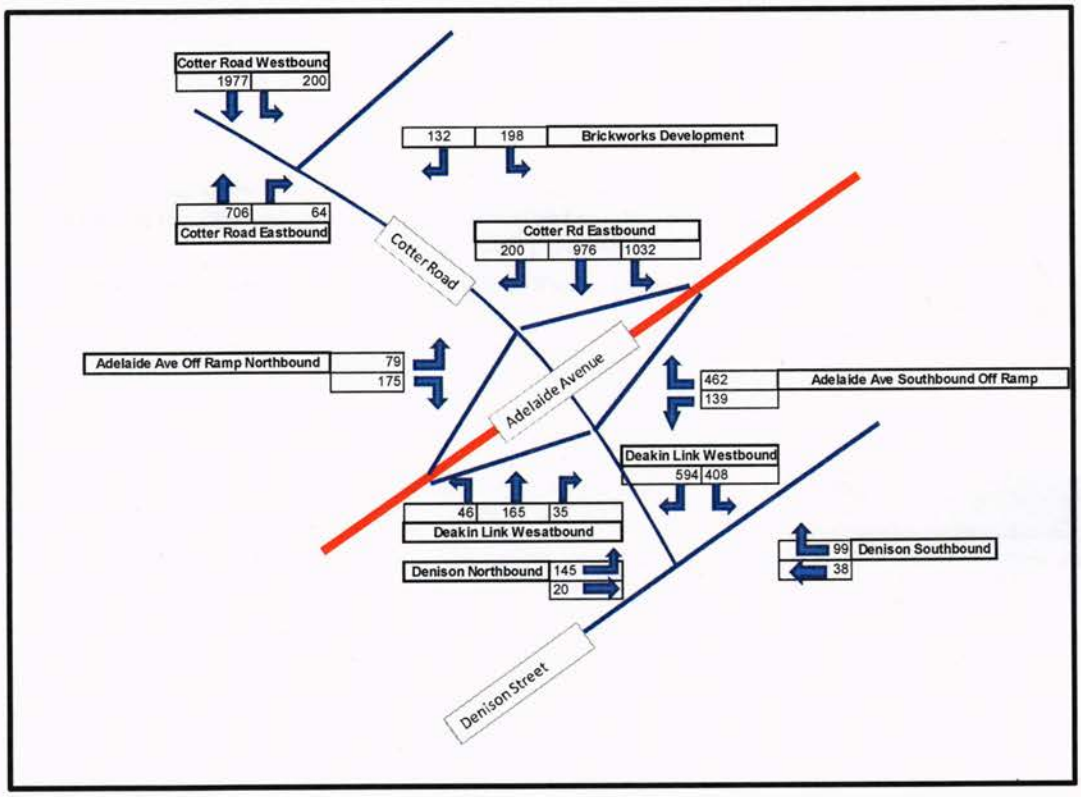
Traffic flows were initially provided to AECOM from the SMEC EMME/2 model and Paramics model which indicated high volumes of traffic along Cotter Road and large volumes of traffic heading through the Mint Interchange which were largely the result of the development in the Molonglo area. The SMEC Paramics model also indicated high volumes of traffic entering and exiting the proposed Brickworks development which further increased the flows along Cotter Road and at the Mint Interchange.

Following lengthy discussions between AECOM, SMEC and the ACT Government AECOM were asked to revise the flows based on high level trip generation calculations for the Brickworks and the ACT Government EMME/2 model traffic flows.

2.2.2 Agreed Flows

Figure 1 illustrates the final flows that were agreed between AECOM and the ACT Government and best represented the forecasted flows for 2031.

Figure 1 **Agreed flows between the ACT Government and AECOM**



2.3 Methodology

2.3.1 Sidra

Sidra is an intersection modelling tool that is regularly used to assess intersection performance across Australia. The performance of an intersection is defined in terms of Level of Service (LoS) that is experienced by the traffic using the intersection. **Table 1** outlines the definitions for the various LoS which is determined by the level of delay experienced by vehicles at the intersection.

Table 1 **LoS definition table**

Level of Service	Average Delay / Vehicle (sec/veh)	Traffic Signals, Roundabouts	Give Way and Stop Signs
A	Less than 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

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The LoS at an intersection is determined by the average delay experience by vehicles travelling through the intersection. In the ACT, if the intersection is operating at a LoS D or higher the intersection is considered to be operating at a satisfactory level.

For the purpose of this analysis the Sidra Modelling tool will be used to assess both signalised and unsignalised intersection layouts.

2.3.2 LinSig

LinSig is a similar modelling tool to Sidra however has the ability to model multiple signalised intersections to optimise signal timings to provide the optimum LoS. The LoS is measured by LinSig as the definitions outlined in **Table 1** which remains consistent with Sidra for comparison purposed.

For the purpose of this analysis the LinSig Modelling tool will be used to assess only signalised intersections layouts that are in close proximity.

3.0 Results

3.1 Introduction

This section outlines the results of the modelling exercises that were undertaken on the various intersection layouts considered as part of this pre-feasibility study. Primarily the analysis focused on:

- Mint Interchange – three different layouts;
- Denison / Deakin Link – two different layouts; and
- Cotter Road / Brickworks access – two different layouts.

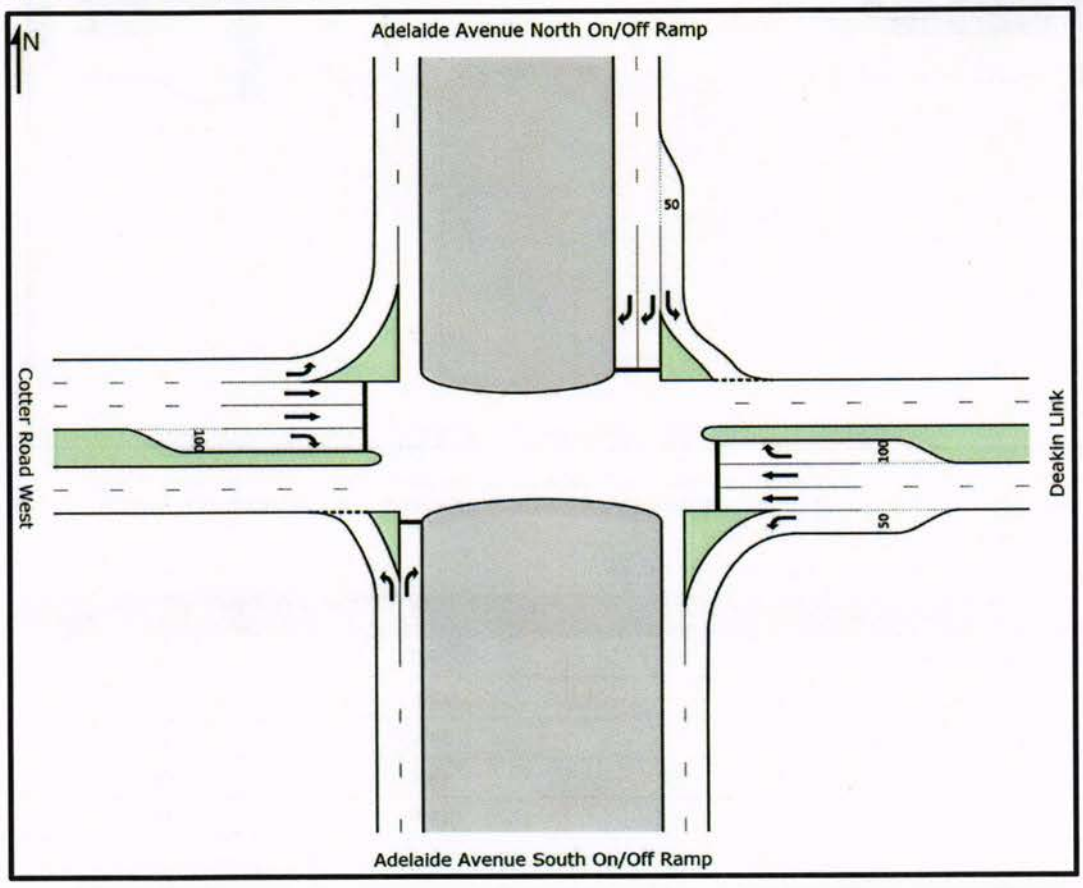
The results outlined within this chapter provide an overview of the intersection operation of individual intersection layouts and no combined or corridor testing has been undertaken at this stage.

3.2 Mint Interchange

3.2.1 Single Point Signalised Diamond Interchange

The first configuration that was investigated was a Single Point Diamond Interchange layout which is of similar configuration to the Parkes Way / Kings Avenue intersection. **Figure 2** illustrates the proposed layout for the interchange that was modelled in Sidra.

Figure 2 Intersection Layout / Configuration in Sidra



The intersection would operate as one large signalised intersection with three phases which includes diamond turns for movements coming from the off ramps and vehicles going to the on-ramps for Adelaide Avenue. Due to

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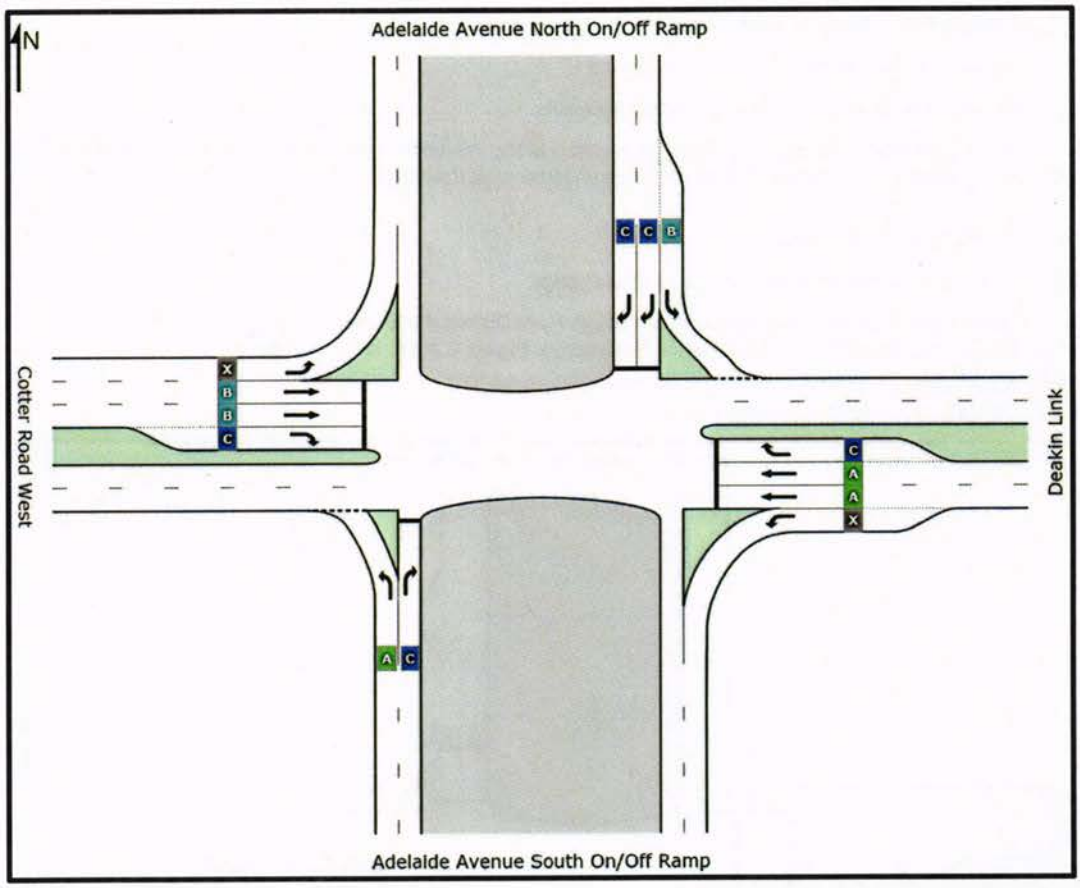
the heavy right turn movements from Adelaide Avenue north off ramp during the PM peak there is a requirement for two right turn lanes to provide sufficient capacity to minimise queuing and delays. There is also a need for a continuous left turn lane from Cotter Road turning onto Adelaide Avenue northbound due to the large volume of traffic in the AM peak. **Figure 3** provides an overview of the observed LoS for each lane during the AM peak period.

Figure 3 Summary of LoS by lane during the AM peak



The initial modelling results indicate that in general all lanes across the intersection will operate at a LoS C or higher during the AM peak period. **Table 2** provides a summary of the intersection operation by arm and the overall average during the AM peak period.

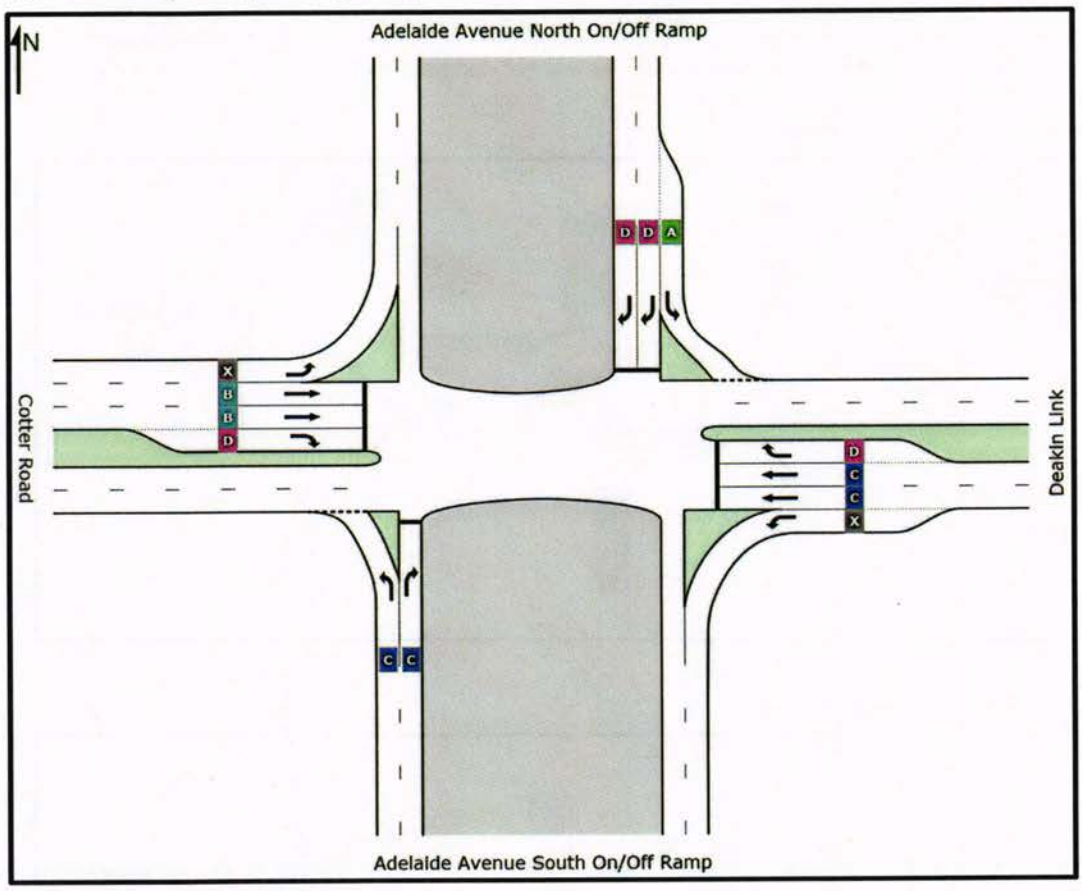
Table 2 AM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Adelaide Avenue South	C	29.0	32
Deakin Link	A	14.1	10
Adelaide Avenue North	C	34.9	48
Cotter Road	B	15.4	90
Overall	**B**	**19.9**	**90**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS B during the AM Peak period. Average delays across the intersection will be approximately 20s with queue lengths not exceeding 90m.

Figure 4 illustrates that operation of the intersection by lane during the PM peak period.

Figure 4 Summary of LoS by lane during the PM peak



The sidra analysis indicates that all the movements will operate at a LoS D or higher during the PM peak period. Whilst this is slightly less efficient than the AM peak the intersection is still operating at a satisfactory LoS. **Table 3** provides a summary of the intersection operation by arm and the overall average during the PM peak period.

Table 3 PM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Adelaide Avenue South	C	29.2	377
Deakin Link	C	32.8	144
Adelaide Avenue North	C	42.4	145
Cotter Road	A	14.4	20
Overall	**C**	**32**	**145**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS C during the PM Peak period. Average delays across the intersection will be approximately 32s with queue lengths not exceeding 145m both of which are a slight increase on the AM peak results however still at a satisfactory level.

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3.2.2 Diverging Diamond Interchange

The diverging diamond interchange was assessed using the LinSig modelling tool. As LinSig is a tool that can optimise multiple signalised intersections in close proximity the analysis was completed of the proposed Mint Interchange and the Deakin link / Denison Street intersection in a single model layout. **Figure 5 and Figure 6** illustrate the intersection layout and signal phasing that was modelled within the LinSig model for the AM and PM peak periods.

Figure 5 AM layout and Signal Phasing

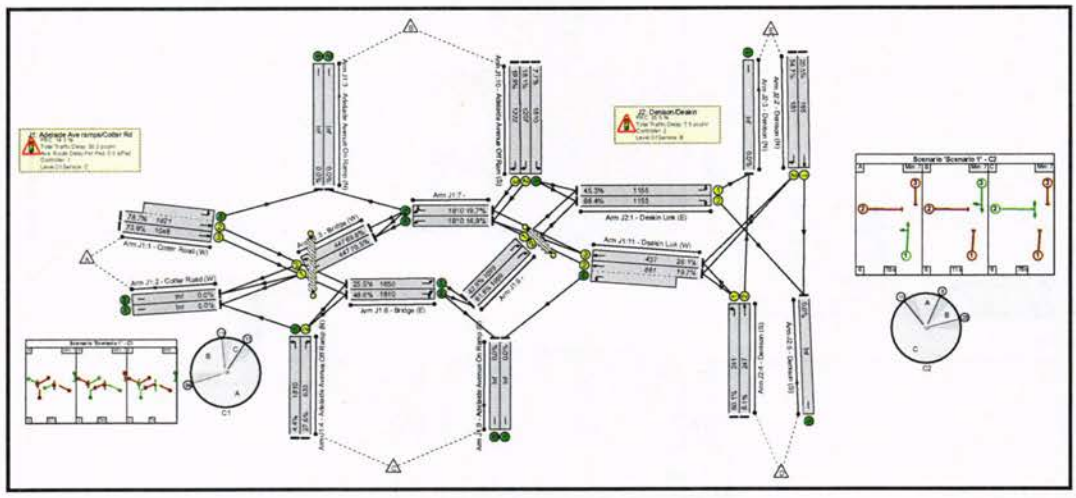


Figure 6 PM layout and Signal Phasing

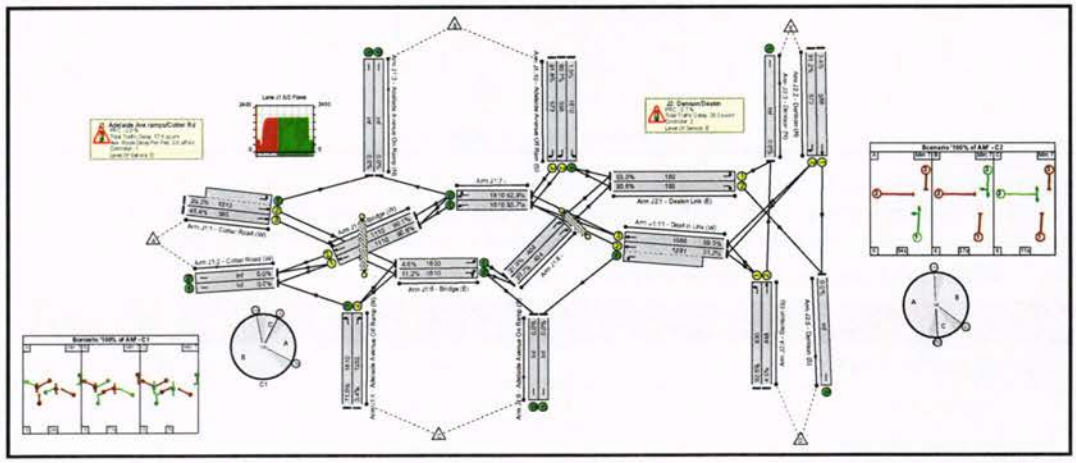


Table 4 and Table 5 illustrate the results from the AM and PM peak period modelling runs.

Table 4 LoS on each arm during the AM peak period

Item	Lane Description	Level Of Service
Network	-	**C**
J1: Adelaide Ave ramps/Cotter Rd	-	**C**
1/2+1/1	Cotter Road (W) Left Ahead	A
1/3	Cotter Road (W) Ahead	C
2/1	Cotter Road (W)	-
2/2	Cotter Road (W)	-
3/1	Adeliade Avenue On Ramp (N)	-
3/2	Adeliade Avenue On Ramp (N)	-
4/1	Adelaide Avenue Off Ramp (N) Left	-
4/2	Adelaide Avenue Off Ramp (N) Right	C
5/1	Bridge (W) Ahead	D
5/2	Bridge (W) Ahead	D
6/1	Bridge (E) Ahead	-
6/2	Bridge (E) Ahead Right	-
7/1	Ahead	-
7/2	Right Ahead	-
8/1	Right	B
8/2	Right	B
9/1	Adelaide Avenue On Ramp (S)	-
9/2	Adelaide Avenue On Ramp (S)	-
10/1	Adelaide Avenue Off Ram (S) Left	-
10/2	Adelaide Avenue Off Ram (S) Right	A
10/3	Adelaide Avenue Off Ram (S) Right	A
11/2+11/1	Deakin Link (W) Ahead Left	D
11/3	Deakin Link (W) Ahead	E
Ped Link: P1	1	-
Ped Link: P2	2	-
J2: Denison/Deakin	-	**B**
1/1	Deakin Link (E) Left	A
1/2	Deakin Link (E) Right	A
2/1	Denison (N) Ahead	E
2/2	Denison (N) Right	E
3/1	Denison (N)	-
4/1	Denison (S) Left	E
4/2	Denison (S) Ahead	D
5/1	Denison (S)	-

Table 5 LoS on each arm during the PM peak period

Item	Lane Description	Level Of Service
Network	-	**D**
J1: Adelaide Ave ramps/Cotter Rd	-	**D**
1/2+1/1	Cotter Road (W) Left Ahead	A
1/3	Cotter Road (W) Ahead	D
2/1	Cotter Road (W)	-
2/2	Cotter Road (W)	-
3/1	Adeliade Avenue On Ramp (N)	-
3/2	Adeliade Avenue On Ramp (N)	-
4/1	Adelaide Avenue Off Ramp (N) Left	-
4/2	Adelaide Avenue Off Ramp (N) Right	A
5/1	Bridge (W) Ahead	D
5/2	Bridge (W) Ahead	D
6/1	Bridge (E) Ahead	-
6/2	Bridge (E) Ahead Right	-
7/1	Ahead	-
7/2	Right Ahead	-
8/1	Right	C
8/2	Right	C
9/1	Adelaide Avenue On Ramp (S)	-
9/2	Adelaide Avenue On Ramp (S)	-
10/1	Adelaide Avenue Off Ram (S) Left	-
10/2	Adelaide Avenue Off Ram (S) Right	E
10/3	Adelaide Avenue Off Ram (S) Right	E
11/2+11/1	Deakin Link (W) Ahead Left	B
11/3	Deakin Link (W) Ahead	C
Ped Link: P1	1	-
Ped Link: P2	2	-
J2: Denison/Deakin	-	**E**
1/1	Deakin Link (E) Left	D
1/2	Deakin Link (E) Right	E
2/1	Denison (N) Ahead	C
2/2	Denison (N) Right	E
3/1	Denison (N)	-
4/1	Denison (S) Left	E
4/2	Denison (S) Ahead	C
5/1	Denison (S)	-

The model results indicate that during the AM peak the majority of traffic lanes operate above a satisfactory LoS at the Mint Interchange with only one lane Deakin Link (W) Ahead operating at a LoS E. Despite this the intersection is operating at a LoS C during the AM peak period. Whilst at the Deakin / Denison Intersection there are a number of lanes operating at a LoS E however the intersection continues to operate at a LoS B overall during the AM peak period.

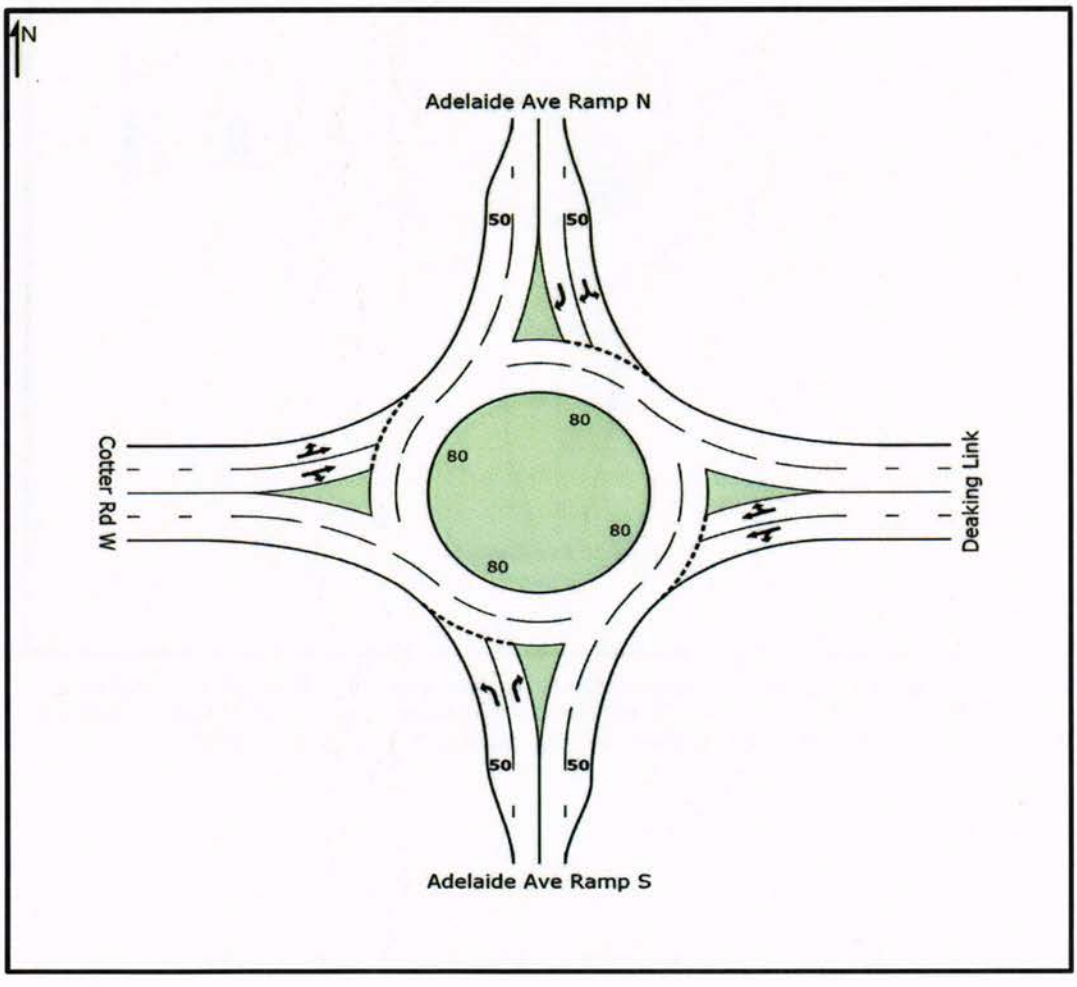
The PM peak modelling results indicate that the traffic exiting the Adelaide Avenue off ramp southbound would experience a LoS E whilst all other lanes would operate either at or above a satisfactory LoS. Overall the interchange would operate at a LoS D during the PM peak period. Whilst at the Deakin / Denison Intersection a number of lanes would operate at a LoS E which results in the intersection operating at a LoS E overall during the AM peak period.

The modelling undertaken therefore indicates that during the AM peak both intersection would provide a good LoS and operate efficiently with minimal delays and queuing. However, during the PM peak, whilst the Mint Interchange would operate at an acceptable LoS D the Deakin /Denison intersection would operate at a LoS E which would result in delays and queuing for vehicles at the intersection.

3.2.3 Standard Roundabout

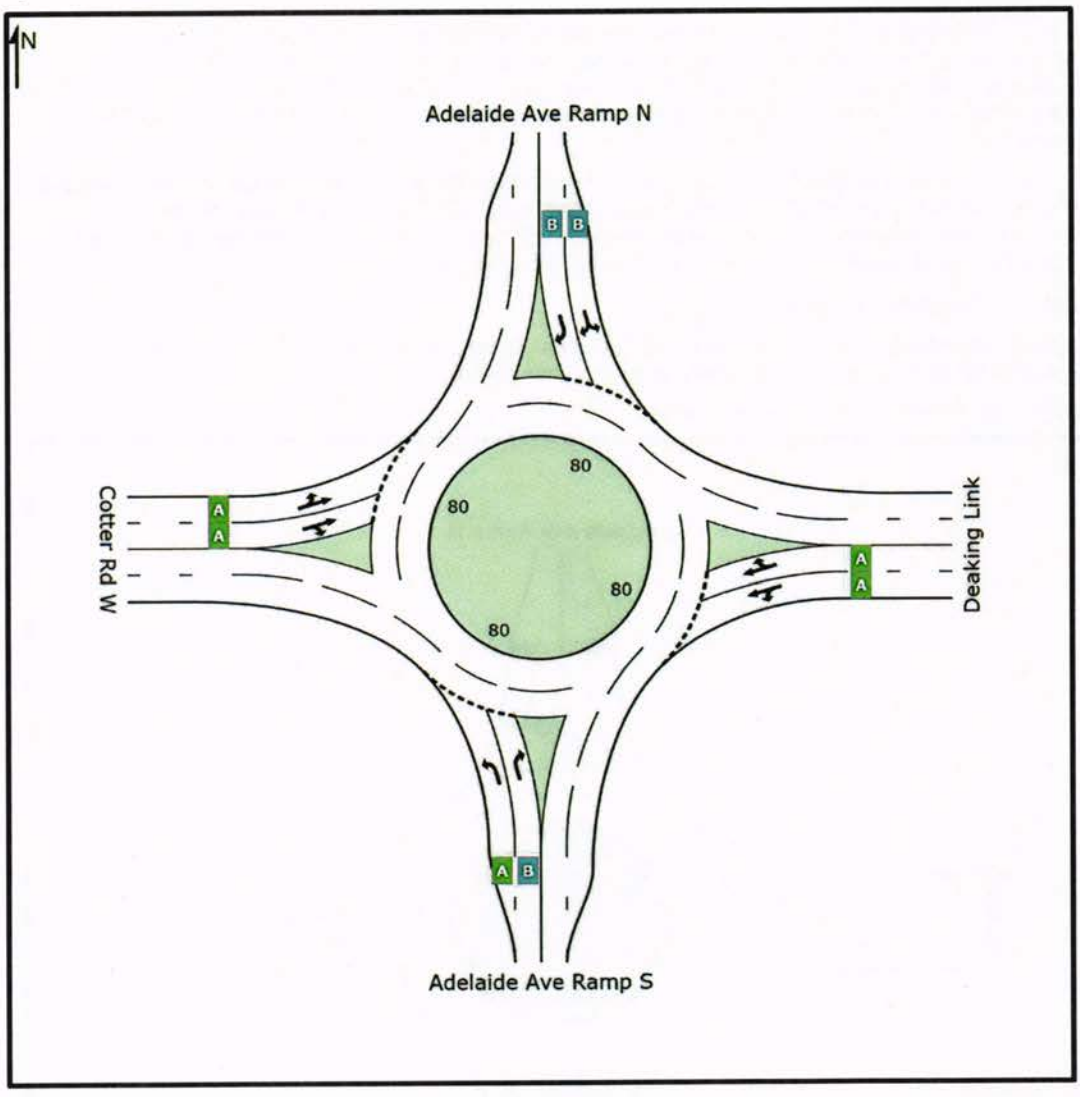
The third intersection configuration that was investigated was an elevated roundabout Interchange layout. **Figure 7** illustrates the proposed layout for the interchange that was modelled in Sidra.

Figure 7 Intersection Layout / Configuration in Sidra



The intersection would operate as one large priority controlled intersection with two approach lanes on each arm and two circulating lanes around the roundabout. The roundabout would also have a diameter of approximately 80m creating a large footprint. **Figure 8** provides an overview of the observed LoS for each lane during the AM peak period.

Figure 8 Summary of LoS by lane during the AM peak



The initial modelling results indicate that in general all lanes across the intersection will operate at a LoS B or higher during the AM peak period with the key large volume movements operating at a LoS A. **Table 6** provides a summary of the intersection operation by arm and the overall average during the AM peak period.

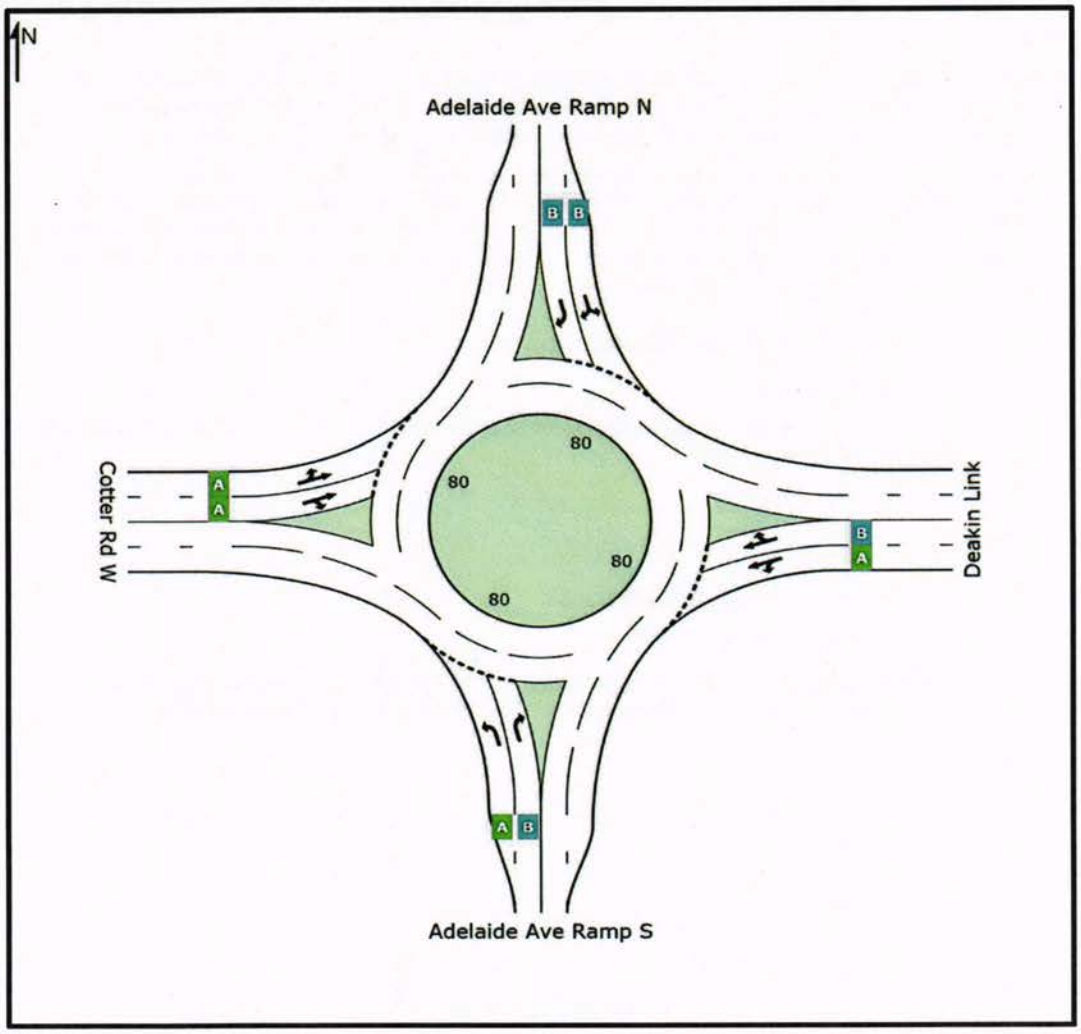
Table 6 AM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Adelaide Avenue South	A	9.3	4
Deakin Link	A	5.2	4
Adelaide Avenue North	B	15.8	25
Cotter Road	A	4.9	55
Overall	**A**	**7.2**	**55**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS A during the AM Peak period. Average delays across the intersection will be approximately 7s with queue lengths not exceeding 55m. This intersection layout provides the most efficient layout for vehicles movements with minimal delays and queues during the peak hour.

Figure 9 illustrates that operation of the intersection by lane during the PM peak period.

Figure 9 Summary of LoS by lane during the PM peak



The Sidra analysis indicates that all the lanes will operate at a LoS B or higher during the PM peak period. **Table 7** provides a summary of the intersection operation by arm and the overall average during the PM peak period.

Table 7 PM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Adelaide Avenue South	A	1.8	12
Deakin Link	A	4.9	35
Adelaide Avenue North	B	2.3	16
Cotter Road	A	1.7	12
Overall	**A**	**4.9**	**35**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS A during the PM Peak period. Average delays across the intersection will be approximately 5s with queue lengths not exceeding 35m which are both a slight improvement on the AM peak.

Whilst this intersection layout provides the most efficient operation for vehicles in both AM and PM peak periods, there are a number of other considerations that should be taken into account during the next stage (feasibility) of the study:

- In general, roundabouts are not favourable for pedestrian and cycle movements especially when trying to negotiate across key road corridors such as Cotter Road – as such, consideration needs to be given to crossing facilities on all approaches if sufficient demand is identified to support such a facility; and
- The operation of the roundabout has been assessed as an isolated intersection and therefore no consideration has been given to the impact that intersections on intersections to the east and west on the roundabout. During the feasibility stage, consideration should be given to a micro-simulation of the complete corridor to understand the interaction between the roundabout and the intersection to the east and west as this may impact the operation of these intersections.

3.3 Denison / Deakin Link Intersection

3.3.1 Priority T-intersection

A priority 'T' intersection was considered in the early analysis however initial indications indicated that this was not favourable for both traffic and pedestrians.

3.3.2 Signalised Intersection

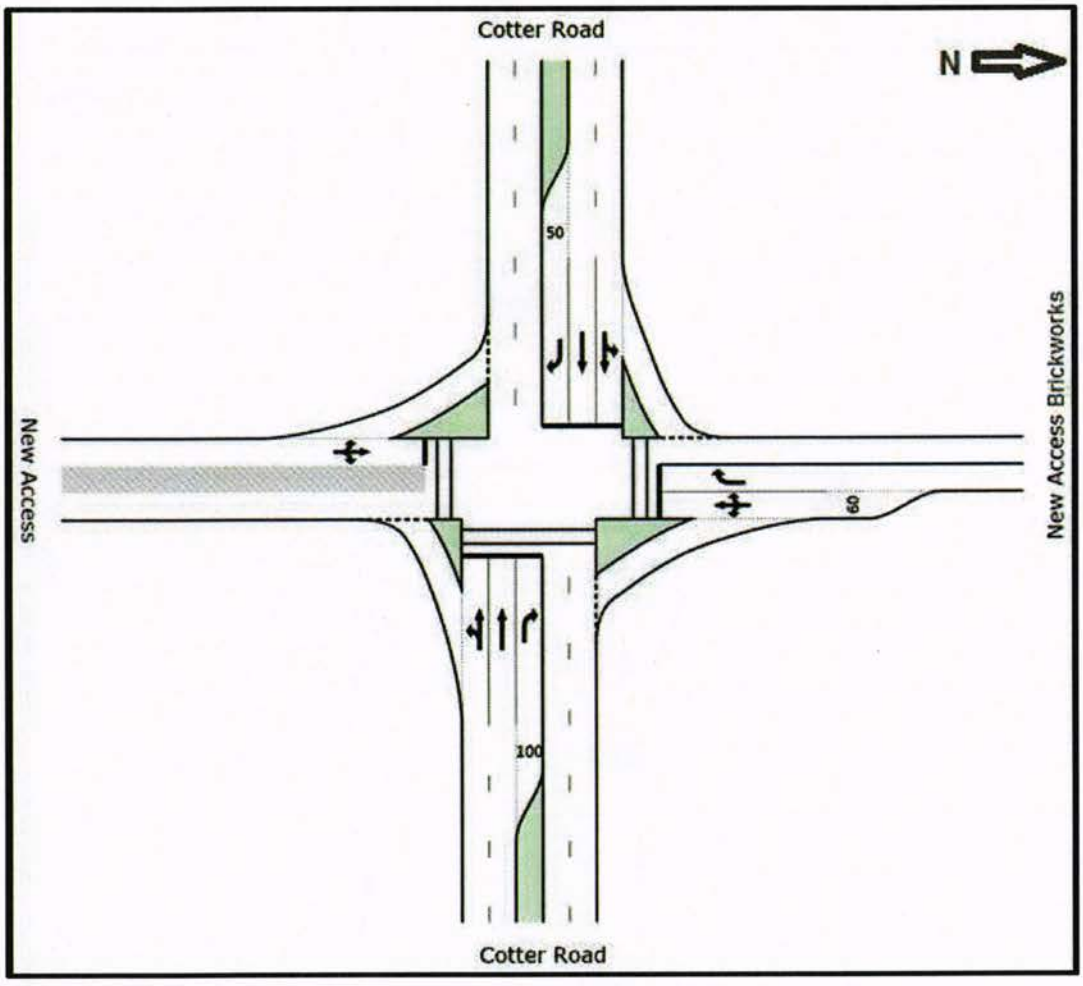
Refer to Section **3.2.2.**

3.4 Cotter Road / Brickworks Access

3.4.1 Signalised intersection

The first intersection layout that was considered as part of this exercise was a standard four arm signalised intersection. **Figure 10** illustrates the proposed layout for the interchange that was modelled in Sidra.

Figure 10 Cotter Road / Brickworks signalised intersection layout



The intersection would operate a four way signalised intersection with three approach lanes on the east and west approach legs, a two lane approach on the north leg and a single lane approach on the south. Each leg also has a slip lane to account for left turners. **Figure 11** provides an overview of the observed LoS for each lane during the AM peak period.

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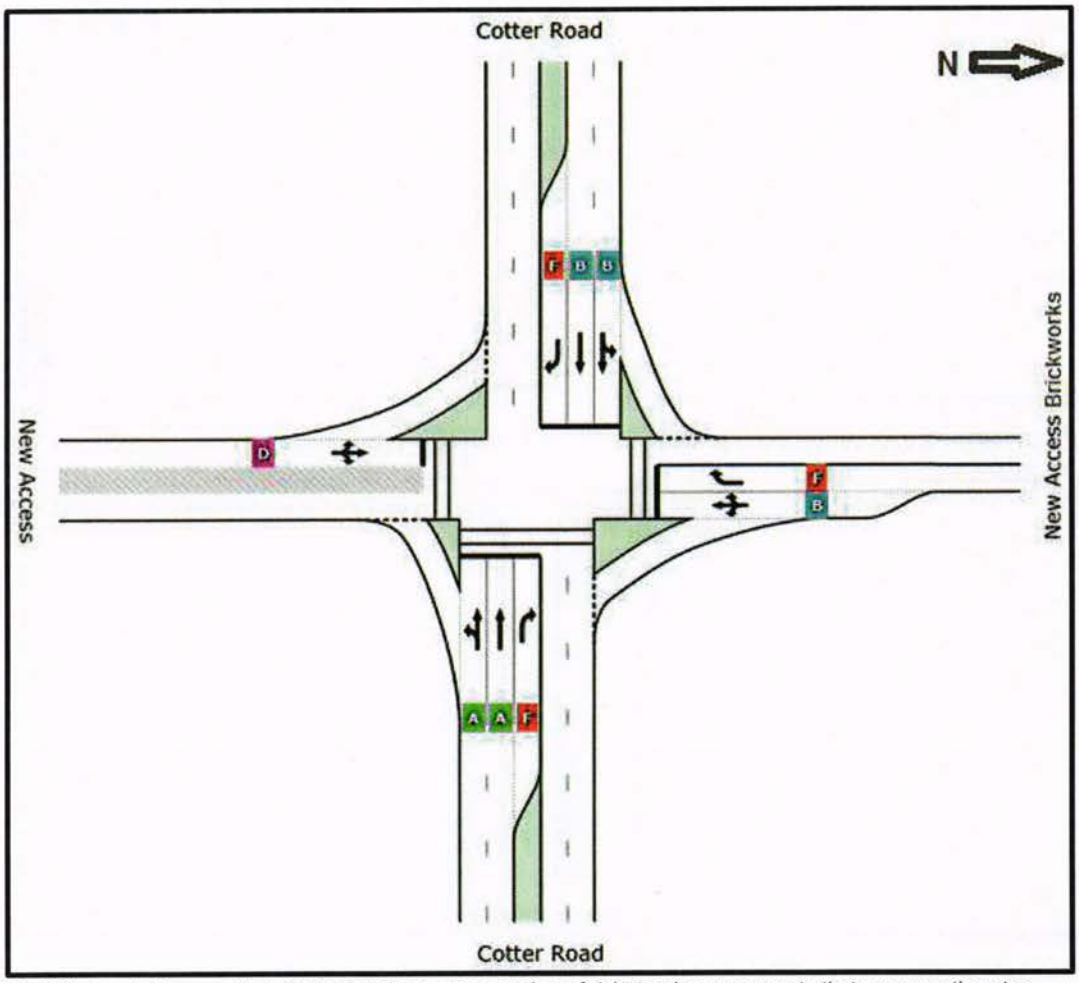
Figure 11 Observed LoS on each approach during the AM Peak



The initial modelling results indicate that there are a number of right turning movements that are operating at a LoS F at during the AM peak period with the key large through movements operating at a LoS A or B. **Table 8** provides a summary of the intersection operation by arm and the overall average during the AM peak period.

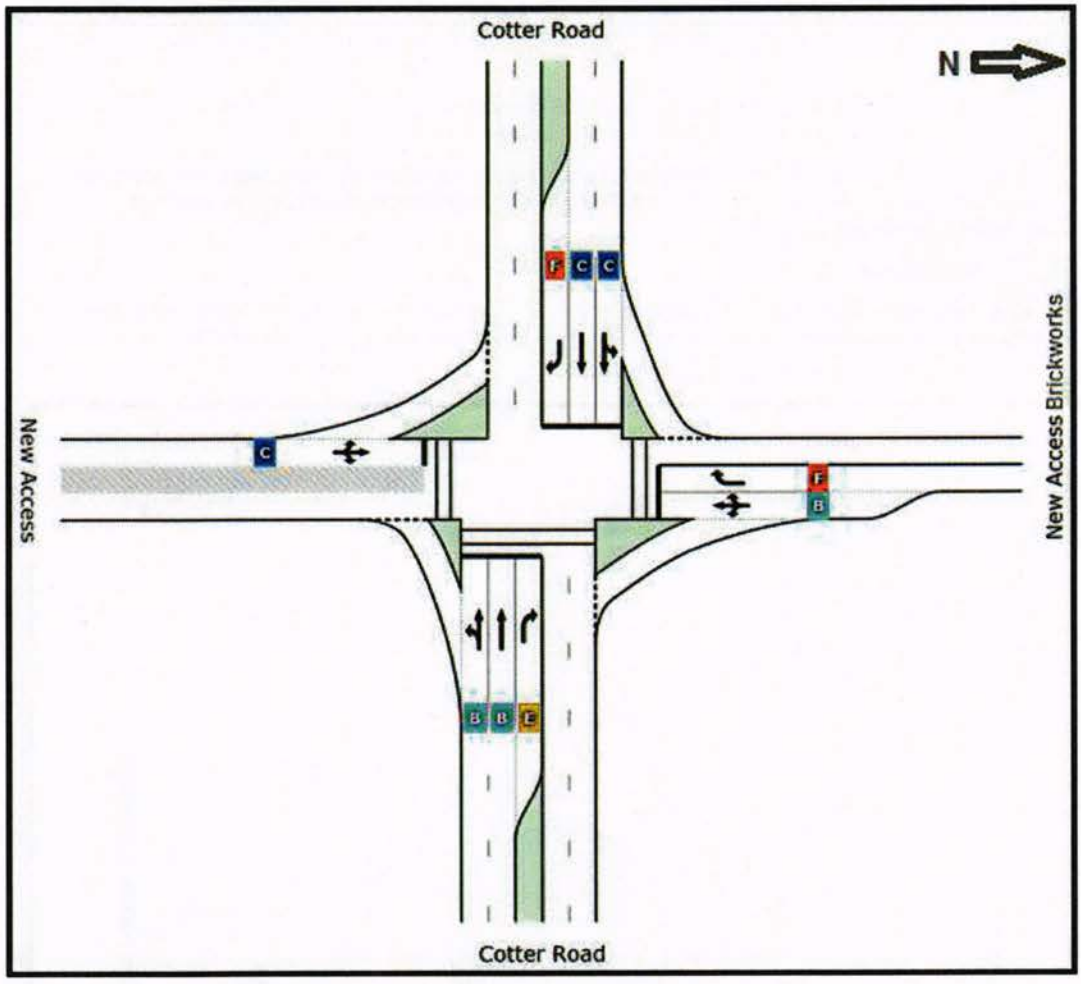
Table 8 AM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Cotter Road East	B	20.5	87
New Access Brickworks North	D	49.0	69
Cotter Road West	B	24.2	477
New Access South	E	59.6	4
Overall	**B**	**26**	**477**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS B during the AM Peak period. Average delays across the intersection will be approximately 26s with queue lengths not exceeding 477m. Whilst the queuing that occurs at the intersection is fairly long it's worth noting that the overall LoS is well above the satisfactory requirements.

Figure 12 illustrates that operation of the intersection by lane during the PM peak period.

Figure 12 Observed LoS on each approach during the PM Peak



The initial modelling results indicates that there are two right turn movements that are operating at a LoS F during the PM peak period with the key large through movements operating at a LoS B or C. **Table 9** provides a summary of the intersection operation by arm and the overall average during the AM peak period.

Table 9 PM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Cotter Road East	B	27.4	413
New Access Brickworks North	E	45.9	66
Cotter Road West	C	36.3	174
New Access South	E	35.9	15
Overall	**C**	**31**	**413**

Overall the analysis indicates that the intersection will perform at a satisfactory level operating at a LoS C during the PM Peak period. Average delays across the intersection will be approximately 31s, however a long queue of over 400m is possible on the Cotter Road south approach. This has the potential to interfere with the operation of

the Mint Interchange in PM peak. Whilst the queuing that occurs at the intersection is fairly long it's worth noting that the overall LoS is well above the satisfactory requirements.

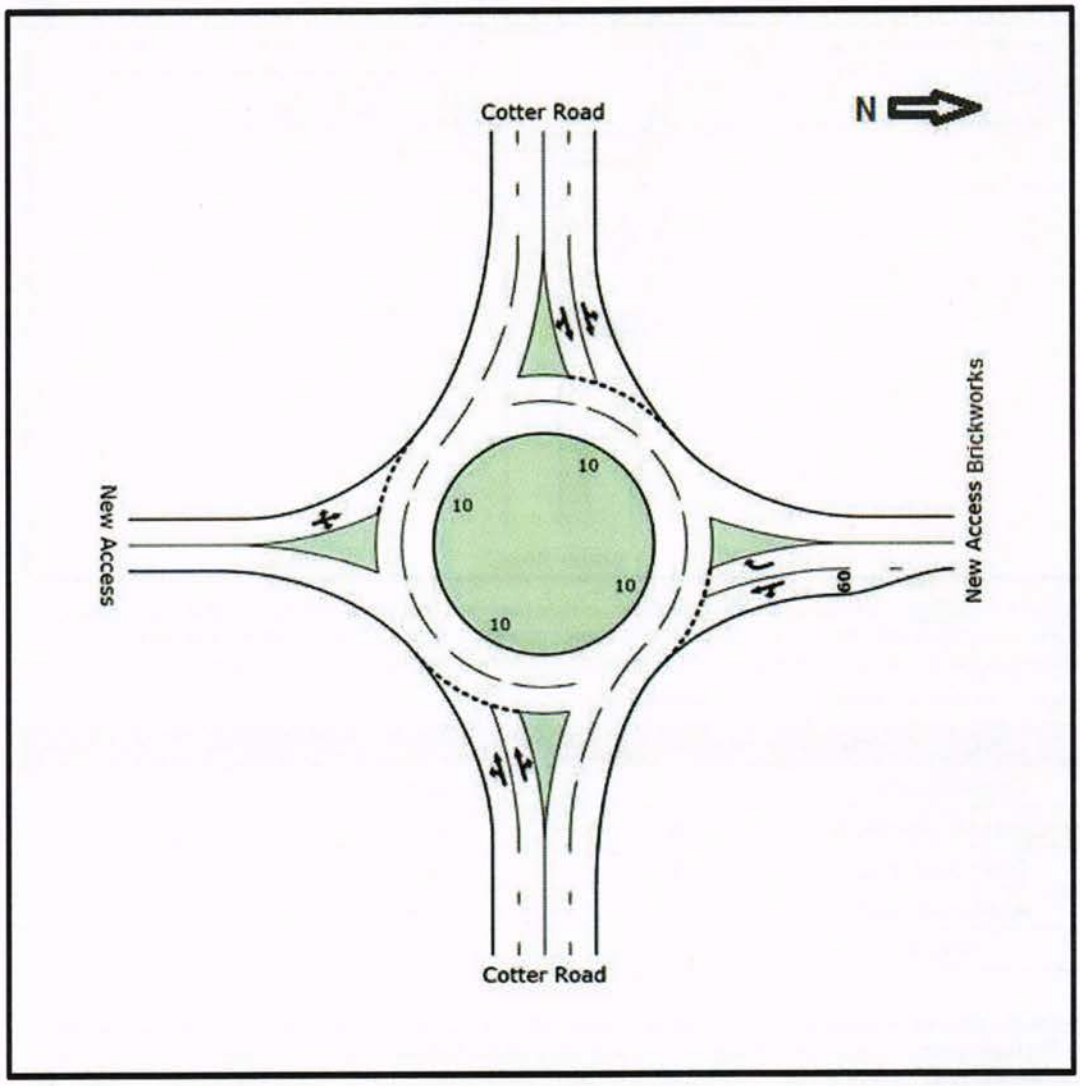
Whilst this intersection layout does not provides the most efficient operation for vehicles in both AM and PM peak periods, there are a number of additional considerations that should be taken into account during the next stage (feasibility) of the study:

- Pedestrian crossing facilities – the signalisation of the intersection allows pedestrians and cyclists to negotiate Cotter Road within a controlled and safe environment; and
- The current configuration minimises the footprint of the intersection providing only a single lane approach to the west and a two lane approach to the east. There is room to add additional capacity by providing additional lanes on every approach.

3.4.2 Roundabout

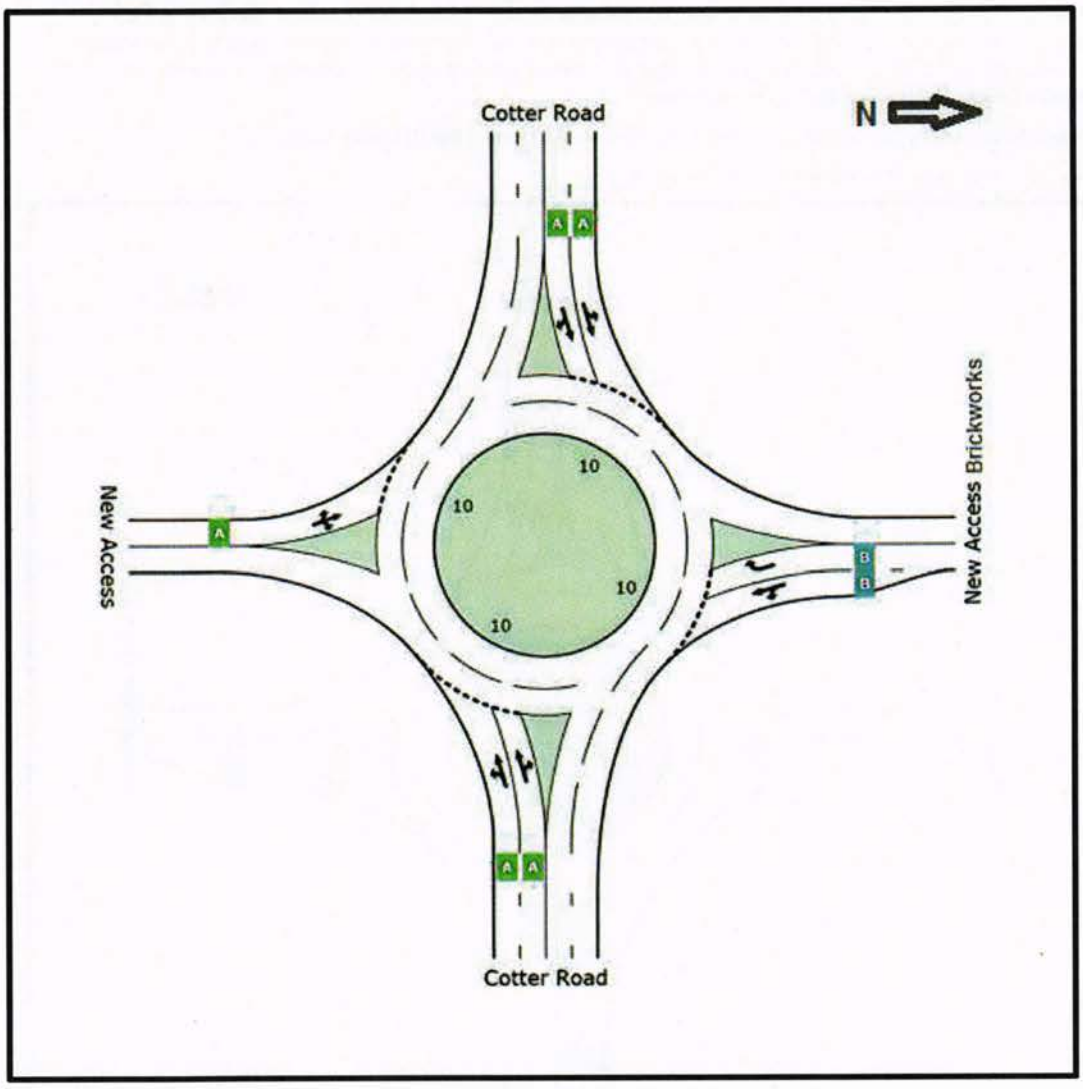
The second intersection layout that was considered as part of this exercise was a standard 2-lane roundabout intersection. **Figure 13** illustrates the proposed layout for the interchange that was modelled in Sidra.

Figure 13 Cotter Road / Brickworks roundabout intersection layout



The proposed layout is a four arm priority controlled roundabout. There are two lanes on each approach arm with two circulating lanes and a diameter of 10m. **Figure 14** provides an overview of the observed LoS for each lane during the AM peak period.

Figure 14 Observed LoS on each approach during the AM Peak



The initial modelling results indicate that in general all lanes across the intersection will operate at a LoS B or higher during the AM peak period with the key large volume movements operating at a LoS A. **Table 10** provides a summary of the intersection operation by arm and the overall average during the AM peak period.

Table 10 AM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Cotter Road East	A	7.8	14
New Access Brickworks North	B	21.7	31
Cotter Road West	A	7.6	87

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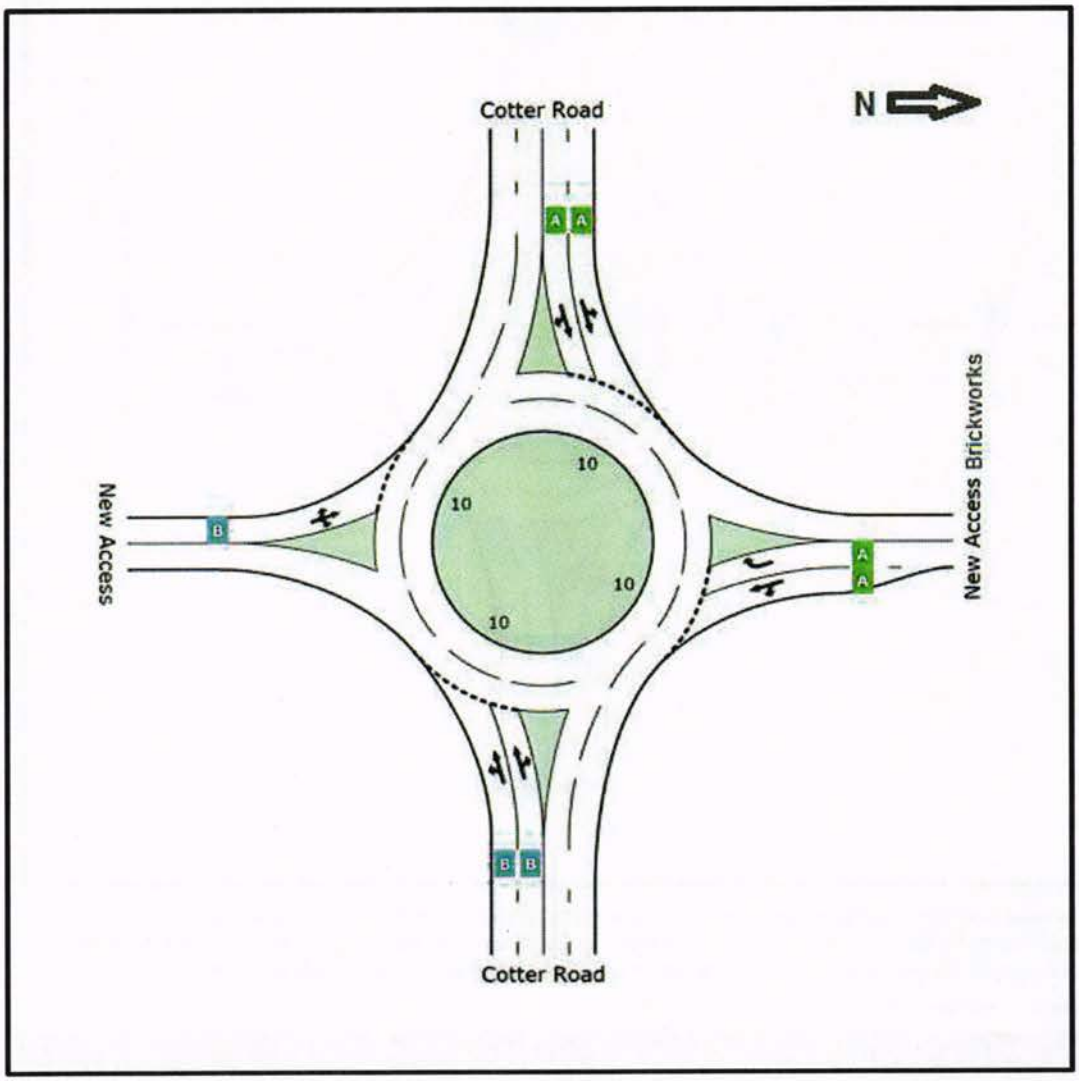
Approach	LOS	Average Delay (s)	Queue (m)
New Access South	A	11.2	1
Overall	**A**	**9.2**	**87**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS A during the AM peak period. Average delays across the intersection will be approximately 9s with queue lengths not exceeding 87m. This intersection layout provides the most efficient layout for vehicles movements with minimal delays and queues during the peak hour.

Figure 15 illustrates that operation of the intersection by lane during the PM peak period.

Figure 15 Observed LoS on each approach during the PM Peak



The Sidra analysis indicates that all the lanes will operate at a LoS B or higher during the PM peak period. **Table 11** provides a summary of the intersection operation by arm and the overall average during the PM peak period

Table 11 PM Peak LoS, Average Delay and Length of Queue

Approach	LOS	Average Delay (s)	Queue (m)
Cotter Road East	B	17.5	191
New Access Brickworks North	A	12.7	8
Cotter Road West	A	7.8	16
New Access South	B	28.2	11
Overall	**B**	**14.8**	**191**

Overall the analysis indicates that the intersection will perform above a satisfactory Level operating at a LoS B during the PM Peak period. Average delays across the intersection will be approximately 15s with queue lengths not exceeding 191m.

Whilst this intersection layout provides the most efficient operation for vehicles in both AM and PM peak periods, there are a number of additional considerations that should be taken into account during the next stage (feasibility) of the study:

- In general, roundabouts are not favourable for pedestrian and cycle movements especially when trying to negotiate across key road corridors such as Cotter Road – as such, consideration needs to be given to crossing facilities on all approaches if sufficient demand is identified to support such a facility; and
- The operation of the roundabout has been assessed as an isolated intersection and therefore no consideration has been given to the impact that intersections on intersections to the east and west on the roundabout. During the feasibility stage, consideration should be given to a micro-simulation of the complete corridor to understand the interaction between the roundabout and the intersection to the east and west as this may impact the operation of these intersections.

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4.0 Conclusions

AECOM has undertaken a number of intersections modelling exercises assessing numerous proposed intersection layouts for the following intersections:

- The future Mint Interchange;
- The Duplication of Cotter Road; and
- The future Deakin Link / Denison Street intersection.

The analysis has indicated the following key conclusions that should be considered further at the feasibility stage of the project:

- The analysis undertaken by AECOM indicates that all the intersection layouts tested, apart from a priority intersection layout at the Deakin Link/ Denison intersection, are feasible at this stage of the study based on the projected 2031 traffic volumes provided by the ACT Government;
- Of all the intersection layouts tested, the roundabout layouts offer the most efficient solution for the general traffic movements in terms of minimising delay and queuing at the intersections;
- Whilst the roundabouts offer the best solution for traffic, they do not offer the best solution to facilitate the movements of pedestrian and cyclist along the corridor and given the pedestrian and cycle demands are unknown at present its difficult to suggest a roundabout is the best solution;
- Whilst the signalised layouts do not operate as efficiently as the roundabout options they do operate at a satisfactory LoS and they all offer signalised and controlled pedestrian crossing facilities; and
- In all modelling exercises all intersections operated with minimum delay and queuing during the AM peak period, whilst the PM peak experienced greater delays and queuing as a result of conflicting movements.

5.0 Recommendations for Feasibility Stage

Following the conclusion of the modelling exercise undertaken by AECOM the following recommendations are outlined for further consideration and to facilitate EDD in developing a brief for a feasibility study:

- All intersections have been analysed in isolation and no corridor assessment has been completed – In order to fully understand the operation of the corridor and the interaction between the intersections along the corridor it is recommended that a Micro-simulation model of the network should be developed;
- The impact of the brickworks development has not been fully assessed as part of this study and the micro-simulation should include the brickworks development to assess the impacts of any rat running
- There is an ambition to develop a transport interchange in the median of Adelaide Avenue which will provide a segregated busway link to the City Centre, therefore, as part of the micro simulation assessment consideration should be given to the inclusion of the bus interchange within the model and a comprehensive assessment of pedestrian and cycle interaction with vehicles – the micro simulation package chosen for this assessment should have the ability to assess and capture this interaction; and
- Consideration of the urban form / environment across the area to assist with the development of a bus interchange and the promotion of the walking and cycling linkages between the areas of the Brickworks and Deakin – this is important in promoting the bus as a mode of transport for local residents and workers and will assist in local traffic reduction and congestion along Adelaide Avenue

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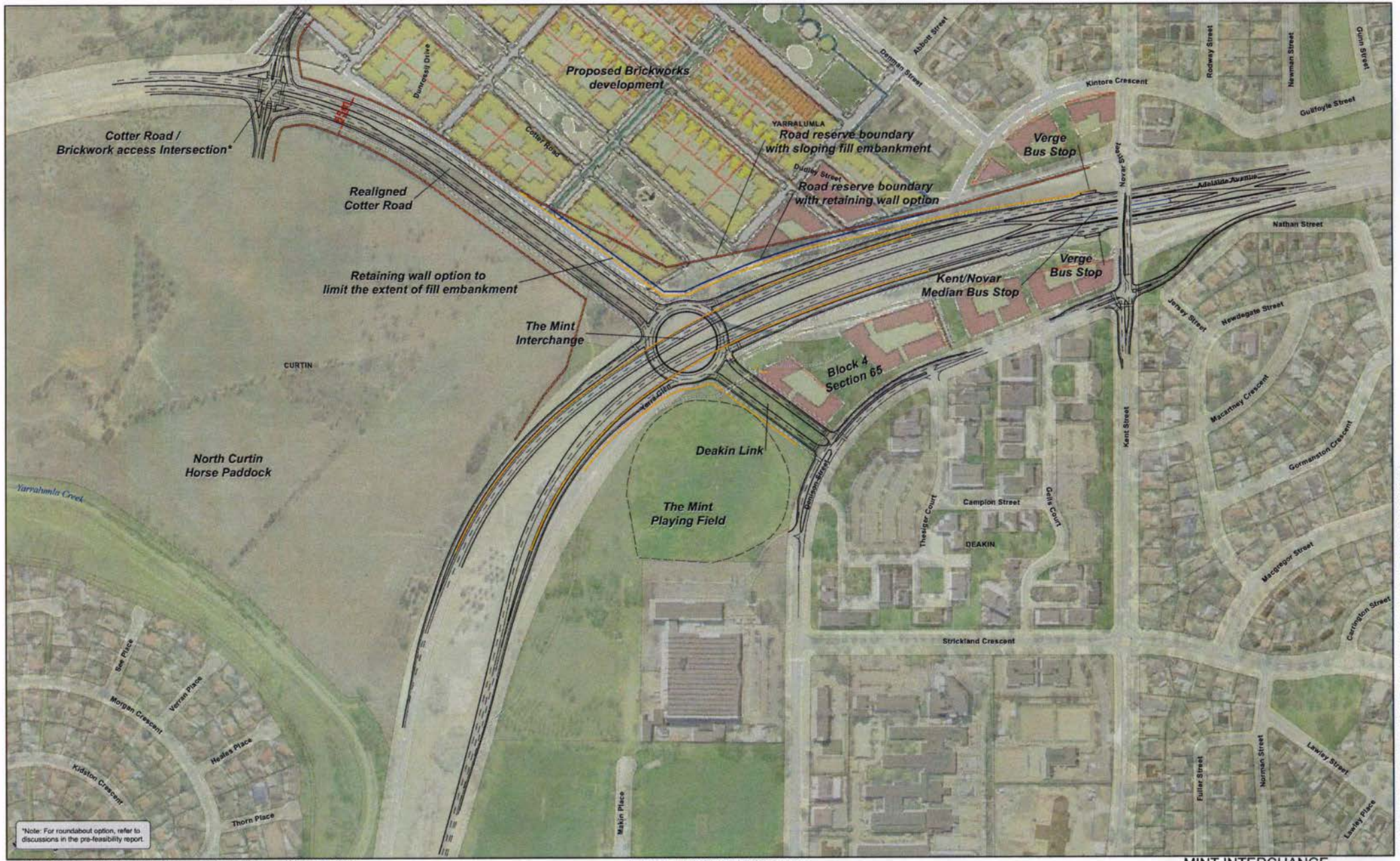
Appendix B

Pre-feasibility Study Plans and Typical Sections

AECOM



Road Reserve - Retaining wall option
Road Reserve - Sloping fill option
Retaining wall
Bus station
Cycleway
Kerb
Urban open space
Block boundary
Oval boundary

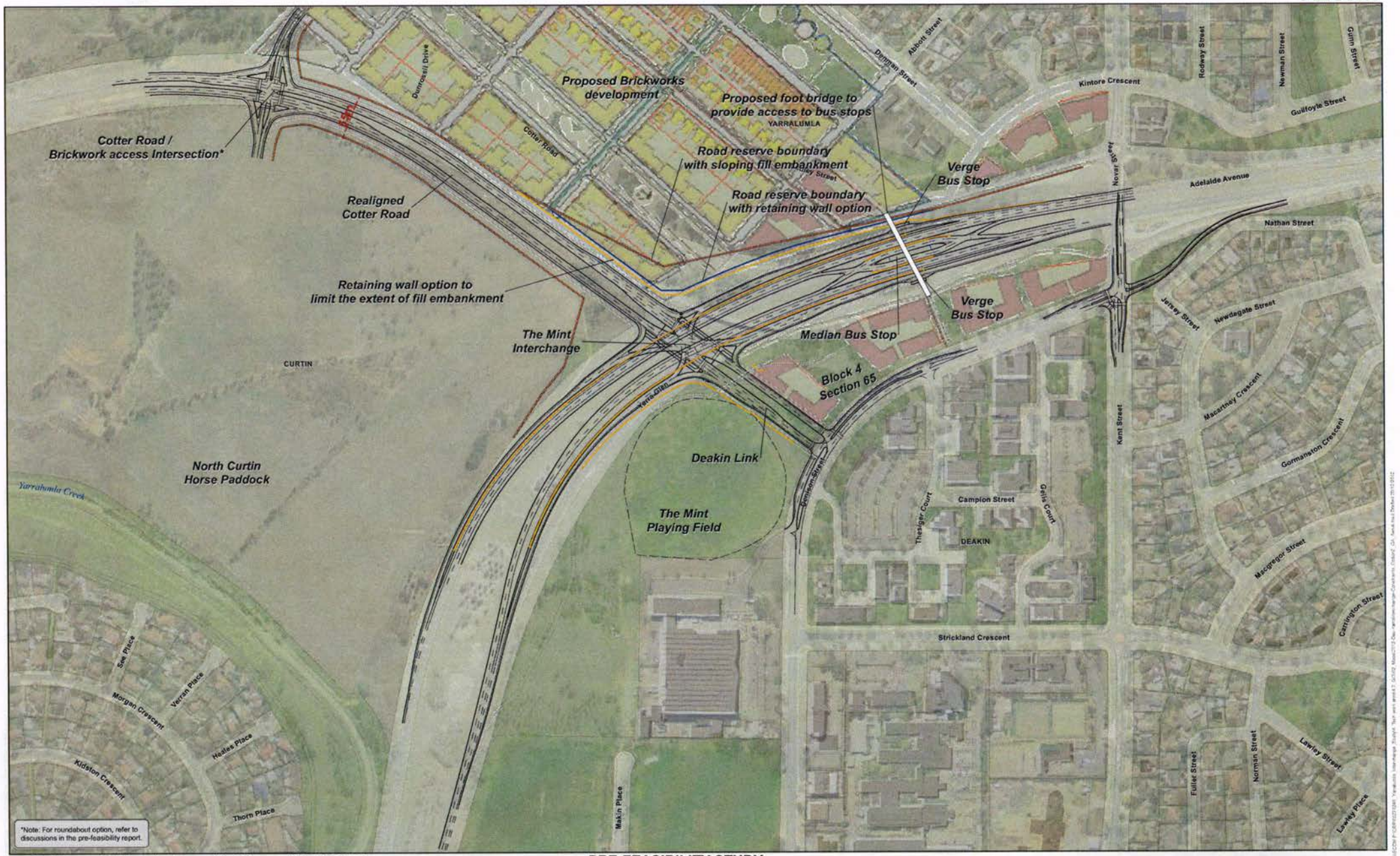
PRE-FEASIBILITY STUDY

MINT INTERCHANGE
GENERAL ARRANGEMENT
Layout Option 1 - Elevated Roundabout Interchange with Kent/Novar Bus Stop
Source: ESDD (2012)
0 50 100 200 m

N

DEC 2012
60276240

AECOM



Road Reserve - Retaining wall option
Road Reserve - Sloping fill option
Retaining Wall
Proposed foot bridge
Bus station
Cycleway
Kerb
Urban open space
Oval boundary
Block boundary

PRE-FEASIBILITY STUDY

MINT INTERCHANGE
GENERAL ARRANGEMENT
Layout Option 2 - Single Point Diamond Interchange with Bus Stops between Kent/Novar overpass & the Mint Interchange

0 50 100 200 m

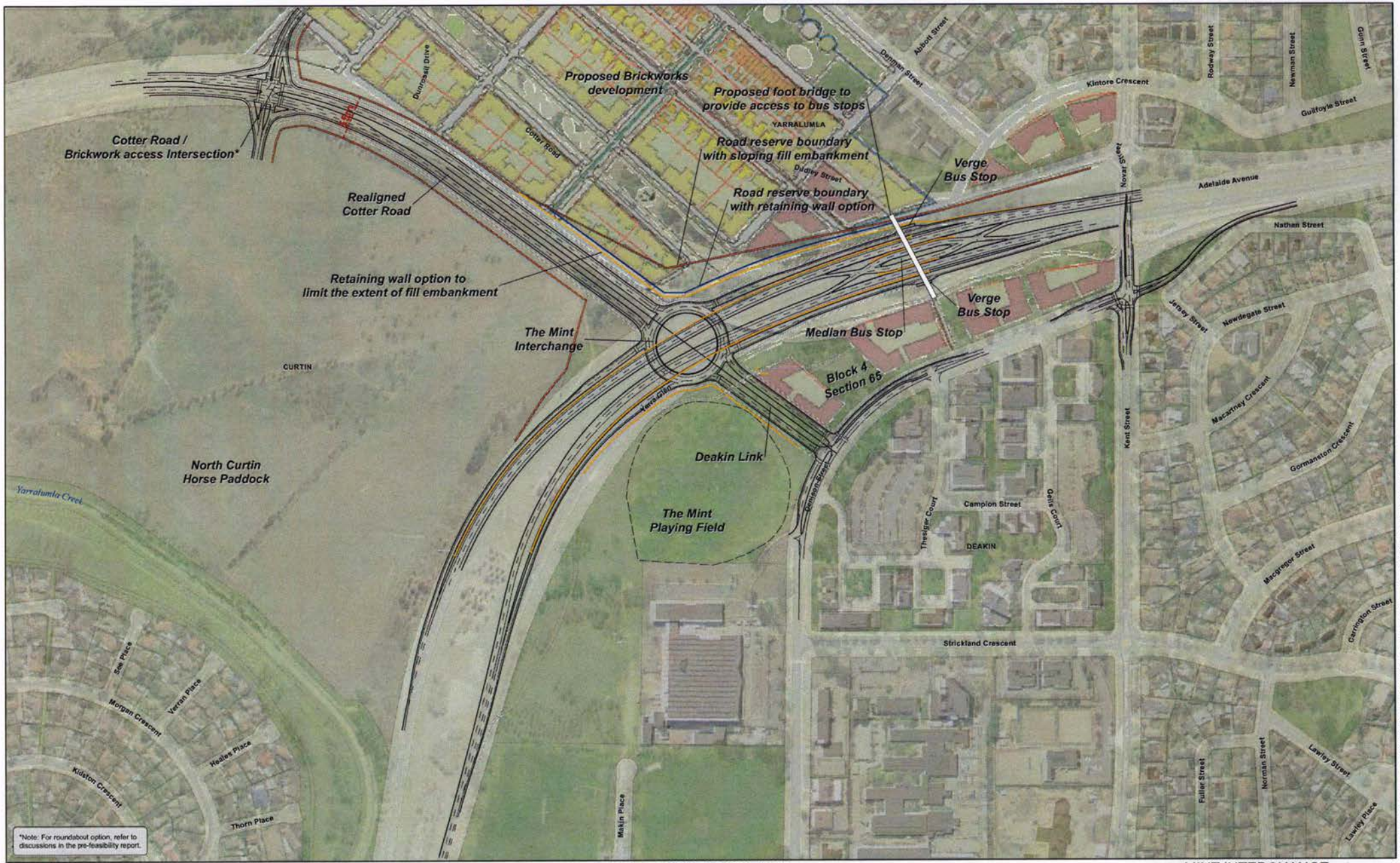
Source: ESDD (2012)

N

DEC 2012

60276240

AECOM



Road Reserve - Retaining wall option
Road Reserve - Sloping fill option
Retaining wall
Bus station
Cycleway
Kerb
Proposed foot bridge
Urban open space
Oval boundary
Block boundary

PRE-FEASIBILITY STUDY

MINT INTERCHANGE
GENERAL ARRANGEMENT
Layout Option 3 - Elevated Roundabout Interchange with Bus Stops between Kent/Novar overpass & the Mint Interchange

0 50 100 200 m

Source: ESDD (2012)

N

DEC 2012
60276240

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AECOM

*Note: For roundabout option, refer to discussions in the pre-feasibility report.

— Road Reserve - Retaining wall option
— Road Reserve - Sloping fill option
— Retaining Wall
— Bus station
— Cycleway
— Kerb
- - Existing road pavement
Urban open space
Block boundary
Oval boundary

PRE-FEASIBILITY STUDY

MINT INTERCHANGE
GENERAL ARRANGEMENT
Layout Option 4 - Diverging Diamond Interchange with Kent/Novar Bus Stop
Source: ESDD (2012)
0 50 100 200 m

N

DEC 2012
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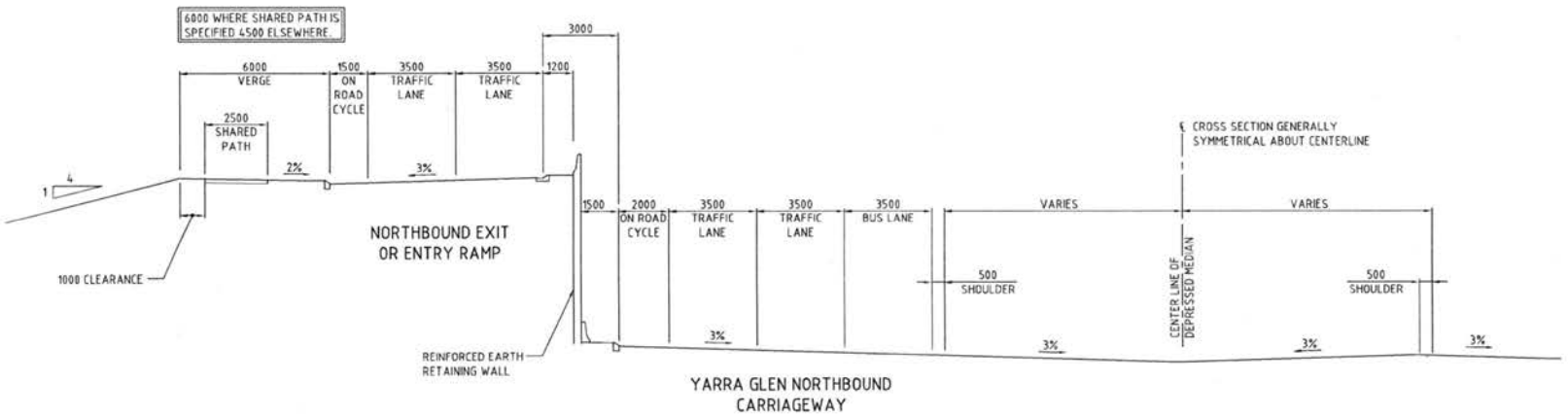
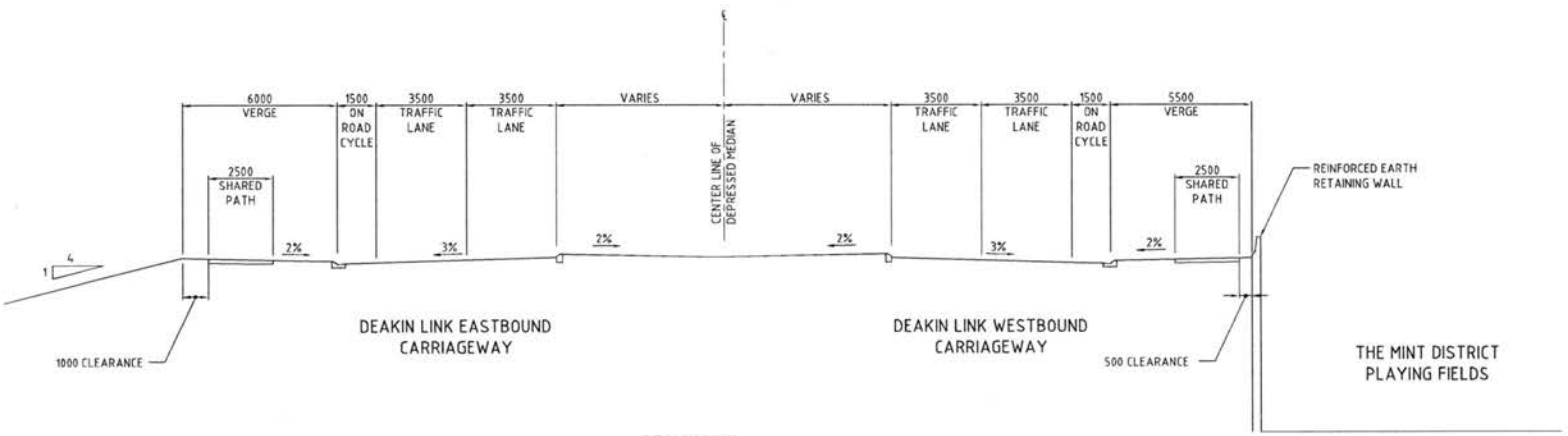


ADELAIDE AVENUE NORTHBOUND EXIT OR ENTRY

SCALE 1:100



DEAKIN LINK

SCALE 1:100

0433

REVISIONS				
No.	BY	DATE	DESCRIPTION	APPD

Scale: 1:100 FULL SIZE A1

THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000

DESIGNED		CHECKED	
DRAWN		CHECKED	
APPROVED		DATE	

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Contractor:

Client:

Designer: AECOM

AECOM Australia Pty Ltd
A.B.N. 20 093 846 925

Project: YARRALUMLA INTERCHANGE STUDY

Title: TYPICAL CROSS SECTIONS

SHEET 1

Status	Drg No.	Rev.
FOR INFORMATION	60276240-SKE-10-RD0001	A