ACT Government
Transport Canberra and City Services

FREEDOM OF INFORMATION COVERSHEET

The following information is provided pursuant to section 28 of the *Freedom of Information Act 2016*.

FOI reference: 22-059

Information to be published	Status
1. Access application	Published
2. Decision notice	Published
3. Schedule	Published
4. Documents	Published
5. Additional information identified	Not Applicable
6. Fees	Not Applicable
7. Processing time (in working days)	29 days
8. Decision made by Ombudsman	Not applicable
9. Additional information identified by Ombudsman	Not applicable
10. Decision made by ACAT	Not applicable

11. Additional information identified by ACAT	Not applicable

From: [redacted]
To: TCCS_FreedomOfInformation
Subject: FOI Request - Belconnen Transitway study
Date: Wednesday, 7 June 2023 2:39:58 PM

Dear FOI team

Under the FOI Act, I request a copy of the 2011 Belconnen Transitway feasibility study that was referred to by Minister Steel in an answer in Question Time today (Wednesday 7 June 2023).

Thank you for your assistance with this request.

Regards

[redacted]

ACT Government
Transport Canberra and City Services

[redacted]

Dear [redacted]

Freedom of Information Request - Reference 23-059

I refer to your application under section 30 of the *Freedom of Information Act 2016* (the FOI Act) received by Transport Canberra and City Services (TCCS) on 7 June 2023. It is my understanding that you are seeking access to the following information:

> *"a copy of the 2011 Belconnen Transitway feasibility study that was referred to by Minister Steel in an answer in Question Time today (Wednesday 7 June 2023)."*

Authority

I am an Information Officer appointed by the Director-General under section 18 of the Act to deal with access applications made under Part 5 of the FOI Act.

Timeframes

A decision is due on your application by 20 July 2023.

Decision on access

In accordance with the FOI Act, a search of TCCS records has been completed and the records you have requested access to has been identified.

Upon reviewing the information within the records and applying the public interest test under section 17 of the FOI Act, I have decided to provide you with full disclosure of this record. A copy is enclosed at Attachment A. Reasons for my decision are detailed further below in my statement of reasons.

Statement of Reasons

In reaching my access decision, I have taken the following into account:

- The FOI Act; and
- The *Human Rights Act 2016.*

Consistent with section 17 of the FOI Act, I have reviewed the relevant records and considered all relevant factors in schedule 1 and 2 of the FOI Act to determine, on balance, where the public interest lies.

Schedule 1:

- No relevant sections identified.

Schedule 2:

Factors favouring disclosure in the public interest (Section 2.1)

- Section 2.1(a)(i) - promote open discussion of public affairs and enhance the government's accountability; and
- Section 2.1(a)(viii) - reveal the reason for a government decision and any background or contextual information that informed the decision.

Factors favouring non-disclosure (Section 2.2)

- No relevant sections identified.

In accordance with the FOI Act, I find that the disclosure of the information within this record is, on balance, in the public interest. A copy of the relevant information is enclosed at Attachment A.

Charges

In with the FOI Act, a fee may be applied to an application where the total number of pages exceeds 50 pages. Fees are calculated under the *Freedom of Information (Fees) Determination 2018*, $0.35 per page above the fee free threshold (50 pages).

I have considered that the information you are seeking is material referenced in Question Time and is of special benefit to the public (Section 107(b) of the FOI Act). As such, no fee has been applied.

Disclosure log

Under section 28 of the Act, TCCS maintains an online record of access applications called a disclosure log. Your access application and this notice of decision will be published on the disclosure log within 3 – 10 business days. Your personal information will be removed from these documents prior to publication.

Ombudsman review

My decision on your access request is a reviewable decision as identified in Schedule 3 of the Act. You have the right to seek Ombudsman review of this outcome under section 73 of the Act within 20 working days from the day that my decision is published in TCCS' disclosure log, or a longer period allowed by the Ombudsman.

If you wish to request a review of my decision you may write to the Ombudsman at:

The ACT Ombudsman
GPO Box 442
CANBERRA ACT 2601
Email: ombudsman@ombudsman.gov.au

ACT Civil and Administrative Tribunal (ACAT) review

Under section 84 of the Act, if a decision is made under section 82(1) on an Ombudsman review, you may apply to the ACAT for review of the Ombudsman decision.

Further information may be obtained from the ACAT at:

ACT Civil and Administrative Tribunal
Level 4, 1 Moore Street
GPO Box 370
Canberra City ACT 2601
Telephone: (02) 6207 1740
www.acat.act.gov.au

If you have any queries concerning the directorate's processing of your request, or would like further information, please contact the TCCS FOI team on (02) 620 72987 or email tccs.foi@act.gov.au.

Yours sincerely

Cherie Hughes
Information Officer

19 July 2023

ACT Procurement Solutions
29 April 2011

Belconnen to City Transitway Stage 1 and City Bus Services and Facilities Improvement Forward Design

Options Report

Belconnen to City Transitway Stage 1 and City Bus Services and Facilities Improvement Forward Design

Options Report

Prepared for

ACT Procurement Solutions

Prepared by

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ABN 20 093 846 925

29 April 2011

60187247

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

Quality Information

Document	Belconnen to City Transitway Stage 1 and City Bus Services and Facilities Improvement Forward Design
Ref	60187247
Date	29 April 2011
Prepared by	Neil Graham and Peter Evans
Reviewed by	Tom Brimson

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	11-Jan-2011	Preliminary Draft	Marc Blackmore Project Manager	
1	15-Feb-2011	Draft	Marc Blackmore Project Manager	
2	17-Feb-2011	Draft (Internal Revision)	Marc Blackmore Project Manager	
4	29-Apr-2011	Final	Marc Blackmore Project Manager	

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Executive Summary

As part of the Transport for Canberra (TfC) initiatives, AECOM has undertaken four elements of bus priority work in the City to Belconnen corridor. The four elements are as follows:

- College Street / Haydon Drive bus priority improvements in the Belconnen sector
- Barry Drive / City West bus priority improvements in the City sector
- Business case development for a possible Watson Street bus layover
- City Circle bus routes to suite the new City West Bus Station

To facilitate initial assessment some preliminary intersection analysis has been undertaken using Paramics, Sidra and Transyt software tools.

Some general principles were adopted in the project as follows:

- Buses pull out from a bus stop into a bus lane or travel directly from the bus stop into a traffic lane without merging
- Proposed improvements are targeted towards buses without significantly disadvantaging traffic
- The frequent rapid bus service is along roads with no less than 4 lanes in order to ensure that buses may be able to negotiate any obstruction along the route.
- Austroads Guidelines and Australian standards have been adopted for the proposals and ACTPLA Bus Stop design guidelines have been modified to take account of the ACTION fleet including 14.5m tag steer buses.

The development and assessment of options has recognised a number of constraints at this point in time as follows:

- Potential future duplication of College Street
- Proposed new access and internal road system for the University of Canberra
- Internal traffic congestion at Radford College impacting on the external road network
- Duplication of Gungahlin Drive Extension and future traffic flows
- Proposed alignment study of the Bruce Ridge section to be undertaken
- Proposed intersection improvements to Barry Drive / Clunies Ross Street
- Desired new bus stop at North Road / Barry Drive
- ANU Exchange reservation width being less than required to meet all desirable standards
- Potential relocation of the City bus layover from Section 4 to City Watson Street

The development and assessment of the options has considered the benefit to buses, capital cost, passenger safety, and dis-benefit to other road users with priority determined on a needs basis combined with the opportunity to combine elements to achieve a signature project.

Bruce Sector Corridor

No	Proposal	Priority
1	College Street / Eastern Valley Way widen College Street to allow for diamond turns at Eastern Valley Way	Low
2	Duplicate College Street	low priority
3	Install bus lanes on College Street in each direction on existing 4 lane sections	
4	In combination with University of Canberra relocate University entrance to opposite Radford College and signalise intersection. Construct service roads to segregate buses from school set down and pick up. Construct park and ride in north east corner	
5	Signalise Purdie Street (TAFE) to provide gaps for buses, relocate cycle crossing to the intersection	
6	Construct bus lane from Mary Potter Circuit (North) to connect to exiting 3rd lane between Mary Potter Circuit South and Belconnen Way	
7	Construct new 3rd lane from Haydon drive to eastbound on Belconnen Way	
8	Construct new bus lane on Belconnen Way to connect to bus lane at GDE	
9	Construct new (3rd) right turn lane from Belconnen Way into Haydon Drive as bus only lane	
10	Construct new northbound bus only lane on Haydon Drive from Belconnen Way to Jaeger Circuit. Provide B signal jump start and merge length for 80 km/h at Jaeger Circuit	

City Sector Corridor

No	Description	Priority
11	Convert existing 1st and 3rd lanes on Barry Drive to bus only lane from Clunies Ross Street to North Road changing immediately to the west of Boldrewood Street. Also includes on road cycling provision	
12	Install a B set of signals to allow transition from the 1st to 4th lane on Barry Drive between	
13	Install traffic signals at Kingsley Street with additional right turn lane for buses from Barry Drive into Kingsley Street	
14	Install bus only right turn lane at Kingsley Street	
15	Public traffic mixes with buses for left turn from Kinsley Street to westbound on Barry Drive	
16	City West Bus station -provide for 2 bus stops for two buses at each stop – 109m in each direction. Also allow for ANU free bus to use the station	
17	“Square up” Childers Street intersection with Rudd Street to provide for pedestrians to cross to and from the bus station safely	
18	Install traffic signals at Rudd / Marcus Clarke Street from Rudd Street permitting cross movements across Marcus Clarke Street in both directions.	
19	Marcus Clarke Street widen on the eastern side to provide northbound bus lane	Long term
20	Widen Marcus Clarke Street northbound to reduce congestion resulting in delays to buses	

No	Description	Priority
21	Marcus Clarke Street / Alinga Street allow buses to turn right from left lane outbound into northbound lane	
22	Signalise Alinga Street / West Row to reduce delays to buses	
23	Install peak hours bus lanes on Alinga Street	

City West layover

No	Description	Priority
24	Provide for City West layover area with capacity for up to 15 buses / coaches	
25	Extend routes 1, 4, 5, 7 to Watson Street Layover.	

City bus network

No	Description	Priority
26	Extend routes 1 and 7 anticlockwise around London Circuit to terminate at the Watson Street Layover	
27	Extend routes 160, 161, 162, 265 and 267 through the City interchange and Alinga Street to the Watson Street Layover	
28	Consider extending routes 56, 57, 58 and 59 anticlockwise around London Circuit	

Other recommendations

No	Description	Priority
29	Do not construct a new bus stop on Barry Drive at North Road as there is no advantage of increased ANU catchment and it penalises through passengers	
30	Construct lay-by for ANU exchange service vehicles	
31	Construct new cycle lane bridges over Sullivans Creek	

1.0 Introduction

This report provides an outline of the options developed for five elements of this project:

1) The Belconnen to City Transitway (Bruce Section) – Chapter 2
2) The Belconnen to City Transitway (City Section) – Chapter 3
3) City Permanent Bus Layover – Chapter 4
4) ANU City West Bus Station – Chapter 5
5) City Bus Services and Facilities Improvements – Chapter 6

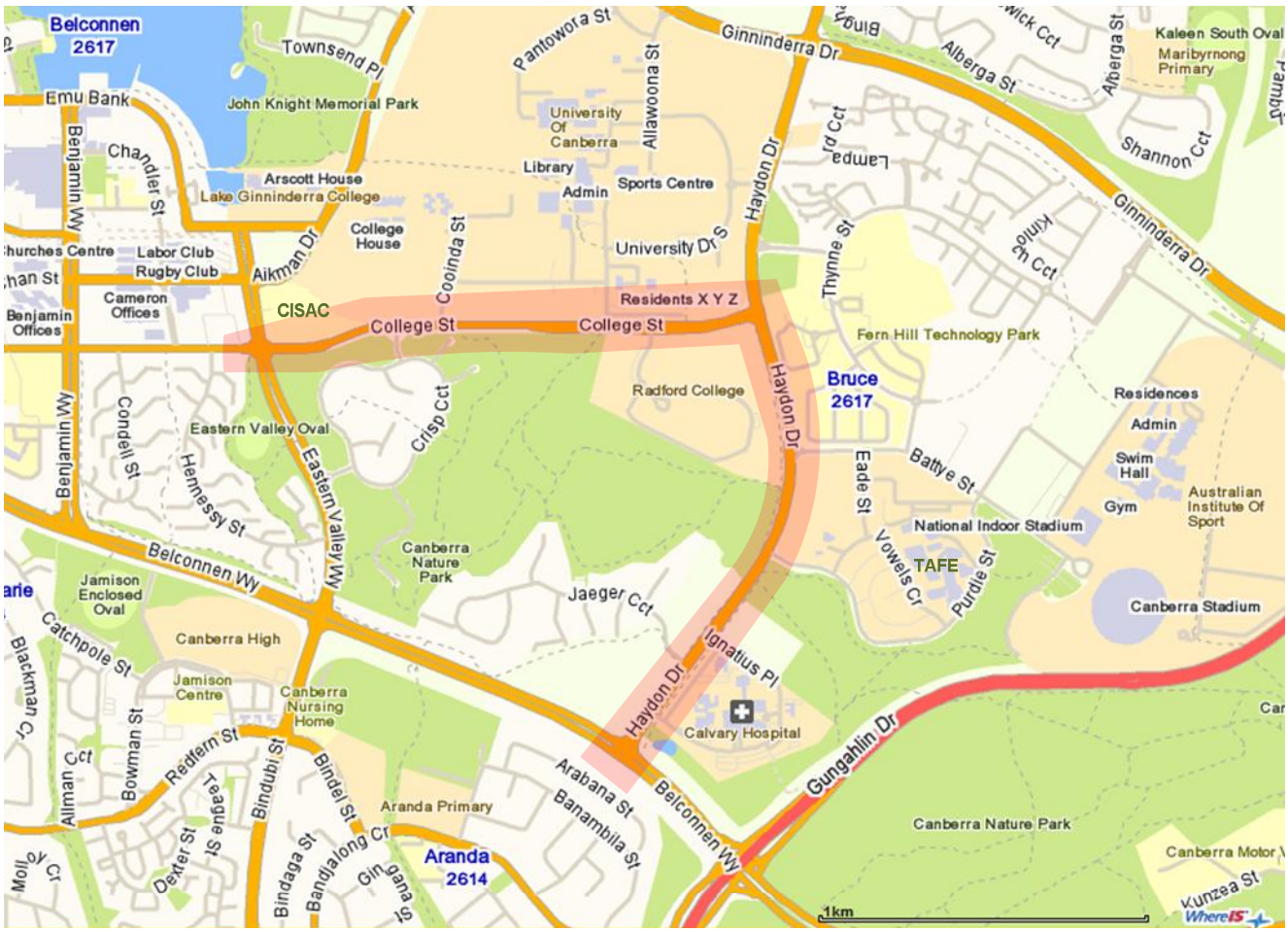
It includes some concept sketches and a description of the pros and cons of the various options, as well as the results of some network modelling in City.

2.0 The Belconnen to City Transitway (Bruce Sector)

2.1 Introduction

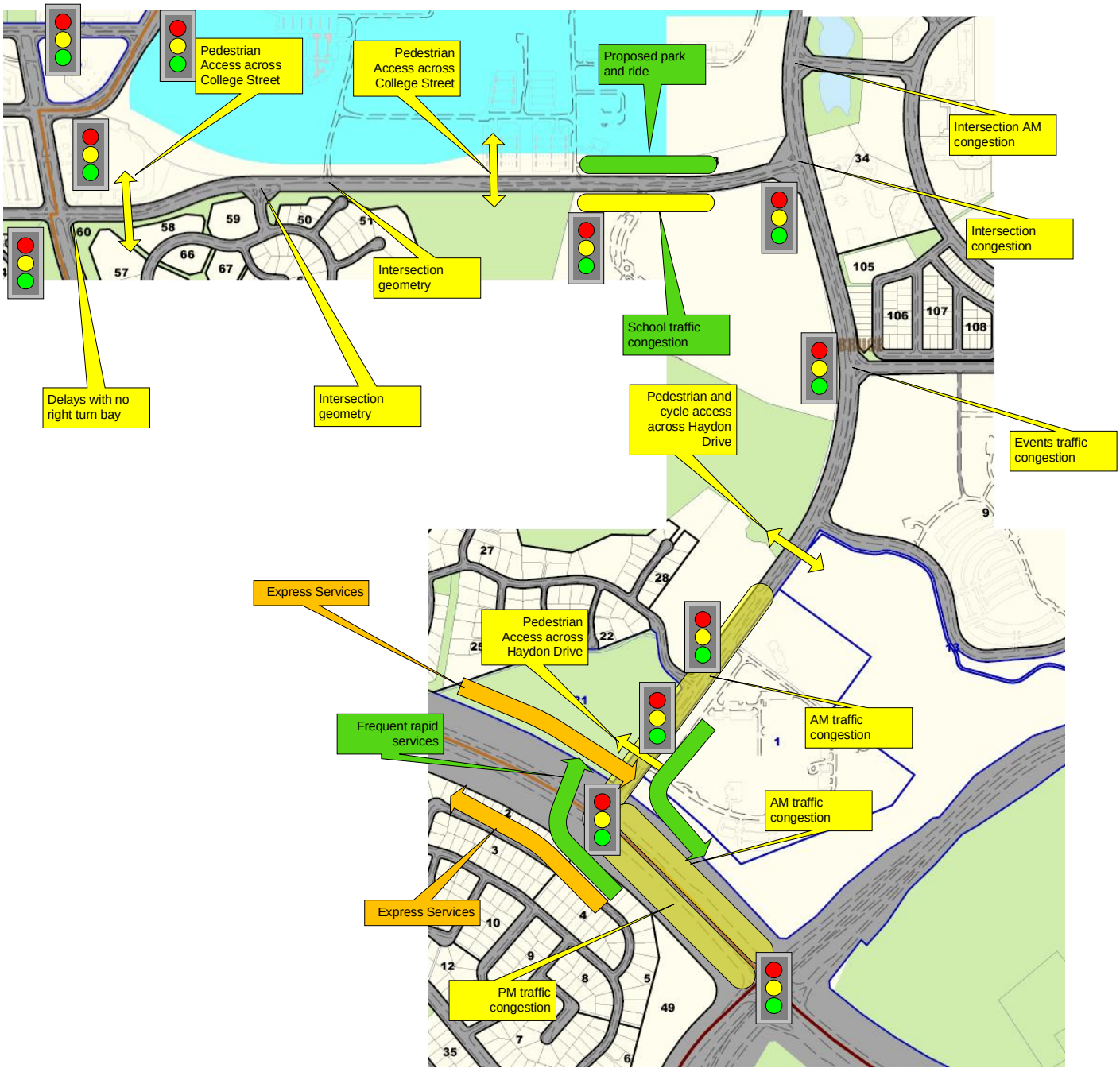
Figure 2-1 shows the extent of the Bruce Sector corridor and the location of some of the key land-uses in the Bruce sector corridor. These include CISAC, University of Canberra and Radford College along College Street. University of Canberra includes a number of existing and proposed residences adjacent to College Street. Key uses along Haydon Drive include Fern Hill Technology Park, Bruce TAFE and Calvary Hospital. The Australian Institute of Sport is also within close proximity of the corridor.

Figure 2-1: Key Uses in the Bruce Sector Corridor



Some of the key road and traffic issues identified in the corridor are summarised in Figure 2-2. A description of the issues follows.

Figure 2-2: Traffic and Transport Issues in Bruce Sector Corridor



2.1.1 College Street

College Street is a relatively steep street that was initially unsuitable for ACTION buses in the mid – late 1970's. With increased bus performance the gradient should no longer be an issue for the Frequent Rapid services. An issue to consider is the integration of the local services that currently penetrate the University of Canberra or whether greater use could be made of the external facility and still maintain University access at acceptable levels. The University has been developing a new Master Plan and there is a strong desire to develop a more sustainable campus including the opening up of the College Street address and increased use of these bus routes to reduce their current high dependency on car trips.

There have been a number of fatal crashes on College Street over the past 3 decades some of which involved a pedestrian. With an increase in public transport patronage expected from the University, the safe provision for pedestrians crossing to and from the bus stops will need to be considered.

College Street is an unusual mix of cross section with duplication at the eastern end merging to a single carriageway, channelisation of the University western access at Cooinda Street then unused duplication past Whelan Street back to single carriageway and the final western section is duplicated. The study should investigate the rationalisation of these cross sections to provide a clear and unimpeded route for long term efficiency of bus operations.

The intersection of College Street at Eastern Valley Way operates as a split phase signal operation for College Street and diamond overlaps for Eastern Valley Way. Converting the operation to a double diamond may improve intersection efficiency particularly in off peak operation.

There is a pair of bus stops on College Street that serve Bruce and CISAC. With the planned development of Section 45 Belconnen there may be merit in installing another bus stop on Eastern Valley Way or Emu Bank that can serve the new development on Section 45 and also Ginninderra College.

Towards the eastern end of College Street, AECOM are currently investigating the potential for park and ride. There is an existing pair of bus stops that could service this site and Radford College. Radford College also generates significant turning movements particularly in the late morning peak which impacts on bus and general traffic performance and safety.

A 'B signal' provides buses exiting from College Street a jump start onto Haydon Drive for the City bound journey whilst the Belconnen bound journey is provided with a continuous lane for the left turn movement from Haydon Drive into College Street.

2.1.2 Haydon Drive

Haydon Drive is a busy sub arterial road providing access to several community facilities. Access to these facilities generates significant turning movements whilst the bus stops on Haydon Drive generate pedestrian movements across the road. Traffic signals control many of these movements, but the signals also can result in delays to buses. These elements will need to be addressed in the study to provide safe access for all road users.

Whilst the typical weekday peak periods is generally the major consideration in providing for bus priority and bus accessibility the AIS and Bruce Stadium attract very large attendances for the range of functions held at these venues. Therefore the development of options for Haydon Drive will need to incorporate traffic management requirements for major events at Bruce.

2.1.3 Belconnen Way

The inbound direction of Belconnen Way is often delayed at the Gungahlin Drive extension overpass back through the intersection with Haydon Drive. With the *Frequent Rapid* service being routed via Belconnen Way and Haydon Drive there are opportunities to reduce delays to buses for the inbound direction. These measures may also benefit the general traffic.

The outbound direction is more limited in the potential options because of the road grade and intersection levels that restrict some options for the west to northbound movement. Nevertheless the combination of providing bus priority in both directions along Haydon Drive will generate opportunities at the Belconnen Way / Haydon Drive intersection.

2.2 Eastern Valley Way/ College St intersection

2.2.1 Issues for Buses

The key source of delay for buses at this intersection is for westbound right turners from College Street into Eastern Valley Way. Currently, there are few delays to westbound buses moving off from the bus stop opposite CISAC into the right turn lane to turn into Eastern Valley Way.

2.2.2 Options

Options relate to reducing the delays to right turning buses. Note that all options include the provision for extending existing cycle path facilities with a combination of on and off road cycling, at all locations in the corridor.

Option	Pros	Cons	Priority
A1. Do nothing	- No capital cost - Currently works satisfactorily most of the time	- Delays to buses and other traffic will continue to grow as Belconnen and University of Canberra develops - Does not provide conspicuous priority for this part of the route	NA
A2. Build right turn pockets on College St to enable diamond turn phasing	- Increased flexibility for signal phasing. Leading, lagging, filter option for signals phasing will reduce bus delays in the PM peak, but not the AM peak.	- Road widening of College Street required which would involve a change in property boundaries on the south-west corner of the intersection (open space). - Likely to be costly and low benefit cost.	Low
			
Option A2 Schematic			
A3. Add westbound turn/ through lane on College St	- Provides for buses to depart westbound bus stop and enter directly into the right turn lane - Potentially more benefit than the diamond turn option (ie., A2), particularly in the AM peak - Likely to be lower cost than A2 - May not require property boundary changes	- Requires widening of College Street	Low - Medium

Option	Pros	Cons	Priority
			
Option A3 Schematic			
A4. Extend left-turn bay and create a bus-only right turn bay from the kerbside lane, with integrated bus stop	- Overcomes need for buses to merge across two lanes to turn right - Does not require change to property boundaries	- Increased delays to other traffic, potentially affecting queues on Eastern Valley Way and delays to eastbound buses	Not recommended

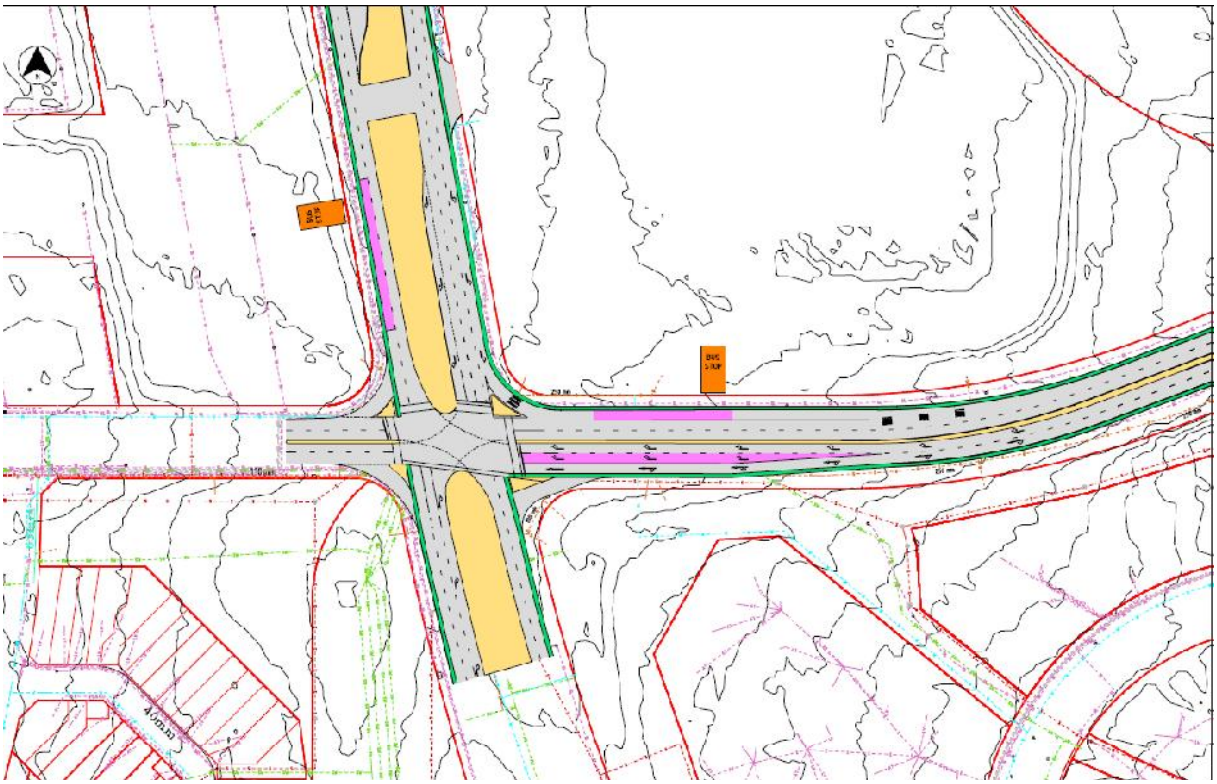
2.2.3 Conclusion

Do nothing is the most appropriate option here in the short-term. The options for improvements for right turning buses may become worthwhile in the longer-term, with growth in bus passenger numbers and increased delays to buses.

The preferred option here is adding a westbound through/right turn lane on the College Street approach (ie., A3), but this is not required in the short-term. The indicative cost for constructing this is $950,000.

The proposed layout is shown in Figure 2-3.

Figure 2-3: Preferred Intersection Layout College Street / Eastern Valley Way



2.3 College Street Adjacent to University of Canberra and Radford College

2.3.1 Issues for Buses

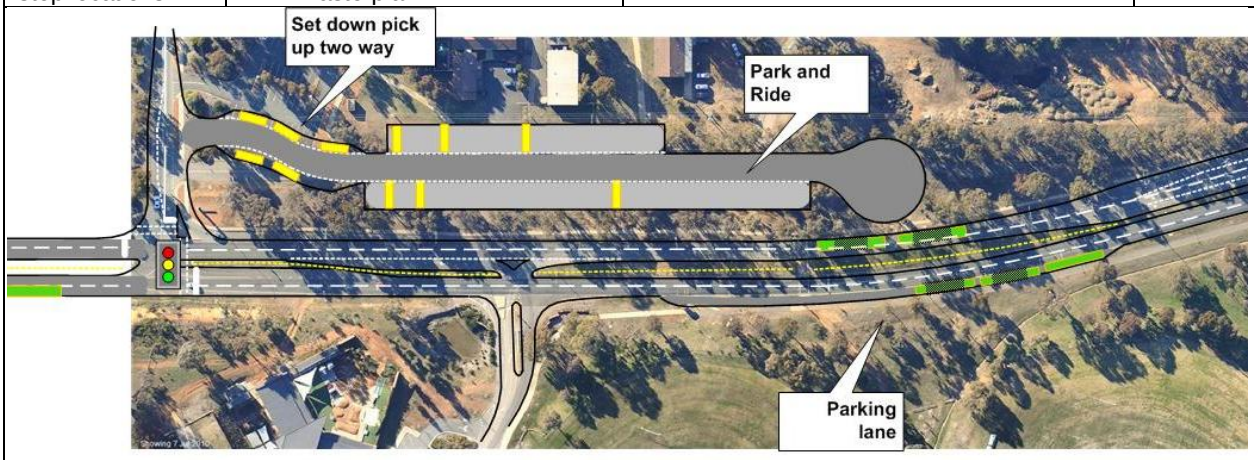
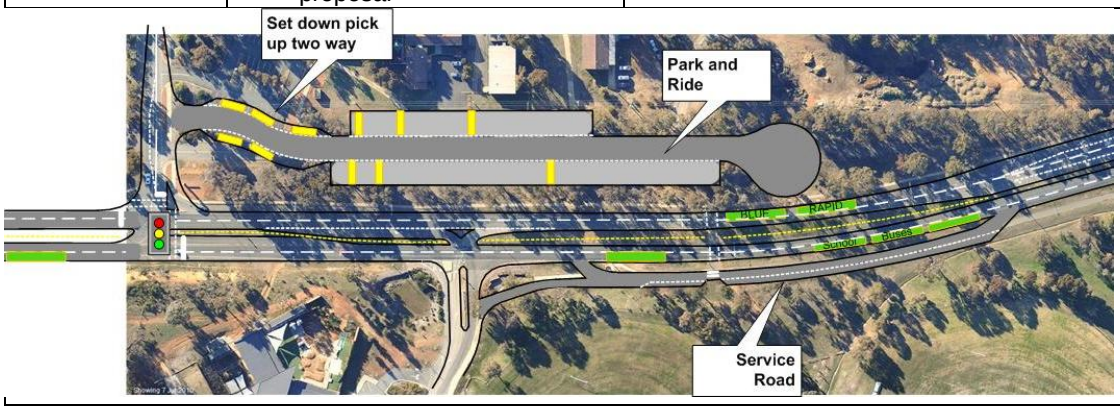
The key sources of delays for buses on College Street are:

- Traffic and queues associated with Radford College in the AM peak; and
- Multiple bus stops.

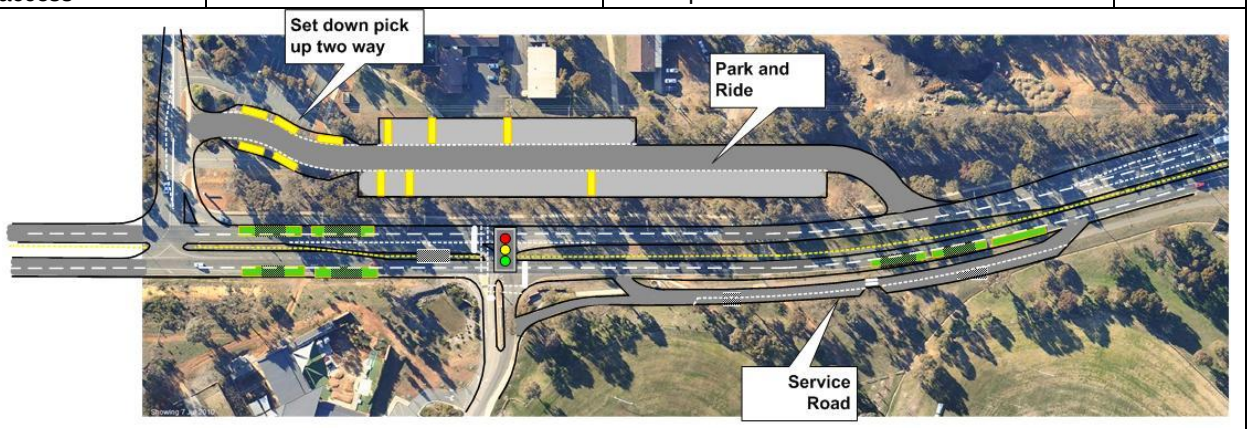
There are also safety concerns for pedestrians crossing College Street as there have been serious / fatal accidents along this section in the past 40 years. Furthermore, a park-and-ride facility is being assessed as part of another study by AECOM as an important element of the TfC series of projects. The current preference is to locate the park-and-ride car park on Pinnaroo Street, located on ACT Government land between the university and College Street currently designated as public transport route.

2.3.2 Options

Options have been developed that relate to resolving bus conflicts with Radford College traffic and improving safety for pedestrians and general traffic movements. The ideas have been developed following consultation with both the University of Canberra and Radford College – although they have not as yet been presented to those organisations. Although the projects involve more than just bus priority, the institutions have indicated a willingness to contribute to a coordinated proposal that benefits all stakeholders. Unfortunately the time frames may not coincide with budget provisions.

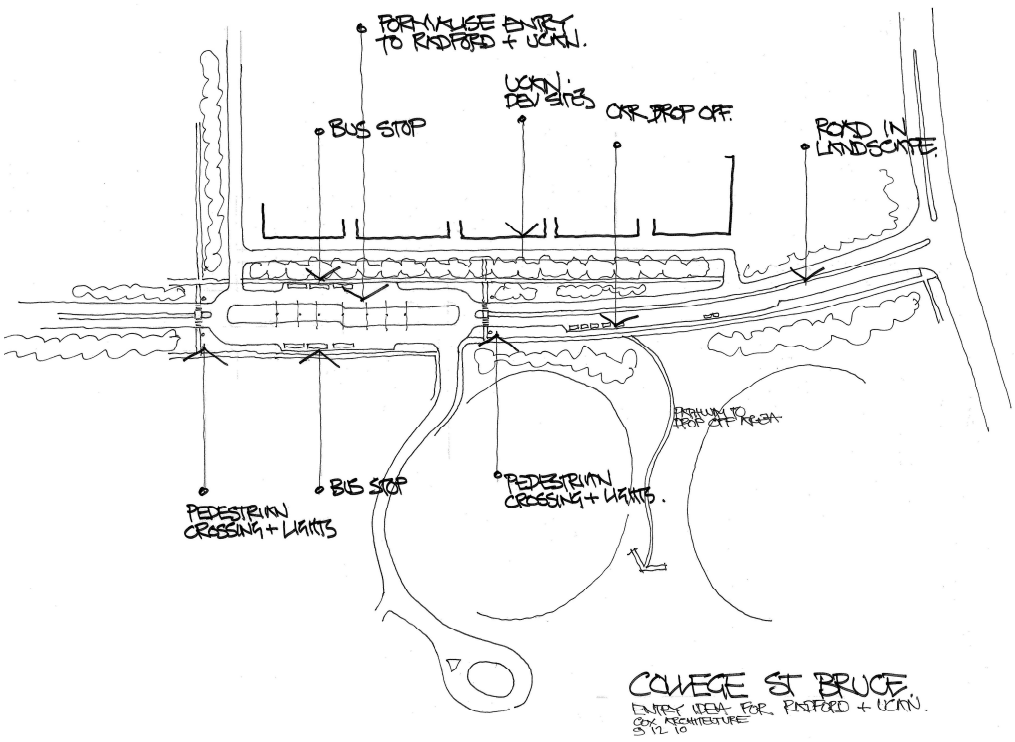
Option	Pros	Cons	Priority
B1. Do nothing	- No capital cost	- Morning disruption to buses remains - Does not address safety problems	NA
B2. Signalise Kirinari St access, fence median and develop a parking lane adjacent to Radford College and keep current stop locations	- Separates set down/pick up facility from College St - Fits with Park and Ride ideas - Potentially improves pedestrian safety (median fence) - Not inconsistent with UC masterplan	- Costly and unlikely to solve all problems - Affects access to some UC car parks	Not Recomm-ended
			
Option B2 Schematic			
B3. As for B2, except create service road adjacent to Radford College	- Fits with University of Canberra master plan - Improves pedestrian safety - Reduces delays - Improves running times - Fits well with Park and Ride proposal	- Increases passenger walking distance for UC and Radford - Increased traffic delays due to new signals - Service road in Radford lease requires Radford funding / government grant	Not Recomm-ended
			
Option B3 Schematic			
B4. As for B3, but with Pinnaroo St connection to College St, as shown in schematic for B5	- As for B3 - Provides for set down and pick up to return to the west after passing through P&R	- As for B3, but some additional cost	Possible short to medium-term

Option	Pros	Cons	Priority
B5. Signalise Radford access, fence median and create new bus stops at Radford access	- Traffic signal controlled access to Radford	- Requires retention of western bus stop with inherent safety problems - Does not recognise University of Canberra main access - Virtually no demand off peak for signal operation	Not Recomm-ended



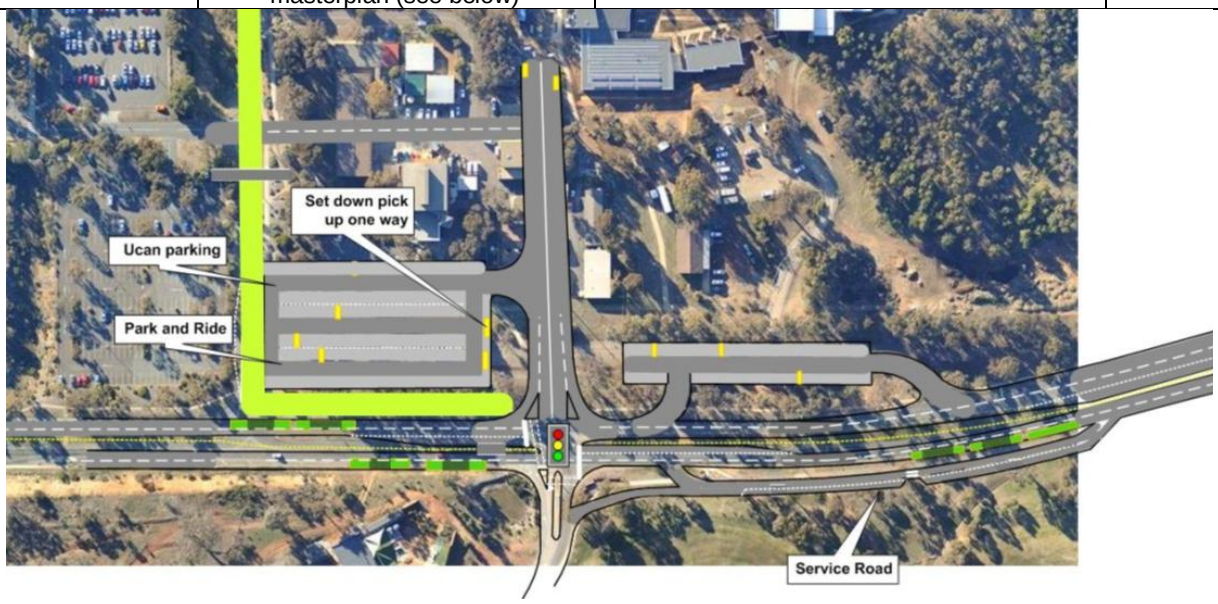
Option B5 Schematic

B6. Cox Option – elongated roundabout on College Street	- Reduces traffic speeds past University and Radford - Potentially strong land mark to identify UC and Radford addresses	- Generates higher traffic volumes and pedestrian conflicts between Kirinari Street and Radford access - Can cause locking of roundabout with queuing - Does not separate parking from through traffic - Utilises road reservation for University development	Not Recomm-ended

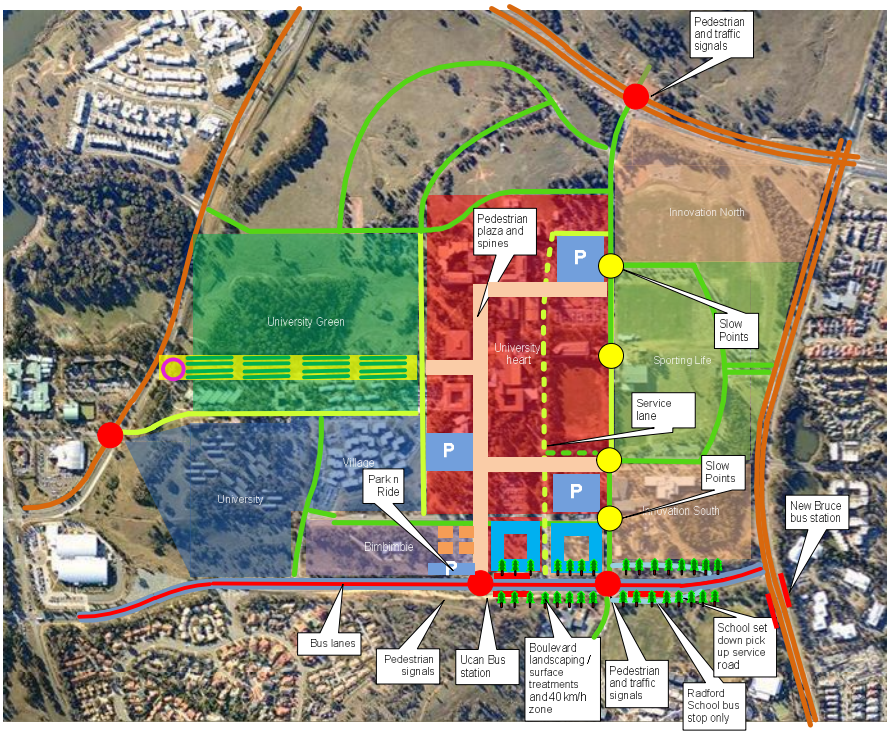


Option B6 Schematic

Option	Pros	Cons	Priority
B7. New Cross Road with Radford and University of Canberra	- Creates entry for both University of Canberra (UC) and Radford - Reduces the number of conflict points - Provides safer access to University of Canberra and Radford College - Consistent with UC masterplan (see below)	- Requires demolition of some existing internal University buildings - Program coordination may be difficult - Service road in Radford lease requires Radford funding / government grant - Increased delays to buses due to new signals, but safer for pedestrians	Medium to long-term



Option B7 Schematic



UC Masterplan

Option	Pros	Cons	Priority
B8. New signalised access to Radford College	- Provides significant additional road space off College Street - Greater flexibility for Radford traffic management	- Substantial earthworks required - Proximity to early childhood area - Potential impact on Reserve - High cost	Not Recomm-ended
			
Option B8 Schematic			
B9. New western access to University of Canberra	- Provides safer access for pedestrians to buses via traffic signals - Reduces pedestrian / vehicle conflicts within University of Canberra	- On crest of a hill may be sight distance issues - May not be consistent with University Master-plan - Greater delays to buses due to signals	Not Recomm-ended
			
Option B9 Schematic			
B10. Complete duplication of College Street	- Buses have flexibility to negotiate around obstructions - Improved running times	- High cost - Likely to require some intrusion into IPT reservation rather than Bruce Hill	Not Recomm-ended
B11. Bus lanes each way on College Street in 4 lane sections	- Provides for unconstricted bus movements	- Intersections may lead to confusion with other road users - High cost	Long-term

2.3.3 Conclusion

A number of the above options have a substantial impact on University of Canberra and Radford College. There are a number of competing interests along this corridor, but bus movements and pedestrian safety are most important.

Any options involving works within Radford College grounds are unlikely to be able to be implemented in the short-term without joint funding arrangements with ACT Government. Also, any options impinging on the UC access will require careful design to ensure they are compatible with future planning for the university and maintain suitable access to existing UC car parks.

The preferred solution here is likely to be a combination of the options considered. This will need to be determined in consultation with key stakeholders and via a thorough assessment of issues and options. The likely long-term plan for the corridor may incorporate the following elements:

- Duplication of College Street with a bus lane and one traffic lane in each direction
- A service road for set down and pick up at Radford
- A new signalised cross road for University of Canberra access and existing Radford access
- A pedestrian fence within the median to deter unsafe pedestrian movements

The indicative cost for developing the cross road option together with service roads for set down / pick up at Radford and the duplication of College Street is

College Street duplication $4m.

University / Radford College $1.8m

The preferred layout of both College Street duplication and the entry to the University of Canberra is shown in Figure 2-4 , **Error! Reference source not found.**, and Figure 2-6.

Figure 2-4: Revised Cooinda Street / College Street Intersection

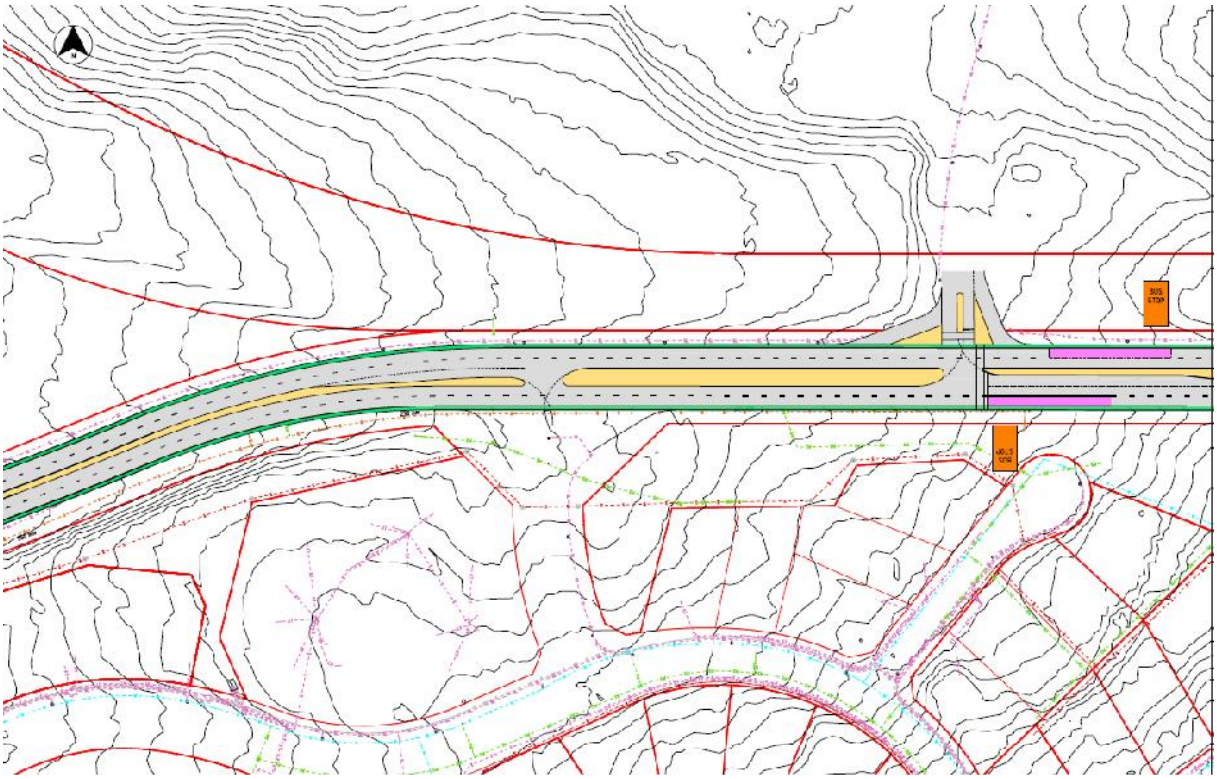


Figure 2-5: College Street duplication

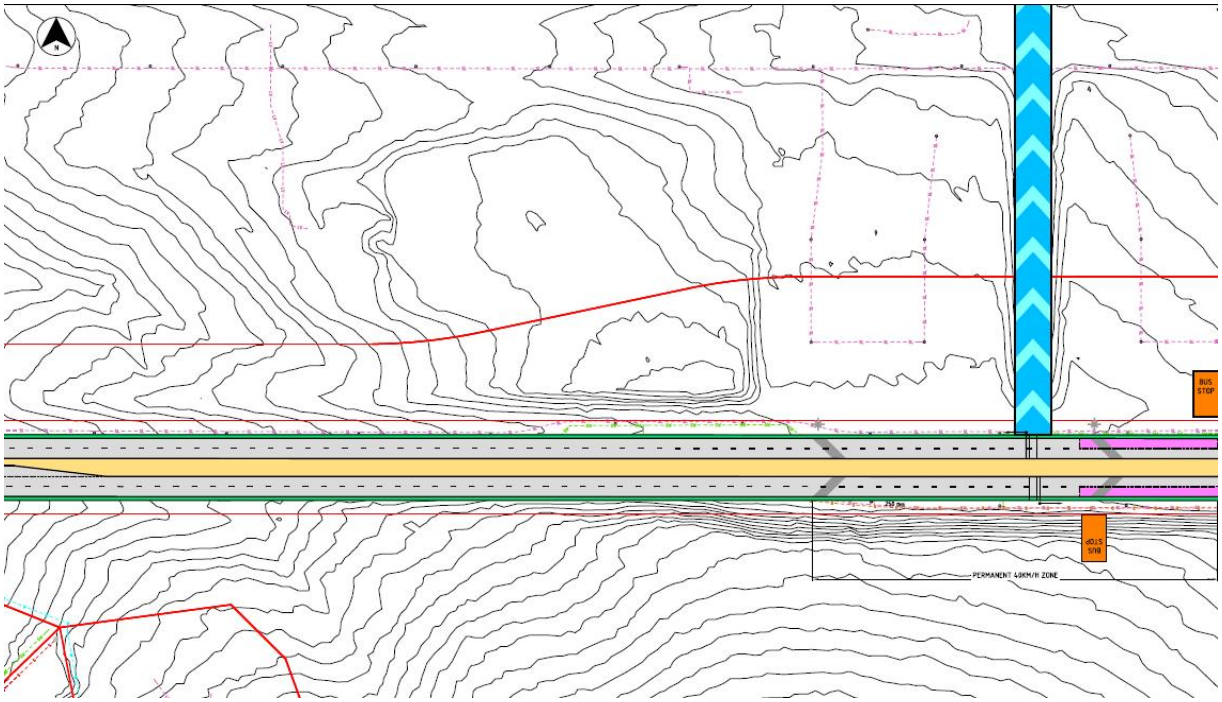
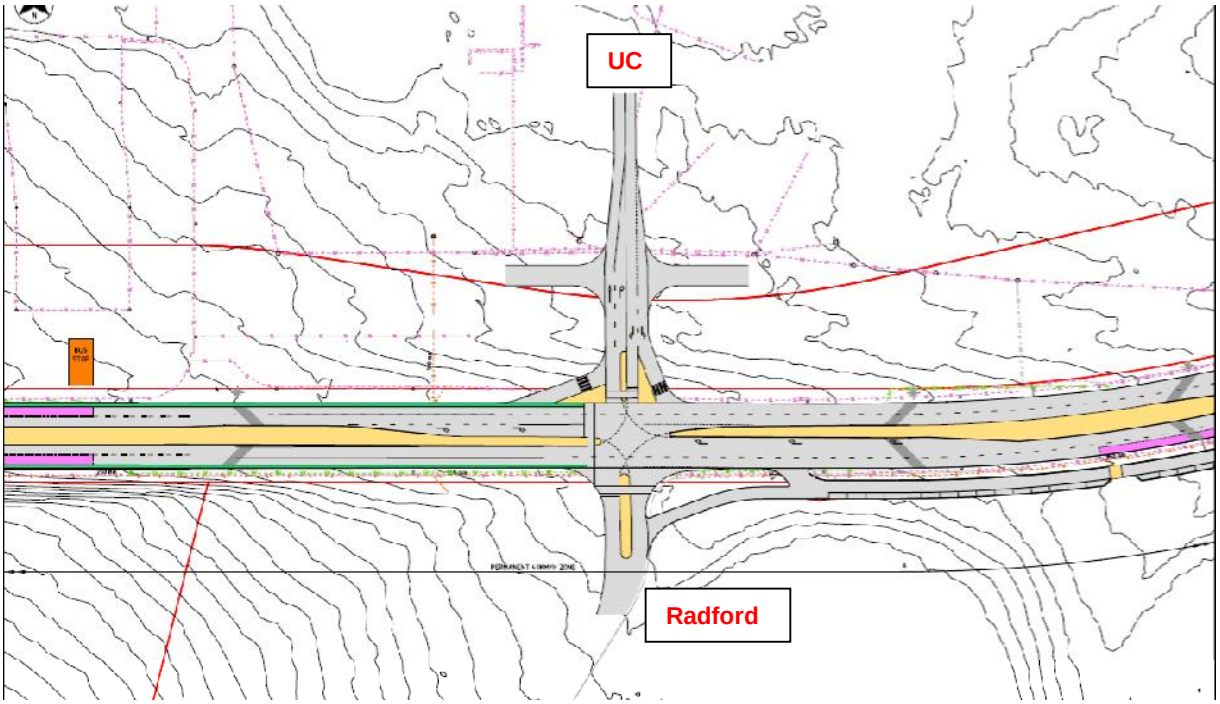


Figure 2-6:.Revised University of Canberra / Radford College Access



2.4 Haydon Dr/ College St intersection

2.4.1 Issues for Buses

There are two issues to consider at this location:

1) Concerns were expressed by ACTION about the turn radius for northbound buses on Haydon Drive turning left into College Street and conflicts with other vehicles cutting across from the median lane to enter Radford College or drop passengers off on College Street.

2) Some options introduced adjacent to UC and Radford College would involve the removal or relocation of bus stops at the eastern end of College Street, affecting bus passenger access to Bruce.

2.4.2 Options

Options relate to resolving bus conflicts with traffic cutting across from the median lane to access Radford College and to provide improved bus stop facilities to service Bruce.

Option	Pros	Cons	Priority
C1. Do nothing	- No capital cost	- Does not address bus conflict problems or passenger access to Bruce	NA
C2. Extend island to better protect left turning buses and improve turn radius	- Reduces weaving conflicts, thus improving bus operation	- Capital cost, albeit relatively small	Short-term
C3. Add new bus stops to serve Fernhill Park on Haydon Drive	- Increased passenger catchment for Fernhill	- Requires merge of Haydon Drive traffic - Additional delays to buses and bus passengers due to new stop	Possible short-medium term

Option C3 Schematic

2.4.3 Changes or Additions to Bus Stops

A number of the options considered above involve some changes to bus stop locations or an addition of a bus stop. The addition of a bus stop will add time to the rapid bus services and is not desirable unless it results in significant patronage.

One of the options involves the addition of a bus stop on Haydon Drive just south of College Street (see above schematic). This will result in increased coverage for Fern Hill Technology Park, as illustrated in Figure 2-7. There are about 2,000 jobs in Fern Hill and this could generate about 300 peak hour bus passenger movements in future. There would also be additional trips associated with the medium density housing within the catchment, increasing peak hour movements to about 400 passengers per hour, depending on achievable bus mode use for Bruce. This is considered significant patronage and worth contemplating an additional stop.

The development of this additional bus stop would depend on potential changes to bus stop locations along College Street that may occur as a result of potential changes to access arrangements. The additional stop is more likely to be needed if there are no changes to current stop locations on College Street.

Some of the proposals along College Street involve shifting the existing University of Canberra stop further east. This is likely to be of benefit to a proposed park-and-ride facility and to Fern Hill, as well as providing the opportunity for increased pedestrian safety via a new set of traffic signals for access to the University. The resultant change in passenger catchment is illustrated in Figure 2-8. In this instance, a new bus stop on Haydon drive is not recommended.

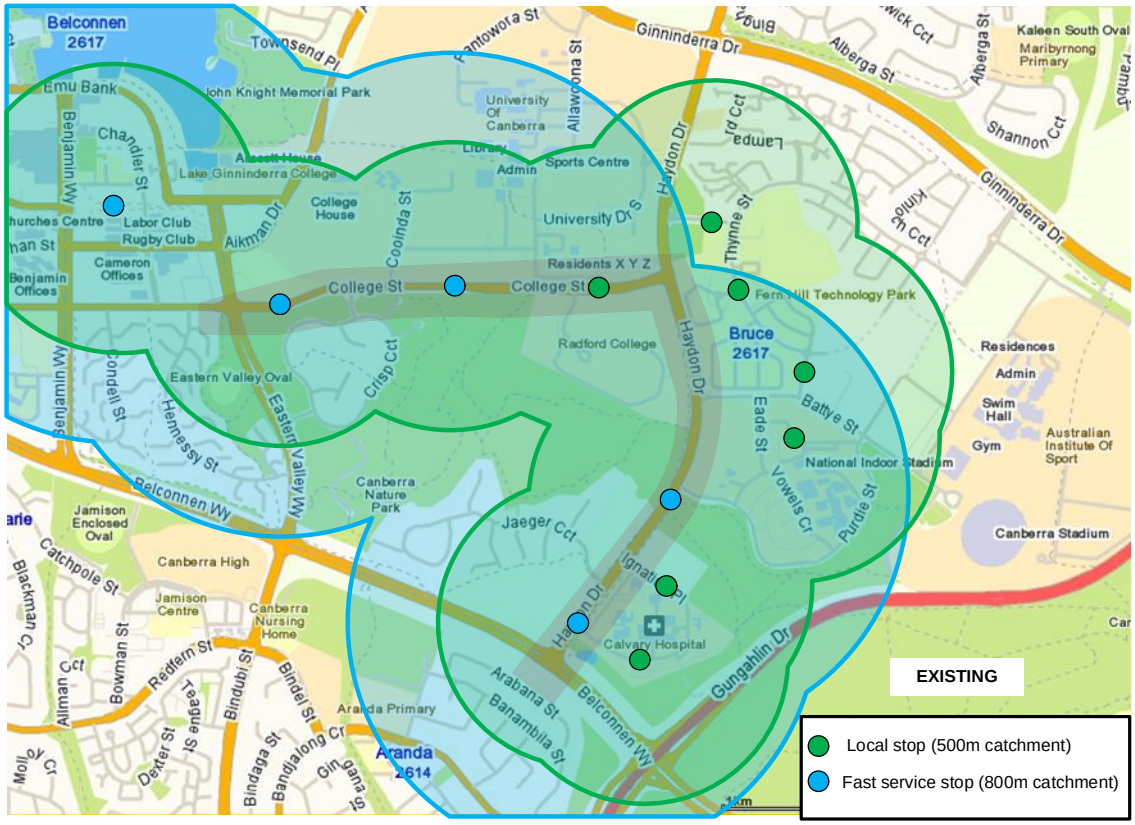
2.4.4 Conclusion

It is appropriate to address the left turn problem from Haydon Drive into College Street, particularly for the new Tag Steer buses.

The development of an additional bus stop on Haydon Drive would depend on potential changes to bus stop locations along College Street that may occur as a result of potential changes to access arrangements. The additional stop is more likely to be needed if there are no changes to current stop locations on College Street.

The indicative cost for this option is $100,000.

Figure 2-7: Bus Stops and Route Coverage in Bruce Corridor (1 of 2)



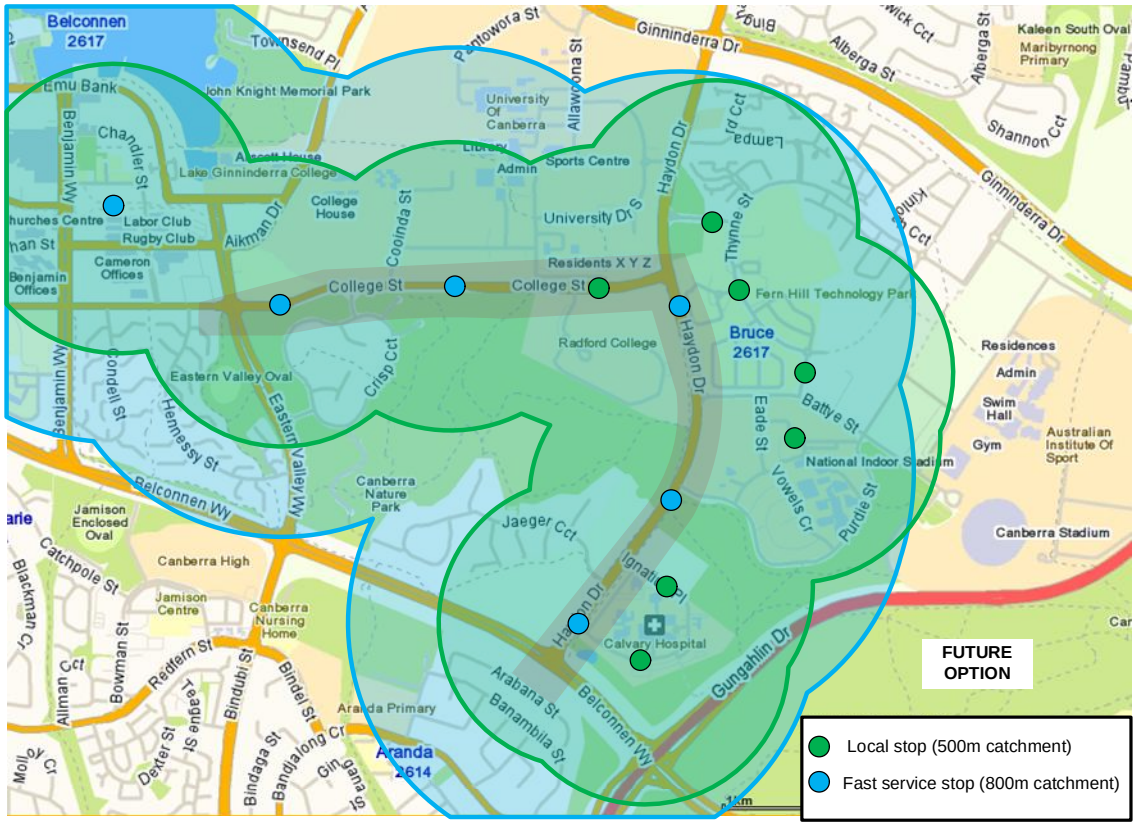
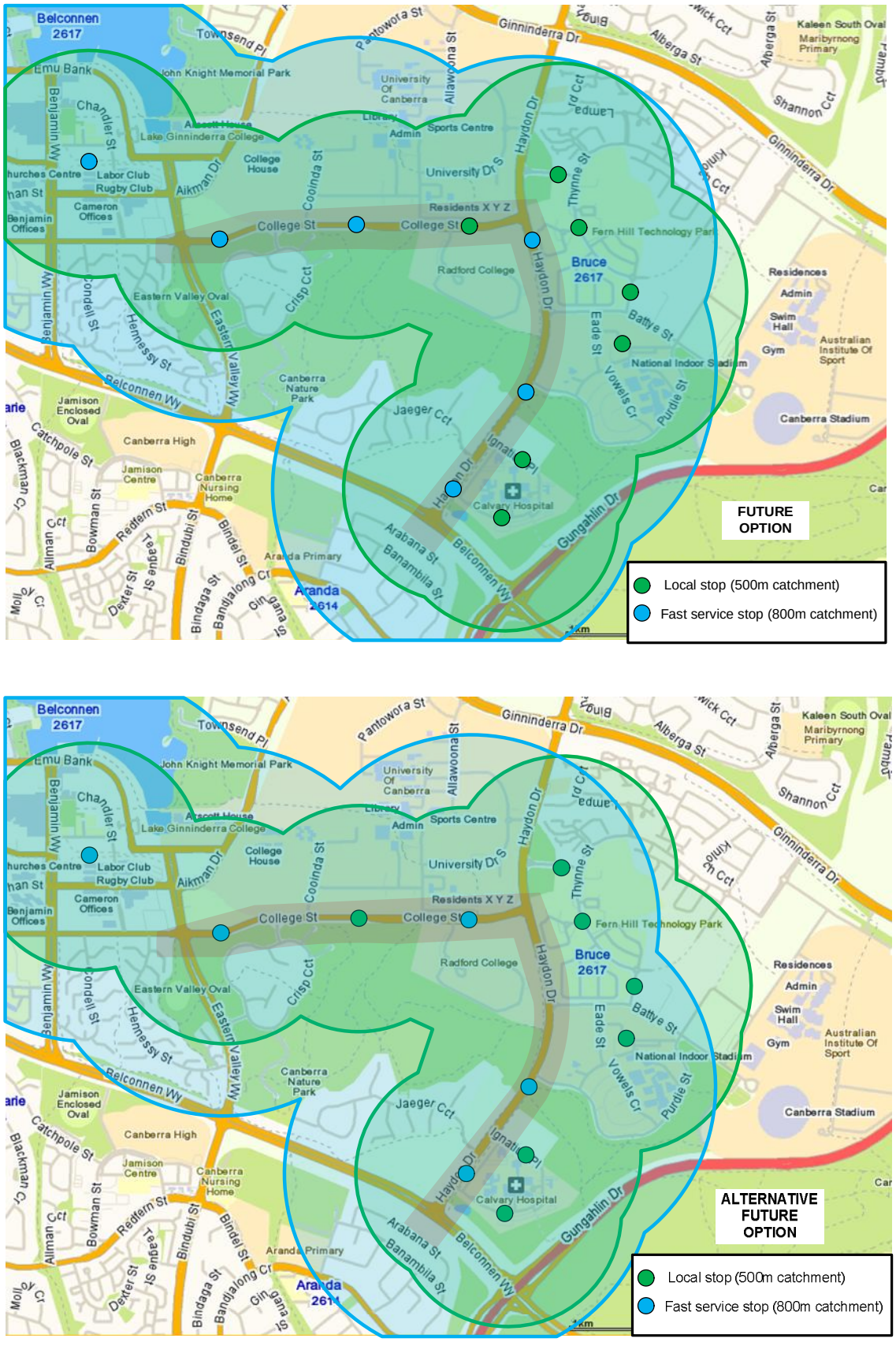
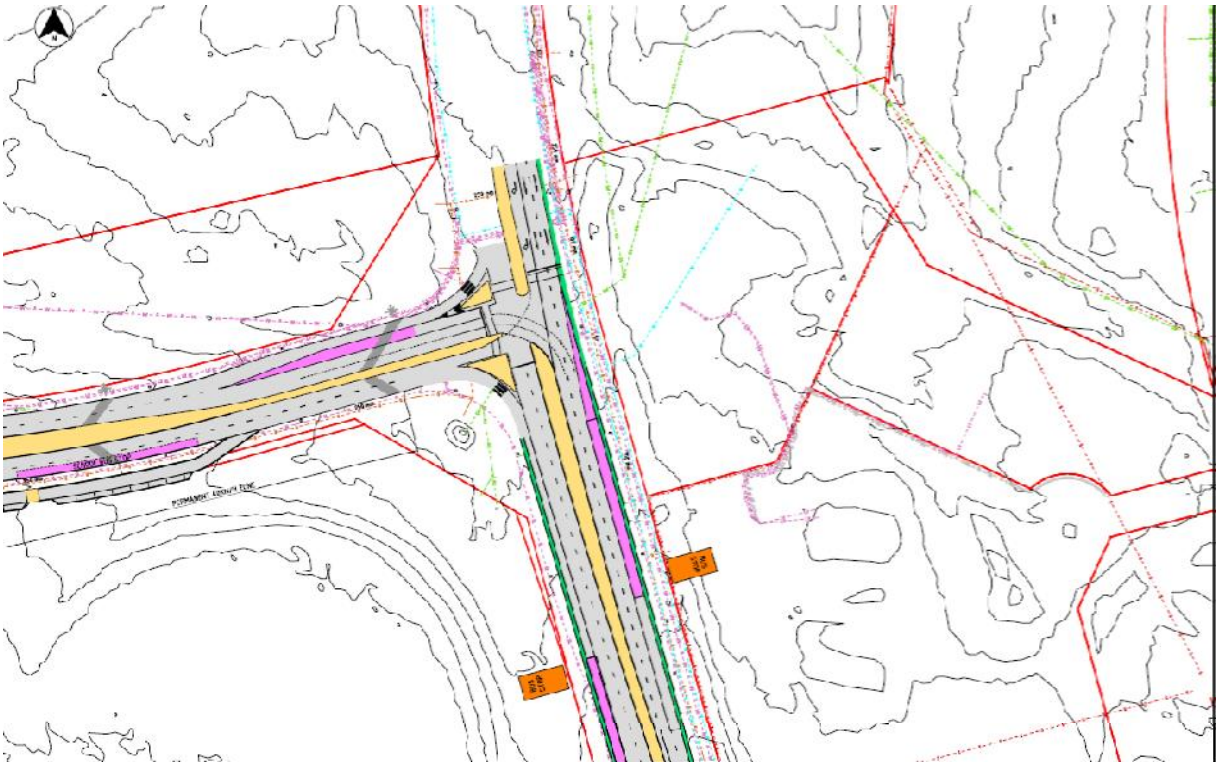


Figure 2-8: Bus Stops and Route Coverage in Bruce Corridor (2 of 2)



The indicative cost of the preferred option is $200,000 and shown in Figure 2-9.

Figure 2-9: Haydon Drive / College Street Intersection Relocated bus stops



2.5 Purdie St. / Haydon Dr. intersection

2.5.1 Issues for Buses

There are four issues driving changes at this intersection:

1) Congestion at nearby bus stops affecting traffic (including buses) on Haydon Drive, because buses block the kerbside lane at these bus stops thus increasing delays for buses and other traffic on Haydon Drive.

2) Safe access for all traffic to/from Purdie Street and Bruce TAFE.

3) Safe access across Haydon Drive for cyclists using a trunk bicycle path that runs adjacent to Purdie Street.

4) Potential for rear end crashes on Haydon Drive associated with buses stopping.

2.5.2 Options

Options relate to reducing the impacts of stopped buses on traffic movements along Haydon Drive and providing safe access for all traffic to/from Purdie Street.

Option	Pros	Cons	Priority
D1. Do nothing	- No capital cost	- Delays to Haydon Drive traffic including buses - Continued safety risks for cyclists and pedestrians crossing Haydon Drive	NA
D2. Indented bus bays	- Reduces delays to following buses to access bus stop - Clarity of bus manoeuvre reducing risk of rear end crashes	- Difficulty of egress into traffic stream - Requires long acceleration lane	Short-term

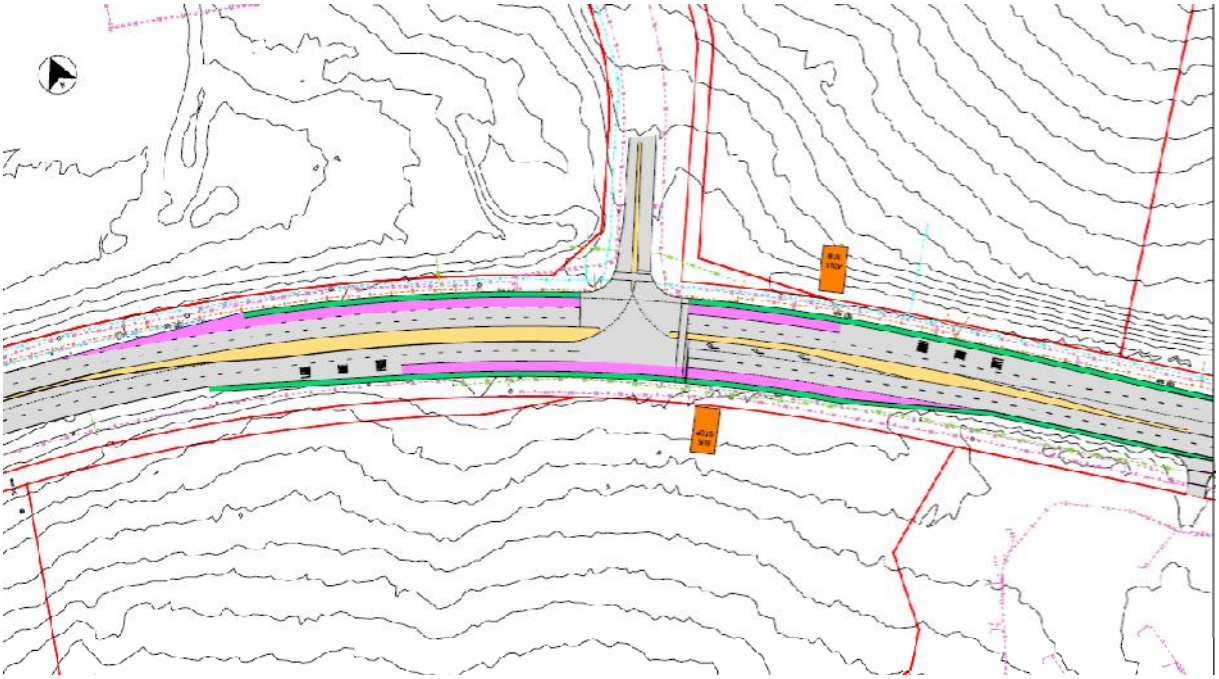
Option	Pros	Cons	Priority
			
Option D2 Schematic		*Option D3 Schematic*	
D3. Signalise intersection and develop queue jump lanes and indented bus bays on eastern side of intersection	- Creates gaps for buses exiting bus stop - Reduces delays to close following buses - Safer cycle path crossing - Safer crossing for pedestrians	- Unlikely to coordinate traffic flow in both directions - Increased delays to buses due to new signals - Increased delays to all traffic in off-peak	Short-Medium Term

2.5.3 Conclusion

The option of signalising the Purdie Street intersection and making provision for buses addresses the issues identified at this location, although it will result in some increased delays to buses and other traffic due to the new signals.

The indicative cost for this option is $1,600,000 and is shown in Figure 2-10

Figure 2-10: Option Purdue Street / Haydon Drive Intersection



2.6 Haydon Dr, Purdie St to Mary Potter Cct North

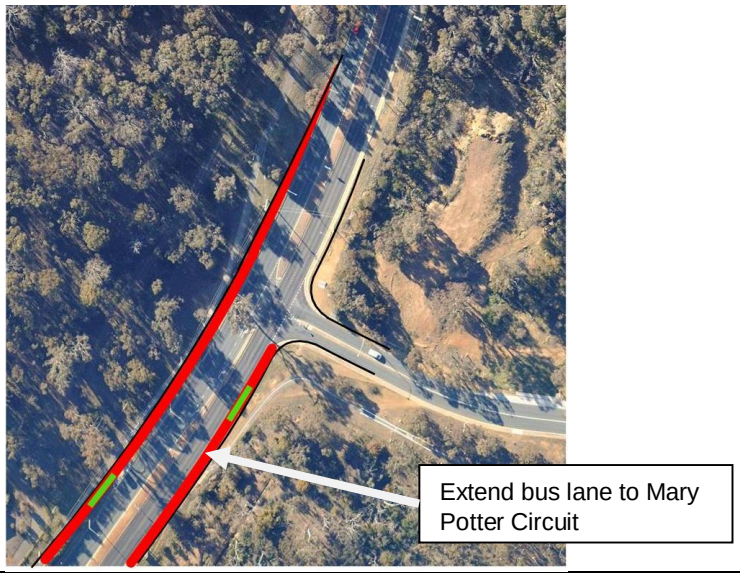
2.6.1 Issues for Buses

There are already noticable delays to buses in this section of road, particularly in the AM peak. The primary issue here is the question of whether to extend the proposed bus lane facilities at Purdie Street further towards Belconnen Way or not. The Paramics modelling presented in the next chapter suggests that this is not likely to be necessary and improvements to the bus stops near Purdie Street will resolve the key source of delays in this section of road.

2.6.2 Options

Options relate to extending potential bus lanes through this section of Haydon Drive, to connect proposed bus facilities at Purdie Street with possible facilities adjacent to Calvary Hospital.

Option	Pros	Cons	Priority
E1. Do nothing	- No capital cost - Less opportunity for "through" bus delays in re entering traffic stream	- Delays for route buses exiting from Calvary	NA
E2. Build/extend City-bound bus lane with acceleration lane towards Mary Potter Cct North	- Allows buses to exit from indented bay easily into a bus lane - Reduces delays to all traffic including buses	- Buses rejoining through traffic at end of queue for Jaeger Cct traffic signals	Short - medium-term
E3. Extend bus lanes from Purdie Street through to Belconnen Way (both directions)	- Bus priority for the slow section of Haydon Drive - Safer bus operation - Provides option to relocate Calvary Hospital bus stop to a more central location	- High cost for minimal benefit in short to medium term - Potential impacts on gas main	Consider in long-term

Option	Pros	Cons	Priority
			
Option E3 Schematic			

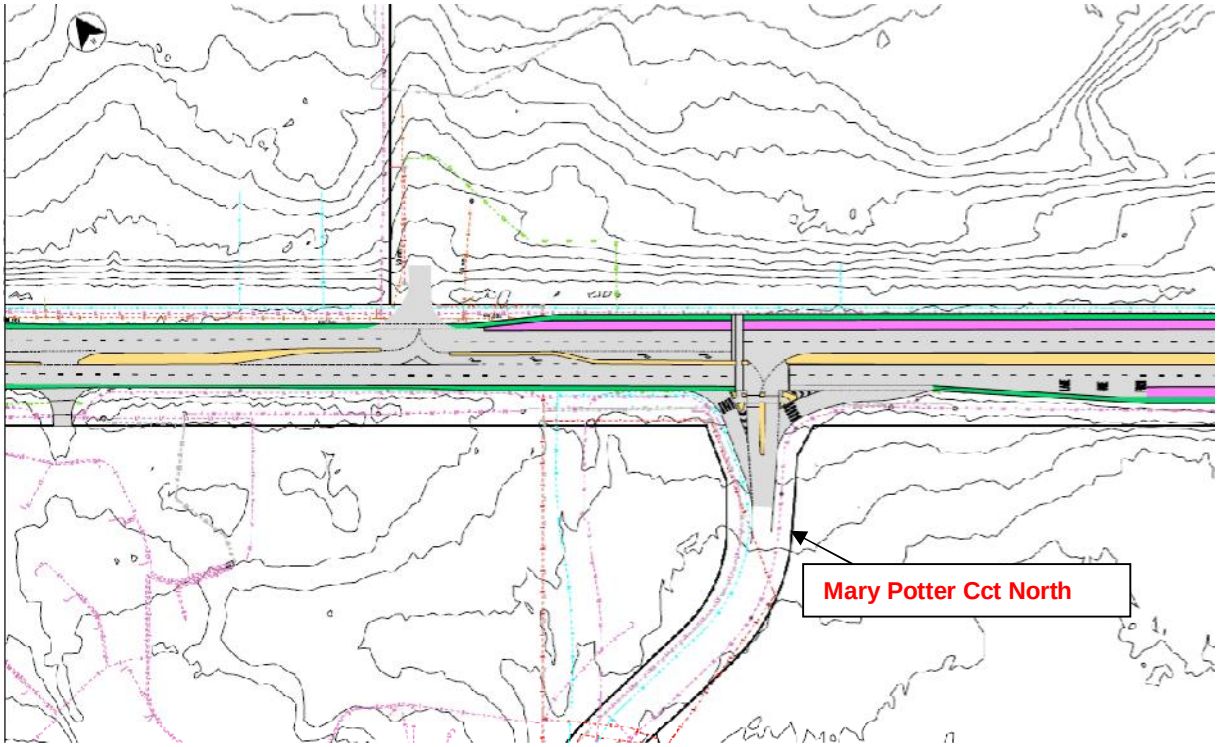
2.6.3 Conclusion

There is not a strong case for extending bus lanes in this section of Haydon Drive, based on the outcomes of the micro-simulation modelling of future traffic conditions on Haydon Drive, documented in Chapter 4.

The indicative cost for signalising the intersection together with bus bays and acceleration lanes is $450,000.

The preferred option has an indicative cost of $ 600,000 and is shown in Figure 2-11.

Figure 2-11: Preferred Option Mary Potter / Circuit North Intersection



2.7 Haydon Dr, Mary Potter Cct North to GDE/ Belconnen Way (City-bound)

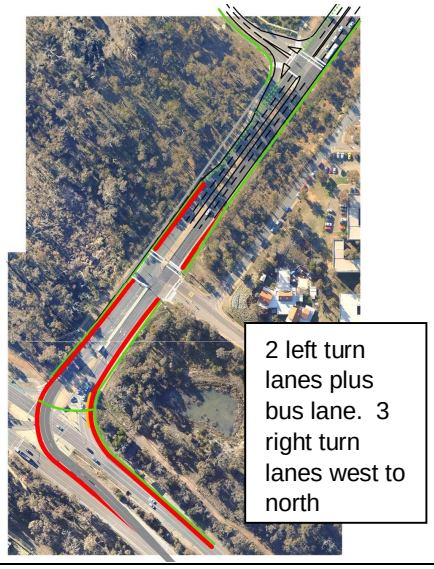
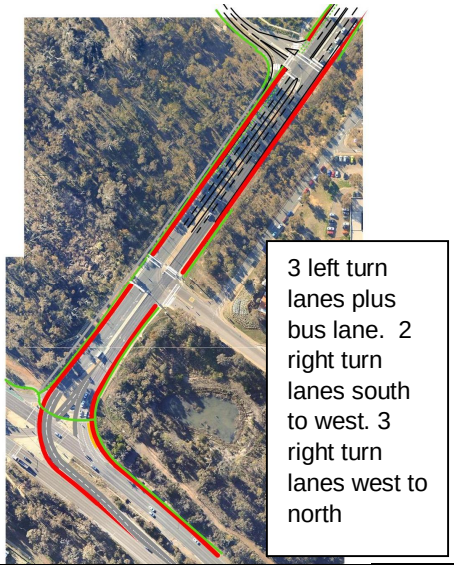
2.7.1 Issues for Buses

The issues affecting bus operations in this section of road are:

- Long queue lengths and delays on Hayden Drive due to congestion on the section of Belconnen Way between Haydon Drive and GDE, which is running at capacity during the AM peak.
- It is difficult for buses and other traffic to get into the kerbside lane due to its short length and queues backing up well beyond this lane in peak periods.
- The Calvary Hospital bus stop is not well located.
- It is difficult for local buses to turn right out of Mary Potter Cct North in the AM peak.

2.7.2 Options

Options relate to reducing delays to buses on Haydon Drive and improving bus passenger access to Calvary Hospital.

Option	Pros	Cons	Priority
F1. Do nothing	- No capital cost	- Does not address issues	NA
F2. Extend kerbside lane to GDE as bus-only lane (ie., 2 lanes only turning left out of Haydon Dr)	- Allows buses to queue jump, during shoulder peak periods - Allows formation of bus lane on Belconnen Way to service express services	- Significantly increased delays to traffic and buses on Haydon Drive - Potential increased queuing northbound on Haydon Drive waiting to enter Mary Potter Circuit South	Not Recomm-ended
			
Option F2 Schematic		*Option F3 Schematic*	
F3. As for F2, but create short third left-turn lane and additional short right-turn lane and add lane to Belconnen Way	- Provides for westbound bus priority lane - Contains delays to other traffic with additional bus lane - Improves safety by reducing potential for rear end crashes - Improves queue jump for all eastbound buses - Provides for all eastbound buses	- Cost - May impact on engineering services	Short to medium-term

2.7.3 Conclusion

Works at this location is a high priority for the Bruce Section of the Transitway. The micro-simulation modelling presented in Chapter 4 shows that Option F3 is preferred. It is evident from the modelling that additional right-turn capacity is needed from Haydon Drive and that the bus lanes on Haydon Drive be extended beyond the Jaeger Circuit intersection.

Micro-simulation modelling indicated that consideration will need to be given to signalising the northern access to the hospital in future to enable right turns out of this access in peak periods. It will be essential that the Jaeger Circuit signals be linked with other signals along Haydon Drive to ensure smooth progression of traffic on Haydon Drive during peak periods. This will be difficult to achieve in the off-peak direction, resulting in additional delays to buses and other traffic travelling in the off-peak direction.

The indicative cost for constructing the additional lane on Belconnen Way and the intersection improvements at Haydon Drive together with additional bus lanes on Haydon Drive from Belconnen Way to Jaeger Circuit is $1.6m.

2.8 Haydon Dr, Belconnen Way to Jaeger Circuit (Belconnen-bound)

2.8.1 Issues for Buses

There are two sources of delay that are of concern in this section of road:

- The northbound / outbound Calvary Hospital bus stop is not well located and causes delays to traffic and other buses, resulting in underutilisation of the kerbside lane and risks of rear end crashes with stopping buses.
- Increasing delays for buses turning right from Belconnen Way into Haydon Drive.

2.8.2 Options

Options relate to resolving delays at the bus stop on Haydon Drive adjacent to Calvary Hospital and improving the right turn from Belconnen Way.

Option	Pros	Cons	Priority
G1. Do nothing	- No capital cost	- Does not address issues	NA
G2. Create bus layby at Mary Potter Cct South	- Reduces potential for rear end crashes - Safer egress from bus stop	- Joins before Jaeger Circuit, which may not benefit some buses	Not Recomm-ended
G3. As for G2, but also create short bus-only right turn lane from Belconnen Way (see Option F2 schematic)	- Provides for westbound buses to queue jump at Haydon Drive	- Adverse cross-fall negotiating right turn into Haydon Drive with discomfort for passengers	Medium-term
G4. As for G3, but extend northbound acceleration lane through the Jaeger Circuit intersection (see Option F3 schematic)	- Improved bus operation and reliability - Safer traffic operation	- Increased cost	Medium to long-term

2.8.3 Conclusion

Option G4 is preferred at this location, as it would provide for safer and more reliable traffic operations. The timing is less critical than the works in the City-bound direction. The widening of Belconnen Way has an indicative cost of $600,000 and shown in Figure 2-12 and

Figure **2-13**

Figure 2-12: Mary Potter (South) / Haydon Drive / Belconnen Way Intersection Preferred option

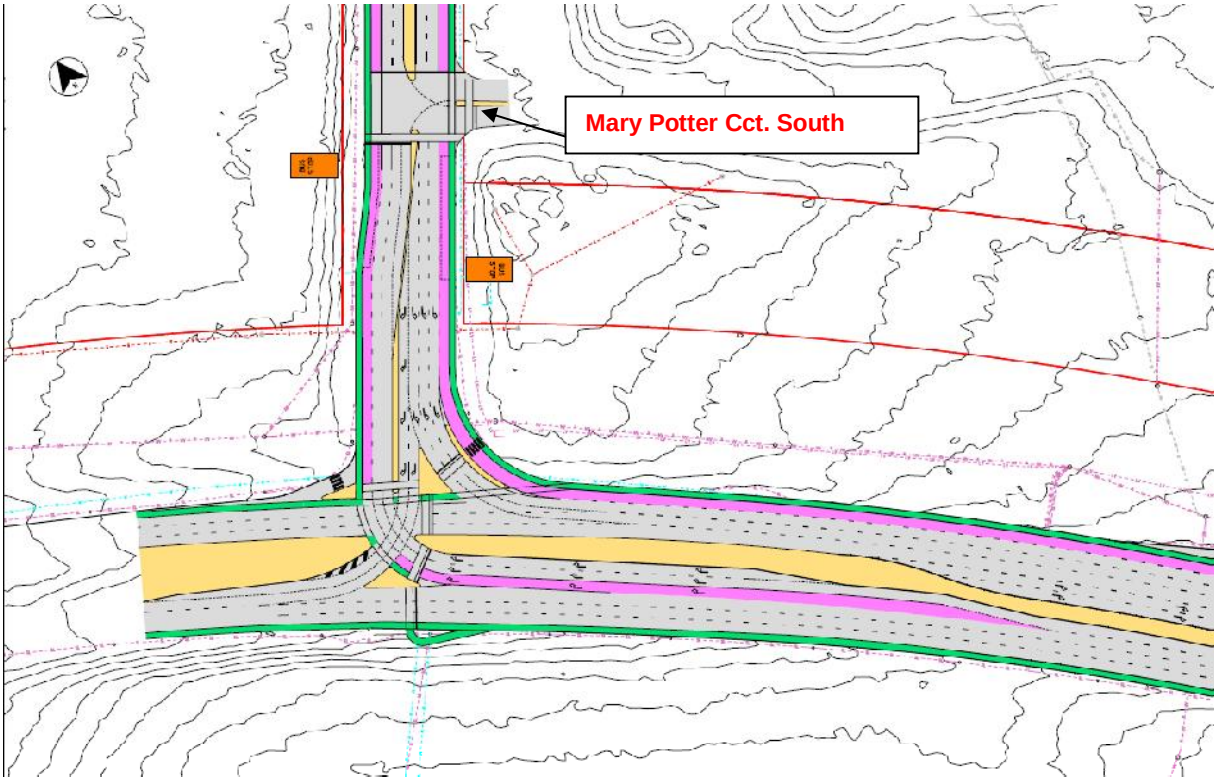
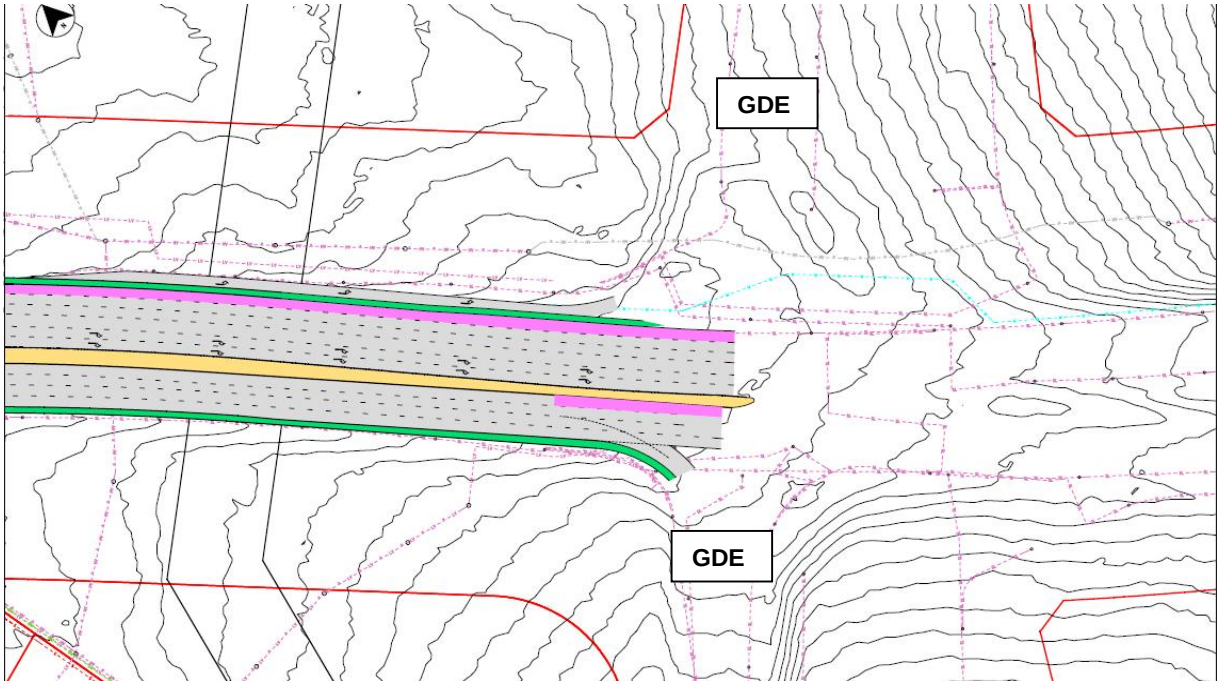


Figure 2-13: Preferred Option Belconnen Way

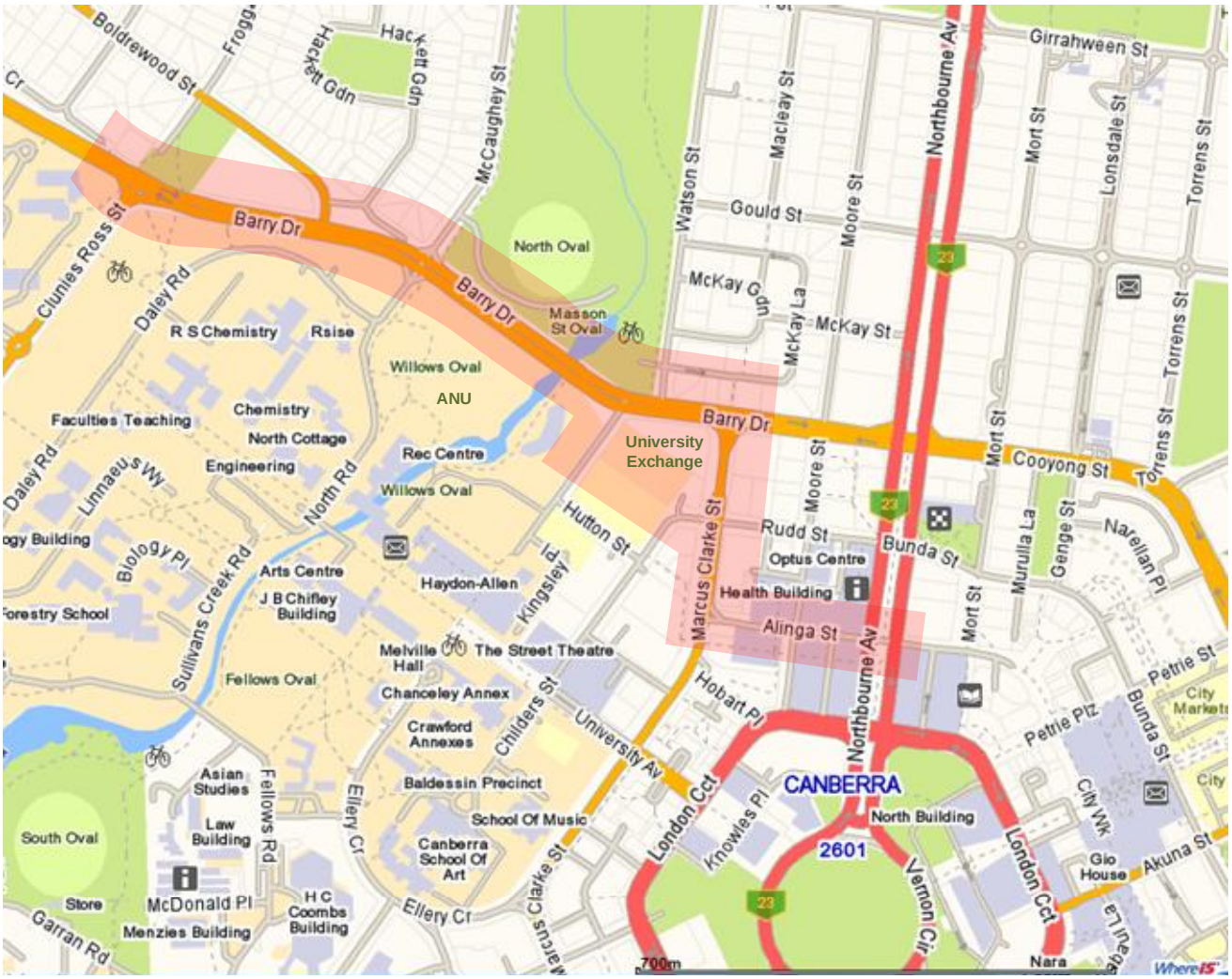

GDE
GDE

3.0 The Belconnen to City Transitway (City Sector)

3.1 Introduction

Figure 3-1 shows the extent of the City Sector corridor and the location of some of the key land-uses in the corridor. These include ANU, University Exchange (under construction) and City offices and other commercial and community uses.

Figure 3-1: Key Uses in the City Sector Corridor



Some of the issues identified in this section of the Transitway route are summarised in Figure 3-2. A description of the issues follows.

Figure 3-2: Traffic and Transport Issues in City Sector Corridor

3.1.1 Barry Drive

The ANU is currently served by bus stops on Barry Drive at the western end of the ANU site. Students and workers are seen every day crossing the highly trafficked Barry Drive midblock between Clunies Ross Street and North Road. The potential to install or replace the existing bus stops may also create opportunities to provide for a safer crossing of Barry Drive by pedestrians destined for the ANU. There may be potential to install such a stop at the North Road intersection. This location is also more central to the main student areas.

The major challenge on Barry Drive is to manage a change of lane designation from the 1st or kerbside lane to access Kingsley Street efficiently and effectively. The study brief calls for a review of the GHD proposal to cross Barry Drive at right angles into Kingsley Street. Whilst this is one way of providing access a SIDRA intersection analysis of the Kingsley Street and Barry Drive intersection with the ANU Exchange Precincts completed shows that there will be longer delays to buses under the GHD scheme than buses currently experience. However the GHD proposal does provide some level of assuredness or reliability of travel times, so the development and assessment of the ANU Exchange bus station will need to balance travel time against reliability and assuredness of the bus services.

The recently completed section of busway west of Clunies Ross Street is expected to be continued in the existing kerbside lane to North Road. This short section of lane contributes little to the overall capacity of Barry Drive as it must merge with the other two lanes after North Road. After North Road the bus lane is expected to continue to the Watson Street layover. There is sufficient pavement space on the Sullivan's Creek bridge to accommodate a bus lane plus the two existing traffic lanes, but there will need to be adjustments to the median width and update the current vehicular barriers at the bridges to provide safe storage for traffic turning right into Kingsley Street. Minor adjustments to the northern verge of Barry Drive would further improve the current situation but it is known that there are significant services in this verge including trunk gas, communications and HV electricity.

3.1.2 The ANU Exchange Precinct

The route has now left the arterial road environment and is operating on the local city streets where there is an increased interface with local intersections, property accesses and pedestrians all of which are capable of reducing the efficiency of the bus operations. It is important for all road users that the busway is clearly delineated and given the appropriate priority. The narrowness of Kingsley Street will be a challenge and requires careful investigation. The intersection of the busway with Childers Street should be reviewed with the expectation that priority be given to buses though some changes to the current intersection. There have been significant enhancements to the urban design of this precinct and these qualities must be continued on this project.

There will be a number of conflicts within the ANU Exchange precinct between pedestrians and buses that will need to be managed in an environment where urban design considerations are particularly significant. In addition with the new ANU Exchange bus station, there will be increased risk to alighted passenger / pedestrians to cross Marcus Clarke Street, whereas under the current arrangement the inbound stop does not require this pedestrian movement to occur. Observations show that there is a considerable safety risk as pedestrians choose to cross Marcus Clarke Street midblock rather than at the existing Barry Drive / Marcus Clarke Street traffic signals. Many stand on or before the centreline waiting for a gap in the traffic and are oblivious to traffic coming from the direction from which they have just crossed. Even with new traffic signals at Rudd Street / Marcus Clarke Street intersection the pedestrian risk to crossing Marcus Clarke Street will increase.

3.1.3 Bus Layover area

The proposed bus layover area off Watson Street is low lying and a previous study for a parking structure at this site identified it as the route of the overland flow path from McKay Gardens and Barry Drive. The scheme for this layover facility will need to incorporate appropriate drainage protection measures to ensure the reliability of the facility. Integrating the bus cross over of Barry Drive with the Sullivans Creek cycle path is likely to improve cyclists usage but this action may also require resolution of conflicts between cyclists, pedestrians and buses.

3.1.4 Marcus Clarke Street

The City West masterplan identified cross sections for Marcus Clarke Street together with a rearranged intersection of Marcus Clarke Street and Alinga Street. With increased development in City West there will be increased bus patronage and increased pedestrian demand across Marcus Clarke Street. The City West Study identified the potential to reorientate the Alinga Street / Marcus Clarke Street intersection, however for the purposes of this study it is suggested that the intersection be assessed as to its suitability to meet the needs for the Frequent Rapid network as a stand-alone project.

3.1.5 Alinga Street

Alinga Street is a busy section of road especially between West Row and Northbourne Avenue with high turnover of the parking spaces associated with the post office. The intersection of Alinga / West Row is one that appears to be confusing to some motorists and there have been a number of minor crashes since the change in intersection geometry. With the increased development in City West there may be a need to enhance pedestrian safety and improve traffic operations by signalising the intersection – perhaps with a scramble crossing.

3.1.6 City Bus Stations

The concept for through routing of buses through the interchange to reduce the demand for bays at the interchange and to also better service City West was based on a scheme developed by AECOM (Maunsell) for Parramatta, which was extended to developing the concepts for Belconnen that have now been implemented.

Terminating buses at University Avenue will require some detailed assessment with previous schemes including a roundabout at Childers Street / University Avenue. Assuming that the previous routing study did not identify a preferred solution for this station various potential solutions will need to be developed, assessed and reviewed.

3.2 Clunies Ross St / Barry Dr Intersection

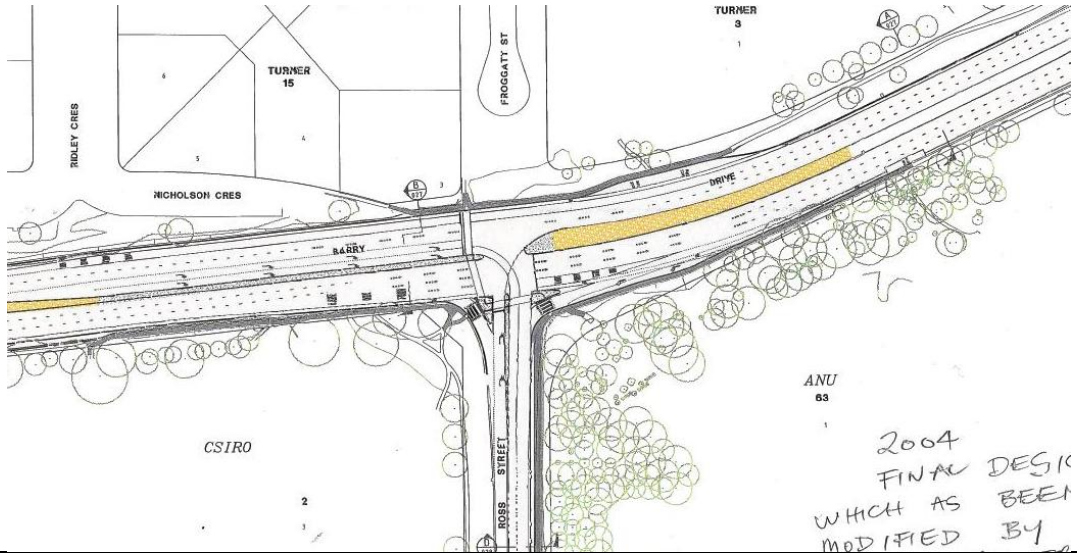
3.2.1 Issues for Buses

Good facilities to assist bus movements already exist at this intersection. Some capacity improvements are proposed as there are significant traffic delays along Barry Drive in the morning peak, largely associated with right turns from Barry Drive to Clunies Ross Street – these improvements will assist both general traffic and bus movements and are currently subject to design and construction under a separate project. Any changes should be consistent with any proposed future improvements along Barry Drive.

3.2.2 Options

Options relate to improving the capacity of the intersection, whilst enhancing bus operations. Note that all options include the provision for extending existing cycle path facilities with a combination of on and off road cycling, at all locations in the corridor.

Option	Pros	Cons	Priority
H1. Do nothing	- No capital cost	- Does not address issues	NA
H2. Extra capacity at intersection (Brown Consulting design)	- Increased traffic capacity and less traffic delays	- Unnecessary additional capacity in the westbound direction may limit options for bus improvements - High cost option	Not Recomm -ended



Option H2 Schematic

Option	Pros	Cons	Priority
H3. Second right-turn lane into & out of Clunies Ross St and redesign left-turn into Clunies Ross to create new Belconnen-bound stop	- Improves bus performance when no pedestrians are present - Provides for bypass in times of vehicle breakdown. - Post Molonglo provides for increased demand out of Clunies Ross Street	- Little / no benefit when there is a pedestrian demand	Not Recomm-ended
			
Option H3 Schematic			
H4. Second right-turn lane into & out of Clunies Ross St and retain current through capacity on Barry Drive	- As for Option H3, but lower cost	- As for Option H3	Short-term

3.2.3 Conclusion

The preferred option here is H4. The location of nearby bus stops and pedestrian access to/from bus stops on Barry Drive was raised as issues during the assessment of options.

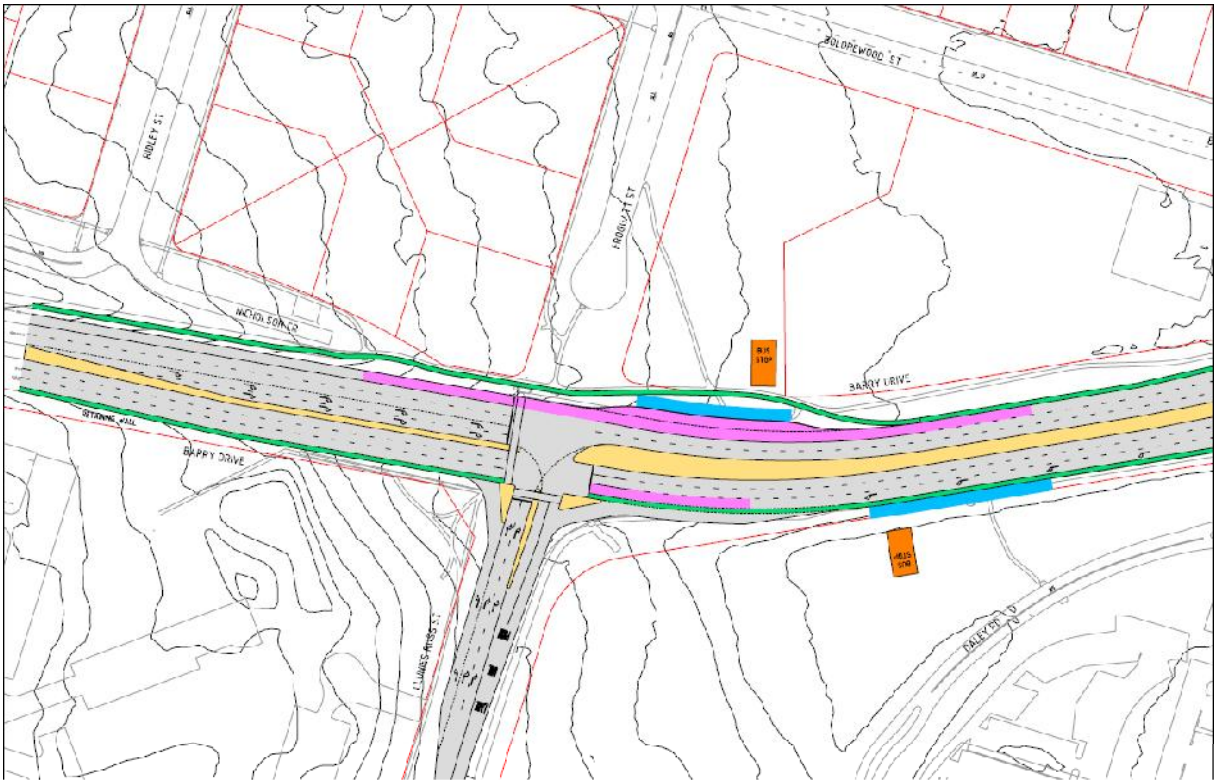
The relocation of the nearby bus stops to the western side of the intersection would enable bus passengers to use the existing pedestrian crossing, ensuring a safer crossing of Barry Drive. However, a westbound bus stop would be on a relatively steep grade, unsuitable for a bus stop. There would be similar problems for an eastbound bus stop, as well as potential sight distance problems.

The existing eastbound bus bay will need to be extended, so as to cater for at least one articulated and two rigid buses or two tag steer and one rigid bus.

An additional pedestrian crossing was also considered on the southern side of the intersection, but this would have adverse impacts on traffic queues and delays.

The preferred option is shown in Figure 3-3

Figure 3-3: preferred layout Clunies Ross Street / Barry Drive Intersection



3.3 Boldrewood St / Barry Dr Intersection

3.3.1 Issues for Buses

The movement of bus passengers to ANU from the existing City-bound bus stop just south of Clunies Ross Street is seen as unsafe. This intersection treatment was seen as an opportunity for enhancing pedestrian safety to cross Barry Drive and providing a key ANU bus stop segregated from the busy Barry Drive/North Road intersection and its associated high volume of pedestrians, cyclists and turning traffic.

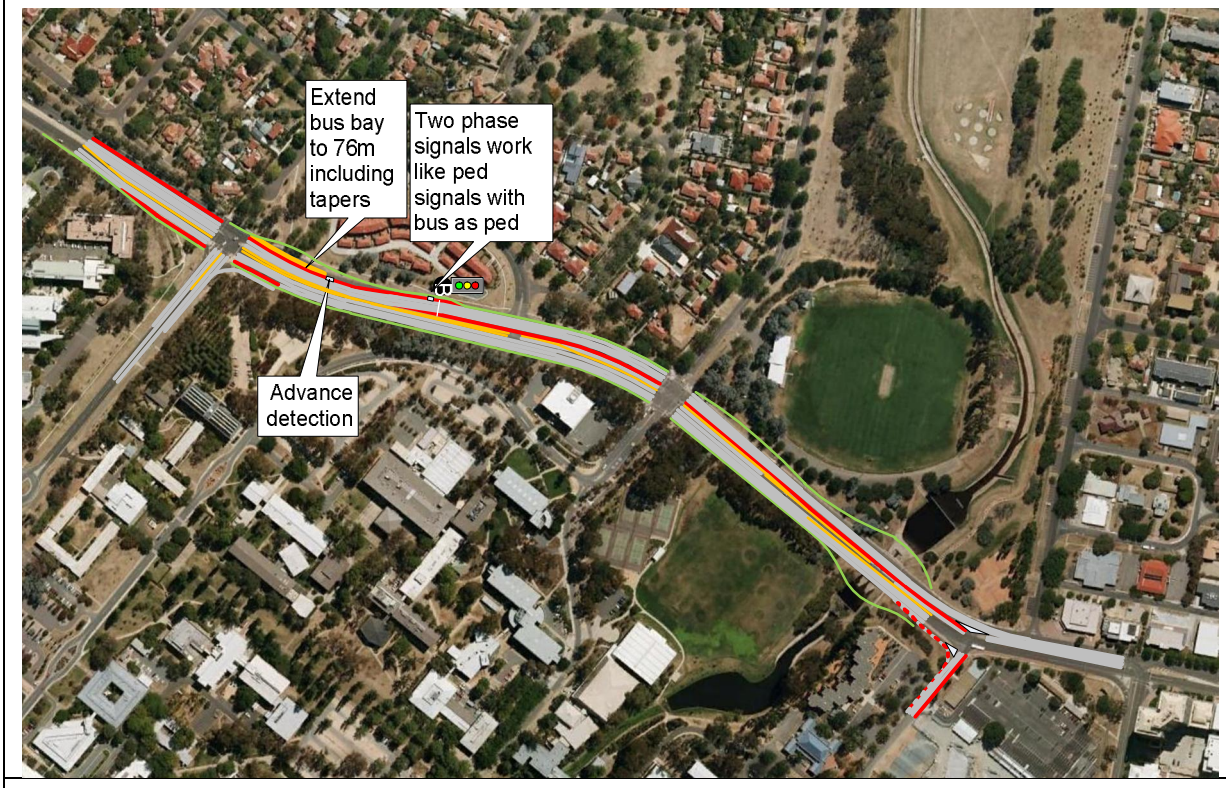
3.3.2 Options

Options relate to extending the existing bus lane that ends near Clunies Ross Street through the Boldrewood Street intersection and a possible bus stop and pedestrian crossing facilities adjacent to the intersection.

Option	Pros	Cons	Priority
I1. Do nothing	- No capital cost	- Does not address issues	NA
I2. Signalise and create bus stops adjacent to intersection with median fencing	- Created gaps for buses exiting near side bus stop - Improved intersection safety	- Signals could cause some redistribution of traffic from Macaughey Street to Boldrewood Street and other local streets in the area - Potential for some adverse resident reaction - Two way signal linking is difficult - No new provision for cyclists	Not Recomm -ended

Option	Pros	Cons	Priority
			
Option I2 Schematic			
I3. As for I2, with bus lanes both directions with widening into median	- Pairs the bus stop locations - Allows for relocation of CSIRO bus stop to be moved to post Clunies Ross Street intersection (but on a steep starting grade) giving substantially better coverage	- Introduces another bus stop / delays if CSIRO stop retained	Not Recomm-ended
I4. Install bus stop but not traffic signals with pedestrian fence	- Reduces motivation for increased traffic on Boldrewood Street	- Further distance from CSIRO	Not Recommended
I5. Install eastbound queue jump lane with B-start signal for buses	- Enables buses to quickly and safely get across to their own lane to turn into Kingsley Street - Provides bus lane continuity along full length of Barry Drive - Will provide additional gaps for Boldrewood St traffic	- Will create additional traffic delays to Barry Drive traffic - The management of traffic queues will add delays to buses - Will relocate traffic delays from North Road / Mc Caughey Street to this bus switch - Rules out the potential bus stop at North Road	Short-term

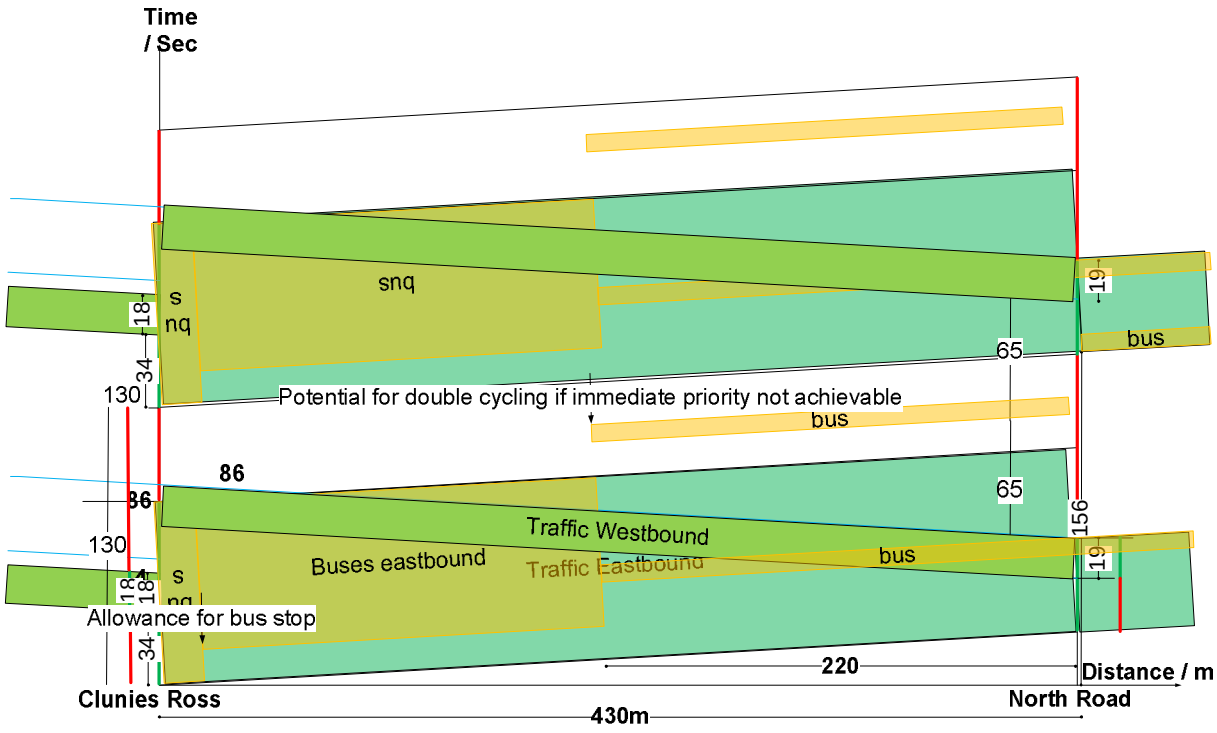
Option	Pros	Cons	Priority



Option I5 Schematic

3.3.3 Conclusion

The current preferred option here is Option I5, but more detailed modelling is needed to confirm that it will work satisfactorily. Current indications from SIDRA analysis and time distance diagrams indicate that it could be workable (see time-distance diagram below).



The issue of pedestrian safety crossing Barry Drive remains. It is recommended that median fencing be installed between Clunies Ross Street and Boldrewood Street to encourage use of the existing signals to cross Barry Drive. Note that it is not feasible to install another (southern) pedestrian cross-walk and associated pedestrian phase due to its adverse impacts on traffic queueing and delays.

The existing east-bound bus stop needs to be expanded to accommodate at least one articulated and two rigids or two tag steer and one rigid bus. This expansion should occur towards Clunies Ross Street, so as to reduce walking distances to the signalised crossing and thus encouraging bus passengers to use the crossing.

The preferred layout is shown in

3.4 North Rd / Barry Dr Intersection (City-bound)

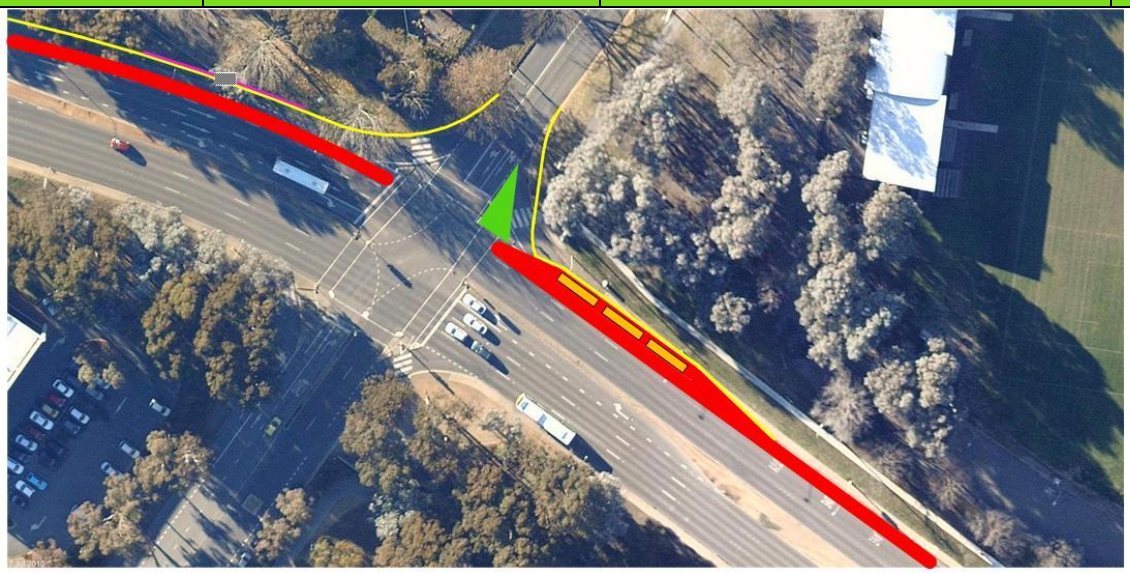
3.4.1 Issues for Buses

This intersection approach is a source of AM peak hour delays to buses and is the cause of some difficulties for buses to weave across into the median lane to turn right either at Marcus Clarke Street (currently) or Kingsley Street (in future). In the AM peak there is a large volume of traffic turning into ANU, as well as large numbers of pedestrians and cyclists. The predominant movement of pedestrians and cyclists is across the eastern leg of the intersection.

3.4.2 Options

Options relate to extending the existing bus lane that ends near Clunies Ross Street through the North Road intersection and the possible provision of bus stop facilities adjacent to the intersection.

Option	Pros	Cons	Priority
J1. Do nothing	- No capital cost	- Does not address issues	NA
J2. Create bus lane through North Rd intersection	- Continued on from existing Barry Drive Bus lane - Provides for either approach or departure bus lanes - Provides for B signal bus start	- Reduced intersection capacity - Creates conflicts with left turning vehicles	Short-Term
J3. As for J2, but including new far-side bus stop	- Connects well with bus layover routing	- Prevents interim weave solution for bus stop - Too far from CSIRO and bus passenger catchment overlaps with City West Bus Station	Not Recomm-ended

Option	Pros	Cons	Priority
			
Option J3 Schematic			

3.4.3 Review of Blue Rapid Bus Stops Serving ANU

Figure 3-4 shows a significant overlap of bus passenger catchments if an additional bus stop is provided at North Road. It is more appropriate to keep the existing bus stop locations, so as to properly service CSIRO as well as ANU. Stops for Blue Rapid services should be spaced at a minimum of 500m (MRC 2009), so a bus stop at North Road is not consistent with this guide.

Bus service should be provided to operate as an efficient and effective service for the benefit of passengers and the community. The rapid service is to carry as many passengers as quickly and reliably between centres. The frequent local service is intended to provide frequent services to cover as much high density coverage as possible.

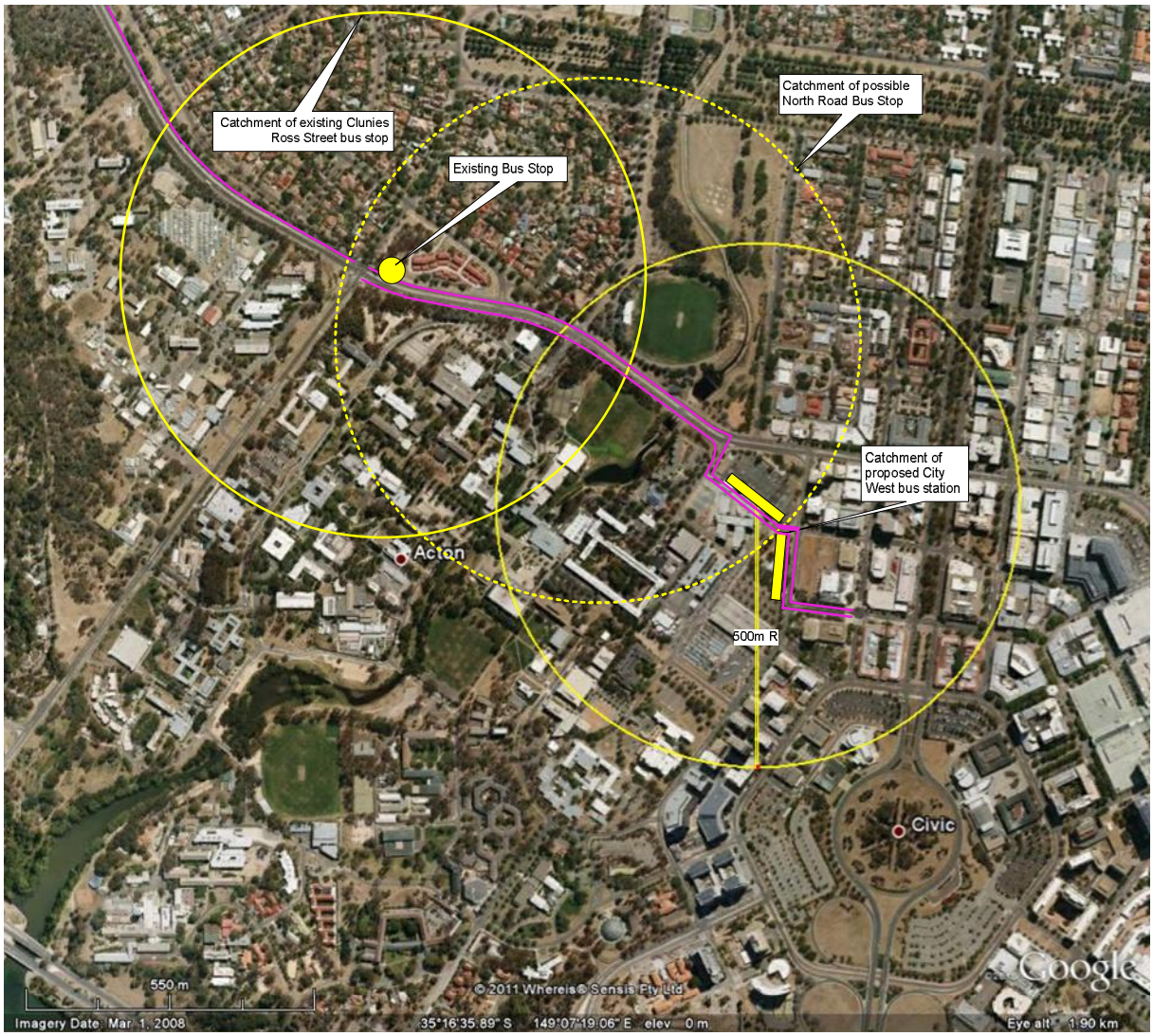
The frequent local service function is therefore to service the internal distribution within the ANU.

The merits / dis-benefits of a North Road bus stop as summarised as follows:

- Pros
  - Helps to defines a northern entry to the ANU by a defined ANU bus stop
  - Reduces pedestrian risk through crossing at traffic signals
  - Marginally reduces walking distance to some parts of the university
- Cons
  - Adds an additional bus stop to the rapid frequent service – additional 30 seconds delay – a key issue with the frequent rapid service.
  - Locks in a far side right turn movement into Kingsley Street adding 80 seconds of travel time as all buses would have to use the stop and proposed bus lane. Note although we are proposing a bus lane at McCaughey Street buses can weave earlier.
    - Undoes a significant proportion of the benefits of the proposed bus priority measures nearly two minutes extra travel time.
    - Also would add an additional bus stop on the western side of the intersection.
  - Could relocate Clunies Ross Street bus stop to the western side of the intersection – also adding an additional stop.
    - Westbound would be on relatively steep grade
    - Eastbound has sight distance issues.

Overall it simply adds additional travel time for the majority of users with no significant advantage to ANU.

Figure 3-4: ANU Blue Rapid Bus Stop Catchments Within 500m of Stop



3.4.4 Conclusion

An improvement to bus operation is an important consideration at the North Road intersection. There is no significant difference in the passenger catchment achieved by the installation of a new bus stop at North Road. There are however disbenefits to through passengers being delayed. It is likely that the preferred option in this section of road is likely to be Option I5 shown earlier. The operational impacts of the proposed changes and the details of how it would work in a physical sense need to be investigated in association with the treatment at Kingsley Street.

3.5 North Rd / Barry Dr Intersection (Belconnen-bound)

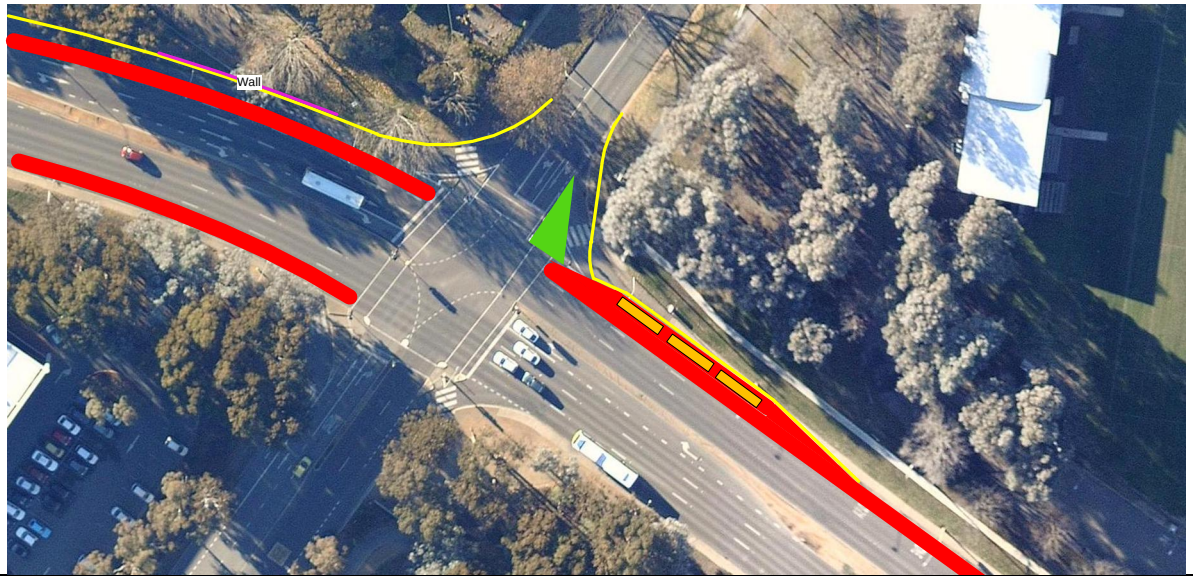
3.5.1 Issues for Buses

This intersection approach is a source of PM peak hour delays to buses. As in the AM peak, there is large numbers of pedestrians and cyclists across the eastern leg of the intersection.

3.5.2 Options

Options relate to creating a bus only lane through the North Road intersection and the possible provision of bus stop facilities adjacent to the intersection.

Option	Pros	Cons	Priority
K1. Do nothing	- No capital cost	- Does not address issues	NA
K2. Create bus lane through North Rd intersection by widening into median	- Maintains current traffic capacity - Reduces bus delays	- High cost - Requires modifications to access for residential property on the north-west corner of the intersection	Short to medium-term
K3. As for K2, but including new far-side bus stop	- Improves bus passenger access to ANU	- Bus stop is on a curve in Barry Drive, reducing sight distance and adversely affecting safety	Not Recomm-ended



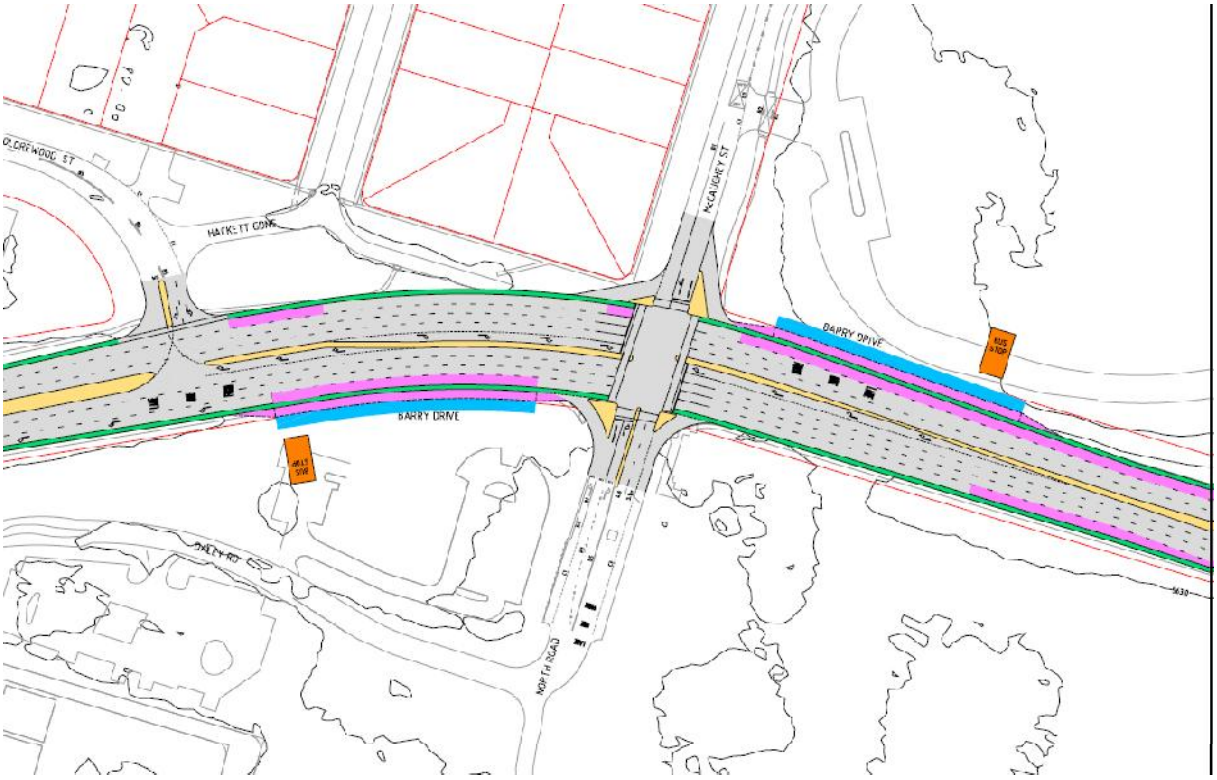
Option K3 Schematic

3.5.3 Conclusion

An improvement to bus operation is an important consideration at this intersection. The physical constraints at this location and difference in AM and PM operations here indicate that widening for a new bus lane should only occur in the City-bound direction. This will achieve much greater benefits than widening in the Belconnen-bound direction and avoids the potential need to remove significant trees adjoining ANU.

The indicative cost of this option is $1.3m and is shown in Figure 3-5.

Figure 3-5: North Road / Barry Drive Intersection Upgrade



Note bus stop not able to be accommodated within road boundary

3.6 Barry Dr / Kingsley St Intersection (City-bound)

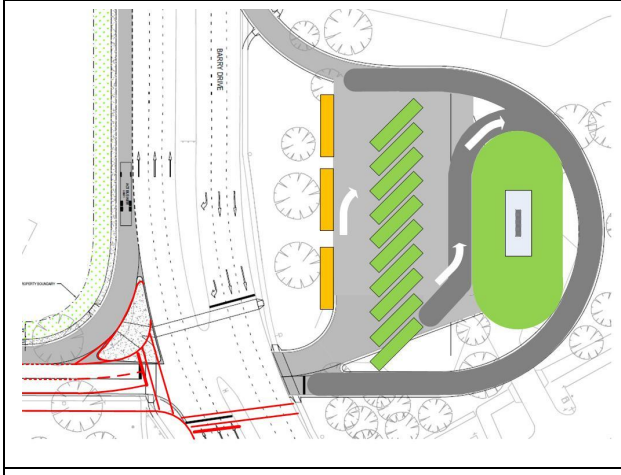
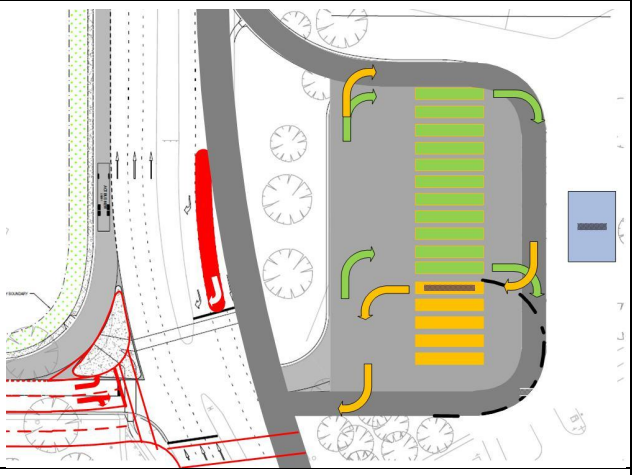
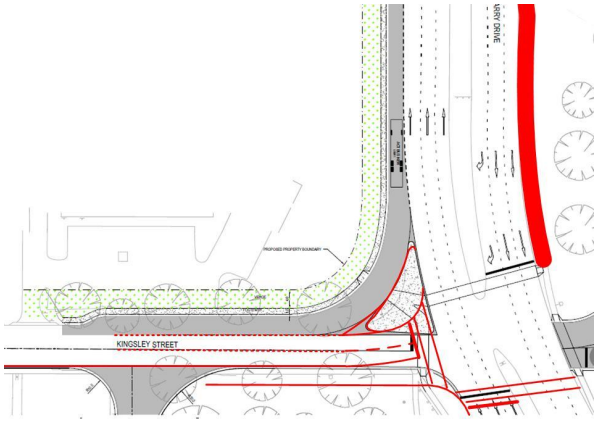
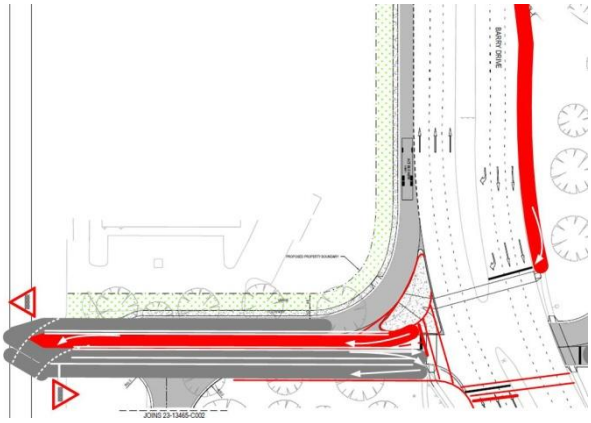
3.6.1 Issues for Buses

This intersection is to be signalised and will form a future access to the proposed ANU City West Bus Station. It will be integrated with a proposed permanent bus layover.

3.6.2 Options

Options relate to the movement of buses through this intersection and how this might be integrated with the bus layover.

Option	Pros	Cons	Priority
L1. Run buses through proposed layover loop, via bus lane	- Allows kerbside bus lane on Barry Drive, increasing the reliability of peak hour services - Avoids need for buses to weave across busy traffic lanes during AM peak	- Requires additional Cycle/pedestrian bridge over Sullivans Creek - Could increase delays for buses and other traffic to negotiate this intersection	Not Recomm -ended
L2. Bus right turn lane to Kingsley St	- Less travel time than running the buses through a layover loop - Does not rule out future lane through layover - Consistent with proposal to have bus switch signals near North Road	- Requires widening to possible 4 lanes on Kingsley Street - requires vehicles entering car park to cut across buses	Short-term

Option	Pros	Cons	Priority
			
Option L1 Schematic		*Option L2 Schematic*	
L3. Turn buses right from new kerbside lane and no layover connection at Kingsley St	- Same functionality as L1 - Allows kerb side bus lane on Barry Drive inbound. - Improves reliability over the weave option	- Likely to require bridge widening	Not Recomm-ended
L4. Turn buses right from kerbside lane on Barry Drive into median lane / counter flow on Kingsley Street	- Right turns into Kingsley Street occur at same time as right turns out of Kingsley Street - Bus lane along Barry Drive improves reliability	- High risk for pedestrians - Unexpected movements for other motorists	Not Recomm-ended
			
Option L3 Schematic		*Option L4 Schematic*	

3.6.3 Conclusion

Some analyses of these options have already been undertaken using TRANSYT (see Appendix A). These analyses highlight potential travel time advantages for Option L2, but running buses through a layover loop is preferred. It provides a clearer statement of Government transportation objectives, easier and safer conditions for bus drivers and passengers and more reliable travel times.

3.7 Barry Dr / Kingsley St Intersection (Belconnen-bound)

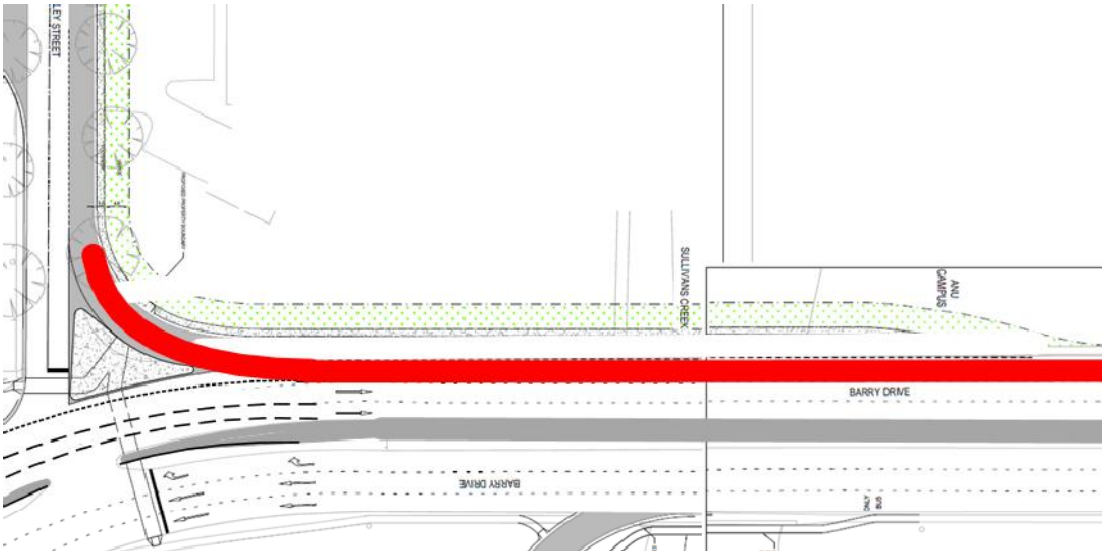
3.7.1 Issues for Buses

This intersection is located close to the ANU City West Bus Station and buses need to get a good run though here onto Barry Drive. There will be potential delays to buses caused by other traffic on Kingsley Street and potentially long delays in accessing Barry Drive in the PM peak.

3.7.2 Options

Options relate to resolving bus conflicts with other traffic on Kingsley Street and enabling smooth access onto Barry Drive.

Option	Pros	Cons	Priority
M1. Mixed traffic left-turn lane with merge onto Barry Dr	-	- Delay stop buses merging with other traffic	Short-term
M2. Bus lane westbound, with widening of traffic lanes into median to create 3 traffic lanes and a bus lane	- Improves for all users.	- More difficult access across lanes for bikes - Westbound currently few delays	Not Recomm-ended



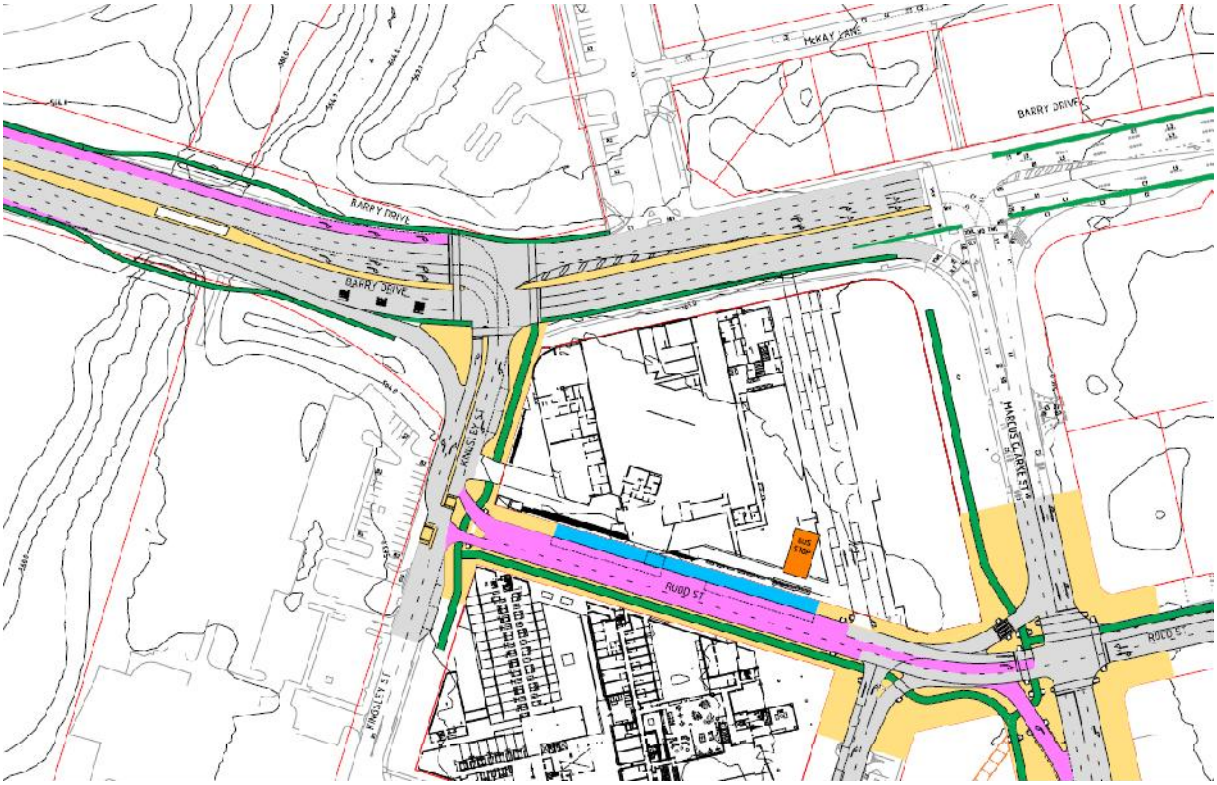
Option M2 Schematic

3.7.3 Conclusion

The provision of clear priority for buses is important for the efficient operation of the ANU City West Bus Station. The physical means for making this work needs further investigation. Some analyses of alternative options for this intersection have been analysed in TRANSYT (see Appendix A). Option M1 is preferred based on modelling with Paramics and the investigation of physical constraint for widening.

The indicative cost of the preferred solution is $1.5m along the Barry Drive sector and is shown in Figure 3-6. The indicative cost of the City West bus station is $1.5m with an additional $450,000 for traffic signals at Rudd Street / Marcus Clarke Street.

Figure 3-6: Barry Drive/ Kingsley Street / Bus Station / Marcus Clarke Street proposals



3.8 Kingsley St / Busway Intersection

3.8.1 Issues for Buses

There are potential delays to buses at this intersection due to conflicts with other traffic on Kingsley Street. Any queueing of buses back into the bus station or along Kingsley Street should be avoided if possible.

3.8.2 Options

Options relate to resolving bus conflicts with Kingsley Street traffic and potential queuing at this intersection.

Option	Pros	Cons	Priority
N1. Signalise intersection	- Provides for pedestrians and cyclists - Can minimise time for Kingsley St traffic and thus deter traffic from using it as a through route	- Costly option - Creates extra delays to buses	Not Recomm-ended
N2. Kingsley St traffic gives way to busway traffic	- Minimal delays to buses	- No provision for pedestrians and cyclists - Potential safety issues, depending on design	Short-term

3.8.3 Conclusion

A priority arrangement favouring bus movements would be preferable at this location. The safe operation of this option will rely on the detail of the design including swept paths and sight distances.

3.9 Rudd St / Marcus Clarke St Intersection

3.9.1 Issues for Buses

This intersection is to be signalised as part of the works for the construction of the ANU City West Bus Station. This will enable access for buses onto Marcus Clarke Street and safer provision for pedestrians and cyclists.

3.9.2 Options

Options relate to minimising delays to buses at this intersection, whilst making reasonable provision for general traffic movements.

Option	Pros	Cons	Priority
O1. Signalise with limited turns (2-phase)	- Maintains status quo with turning movements	- Potential queuing across bus lane (both directions) - Reduced accessibility for taxis and removalists etc	Not Recomm-ended
O2. Signalise but allow most turns and square up Childers Street / Rudd Street intersection	- Fits with the City West masterplan - Reduces delays to buses (avoids queuing from Marcus Clarke Street) - Improves accessibility to City West and removes circulating traffic from main roads and bus routes	- Minor additional cost	Short-term

Option	Pros	Cons	Priority
			
Option O2 Schematic			

3.9.3 Conclusion

The current preferred concept design for this intersection is shown in Figure 3-6. The Paramics modelling showed that it was necessary to provide two northbound through lanes to cater for PM peak conditions. Likely order of cost for works at this location is $450,000.

3.10 Marcus Clarke St, Rudd St to Alinga St

3.10.1 Issues for Buses

The signalisation of the Rudd Street/Marcus Clarke intersection will result in increased delays to traffic on Marcus Clarke Street. The existing one lane section on Marcus Clarke Street will cause significant delays to buses, unless some widening occurs along here.

3.10.2 Options

Options relate to resolving potential delays to buses on Marcus Clarke Street.

Option	Pros	Cons	Priority
P1. Do nothing	- No capital cost	- Significant delays to buses and other traffic on Marcus Clarke Street	NA
P2. Widen northbound carriageway to 2 general traffic lanes	- Reduced delays to buses and general traffic	- Widening may be difficult to proximity of child care centre boundary to edge of northbound carriageway - Greater delays to buses if in mixed traffic and no bus lane	Not Recomm -ended
P3. Widen northbound carriageway to 3 lanes, including 1 bus lane and 2 general traffic lane	- Less delays to buses - More reliable bus travel times - Facilitates cycle provision	- As for P2 - Requires lane shift through Rudd Street intersection	Not Recomm -ended

Option	Pros	Cons	Priority
 Marcus Clarke Street widening with northbound bus lane			
Option P3 Schematic			
P4. Remove central median and re-linemark northbound carriageway to create 2 lanes, including 1 bus lane and 1 general traffic lane	- Low cost option - Minimal impacts due to construction activity	- As for P2	Short-term

3.10.3 Conclusion

Option P4 is recommended. A concept layout for this option is illustrated in Figure 3-7.

Figure 3-7: Proposed Marcus Clarke Street Layout between Rudd Street and Alinga Street

3.11 Alinga St / Marcus Clarke St Intersection

3.11.1 Issues for Buses

There are few delays to buses at this intersection, but there is an opportunity to enhance bus movements by integrating some improvements here with improvements along Marcus Clarke Street.

3.11.2 Options

Options relate to creating options that will enhance bus operations between Northbourne Avenue and the ANU City West Bus Station.

Option	Pros	Cons	Priority
Q1. Do nothing	- No capital cost	-	NA
Q2. Introduce second bus-only right turn lane (refer Figure 3-7)	- Improves bus travel times and reliability	- Some extra costs	Short-medium term

3.11.3 Conclusion

It should be possible to implement a relatively low cost option to improve bus operation at this intersection and an integrated transitway facility. The recommended works being designed by GHD are shown in Figure 3-7). Note that by allowing twin right turns, a filter through the pedestrian crossing on the northern leg would not be safe and therefore an exclusive right turn lane from Marcus Clarke into Alinga Street is highly desirable. Note that the traffic modelling indicates that it will be important to provide four through traffic lanes plus turning lanes in the future to accommodate the expected traffic growth on Marcus Clarke Street.

3.12 Alinga St / West Row Intersection

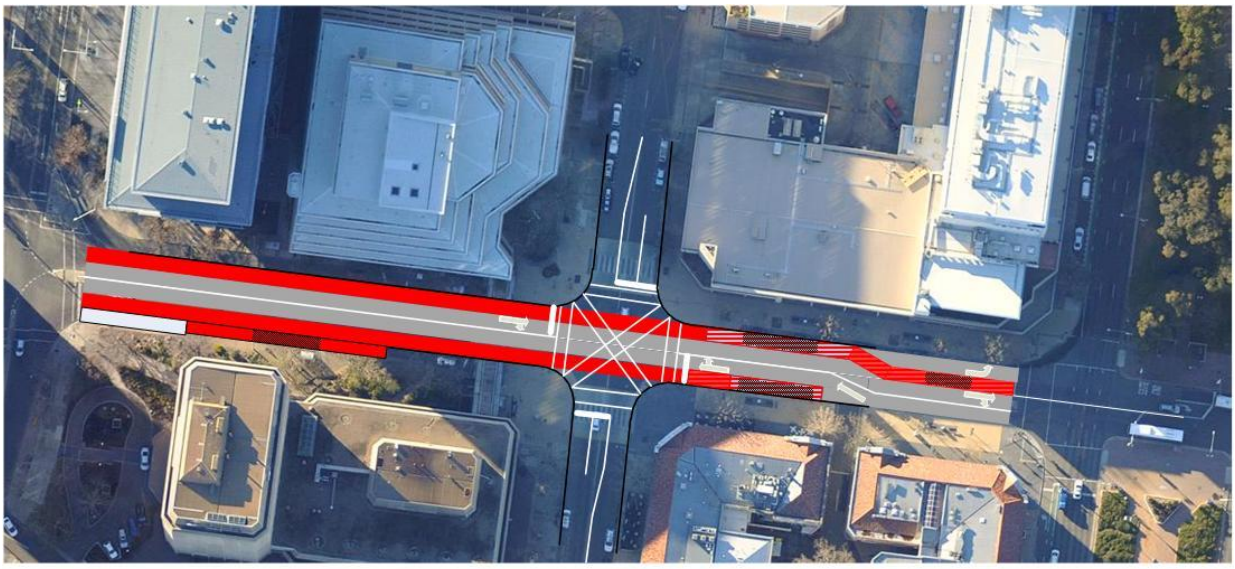
3.12.1 Issues for Buses

Buses are occasionally blocked by turning vehicles at this intersection, due to delays caused by pedestrians on the West Row and Moore Street pedestrian crossings.

3.12.2 Options

Options relate to resolving queuing problems caused by the pedestrian crossings.

Option	Pros	Cons	Priority
R1. Do nothing	- No capital cost	- Queuing across intersection from dramatic increase in pedestrian activity	NA
R2. Signalise and extend right turn lanes on Alinga St. Consider pedestrian scramble crossing	- Add peak hour bus lane towards bus interchange (ban parking in peaks as shown in sketch below) - Increases safety for all road users including buses and pedestrians	- Possible increased off peak delays for buses - Impacts on parking for some key uses (eg., Post Office)	Medium-term



Option R2 Schematic

3.12.3 Conclusion

The traffic modelling indicated that signalisation of this intersection would increase delays to buses, but would improve the operation of the intersection overall. There are three issues here:

- Achieving reliability of bus travel times,
- Improving / reducing bus travel times and
- reducing road safety risks to bus passengers and other road users.

Alinga Street / West Row will suffer from queues across the intersection from increased pedestrian activity arising from the new developments in City West. Although traffic signals will not improve the average travel time for eastbound movements they will achieve reliability. At this stage the intersection was observed to be blocked by vehicles queuing for pedestrians using the pedestrian crossings. Increased pedestrian activity will increase the delays and queues. Sidra analysis has been undertaken and shows that queuing along Alinga Street will increase but there will be no queuing across the intersection.

At Northbourne Avenue left turning movements queue waiting for pedestrians to clear the crossing. These left turning vehicles queue back along Alinga Street and block buses and other vehicles. In peak periods buses at the end of the queue require two move ups to clear the intersection. Separating the cars from buses will achieve reliable bus travel times.

For westbound buses, they will be picking up passengers and the numbers will be variable resulting in variable dwell times I recollect that RTA Guide to the design of transitways recommends bypass lanes for busy stops which this falls into. Providing an indented bus bay against a bus lane has been adopted as best practice on modern transitways and is recommended to future proof bus operation at this location.

As pedestrian numbers increase delays to vehicles at pedestrian crossings increases to the stage where drivers push their way through the crossing – remember Bunda Street at the Canberra Centre. Traffic signals platoons pedestrians and reduce risks.

There are still some difficult issues to resolve in relation to parking and pedestrians along this section of road. Further investigations and consultation are needed to resolve a way forward here. The likely order of costs for traffic signals is $400,000.

3.13 Alinga St / Northbourne Ave Intersection

3.13.1 Issues for Buses

There are some substantial delays to pedestrians and buses crossing Northbourne Avenue. Delays and queues are longer in the PM peak, exacerbated by car parking on the eastbound approach of Alinga Street.

There are also plans to narrow the median of Northbourne Avenue which will influence the operation of this intersection.

3.13.2 Options

Options relate to reducing bus delays and improving bus operations.

Option	Pros	Cons	Priority
S1. Do nothing	-	-	NA
S2. Ban some parking on Alinga St (north) in peak hours	- Reduces delays to all traffic	- Adversely impacts on Post Office	Short-Medium term
S3. As for S2, but including narrowing of median and introduction of diamond right turns on Northbourne Ave	- Improved pedestrian amenity	- May cause increased delays due to expectation for pedestrians to cross Northbourne Ave in a single phase	Medium-long term

3.13.3 Conclusion

Again, there are some difficult issues to resolve in relation to traffic, parking and pedestrians at this intersection. Further investigations and consultation are needed to resolve a way forward here.

4.0 Traffic Modelling of Bruce Sector Options

The results of traffic modelling of key options are provided in this Chapter. The primary modelling tool was a Paramics microsimulation model of the Bruce sector of the transitway. This was established for a base (2011) model and two future year models (2021 and 2031), for the AM and PM peak periods. A description of model development and calibration is given in Appendix B.

4.1 Scenarios Modelled

Two alternative scenarios and a do-nothing case were established and modelled for 2021 and 2031 AM and PM peak periods. These incorporated various key options described in Chapter 3. They reflect a different extent of future works, as noted in Table 4-1. An outline of the outcome of the modelling of these scenarios follows in Sections 4.2 to 4.4.

Table 4-1: Options Included in Scenarios Modelled for the Bruce Sector

Location	Do Nothing	Scenario 1 (Moderate Works)	Scenario 2 (Major Works)
Eastern Valley Way / College St intersection	A1	A1	A2
College St adjacent to UC	B1	B5	B7
Haydon Dr / College St intersection	C1	C2	C3
Haydon Dr / Purdie St intersection	D1	D2	D3
Haydon Dr - Purdie St to Mary Potter Cct South	E1	E2	E3
Haydon Dr - Mary Potter Cct South to GDE	F1	F2	F3
Haydon Dr - Belconnen Way to Jaeger Cct	G1	G2	G3

4.2 Do-Nothing

The Do-Nothing scenario used the calibrated existing 2011 road layout operating under future year demands for the years 2021 and 2031. These Do Nothing models provide a benchmark against which the effectiveness of the scenario designs can be compared. Future year demand forecasts were based on EMME data supplied by TAMS with the resulting network traffic demands for the Bruce Sector shown in Table 4-2.

Table 4-2: Future Year Network Demands

Time Period	2021	2031
AM Peak	2011+14%	2011+16%
PM Peak	2011+15%	2011+19%

The 2021 models represented a 14% and 15% increase in overall demand compared to 2011 for the AM and PM peaks respectively. The 2031 models represented a 16% and 19% increase in overall demand compared to 2011 for the AM and PM peaks respectively.

The main congestion issues in the Do-Nothing network are located along Haydon Drive during both peak periods. In the AM peak this is caused by the existing bottleneck at the Gungahlin Drive / Belconnen Way intersection that lies outside this study area. This intersection currently operates at capacity during the AM peak resulting in extensive eastbound queuing along Belconnen Way that impacts upon Haydon Drive. There are no proposed design upgrades to this intersection so no increase in eastbound capacity could be assumed in 2021 or 2031. As a result of this constraint and the forecast increase in traffic demand in the network, southbound queues along Haydon Drive are extensive in the Do-Nothing 2021 and 2031 models. These queues also have the knock on effect of blocking some of the side road accesses including Purdie Street and Mary Potter Circuit.

In the PM peak congestion in the southbound direction along Haydon Drive is caused by demand for the right turn into Belconnen Way rising from 187 vehicles per hour in 2011 to 377 vehicles per hour in 2021 and 610 vehicles per hour in 2031. These volumes cannot be accommodated with the proposed intersection layouts in the future years.

4.3 Moderate Improvement Works Package (Scenario 1)

Modelled bus and general traffic travel times through the Bruce Sector corridor are summarised in Table 4-3 and Table 4-4 respectively.

4.3.1 Bus Travel Times

General bus travel time improvements are achieved in this scenario of between 3-14%, with the exception of:

- Citybound Blue Rapid routes in the 2021 PM peak which experience a 14% increase in travel time; and
- Route 3 buses which form part of “Other routes westbound” which experience a 10-28% increase in travel time, largely due to large delays turning right out of Mary Potter Circuit North.

These increases and limited bus travel time benefits on other routes are due to the increased queuing that occurs southbound on Haydon Drive in Scenario 1 when compared to the Do-Nothing scenario. The increased queuing and congestion is caused by the conversion of an existing general traffic lane to bus only at the Haydon Drive / Belconnen Way intersection. Effectively the increased delay on Haydon Drive cancels out the improved bus travel times achieved in the rest of the network as a result of the other transitway upgrades.

4.3.2 Vehicle Travel Times

Vehicle travel time improvements are achieved along College Street during the 2021 AM peak as a result of the service road removing the need for on street school drop-offs by school buses and private vehicles. In 2031 however, these benefits are exceeded by the increased delay that occurs at the Eastern Valley Way / College Street intersection which has insufficient capacity for the 2031 traffic demands.

Vehicles travelling southbound on Haydon Drive experience a 203% and 133% increase in travel time when compared to the Do-Nothing Scenarios in 2021 and 2031 respectively. These large increases in delay occur as a result of the reduction in southbound capacity at the Haydon Drive / Belconnen Way intersection. These queues cause secondary blocking of side road accesses, which in turn leads to increased delay in the northbound direction.

4.4 Major Improvement Works Package (Scenario 2)

4.4.1 Bus Travel Times

Scenario 2 shows clear improvements in 2021 when compared against Scenario 1 and the Do Nothing models. The improvement gained by eastbound ‘Blue Rapid’ services in the AM peak is as high as 33%. These significant gains are possible due to the bus lane running the length of Haydon Drive, allowing buses to bypass the queues that extend back from the Gungahlin Drive / Belconnen Way intersection. The queuing and congestion along Haydon Drive is also reduced when compared to Scenario 2 as a result of the additional traffic lane at the intersection with Belconnen Way.

4.4.2 Vehicle Travel Times

Vehicle travel time improvements are achieved along College Street in both directions during AM and PM peaks for both future years. Scenario 2 represents an improvement over Scenario 1 as a result of the additional turn bays and modified phasing arrangement at the Eastern Valley Way / College Street intersection allowing it to operate within capacity.

Vehicles travelling southbound on Haydon Drive experience increased delays when compared to the Do-Nothing model. This is attributed to the additional signals installed at Purdie Street and the issues associated with coordinating these effectively with surrounding intersections along a congested Haydon Drive.

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Table 4-3: Bus Travel Times

	Route	Base 2021	Scenario 1 2021	Difference to Base	%	Scenario 2 2021	Difference to Base	%
2021 8-9AM Base vs Scenario 1 and Scenario 2	Blue Rapid EB	0:11:34	0:09:56	0:01:38	14%	0:07:44	0:03:50	33%
	Blue Rapid WB	0:08:52	0:08:16	0:00:36	7%	0:07:36	0:01:16	14%
	Other Routes EB	0:06:11	0:04:04	0:02:07	34%	0:03:49	0:02:22	38%
	Other Routes WB	0:05:43	0:06:17	0:00:34	10%	0:05:34	0:00:09	3%
	Route	**Base 2021**	**Scenario 1 2021**	**Difference to Base**	**%**	**Scenario 2 2021**	**Difference to Base**	**%**
2021 5-6PM Base vs Scenario 1 and Scenario 2	Blue Rapid EB	0:07:14	0:08:14	0:01:00	14%	0:07:14	0:00:01	0%
	Blue Rapid WB	0:08:29	0:08:17	0:00:12	2%	0:07:43	0:00:45	9%
	Other Routes EB	0:03:37	0:03:40	0:00:04	2%	0:03:24	0:00:12	6%
	Other Routes WB	0:05:25	0:05:00	0:00:25	8%	0:04:39	0:00:46	14%

	Route	Base 2031	Scenario 1 2031	Difference to Base	%	Scenario 2 2031	Difference to Base	%
2031 8-9AM Base vs Scenario 1 and Scenario 2	Blue Rapid EB	0:08:25	0:07:59	0:00:26	5%	0:07:04	0:01:21	16%
	Blue Rapid WB	0:08:39	0:07:52	0:00:47	9%	0:07:11	0:01:27	17%
	Other Routes EB	0:04:07	0:03:43	0:00:24	10%	0:03:44	0:00:24	10%
	Other Routes WB	0:05:35	0:05:39	0:00:05	1%	0:04:21	0:01:14	22%
	Route	**Base 2031**	**Scenario 1 2031**	**Difference to Base**	**%**	**Scenario 2 2031**	**Difference to Base**	**%**
2031 5-6PM Base vs Scenario 1 and Scenario 2	Blue Rapid EB	0:09:10	0:08:41	0:00:29	5%	0:07:17	0:01:53	21%
	Blue Rapid WB	0:08:10	0:07:53	0:00:17	3%	0:07:43	0:00:27	5%
	Other Routes EB	0:05:07	0:04:12	0:00:55	18%	0:03:27	0:01:40	33%
	Other Routes WB	0:05:44	0:07:22	0:01:37	28%	0:04:40	0:01:04	19%

travel time lower than in base scenario

travel time higher than in base scenario

travel time difference <10 seconds compared to base scenario

Table 4-4: Vehicle Travel Times

	Route	Base 2021	Scenario 1 2021	Difference to Base	%	Route	Scenario 2 2021	Difference to Base	%
2021 8-9AM Base vs Scenario 1 and Scenario 2	College Street EB	0:05:05	0:03:58	0:01:07	22%	College Street EB	0:03:46	0:01:19	26%
	College Street WB	0:03:50	0:03:28	0:00:21	9%	College Street WB	0:03:37	0:00:13	6%
	Haydon Drive SB	0:02:39	0:08:03	0:05:23	203%	Haydon Drive SB	0:04:18	0:01:39	62%
	Haydon Drive NB	0:03:14	0:05:05	0:01:51	57%	Haydon Drive NB	0:03:12	0:00:02	1%
	Route	**Base 2021**	**Scenario 1 2021**	**Difference to Base**	**%**	**Route**	**Scenario 2 2021**	**Difference to Base**	**%**
2021 5-6PM Base vs Scenario 1 and Scenario 2	College Street EB	0:05:05	0:04:48	0:00:16	5%	College Street EB	0:03:24	0:01:41	33%
	College Street WB	0:03:50	0:03:46	0:00:04	2%	College Street WB	0:02:45	0:01:05	28%
	Haydon Drive SB	0:02:39	0:03:40	0:01:01	38%	Haydon Drive SB	0:02:55	0:00:15	10%
	Haydon Drive NB	0:03:14	0:03:20	0:00:06	3%	Haydon Drive NB	0:03:22	0:00:08	4%
	Route	**Base 2031**	**Scenario 1 2031**	**Difference to Base**	**%**	**Route**	**Scenario 2 2031**	**Difference to Base**	**%**
2031 8-9AM Base vs Scenario 1 and Scenario 2	College Street EB	0:03:54	0:04:38	0:00:44	19%	College Street EB	0:03:48	0:00:06	2%
	College Street WB	0:04:21	0:03:35	0:00:46	18%	College Street WB	0:03:12	0:01:08	26%
	Haydon Drive SB	0:03:04	0:03:26	0:00:22	12%	Haydon Drive SB	0:03:25	0:00:20	11%
	Haydon Drive NB	0:02:58	0:03:11	0:00:13	7%	Haydon Drive NB	0:03:21	0:00:23	13%
	Route	**Base 2031**	**Scenario 1 2031**	**Difference to Base**	**%**	**Route**	**Scenario 2 2031**	**Difference to Base**	**%**
2031 5-6PM Base vs Scenario 1 and Scenario 2	College Street EB	0:04:00	0:04:22	0:00:22	9%	College Street EB	0:03:19	0:00:41	17%
	College Street WB	0:03:38	0:03:58	0:00:21	10%	College Street WB	0:02:48	0:00:49	23%
	Haydon Drive SB	0:02:31	0:05:51	0:03:20	133%	Haydon Drive SB	0:03:35	0:01:04	43%
	Haydon Drive NB	0:03:18	0:02:46	0:00:33	17%	Haydon Drive NB	0:03:11	0:00:08	4%

travel time lower than in base scenario
travel time higher than in base scenario
travel time difference <10 seconds compared to base scenario

4.5 Conclusions

The key findings from the modelled scenarios for the Bruce Sector corridor are as follows:

- Scenario 2 upgrade measures can deliver City-bound bus travel time improvements of 33% or 3 minutes 50 seconds during the AM peak when compared to the Do-Nothing scenario.
- Scenario 1 upgrade measures can deliver City-bound bus travel time improvements of 14% or 1 minute 38 seconds during the AM peak when compared to the Do-Nothing scenario.
- The main bottleneck in the entire network is the Gungahlin Drive / Belconnen Way intersection. As a result delays and travel times through this part of the road network will increase. The most efficient way to protect buses against these increased delays is to supply a bus lane along the entire length of Haydon Drive and Belconnen Way, connecting with the existing bus lane at GDE.
- It is necessary to retain 3 southbound left turning traffic lanes at the Haydon Drive / Belconnen Way intersection. Supplying a bus lane by replacement of a general traffic lane at the Haydon Drive / Belconnen Way intersection will cause an increase in traffic delays and queues that will in turn impact upon bus operations and is therefore not recommended.
- Additional right-turn capacity is required for traffic turning right from Haydon Drive onto Belconnen Way, to avoid right turn queues impacting on other traffic movements.
- Upgrade of the Eastern Valley Way / College Street Intersection is required before 2031 to ensure sufficient traffic capacity is available at this location.
- Removal of conflicting traffic movements at and around Radford College by signalisation of the access and provision of a service road for drop-offs will improve travel times for buses and general traffic.

5.0 Traffic Modelling of City Sector Options

The results of traffic modelling of key options are provided in this Chapter. The primary modelling tool was a Paramics microsimulation model of the City sector of the transitway. This was established for a base (2011) model and two future year models (2021 and 2031), for the AM and PM peak periods. A description of model development and calibration is given in Appendix B.

5.1 Scenarios Modelled

Two alternative scenarios and a do-nothing case were established and modelled for 2021 and 2031 AM and PM peak periods. These incorporated various key options described in Chapter 3. They reflect a different extent of future works, as noted in Table 5-1. An outline of the outcome of the modelling of these scenarios follows in Sections 4.2 to 4.4.

Table 5-1: Options Included in Scenarios Modelled for the City Sector

Location	Do Nothing	Scenario 1 (Moderate Works)	Scenario 2 (Major Works)
Clunies Ross St/Barry Dr int	H1	H2	H3
Boldrewood St/Barry Dr int	I1	I4	I1
North Rd/Barry Dr int (City-bound)	J1	J1	J3
North Rd/Barry Dr int (Belconnen-bound)	K1	K1	K3
Barry Dr/Kingsley St int (City-bound)	L2	L2	L1
Barry Dr/Kingsley St int (Belconnen-bound)	M1	M1	M2
Kingsley St/busway int	N2	N2	N2
Rudd St/Marcus Clarke St int	O1	O2	O2
Marcus Clarke St - Rudd St to Alinga St	P2	P4	P3
Alinga St/Marcus Clarke St int	Q1	Q2	Q2
Alinga St/West Row int	R1	R1	R2
Alinga St/Northbourne Ave int	S1	S2	S3
City permanent bus layover	T3	T3	T2
ANU City West Bus Station	4 bays	4 bays	5 bays
City Bus Services Facilities Improvements	Watson St	Watson St	Watson St

5.2 Do-Nothing

Do-Nothing models were developed to provide a benchmark against which the effectiveness of the scenario designs could be compared. Future year demand forecasts based on EMME data supplied by TAMS were used to create demand matrices for input to Paramics. The resulting network wide growth levels for the City Sector are shown in Table 4-2.

Table 5-2: Future Year Network Demands

Time Period	2021	2031
AM Peak	2011+10%	2011+25%
PM Peak	2011+10%	2011+26%

Given the existing level of congestion experienced in the City with the main access roads currently operating at capacity during the peaks, traffic growth levels of 25% by 2031 were not deemed reasonable. As such modelling was only conducted for the AM and PM peak periods in 2021. The Do-Nothing scenario incorporated committed infrastructure changes such as the ANU bus station and the Watson Street layover.

5.2.1 Do-Nothing Network Observations

The AM peak Do-Nothing experiences significant congestion on the model boundary due to commuter traffic attempting to access the City CBD area. The main roads that experience long queues and delays on the edge of the model are:

- Northbourne Avenue at the intersection with Barry Drive. The southbound approach of this intersection currently operates at capacity during this peak hour and by 2021 an additional 200 vehicles/hour are expected on this approach.
- Barry Drive at the intersection with Clunes Ross Street. T he eastbound approach of this intersection currently operates at capacity during this peak hour and by 2021 an additional 120 vehicles/hour are expected on this approach.
- McCaughey Street at the intersection with Barry Drive. The eastbound approach of this intersection currently operates at capacity during this peak hour and by 2021 an additional 215 vehicles/hour are expected on this approach.

As a result of these bottlenecks on the edge of the network, the internal roads are generally free flowing with only local level congestion experienced at zone access points (e.g. car parks) as a result of increased levels of demand.

The PM peak Do-Nothing scenario experiences less congestion on the model boundaries when compared to the AM peak, but internal roads show greater congestion as a result of commuter traffic departing the local car parks in the CBD area. Major points of congestion are:

- Rudd, Childers and Hutton Streets as a result of the new signalised intersection at Rudd Marcus Clarke Street. This in part is a result of the queue extending back from Marcus Clarke / Barry Drive intersection which prevents left turning traffic from exiting Rudd Street.
- Bunda Street and Rudd Street at intersection with Northbourne Avenue. This occurs mainly as a result of the competing northbound and southbound demands on Northbourne Avenue.
- Intersection of Marcus Clarke Street and University Avenue - an increase in demand for all approaches at this intersection create queues that extend back to London Circuit and Childers Street.

5.3 Short-Term Improvement Package (Scenario 1)

5.3.1 Scenario 1 Network Observations

Scenario 1 delivers bus travel time benefits during both peaks and for all key services as shown in Table 5-4 and Table 5-5. This includes City-bound Blue Rapid services saving 1 minute in the AM and PM peaks.

General traffic patterns and areas of congestion are consistent between Scenario 1 and the Do-Nothing scenario. The main exception being at the Marcus Clarke Street / Rudd Street intersection where, as a result of the intersection upgrade, alternative phasing arrangements and approach modifications (Options O2 and P4) localised queuing is shifted from Rudd Street to Marcus Clarke Street. These queues are not extensive and do not impact upon the operation of surrounding intersections, although they do cause an increase in general traffic travel times along Marcus Clarke Street.

5.3.2 Scenario 1 Options Performance

Westbound journey time benefits of 21 seconds (AM Peak) and 37 seconds (PM Peak) are realised along Barry Drive between Kingsley Street and Clunies Ross Street. These improvements are attributed to the upgrade of the Clunies Ross Street intersection (Option H2) and the refinement of traffic signal offset timings to provide improved westbound progression.

Installation of the new indented stop at Boldrewood (Option I4) has little or no impact upon bus travel times in this section of the corridor. This is because all buses have been simulated as stopping, so there are no express or through routes able to benefit from the indented bays. A clear strategy and alignment of bus stops is required in this area with two City-bound stops within 200 meters of each other (i.e. the existing stop to the east of Clunies Ross Street and a possible new stop to the east of Boldrewood Street).

The upgrade of the Marcus Clarke / Rudd Street intersection by providing two lanes and split phasing on each of the Rudd Street approaches (Option O2), significantly reduces the queues on Rudd Street. This is mostly as a

result of the high volume of right turning buses out of Rudd Street west no longer blocking general traffic passing through the intersection. The reduced queues on Rudd Street are offset by increased queuing on the Marcus Clarke Street approaches, particularly in the northbound direction where a general traffic lane is replaced by a bus only left turn lane (Option P4). This bus only lane ensures that whilst there is an increase in general traffic travel times along Marcus Clarke Street, bus travel times are protected and improved.

The upgrade of the Marcus Clarke Street / Alinga Street intersection (Option Q2) provides increased capacity both to general traffic and buses exiting Alinga Street. This results in bus travel time improvements, however consideration needs to be given to the safety implications of left turning general traffic having to weave across the central bus lane at a point where right turning buses will be attempting to exit their stop to access the bus lane. These conflicting movements could also impact upon operational capacity of the intersection that is not picked up in these models. Furthermore, at this location, consideration should be given to an alternative design option that is able to provide two southbound lanes on Marcus Clarke Street. Traffic demand for the southbound movement in the AM peak is expected to increase 50% by 2021, to a level that the current design cannot support.

Removal of some parking on Alinga Street (Option S2) allows the left turn bay to be extended a further 50m, which helps to reduce the length of the queues on Alinga Street, the benefits of which are reflected in lower bus travel times.

5.4 Medium-Term Improvement Package (Scenario 2)

5.4.1 Scenario 2 Network Observations

Scenario 2 delivers bus travel time benefits during both peaks and for all key services as shown in Table 5-4 and Table 5-5. City-bound Blue Rapid services save 1 minute in the AM peak and 1 minute 48 seconds in the PM peak. The rerouted City services achieve significant bus journey time savings in the PM peak of around 1 minute.

Levels of queuing and congestion in Scenario 2 are comparable to Scenario 1, except at two key locations:

- The conversion of a general traffic lane on the eastbound Barry Drive approach to the North Road intersection causes a major increase in queues and delays on this approach during the AM peak; this is reflected in increased eastbound journey times on Barry Drive during this period. Bus travel times are not affected by this queue, and show an improvement eastbound along Barry Drive as a result of the bus lane that runs to the Kingsley Street intersection.
- In comparison to Scenario 1, a shift in traffic queues is experienced on Alinga Street as a result of signalising the West Row intersection. This upgrade (Option R2) results in significantly less queuing on West Row in both directions, but queues now build up on Alinga Street which used to have priority over all other movements. These queues however do not represent an increase in delay on Alinga Street, they represent a shift in the location at which queuing occurs away from the Northbourne Avenue intersection.

5.4.2 Scenario 2 Options Performance

Provision of a second right turn lane out of Clunies Ross Street (Option H3) provides some benefit providing additional capacity that enables an extra 100 queued vehicles to exit Clunies Ross Street in the PM peak when compared to Scenario 1. The benefits in the morning peak are limited by the congestion and queuing traffic heading eastbound on Barry Drive, but should this bottleneck be removed the possibility exists to redistribute green time to reduce delays further.

Extending the City-bound bus lane through the North Road intersection by replacing an existing traffic lane (Option J3) causes an approximate 500 vehicles/hour shortfall in capacity during the AM peak. This in turn creates extensive queuing both on Barry Drive and McCaughey Street (McCaughey Street queues are as a result of redistribution of green time from McCaughey to Barry Drive to offset the loss of the lane).

The impact on bus travel times of running them through the layover loop at the Barry Drive / Kingsley Street intersection (Option L1) has been assessed in detail using TRANSYT. The results of this assessment are given in Appendix A.

Assessment in Paramics shows that there are no adverse effects on queues or capacity along Barry Drive as a result of implementing this option. There are however increased queues on Kingsley Street during the PM peak when demand to exit onto Barry Drive is at its highest. This increased queuing is as a result of left turn slip being made bus only, forcing general traffic to turn left through the signals. Paramics modelling also shows that there is an increased risk of buses bunching as they have to wait for a short green signal to exit the layover, whereas by

turning right off Barry Drive they receive a longer green signal and are less likely to be stopped. This bunching could impact upon operations at the ANU bus station, increasing the stop requirements.

The benefits of upgrading Marcus Clarke Street to three northbound lanes between Alinga Street and Rudd Street (Option P3) are limited if filter right turn movements from Marcus Clarke Street are permitted at the Rudd Street intersection. Whilst the right turning traffic volumes are relatively light they the heavy opposing flows on Marcus Clarke cause the median lane to be blocked to through traffic during most cycle.

Signalisation of the Alinga Street / West Row intersection and provision of a scramble crossing (Option R2) has little impact on bus travel times but causes a relocation of queues along Alinga Street.

Through visual observation of the AM peak model it was possible to confirm that 4 City-bound bus bays at the ANU City West bus station are likely to be sufficient (Option T3). It should be noted that this assumes the bus routes and frequencies servicing the station do not change from existing levels.

5.4.3 TRANSYT Assessment of Bus Travel Times through Watson Street Layover

Initial assessment of alternative options for City-bound Belconnen bus routes passing through the Barry Drive / Kingsley Street intersection were undertaken using TRANSYT. TRANSYT enables the assessment of coordinated traffic signals, which made it an ideal tool to assess how buses would progress along Barry Drive and through the Kingsley Street intersection depending upon whether they were routed through the bus layover or able to turn right directly off Barry Drive. A summary of the results of this assessment are shown in Table 5-3.

Table 5-3: TRANSYT assessment of city bound bus route journey times at Kingsley Street intersection

	Bus Journey Times (seconds)			
Inbound Route Section	AM Peak		PM Peak	
	Layover Loop Option (T2)	Right Turn Option (T3)	Layover Loop Option (T2)	Right Turn Option (T3)
Layover Loop	77	17	51	51
ANU Exchange Bus Station (includes an assumed 40sec stop dwell time)	74	74	73	73
Rudd St/ Marcus Clarke St Intersection	47	49	45	33
TOTAL	**197**	**140**	**169**	**157**

The 58 second journey time benefit associated with turning buses right at the intersection in the AM peak are achieved due to the heavy traffic demand for this movement, which means the right turn receives a large share of the green time at the intersection. The benefits in the PM peak are much smaller because low right turning traffic and high competing westbound demand means the right turn only receives a short green time.

5.5 Conclusions

Modelled bus and general traffic travel times through the City Sector can be found in Table 5-4 to Table 5-7. The key conclusions that can be drawn from the City Sector modelling using Paramics and TRANSYT are:

- Three general traffic through lanes need to be maintained on Barry Drive at the intersection with North Road;
- The rerouting of City bus services to service City West results in longer distances being travelled when compared to existing routing, but they do so at higher average speeds as a result of the transitway upgrades;
- Running buses through the layover loop has the potential to erode some of the journey time benefits achieved in the rest of the network and also to bunch bus services;
- Two southbound lanes on Marcus Clarke at the intersection with Alinga Street are desirable to cope with forecast traffic demands;

- Modelling indicates four city bound stops are sufficient at the ANU bus station;
- Upgrade of the Alinga Street intersection provides tangible benefits to buses, but consideration needs to be given to safety implications of conflicting turning movements;
- Full signalisation of Alinga Street and West Row has minimal effect on buses, but reduces general traffic queues on West Row; and
- The P3 option to widen Marcus Clarke Street northbound to three lanes doesn't deliver maximum level of benefit if filter right turn movements into Rudd Street are permitted.

Table 5-4: AM Peak Bus Travel Times

	Route Description	Do Nothing	Scenario 1	Diff	%	Scenario 2	Diff	%
2021 8-9AM Base vs Scenario 1 and Scenario 2	Blue Rapid Citybound	0:12:51	0:11:37	0:01:14	10	0:11:50	0:01:01	8
	Blue Rapid Belconnen Bound	0:12:19	0:11:24	0:00:55	7	0:11:13	0:01:06	9
	Belconnen Way Xpresso Services	0:12:10	0:11:25	0:00:45	6	0:12:01	0:00:08	1
	Diverted Through Routes	0:11:54	0:11:44	0:00:11	1	0:11:51	0:00:03	0
	Diverted Terminating Routes	0:12:55	0:12:55	0:00:01	0	0:12:42	0:00:13	2

Table 5-5: PM Peak Bus Travel Times

	Route Description	Do Nothing	Scenario 1	Diff	%	Scenario 2	Diff	%
2021 8-9PM Base vs Scenario 1 and Scenario 2	Blue Rapid Citybound	0:12:32	0:11:17	0:01:15	10	0:10:44	0:01:48	14
	Blue Rapid Belconnen Bound	0:10:52	0:10:48	0:00:03	1	0:10:41	0:00:10	2
	Belconnen Way Xpresso Services	0:11:48	0:11:10	0:00:38	5	0:11:12	0:00:37	5
	Diverted Through Routes	0:12:23	0:11:54	0:00:29	4	0:11:19	0:01:05	9
	Diverted Terminating Routes	0:13:41	0:12:19	0:01:22	10	0:12:16	0:01:24	10

Table 5-6: AM Peak General Traffic Travel Times

M Peak Traffic Travel Times (Seconds)							
	Do-Nothing	Scenario 1	Difference	% Diff	Scenario 2	Difference	% Diff
Barry Drive Eastbound between Clunies Ross St & Kingsley St	254	247	-7	-3	283	29	11
Barry Drive Westbound between Kingsley St & Cluines Ross St	156	135	-21	-13	154	-3	-2
Barry Drive Eastbound between Kingsley St & Mort St	131	138	7	5	135	4	3
Barry Drive Westbound between Mort St & Kingsley St	268	275	7	3	270	3	1
Northbourne Ave Southbound between Barry Dr & Vernon Circ	159	160	1	1	161	3	2
Northbourne Ave Northbound between Vernon Circ & Barry Dr	115	188	73	63	112	-4	-3
Marcus Clarke Southbound between Barry Dr & University Ave	98	115	16	17	143	44	45
Marcus Clarke Northbound between University Ave & Barry Dr	120	186	65	55	203	83	69
TOTAL	**1302**	**1444**	**142**	**11**	**1462**	**160**	**12**

Table 5-7: PM Peak General Traffic Travel Times

PM Peak Traffic Travel Times (Seconds)							
	Do-Nothing	Scenario 1	Difference	% Diff	Scenario 2	Difference	% Diff
Barry Drive Eastbound between Clunies Ross St & Kingsley St	174	181	7	4	144	-30	-17
Barry Drive Westbound between Kingsley St & Clunies Ross St	157	119	-37	-24	140	-16	-10
Barry Drive Eastbound between Kingsley St & Mort St	260	246	-14	-5	203	-57	-22
Barry Drive Westbound between Mort St & Kingsley St	430	251	-179	-42	377	-53	-12
Northbourne Ave Southbound between Barry Dr & Vernon Circ	188	136	-53	-28	156	-33	-17
Northbourne Ave Northbound between Vernon Circ & Barry Dr	131	176	45	35	168	37	29
Marcus Clarke Southbound between Barry Dr & University Ave	156	146	-11	-7	198	42	27
Marcus Clarke Northbound between University Ave & Barry Dr	160	189	29	18	153	-8	-5
TOTAL	**1657**	**1444**	**-212**	**-13**	**1538**	**-118**	**-7**

6.0 City Permanent Bus Layover

6.1 Issues

The City Area bus layover facility has been proposed on Block 8 Section 25 Turner. The layover facility will be located adjacent to the Barry Drive portion of the Belconnen to City Transitway and will play an integral role in the Transitway's future operation. The proposed permanent facility will be required to replace the current layover facility, located on Blocks 2 & 7 Section 4 City, which is identified as a development site in the ANU exchange master plan.

The bus layover facility would cater to buses laying over for short or long periods of time. This will reduce capacity and congestion problems in the City bus interchange.

The layover facility will be co-located with another important feature of the Belconnen to City Transitway, an outside bus-only right turn lane for eastbound buses on Barry Drive to turn south onto Kingsley Street.

The primary goal of the bus layover proposal is to replace the existing (13 space) facility. Additional objectives include:

- assist in the efficient operation of the Belconnen to City transitway facility,
- provide a termination location and short-term layover for extended City services
- improve the efficiency and capacity of the City centre Major Station (City Bus Interchange).

Design criteria include:

- minimise the travel distance for buses accessing the layover facility or travelling through to Kingsley Street,
- minimise need for backing or excessive manoeuvring for buses accessing the layover facility, and
- provide excess capacity or room for future expansion, for up to 15 buses

Existing conditions were determined through field inspection and review of a previous study for the site. Challenges and design recommendations posed by existing conditions are summarised in Table 6-1.

Table 6-1: Summary of Design Challenges

Challenges	Design Recommendations
- Sullivans Creek flood embankment	- Minimise encroachment into levee
- Existing mature trees	- Minimise impacts to groups of mature trees, particularly on street frontages
- Uncontrolled fill to 1 metre depth	- Fill should be removed and replaced
- Sewer tunnel traversing site	- Locate structures away from sewer path
- Stormwater handling - On-site drainage	- Stormwater is accommodated by available infrastructure - Drainage treatment will be considered during design
- Existing and planned transport facilities	- Barry Drive/Kingsley Street intersection should be designed for safe and efficient movement of automobiles, bicyclists, and pedestrians
- Planning context/community impact	- Planning Study should include impact analysis, refined designs and a strong community consultation element

A bus layover facility at or close to the desired capacity, while still meeting design criteria, is feasible on this site. Six designs have been drawn-up to illustrate challenges and options, these are summarised in Table 6-2.

6.2 Options

Table 6-2: Summary of Options

Option		Features	Benefits/Detriments
1		- Original concept, - 10 bus spaces - Perimeter bus lane - Buses Pull-in to Spaces	- Small Footprint - All spaces require reversing - Longer trip for through buses
2		- 18 spaces - Direct bus lane - Mostly pull-through spaces	- Larger footprint - Narrower design - Less reverse movement - Stacked parking - Faster trip for through buses
3		- 15 spaces - Perimeter bus lane - Pull-through spaces	- Wider design - Larger footprint - Less reverse movement - Longer trip for through buses
4		- 14 spaces - Perimeter bus lane - Pull-through spaces - 45 degree angle parking	- Wider design - Smaller footprint - Less reverse movement - Longer trip for through buses
5		- 15 spaces - Perimeter bus lane - Pull-through spaces - Two rows angle parking	- Wider design - Larger footprint - Less reverse movement - Longer trip for through buses
6		- 15 spaces - Direct bus lane - 1 row pull-through spaces - 1 row pull-in spaces	- Wider design - Smaller footprint - Some reverse movement - Faster trip for through buses

Option 2 is the strongest candidate with a direct bus lane, and Options 4 and 5 are the strongest candidates for perimeter routing of the bus lane. They are superior to other options because they accommodate all or almost all of the target design capacity, and they do so without requiring buses to make reverse movements. These designs should be carried forward for refinement in the design stage of the Planning Study. New designs should be evaluated against the stated objectives, and others that arise and are accepted through consultation and further refinement.

7.0 ANU City West Bus Station

7.1 Requirements

The physical space for City West Bus Station is effectively fixed from decisions previously made for the construction of the ANU Exchange; in particular, the 20m road reservation width. There are two key aspects to the City West Interchange design:

- capacity or number of bus bays; and
- geometry.

7.2 Capacity

The capacity or number of bus bays required is dependent upon the number of passengers boarding/alighting and the number of buses serving the stop.

7.2.1 Bus Passenger Demands and Boarding/Alighting Times

Surveys of bus passenger boarding and alighting times were undertaken in 2006 and 2007 of bus operation at bus stops. The summary results from these surveys are given in Table 7-1. ACTION are in the process of introducing a new ticketing system (MyWay) that will reduce the time to board but increase the time to alight. Observations of the new MyWay ticketing system is that the average board and tag-on time is 3 seconds with the range 2 – 6 seconds) but the sample size has only been a handful. Alighting times with the MyWay card have not yet been observed.

Table 7-1: Bus Passenger Boarding and Alighting Times

Criteria	Surveyed / estimated duration, seconds	Assumed 2012, seconds
Time to occupy bus bay (length of bus at 10 km/h). 12.5 m bus 14.4 m bus 17.5 m bus	 4.6 5.3 6.5	 4 5 6
Time for doors to open from the time the bus comes to a complete stop	2 (range 1 – 9)	2
Time per passenger to alight	2 (range 1-3)	3
Time per passenger to board Pre paid cash	 5 (range 3.5 -7) 5 (range 3 – 20)	 3 5
Time to close doors and move off	2	2
Time to completely exit bus stop 12.5m bus 14.4m bus 17.4m bus		 3 4 5

The 2007 surveys showed that the number of passengers alighting at the Marcus Clarke Street stop was 72 in the peak 30 minutes or 2 passengers per bus. This seems low compared to the level of activity and the observations of some key routes in the AM peak period where the range of alighting passengers is from 5 to 25 per bus. The additional development that has occurred in City West since 2007 that will be serviced by the new station will increase patronage by at least 50% by 2012. This is expected to increase the peak passenger movements to 216 passengers per hour at the City West Station.

With the sustainable transport plan objective of doubling the 2006 mode split, this demand will increase further to 432 passengers per hour. In addition extra demand will be created by the extension of the City Services to the City Loop Service and interchanging between the Blue Rapid and Belconnen services will occur with the City Loop service. An estimate of this interchanging demand can be derived from the expected 6500 employees in the Section 63 development, generating 2300 additional bus passengers. Of these about 25% will come from Belconnen and about 80% will arrive in the peak and generate a further 500 interchanging passengers at the City West bus station. There will also be more university students who will use this stop in preference to the Barry Drive / Clunies Ross Street stop.

On this basis the station should be planned to accommodate at least up to 1000 passengers per hour.

7.2.2 Bus Frequency and Bus Bay Requirements

If one assumes that the existing bus fleet is at 75% of full loadings and that by 2026 the Blue Rapid route will be serviced only by buses with a capacity of about 100 passengers (ie., either articulated or tag steer), then the existing frequency can just be maintained with all buses running at capacity loadings. With a four bay station and 66 buses per hour servicing 1000 passengers on average there will not be a bus bay available for 3.5 minutes in the AM peak hour which is likely to result in queuing back onto Kingsley Street.

Should the passenger demand become skewed and the peak 30 minute demand increase from 15 to 20 passengers per bus then for a 4 bay bus station there will be no bus bay available for 21.5% of the time or nearly 13 minutes. This will result in significant queuing to the extent of potentially adversely impacting on the Kingsley Street / Barry Drive intersection.

Given that observations of existing bus queuing at the Marcus Clarke Street stop regularly has a demand of 4 buses concurrently, it is considered essential to provide for future lengthening of the City West Bus Station to accommodate at least 5 buses for the southbound journey. This was confirmed by Paramics modelling.

If one assumes that the existing fleet operates at 100% of capacity and that the additional demand will need to be achieved by an increased fleet size, then the average need for 5 bays will exist for 14 minutes in the peak hour for 1000 passenger bus station. However during the peak 30 minutes if an extra 10 buses are scheduled to arrive (such as may happen if not all buses are 100 passenger capacity, then it could be expected that this shortfall in bus bays will occur for 16.5 minutes during that period.

Should ACTION allow passengers to exit via the rear doors at the City West Bus station then a bus station with a 4 bay capacity will be adequate, for the AM peak. However, this extra capacity provided for alighting passengers does not assist with PM peak operations, when bus boarding operations predominate.

In conclusion, a 5 bus bay station is likely to be adequate for the design horizon of 2026.

7.3 Geometry

7.3.1 ACTION Bus Station Design Guide Requirements

ACTION has a mix of bus sizes in its fleet from midi to articulated including tag steer buses. They range in dimensions from 9.4m for the Dart Midi, to 12.4m for the rigid bus fleet, 14.5m for the tag steer buses and 17.75 for the existing articulated fleet. These dimensions exclude the additional length required for the bicycle racks.

The length requirements for the bus stops are shown in Table 7-2 assuming:

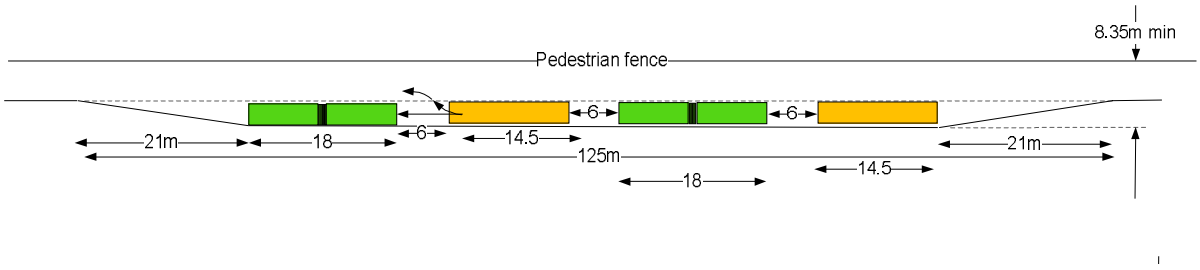
- two stops with 2 buses at each stop;
- that there is sufficient width for buses at the second stop to clear the bus in the front stop and median fence with the standard required clearance of 600mm;
- ACT Bus station design guidelines are to be met; and
- Conformance to Design for Access and Mobility (AS1428) standards

Table 7-2: Key Bus Stop Design Criteria

Criteria	Dimension	Comment
Run in length	21m	As per ACT Bus stop guidelines
Articulated bus	18m	Assume new buses will be 3 door and 0.5m longer than existing
Gap to next bus	1m	
Articulated bus – or tag steer with bike rack	18 max	Assumed tag steer with bike rack is 15.4m
Pull in	15m	
Tag Steer bus	14.5m	
Gap to following bus	1m	
2nd bus	14.5	
Pull out taper	21m	
Total continuous length required	124m	This could be reduced by 2.6m if one could guarantee that two articulated buses would not be present at the one time
Standard bus with bike rack	12.5m + 1.2m = 13.7m	

The swept path assessment shows that if the buses were to attempt to exit from as close as possible to the preceding bus and are also to clear the centreline by the minimum 600mm required by Austroads then the minimum with of the lane and lay-by would be up to 7.75m if the absolute minimum gap between buses is provided. A 6m gap between buses allows them to exit but not enter and the minimum arrangement for pavement width is shown in

Figure 7-1: Single bus stop independent exit



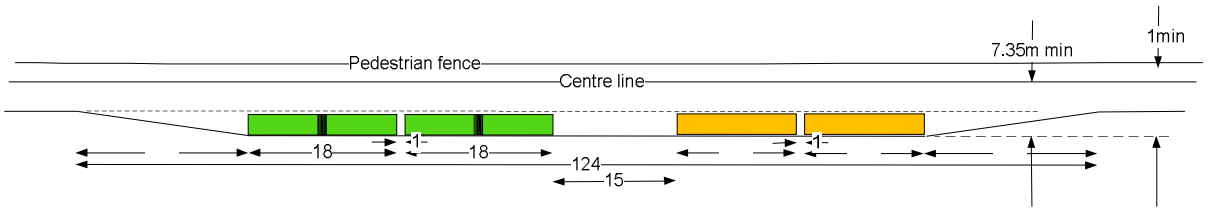
If the buses are to operate in tandem with 1st in 1st out for each of two stops, then with 15m between the two stops the minimum width can reduce to 7.35m. This separation for this form of operation is considered essential in order to avoid the tag steer buses from having a 1m swept path overhang when exiting the bus bay. If 1st in 1st out operates with 2 bus stops then the kerb overhang from the swept path reduces from 1m to 200mm with a 15m separation - as required for articulated buses. This is considered a much safer operation for waiting passengers.

In order to accommodate the swept path requirements and with a pedestrian fence along the centre line it is recommended that the minimum total pavement width for independent exit would comprise: 7.75m + 1.5m + 7.75m = 17m.

If the station operates as two stops for two buses each, with 10m gap between the stops, then the minimum width is: 7.35m + 1.5m + 7.35m = 16.2m.

These two options are shown in the following diagrams:

Figure 7-2: Two stops with two buses for each stop



The footpath passenger waiting width needs to accommodate not only the waiting passengers but also potential pedestrian through movements and possibly an occasional bicycle movement.

In order to comply with Design for Access and Mobility (AS1428) requirements there needs to be tactile pavers placed along the platform. These are 600mm wide and if placed 300mm from the kerb the resultant width that indicates a keep clear area is 900mm. This is considered an appropriate treatment in order to indicate to passengers that the potential bus overhang from the Tag-steer buses does not protrude beyond the tactile paver edge.

Pedestrian requirements to allow through pedestrians and waiting passengers will require the following:

- 1.0m for a mandatory continuous accessible pathway (AS1428.1, clause 6.3). No structures or street furniture is to be placed in this zone.
- 0.8m for passing space at a maximum of 6 intervals (ie., coincident with landings).
- O.6m for waiting passengers
- 0.2m for awning support structures
- 0.9m for kerb tactile paver zones

This equates to a total minimum pavement width of 3.5m. Adjacent to the Blue Rapid bus stops (at the eastern end) it would be highly desirable that this width be increased to 5.0m to accommodate waiting passengers (up to about 15 people per bus).

When combined with the minimum road width the resultant requirements are for a reservation 2 by 3.5m + 17m = 24.1m to meet the minimum desirable standards which is 4.1 metres wider than the available corridor width. The minimum standard is 16.2m plus 7.0m = 23.2m which is still 3.2m wider than is available. Therefore in order to allow the station to operate some elements need to be compromised. In order to identify areas of potential compromise examples of existing bus operational needs have been reviewed. If the median pedestrian fence is not installed the absolute (but non conforming) minimum width is 21.7m.

An alternative option is to develop a split station with inbound services within the ANU exchange on Section 21 and the outbound platform on Marcus Clarke Street between Alinga and Rudd Streets.

7.3.2 Design of Other Existing ACT Bus Stations

7.3.2.1 City Bus Interchange

The existing pavement manoeuvre width and parking bay width in the City Bus Interchange is 13.5m with no median fencing to contain pedestrians from crossing the road. Observations and discussions with ACTION (Road Safety Audit City Bus Interchange 2010) shows that buses do swing over the centreline to manoeuvre but also that there is a satisfactory record of the interchange safety with respect to bus to bus and bus / pedestrian conflicts. It is therefore suggested that it may not be unreasonable in this case to adopt the city bus interchange pavement cross section – even though ACT Bus interchange design standards, Austroads and Australian standards are not met.

However the City Bus Interchange is provided with footpaths significantly more generous than those proposed for the City West bus station and it is suggested that DDA issues are really not able to be compromised.

The pavement width required is therefore a minimum of 13.5m and footpath width of 7.6m (combined) or 22.1m which is still 2.1m greater than the width available for the City West Bus station road reservation.

Disability and vehicle safety standards will therefore also have to be compromised together with operational standards in order to construct the bus station or the available width must be increased – perhaps by insetting the passenger waiting area.

7.3.2.2 Belconnen Westfield Bus Station

Observations at the new Westfield Bus Station show that a 7.0m width does not permit the tag steer buses to pull out and clear the bus in front and the pedestrian fence by 600mm each.

The Westfield station comprises pavements 7.0m wide and a central fenced median 1.5m wide.

Observations show that buses do not clear the pedestrian fence by the required 600mm nor the parked buses and therefore is not fully compliant with current ACTION design guidelines. While this facility is not fully compliant bus operations appear to be satisfactory here.

The footpaths are adequate.

7.3.3 Consideration of an Alternative Station Design

ANU suggested an alternative one-way loop to overcome the physical constraints of the current station location. This would involve City-bound buses travelling one-way eastbound through the ANU Exchange busway link and Belconnen-bound buses using Marcus Clarke Street between Alinga and Rudd Streets. The positive aspects of this proposal include:

- Achieves adequate space for bus passengers adjacent to the busway in ANU Exchange
- Reduces bus traffic within the Exchange with an associated reduction in noise and fumes
- Makes it easier for pedestrians to cross busway

However, the proposal has some significant negative aspects which make this alternative scheme unacceptable:

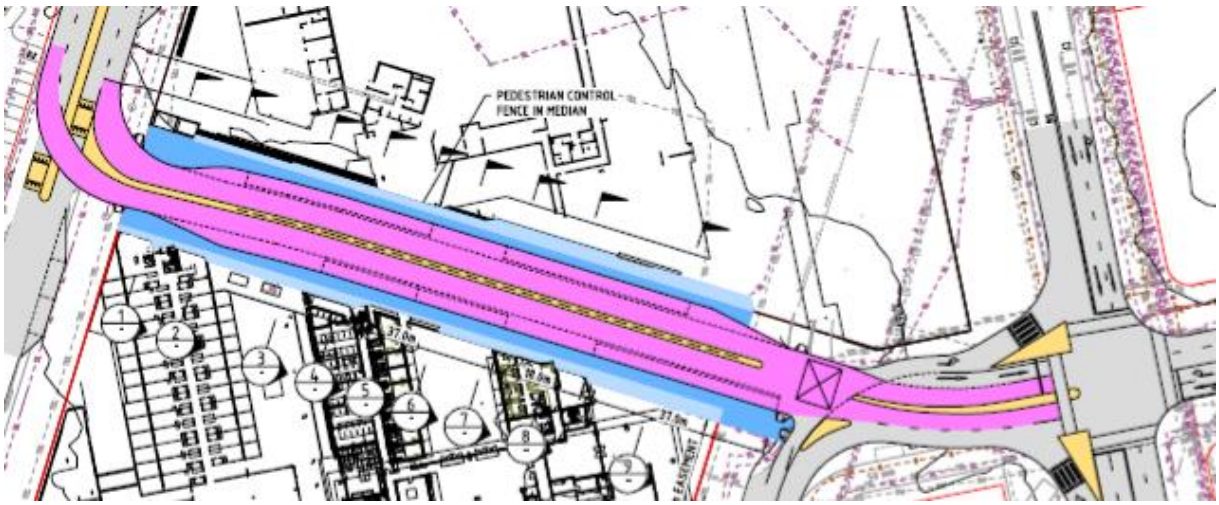
- Does not provide sufficient space for require number of bus bays on Marcus Clarke Street to allow fully independent operation of the two stops
- Does not achieve place making objectives because stops for each direction of travel are physically separated
- Requires widening of Marcus Clarke Street

7.3.4 Current City West Station Design Parameters

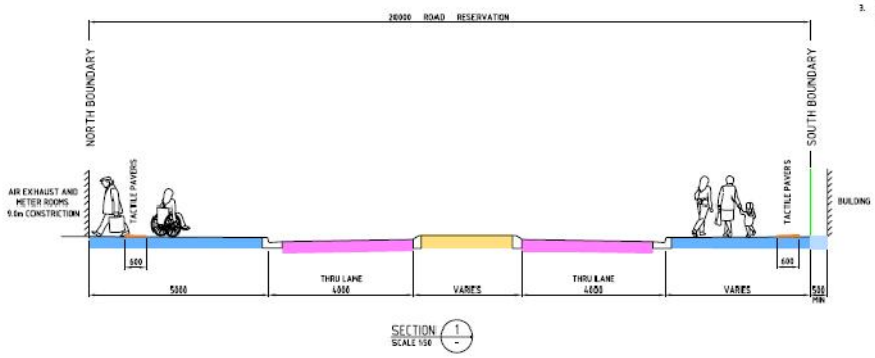
As previously noted, the existing 20m road reserve is not wide enough for this facility. There is a need to rationalise design guidelines and identify safe compromises within the current road reservation and adjoining ANU properties that will provide a suitable environment for bus operations, bus passengers and users of adjoining buildings. The following design parameters have been adopted from AS1428.1, TAMS/ACTION design guides, the satisfactory operation of existing facilities such as the Belconnen Westfield Bus Station and commonly acceptable design parameters:

1. 7.0m heavy bus carriageway. This is based on turning templates for both the 14.5m tag steer and 18m articulated buses, increasing the distance between the two bus zones from 10m to 15m and the current satisfactory performance at Westfield Belconnen which uses the same dimension.
2. 1.3m wide median for the mandatory pedestrian safety fence.
3. 0.9m width from face of kerb to back of tactile pavers.
4. 1.0m wide mandatory continuous accessible pathway zone.
5. 0.8m wide passing space at 6m centres.
6. 0.6m wide minimum space for waiting passengers. This should increase to 2.1m adjacent to the Blue Rapid stops.
7. 0.2m for awning structure support.

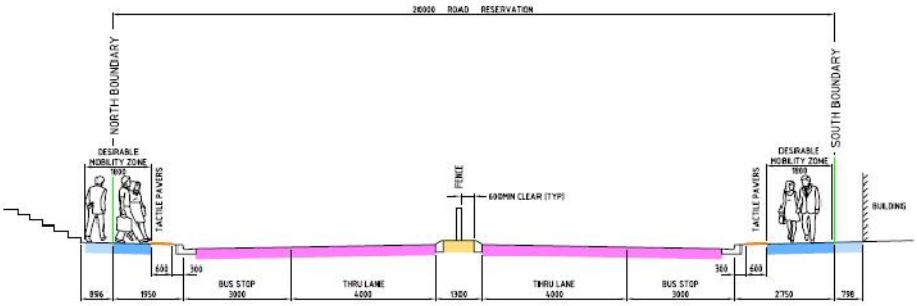
These constraints are shown in the following plan and cross sections. The pink shade is bus pavement, dark blue shows the area between the ANU boundary and kerb, and the light blue shows the area of intrusion that is required into ANU land.



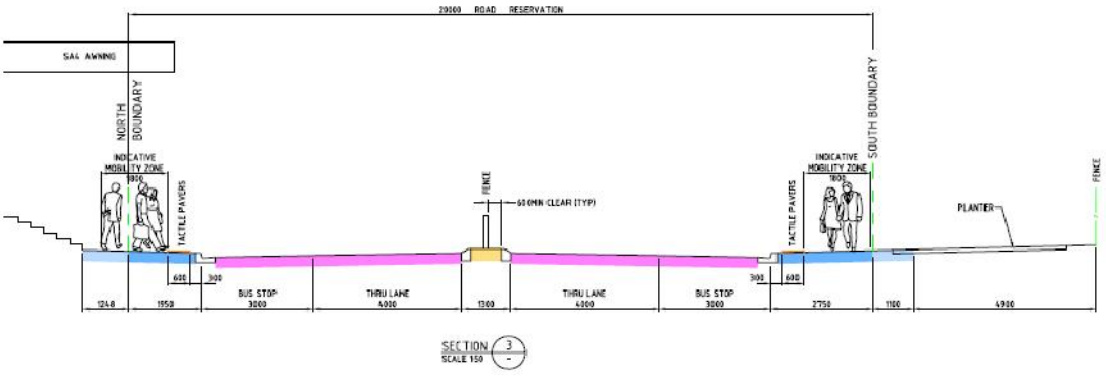
NOTES:
1. DESIRABLE MOBILITY ZONE IS MADE UP OF A MANDATORY 1800mm WIDE CONTINUOUS ACCESSIBLE PATH (AS1428.1 - CLAUSE 6.3) PLUS AN 800mm "DESIRABLE CONTINUOUS PASSING SPACE"
2. NO STRUCTURES OR STREET FURNITURE TO BE PLACED IN THE MANDATORY 1800mm WIDE CONTINUOUS ACCESSIBLE PATH.
3. CONSTRICTIONS WITHIN THE 800mm DESIRABLE PASSING SPACE MUST NOT BE MORE THAN 32.5m LONG



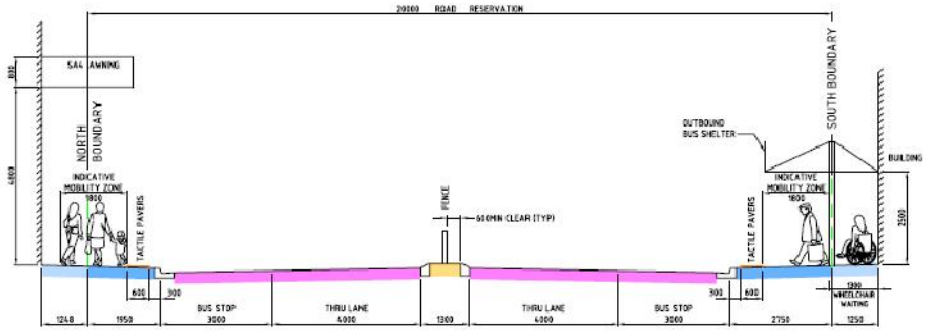
SECTION 1 SCALE 1:50



SECTION 2 SCALE 1:50



SECTION 3
SCALE 150



SECTION 4
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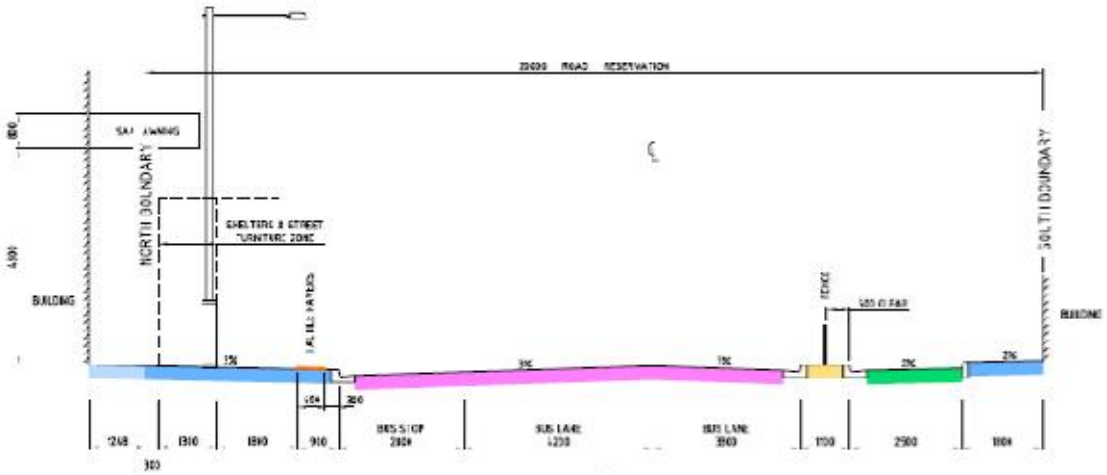


SECTION 5
SCALE 150

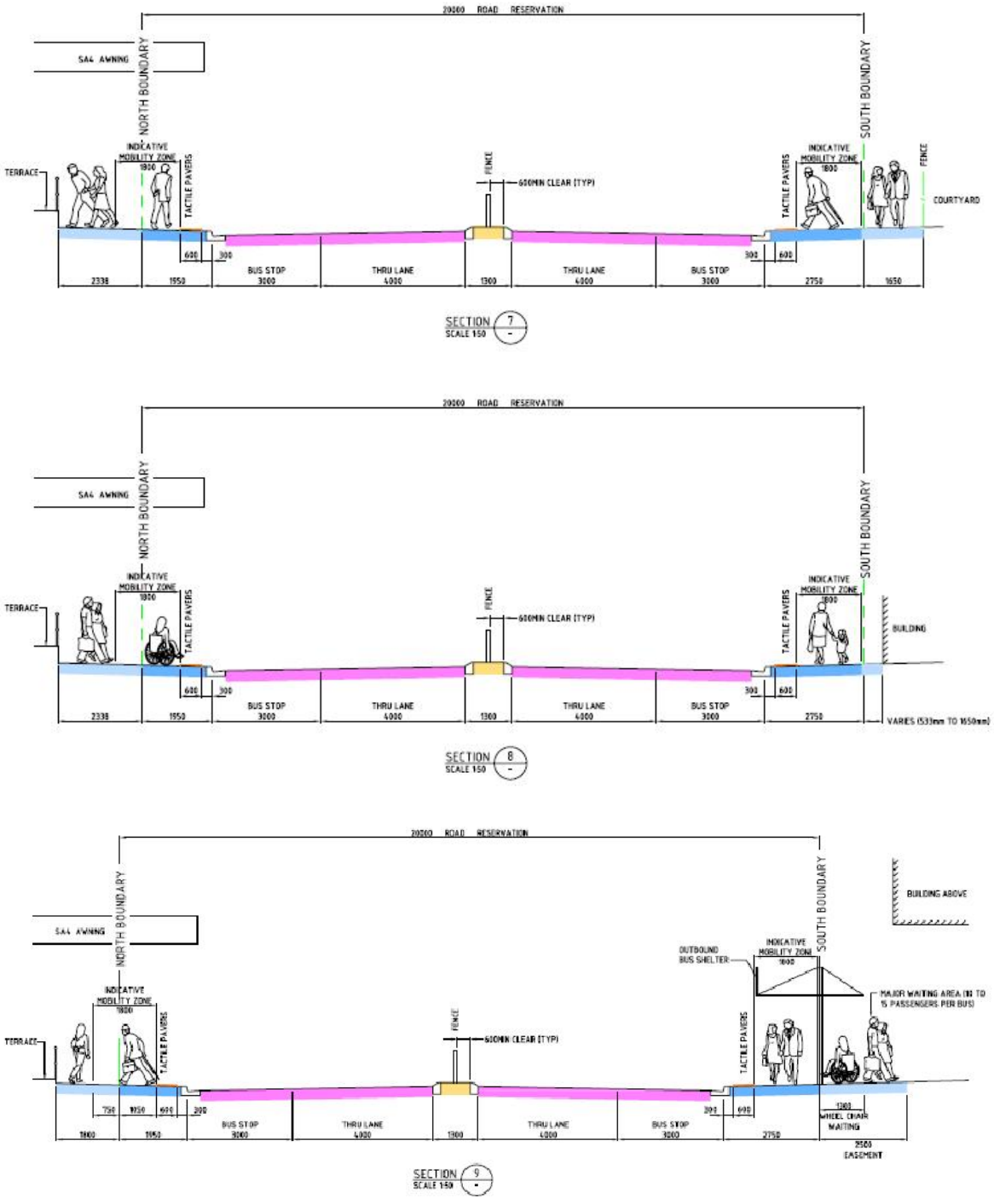


Figure 7-3 Bus station Cross Sections

7.4 Conclusions

The passenger and bus demands for the City West Bus Station show that the station should be planned to provide for 1000 passengers per hour and 4 bus bays in each direction.

The bus bays need to be aligned to have two stops with two bays at each stop. A 15 metre gap is required between these stops. The bays should provide for two articulated and 2 tag steer buses a total length of 124 m to meet the length requirements defined in the ACTPLA ACT Bus Stop Guide. In the future sufficient space should be allowed to accommodate 2 bus stops with 2 buses in the first bay and 3 buses in the second bay. The second bay will allow independent exiting from the front bus stop.

The width available in the station is inadequate to meet the design requirements defined in the ACTPLA Bus Stop Guidelines and the requirements of the Commonwealth Act for Accessible public transport 2003– however the pavement width is similar to the existing space in the City Bus Interchange. The available space for waiting passengers is too narrow and needs to be increased to meet DDA, passenger waiting and clearance outside of the swept path / kerb overhang of tag steer buses.

Consequently the preferred bus station arrangement is for a split station with the general arrangement recommended for the City West Bus Station shown in Figure 7-4.

Figure 7-4: City West Bus Station General Arrangement

8.0 City Bus Services and Facilities Improvements

8.1 Introduction

In order to both reduce congestion at the City Interchange and to better service City West / City South a proposal was developed to extend certain services through the City Bus interchange and terminate with two far side interchanges - one at University Avenue and a further one in City East on Nangari Street. Further analysis of the Nangari Street bus station has shown that there are too many operational constraints to allow this location to function as desired.

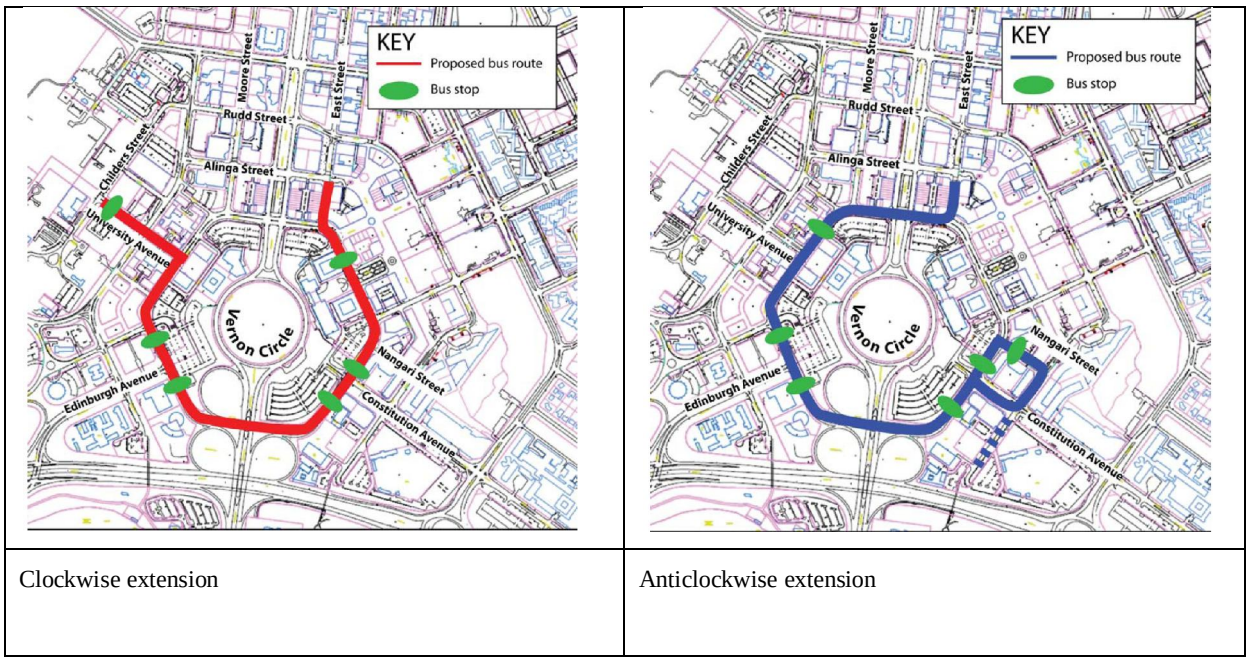
Further analysis of University Avenue has also shown that it is preferable to combine the terminus with the Watson Street lay over area. This chapter documents the suggested arrangement for City bus services to fulfil the objective of serving City West with improved bus coverage. Previous studies identified these options in order to not only improve City West bus coverage but also to reduce the congestion at the City interchange platforms.

The extension of services around London Circuit via the new City West Bus station to terminate at Watson Street layover area is limited to those services that currently terminate in the City and that does not require any back tracking / dead running to service the City West station.

8.2 Previous Proposals

The above options were reviewed by others and were subsequently modified. This latter proposal reduced the frequency and number of services to the routes 7, 9, 30, 31 and 39. The route extensions are shown in

Figure 8-1: Route Extension Options



Clockwise extension	Anticlockwise extension

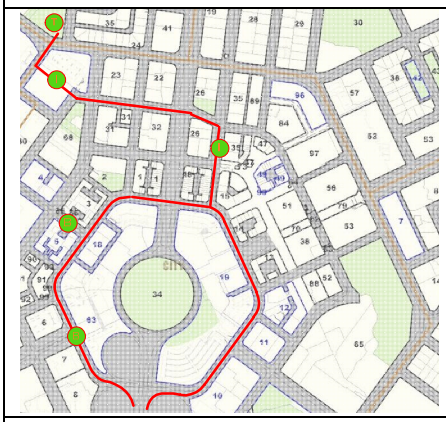
Source PB 2009

8.3 Services terminating at Watson Street

The assessment of the Nangari Street terminus concluded that it is an unsuitable location because of the number of driveways and service access needs. Further the University Avenue site was also deemed as unsuitable for urban design reasons. Hence a new terminus for the extension of the City services to relieve the City Interchange and to also service City West was investigated. These services are generally those from North Canberra that currently terminate at the City Interchange. The affected services and their proposed routes will continue through

the City Bus interchange, and pass through the City West Station to terminate at the Watson Street layover area. These routes are shown in the following figures:

Figure 8-2: Route Extension

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Route 5 extension</td><td>Route 7 extension</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Route 11 Extension</td><td>Routes 36, 51, 52, 56, 57, 58, 59 extensions</td></tr>
</table>

All of these options can utilise existing / planned bus stops and shelters to service City West and no new infrastructure will be required. New stops include that proposed for inbound services on Commonwealth Avenue using the proposed Edinburgh Avenue extension and new bus stop opposite the Lakeside hotel. These suggested routing variations have been assessed for change in route length and expected impacts on travel time. These are presented in **Table 8-1**

Table 8-1: Route Travel Times

Route No	Frequency		Existing route City length	Proposed City route length	Difference	Travel Time 25Km/hr
	Peak	Off peak				
5	30 min	1 hr	1	2.8	1.8	4.3
7	30 min	30 min	0.6	2.93	2.33	6
11	20 min	30 min	2.3	2.9	0.6	1.5
51	30min		0	2.5	2.5	6
52	20 min		0	2.5	2.5	6
56	20 min	1 hr	0	2.5	2.5	6
57	40 min	1 hr	0	2.5	2.5	6
58	15 min	1 hr	0	2.5	2.5	6
59	15 min		0	2.5	2.5	6

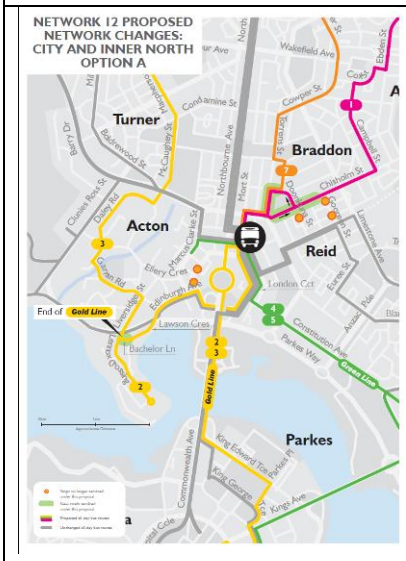
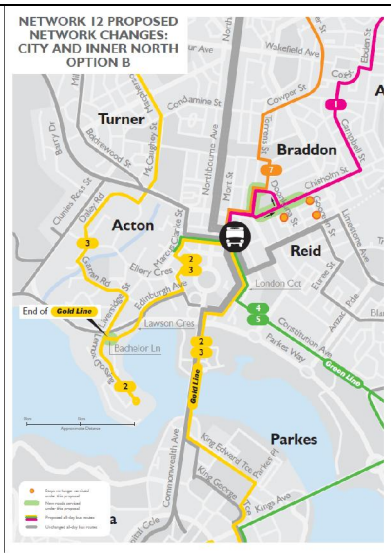
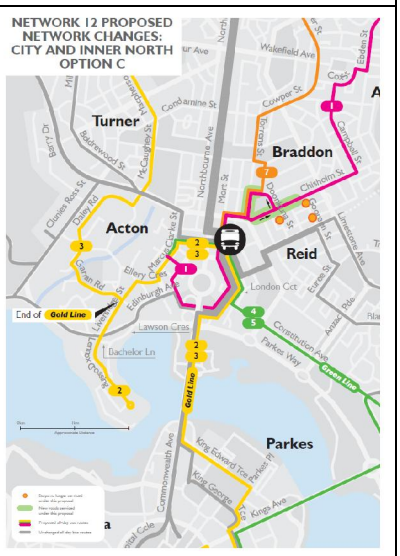
This demonstrates the feasibility of the route extensions to not only relieve congestion at the City Interchange burt also provide coverage to City West. Although these routes are significantly greater than earlier reports recommended it is AECOM view that unless a 5 minute frequency can be achieved then the extensions will not perform as intended.

8.4 City 2012 Network

Concurrent with this study is the 2012 network planning study. At this stage the 012 network is recommending that route 3 be split into routes 2 and 3 with both services travelling on London Circuit and Edinburgh Avenue. If the Network 12 proposals indicate that the changes to routes 2 and 3 will be sufficient to service City West then the routes to terminate at Watson Street can be shortened to take the most direct route to Watson Streets shown in the following diagrams.

The three options are shown in Figure 8-3.

Figure 8-3: Bus Route options 012 network City West.

Routes 2 and 3 service City West	Routes 2 and 3 service City West	Routes 1, 2 and 3 service City West.
		

8.5 Conclusions

There are conflicting routing proposals being generated between previous studies and the Network 012 proposals. Advice from the 012 proposals is that it is not necessary to provide additional services to provide coverage to City West.

However should it be decided that additional services and coverage are required then it is a simple matter to extend the services identified in **Figure 8-2**.

An examination of the changes in route structure to service City West indicates that no new infrastructure will be required in terms of bus stops or shelters other than what is needed for existing services. However if it is decided to extend services other than routes 2 and 3 to service City West, or to adopt option C from the 012 proposals then it may be necessary to install traffic signals at the intersection of University Avenue and London Circuit especially when Section 63 development proceeds

9.0 Conclusions

The Belconnen to City Transitway Stage 1 presents several opportunities to provide bus priority measures. Many of these measures will not be required immediately but are likely to be required within the foreseeable future to not only minimise bus travel time but to also ensure bus travel time reliability.

Indicative costs have been developed for each of the measures identified to assist in the assessment of these options. The indicative costs show that a logical bundle of works can be assembled to provide sound projects to enhance bus travel end reliability.

The measures and the indicative costs are shown in Table 9-1. The table shows a logical series of measures that can be achieved within the budget.

Table 9-1: Indicative costs of Belconnen to City Stage 1

	Location	Description	Indicative cost	Must do	Logical extensions	Later stages
Belconnen Section						
	College Street / Eastern Valley Way	Diamond turns	$ 950,000			$ 950,000
	College Street	Widen to 4 lanes full length	$ 4,000,000			$ 4,000,000
	University Entry	Pedestrian Crossing	$ 300,000			$ 300,000
	Radford College	Service Road	$ 550,000			$ 550,000
	University Entry	new entry with Radford	$ 800,000			$ 800,000
	College Street at University / Radford	Slow-Way	$ 150,000			$ 150,000
	Haydon Drive at College Street	Relocated Bus Stops	$ 200,000			$ 200,000
	Haydon Drive at Purdie Street	Signalise Purdie Street	$ 1,600,000			$ 1,600,000
	Haydon Drive	Bus lane from Mary Porter South to Mary Porter North	$ 600,000			$ 600,000
	Haydon Drive/ Belconnen Way	Upgrade intersection and Bus Stops	$ 1,600,000			$ 1,600,000
	Belconnen Way	Extend Bus lane to GDE	$ 600,000			$ 600,000
City Section						
	Upgrade Clunnies Ross Intersection	In another Project				
	Barry Drive	Bus Gate	$ 200,000	$ 200,000		
	Barry Drive	Bus lanes at North Road	$ 1,300,000	$ 1,300,000		
	Barry Drive	Cycle bridges over Sullivans Creek	$ 500,000	$ 500,000		
	Barry Drive	New signals at Kingsley Street	$ 1,000,000	$ 1,000,000		
	Kingsley Street	Bus Lanes	$ 500,000	$ 500,000		
	City West Bus Station		$ 1,500,000	$ 1,200,000		
	Marcus Clarke Street / Rudd Street	Signalise Intersection	$ 450,000	$ 450,000		
	Marcus Clarke Street	Remove median and resheet	$ 200,000	$ 200,000		
	2nd turn lane at Alinga Street	Modify Alinga St Intersection	$ 300,000	$ 300,000		
	Alinga Street	Signalise West Row Alinga Street	$ 400,000		$ 400,000	
	Alinga Street	Resheet and linemark	$ 100,000		$ 100,000	
Indicative total cost			$ 17,800,000	$ 5,650,000	$ 500,000	$ 11,350,000
Total Strage 1				**$ 6,150,000**		

The elements of these measures that are able to be accommodated within the Stage 1 budget are those at the City end of the project rather than the Belconnen end.

The elements recommended for Stage 1 are:

- Bus lanes in each direction on Barry Drive between Clunies Ross Street and Kingsley Street
- Cycle lanes and paths on / adjacent to Barry Drive between Clunies Ross Street and Kingsley Street
- New cycle / pedestrian bridges over Sullivans Creek at Barry Drive
- Traffic signals at the intersection of Barry Drive and Kingsley Street
- Widening of Kingsley Street to 4 lanes between Russ Street and Barry Drive

- Construction of the busway between Kingsley Street and Marcus Clarke Street
- Construction of the eastbound platform within Section 21 City
- Provision for cycleway on the southern side of the busway through Section 21
- Construct a westbound bus stop on Marcus Clarke Street between Alinga Street and Rudd Street
- Provide for buses to turn from Alinga Street bus lane to Marcus Clarke Street via a second turn lane
- Allow for future signalisation of West Row / Alinga Street
- Change lane arrangements on Alinga Street to provide eastbound bus lane between West Row and Northbourne Avenue

Appendix A

TRANSYT Analysis of City West

Appendix A TRANSYT Analysis of City West

Bus Journey Times

INBOUND Route Section	Journey Time (secs)					
	AM PEAK			PM PEAK		
	Layover Loop Option	Right turn Option	Lead/ Lag Right	Layover Loop Option	Layover Loop Option	Right turn Option
Layover Loop	77	17	14	51	51	51
ANU Exchange Bus Station (includes an assumed 40sec stop dwell time)	73.77	74	74	73	73	73
Rudd St/ Marcus Clarke St Intersection	47	49	47	45	45	33
TOTAL	197	140	135	169	169	157

Kingsley St Intersection Performance

AM PEAK	Movement	Barry Drive / Kingsley Street											
		Layover Option				Right Turn Option				Leading & Lagging Right Turn Option			
		DoS	Ave Delay	LOS	Queue (m)	DoS	Ave Delay	LOS	Queue (m)	DoS	Ave Delay	LOS	Queue (m)
Barry Drive (West)	Through	83	6	A	81	83	5.3	A	37.5	83	12.74	A	112.5
	Right	48	22	B	44	48	23.06	B	43.75	60	19.15	B	43.75
St		32	56	D	19	11	7.68	A	0	13	4.57	A	6.25
Barry Drive (East)	Through & Left	61	59	E	50	61	56.6	E	56.25	48	22.52	B	37.5
	Right Turn	55	60	E	50	55	54.73	D	53.125	43	10.07	A	18.75

Appendix B

Paramics Modelling

Appendix B Paramics Modelling