Final Report

Molonglo Arterial Roads Feasibility Study

22 January 2013 3002301

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SMEC COMPANY DETAILS

SMEC Australia Pty. Ltd.

Level 1, 243 Northbourne Ave, Lyneham ACT 2602

Tel: **(02) 6234 1958**

Fax: **(02) 6234 1966**

Email: [redacted]**@smec.com**

WWW: **http://www.smec.com**

Final Feasibility Study Report

For: Economic Development Directorate (EDD)

JANUARY 22, 2012

EXECUTIVE SUMMARY

ES.1 Introduction

The planning intent for the proposed Molonglo development is outlined in ACTPLA's May 2006 *Molonglo Valley Structure Plan*. This document guides all future planning and design in the area. The stated vision for the area is:

> "*The Molonglo Valley will grow over several decades as a series of integrated communities within the spectacular natural landscape of the river corridor, its surrounding valleys and rolling hills. These communities will be highly accessible and be linked with public transport as well as encourage walking and cycling. Group and local centres will provide for shopping, services and jobs, and significant new areas will be developed for employment generation. The natural and cultural heritage of the area will be integrated with new urban development and a long term strategy to oversee the timely implementation of infrastructure will deliver sustainable and high quality suburbs.*"

The Molonglo Arterial Roads Feasibility Study builds on earlier preliminary options and feasibility studies for the development of the Molonglo Valley into a group centre with a population of 45,000 in 2031, and ultimately 55,000. In particular, this study builds on the Molonglo Roads Feasibility Study (SMEC 2008), with updated inputs from a number of other studies undertaken in the intervening period regarding various arterial roads, planning and framework studies and environmental studies.

The objectives of this study are as follows:

- Review previous road alignment studies and validate/determine the key arterial road alignments, intersections/interchange arrangements with the existing road network and the river crossing locations and details.
- Substantiate the timing for the John Gorton Drive (formerly North-South Arterial) and East-West Arterial and associated bridges over the Molonglo River based on the development staging assumptions and the transport model.
- Review the impact on the external road network imposed by the Molonglo development and evaluate Coppins Crossing Road's capacity to serve as an interim north-south link.
- Based on the recent planning studies review the existing Molonglo traffic model and provide projections on the transport mode shifts to public transport, cycling and walking.
- Provide road alignments that support future land use intentions that minimise environmental impacts.

ES.2 Review of Background Information

The following studies and materials have been reviewed as these inform and affect the development of the Molonglo arterial road network.

- ACT Territory Plan
- Molonglo Roads Feasibility Study, SMEC For ESDD 2008
- North-South Arterial Alignment Study, SMEC For ESDD 2010
- Molonglo Valley Stage 2 Planning and Design Framework Study, SGS For ESDD 2012
- Molonglo Transport Model Review, AECOM For ESDD 2010
- Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (NES Plan), ACTPLA 2011
- Molonglo River Park Concept Plan, ESDD 2011
- Preliminary Risk Assessment – Stage 2, NGH 2011
- Molonglo 3 Stormwater Master Planning, GHD for ESDD 2012

ES.3 Preliminary Work

A number of constraints that affect the road design have been identified and these include the following:

- Topography
  - Hilly Terrain
  - Rivers and watercourses
- Ecology/Environment
  - Pink-Tailed Worm Lizard (PTWL) habitat
  - Box-gum Woodland
  - Aboriginal heritage sites
- Services
  - Trunk sewerage lines
  - 132 kV power lines
  - Bulk supply water mains

Coffey Geosciences Pty. Ltd. reported in 2005 that there are no geological issues influencing road alignments other than the Winslade Fault. This fault is not suitable for deep excavations, but is not active and should not impose constraints to developing roads, housing, or shallow ponds. Should proposed roads fall within the vicinity of the fault, the geotechnical investigation for this road and adjacent development should include specific consideration of the presence of the fault and include appropriate design recommendations.

The Coppins Crossing Sewerage Sludge Ponds is the main area of contaminated land in Molonglo 3. There are also a number of sheep dips which will require remediation, but these have not been treated as a constraint to road location.

Figure ES.1, taken from previous work undertaken by SMEC, shows the geotechnical and contamination constraints in and around the study area. This figure includes an area for Central Molonglo, which was part of the planning assumptions at the time the study was undertaken but has been removed from future development plans by the ACT Government.

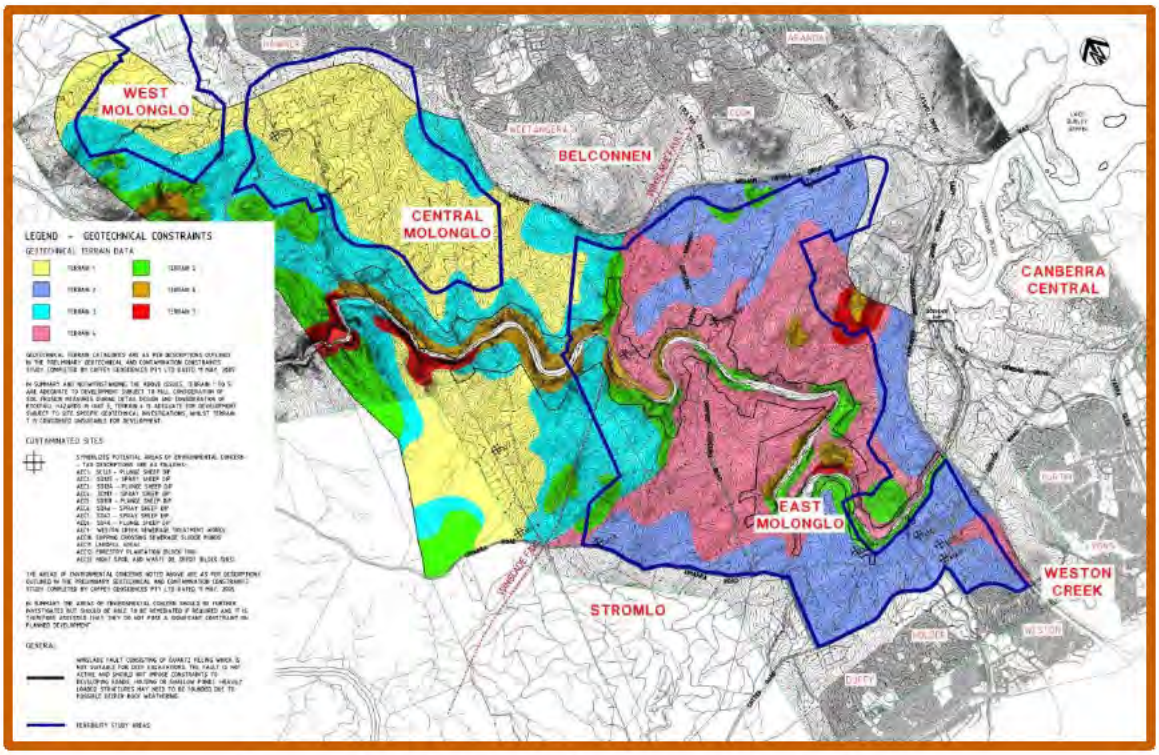

Figure ES.1: Geotechnical and Contaminated Sites Constraints

Design criteria based on Austroads standards and ACT Guidelines were used during the design process:

- Design speed
- Horizontal and vertical curves
- Gradients
- Sight distances
- Intersections
- Cross-sections

Consultation meetings and a value management workshop have been conducted throughout the course of the project, including a Value Management Workshop at which the preliminary alignments were presented to the client and stakeholders.

ES.4 Arterial Road Alignments

Two levels of road hierarchy have been considered – arterial roads and lower order roads (sub-arterials, collectors and locals). The three major arterial roads were investigated in detail. The indicative road hierarchy is shown in Figure ES.2. The three major arterial roads are:

- John Gorton Drive (JGD, formerly North-South Arterial)
- Coulter Drive Extension (CDE)
- East-West Arterial (EWA)

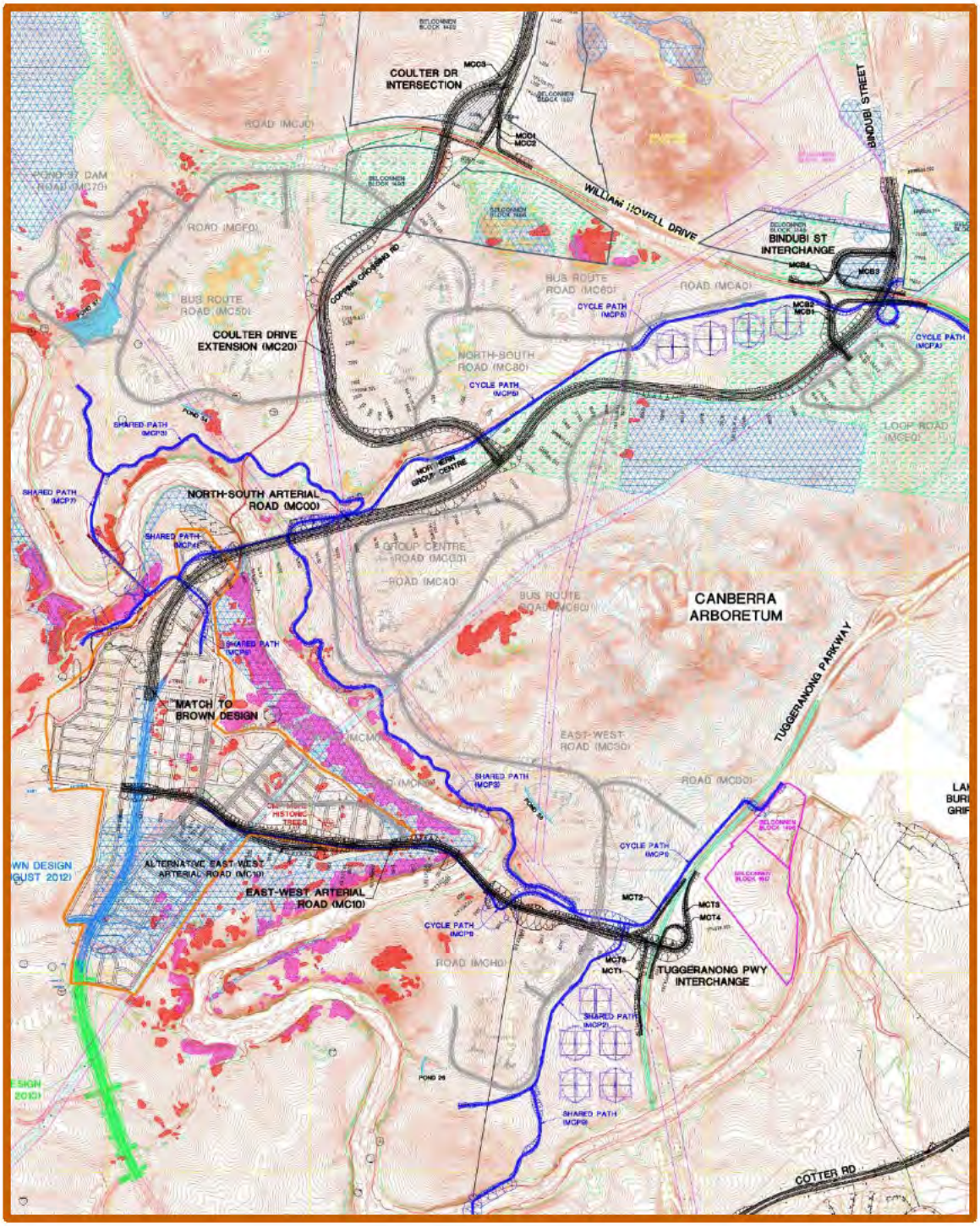

Figure ES.2: Road Hierarchy

The colour coding for Figure ES.2 is as follows: black – arterial roads; grey – sub-arterial/collector/local roads; blue – cycleways; light blue – JGD (Brown Consulting design, currently under construction); green – JGD (GHD design, currently under construction).

The locations of the district playing fields north of JGD and south of EWA near Tuggeranong Parkway are notional.

ES.4.1 John Gorton Drive (JGD)

The John Gorton Drive alignment investigated in this study has its southern extent at the Molonglo 2 Group Centre and connects to Bindubi Street in the north.

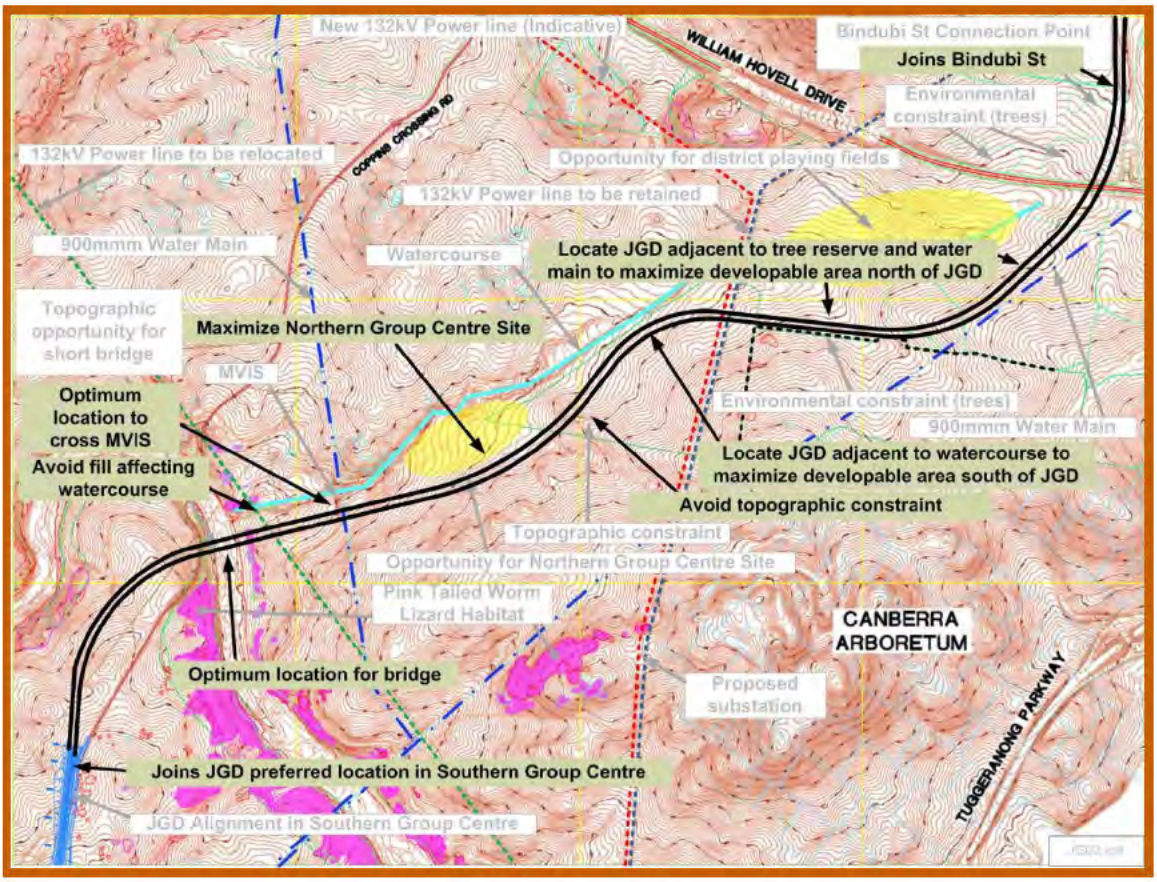

Figure ES.3: JGD Horizontal Alignment

Intersection opportunities for connecting to John Gorton Drive are shown in Figure ES.4. Not including William Hovell Drive, four possible intersection locations have been identified, evenly spaced to optimise local access and signal progression. The figure also shows the location of a potential site for district playing fields, however this is not final and the location shown is only one of the options being considered.

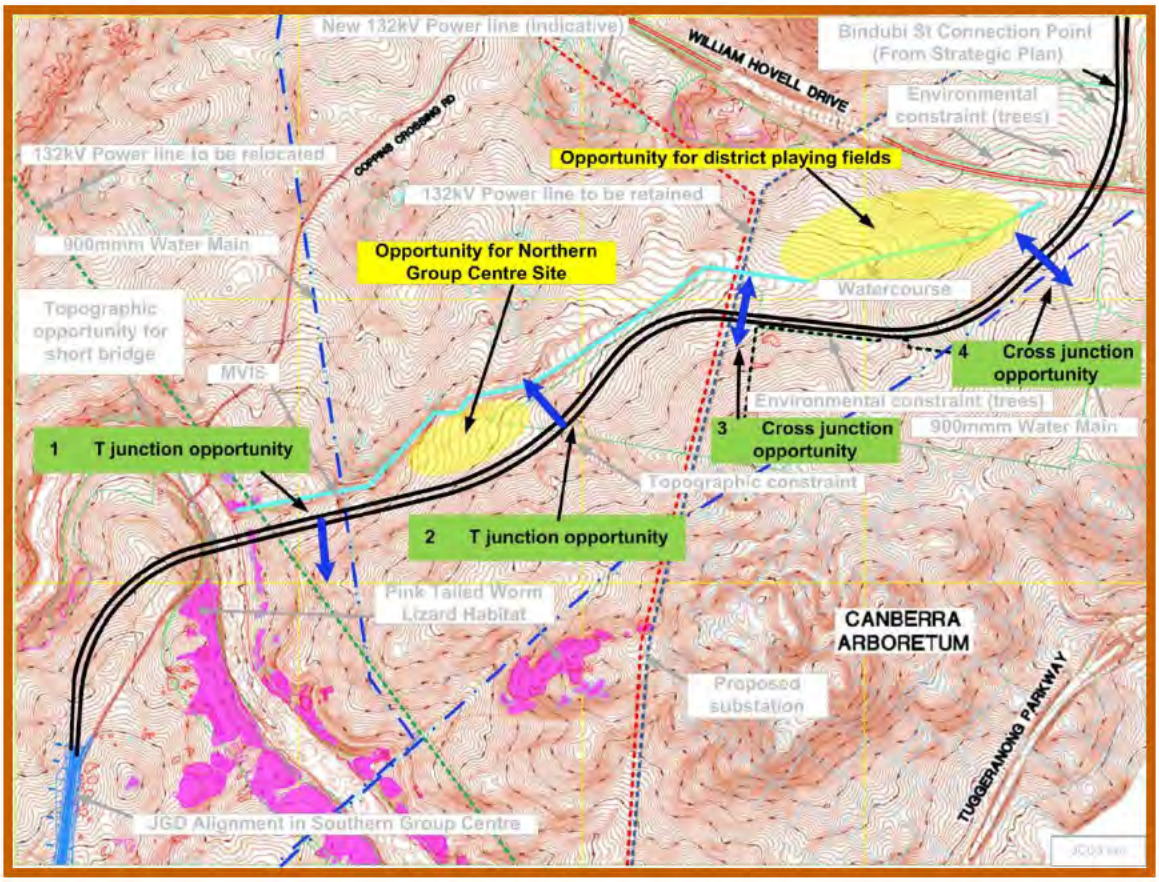

Figure ES.4: JGD Intersection Opportunities

Two designs were investigated for the interchange of William Hovell Drive and John Gorton Drive/Bindubi Street. The first, shown in Figure ES.5, comprises a folded diamond and maximises spacing between the on- and off-ramps at John Gorton Drive/Bindubi Street, and Glenloch Interchange.

The provision of a loop ramp for the eastbound entry to William Hovell Drive would facilitate a bus bypass of ramp metering signals which are expected to be desirable because of the congestion expected at the merge during the AM peak period.

The second interchange design option is shown in Figure ES.6. It is of the traditional tight diamond type, and is presented as it provides more flexibility for the location of sporting fields in the area, specifically in the northwest quadrant of this interchange. It otherwise suffers from the following disadvantages compared to the folded diamond option:

- It requires the reconstruction of a significant length of Bindubi Street with a consequent increase in cost.
- The east facing on- and off-ramps are physically closer to Glenloch Interchange. The reduction in westbound weaving length will exacerbate operational problems in the PM peak on William Hovell Drive.
- The alternative JGD alignment's horizontal geometry, vertical geometry and adjacent water main required the collector road for the development area south of

the JGD/William Hovell Drive interchange to be on a high fill (inappropriate for a residential area).

- Environmental and community issues could potentially arise if the district playing fields were located north of William Hovell Drive.
- The realignment of JGD/Bindubi Street requires the district playing fields to be located north of William Hovell Drive, separating them from Molonglo. The fields would also be built on ecologically sensitive land that the folded diamond was designed to avoid.

Accordingly, following discussions with the client, the alternative shown in Figure ES.6 was judged to be ineffective in improving the viability of the development.

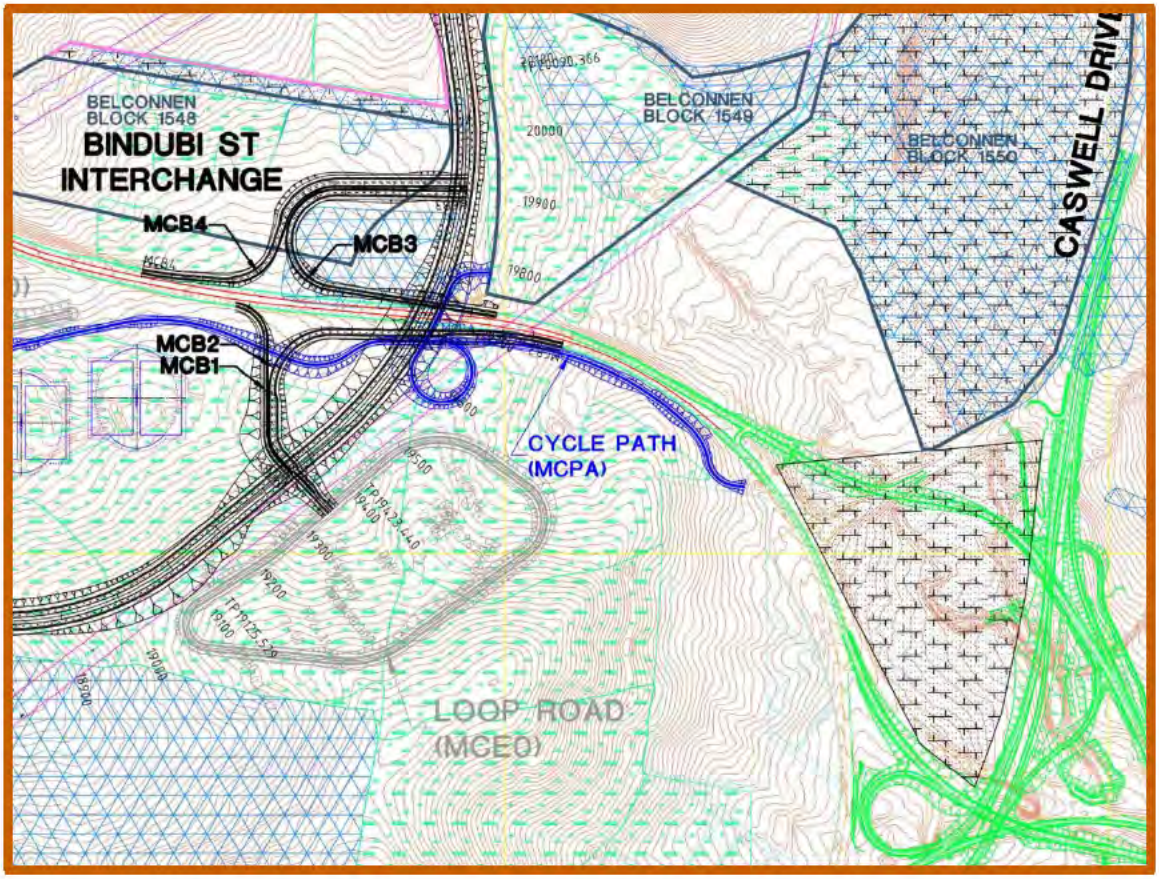

Figure ES.5: Folded Diamond Interchange Location and Layout

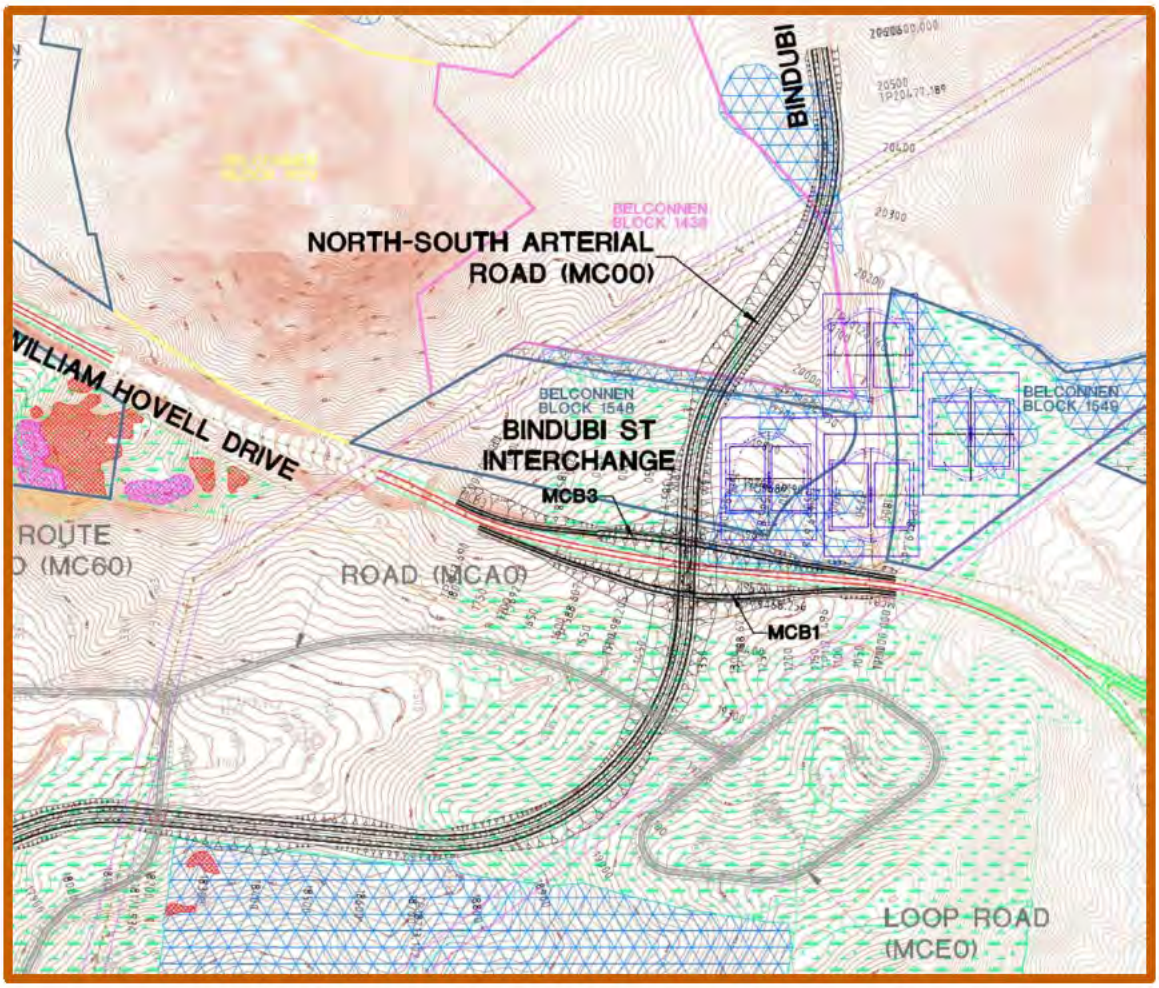

Figure ES.6: Alternative JGD Alignment with District Playing Fields Option 2

ES.4.2 Coulter Drive Extension (CDE)

A continuation of CDE south of JGD is considered unsuitable because it could encourage inappropriate use of CDE and the EWA by traffic that should use William Hovell Drive and the Tuggeranong Parkway. To allow a cross intersection to be safely connected, the JGD alignment would need to be moved to the north, making the Northern Group Centre site too small. Accordingly, a T-junction is recommended.

The recommended CDE horizontal alignment is shown in Figure ES.7. The alignment uses the existing Coppins Crossing Road intersection with William Hovell Drive as the preferred connection point.

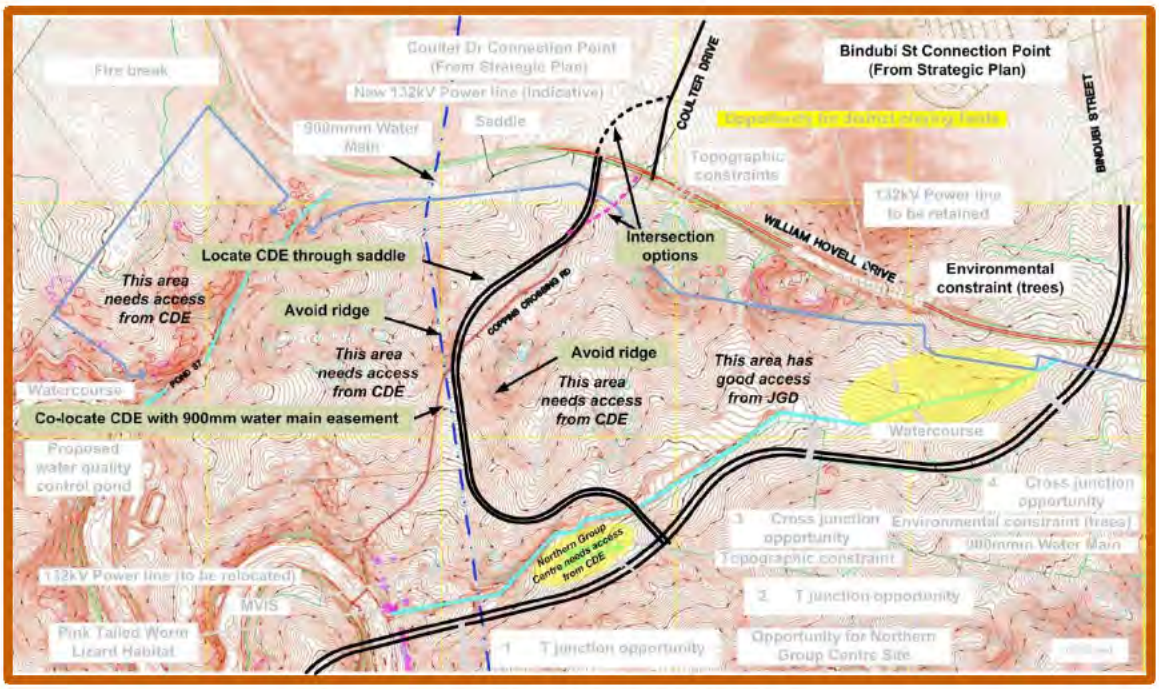

Figure ES.7: CDE Horizontal Alignment

At the southern end the alignment joins John Gorton Drive at a location which makes provision for the Northern Group Centre.

In the central part of the alignment, the Coulter Drive Extension is located with a westerly swerve in the alignment so the arterial is within a reasonable distance of the western parts of the proposed residential areas so as to limit the distance travelled on collector roads.

The maximum grade on Coulter Drive Extension is 5% for about 700 m, which is longer than the desirable maximum of 600 m (per Austroads). This length is necessary as the site constraints preclude shortening the length of upgrade. This will be a challenge for on-road cyclists, but those choosing this route are expected to be experienced and fit. On-road cycling is accommodated by a cycle lane and a gradient not exceeding 5%. It is not practical to limit the length of the grade.

As well as facilitating access to the western residential areas, the relatively indirect alignment assists in discouraging through traffic.

Proposed intersection locations along Coulter Drive Extension have been shown in Figure ES.8.

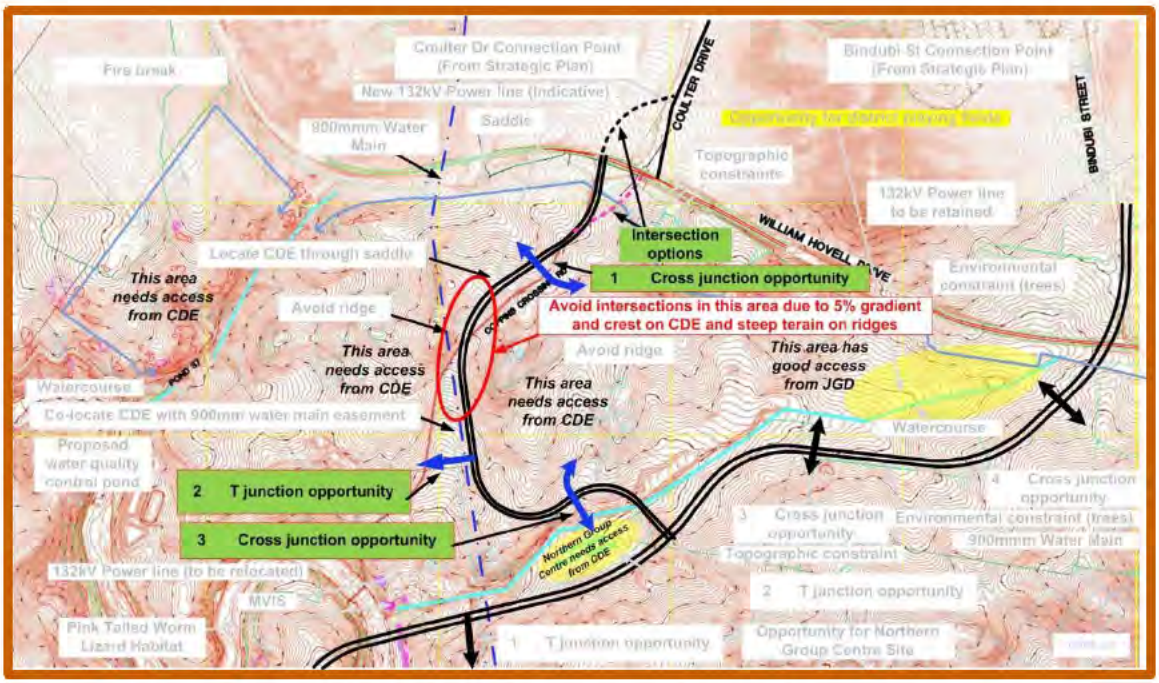

Figure ES.8: CDE Intersection Opportunities

Three intersection configurations were considered for the junction of William Hovell Drive, Coulter Drive and Coulter Drive Extension:

- Quadrant layout (shown in Figure ES.9) which provides a four-way intersection connecting the three roads, but has an additional connection in one *quadrant* of the junction (in this case the north-east quadrant between William Hovell Drive and Coulter Drive, labelled as MCC1 and MCC2 in Figure ES.9) to remove particularly heavy movements from the main intersection. This represents the ultimate layout.
- Staggered T layout, which connects Coulter Drive Extension to William Hovell Drive in approximately the same location as the existing Coppins Crossing Road junction. This is recommended as an interim option.
- Four-way layout, which connects all three roads at a single signalised intersection, without the additional connection provided in the Quadrant layout. This interim option was tested to assess its performance. This option is not recommended.

The Staggered T and Four-way options were assessed in SIDRA Intersection only. The scale of road works required for construction by 2031 was considered to be unreasonably excessive and generally impractical, and as such the designs were not taken further.

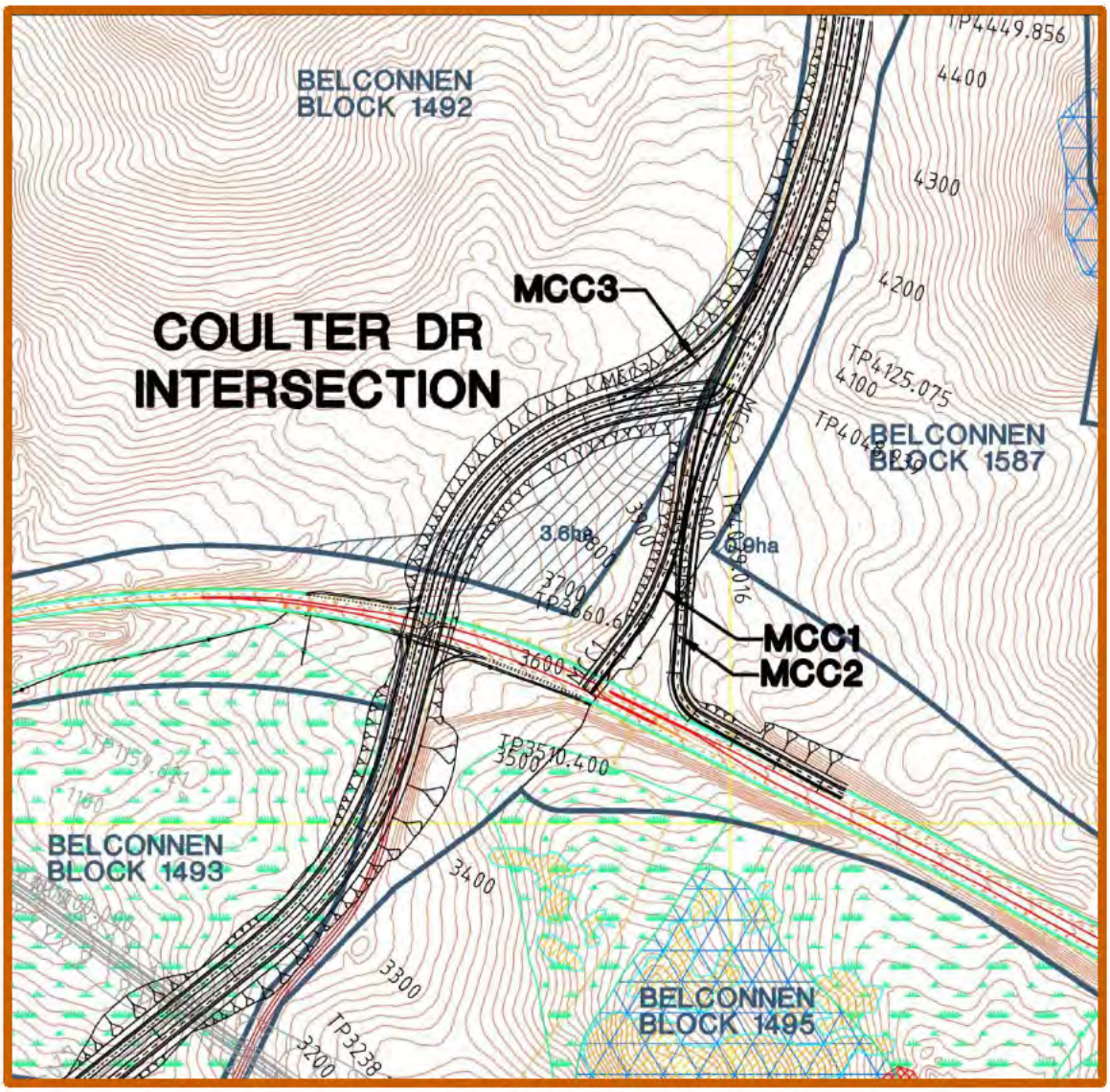

Figure ES.9: Ultimate At-grade Intersection (three sets of signals)

ES.4.3 East-West Arterial (EWA)

The East-West Arterial, shown in Figure ES.10, connects the Molonglo 2 Group Centre to Tuggeranong Parkway. Two alignment options within the Molonglo 2 Group Centre were considered and are shown in Figure ES.11. An alternative that encroaches on the River Reserve is shown as well as an option outside the Reserve. The advantage of the alternative alignment is that the topography is more favourable, and earthworks are reduced, improving development opportunities adjacent to the road. The area of developable land is also increased. It should be noted however that this alternative alignment encroaches on the Box Gum Woodland to the south. This needs to be taken into account in the NES Biodiversity Budget should this alignment be ultimately chosen.

Additionally, four options were considered near the Molonglo River, shown in Figure ES.12. The recommended option (black) minimises bridge length and impacts on the Pink-Tailed Worm Lizard habitat. This option also has significantly less cut requirements compared to the green or red options.

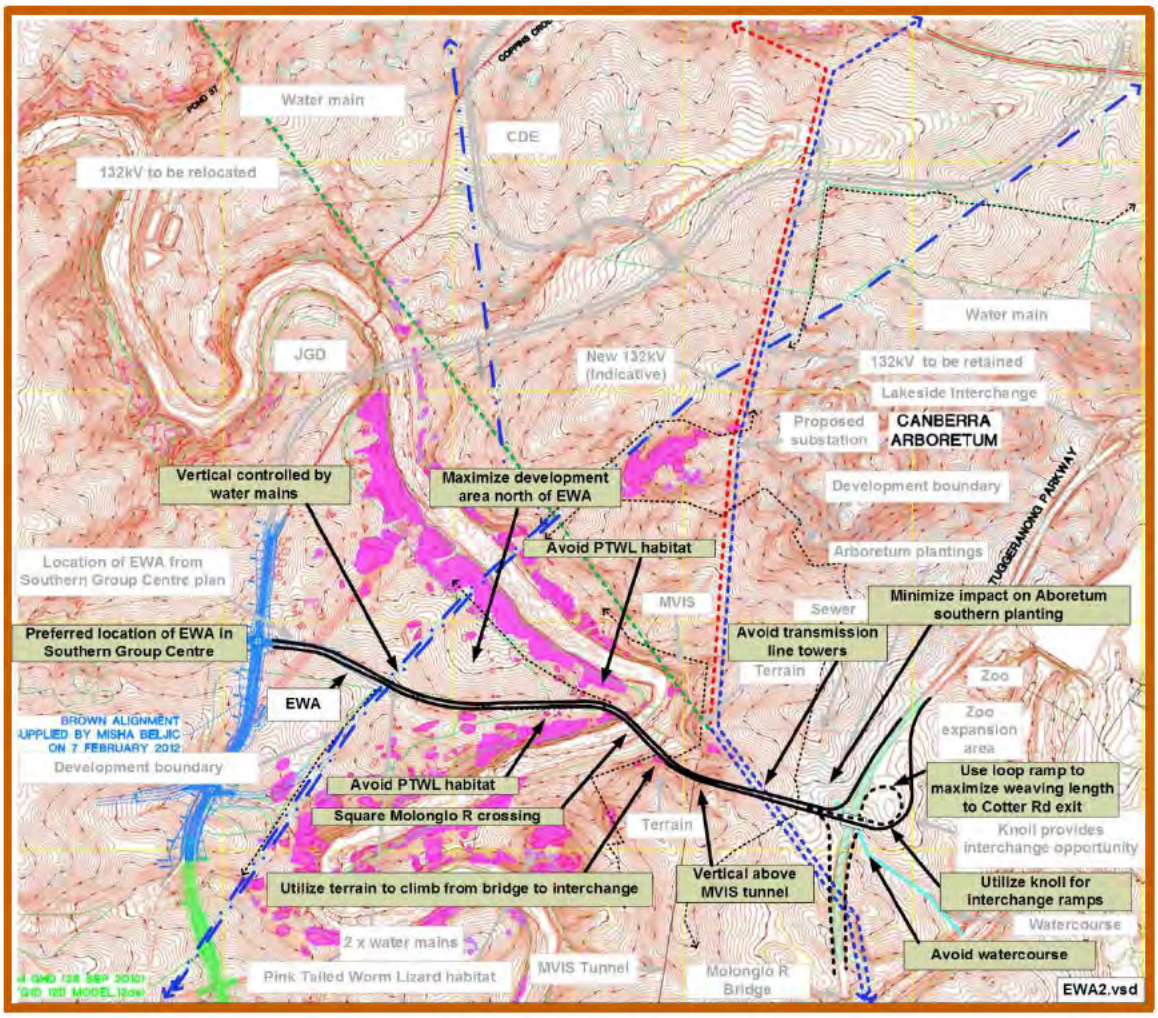

Figure ES.10: EWA Horizontal Alignment

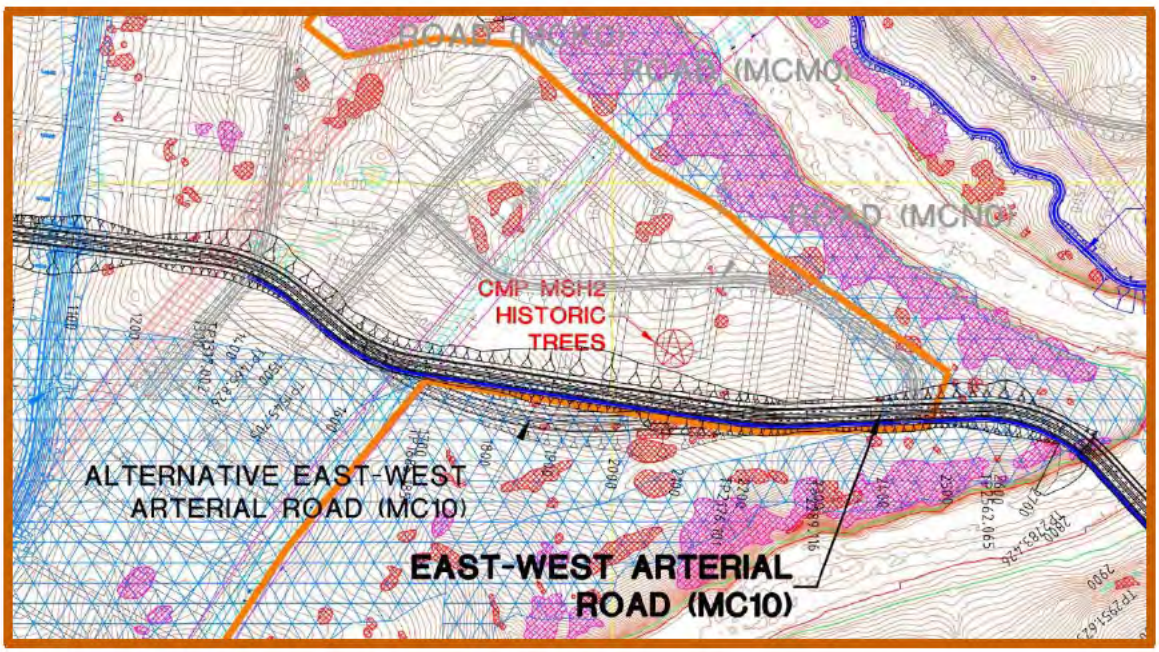

Figure ES.11: EWA Alignment Options

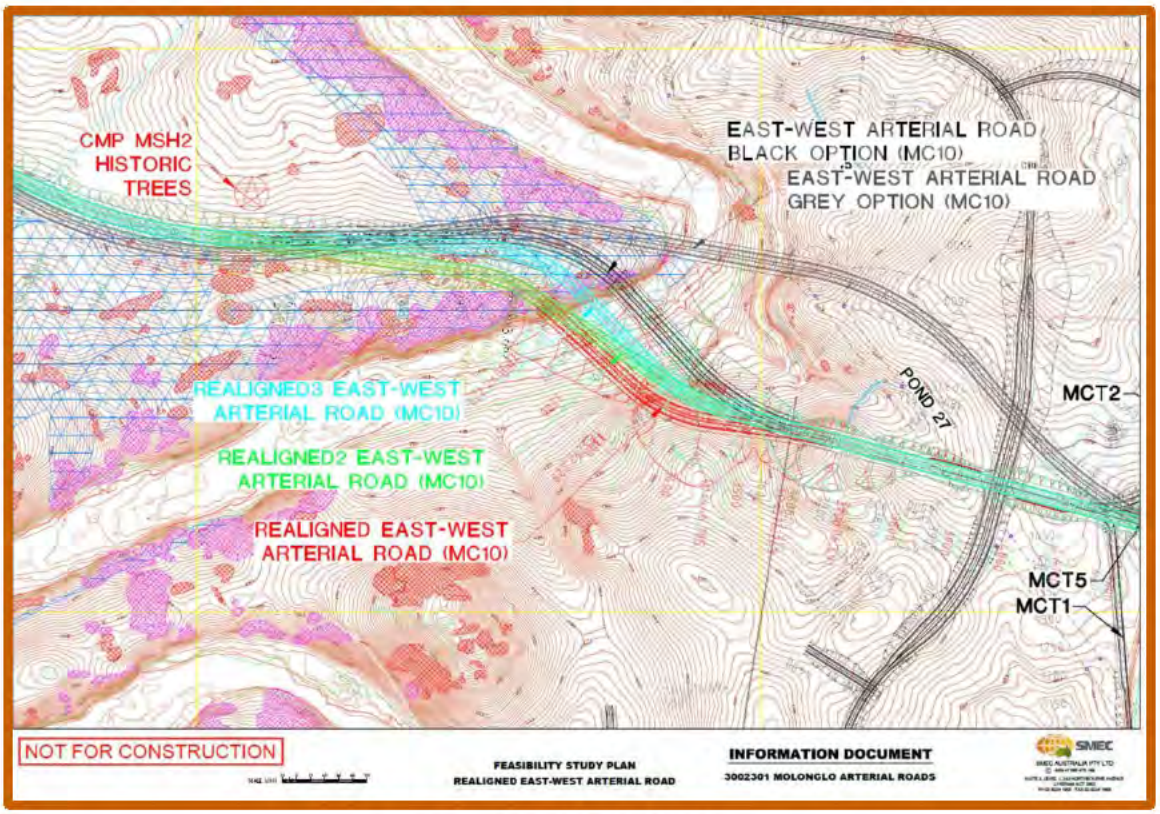

Figure ES.12: EWA Options

Several options for the EWA east of the Tuggeranong Parkway were tested, including full or partial interchange with the Tuggeranong Parkway, no interchange (flyover), with links to either Lady Denman Drive or Cotter Road.

The option of a trumpet interchange is shown in Figure ES.13. The loop entry ramp is proposed in order to maximise the weaving length to the Cotter Road exit ramp. The layout also suits the terrain.

The EWA impacts on the arboretum boundary and plantations. This area has recently been planted even though the EWA has been part of the Molonglo Structure Plan for several years. The recommended location minimises these impacts.

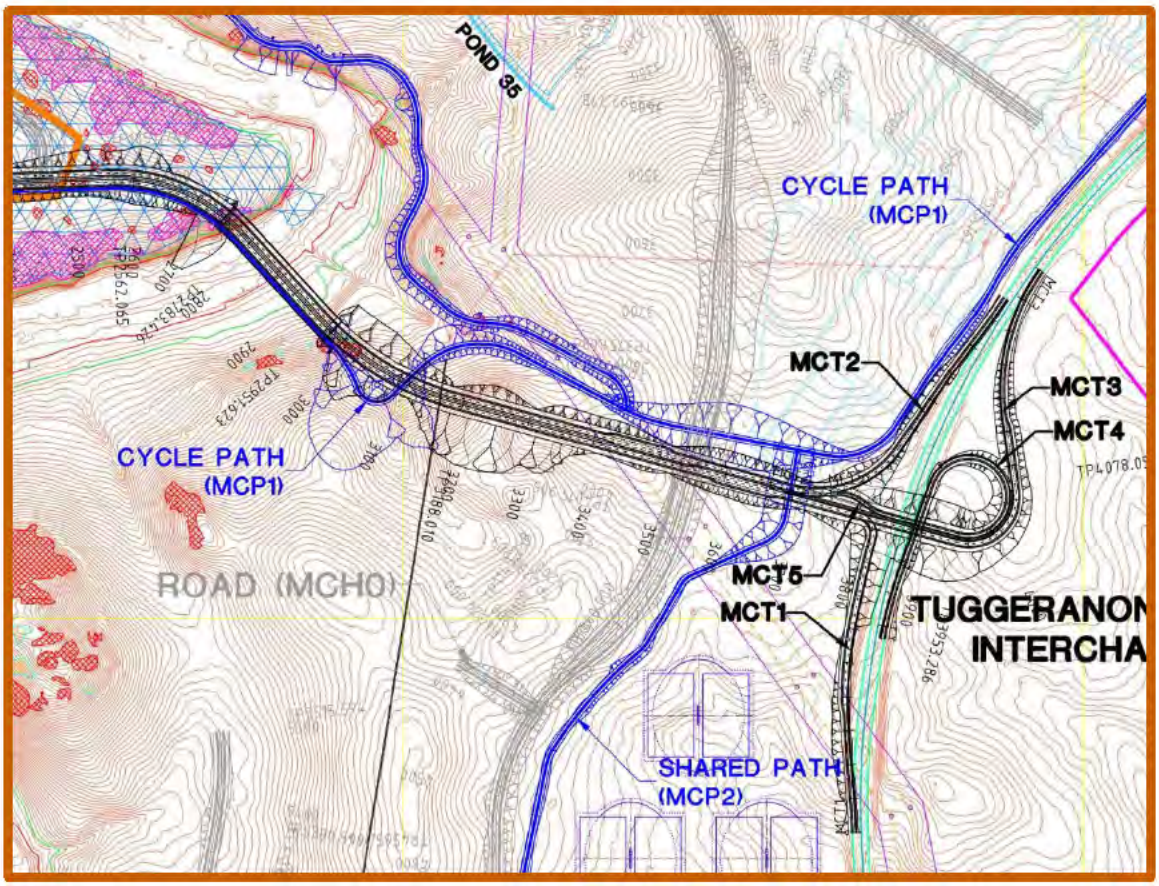

Figure ES.13: EWA-Tuggeranong Parkway Trumpet Interchange

ES.5 Sub-Arterial, Collector and Local Roads

ES.5.1 Sub-Arterial Road JGD-EWA

This road is expected to carry a significant volume of traffic, and this factor, as well as the steep topography, will require special attention to the design and location of property access. Potential noise issues may also require special design and siting requirements. Medium density development with driveways and site layout ensuring vehicles only enter the road in a forward direction are recommended.

ES.5.2 Collector Roads

Collector road alignments were developed to provide connections from the arterial roads to local streets. These are shown in Figure ES.2. The collector roads have been located so that most residences are conveniently served by local buses using each collector road.

To meet Disability Discrimination Act (DDA) requirements, the collector roads have been located so that bus stops can be provided on a longitudinal grade of 2.5% or less as recommended in the *Draft Guideline for assessing compliance of bus stops with the Disability Standards for Accessible Public Transport 2002*. This requirement is shown in Figure ES.14.

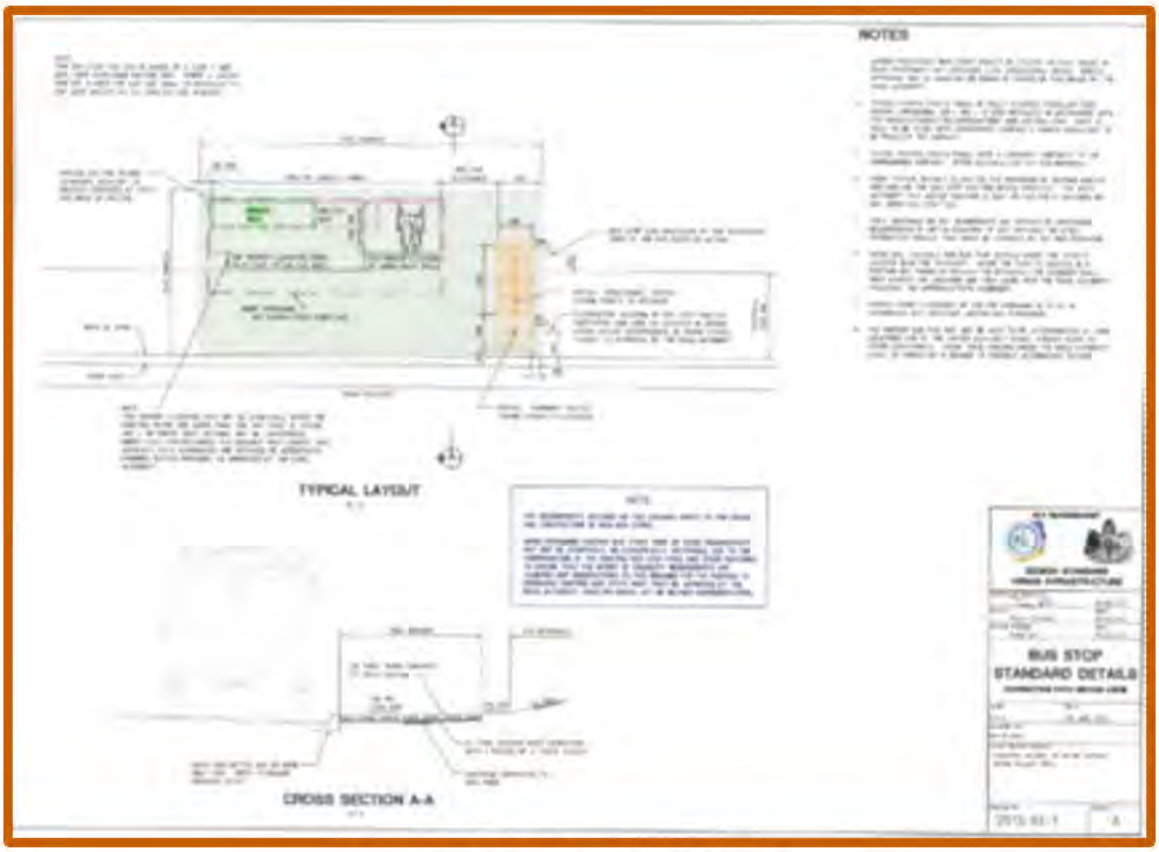

Figure ES.14: Bus Stop Standard Details

The maximum gradient on collector roads is generally 5% so that on road cycling is accommodated. A section of one of the collector roads requires 6%. The collector roads' gradient is kept to 4% as much as possible so that intersections can be provided.

ES.5.3 Local Roads

Indicative alignments and profiles have been prepared in some areas. While outside the scope of this study, this was undertaken to demonstrate that the land can be accessed. The alignments will require modification when the subdivision layout is prepared, and other access arrangements may be preferred.

The proposed local roads are shown in Appendix A of the report.

ES.6 Traffic and Transport Assessment

Both strategic transport modelling and intersection modelling were conducted.

ES.6.1 Strategic Transport Modelling

Strategic modelling has been conducted for the following time periods and options:

- **2016 AM peak hour**
  One scenario has been modelled for the 2016 AM peak period. This scenario includes works south of the Molonglo River only. John Gorton Drive has not been extended past the group centre and the existing low level river crossing on Coppins Crossing Road is still in operation. Results are shown in Figure ES.15.

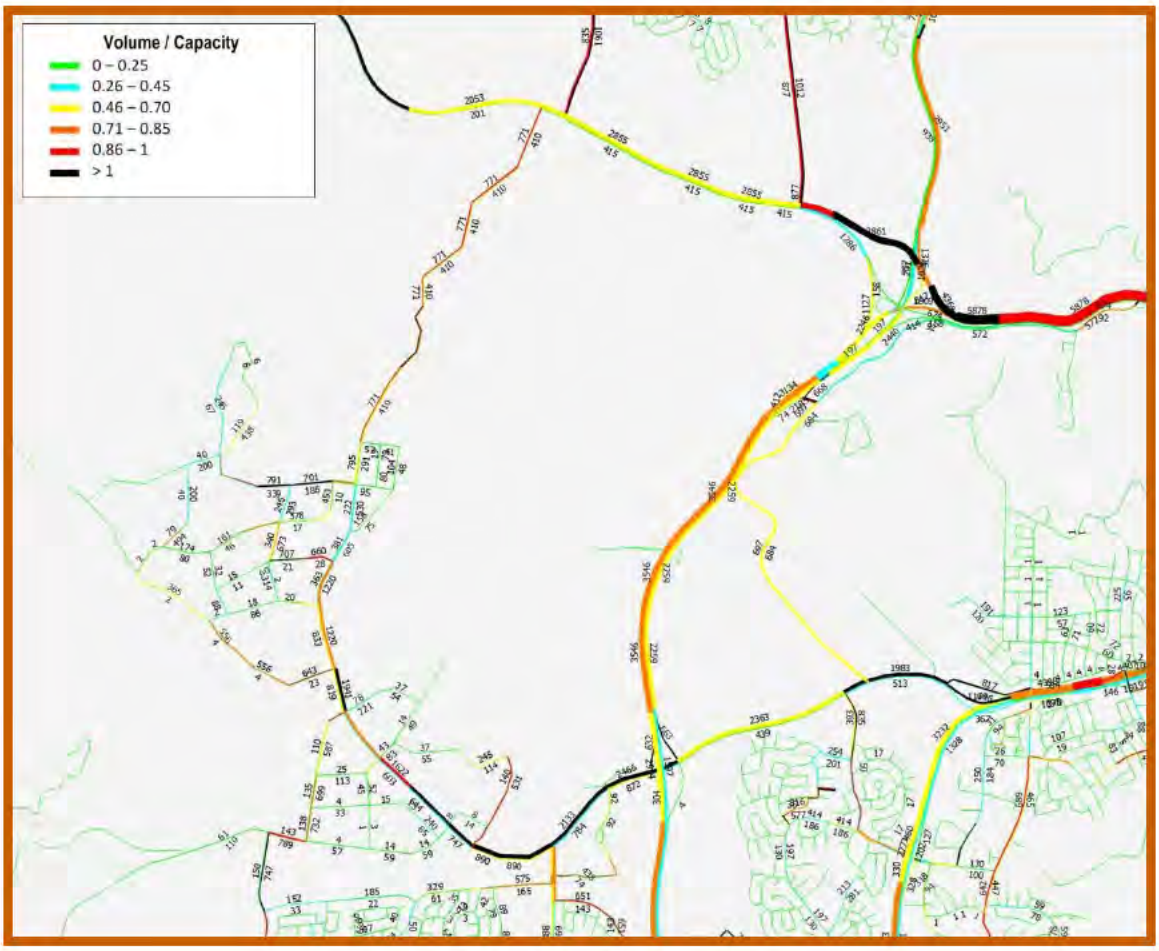

Figure ES.15: 2016 AM Volumes

- **2021 AM peak hour**
  Three staging options have been modelled for the 2021 AM scenario:
  - **John Gorton Drive to Coulter Drive**
    This scenario includes the extension of John Gorton Drive and Coulter Drive extension to their proposed intersection location to provide connectivity to William Hovell Drive.
  - **John Gorton Drive to Bindubi Street**
    This scenario includes the completion of John Gorton Drive to the intersection of Bindubi Street and William Hovell Drive. It also includes the construction of the interchange proposed for the long term at this location. Results are shown in Figure ES.16.
  - **Coppins Crossing Road Only**
    This scenario assumes that John Gorton Drive is not extended north of the M2GC, and that the existing alignment and configuration of Coppins Crossing Road is relied upon for access to and from the north.

The strategic model analysis suggests that on the roads that do not differ between the two scenarios, the difference in traffic flows is insignificant.

It would probably be more beneficial to connect JGD to William Hovell Drive initially, as opposed to EWA, as it provides a more direct link to the City from Molonglo. This would also facilitate the provision of a high quality transport link as soon as possible.

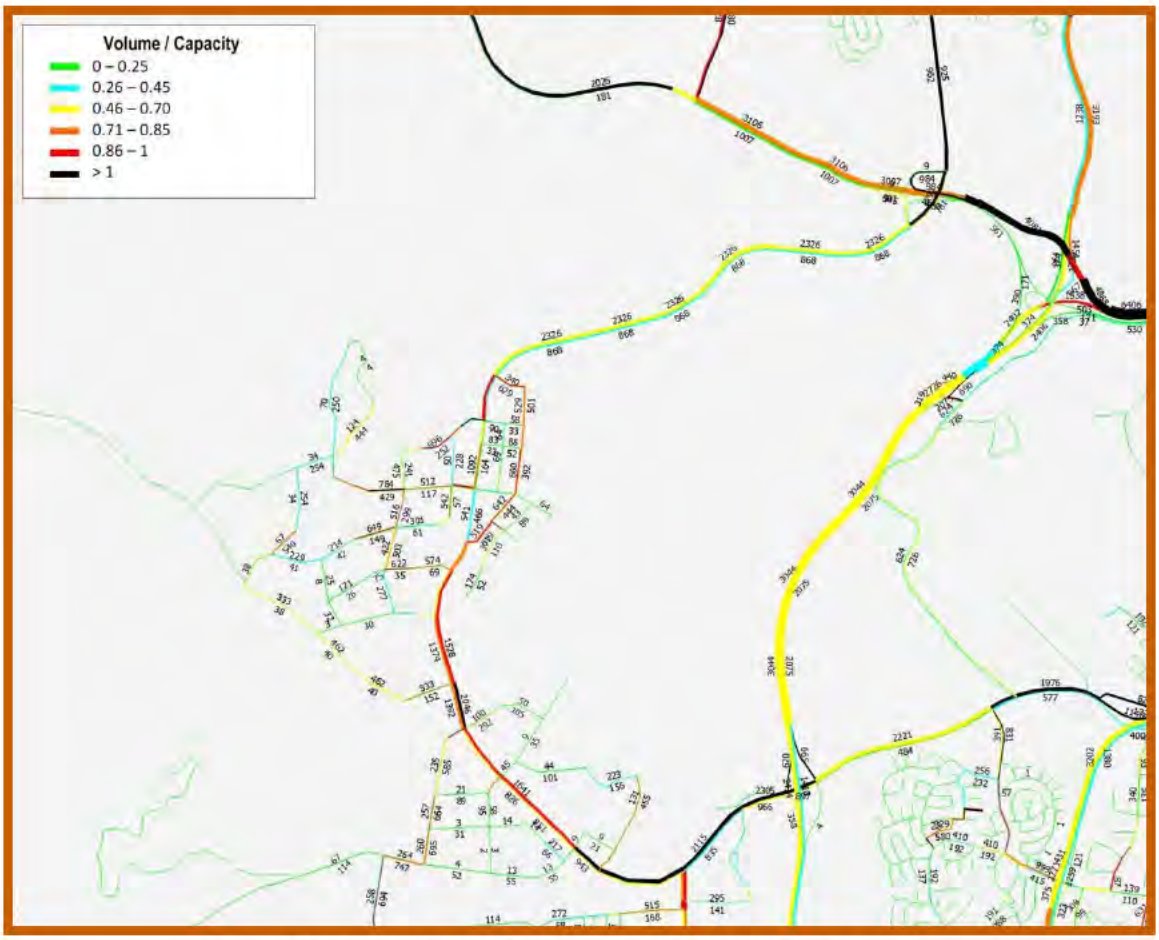

Figure ES.16: John Gorton Drive to Bindubi Street 2021 AM Volumes

- **2031 AM peak hour**
  Seven road network scenarios were modelled for the 2031 horizon year:
  - **Scenario 1 (Base)**
    Scenario 1 includes the full length of the East-West Arterial from John Gorton Drive to Tuggeranong Parkway, connecting to the latter via a full interchange. William Hovell Drive connects to Bindubi Street/John Gorton Drive via a folded diamond interchange and to Coulter Drive/Coppins Crossing Road via an at-grade "quadrant" style junction. Results are shown in Figure ES.17.
  - **Scenario 2 (South Facing Ramps)**
    As for Scenario 1 but with the inclusion of a half diamond interchange between East-West Arterial and Tuggeranong Parkway, with ramps to and from the south only. This results in a reduction of traffic on the East-West Arterial, increased traffic on Tuggeranong Parkway south of the East-West Arterial interchange, and decreased traffic to the north.
  - **Scenario 3 (North Facing Ramps)**
    As for Scenario 1 but with the inclusion of a half diamond interchange between East-West Arterial and Tuggeranong Parkway, with ramps to and from the north only. This results in a reduction of traffic on the East-West Arterial, increased traffic on Tuggeranong Parkway north of the East-West Arterial interchange, and decreased traffic to the south.

- **Scenario 4 (Lady Denman Drive Connection)**
  East-West Arterial is extended to connect to Lady Denman Drive, and does not interchange with Tuggeranong Parkway. This results in an increase in traffic on Cotter Road and Lady Denman Drive, a reduction on East-West Arterial, increased traffic on Tuggeranong Parkway north of the East-West Arterial interchange, and decreased traffic to the south.
- **Scenario 5 (Lady Denman Drive Connection w/o East-West Arterial)**
  As for Scenario 4 but without the complete East-West Arterial connection between John Gorton Drive and Tuggeranong Parkway. Lady Denman Drive operates fairly close to its capacity, traffic on Cotter Road and Tuggeranong Parkway southbound are reduced, while Tuggeranong Parkway northbound shows an increase.
- **Scenario 6 (Cotter Road Connection)**
  The East-West Arterial is extended to Cotter Road, connecting between Tuggeranong Parkway and McCulloch Street, and does not interchange with Tuggeranong Parkway. The East-West Arterial extension to Cotter Road operates over capacity even with two lanes each way. The option relieves traffic slightly on Tuggeranong Parkway and East-West Arterial, increases it slightly on John Gorton Drive, and increases it substantially on Cotter Road east of the East-West Arterial extension. This option also requires another river crossing east of Tuggeranong Parkway, the cost of which could be prohibitive.
- **Scenario 7 (Cotter Road Connection with North Facing Ramps)**
  As for Scenario 6 but with a half diamond interchange between East-West Arterial and Tuggeranong Parkway, with ramps to and from the north only. Compared to Scenario 1, there is increased southbound traffic on Tuggeranong Parkway north of East-West Arterial and reduced traffic in both directions south of the interchange. As with Scenario 6, this also requires a major bridge east of Tuggeranong Parkway, which could potentially make this option economically unfeasible.

An examination of the results indicates that most of the options exhibit negligible or minimal differences in traffic volumes on the external road network compared to Scenario 1. One notable exception is Scenario 7, which decreases traffic volumes around the interchange of Cotter Road and the Tuggeranong Parkway. However, this option leads to increased traffic volumes on Cotter Road east of McCulloch Street, and Adelaide Avenue.

This analysis was conducted to determine whether any other scenarios had significant benefits compared to the base case (Scenario 1). As there is no scenario that is clearly better than Scenario 1 in terms of traffic impacts on external roads, the detailed traffic analysis has been conducted using Scenario 1.

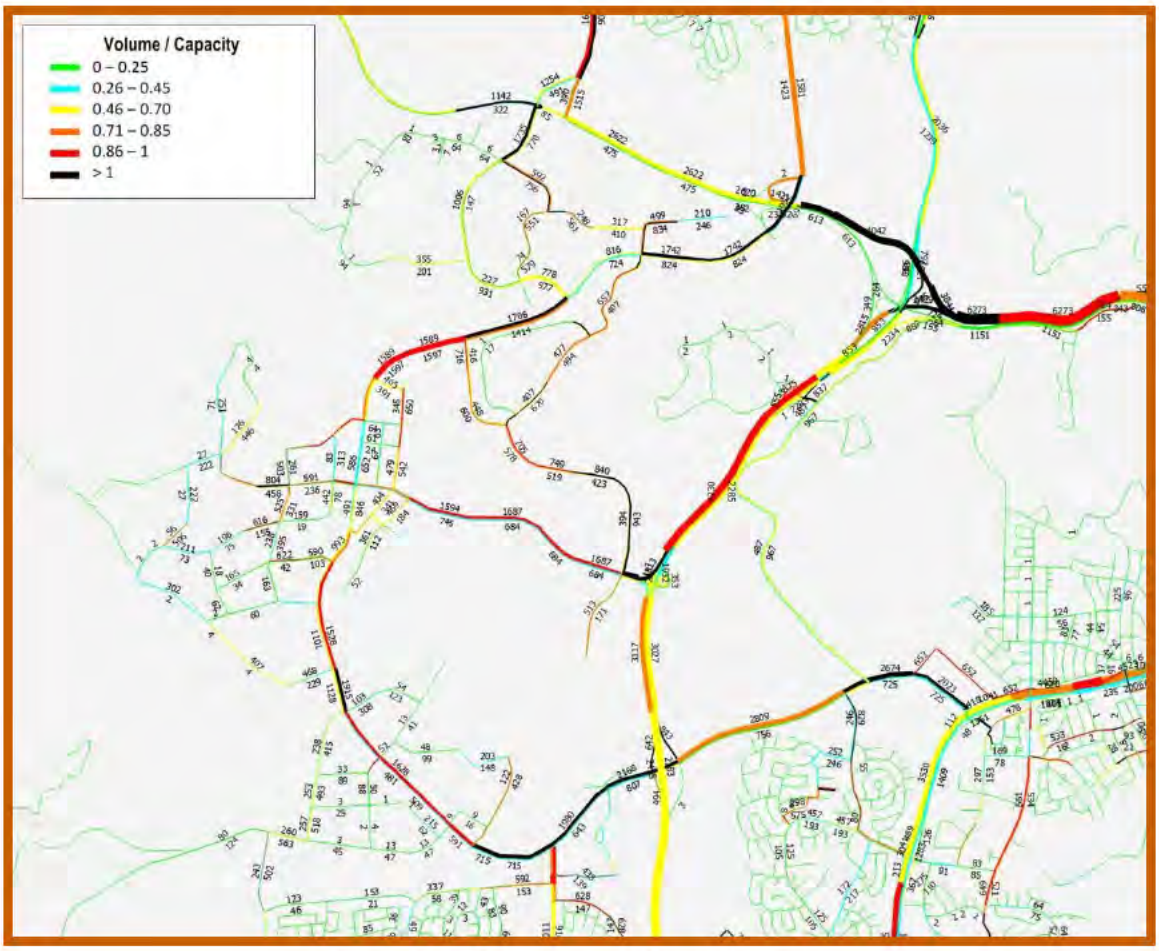

Figure ES.17: Scenario 1 – 2031 AM Volumes

ES.6.2 Traffic Operational Analysis (Intersection Modelling)

Traffic operational analysis (mainly intersection assessments, with some merge, diverge and weaving analysis) was conducted for the 2021 and 2031 AM and PM peak periods.

As with the 2021 strategic modelling runs, the following scenarios were investigated, with the results shown in Table ES.1:

- **John Gorton Drive to Coulter Drive**
  John Gorton Drive connects to Coulter Drive Extension at the group centre. To achieve this level of performance shown the right turn movement from Coulter Drive Extension to William Hovell Drive requires three lanes, which may raise design safety issues. In addition, the intersection of William Hovell Drive – Bindubi Street is also expected to require upgrades.
- **John Gorton Drive to Bindubi Street**
  John Gorton Drive connects to William Hovell Drive at the Bindubi Street intersection.
- **Coppins Crossing Road Only**
  The existing alignment and configuration of Coppins Crossing Road provides access to and from the north.

Table ES.1: Comparison of 2021 Staging Scenarios Traffic Operations

Scenario	Location	AM Peak		PM Peak	
		Delay	LoS*	Delay	LoS*
William Hovell Drive – Coulter Drive T-intersection Upgrade Only	William Hovell Drive – Coulter Drive Extension (West Intersection)	50.5 s	D (E)	19.2 s	B (E)
	William Hovell Drive – Coulter Drive (East Intersection)	11.3 s	B (E)	32.5 s	D (D)
	William Hovell Drive – Bindubi Street (Intersection)	57.9 s	E (E)	13.1 s	B (E)
William Hovell Drive – John Gorton Drive/Bindubi Street Folded Diamond Interchange Upgrade Only	Bindubi Street – William Hovell Drive (North Intersection)	14.5 s	B (E)	23.8 s	C (D)
	John Gorton Drive – William Hovell Drive (South Intersection)	9.0 s	A (E)	48.3 s	D (E)
	William Hovell Drive – Coulter Drive (Intersection)	23.0 s	C (E)	11.0 s	B (E)
	William Hovell Drive – Bindubi Street Eastbound Onramp (Merge)	-	E	-	A
	William Hovell Drive – John Gorton Drive Westbound Onramp (Merge)	-	A	-	D
	William Hovell Drive – Bindubi Street Westbound Offramp (Weaving with Tuggeranong Parkway Onramp)	-	-	-	E
Coppins Crossing Road Scenario	William Hovell Drive – Coppins Crossing Road (West Intersection)	41.7 s	D (E)	15.3 s	B (E)
	William Hovell Drive – Coulter Drive (East Intersection)	14.3 s	B (E)	29.1 s	C (E)

* Overall Level of Service is given, with worst movement Level of Service in parenthesis.

The traffic assessment shows that connecting Coulter Drive Extension to William Hovell Drive will require significant work at the Staggered T intersection. Some of the required upgrade will not be required by 2031 after Bindubi Street/John Gorton Drive is connected to William Hovell Drive. Furthermore, the existing intersection of William Hovell Drive and Bindubi Street will need to be upgraded for this scenario.

The William Hovell Drive – John Gorton Drive/Bindubi Street Folded Diamond Interchange scenario can operate with an interim lane configuration that will require little modification for the 2031 Ultimate scenario. Furthermore, the existing intersection of William Hovell Drive – Coulter Drive will operate at an acceptable level.

The intersection of William Hovell Drive and Coulter Drive/Coulter Drive Extension has been assessed using traffic volumes obtained from the 2031 Scenario 1 (Base). The following three intersection options were assessed, with the results shown in Table ES.2:

- **Quadrant**
  This design separates movements, thus reducing conflict. It employs the existing intersections of William Hovell Drive with Coulter Drive and Coppins Crossing Road/Coulter Drive Extension, and adds a third between Coulter Drive and Coulter Drive Extension. This is the recommended design.
- **Staggered T Intersection**
  This design maintains the existing intersections of William Hovell Drive with Coulter

Drive and Coppins Crossing Road, with upgrades. To achieve acceptable performance the design requires three lanes for both the left turn from Coulter Drive to William Hovell Drive and numerous through lanes with adjacent downstream merges.

- **Four Way Intersection**
  This design realigns Coulter Drive so that it meets William Hovell Drive at the existing intersection with Coppins Crossing Road. This option also requires three right turning lanes from William Hovell Drive to Coulter Drive and numerous through lanes with downstream merges.

Table ES.2: William Hovell Drive – Coulter Drive 2031 Performance Summary

Option	Location	AM Peak		PM Peak	
		Delay	LoS*	Delay	LoS*
Quadrant Intersection	Coulter Drive – Coulter Drive Extension North (Intersection)	11.3	B (C)	33.2 s	C (D)
	William Hovell Drive – Coulter Drive Extension West (Intersection)	55.8 s	D (E)	57.1 s	E (E)
	William Hovell Drive – Coulter Drive East (Intersection)	22.7 s	C (E)	11.7 s	B (E)
	William Hovell Drive – Coulter Drive Eastbound Onramp (Merge)	-	C	-	A
Staggered T Intersection	William Hovell Drive – Coulter Drive (West Intersection)	34.9 s	C (E)	23.1 s	C (E)
	William Hovell Drive – Coulter Drive (East Intersection)	18.8 s	B (D)	47.1 s	D (E)
Four-way Intersection	William Hovell Drive – Coulter Drive/Coulter Drive Extension (Intersection)	34.9 s	C (E)	49.3 s	D (E)

* Overall Level of Service is given, with worst movement Level of Service in parenthesis.

Since the design criterion was to achieve acceptable performance, there is little difference between the options. The Quadrant option is preferred due to the impractical designs required to achieve acceptable performance with the Staggered T and Four-way options.

The upgrade of both William Hovell Drive – Coppins Crossing Road and William Hovell Drive – Coulter Drive was considered for the 2016 and 2021 years without the construction of Coulter Drive Extension or John Gorton Drive, or upgrade to Coppins Crossing Road. The intersection configurations required to support the additional traffic were found to be impractical.

The intersection of William Hovell Drive and John Gorton Drive/Bindubi Street has been assessed using traffic volumes obtained from the 2031 Scenario 1 (Base) strategic transport modelling. The following interchange options were assessed, with the results shown in Table ES.3:

- Folded Diamond Interchange
- Diamond Interchange

Table ES.3: William Hovell Drive – Bindubi Street/John Gorton Drive Performance Summary

Option	Location	AM Peak		PM Peak	
		Delay	LoS*	Delay	LoS*
Folded Diamond Interchange	William Hovell Drive – Bindubi Street (North Intersection)	36.9 s	D (E)	12.2 s	B (E)
	William Hovell Drive – John Gorton Drive (South Intersection)	19.8 s	B (E)	34.5 s	C (E)
	William Hovell Drive – Bindubi Street Eastbound Onramp (Merge)	-	E	-	A
	William Hovell Drive – Bindubi Street Westbound Onramp (Merge)	-	A	-	C
	William Hovell Drive – Bindubi Street Westbound Offramp (Weaving with Tuggeranong Parkway Onramp)	-	-	-	E
Tight Diamond Interchange	William Hovell Drive – Bindubi Street/John Gorton Drive (North Intersection)	17.2 s	B (D)	11.5 s	B (D)
	William Hovell Drive – Bindubi Street/John Gorton Drive (South Intersection)	8.7 s	A (E)	34.6 s	C (E)

* Overall Level of Service is given, with worst movement Level of Service in parenthesis.

The intersections associated with the connection of the East-West Arterial with Tuggeranong Parkway and Cotter Road were assessed for the following three scenarios in 2031, with the results shown in Table ES.4:

- **Scenario 1 (Base)**
- **Scenario 6 (Cotter Road Connection)**
  EWA does not connect to Tuggeranong Parkway
- **Scenario 7 (Cotter Road Connection with North Facing Ramps)**
  Ramps to and from the north only are provided for EWA at Tuggeranong Parkway.

Although Scenario 1 (Base) is the recommended EWA connection scenario, the other two options were also analysed to provide a clearer understanding of the traffic operational impacts on Cotter Road if the EWA is directly connected to it. Scenarios 6 and 7 reduce the amount of traffic being loaded on to Tuggeranong Parkway by delivering it to Cotter Road by varying degrees instead.

The traffic analysis shows that the inclusion of north-facing ramps in Scenario 7 results in a significant reduction in traffic at the intersection of Cotter Road and East-West Arterial compared to Scenario 6. It should be noted that the PM Peak traffic travelling from the City area to Molonglo can utilise the north facing ramps on Tuggeranong Parkway (via Parkes Way). Without this connection, traffic will use Adelaide Avenue and Cotter Road instead and the right turn from Cotter Road to East-West Arterial will require three right lanes. The intersection analysis results are shown in Table ES.4.

Table ES.4: Cotter Road – East-West Arterial 2031 Performance Scenario

Scenario	Location	AM Peak		PM Peak	
		Delay	LoS*	Delay	LoS*
Tuggeranong Parkway Full Interchange (Without Cotter Road Connection)	East-West Arterial Westbound – Tuggeranong Parkway Northbound Offramp (South Intersection)	18.5 s	B (C)	38.4 s	D (D)
	Tuggeranong Parkway – East-West Arterial Northbound Onramp (Merge)	-	E	-	B
	Tuggeranong Parkway – East-West Arterial Southbound Onramp (Merge)	-	C	-	C
Tuggeranong Parkway Overpass (With Cotter Road Connection)	Cotter Road – East-West Arterial (Intersection)	17.6 s	B (D)	26.0 s	C (D)
Tuggeranong Parkway North- Facing Ramps (With Cotter Road Connection)	Cotter Road – East-West Arterial (Intersection)	20.8 s	C (E)	22.5 s	C (E)
	East-West Arterial – Tuggeranong Parkway Southbound Offramp (Intersection)	15.5	B (D)	34.4 s	C (D)
	Tuggeranong Parkway – East-West Arterial Northbound Onramp (Merge)	-	E	-	C

* Overall Level of Service is given, with worst movement Level of Service in parenthesis.

ES.7 Public Transport and Cycling

ES.7.1 Public Transport

Service planning for a new development area such as Molonglo Stage 3 is difficult given the preliminary nature of land use planning and absence of planning of the local street network.

The important challenge that must be addressed is to define a network of higher-order roads that are designed to accommodate public transport services. If this bus-accessible road network is well connected and logically designed, with bus stops located strategically in terms of proximity to key attractors, connecting side-streets and active transport networks, then it will offer the inherent flexibility to allow for different route options to be designed at a later date when detailed planning has been completed.

Two rapid routes are envisaged for Molonglo:

- **Molonglo-City**
  This route runs from the Town Centre, northwards along the John Gorton Drive, stopping at the Northern Group Centre, before heading east along Parkes Way to Civic. There is potential to extend this route eastwards from the Molonglo Town Centre along the East-West Arterial, and then on to Tuggeranong Parkway. It would provide service to the areas along the eastern half of the East-West Arterial, but other than that it would travel through undevelopable areas and may not be able to generate adequate patronage to justify the extension.
- **Belconnen-Molonglo-Woden**
  This route would travel through Molonglo on a journey from Belconnen to Woden.

This option would benefit considerably if a link (bus-only if necessary) can be provided through the Northern Group Centre, linking the Coulter Drive Extension to the John Gorton Drive, to shorten the trip around the sharp deviation created by the junction of these two roads.

In the southern part of the site, two roads are shown as incomplete, possibly to be planned in later stages. These are the southern extension of East-West Arterial (MC30) and a local road (MCH0). This area needs to be penetrated by local bus services, and if each road is left as a cul-de-sac, bus servicing will become difficult, inefficient and unattractive. It is recommended that these two roads be developed as a completed loop.

Bus stops need to be provided along each of the bus-accessible roads at locations that provide access to the pedestrian network and local streets, along with nearby attractors. Noting the requirements of DDA legislation to have a maximum grade at a bus stop of 2.5%, the provision of stops within the hilly terrain of Molonglo requires careful planning. Again, this needs to be planned without the guidance of detailed land use detail, so there may be locations that simply do not need stops due to the lack of adjacent development.

ES.7.2 Public Transport Mode Share

The operation of the proposed bus stops and routes were included in the strategic transport modelling to forecast the likely patronage. The modelling showed that the targets of the Sustainable Transport Plan (STP) were met in 2031 for the whole Canberra network. The predicted bus mode share for Molonglo is expected to increase between 2016 and 2031 to 7.9% for Home-Based Work trips and 5.3% for all trip purposes.

While this bus mode share is somewhat lower than is expected for a development like Molonglo, which is relatively central with higher density residential areas, the low forecast is likely due to the constraints of the strategic modelling process. In the future, when more data on land use distribution and pedestrian networks are known, the strategic model can be updated to provide a better indication of the future bus mode share. The future modelling is expected to forecast a higher mode share than that forecast in this study.

ES.7.3 Cycleways and Shared Paths

The study includes consideration of a cycle highway or “veloway” through Molonglo, between Stromlo Forest Park, the Arboretum and Lake Burley Griffin, as well consideration of the option of a veloway between the Molonglo 2 Group Centre and Lake Burley Griffin utilising additional width on the East-West Arterial. Currently, all off road paths in the ACT are shared by cyclists and pedestrians. The main difference between current ACT shared paths and the veloway is that the latter is intended to be a segregated or cyclist only facility.

Control and access arrangements for existing veloways vary by jurisdiction:

- No fences to control pedestrian access have been used in the Netherlands Breda cycle highway project.
- The Adelaide Southern Veloway and the proposed V1 in Brisbane are for the exclusive use of cyclists.
- In some parts of the United States a veloway may be used by both cyclists and roller bladers.

Figure ES.18 shows proposed cycle paths in Molonglo 3. The shared path adjacent to the MVIS is not suitable as a fast cycleway or veloway as the horizontal curves do not allow high speeds. The other paths following the JGD and EWA corridors can generally be

designed for higher speeds. The paths within Molonglo can all be designed to avoid at grade road crossings. Both of these connect to the cycleway around Lake Burley Griffin.

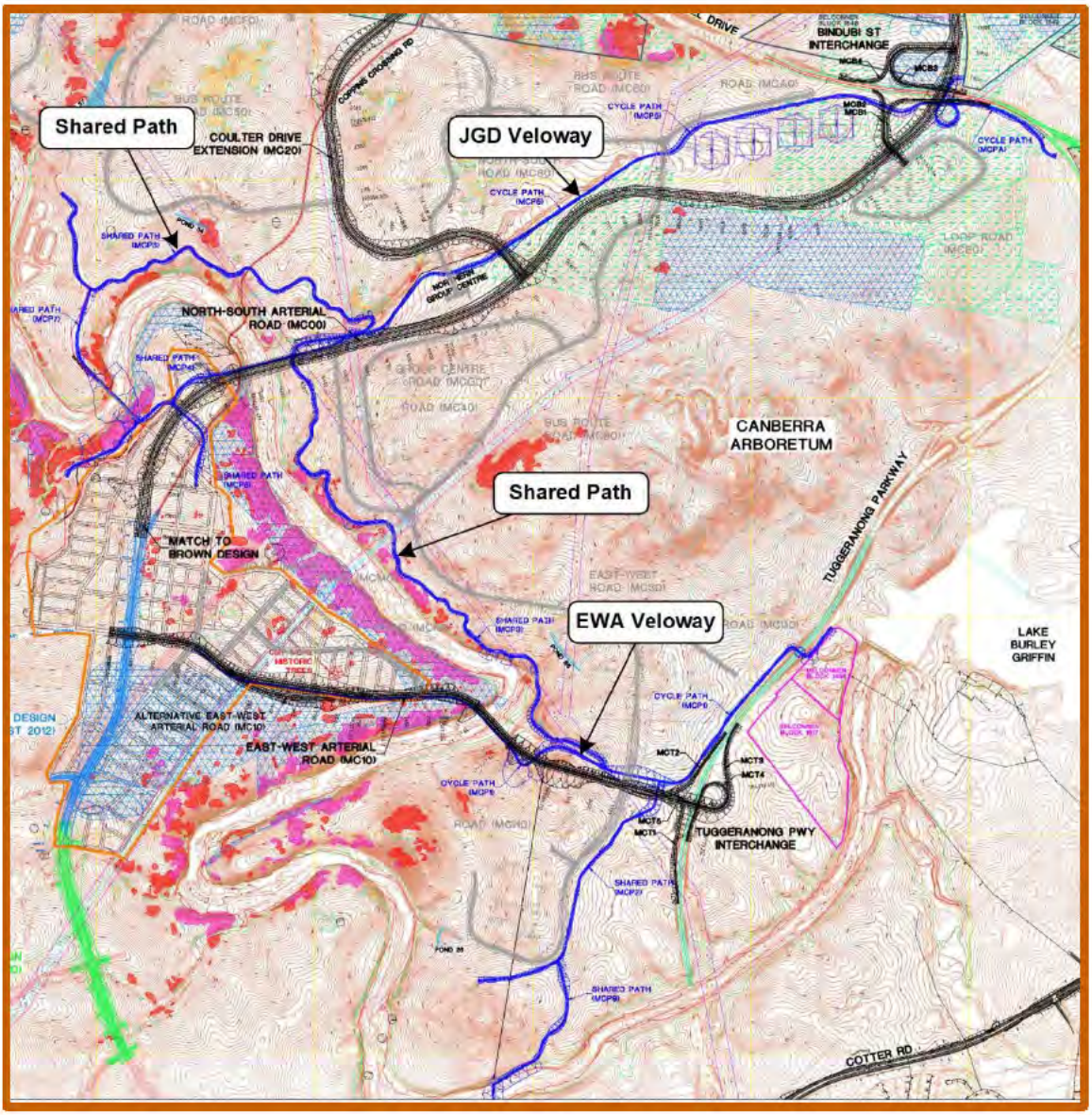

Figure ES.18: Proposed Off Road Paths (Blue)

The proposed arterial roads allow for 2.0 m on-road cycle lanes, as well as 7.5 m wide verges that can possible accommodate footpaths/shared paths of up to 3.0 m.

ES.7.4 Potential Cycling and Walking Mode Share

While it is not possible to conduct detailed modelling of the cycling and walking trips in Molonglo with the currently available tools and data, a brief investigation was carried out to determine the potential for walking and cycling trips in Molonglo.

The STP defines the maximum walk and cycle distances to be two and ten kilometres, respectively. Examination of ABS Census data shows that these distances may be lower than what is currently happening and may need to be reviewed.

Figure ES.19 shows the area covered by two (green) and ten (blue) kilometre travel distances. Trips travelling to and from the group centres in the green area are expected to have a mode share of approximately 30% walk and 3% cycle. In the blue area, trips to

and from the group centres are expected to have a mode share of approximately 9% walk and 4% cycle. These values are based on census day in 2006 and may not be indicative of typical conditions.

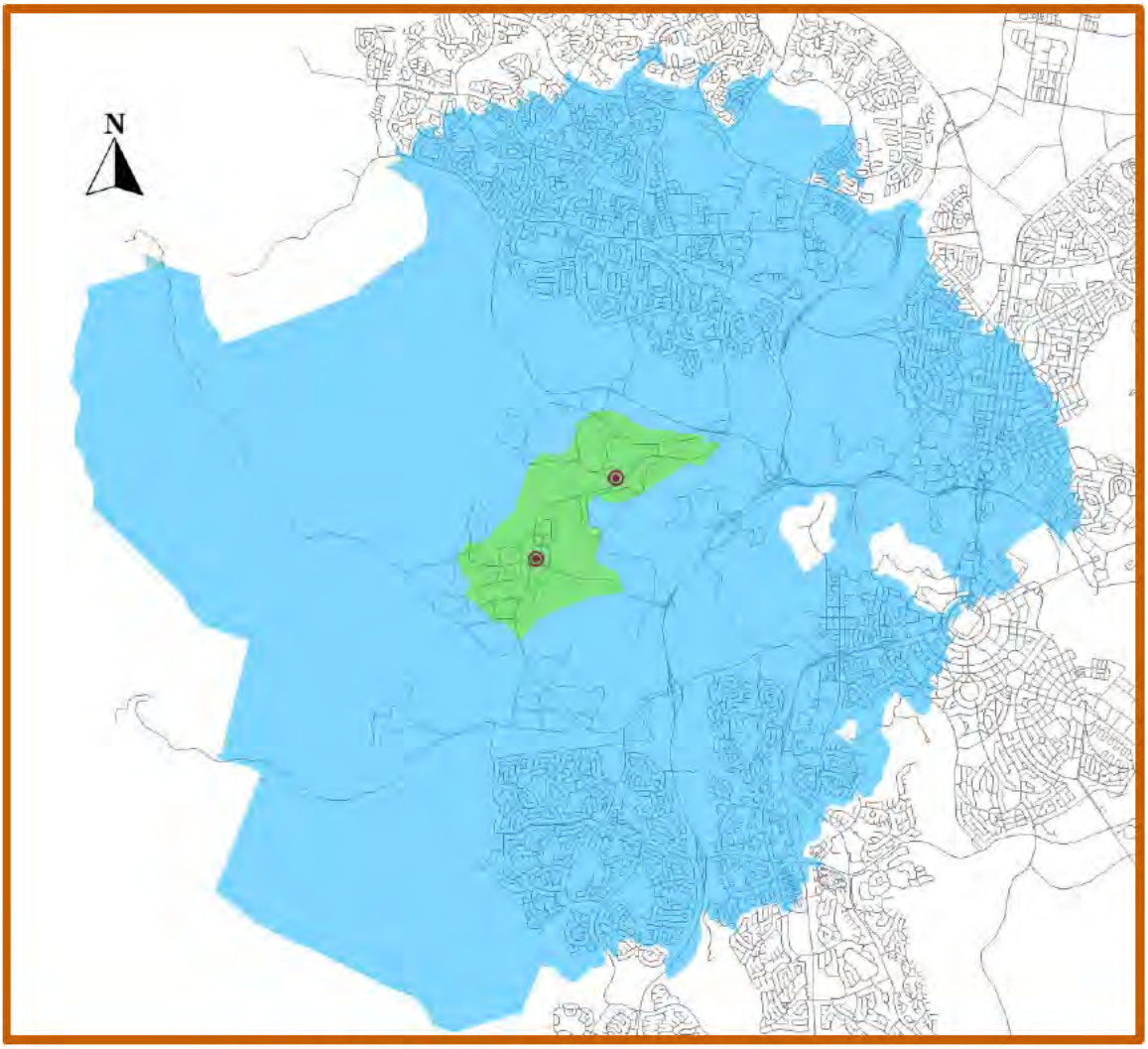

Figure ES.19: Walk (Green) and Cycle (Blue) Coverage Areas

High quality paths allowing reasonable direct access to the town centres should be focused in the areas shown in Figure ES.19. Particular attention should be paid to providing safe crossing points across arterial roads around both of the centres to improve access. In addition to the high quality path network, higher density residential development in the walk catchment (shown in green) will mean that a relatively large proportion of the trips to and from the group centres will use the walk and cycle modes.

ES.8 Bridge Structures

John Gorton Drive (JGD) and East-West Arterial (EWA) cross the Molonglo River within 2000 m of each other with the JGD crossing approximately 1200 m upstream of the proposed trunk sewer and pedestrian bridge. All three bridges are intended to comprise a suite of crossings over the river. As such they will be designed so that their appearances complement each other. The sewer bridge will be designed in advance of the two road crossings and will therefore influence the appearance of the latter two structures.

The alignment of the roads as they cross the Molonglo River corridor, and hence the siting of the bridges, is largely influenced by the need to minimise the impact on environmentally and ecologically sensitive areas; in particular the habitats of the Pink-Tailed Worm Lizard.

As both of the roads are dual carriageways, the river crossings will comprise twin bridges at each site.

The bridges' cross sections would be 12 m wide plus parapets to accommodate:

- Two 3.5 m traffic lanes;
- A 3 m provision for a footpath; and
- A 2 m shoulder accommodating on-road cycling.

The recommended typical section for both the JGD and EWA Arterial bridges is shown in Figure ES.20. The preliminary profiles for these bridges are shown in Figure ES.21 for JGD and Figure ES.22 for EWA.

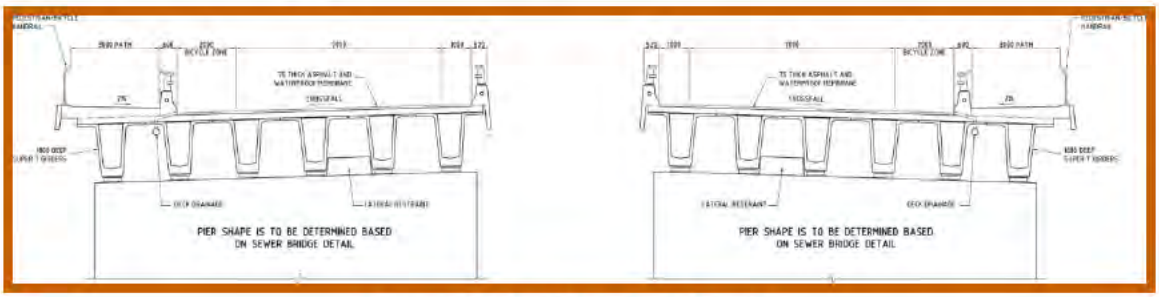

Figure ES.20: Bridges Typical Section

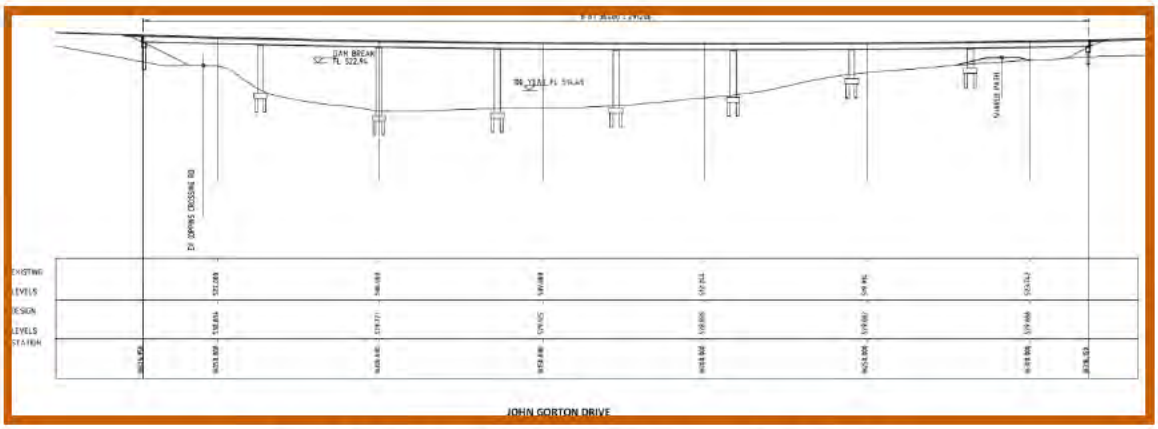

Figure ES.21: John Gorton Drive Preliminary Bridge Profile

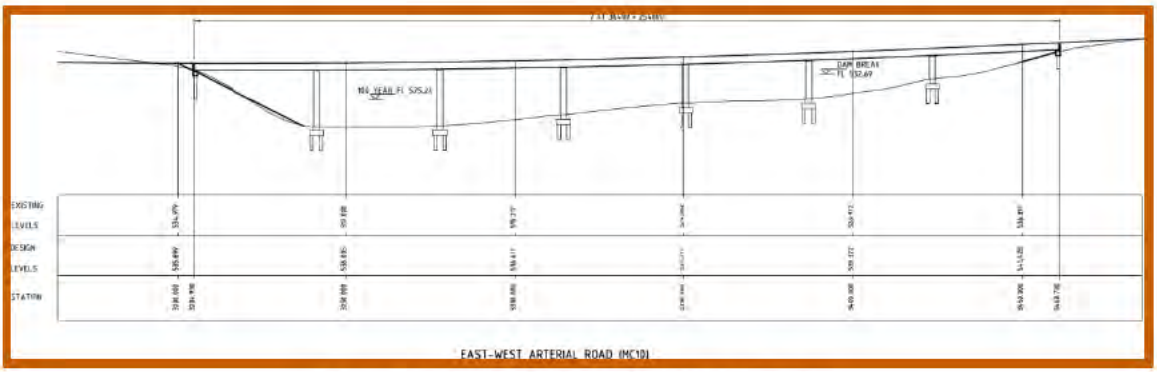

Figure ES.22: East-West Arterial Bridge Profile

The JGD bridge should be expected to cost around $50 million, while the EWA bridge should be expected to cost around $45 million.

ES.9 Hydrology and Drainage

Apart from the catchment north of William Hovell Drive, the remainder of the catchment contributing to the proposed roads lies within the proposed Molonglo 2 and Molonglo 3 development areas.

Currently, the catchment lies largely within open areas in their natural state and within the Molonglo River corridor. However, the catchment lies within a major greenfield residential development to be undertaken over the next 30 years. The proposed development will obviously alter the catchment characteristics which could lead to significant changes in the hydrologic response of the catchment.

The catchment plan is shown in Figure ES.23.

Figure ES.23: Catchment Plan and Node Locations

From about 2 km upstream of its confluence with Coppins Creek to the confluence, the proposed JGD alignment runs parallel to Coppins Creek. The area downstream of the proposed CDE is earmarked for future development. In view of this, it may be necessary to provide an engineered floodway to convey the flow (100-year flow of 46.5 m³/s at CDE and increasing downstream) from the CDE to Molonglo River (approximately 1.25 km).

Over this 2 km distance, it will be necessary to determine the flood levels in Coppins Creek/floodway to ensure the flood level does not encroach on to the road embankment. Such an occurrence would necessitate embankment protection measures or realignment of the creek. This may present some constraints in terms of developable areas downstream of CDE.

Where JGD and EWA cross the Molonglo River, bridge crossings are currently proposed. The 2- and 2000-year ARI peak flows and flood levels for locations close to the proposed bridge locations may be obtained from a study undertaken by SKM in 2010. This information may be used to determine flood levels at the bridge locations and also to evaluate scour protection at the bridge abutments and piers, both of which will be required to complete the bridge design.

The single pond option by GHD for Coppins Creek (Pond 38) could have backwater effects on CDE. It is proposed to be constructed in close proximity to JGD. The cascading ponds option by GHD (Ponds 38a and 38b) could also see flood levels encroach on to the JGD road embankment. Pond 27 is too close to the EWA and therefore could affect the EWA road embankment. If these pond options were to be progressed further, preliminary embankment levels and design flood levels will need to be determined and then the impact of the flood levels on both CDE and the EWA will need to be closely examined.

Two options have been proposed for the playing fields. The option of having the playing fields south of William Hovell Drive encroaches onto an existing farm dam and also lies within a natural drainage path. The alternative of locating the playing fields to the east of Bindubi Street also places the fields within a natural drainage path. A box culvert may be constructed to convey the stormwater flow underground across the playing fields.

ES.10 Environmental Impacts

The feasibility study for Molonglo arterial roads has been informed by a complex set of environmental and jurisdictional factors residing in the Molonglo Valley. The environmental issues and their origins are summarised in the following three documents:

- Strategic Assessment (NES Plan)
- Preliminary Risk Assessment (PRA)
- River Park Concept Plan

Under the principles of sustainable development as adopted in the ACT Guidelines for Scoping an EIS (ACTPLA 2010) a proposal with likely environmental impacts must avoid, minimise, offset or manage significant impacts. This feasibility study identifies the important and significant ways in which the arterial road design has avoided and minimised impacts on the Molonglo Valley environment.

It is assumed that each stage of the proposal will trigger the impact track under the *Planning & Development Act 2007* and *Territory Plan* because of the numerous impacts the roading may cause on Aboriginal heritage sites vegetation, habitats and locally listed threatened species and communities.

A challenge for the design team has been to optimise the alignment, safety and performance of the roads and intersections without compromising the conditions of

approval set down in the NES Plan, important design and conservation aspects of the River Park and any possible ACT approval requirements. This was achieved by the provision of all environmental constraints in mapped form to the design team and iteratively checking the design refinements as the project progressed.

ES.10.1 MNES Commitments

The feasibility road designs for Molonglo Stage 2 and Stage 3 have been crafted to avoid to a large extent the environmental constraints mapped to occur in the Valley. This can be seen in Appendix A and meets the NES Plan obligations of the ACT Government to avoid impacts on MNES in the first instance. Table ES.5 shows the expected impacts that would results from the implementation of the arterial roads as proposed in this feasibility study.

Table ES.5: MNES Impacts

Constraint	Area of Impact	Proportion of Total Loss Budget
Box Gum Woodland	3.9 ha	3.5%
Pink-Tailed Worm Lizard Habitat (medium and high quality)	0.8 ha	2.9%

The impacts shown in Table ES.5 could be further reduced during the PSP and FSP stages by tailoring of the standard cut and fill batters currently supporting the proposed alignments.

ES.10.2 Preliminary Risk Assessment

A Preliminary Risk Assessment (PRA) was undertaken to identify the environmental assessment processes that are required under the ACT legislation for Molonglo Valley Stage 2 development, including supporting infrastructure. The PRA does not discuss the degree of mitigation and offset that the NES Plan (Commonwealth approval) offers the ACT jurisdiction.

For the purpose of estimating the likely outcomes of an ACT assessment process, it is assumed that the environmental outcomes outlined in the NES Plan will also serve as suitable outcomes for the Commonwealth listed threatened species that are also listed as threatened in the ACT.

The outstanding (non MNES) biodiversity issues requiring consideration in future environmental impact assessment documents for the development of arterial roads in Molonglo are likely to be: ACT Box Gum Woodland community, woodland connectivity, vegetation clearing, tree hollows, threatened plants, threatened birds and Perunga Grasshopper.

The degree of scope for Environmental Significance Opinions or s144 applications under the P&D Act to exempt the proposal from future EIS is unclear. This is because the scale of the impact is relatively large. While there has been much study of the area, the biodiversity issues of the non-EPBC listed threatened species have not been not reviewed within the context of the possible impacts on them and their locations. Although the NES Plan serves as a major conservation management outcome for ACT listed threatened species, the degree to which this occurs is yet to be reviewed. Ideally this significant body of work would be accepted as the core of a reduced EIA requirement for the arterial roads proposal.

ES.10.3 Community Interest/Heritage/Woodland Connectivity.

Analysis of the Bindubi Street intersection area in relation to an additional request to look at the feasibility of sports oval development was undertaken. Developments in this area are likely to be constrained by a commitment from Jon Stanhope when Chief Minister to support the addition of the Aranda Snow Gums precinct to the Black Mountain Reserve. The Aranda Snow Gums are listed on the ACT Heritage list. Furthermore the ACT Woodland restoration project has established plans to enhance habitat connection between Black Mountain to the Murrumbidgee River. Whilst these plans can be adapted to suit local development needs, the larger woodland remnants that are present in this area are integral to the success of the project. Any circuitous planting designs developed to replace the loss of these remnants patch sizes are unlikely to be met with favour from stakeholders.

ES.10.4 Consultations

During the course of the project the environmental team consulted with Dr. Will Osborne of the Applied Ecology Institute, the TAMSD River Park Implementation Team and members of the Conservation Planning and Research Team. Their responses are documented in this report. It can be said that these groups are comfortable with the alignments now proposed in this study. Key concerns are for the protection of PTWL habitat and Box Gum Woodland as well as the integrity of the River Park reserve.

ES.10.5 River Park Concept Plan

The feasibility study has reviewed the River Park Concept Plan and most importantly undertaken consultation with the River Park development team. The key aspects of the River Park are to provide passive and nature based recreational opportunities as well as serve as a conservation offset for the EPBC strategic assessment outcomes outlined in the NES Plan. The arterial road alignments avoidance of key environmental components, such as PTWL habitat and Box-Gum Woodland, also serves also to minimise impacts on the Park. The road locations most critical to the Park's design and purpose are the bridge crossing points and where the roads are proposed to fringe or intersect with these two habitats. The location of the associated bicycle paths potentially conflict with horse riding trails. Final design of the park boundaries will occur in parallel with final infrastructure designs. This will ensure conflicts are reduced, however further review is likely to be required in future EIA for the PSP and FSP stages of the arterial road designs.

ES.10.6 Environmental Summary

The proposed arterial road alignments have to the largest extent avoided Commonwealth Matters of National Significance which are managed by the NES Plan. Although much of the ACT jurisdictions biodiversity may also be protected by the NES Plan outcomes, there remains risks to ACT threatened species and their habitats, corridors and nesting locations. These risks will need to be resolved in the PSP and FSP stages of the development proposal. The proposal will trigger the impact track. The type of impact assessment documents required is yet to be determined.

On-going consultation will be needed to maintain the program of road development as stakeholder concerns remain, particularly for the implementation phase where construction impacts may affect adjacent conservation reserves and threatened species and their buffer zones.

ES.11 Construction Staging

SMEC has developed a potential staging structure for implementation of the arterial road network through Molonglo Stage 3. This staging plan is based primarily on constructability, cost and transport considerations. The ACT Government may prefer a different staging plan based on the need to release different types or different quantities of residential and commercial land.

The proposed construction stages are as follows:

- **Stage 3A** is based on providing the first carriageway of John Gorton Drive from the Molonglo 2 Group Centre to the Bindubi Street Interchange. Access is provided to the Northern Group Centre, to allow initial development to occur there. This stage will provide one bridge connection across Molonglo River.
- **Stage 3B** includes the completion of the Coulter Drive Extension. This arterial road provides access to the north-western area of the Molonglo Development. Most of the land in this area is likely to be lower density, single dwelling developments.
- **Stage 3C** includes duplication of John Gorton Drive over the Molonglo River and the provision of a signalised intersection serving the development area. The eastern extent is assumed to be the 132 kV transmission line easement. This land is also assumed to be relatively high value due to its proximity to the river parklands and both of the group centres.
- **Stage 3D** may be able to proceed without connecting the East-West Arterial to the Tuggeranong Parkway. However, construction of the East-West Arterial Molonglo River Bridge may be desirable as it would facilitate the provision of a bus route and also add to the road network security for emergencies such as bushfires.

ES.12 Cost Estimates

Based on the concept design plans, cost estimates have been prepared for the following arterial roads:

- John Gorton Drive;
- Coulter Drive Extension; and
- East-West Arterial Road.

It is noted that these feasibility stage cost estimates are indicative and include a 30% cost contingency. The total cost estimate to deliver the construction of the arterial roads is estimated at **$361,486,169 (GST Excl.)** This estimate includes the two bridges for JGD and EWA as well as the interchanges of WHD – Bindubi Street and Tuggeranong Parkway – EWA.

ES.13 Conclusions and Recommendations

ES.13.1 Roads

The principal objective of the study was to develop a transport network for the development area defined in the Molonglo Structure Plan that achieved the following:

- Minimised through traffic by adopting arterial and sub-arterial routes which efficiently serve Molonglo development, but which do not encourage diversion of through trips from William Hovell Drive and the Tuggeranong Parkway.
- Minimised through traffic in neighbourhoods by locating collector roads so that arterial or sub-arterial roads are more convenient routes for non-local trips.
- Maximised road safety by adoption of a road hierarchy, a road network that discourages through trips, achieved satisfactory sight distance, facilitated the coordination of traffic signals on JGD, and avoided steep gradients on arterial and collector roads.
- Minimised impacts on sensitive environmental areas
- Avoided noise and air pollution by avoiding unnecessary travel over hills by arterial and sub-arterial traffic
- Maximised opportunities for walking and on-road cycling by locating all arterial roads, sub-arterials, and collector roads so that grades will not exceed 5%
- Minimised collector road lengths (and traffic volumes) by selecting appropriate arterial road alignments
- Provided trunk off-road shared paths on grades generally not exceeding 3%
- Providing opportunities for bus stops on gradients of 2.5% or less on collector roads
- Providing opportunities for future light rail stations on arterial roads (adjacent to signalised intersections) with gradients of 2% or less
- Providing opportunities for local street intersections on collector roads by use of gradients not exceeding 4% where feasible
- Spacing JGD signalised intersections to facilitate traffic signal coordination
- Providing access to:
  - a Northern Group Centre at the junction of JGD and CDE
  - district playing fields
  - residential areas by providing collector roads which provided public transport routes with stops generally within 400 m of residences
- Minimised capital costs by avoiding major services, minimizing earthworks, careful selection of river crossings, and appropriate connections to the existing road network

These network features have been taken into consideration in the development of the proposed arterial road network shown in Appendix A.

ES.13.2 Traffic Modelling and Traffic Analysis

In 2016 a single scenario was tested using the strategic model, as a baseline in the 2016 AM peak period. It identified a number of roads in and around Molonglo Valley operating at or above capacity, notably John Gorton Drive south of the Molonglo 2 Group Centre and Cotter Road west of Tuggeranong Parkway.

The strategic model analysis suggests that in the 2021 AM peak period, on the roads that do not differ between the two scenarios, the difference in traffic flow is insignificant. In both scenarios both John Gorton Drive and William Hovell Drive operate above capacity. The connection of John Gorton Drive to William Hovell Drive is considered to be a more direct and higher quality link between Molonglo and the City, and is therefore the preferred option for staging of access to William Hovell Drive.

An operational analysis was also conducted in 2021, for the weekday AM and PM peak periods, using intersection modelling and Highway Capacity Manual freeway facility techniques. This analysis indicated that John Gorton Drive should be connected to William Hovell Drive at Bindubi Street in the interim.

Seven scenarios were tested in the 2031 AM peak period using the strategic model, with various combinations of road connections and movement reduction at the Tuggeranong Parkway – East-West Arterial interchange. The results of this modelling suggested that while the differences between the options are small, Scenario 1 (Base) is most likely to be effective as it provides the best connectivity to East-West Arterial.

The operational analysis for the 2031 AM and PM peak periods indicates that the quadrant design should be selected as the preferred design for the intersection of William Hovell Drive – Coulter Drive Extension/Coulter Drive. The performance of each of the design options for the William Hovell Drive – John Gorton Drive/Bindubi Street interchange is acceptable, however the folded diamond interchange increases the ramp spacing from Glenloch Interchange and is thus preferred. Performance of the Tuggeranong Parkway – East-West Arterial interchange is acceptable for all of the design options tested for that location.

ES.13.3 Public Transport

A detailed distribution of bus stop locations has been developed.

Four new bus routes have been proposed for the Molonglo Valley; two local coverage routes and two rapid trunk routes. The rapid routes can potentially be more intimately linked with the existing bus route network through extension to other town centres at either end.

Comprehensive bus coverage of Molonglo Valley has been achieved through the layout of stops and routes.

ES.13.4 Cycleways

Cycle facilities were investigated, including the potential provision of a cycle highway or “veloway.” Veloways are high-grade paths that allow for segregation of pedestrians and cyclists. Alignments for two veloways were proposed. One of these veloways follows John Gorton Drive and connects the Molonglo 2 Group Centre, Northern Group Centre and the existing trunk cycle path on the eastern side of Bindubi Street. The other follows the East-West Arterial and connects the Molonglo 2 Group Centre to the existing trunk cycle path near Scrivener Dam.

Potential routes for shared paths through the Molonglo River Park area were also considered. These paths are suitable for shared use by pedestrians and cyclists.

It is also assumed that all arterial roads in Molonglo will have on-road cycle lanes as per ACT Government policy.

ES.13.5 Bridges

A layout was proposed for both the John Gorton Drive and East-West Arterial bridges that accommodate two 3.5 m traffic lanes, a 2 m shoulder allowing on-road cycling and a 3 m wide barrier-separated footpath. Preliminary cost estimates for the two bridges, utilising Super-T girders, are $50 million and $45 million respectively.

ES.13.6 Hydrology and Drainage

The existing stormwater drainage contributing to the study area catchment area was modelled for critical points on the proposed roads for flood Average Recurrence Intervals (ARIs) of five and 100 years.

It would not be feasible to provide flood retardation for individual transverse drainage catchments. At node CD8, just upstream of the Coulter Drive extension, the small increase in flow does not warrant the provision of a stand-alone flood retardation facility. However, it may be possible to make the water quality control nominated at this location into a water quality/flood retardation facility. Retardation volume required, flood levels and permanent pool volume required for pollutant retention need to be critically examined during detailed design phase.

The water quality control ponds (Ponds 38, 38a, 38b and 27) nominated by GHD (2012) will need to be reviewed during detailed design, for impact on the road embankments and for acceptable pollutant retention.

Locations of the playing fields need to be carefully considered in view of stormwater drainage diversion requirements and the loss of the existing farm dam.

ES.13.7 Environmental Impacts

The feasibility road designs for Molonglo Stage 2 and Stage 3 have been crafted to avoid, to a large extent, the environmental constraints mapped to occur in the Valley. Furthermore the impacts that would result from the implementation of the arterial roads as proposed in this feasibility study amount to approximately 0.8 ha and 3.8 ha of the Box-Gum Woodland and Pink-Tailed Worm Lizard (medium and high quality) habitat, which is 2.9% and 3.5% of the loss budget allocated in the NES Plan respectively.

The proposed arterial road alignments have to the largest extent avoided Commonwealth Matters of national Significance which are managed in the NES Plan. Although much of the ACT jurisdictions biodiversity will also be protected by the NES Plan outcomes, there remains risks to ACT threatened species and their habitats, corridors and nesting locations. These risks will most likely need to be resolved in at least one EIS at the final sketch plan stage of the development proposal.

During the course of the project the environment team consulted with Dr. Will Osborne of the Applied Ecology Institute, the TAMSD River Park Implementation Team and members of the Conservation Planning and Research Team. Their responses are documented in this report. It can be generally said that these groups are comfortable with the alignments proposed in this study. There will be an on-going need to maintain consultation during the program of road development as concerns remain for the implementation phase where construction impacts may affect adjacent conservation reserves and threatened entities and their buffer zones.

ES.13.8 Construction Staging

A staging plan for the development of the Molonglo arterial road network was developed. This staging plan recommended the following stages:

- Stage 3A: Connect a single carriageway of John Gorton Drive from the Molonglo 2 Group Centre to Bindubi Street. This will allow initial development and implementation of the Strategic Public Transport Network.
- Stage 3B: Connect the Coulter Drive Extension to John Gorton Drive. This will allow development of the north-western region of Molonglo
- Stage 3C: Develop the area north-east of the Molonglo 2 Group Centre and provide road connections to John Gorton Drive. Duplicate John Gorton Drive Bridge.
- Stage 3D: Construct the East-West Arterial and develop the area between the Molonglo 2 Group Centre and the Tuggeranong Parkway (on the eastern side of the Molonglo River)

It is noted that this staging plan is based on the efficient construction of the arterial road network and provision of transport facilities, including public transport, and does not consider the ACT Government's land release targets. If the ACT Government wishes to focus on releasing a certain type of land, the staging will need to be modified so that roads are constructed to provide appropriate access to the released land.

ES.13.9 Preliminary Cost Estimates

Based on the concept design plans, cost estimates have been prepared for the following arterial roads:

- John Gorton Drive ;
- Coulter Drive Extension; and
- East-West Arterial Road.

It is noted that these feasibility stage cost estimates are indicative and include a 30% cost contingency. The total cost estimate to deliver the construction of the arterial roads is estimated at **$361,486,169 (GST Excl.)**

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ABBREVIATIONS

ARI	Average Recurrence Interval
ASD	Approach Sight Distance
BGW	Box Gum Woodland
BSWM	Bulk Supply Water Main
CDE	Coulter Drive Extension
DDA	Disability Discrimination Act
DSUI	Design Standards for Urban Infrastructure
EDD	Economic Development Directorate
EPBC	Environment Protection and Biodiversity Conservation Act
ESDD	Environment and Sustainable Development Directorate
EWA	East-West Arterial
JGD	John Gorton Drive
LOS	Level of Service
MGSD	Minimum Gap Sight Distance
M2GC	Molonglo 2 Group Centre
MNES	Matters of National Environmental Significance
MVIS	Molonglo Valley Interceptor Sewer
NCA	National Capital Authority
NGC	Northern Group Centre
PRA	Preliminary Risk Assessment
PT	Public Transport
PTWL	Pink-Tailed Worm Lizard
SISD	Safe Intersection Sight Distance
SSD	Stopping Sight Distance
SSP	Shared Services Procurement
TAMSD	Territory and Municipal Services Directorate

1 INTRODUCTION

1.1 Background

The Draft Variation to the Territory Plan No. 281 (2007) specifies the principles and policies that will enable urban development in Molonglo. The latest Territory Plan map showing zones and overlays in Molonglo is shown in Figure 1. It responds to the strategic direction provided by the Canberra Spatial Plan (2004) and the general principles identified in the Molonglo Valley Structure Plan (2006). The planning intent for the proposed development is outlined in ACTPLA's May 2006 *Molonglo Valley Structure Plan*. This document guides all future planning and design in the area. The stated vision for the area is:

> "*The Molonglo Valley will grow over several decades as a series of integrated communities within the spectacular natural landscape of the river corridor, its surrounding valleys and rolling hills. These communities will be highly accessible and be linked with public transport as well as encourage walking and cycling. Group and local centres will provide for shopping, services and jobs, and significant new areas will be developed for employment generation. The natural and cultural heritage of the area will be integrated with new urban development and a long term strategy to oversee the timely implementation of infrastructure will deliver sustainable and high quality suburbs.*"

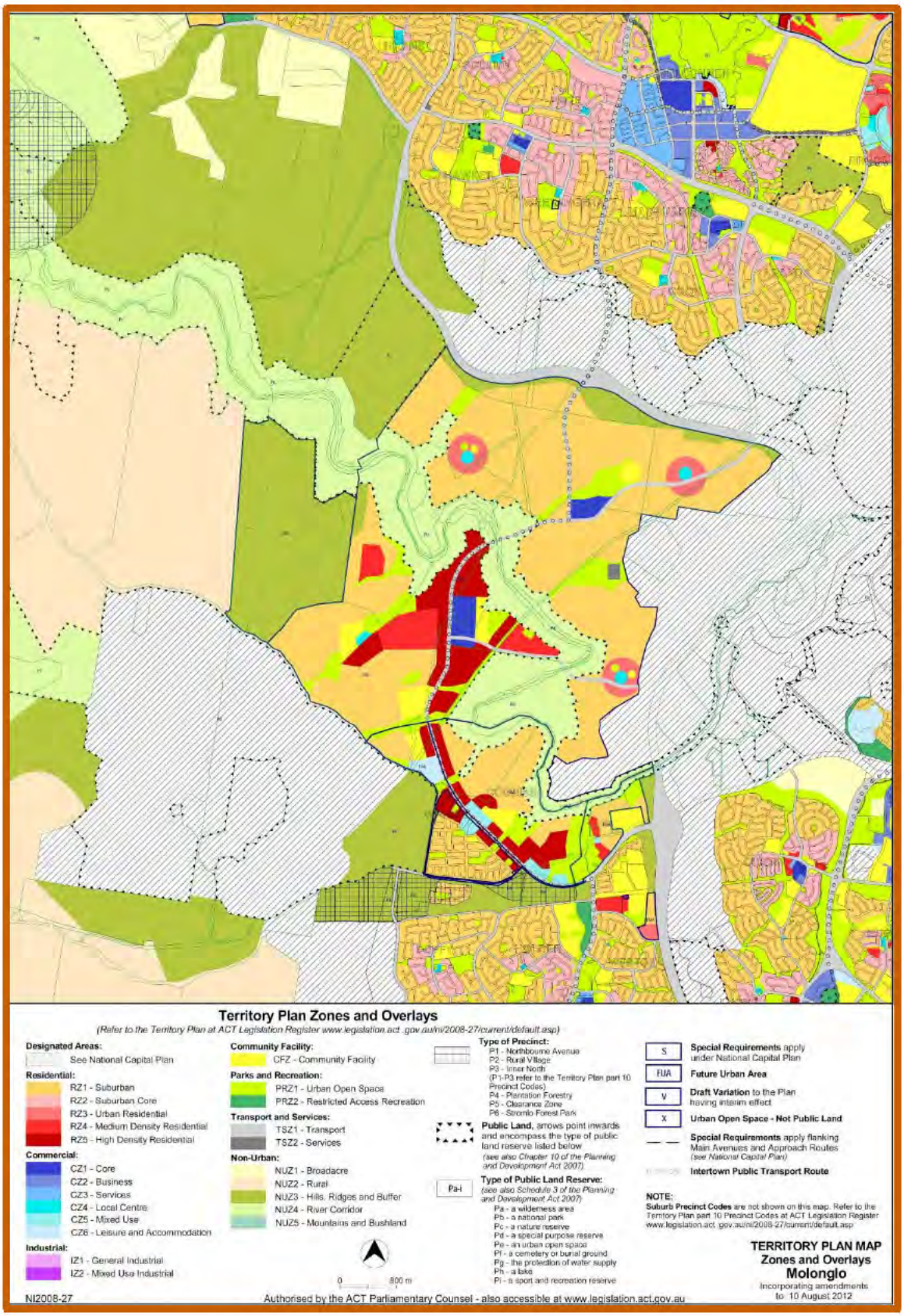

Figure 1: Territory Plan Map for Molonglo (August 2012)

The Molonglo Arterial Roads Feasibility Study builds on earlier preliminary options and feasibility studies for the development of the Molonglo Valley in to a group centre with a population of 45,000 in 2031, and ultimately 55,000. In particular, this study builds on the Molonglo Roads Feasibility Study (SMEC 2008), with updated inputs from a number of other studies undertaken in the intervening period regarding various arterial roads, planning and framework studies and environmental studies.

1.2 Scope

1.2.1 Road Location and Concept Design

1.2.1.1 Arterial Roads

This report provides recommended concept designs and forecast traffic volumes for the following arterial roads:

- John Gorton Drive (JGD)
- Coulter Drive Extension (CDE)
- East-West Arterial (EWA)

1.2.1.2 Sub-Arterial and Collector Roads

This report provides recommended concept designs and forecast traffic volumes for the following sub-arterial and collector roads which connect to the arterial road network as follows:

- JGD-EWA Connection (JGD-EWA) – sub-arterial
- Western Collector (WC) – west of CDE
- Northern Collector (NC) – east of CDE and north of JGD
- Southern Collector (SC) – south of JGD
- Southern Collector Extension (SCE) – south of EWA

1.2.1.3 Local Streets

Local streets have been investigated for feasibility in areas where terrain inhibits the provision of collector roads.

1.2.2 Transportation Planning and Traffic Analysis

Traffic forecasts were undertaken for 2016 AM, 2021 AM and 2031 AM using EMME3, based on the structure plan provided by EDD. The impacts of the proposed roads on the existing adjacent arterial roads were also assessed.

1.2.3 Trunk Off-Road Cycleways

This report provides recommended concept designs for off road trunk shared paths as follows:

- JGD Cycleway
- Molonglo River Cycleway (generally along MVIS access road)
- EWA Cycleway

1.3 Objectives

The objectives of this study were to:

- Review previous road alignment studies and validate/determine the key arterial road alignments, intersections/interchange arrangements with the existing road network and the river crossing locations and details.
- Substantiate the timing for the John Gorton Drive and East-West Arterial and associated bridges over the Molonglo River based on the development staging assumptions and the transport model.
- Review the impact on the external road network imposed by the Molonglo development and evaluate Coppins Crossing Road's capacity to serve as an interim north-south link.
- Based on the recent planning studies review the existing Molonglo traffic model and provide projections on the transport mode shifts to public transport, cycling and walking.
- Provide road alignments that support future land use intentions and that minimise environmental impacts.

2 REVIEW OF BACKGROUND INFORMATION

A number of references and resources have been provided to SMEC as background material for this feasibility study. The following sections discuss the relevant ones and their significant in this study.

2.1 Molonglo Roads Feasibility Study, SMEC 2008

Most of the planning of Molonglo 3 area included in this report has been made obsolete by the changes to the structure plan subsequent to the 2008 SMEC work. In particular, the North-South Arterial (NSA, now John Gorton Drive or JGD) connection to Bindubi Street rather than Caswell Drive has required a complete restructure of the road network.

2.2 North-South Arterial Alignment Study, SMEC 2010

This study by SMEC identified the location of the JGD crossing of the Molonglo River. This location was confirmed and adopted by Brown Consulting for the JGD alignment through the Molonglo 2 Group Centre (M2GC).

During the Alignment Study the Pink-Tailed Worm Lizard (PTWL) habitat was taken into consideration, resulting in the relocation of the route to the west from the original concept alignment, taking a path between two core habitat areas (see Appendix A). This revision was undertaken in consultation with Dr. Will Osborne, a local expert on PTWL and its habitats. Dr. Will Osborne has been retained as a specialist consultant for the feasibility study.

The adopted alignment is similar to the Hybrid Option B1/B2 proposed in this study shown in Figure 2.

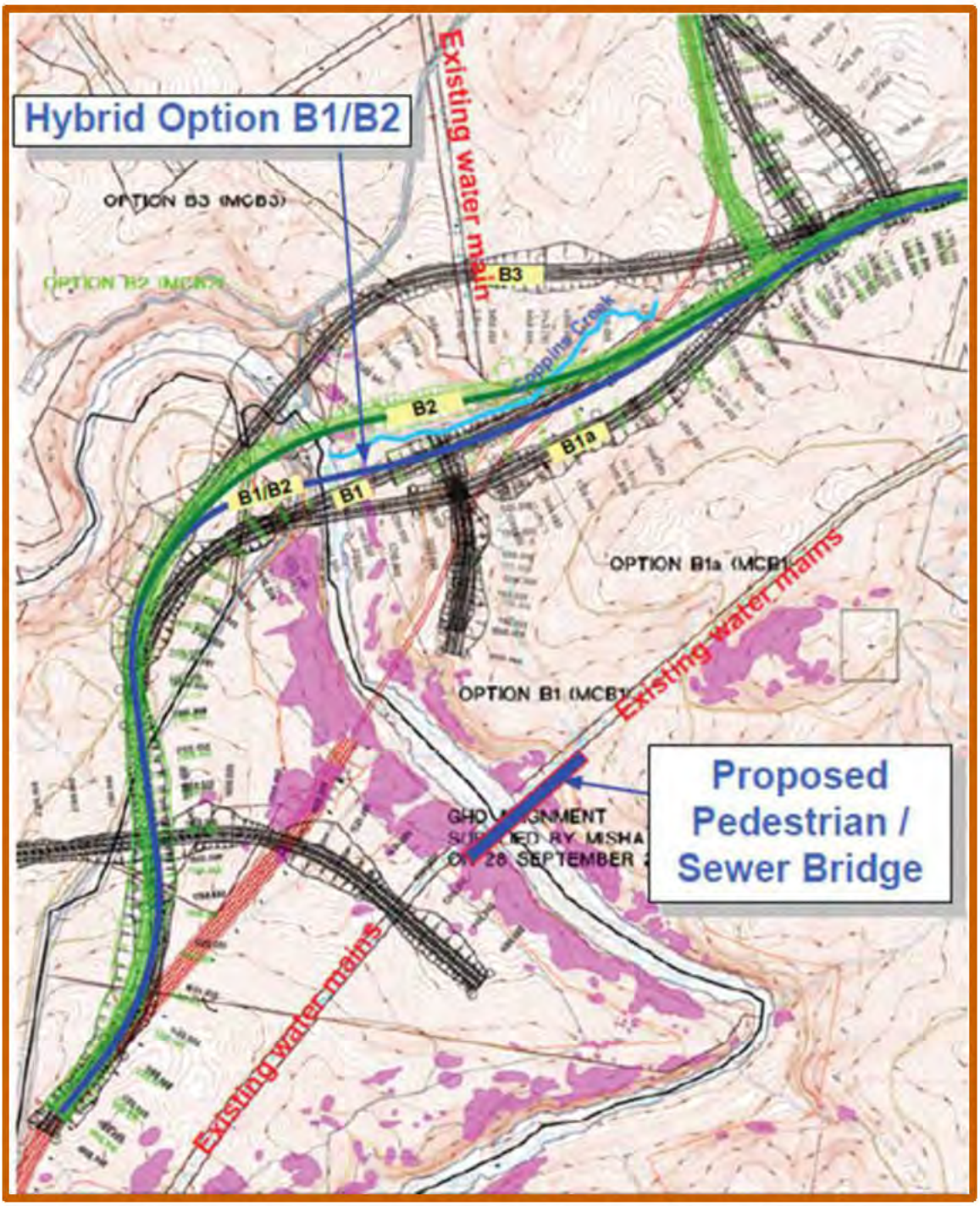

Figure 2: Hybrid Option B1/B2 as Presented in the North-South Arterial Alignment Study (SMEC 2010)

2.3 Molonglo Valley Stage 2 Planning and Design Framework, ACT Government 2012

The Planning and Design Framework (PDF) set the strategic context and planning rationale for the future development of Molonglo Stage 2, which is about 500 hectares in area and is bounded by the Molonglo River and Stromlo Forest Park to the south. The PDF provides the general structure and guidance for land use issues, location of activities and key structuring elements, such as arterial roads

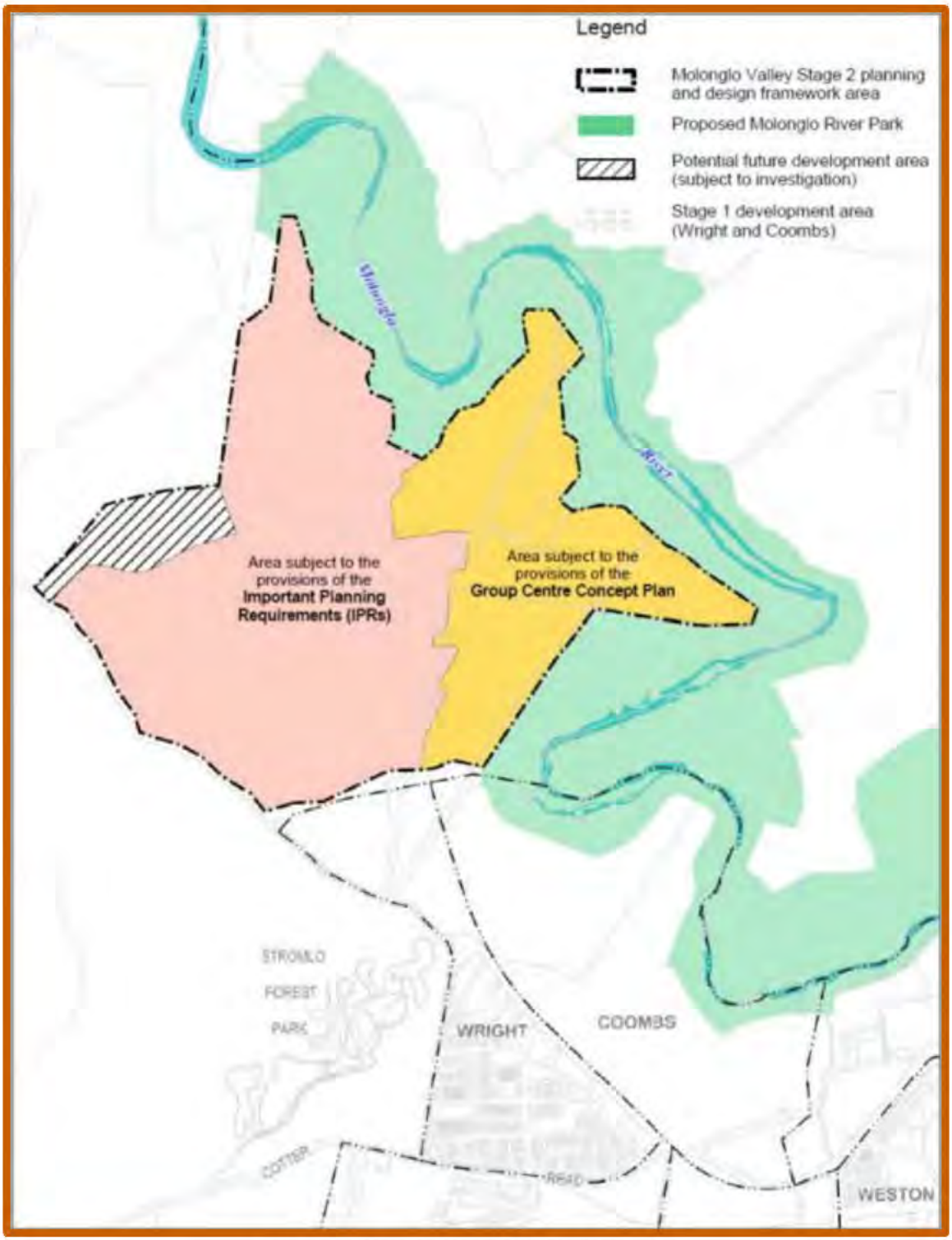

Figure 3: Molonglo Stage 2 PDF Indicative Area

This document was used as a reference for the development of the JGD and EWA alignments as part of this study. It was also one of the bases for the development of the zoning structure and land use figures used in the strategic transport model update.

2.4 Molonglo Transport Model Review, AECOM 2010

In 2010, AECOM undertook a review and update of the strategic transport model of the ACT maintained by ESDD. The purpose of the update was to incorporate:

- Strategic Public Transport Network Plan assumptions
- Latest road network and future works plans
- Latest land use plans

The study found that the road network surrounding Molonglo is not well suited for development in Molonglo. The study recommended that studies be undertaken to investigate the feasibility of widening or augmenting a number of major roads around Molonglo, including:

- Tuggeranong Parkway
- Parkes Way
- Coulter Drive
- Bindubi Street

In addition to these upgrades, the study recommended traffic management for collector roads in the area to manage rat-running.

2.5 Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (NES Plan), ACTPLA 2011

The NES Plan reflects outcomes of a detailed strategic assessment undertaken under the *Environmental Protection and Biodiversity Conservation Act 1999*, guides the development activities proposed for the Molonglo Valley as set out in the Structure Plan, and establishes the ACT Government's commitments to protect Matters of National Environmental Significance (MNES) within the Molonglo Township area.

The NES Plan also includes many broad actions that need to occur to achieve the conservation and mitigation conditions of the Commonwealth approval. Relevant to the feasibility study these include:

- Action 30 – Design of the infrastructure that will be situated in the river corridor to minimise impacts to high and moderate quality PTWL habitat.
- Action 35 – Development of a Park Concept Plan for the "Molonglo River Park" which will be situated along the East Molonglo river corridor. A key focus of this will plan will be the protection of high and moderate quality PTWL habitat.

Other specific measures include undertakings to:

- Alter the East Molonglo development boundary and development rules to minimise the impact on MNES values.
- Design infrastructure to avoid or minimise impacts to MNES in the river corridor.

The guidance in the NES Plan around the road design process includes:

- Re-aligning the location of the major bridges (as compared to the original location proposed in the Molonglo Structure Plan) to minimise impacts on moderate and high quality Pink-Tailed Worm Lizard habitat; and
- Aligning other infrastructure to avoid moderate and high quality Pink-Tailed Worm Lizard habitat, and Box-Gum Woodland where this can be achieved.
- Ensuring specific biodiversity offset locations are protected; and
- Ensuring the prescribed number of hectares of each habitat that can be cleared is not exceeded. These clearing budgets under the NES Plan for the whole of Molonglo are 27 ha for PTWL and 110 ha for Box Gum Woodland and are managed by EDD.

2.6 Threatened Species Overview

The key matters of National Environmental Significance that are protected and offset by the NES Plan are Pink-Tailed Worm Lizard (PTWL), White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland), Natural Temperate Grassland, Superb Parrot and Swift Parrot.

The main environmental issue is the potential impact of any realignment of the Molonglo arterial roads on PTWL habitat. This legless lizard is listed as a threatened species under the Environment Protection and Biodiversity Conservation (EPBC) Act, Commonwealth. (1999) and the Nature Conservation Act, ACT (1980). Much of this habitat is aligned with the river and its minor tributaries. Appendix A shows the PTWL has some of its most significant habitat in the ACT divided by John Gorton Drive. The current alignment is now fixed to cross the Molonglo River between two main habitat nodes.

For this project SMEC has engaged the services of Dr. Will Osborne. Dr. Osborne has had continuous involvement in the discovery, research and management of the PTWL in the Molonglo Valley for many years. In addition to habitat definition Dr. Osborne has identified mitigation and rehabilitation strategies that may reinstate habitat and enable reoccupation of disturbed sites. These measures fulfil the NES obligations to design infrastructure in the river corridor to "minimise impacts to high and moderate quality PTWL habitat."

The Molonglo Valley also contains areas of remnant woodlands that are listed as endangered under both The EPBC (Commonwealth) and Nature Conservation (ACT) Acts. It is likely that route realignments will impact on these remnants. Measures and means to protect and enhance woodlands patches and the linkages between patches will also provide Superb Parrot and Swift Parrot habitat.

2.7 Molonglo River Park Concept Plan Report, Hassell 2011

A public river park will protect much of the habitat set aside to offset the broad acre biodiversity losses resulting from the development of Molonglo. A draft Concept Plan for this reserve has been released and made available to SMEC (shown in Figure 4). Key areas of interaction between the park and the road alignments is around the bridges and where supporting infrastructure such as cycle paths might intrude into woodlands within the draft park boundaries. The TAMSD River Park Implementation Team has been consulted on the interaction between the Park and the arterial road alignments.

Figure 4: Molonglo River Park Draft Concept Plan

2.8 The National Arboretum Canberra

The National Arboretum Canberra is being developed on a 250-hectare site in the Greenhills Forest area adjacent to Tuggeranong Parkway, west of Lake Burley Griffin. It incorporates the existing stand of 5,000 Himalayan Cedars and the 80 year old Cork Oak plantation. The 2003 bushfires was a catalyst for the creation of the international arboretum. It provides an opportunity to conserve threatened species, a place for

community recreation and valuable resource for ongoing education and research. The impact of Molonglo roads on the Arboretum has been considered in this report.

2.9 Preliminary Risk Assessment – Stage 2

A Preliminary Risk Assessment (PRA) for the Structure Plan was undertaken by NGH for Molonglo Stage 2 (the PRA). It identified a number of risks that the development could pose to the environment as a result of roading. These include risks to steep slopes, waterways, groundwater and water quality, view sheds, Aboriginal heritage and threatened species. However, it is apparent that the risks most difficult to avoid or mitigate are those relating to threatened species habitat and native vegetation clearance.

Most of the threatened species risks identified in the PRA are addressed by the NES Plan because the key locally listed threatened species occur in the same habitat as the nationally listed species, i.e. protection of the woodland and grassland habitats also serves the local species. Additional consultation has been undertaken with CPR to ensure that local threatened species are addressed in this study.

Environmental issues not addressed by the NES Plan have been reviewed in this feasibility study.

2.10 Molonglo 3 Stormwater Master Planning

The study undertaken by GHD in 2012 investigated stormwater management strategies for the Molonglo Valley Development Area, which encompasses the future development areas of Molonglo 1, 2 and 3.

The GHD 2012 study presented two water quality improvement options for Coppins Creek catchment:

- A single pond option
  A large water quality control pond (Pond 38) with a volume of 155 ML was proposed upstream of the MVIS. During the consultation phase, GHD were asked to consider a cascading pond option.
- Cascading pond option
  The cascading pond option was developed as a result of the consultation phase of the GHD study. In this option, two smaller ponds were proposed; one downstream of the MVIS (Pond 38a) and one further upstream of the MVIS (Pond 38b).
  The cascading ponds option was preferred. However, they recommended a review once the John Gorton Drive alignment was finalised, to decide on which option to pursue further. In particular, the footprint of Pond 38a would need to be amended to get the embankment clear of the Molonglo River 100-year ARI flood extent.

The GHD study also proposed a pond (Pond 27) east of the proposed Tuggeranong Parkway interchange for East-West Arterial Road.

The GHD study did not consider the need for flood retardation to reduce the post-development flows to existing flows.

2.11 John Gorton Drive Extension to Molonglo 2 Forward Design (JGD Stage 2a), Brown Consulting for EDD

The detailed alignment of JGD designed by Brown Consulting was provided to SMEC early in the study and this was used as a reference to establish the starting point of JGD in Molonglo Stage 3. The JGD Stage 2a design by Brown Consulting is shown in Figure 5.

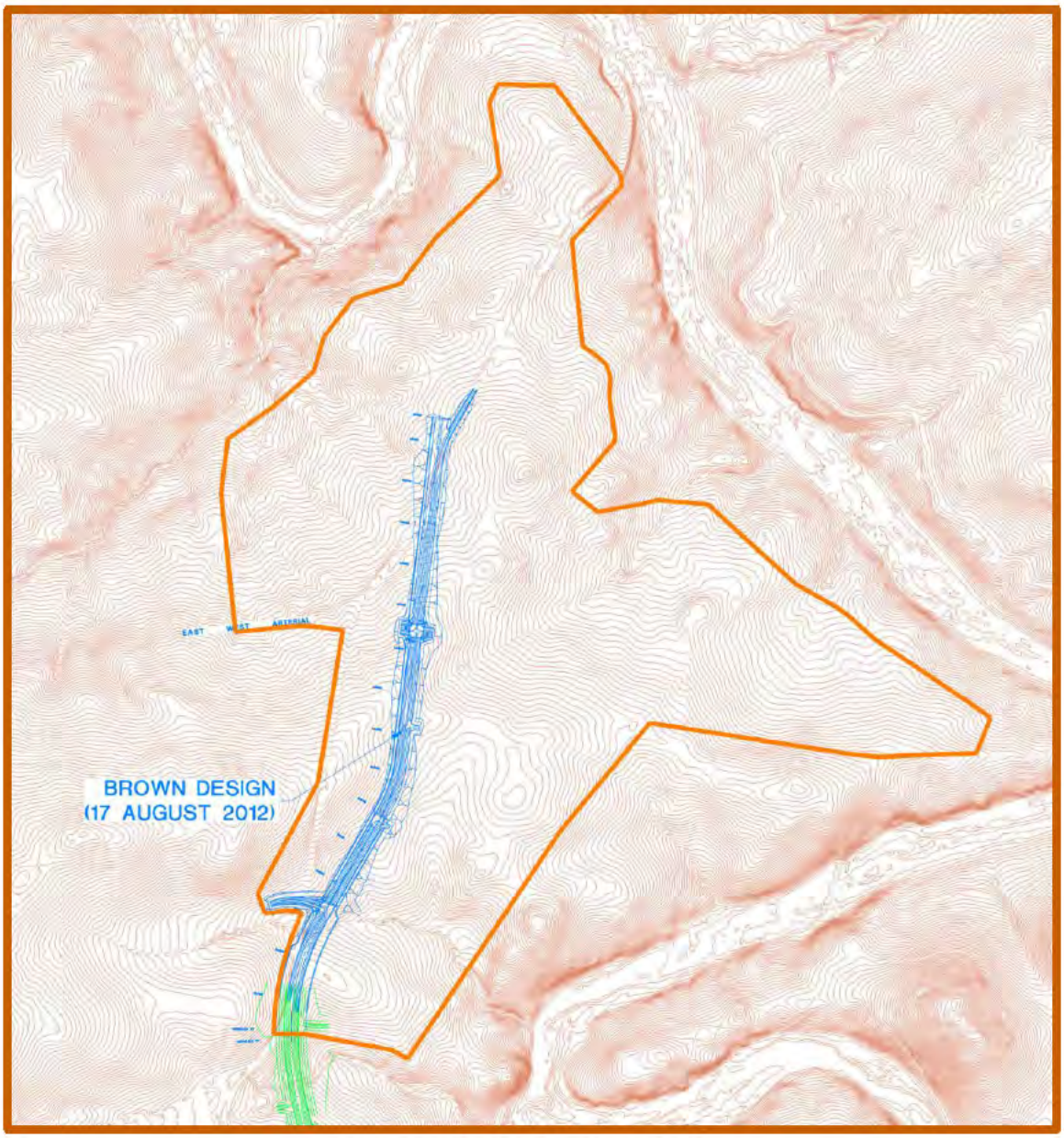

Figure 5: JGD Stage 2a Through M2GC

2.12 Molonglo Valley Stage 2 Group Centre and Environs – Planning and Design Framework Urban Design Component (Hames Sharley, Ross Bonthorne and INDESCO for ESDD)

The preliminary road network layout of the Group Centre and the area to the east of it was provided to SMEC. This was used as the basis for establishing the EWA alignment within the Molonglo Stage 2 boundary. This also provided information on proposed intersections with the EWA, which were also checked in the development of the arterial road alignment. The GC and environs road network layout is shown in Figure 8.

Figure 6: Molonglo 2 Group Centre Boundary and Internal Road Layout

3 PRELIMINARY WORK

Prior to conceptualising the arterial road alignments, a number of tasks have been undertaken.

3.1 Constraints and Opportunities

3.1.1 Topography

The hilly terrain is a major constraint that strongly influenced the route location of the arterial and major collector roads.

The location of a network of roads required consideration of the junction opportunities and how the gradients and sight distance requirements could be met on all the road network links and intersections.

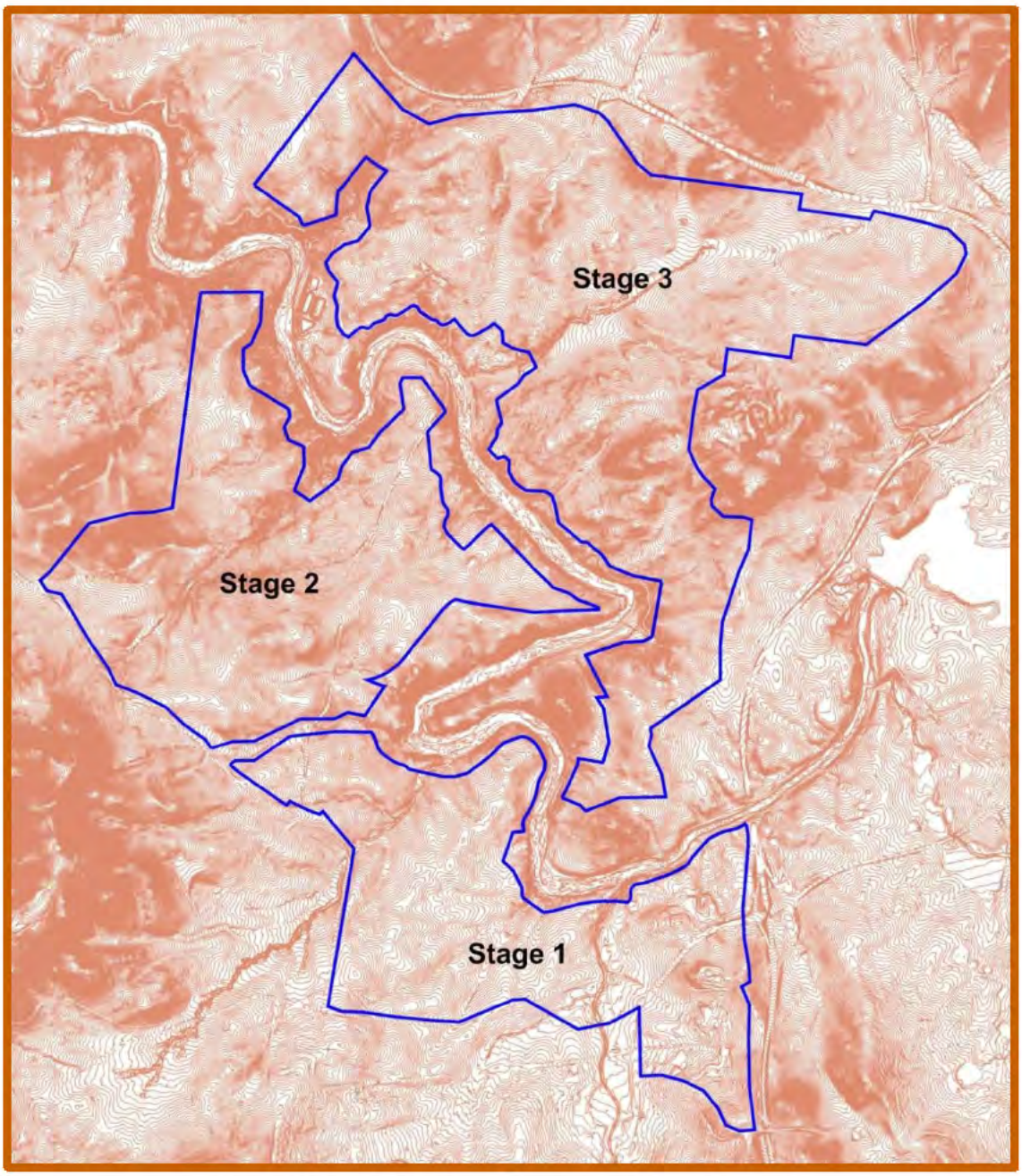

Figure 7: Molonglo Terrain and Development Stage Boundaries

3.1.2 Environmental Constraints Mapping

An important first step was to map all of the environmental constraints known in the valley for the road designers. These included PTWL habitat, Box Gum Woodland, Aboriginal Heritage, European heritage and the most up to date river reserve elements and its boundary. These constraints are shown in Appendix A.

Notable is the high and medium quality PTWL habitat in the river corridor and the endangered ecological community Box Gum Woodland just off the east-west arterial, along the river corridor and in the offset reserve the (area “GG”) in the north eastern quarter.

Aboriginal heritage has not been shown on the mapping for confidentially reasons. It can be said however, there are concentrations of sites:

- In the south west quarter of the project area;
- Near John Gorton Drive on the southern side of the river, and;
- In and around Glenloch Interchange, many of which have already been salvaged as part of the Gungahlin Drive Extension project.

Two European heritage sites are shown on the map and are not impacted by the proposed road alignments.

3.1.3 Existing Services

A number of trunk services cross the development areas. These services predominately comprise:

- Molonglo Valley Interceptor Sewer (MVIS) – This is one of the most significant infrastructure links in Actew’s sewer system.
- Sewer connecting to MVIS, possibly serving the zoo.
- Electricity – A number of overhead 132 kV HV power lines cross the site. Some relocations are proposed.
- Bulk Supply Water Mains – a number of bulk supply mains radiate out from Mount Stromlo through the site to service Belconnen, Civic and Gungahlin.

Road alignments have been developed that avoid the major services (except the section of 132 kV power line intended to be relocated).

The sewer identified in the second point requires modification as the sub-arterial road MC30 requires a deep cutting where it crosses the sewer.

Based on the Draft Report issued 10 September 2012, comments were received from ActewAGL with respect to the project’s impact on the high voltage electricity distribution and Bulk Water Supply Mains infrastructure.

These specific issues are outside the scope of this study and will need to be considered during detailed design phase of the project.

3.1.3.1 Electricity

ActewAGL made the following general comments regarding infrastructure and works near or around 132 kV HV power lines:

> *As per the ActewAGL's standard for the overhead clearance requirement, the 132 kV line over major road carriageway requires 9 m clearance. However these figures are based on maximum operating design temp of 110 C, whereas normally under normal operating conditions say 25 C and 200 m span the conductors should be at least 11.5 m above the new road surface to maintain 9.0 m clearance at 110 C. To calculate the clearance requirements more accurately, you are required to have the 132 kV Lines surveyed clearly identifying the attachment height of the conductors on both end towers, surveyed ground profile of the span between the towers and overlayed in CAD with the new crossing details.*
>
> *Moreover the trees in the vicinity are to be under 3 m in height with a horizontal clearance of 25 m to any pole or tower.*
>
> *You must also seek ActewAGL's approval to install other utilities assets, any above or below ground metallic objects within the existing 132 kV easement.*

In addition specific comments were made about providing adequate clearance from tower footings when developing the road and cycleway/cycle path alignments. This needs to be considered during the next stage of the project.

3.1.3.2 Bulk Supply Water Mains (BSWM)

ActewAGL made the following general comments:

> *There are large bulk supply mains running through the area from Stromlo treatment plant into Aranda. South of the Molonglo River, they are in the form of parallel mains about 12 m apart and north of the river they are on separate alignments. Where the pipes are parallel, an overall easement of 40 m is required. Where they are separate, each main will require a 20 m wide easement, centred over the pipe line.*
>
> *These mains are critical elements in the bulk supply system, and subject to higher pressures than the normal reticulation mains. If they were to fail there would be significant flooding and probable damage to property. Repairs and any damage control measures would require immediate and unhindered access of heavy equipment to the area, to ensure that they can be put back in service as soon as possible. The surrounding estate development will be required to be designed so that any local flooding due to a potential failure of a main will be contained within public spaces and the associated stormwater system, with details to be approved by ActewAGL. Additional building setbacks should be considered in this context also.*
>
> *In all cases, the easements are to be in public space, clear of other encumbrances such as parallel underground services, roads, or structures, and the number of crossings of services are to be minimised. Crossings are to be at or near right angles to the mains and grouped together where possible. Trees would be permitted, subject to ActewAGL approval. Encroachment by roads may be permitted on a specific, case by case basis.*

ActewAGL also made specific comments that need to be taken into consideration during the detailed design phase of the project, and these include the following:

- Where EWA crosses the BSWM, angles closer to 90° minimise disruption in the event that repairs are required to the BSWM and are preferred by ActewAGL. The finished cover over the main should be as thin as possible, but with a minimum thickness of 1.2 m. Reinforced concrete relieving slabs of nominally 300 mm thickness should be provided under the carriageways to transfer superimposed loads alongside the main, and be located at least 500 mm clear above the pipe invert.
- The cut or fill should not encroach within the 20 m limit (centred over the main) as set out in the general requirements above. This may require a realignment of the road(s) and/or the BSWM. The loop cycleway would be allowed to encroach but at minimum finished levels over the main.

3.1.4 Geotechnical and Contamination

Coffey Geosciences Pty. Ltd. reported in 2005 that there are no geological issues influencing road alignments other than the Winslade Fault. This fault is not suitable for deep excavations, but is not active and should not impose constraints to developing roads, housing, or shallow ponds. The proposed collector road MC50 is in the vicinity of the fault. The geotechnical investigation for this road and adjacent development should include specific consideration of the presence of the fault and include appropriate design recommendations.

The Coppins Crossing Sewerage Sludge Ponds is the main area of contaminated land in Molonglo 3. There are also a number of sheep dips which will require remediation, but these have not been treated as a constraint to road location.

Figure 8, taken from previous work undertaken by SMEC, shows the geotechnical and contamination constraints in and around the study area. This figure includes an area for Central Molonglo, which was part of the planning assumptions at the time the study was undertaken but has been removed from future development plans by the ACT Government.

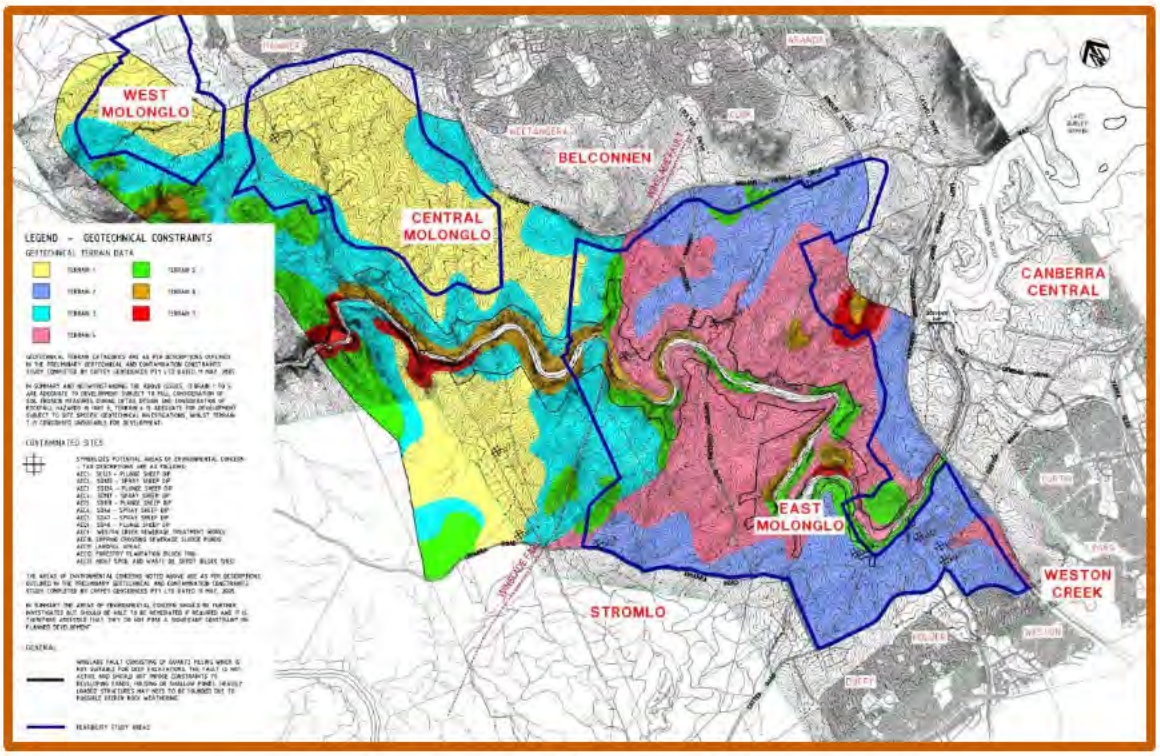

Figure 8: Geotechnical and Contaminated Sites Constraints

3.2 Design Criteria

3.2.1 Design Speed

Austroads and the ACT Guidelines recommend a design speed of the speed limit plus 10 km/hr.

Speed limits on arterial roads used in the ACT vary from 60 to 80 km/hr.

Collector road speed limits are usually 50 or 60 km/hr.

A design speed of 90 km/hr is recommended for arterials, and 70 km/hr for sub-arterial and collector roads. The EWA west of the Molonglo River (through the M2CG) has a design speed of 70 km/hr with an expectation of a speed limit of 60 km/hr or less.

Shared paths design speed is desirably 50 km/hr.

3.2.2 Horizontal Curves

Table 1: Minimum Horizontal Curve Radii

Design Speed	Desirable Minimum [m] 5% Superelevation	Absolute Minimum [m] 5% Superelevation	Adverse Superelevation 3%
70 km/hr (Collector and EWA through M2CG)	161	107	300
90 km/hr (Arterial)	354	255	900

Increase radius by 10% for each 1% increase in gradient over 3%.

3.2.3 Gradient

The following are the gradient requirements for different road classifications adopted for this study:

- Arterial Roads
  - 0.5% minimum
  - 2.0% maximum at bus stop/future light rail stations 153 m long
  - 4.0% maximum at intersections (with no bus stop)
  - 5% maximum
- Collector Roads
  - 1% minimum
  - 2.5% maximum at bus stops
  - 4% maximum at access street intersections
  - 5% maximum for on road cycling (no intersections)
  - 7% maximum for bus operation (no bus stops or intersections)
  - 10% absolute maximum for a maximum of 30 m (bus limitation)
- Access Roads
  - 12% maximum
- Lanes
  - 17% maximum

The desirable maximum lengths of grades, as specified by Austroads, are shown in Table 2.

Table 2: Desirable Maximum Lengths of Grades (Austroads)

Grade (%)	Length [m]
2-3	1800
3-4	900
4-5	600
5-6	450
>6	300
10%	30

3.2.4 Sight Distance Requirements and Crests

Approach sight distance to intersections (ASD), safe intersection sight distance (SISD), and stopping sight distance (SSD) require the crest curve K values shown in Table 3 and Table 4 (Austroads values).

Table 3: Crest K Values – Arterial Roads with 80 km/hr Speed Limit (90 km/hr Design Speed)

Sight Distance Type	Measurement Heights [m]	Sight Distance Minimum [m]	Sight Distance Desirable [m]	Minimum K	Desirable K
ASD	1.10-0.0	139	151	87.3	104
SISD	1.10-1.25	214	226	49	55
SSD	1.10-0.2	139	151	51	76.6
MGSD (8 sec.)	1.10-0.25	200	NA	129	NA

Minimum Gap Sight Distance for junctions on arterial roads (90 km/hr design speed, 8 second critical acceptance gap) is 200 m. Intersections on arterials are located away from crests so that MGSD is achieved. Note that SISD and MGSD criteria are primarily an issue for signalised intersections during signal malfunction.

Table 4: Crest K Values – Collector/Sub-Arterial Roads with 60 km/hr Speed Limit (70 km/hr Design Speed)

Sight Distance Type	Measurement Heights [m]	Sight Distance [m]	Minimum K
ASD	1.10-0.0	92	38.9
SISD	1.10-1.25	151	25
SSD	1.10-0.2	92	19.1
MGSD (8 sec.)	1.10-0.25	97	30.4

For concept design, a minimum K value of 40 has been adopted on 60 km/hr speed limit collector roads to allow driveways to be located virtually anywhere and intersections anywhere that grades do not exceed 4%.

Minimum Gap Sight Distance for un-signalised T junctions on collector roads (70 km/hr design speed, for a 5 second critical acceptance gap) is 97 m. Therefore a K value of 40 will satisfy all intersection vertical sight distance criteria for vertical geometry including MGSD.

3.2.5 Intersection Requirements

Meeting the public transport requirements (2% grade through stations) will ensure that there will be no problems with excessive adverse crossfall for turning vehicles at arterial road intersections, as it is proposed to locate stations on the departure side of intersections.

Intersections on arterials should be located away from crests.

Intersections on collector road crests require a minimum **K value of 38.9.**

Generally, it is preferable that intersections are located on straights or on large radius adverse camber horizontal curves. This assists with horizontal sight lines and avoids side roads channelling stormwater across the through carriageway. Where all of the water potentially entering from the side road can be intercepted by pits then a junction on a superelevated curve may be acceptable.

3.2.6 Cross-Section

The cross-section assumptions for different road types are shown in Table 5.

Table 5: Cross-Section Assumptions

Road Type	Lanes Widths per Carriageway	Median	Verge/ Footpath	Batter Slope
Dual Carriageway Arterial	2 × 3.5 m 1 × 3.5 m bus lane at junctions 1 × 2.0 m (cycles) 9.0 m	12.0 m for JGD (Light rail in median) 6 m EWA	7.0 m	1v:4h
Single Carriageway Arterial	2 × 3.5 m 2 × 2.0 m (cycles) 11.0 m	NA (except at intersections)	6.25 m	
Major Collector/sub-arterial	2 × 3.5 m 2 × 1.5 m (cycles) 10.0 m	NA (Except at slow points)	6.25 m	
Trunk Shared Path (Commuting)	1 × 3.0 m	NA	3.5 m	

Typical cross-sections of the arterial roads are shown in Figure 9 and Figure 10. Larger scale versions are also included in Appendix B.

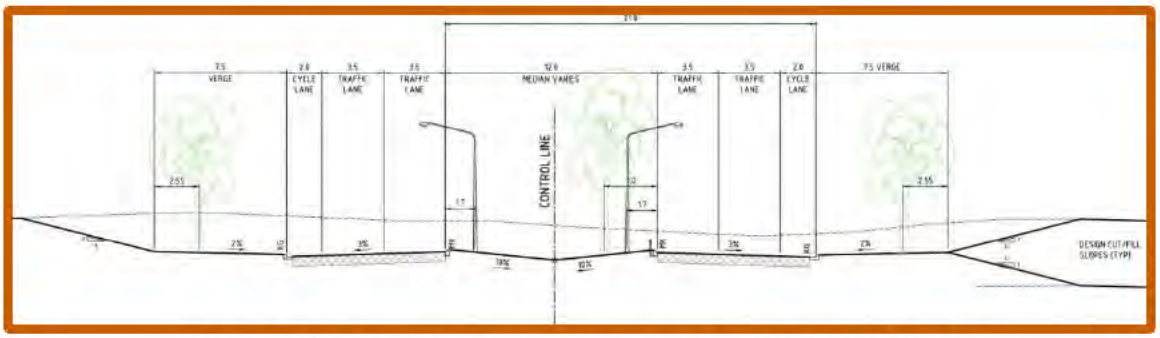

Figure 9: John Gorton Drive and Coulter Drive Extension Cross Section

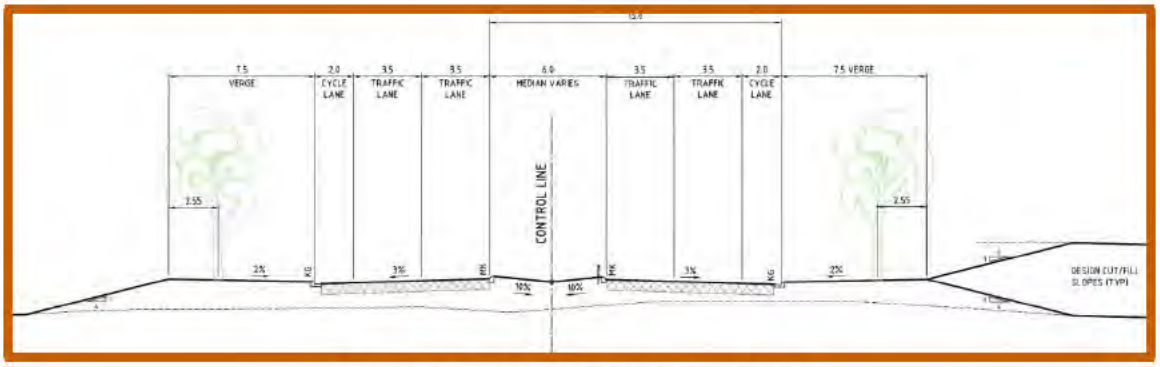

Figure 10: East-West Arterial Cross Section

For this study, cut and fill batter slopes of 1v:4h have been used for the feasibility design. At the next stage of design (following geotechnical investigations) steeper or flatter slopes should be used depending on the soil and rock characteristics, fill height, constraints requiring retaining walls, access requirements on collector roads and local streets, road safety, aesthetics etc.

3.3 Transport Model Review

One of the early tasks in this project was to review the previous strategic modelling, update the model with the latest planning information and then use the model to test various scenarios.

3.3.1 Strategic Transport Model Provided to SMEC

In 2010, AECOM was engaged by ESDD to update their strategic transport model to include the latest (at that stage) planning assumptions for Molonglo. This model was then provided to SMEC. More details of the work undertaken by AECOM have been discussed in Section 2.4.

3.3.2 Land Use and Transport Zone Modifications

Between the time that AECOM updated ESDD's strategic transport model and the start of this project, a number of planning assumptions in Molonglo changed. Most of the changes occurred in Molonglo Stage 2 and were described in the *Molonglo Valley Stage 2 Planning and Design Framework*, discussed in Section 2.3.

Through an iterative process of consultation with ESDD and EDD, SMEC was able to update the road network, transport zones and the relevant land use in the model. Figure 11 shows the road network and location of transport zone connectors at the end of the transport model review process.

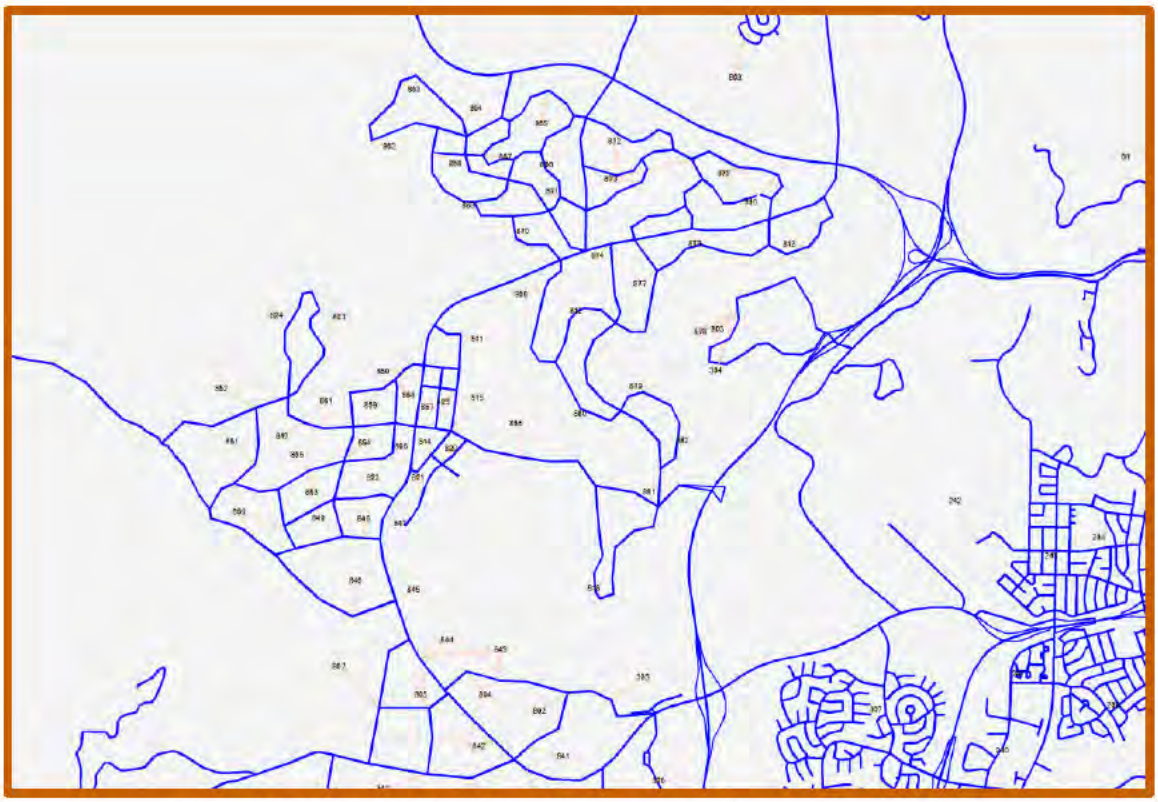

Figure 11: Road Network and Zone Locations after Transport Model Review

The actual zone areas that were defined in the transport model review process are shown in Figure 12. These zones were defined based on the road network shown in Figure 11, the alignment of the Molonglo River and land use in the model.

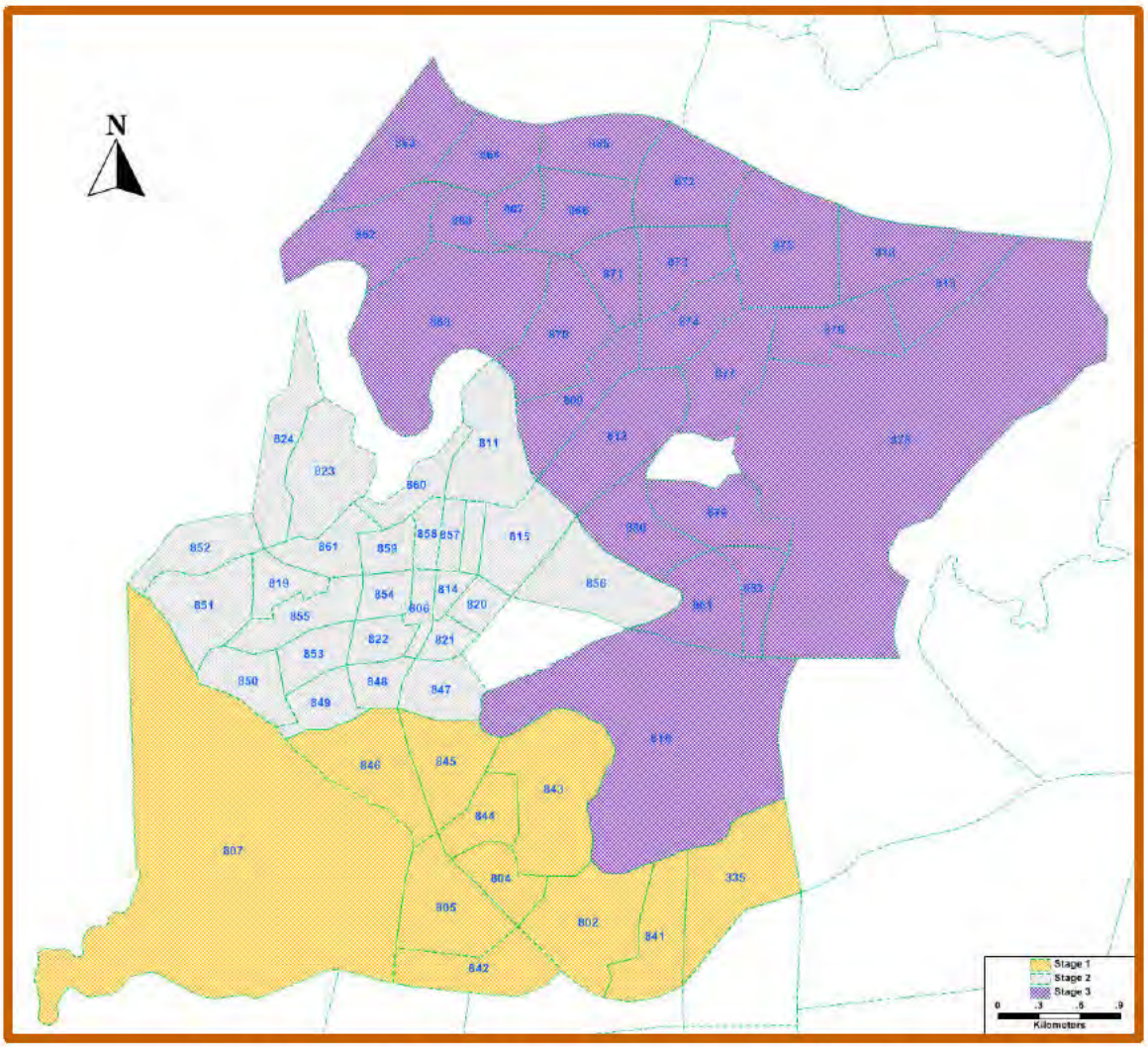

Figure 12: Molonglo Transport Zone Areas after Transport Model Review

Table 6 includes details of the four land uses that are included in the strategic transport model. These values were supplied to SMEC by ESDD based on the zone layouts shown in Figure 12. These land use values were used by SMEC for all of the strategic transport modelling undertaken in this project. Note that the same land uses are assumed in 2021 and 2031 as Molonglo Stage 2 is assumed to be fully developed by 2021.

Table 6: Strategic Model Land Use Assumptions after Transport Model Review

Zone	Population		Employment		Retail Space [m²]		Education	
	2016	2021 & 2031	2016	2021 & 2031	2016	2021 & 2031	2016	2021 & 2031
335	350	680	110	180	0	0	0	0
802	1,400	1,400	50	50	0	0	0	0
804	800	800	150	200	2,000	4,000	600	600
805	1,600	1,650	100	100	0	0	0	0
806	0	853	0	0	0	0	0	0
807	0	0	0	50	0	0	0	0
809	0	0	0	0	0	0	0	0
810	0	0	0	0	0	0	0	0
811	0	1,569	0	18	0	0	0	212
812	0	0	0	0	0	0	0	0
813	0	0	0	0	0	0	0	0
814	73	147	278	555	7,500	15,000	0	0
815	0	401	0	227	0	5,000	0	499
818	0	0	0	0	0	0	0	0
819	661	661	64	175	0	3,000	773	773
820	0	666	0	0	0	0	0	0
821	0	779	0	0	0	0	0	0
822	457	457	0	0	0	0	0	0
823	1,738	1,738	0	0	0	0	0	0
824	973	973	0	0	0	0	0	0
825	147	342	596	1,295	15,000	35,000	0	0
841	150	150	0	0	0	0	0	0
842	1,100	1,200	50	50	0	0	0	0
843	1,100	1,150	50	50	0	0	0	0
844	650	730	0	0	0	0	0	0

Zone	Population		Employment		Retail Space [m²]		Education	
	2016	2021 & 2031	2016	2021 & 2031	2016	2021 & 2031	2016	2021 & 2031
845	600	650	0	0	0	0	0	0
846	350	380	0	150	0	0	0	500
847	0	638	0	0	0	0	0	0
848	0	0	76	76	0	0	915	915
849	715	715	0	0	0	0	0	0
850	968	968	0	0	0	0	0	0
851	1,298	1,298	0	0	0	0	0	0
852	0	0	0	0	0	0	0	0
853	707	707	0	0	0	0	0	0
854	505	505	0	0	0	0	0	0
855	1,015	1,015	0	0	0	0	0	0
856	0	789	0	0	0	0	0	0
857	147	332	745	1,258	15,000	34,000	0	0
858	0	310	0	0	0	0	0	0
859	574	574	0	0	0	0	0	0
860	0	968	0	0	0	0	0	0
861	559	559	0	0	0	0	0	0
862-882	0	0	0	0	0	0	0	0
Stage 1	**8,100**	**8,790**	**510**	**830**	**2,000**	**4,000**	**600**	**1,100**
Stage 2	**10,463**	**17,816**	**1,482**	**3,049**	**30,000**	**77,000**	**1,689**	**2,400**
Stage 3	**73**	**147**	**278**	**555**	**7,500**	**15,000**	**0**	**0**
Total	**18,636**	**26,753**	**2,269**	**4,434**	**39,500**	**96,000**	**2,289**	**3,500**

Stage 1 is highlighted orange, Stage 2 is uncoloured and Stage 3 is highlighted purple.

3.3.3 Base Models

The modelling results for the 2016, 2021 and 2031 AM Peak Hour periods after the transport model review are shown in Figure 13, Figure 14 and Figure 15, respectively.

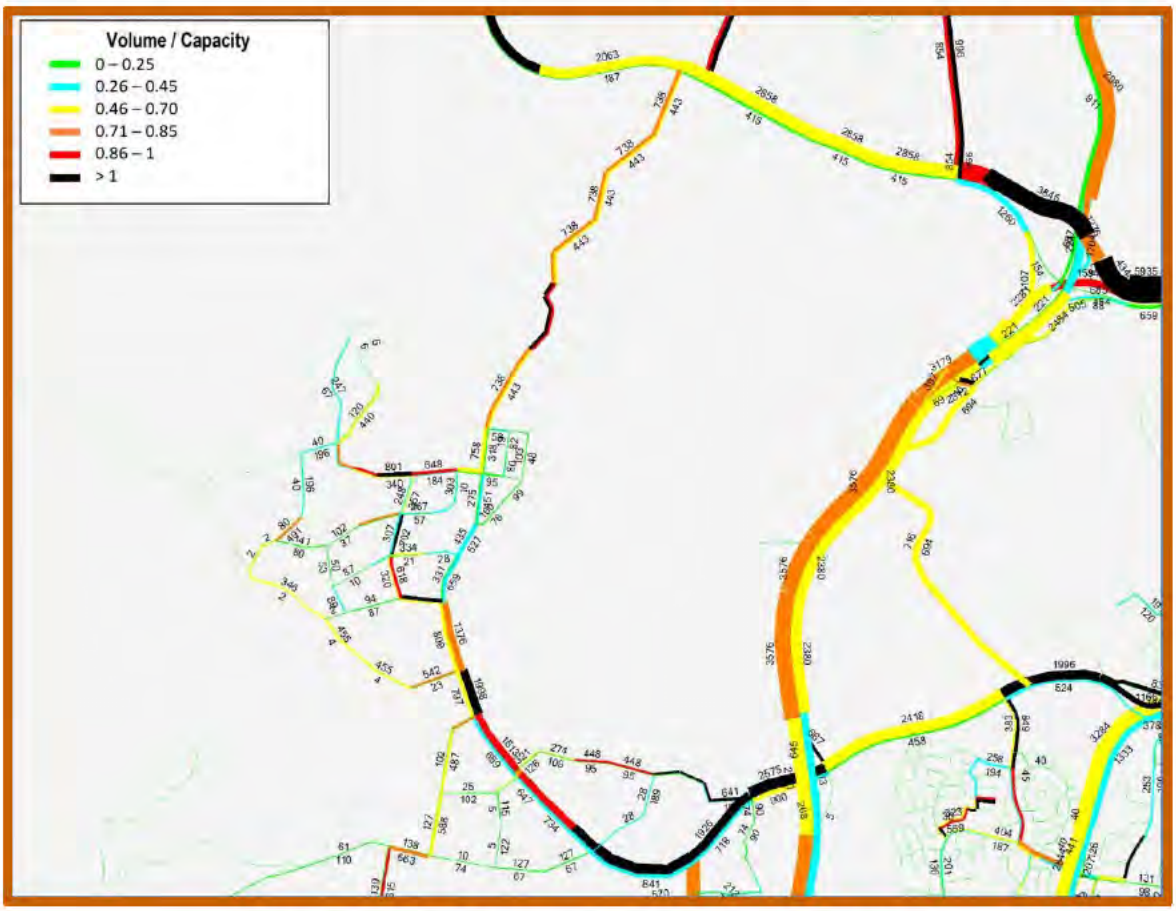

Figure 13: 2016 AM Peak Hour Traffic Volumes and Congestion

From Figure 13, it can be seen that the two major access points to Molonglo are expected to be operating over capacity in 2016. The capacity of the low level crossing on Coppins Crossing Road is quite low and the volumes are expected to be in excess of 700 vehicles per hour northbound.

In addition, eastbound volumes on Cotter Road are expected to be above the capacity of this road and are in excess of 2,500 vehicles per hour eastbound, just west of the Tuggeranong Parkway.

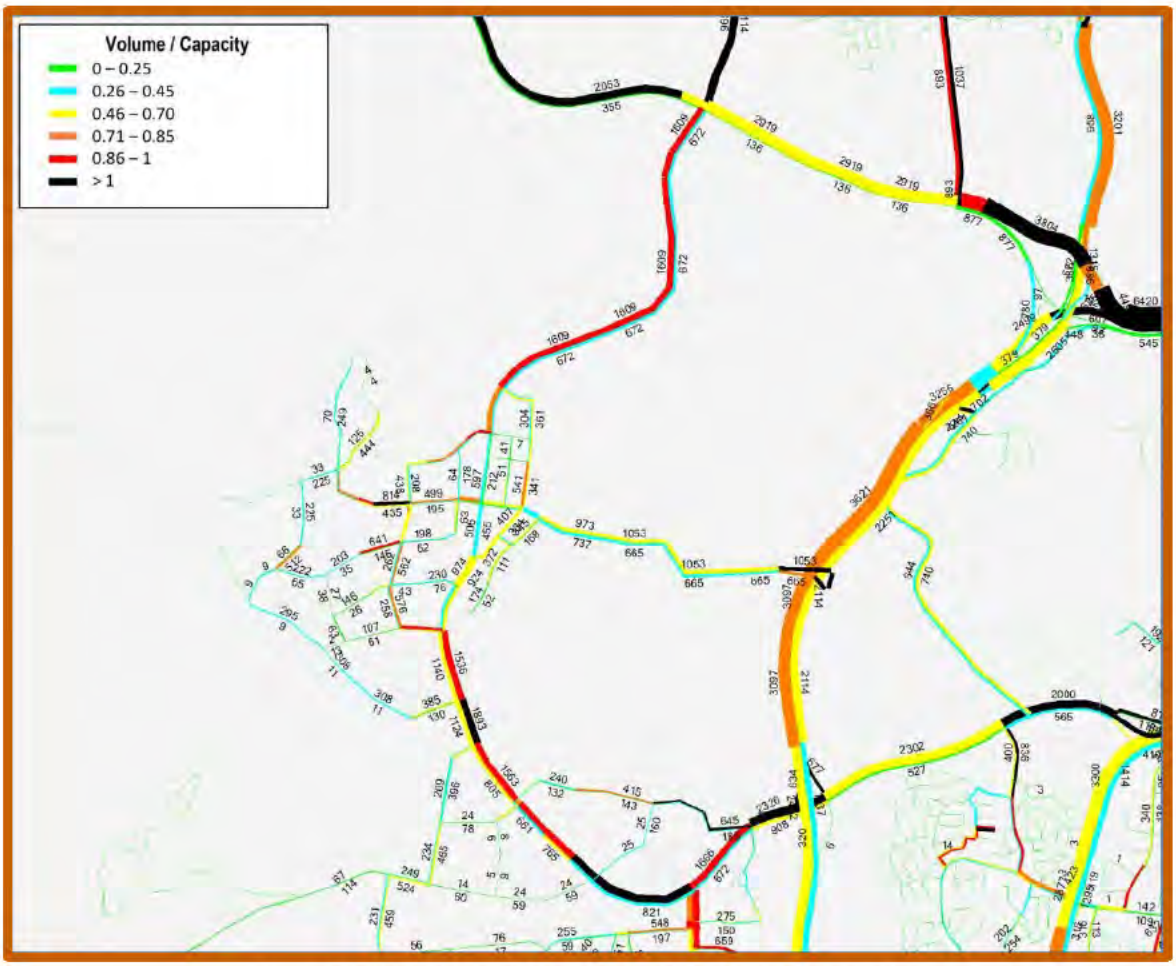

Figure 14: 2021 AM Peak Hour Traffic Volumes and Congestion

Figure 14 shows that, in the 2021 AM peak hour, the roads inside Molonglo are not expected to be operating above capacity, although many of them are operating at or above 86% of their capacity and one section of John Gorton Drive is above capacity. As in 2016, the accesses to Molonglo are operating close to or above capacity.