6.2.7 2031 William Hovell Drive – Coulter Drive Staggered T Option

The Staggered T option retains the approximate existing intersection locations of William Hovell Drive with Coppins Crossing Road and Coulter Drive. This layout results in both east-west and north-south traffic using the central section between the two intersections, resulting in a capacity constraint that isn't present in the quadrant or four-way options.

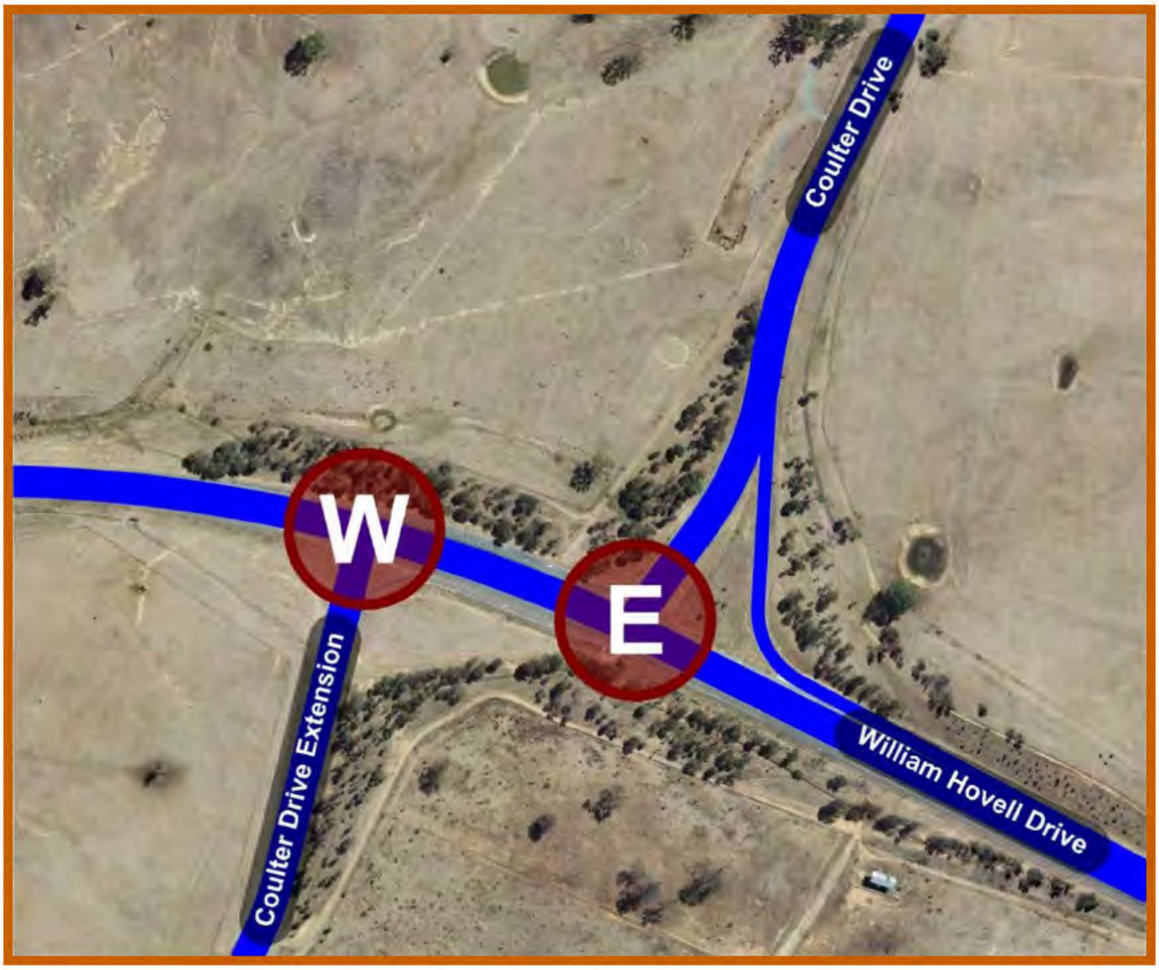


Figure 104: Staggered T Intersection Layout

6.2.7.1 William Hovell Drive – Coulter Drive (East)

The eastern intersection (shown in Figure 105) is expected to operate at LOS B during the AM peak and LOS D during the PM peak. Despite high volumes on most movements the main limitation is the conflict between the right turns from the north and east during the PM peak. Three right turning lanes are required on the eastern leg which may present design safety issues.

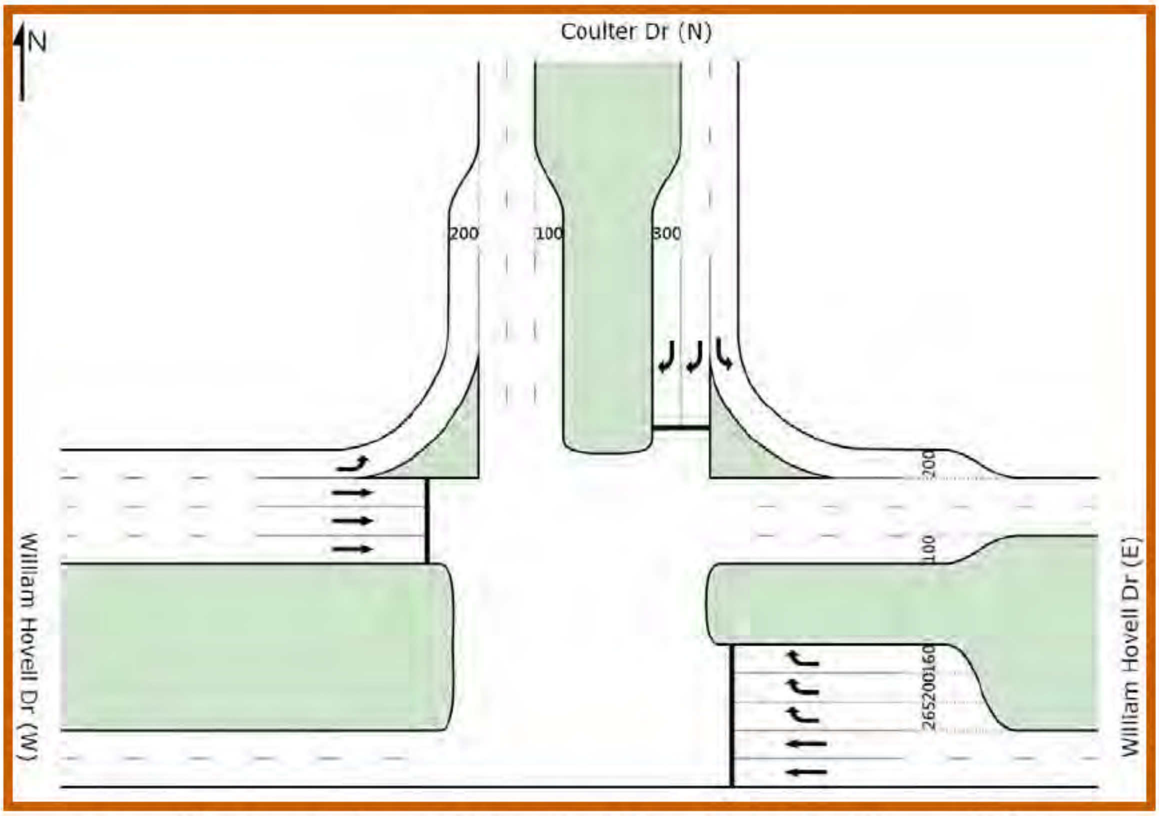


Figure 105: Intersection Layout of William Hovell Drive – Coulter Drive (Staggered T 2031)

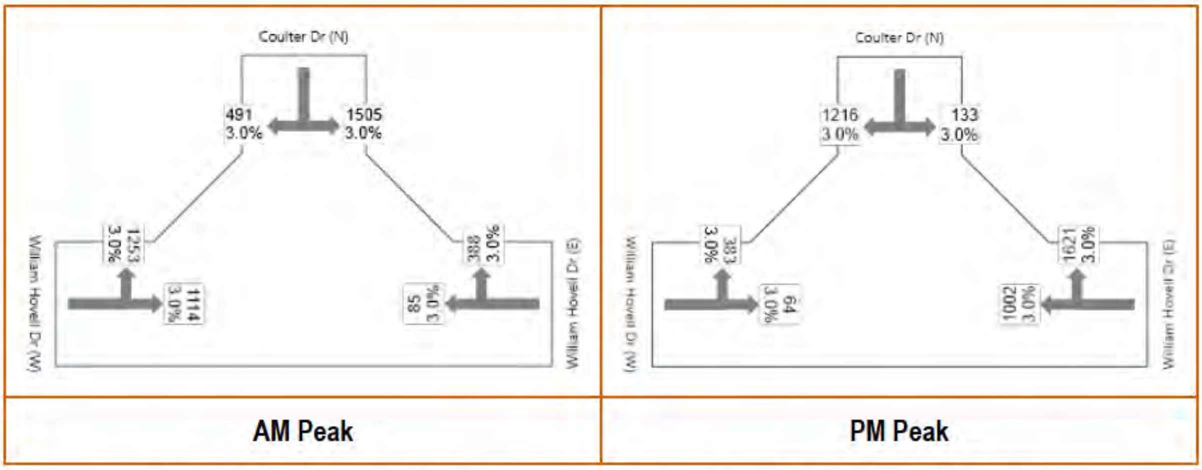


Figure 106: Hourly Volumes at William Hovell Drive – Coulter Drive (Staggered T 2031)

6.2.7.2 William Hovell Drive – Coulter Drive Extension (West)

The western intersection (shown in Figure 107) is expected to operate at LOS C during both weekday peak periods. The limiting factor for this intersection is the conflict between the right turn from the south and the through movement from the west. The left turn from the east is also heavy enough in the PM peak to require a continuous left turn lane.

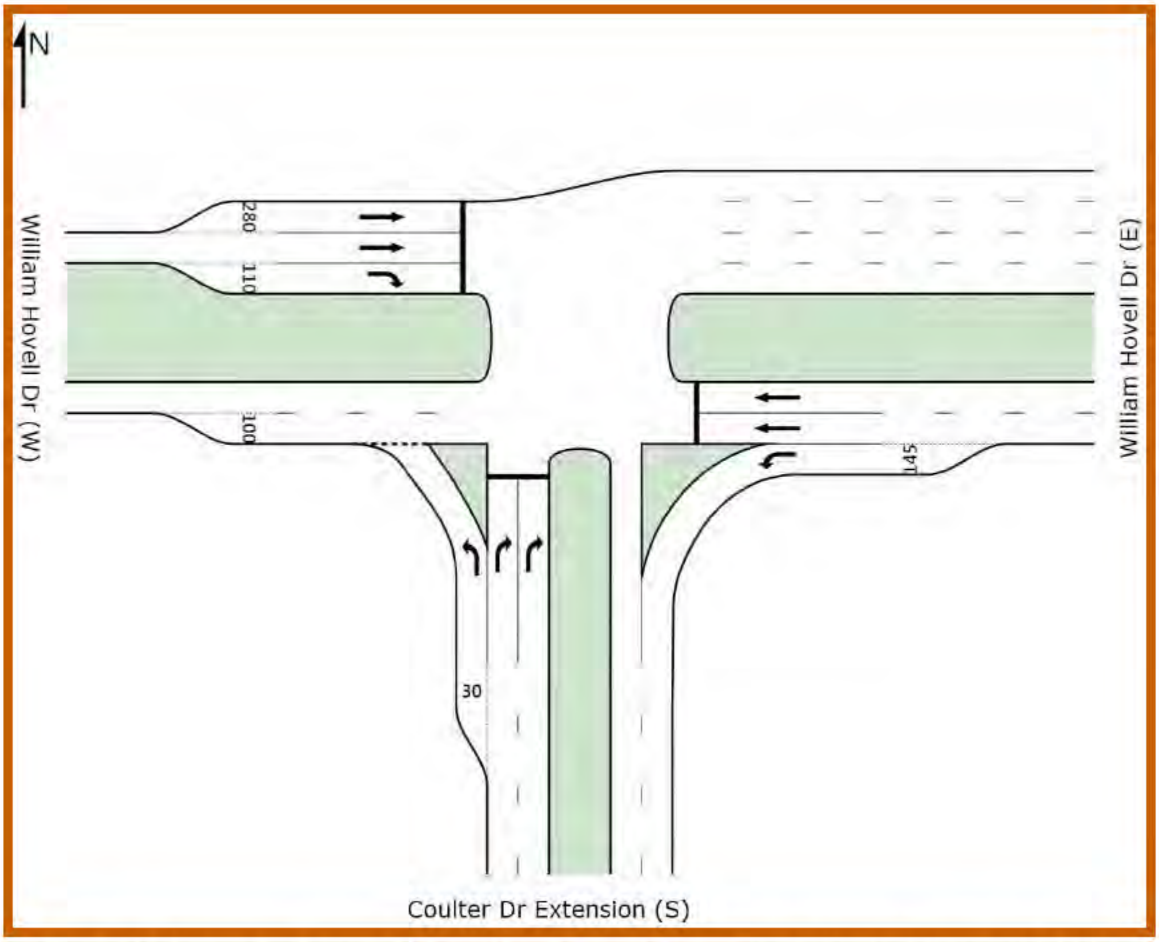
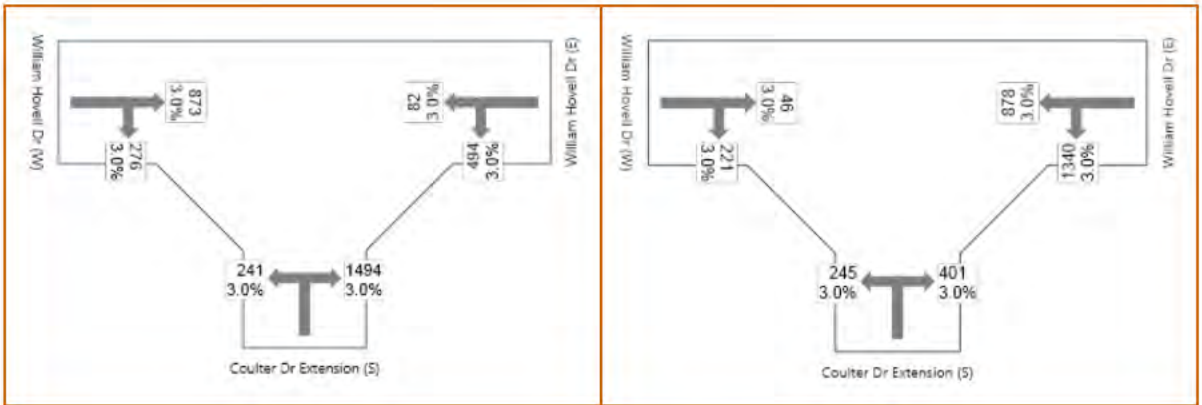


Figure 107: Intersection Layout of William Hovell Drive – Coulter Drive Extension (Staggered T 2031)



AM Peak	PM Peak

Figure 108: Hourly Volumes at William Hovell Drive – Coulter Drive Extension (Staggered T 2031)

6.2.8 2031 William Hovell Drive – Coulter Drive Four-Way Intersection Option

This option includes a realignment of Coulter Drive to connect directly to Coulter Drive Extension (which follows the existing Coppins Crossing Road in this area) at its intersection with William Hovell Drive, resulting in a single four-way intersection.

Figure 109: Four-way Intersection Location

6.2.8.1 William Hovell Drive – Coulter Drive

This intersection (shown in Figure 110) is expected to operate at LOS C during the AM peak and LOS D during the PM peak. The four-way intersection involves a single point of connection between William Hovell Drive, Coulter Drive and Coulter Drive Extension (formerly Coppins Crossing Road). Without the removal of the heavy right turns from the eastern leg (as in the quadrant design) this intersection requires substantial works in order to operate at an acceptable Level of Service. This layout is not considered to be practical due to the number of lanes required.

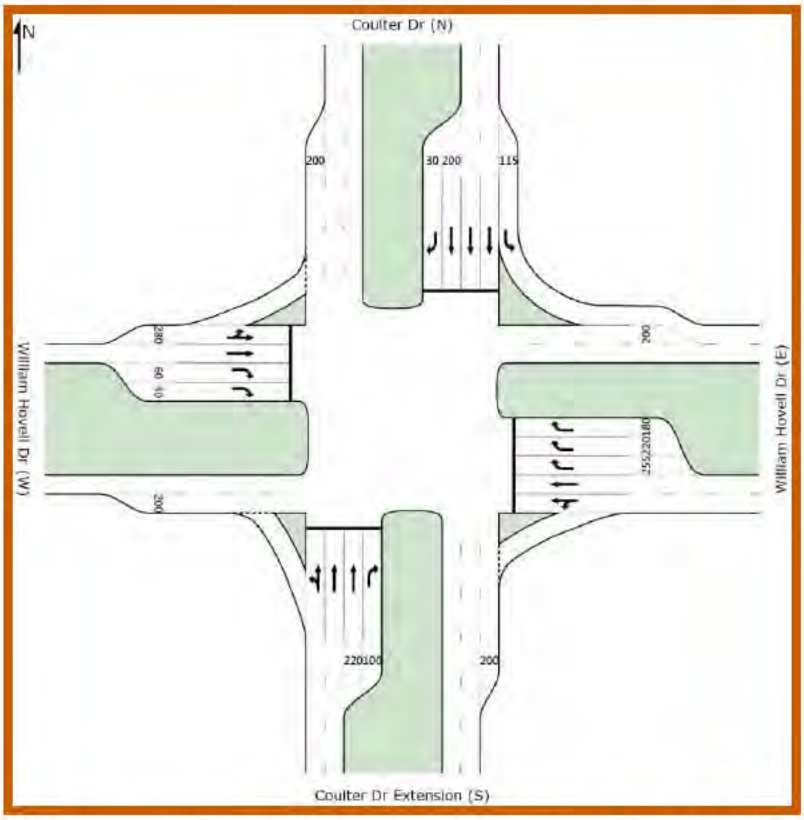
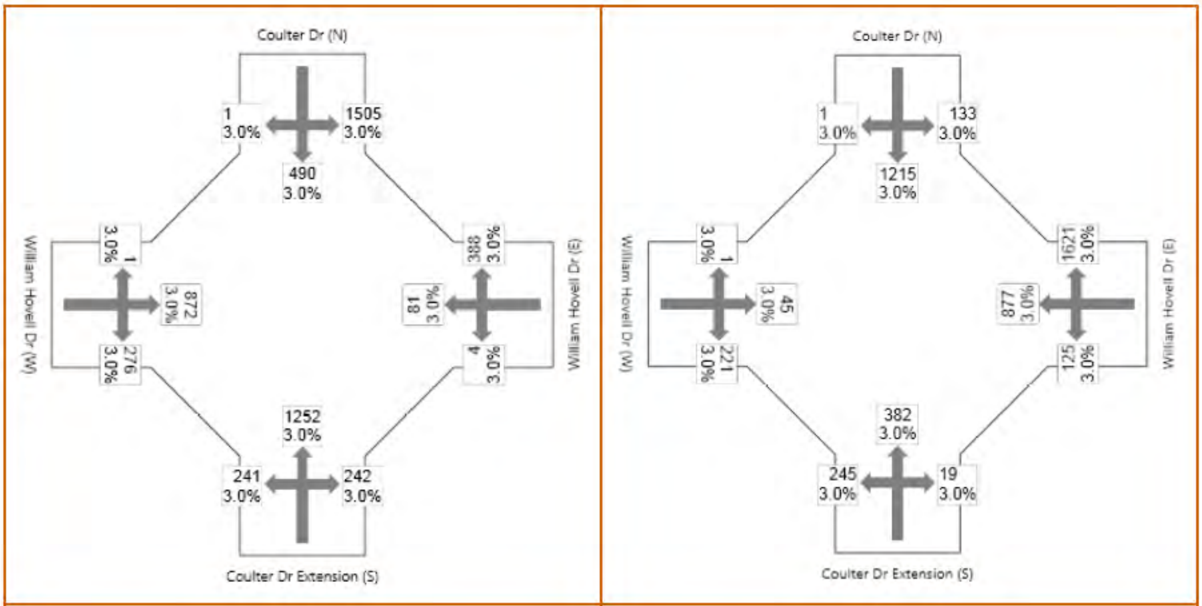


Figure 110: Intersection Layout of William Hovell Drive – Coulter Drive (Four Way 2031)



AM Peak	PM Peak

Figure 111: Hourly Volumes at William Hovell Drive – Coulter Drive (Four Way 2031)

6.2.9 2031 William Hovell Drive – John Gorton Drive/Bindubi Street Folded Diamond Option

Figure 112 shows the location of the intersections assessed for this option. This option will result in two signalised intersections. The southern intersection is expected to have an access road connected to it by 2031.

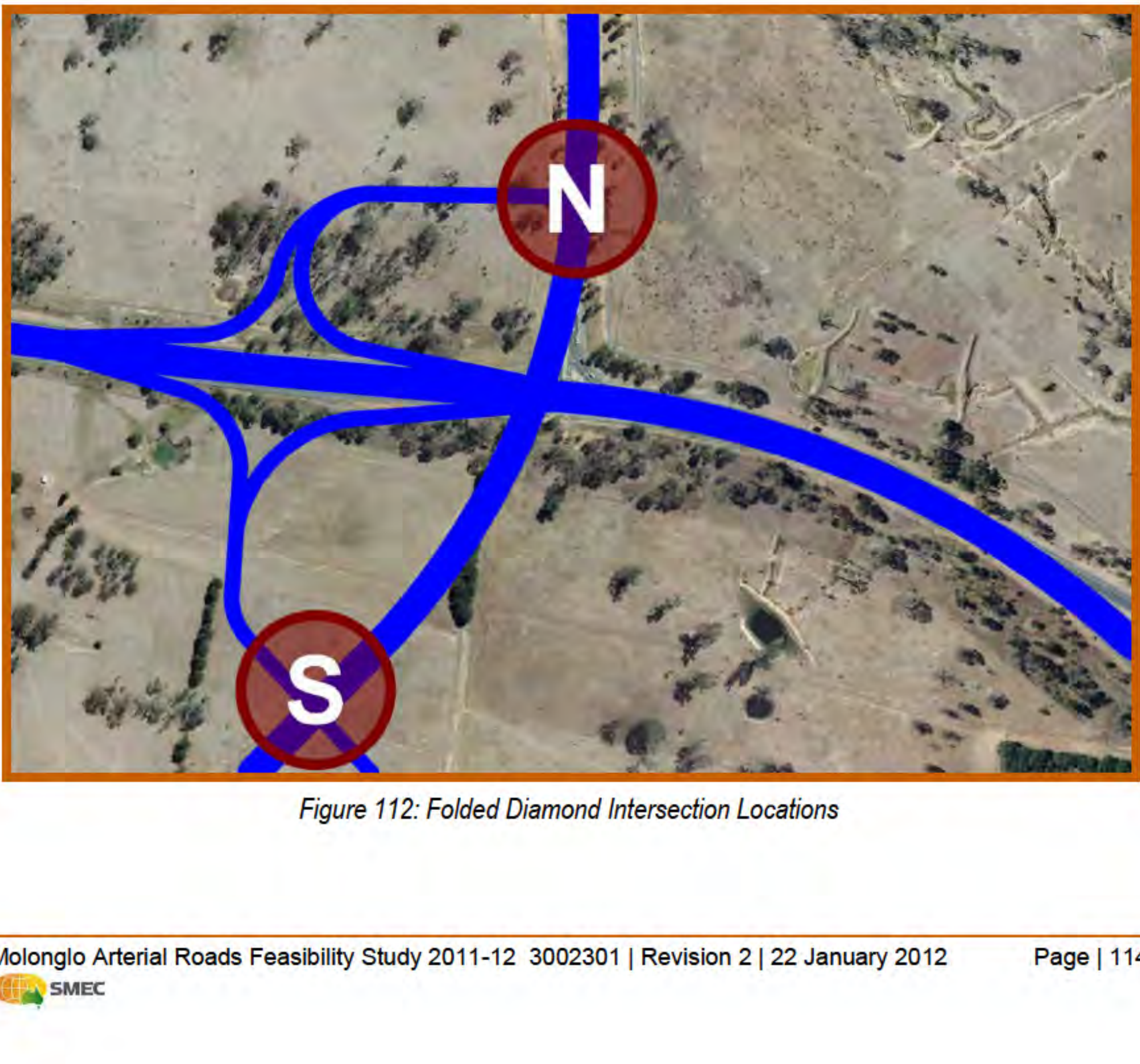


Figure 112: Folded Diamond Intersection Locations

6.2.9.1 William Hovell Drive – Bindubi Street (North)

The northern intersection (shown in Figure 113) is expected to operate at LOS D during the AM peak and LOS B during the PM peak. The limiting factor for this intersection is the conflict between the right turn from the north and the through movement from the south during the PM peak period.

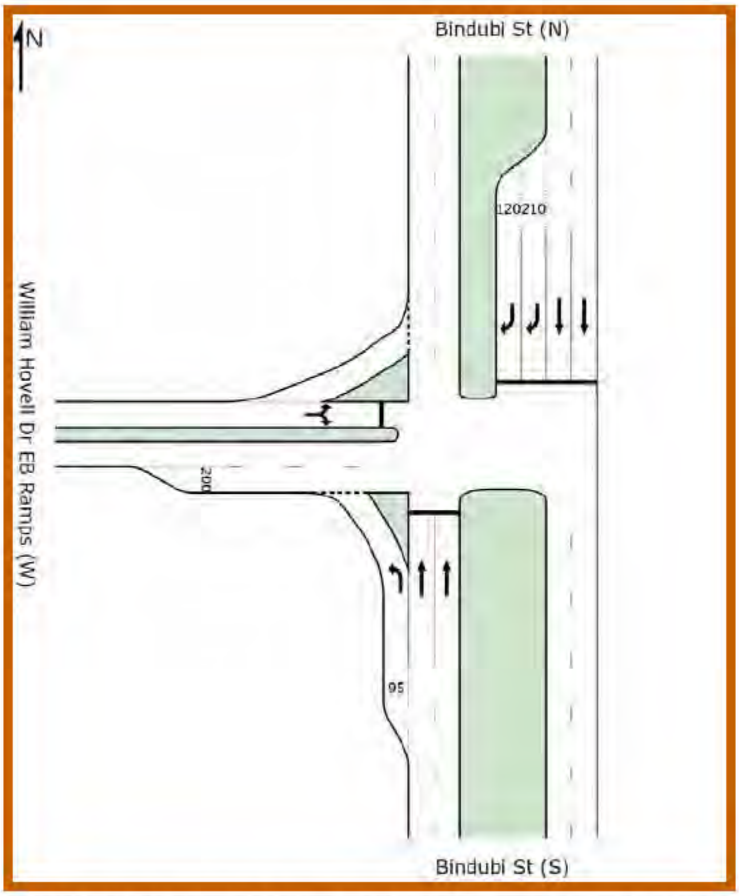


Figure 113: Intersection Layout of William Hovell Drive – Bindubi Street (North 2031)

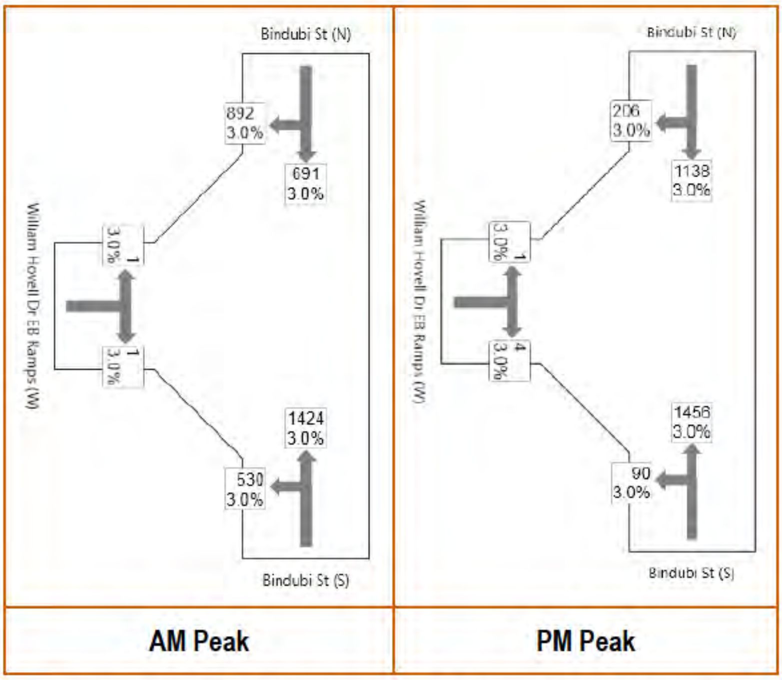


Figure 114: Hourly Volumes at William Hovell Drive – Bindubi Street (North 2031)

6.2.9.2 William Hovell Drive – John Gorton Drive (South)

The southern intersection (shown in Figure 115) is expected to operate at LOS B during the AM peak and LOS C during the PM peak. The limiting factor at this intersection is the volume from William Hovell Drive during the PM peak period.

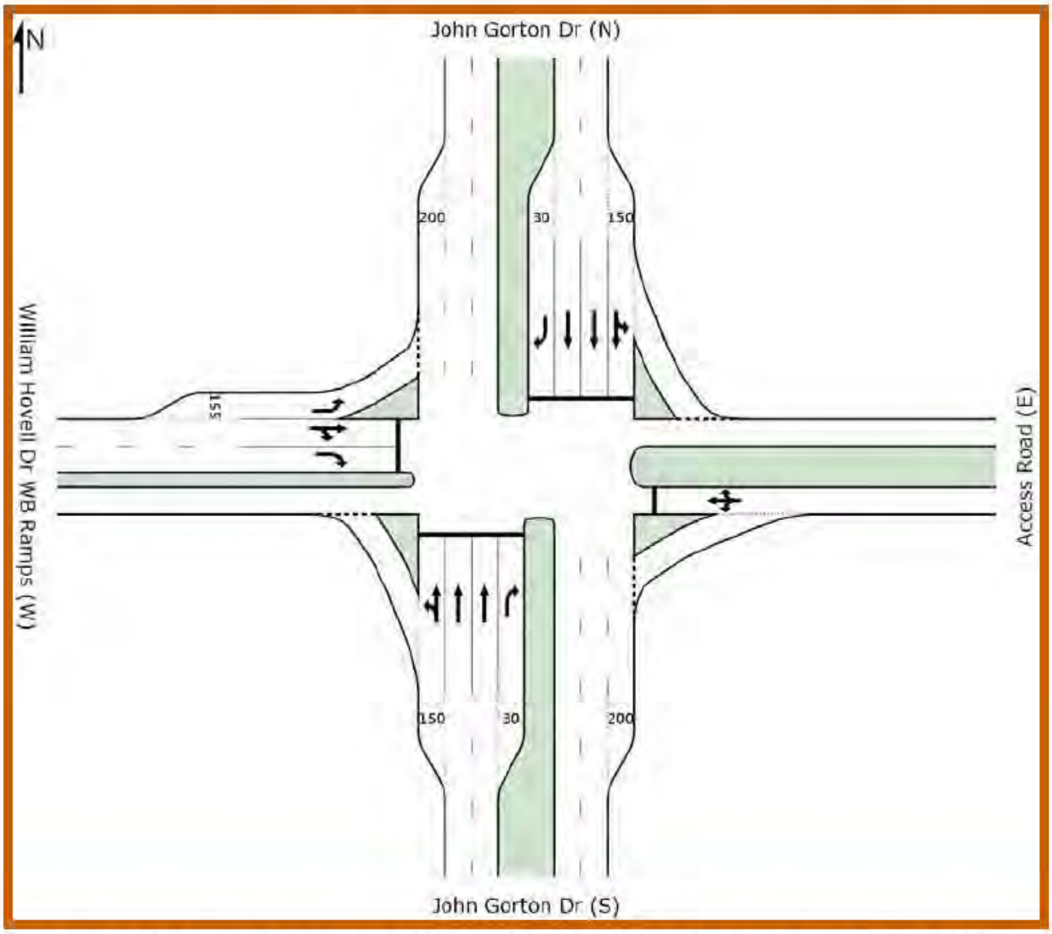


Figure 115: Intersection Layout of William Hovell Drive – John Gorton Drive (South 2031)

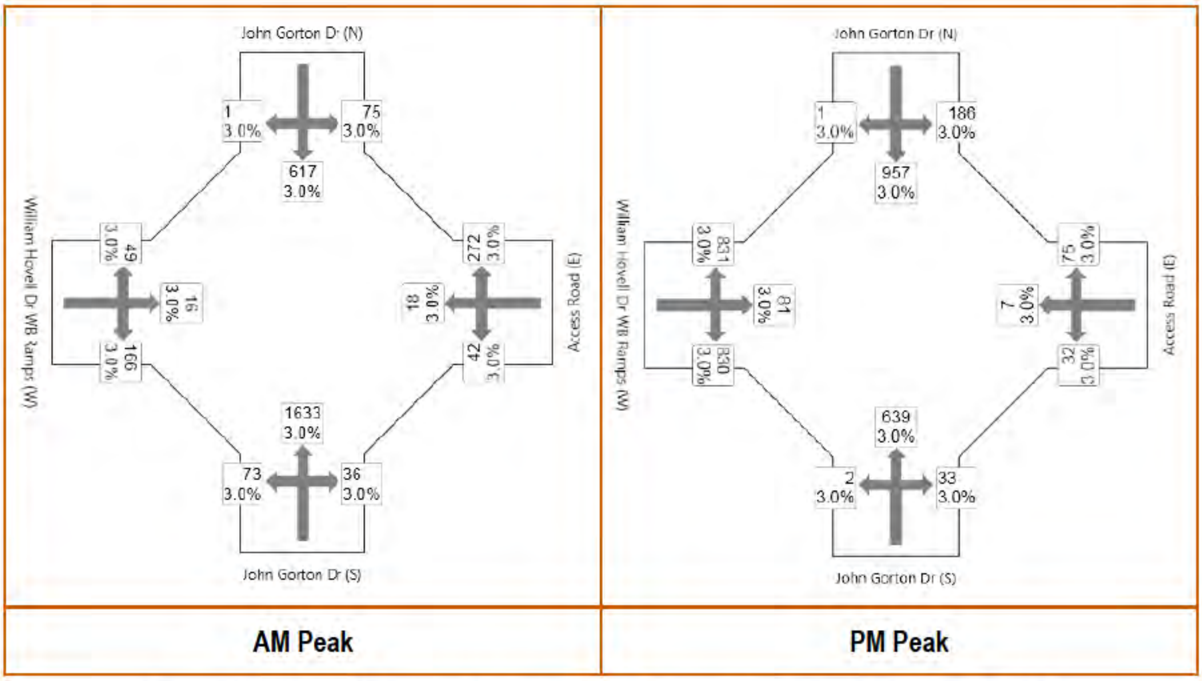


Figure 116: Hourly Volumes at William Hovell Drive – John Gorton Drive (South 2031)

6.2.9.3 William Hovell Drive – Bindubi Street Eastbound Onramp Merge

The eastbound merge operates near capacity during the AM peak, particularly downstream of the acceleration lane. LOS E operation is expected with a 150 metre acceleration lane or LOS D with a 200 metre acceleration lane. During the PM peak it is expected to operate at LOS A.

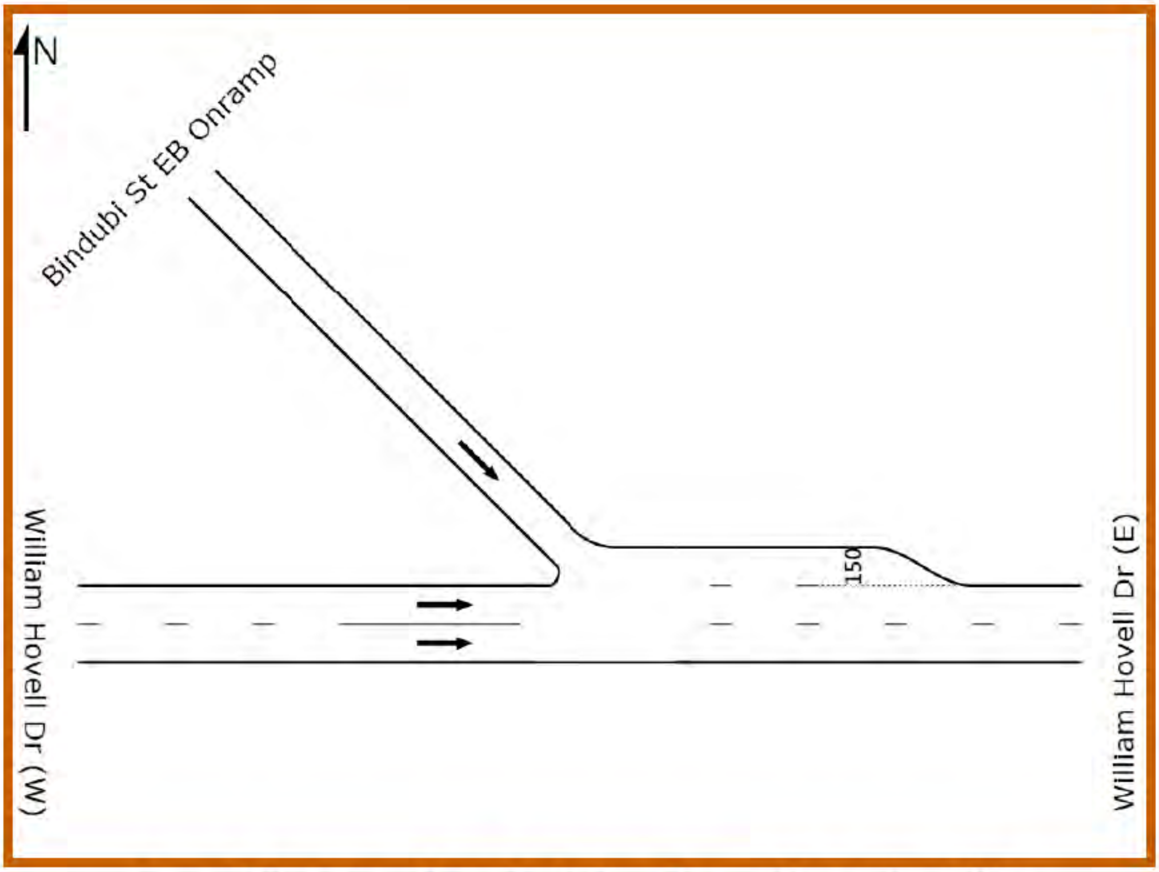
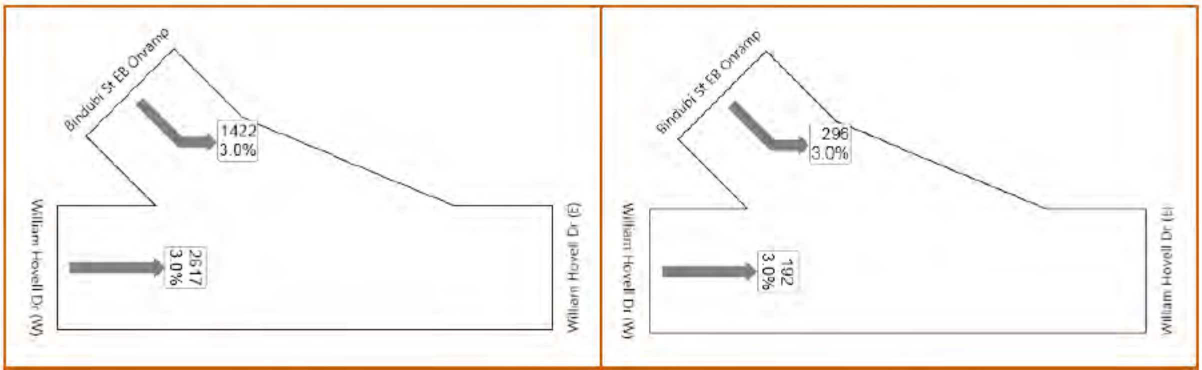


Figure 117: William Hovell Drive – Bindubi Street Eastbound Onramp Merge (2031)



AM Peak	PM Peak

Figure 118: Hourly Merging Volumes at William Hovell Drive – Bindubi Street Eastbound Onramp (2031)

6.2.9.4 William Hovell Drive – John Gorton Drive Westbound Onramp Merge

The westbound merge is expected to operate within its capacity; at LOS A during the AM peak and LOS C during the PM peak.

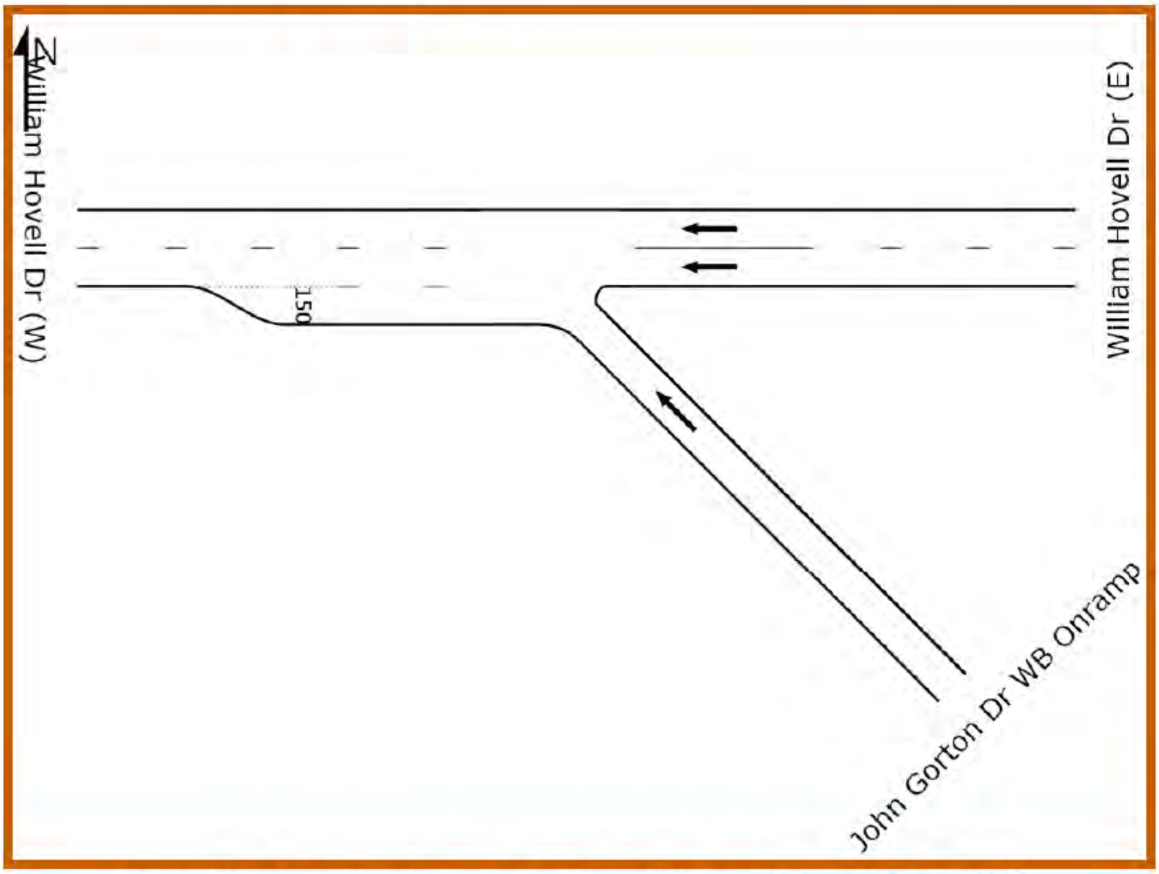


Figure 119: William Hovell Drive – Bindubi Street Westbound Onramp Merge (2031)

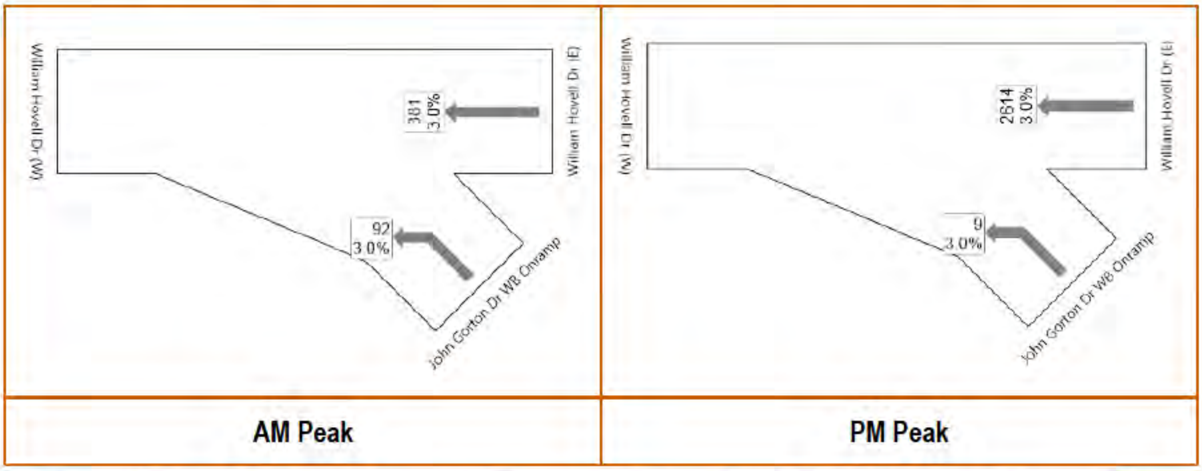


Figure 120: Hourly Merging Volumes at William Hovell Drive – Bindubi Street Westbound Onramp (2031)

6.2.9.5 William Hovell Drive Eastbound Weave from Tuggeranong Parkway to John Gorton Drive

The weaving analysis shows that three lanes are required to provide sufficient capacity within the weaving area. This can be achieved by bringing the ramp from Tuggeranong Parkway on as an added lane, in contrast to the existing merge configuration. In addition, the weaving operation improves significantly by lane balancing the exit as shown in Figure 121. The analysis shows that with a weaving distance of 200 metres, performance is expected to be LOS A during the AM peak and LOS E during the PM peak.

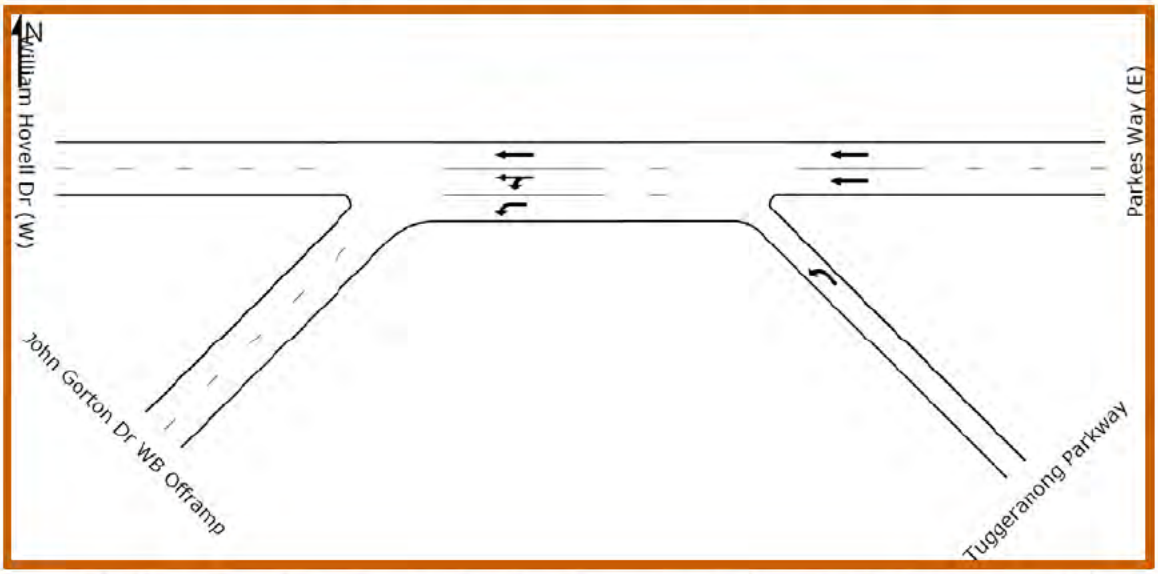


Figure 121: William Hovell Drive Weaving Area from Tuggeranong Parkway to John Gorton Drive (2031 PM)

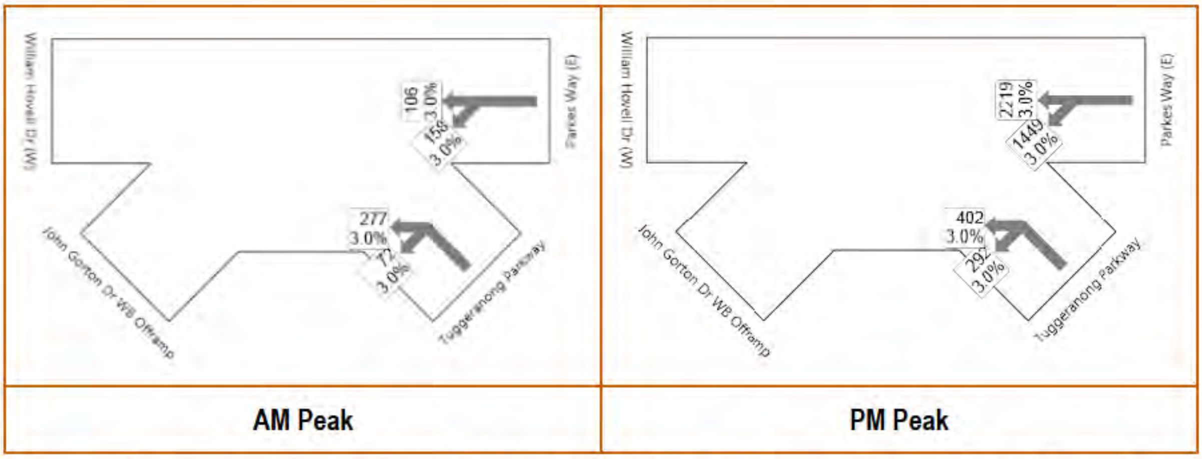


Figure 122: Hourly William Hovell Drive Weaving Volumes from Tuggeranong Parkway to John Gorton Drive (2031)

6.2.10 2031 William Hovell Drive – John Gorton Drive/Bindubi Street Tight Diamond Interchange Option

This option consists of a standard tight diamond interchange with two signalised intersections, and ramps on both sides of Bindubi Street/John Gorton Drive.

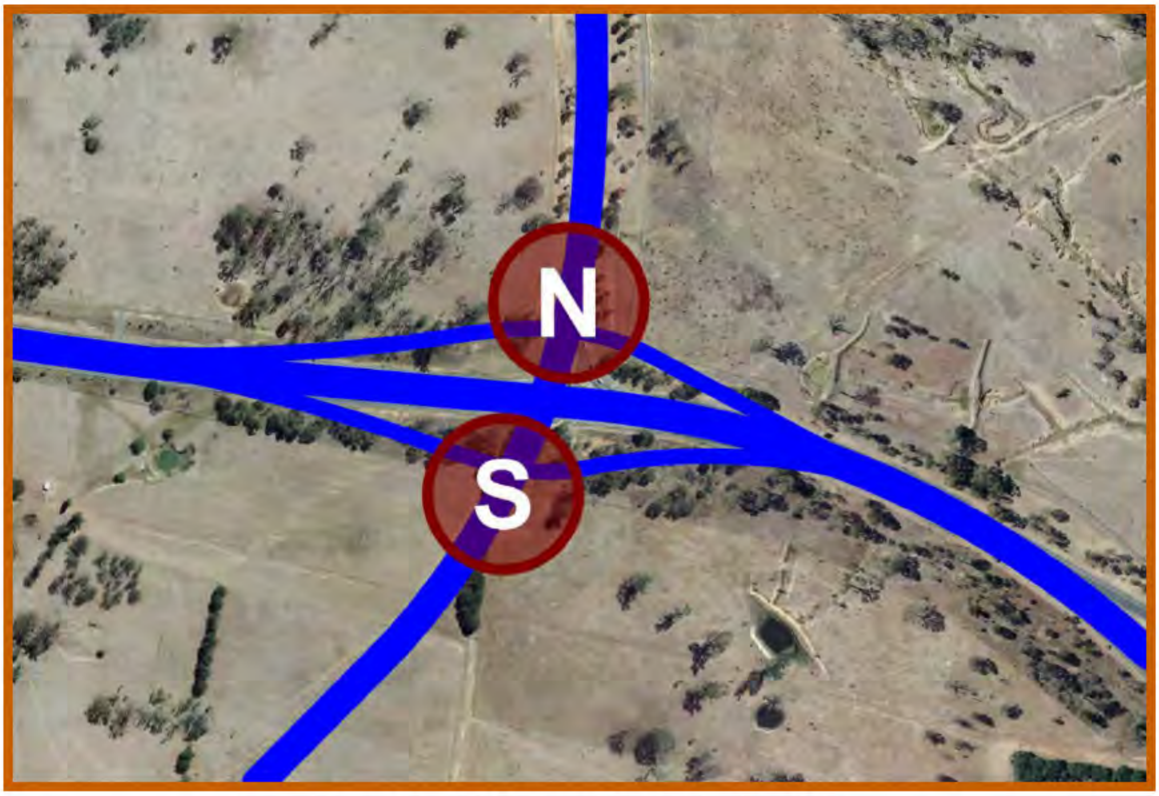


Figure 123: Tight Diamond Intersection Locations

6.2.10.1 William Hovell Drive – Bindubi Street (North)

The northern intersection (shown in Figure 124) is expected to operate at LOS B during both weekday peak periods. The limiting factor is the conflict between the right turn from the south and the through movement from the north during the AM peak period.

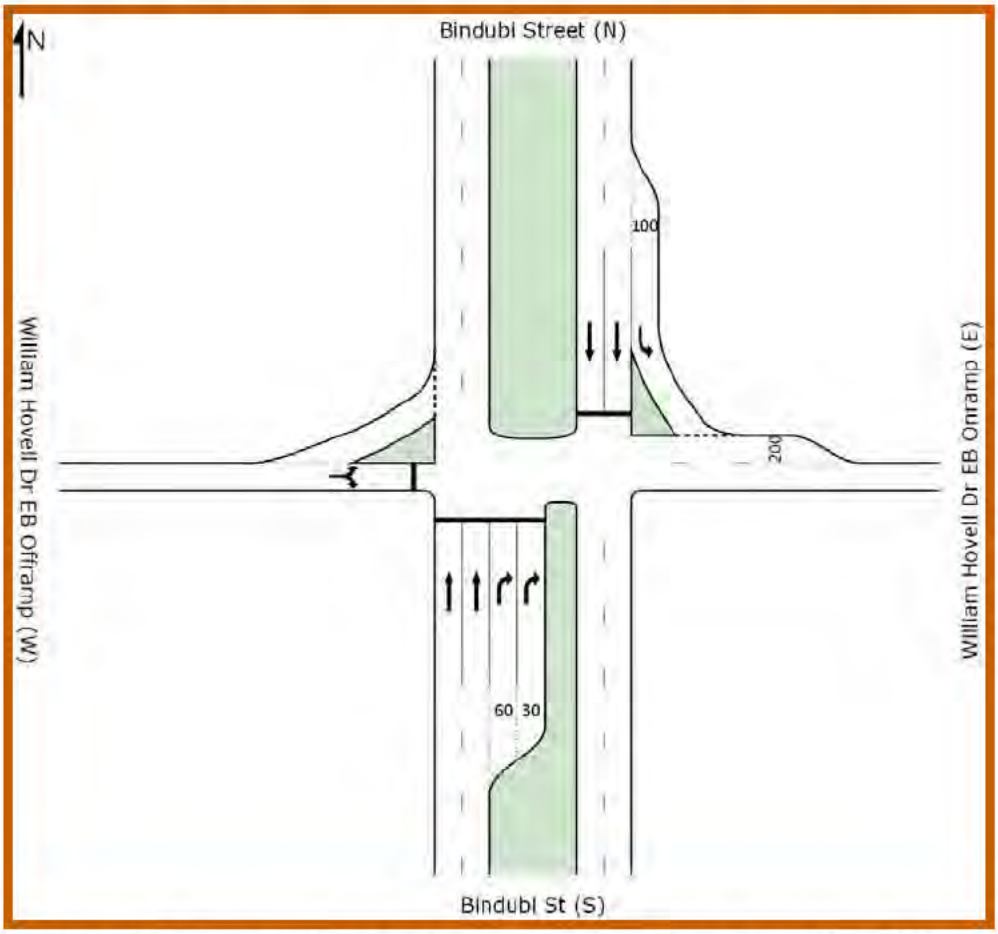


Figure 124: Intersection Layout of William Hovell Drive – Bindubi Street (North 2031)

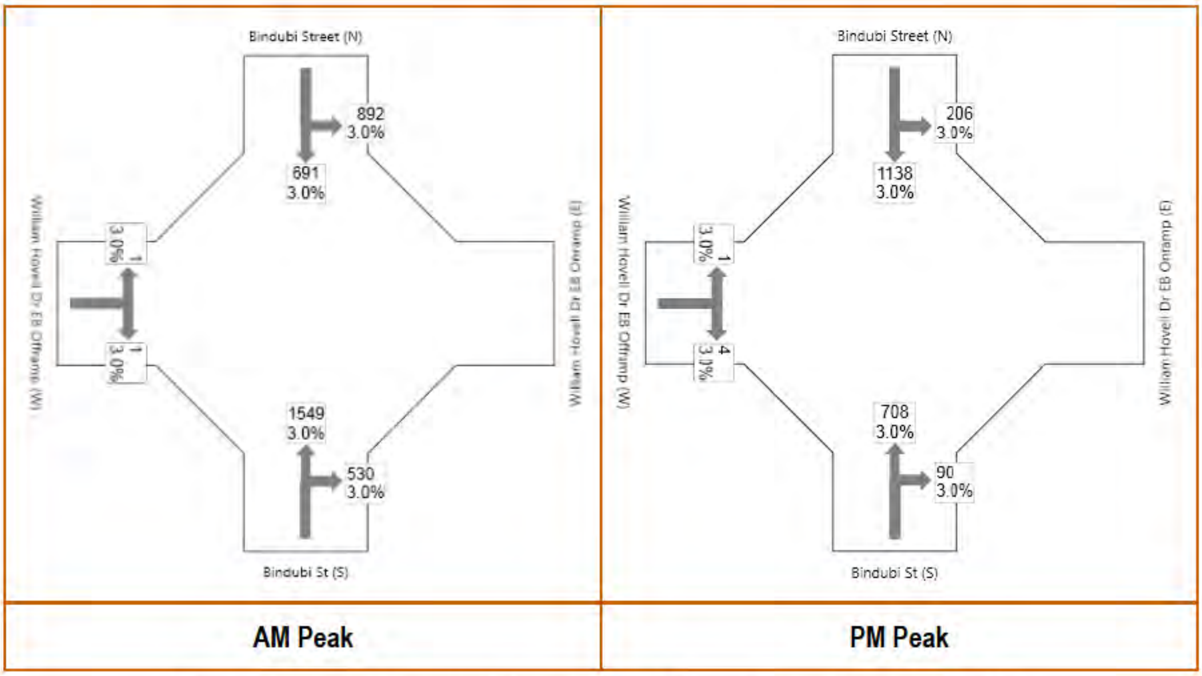


Figure 125: Hourly Volumes at William Hovell Drive – Bindubi Street (North 2031)

6.2.10.2 William Hovell Drive – John Gorton Drive (South)

The southern intersection (shown in Figure 126) is expected to operate at LOS A during AM peak and LOS C during the PM peak. The limiting factor is the volume exiting William Hovell Drive westbound.

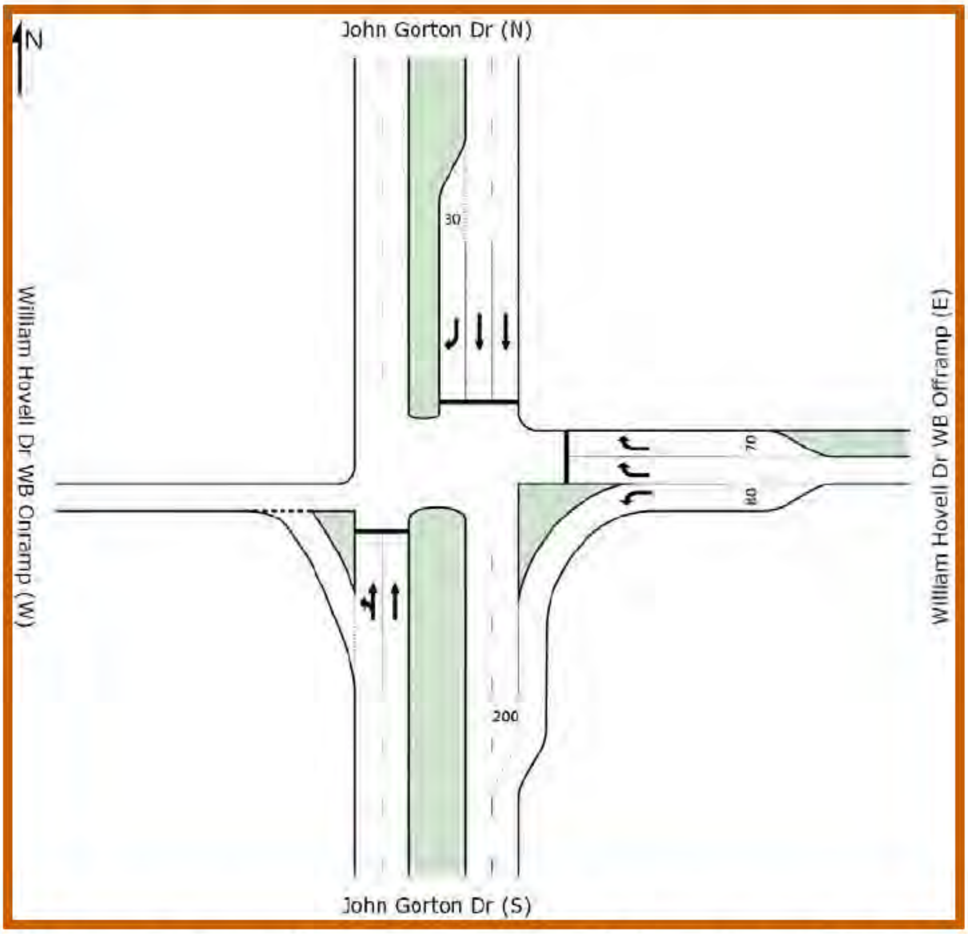
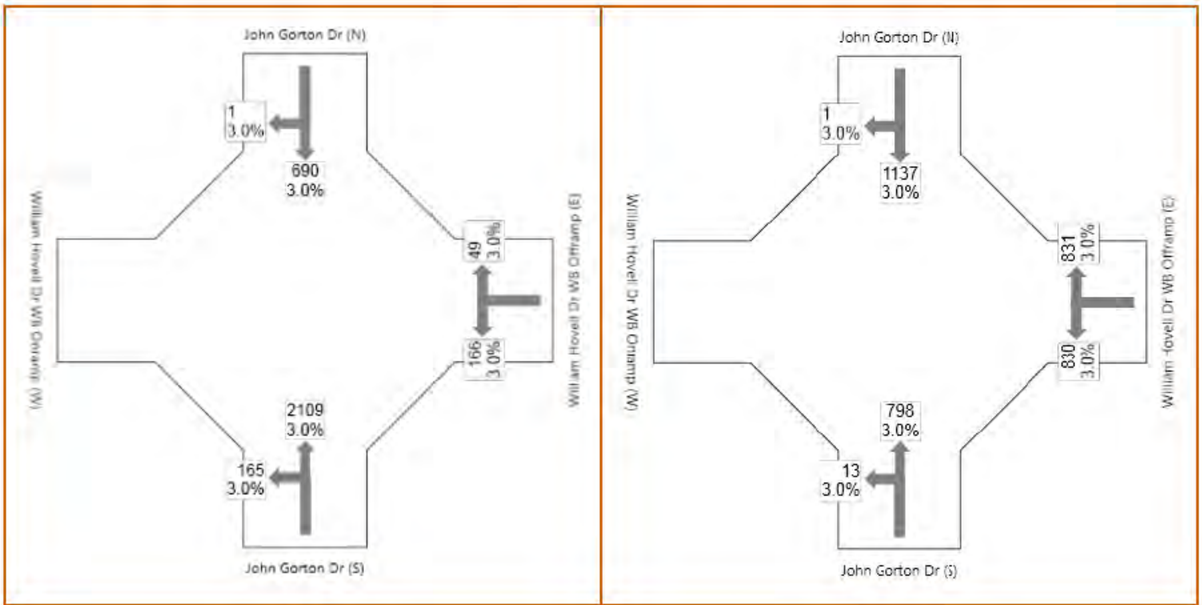


Figure 126: Intersection Layout of William Hovell Drive – Bindubi Street/John Gorton Drive (South 2031)



AM Peak	PM Peak

Figure 127: Hourly Volumes at William Hovell Drive – Bindubi Street/John Gorton Drive (South 2031)

6.2.11 2031 East-West Arterial Scenario 1 (Base)

This scenario includes a full interchange connecting the East-West Arterial and the Tuggeranong Parkway allowing all movements. However, the East-West Arterial is not connected to Cotter Road. The north- and south-bound offramps from Tuggeranong Parkway meet at a signalised intersection at eastern end of the East-West Arterial.

Figure 128: Location of Intersection for EWA/Tuggeranong Pkwy Interchange

6.2.11.1 East-West Arterial Westbound – Tuggeranong Parkway Northbound Offramp

The intersection (shown in Figure 129) is expected to operate at LOS C during the AM peak and LOS D during the PM peak. The 95th percentile queue length on the eastern leg is 265 metres in the PM peak.

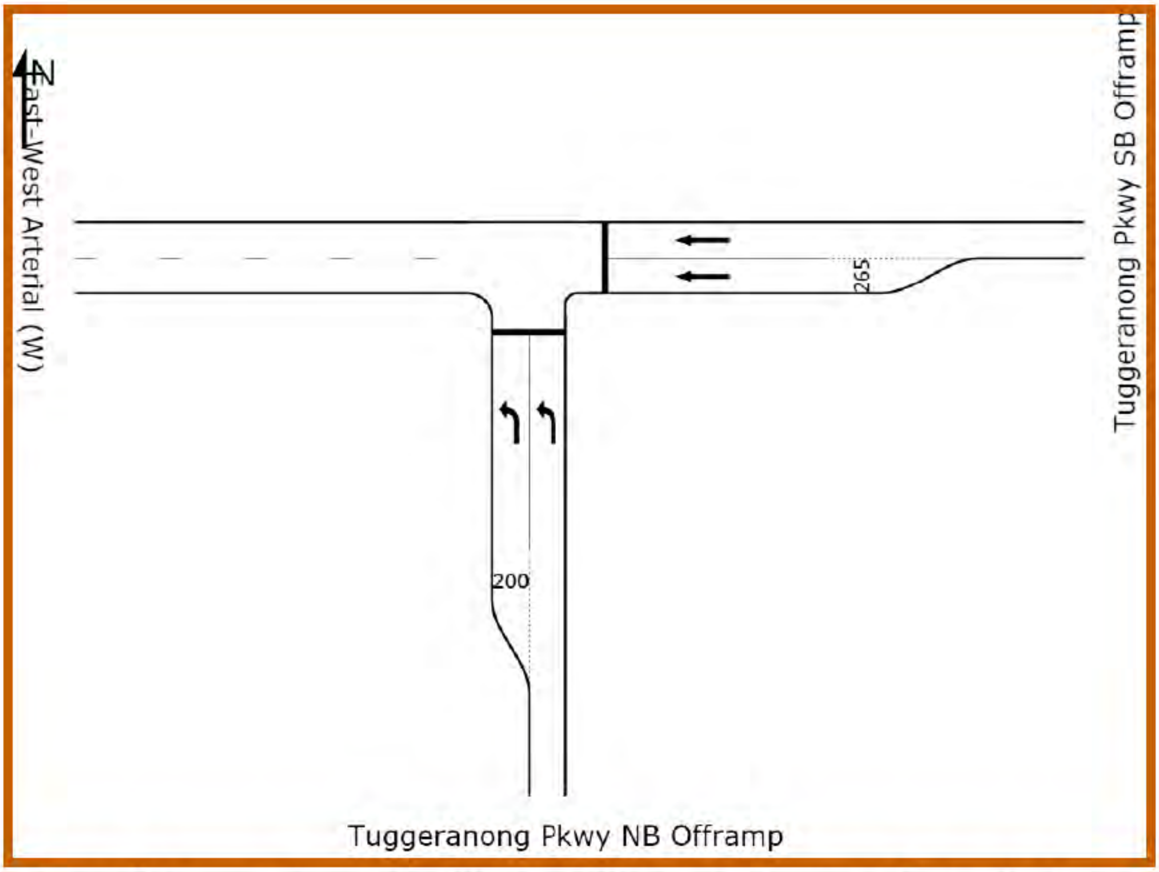


Figure 129: Intersection Layout of East-West Arterial Westbound – Tuggeranong Parkway Northbound Offramp (Full Interchange 2031)

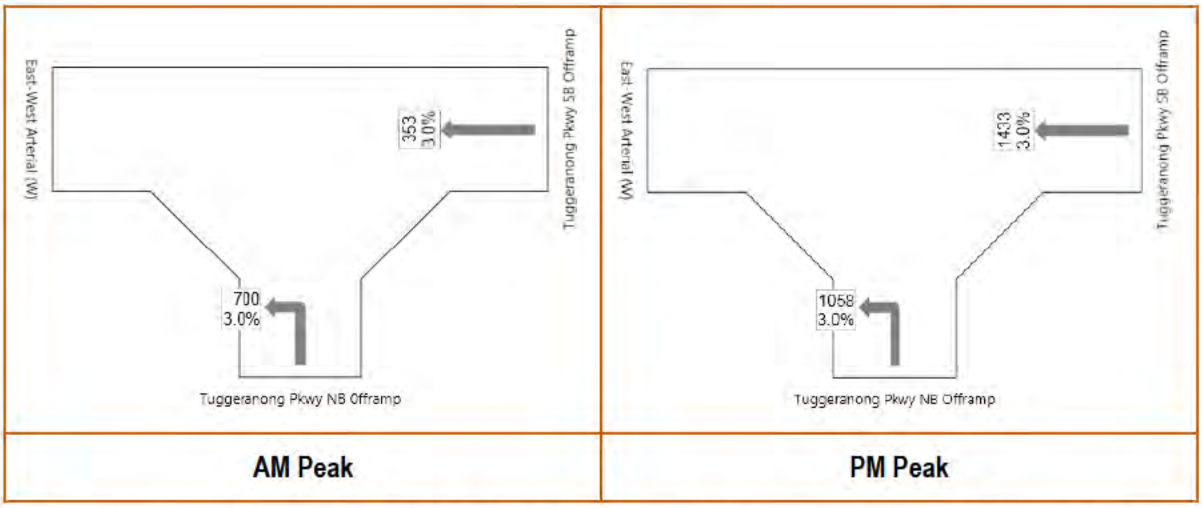


Figure 130: Hourly Volumes at East-West Arterial Westbound – Tuggeranong Parkway Northbound Offramp (Full Interchange 2031)

6.2.11.2 Tuggeranong Parkway – East-West Arterial Northbound Onramp Merge

The northbound merge is expected to operate at LOS E during the AM peak and LOS B during the PM peak. Tuggeranong Parkway downstream of the merge is expected to operate between 95% and 100% of its capacity during the AM peak period.

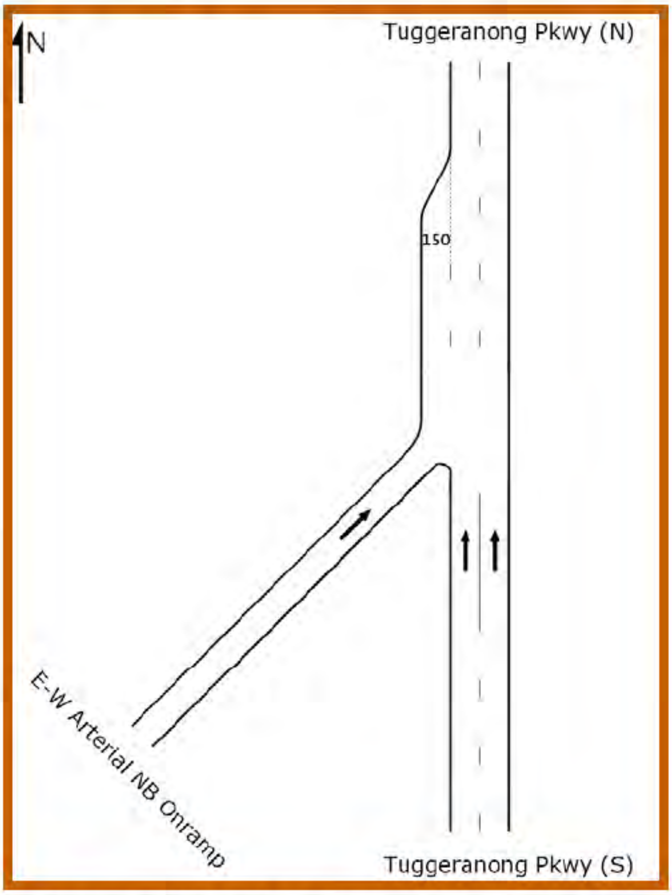


Figure 131: Tuggeranong Parkway – East-West Arterial Northbound Onramp Merge (Full Interchange 2031)

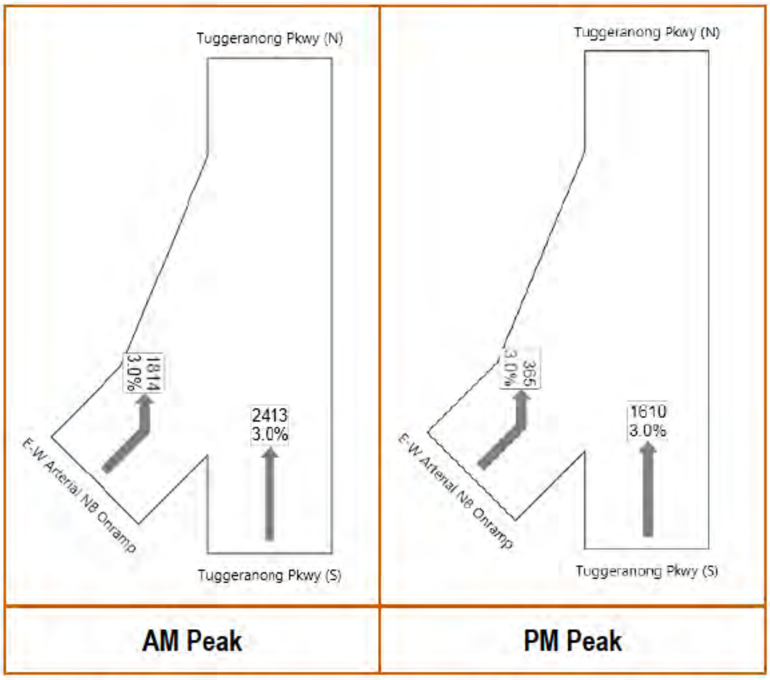


Figure 132: Hourly Merging Volumes at Tuggeranong Parkway – East-West Arterial Northbound Onramp (Full Interchange 2031)

6.2.11.3 Tuggeranong Parkway – East-West Arterial Southbound Onramp Merge

The southbound merge is expected to operate at LOS C during both weekday peak periods.

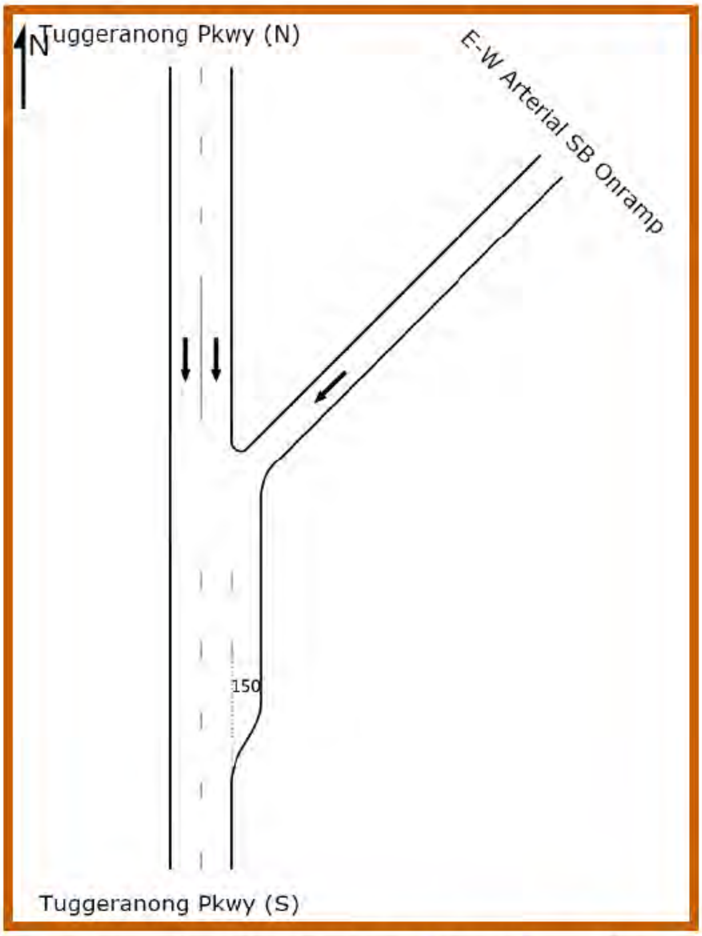


Figure 133: Tuggeranong Parkway – East-West Arterial Southbound Onramp Merge (Full Interchange 2031)

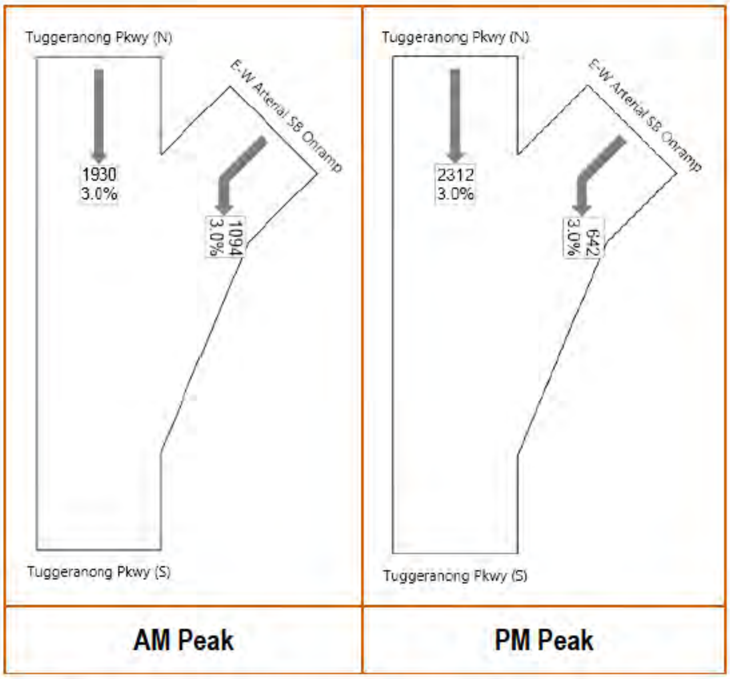


Figure 134: Hourly Merging Volumes at Tuggeranong Parkway – East-West Arterial Southbound Onramp (Full Interchange 2031)

6.2.12 2031 East West Arterial Scenario 6 (Cotter Road Connection)

6.2.12.1 Cotter Road – East-West Arterial

The intersection (shown in Figure 135) is expected to operate at LOS B during the AM peak and LOS C during the PM peak. This scenario includes the connection of East-West arterial with Cotter Road, while the East-West Arterial has no direct connection to Tuggeranong Parkway. This results in a heavy right turn from the east during the PM peak due to vehicles travelling from the City to Molonglo. Hence, three right turn lanes were required for the intersection to operate at an acceptable level of service.

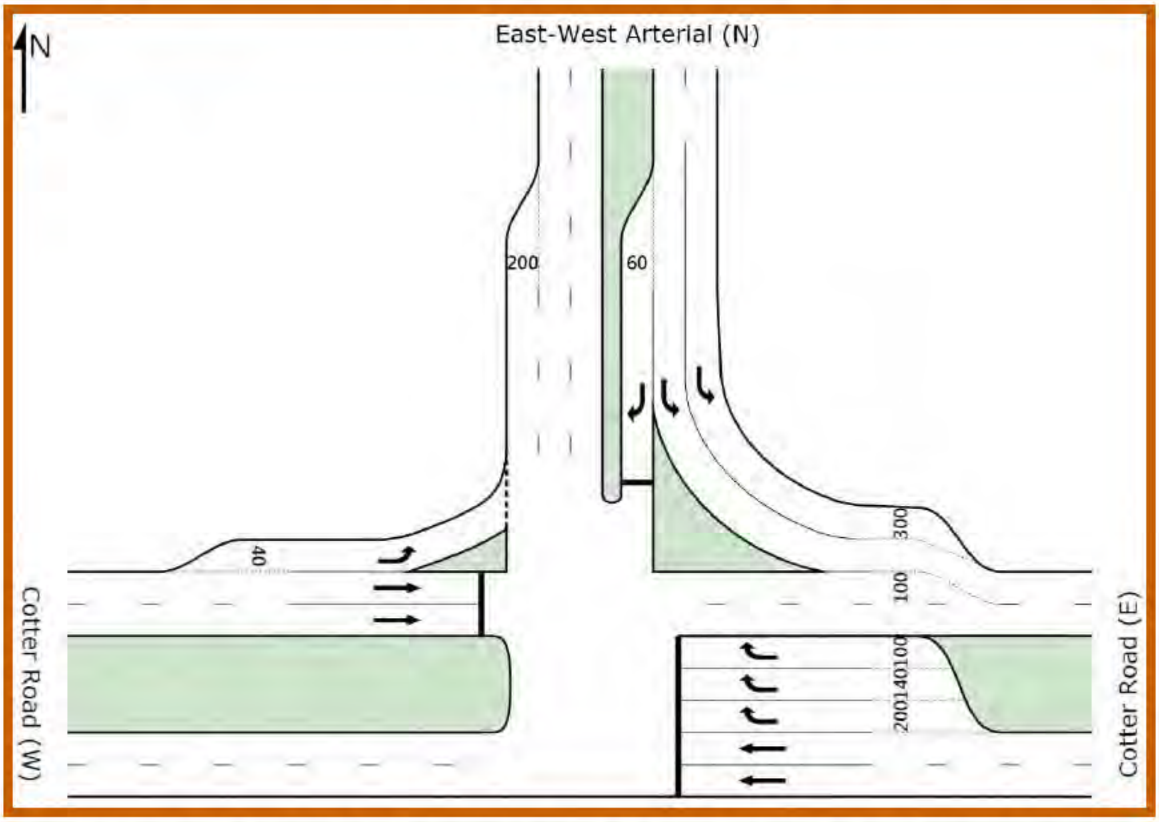


Figure 135: Intersection Layout of Cotter Road – East-West Arterial (Tuggeranong Parkway Bypass 2031)

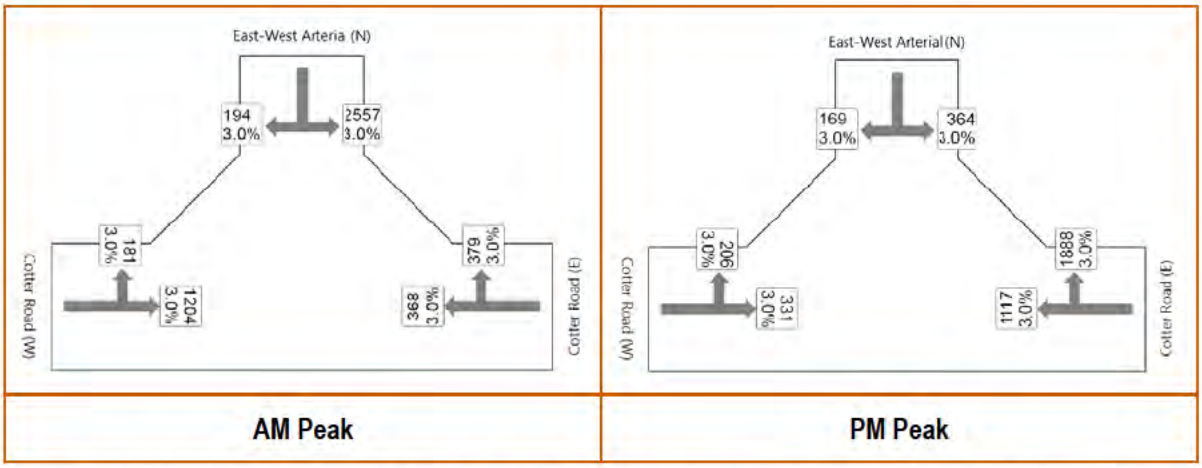


Figure 136: Hourly Volumes at Cotter Road – East-West Arterial (Tuggeranong Parkway Bypass 2031)

6.2.13 2031 East West Arterial Scenario 7 (Cotter Road Connection with North Facing Ramps Only)

This scenario includes the East-West Arterial connection with Cotter Road as well as north facing ramps connecting East-West Arterial with Tuggeranong Parkway.

6.2.13.1 Cotter Road – East-West Arterial

The intersection (shown in Figure 137) is expected to operate at LOS C during both weekday peak periods. In comparison to Scenario 6, the connection of the East-West Arterial to Tuggeranong Parkway results in a reduction of the right turning volume from the east during the PM Peak period. As a result only two right turning lanes are necessary on the eastern approach.

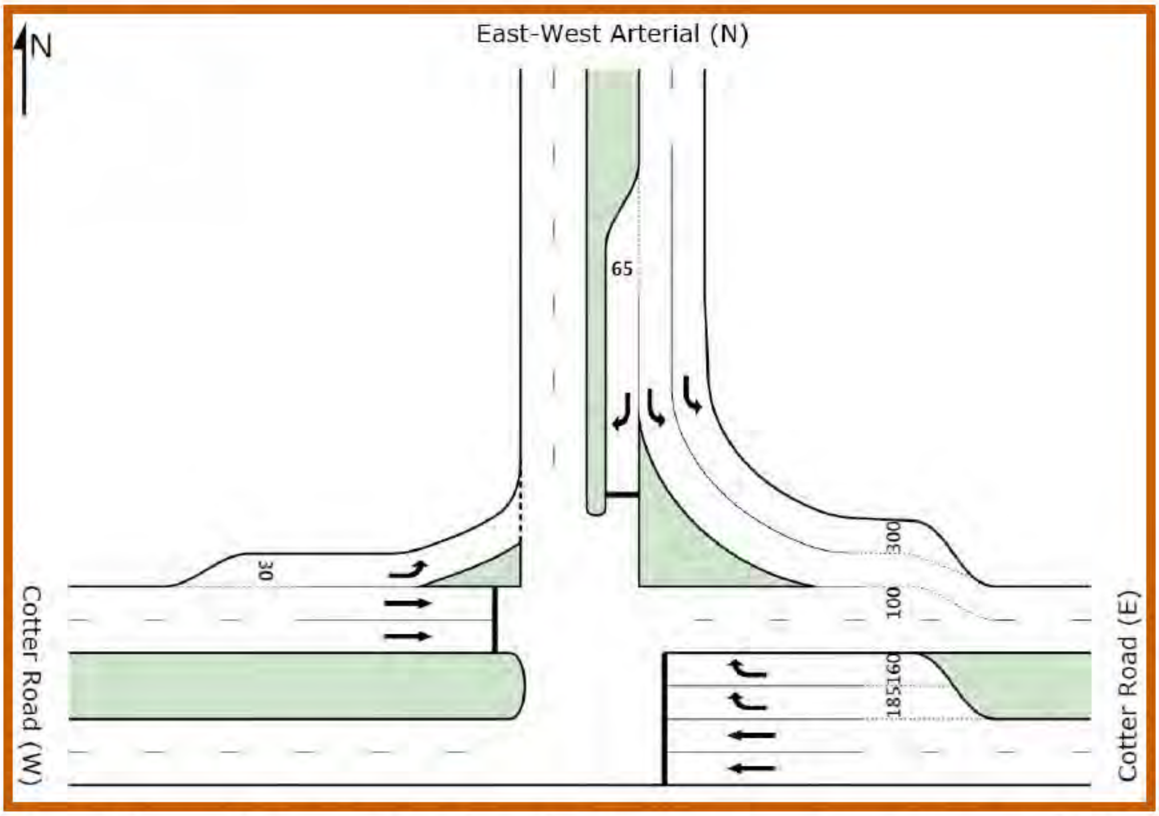


Figure 137: Intersection Layout of Cotter Road – East-West Arterial (Tuggeranong Parkway North Facing Ramps 2031)

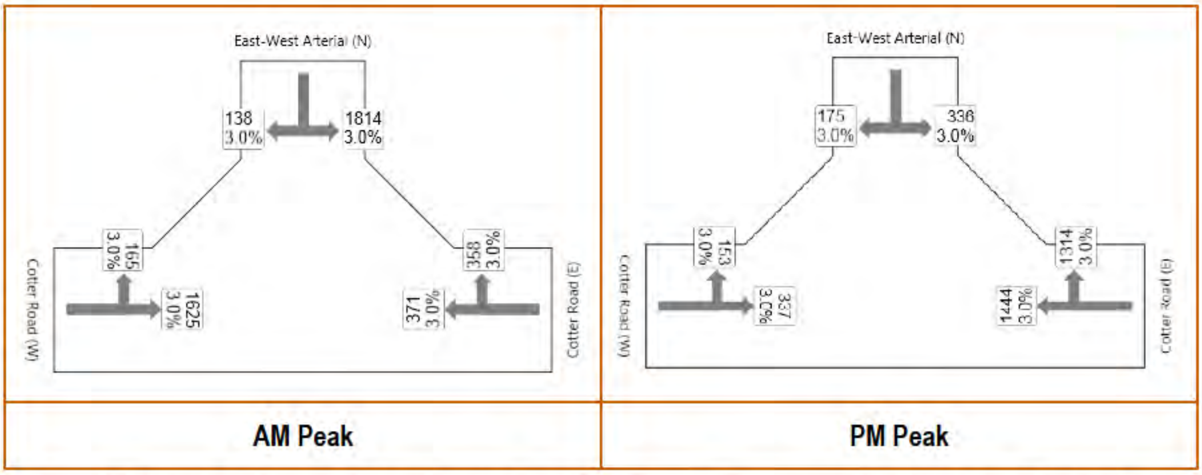


Figure 138: Hourly Volumes at Cotter Road – East-West Arterial (Tuggeranong Parkway North Facing Ramps 2031)

6.2.13.2 East-West Arterial – Tuggeranong Parkway Southbound Offramp

The intersection (shown in Figure 139) is expected to operate at LOS B during the AM peak and LOS C during the PM peak period. The limitation is the right turn from the north during the PM peak. The 95th percentile queue for this movement during the PM peak is approximately 205 metres.

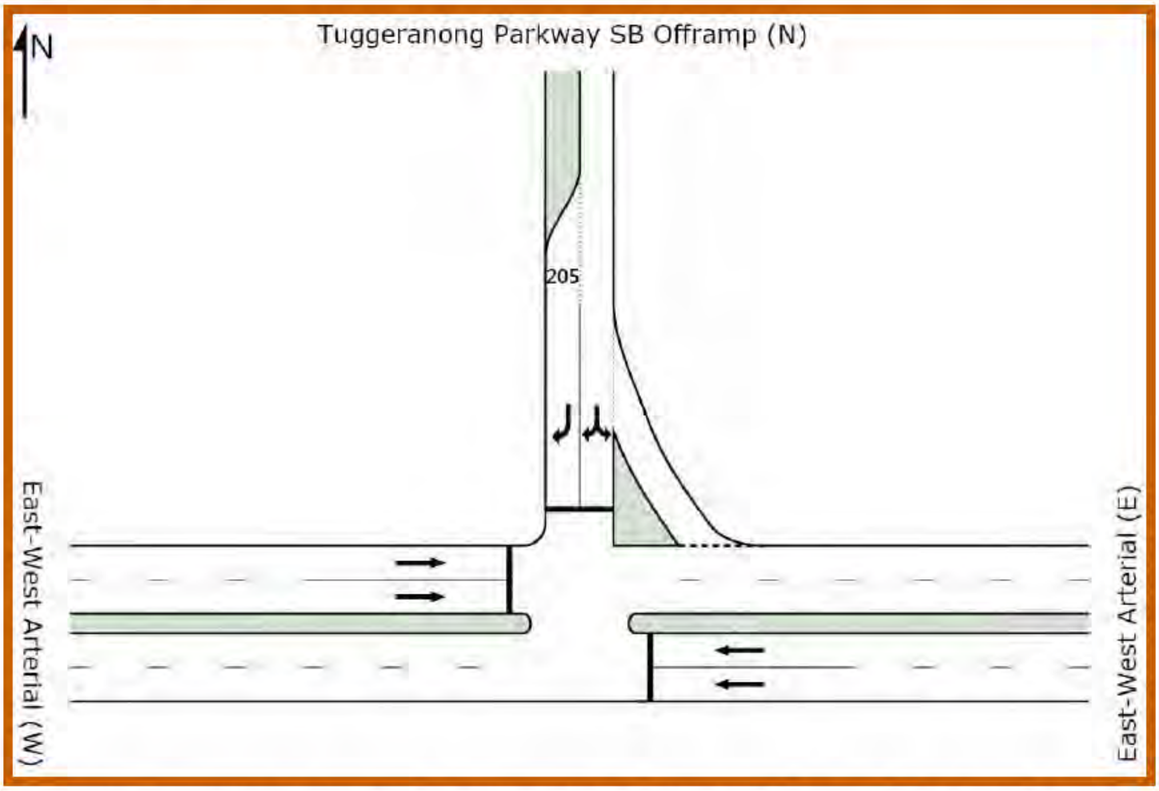
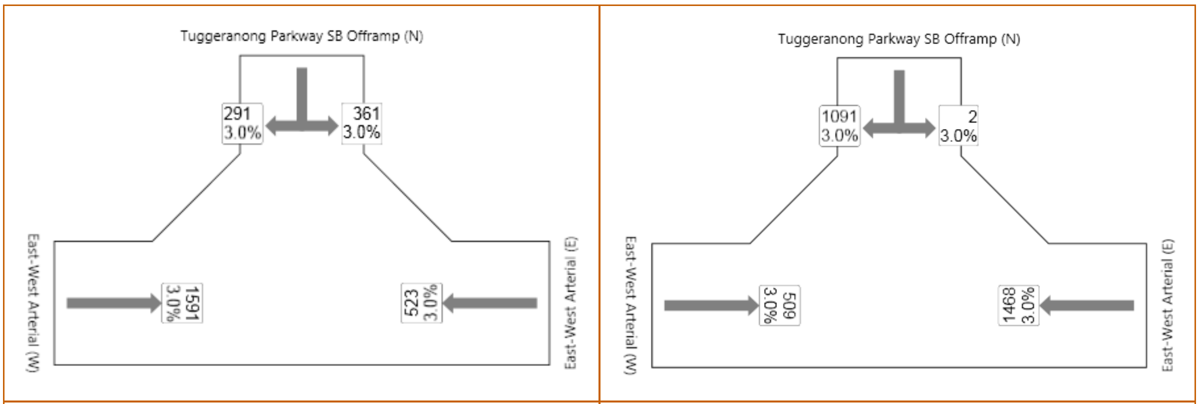


Figure 139: Intersection Layout of East-West Arterial – Tuggeranong Parkway Southbound Offramp (Tuggeranong Parkway North Facing Ramps 2031)



AM Peak	PM Peak

Figure 140: Hourly Volumes at East-West Arterial – Tuggeranong Parkway Southbound Offramp (Tuggeranong Parkway North Facing Ramps 2031)

6.2.13.3 Tuggeranong Parkway – Tuggeranong Parkway Northbound Onramp Merge

The merge is expected to operate at LOS E during AM peak and LOS C during PM peak. Tuggeranong Parkway downstream of the merge is expected to operate between 95% and 100% of its capacity during the AM peak period.

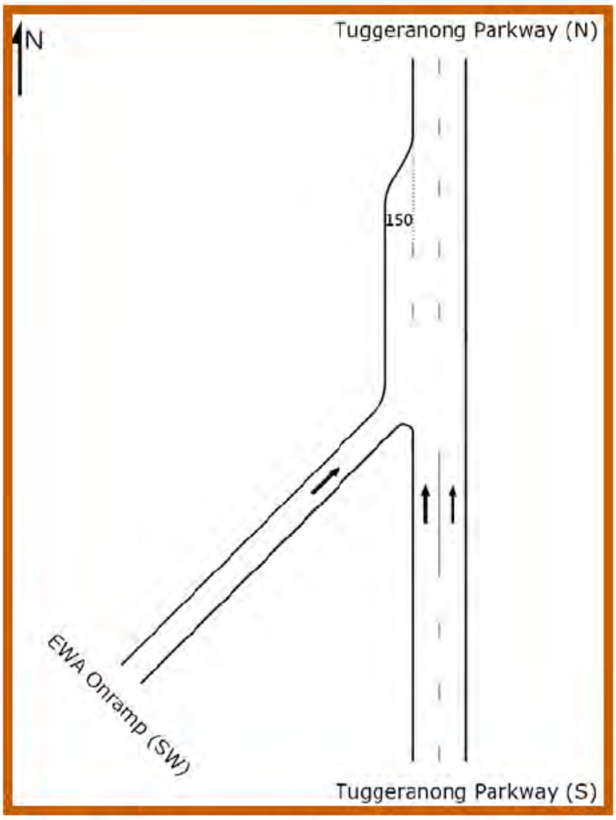


Figure 141: Tuggeranong Parkway – Tuggeranong Parkway Northbound Onramp Merge (Tuggeranong Parkway North Facing Ramps 2031)

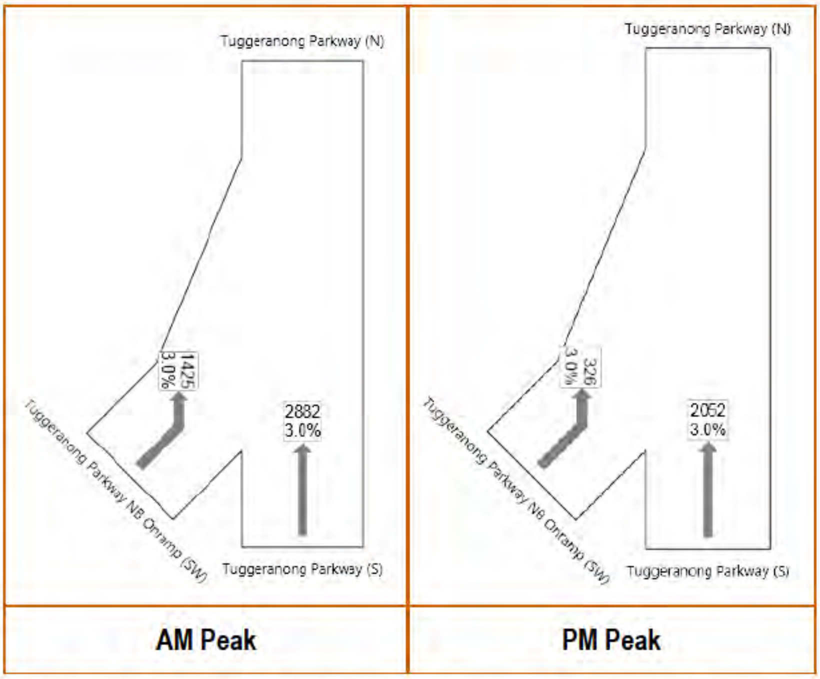


Figure 142: Hourly Merging Volumes at Tuggeranong Parkway – Tuggeranong Parkway Northbound Onramp (Tuggeranong Parkway North Facing Ramps 2031)

6.2.14 Results Summary

6.2.14.1 2016 Intersection Option

The 2016 traffic operational analysis shows that the intersection upgrades at the following two closely spaced intersections will be required as an interim upgrade:

- William Hovell Drive – Coppins Crossing Road
- William Hovell Drive – Coulter Drive

A summary of the traffic operational analysis is included in Table 10.

Table 10: Summary of 2016 Staging Scenario Traffic Operations

Scenario	Location	AM Peak		PM Peak	
		Delay	LoS[1]	Delay	LoS[1]
Coppins Crossing Road Scenario	William Hovell Drive – Coppins Crossing Road (West Intersection)	37.0 s	D (E)	14.6 s	B (E)
	William Hovell Drive – Coulter Drive (East Intersection)	13.8 s	B (E)	30.7 s	C (E)

6.2.14.2 2021 Intersection Options

The traffic operational 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 John Gorton Drive is connected to Bindubi Street – 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 2016 interim upgrade at the intersection of William Hovell Drive and Coulter Drive will also operate at an acceptable level in 2021.

A summary of the traffic operational analysis is included in Table 11.

Table 11: Comparison of 2021 Staging Scenarios Traffic Operations

Scenario	Location	AM Peak		PM Peak	
		Delay	LoS[1]	Delay	LoS[1]
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)

[1] Overall Level of Service is given, with worst movement Level of Service in parenthesis.

6.2.14.3 2031 William Hovell Drive – Coulter Drive Intersection Options

A summary of the traffic operation analysis for the intersection of Coulter Drive and William Hovell Drive for the 2031 AM peak period is shown in Table 12. Since the design criterion was to achieve acceptable performance, there is little difference between the options. The Quadrant option is preferred due to the impracticality of the Staggered T and Four-way options.

Table 12: William Hovell Drive – Coulter Drive 2031 Performance Summary

Option	Location	AM Peak		PM Peak	
		Delay	LoS[1]	Delay	LoS[1]
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)

[1] Overall Level of Service is given, with worst movement Level of Service in parenthesis.

6.2.14.4 2031 William Hovell Drive – John Gorton Drive/Bindubi Street Options

A summary of the analysis of the options for the interchange between William Hovell Drive, Bindubi Street and John Gorton Drive is shown in Table 13.

Table 13: William Hovell Drive – Bindubi Street/John Gorton Drive Performance Summary

Option	Location	AM Peak		PM Peak	
		Delay	LoS[1]	Delay	LoS[1]
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)

[1] Overall Level of Service is given, with worst movement Level of Service in parenthesis.

6.2.14.5 2031 East-West Arterial Intersection Options

The Tuggeranong Parkway Full Interchange Option operates relatively well, with the exception of the merge at Tuggeranong Parkway – East-West Arterial Southbound onramp during the AM peak. This merge operates at near capacity and will reduce the average speeds on the merge influence area on Tuggeranong Parkway to 78 km/hr.

The other two scenarios include a connection of East-West Arterial with Cotter Road. 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. A summary of the traffic operation analysis is included in Table 14.

Table 14: Cotter Road – East-West Arterial 2031 Performance Scenario

Scenario	Location	AM Peak		PM Peak	
		Delay	LoS[1]	Delay	LoS[1]
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

[1] Overall Level of Service is given, with worst movement Level of Service in parenthesis.

7 PUBLIC TRANSPORT AND CYCLING

7.1 Public Transport Services

7.1.1 Overview

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.

7.1.2 Rapid Services

The highest-order bus services in the ACT bus network, as defined in the *ACT Strategic Public Transport Network Plan (SPTNP)*, are the rapid bus routes, designed to connect major centres via the most direct path possible, with limited stop spacing to ensure running speeds are more competitive with car travel than local bus services that stop more frequently. Rapid services operate with a maximum headway of 15 minutes, and often more frequently in peak periods. The intention of the rapid bus network is to provide the same certainty, legibility and reliability as a rail network.

Two rapid routes are envisaged for Molonglo.

7.1.2.1 Molonglo-City

The first of these is straightforward, running from the Molonglo 2 Group Centre (M2GC), northwards along John Gorton Drive, stopping at the Northern Group Centre (NGC), before heading east along Parkes Way to Civic.

There is potential to extend this route eastwards from the M2CG along the East-West Arterial (EWA), 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. An assessment as to whether this extension is feasible can be made once detailed land use planning and subdivision layout is complete.

7.1.2.2 Belconnen-Molonglo-Woden

The second proposed rapid route would travel through Molonglo on a journey from Belconnen to Woden. Earlier planning for this route provided a common route section with the City Rapid, before travelling north along Bindubi Street. With the southern extension of Coulter Drive now providing increased coverage than it did in previous stages of planning, this may be a more useful way to travel to Belconnen. If this rapid service did extend north on Coulter Drive, it would stay on this road to enable access to Belconnen from the west, travelling through Westfield Bus Station and terminating at the Belconnen Community Bus Station.

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. This is shown as the blue link in Figure 143. The location of the proposed bus stop is shown in red, whilst the provision of a pedestrian link to Group Centre Road MCG0 is recommended and is shown in green.

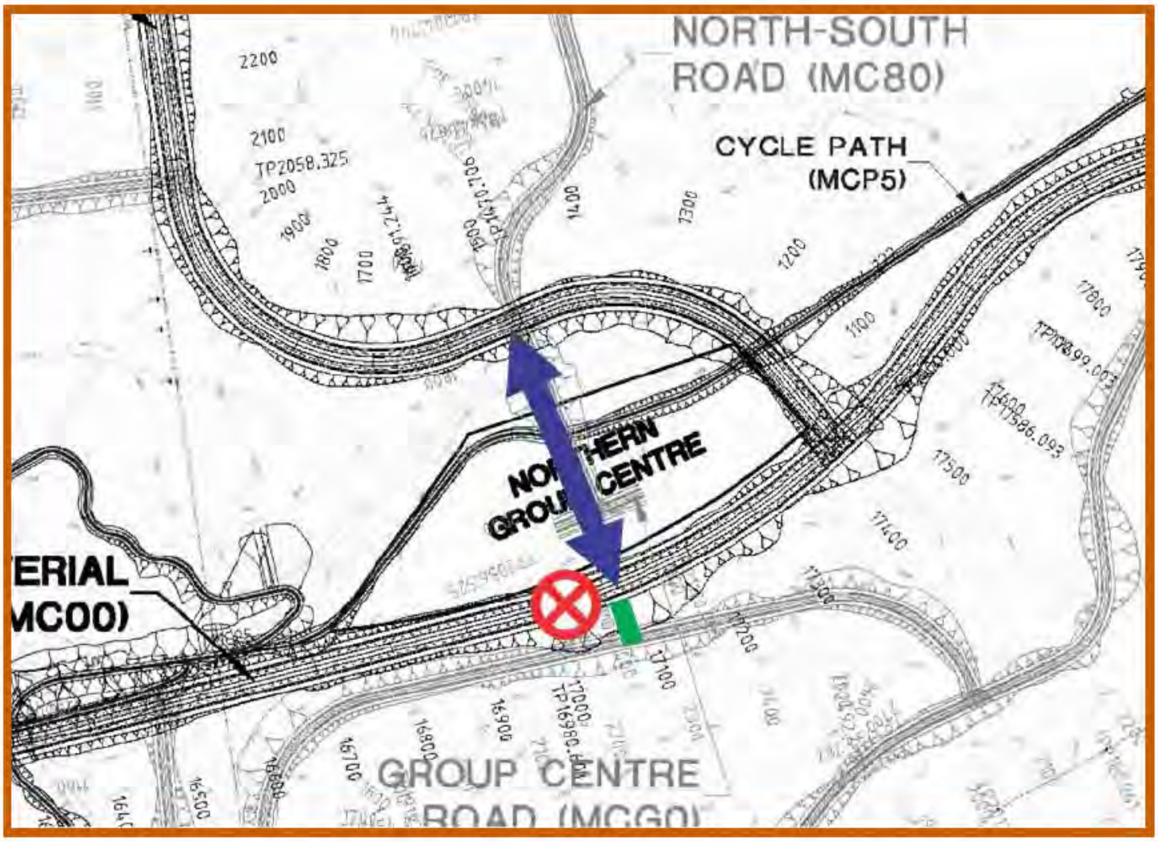


Figure 143: Recommended Link Through Group Centre and Bus Stop Location

7.1.3 Recommended Additional Road Network Connection

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, as shown in Figure 144, to enable bus circulation.

Additional bus stops would be required. The stop shown in green should be investigated even if this loop is not possible to implement. If the loop can be completed, buses would only need to operate in one-direction around the loop. As a result, bus stops would only be required on one side of the road within the loop.

In the instance that the loop cannot be developed, consideration needs to be given to how buses would turn around, noting the 30 m outer turning radius of a 14.5 m bus.

It is suggested that rather than having a bus double back on itself, it may be desirable to have a route terminate within the resulting cul-de-sac, so that it commences a new journey after turning around.

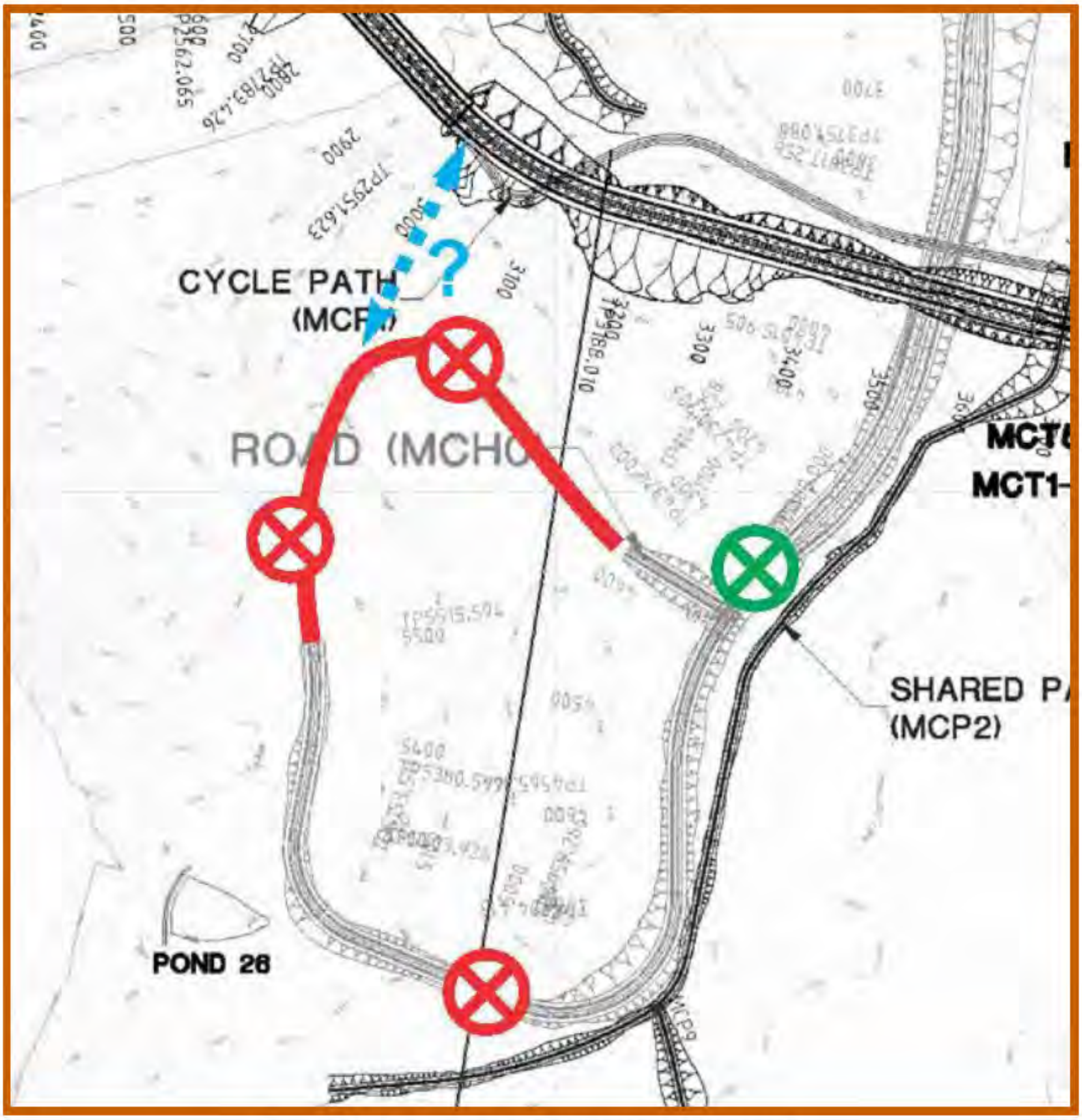


Figure 144: Recommended Additional Road Connection

7.1.4 Bus Stop Locations

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.

However, despite best efforts, there may be locations that the 2.5% grade cannot be achieved. It is better to have a non-compliant bus stop than none at all, as the spacing between stops may become too great if only compliant stops are provided.

In hilly terrain, it is recommended that stop spacing be a little tighter than normal, acknowledging the increased exertion required to walk to access bus stops in these areas. On roads with a long and/or steep incline, stops should be located at the top and bottom of the slope, allowing some passengers to walk down the slope to catch the bus, and again walk down the slope after alighting on the return trip.

Recommended stop locations throughout the site are as shown in Figure 145.

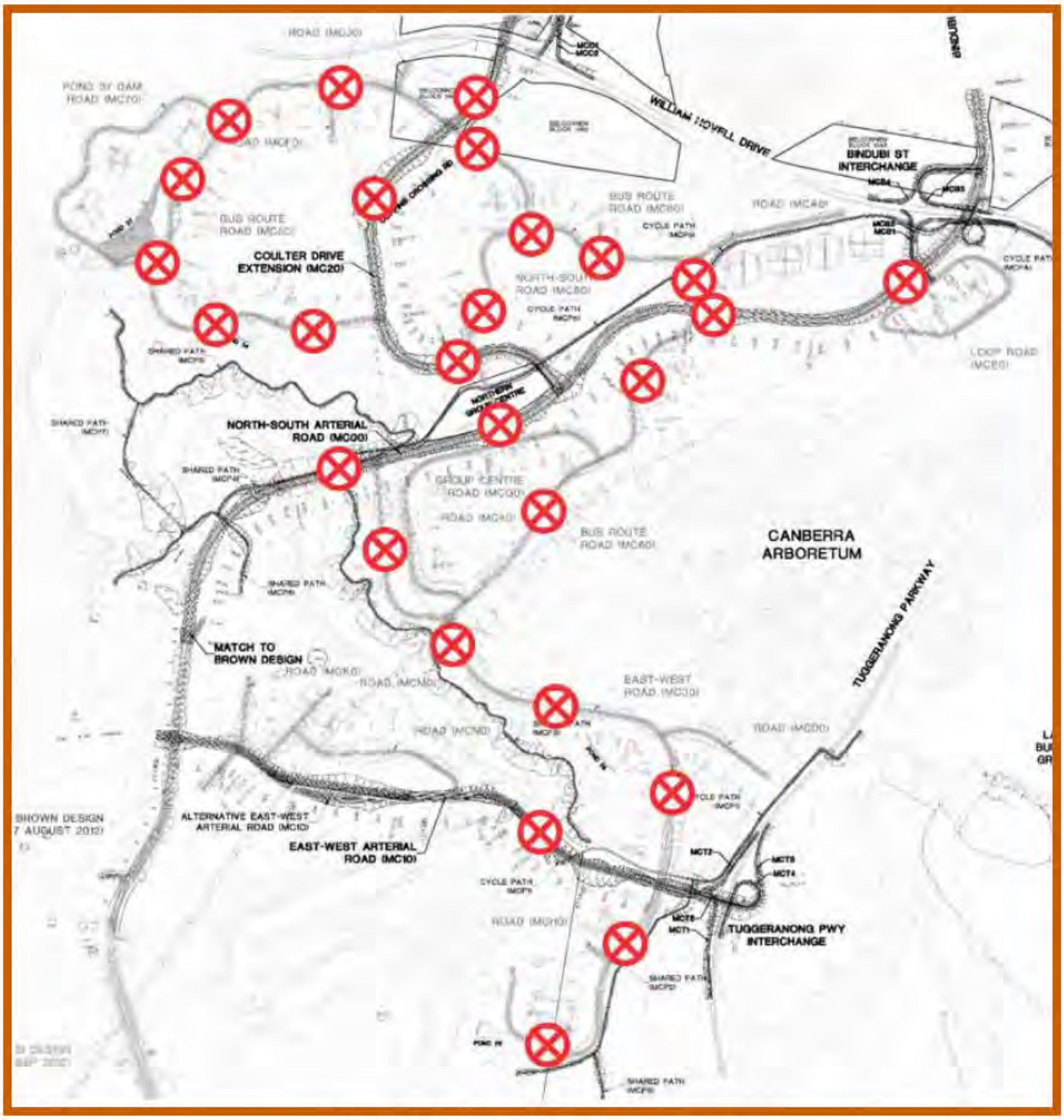


Figure 145: Indicative Bus Stop Locations

The bus route coverage map has been reproduced in Figure 146 to illustrate the interaction between the proposed routes and the proposed stops shown in Figure 145.

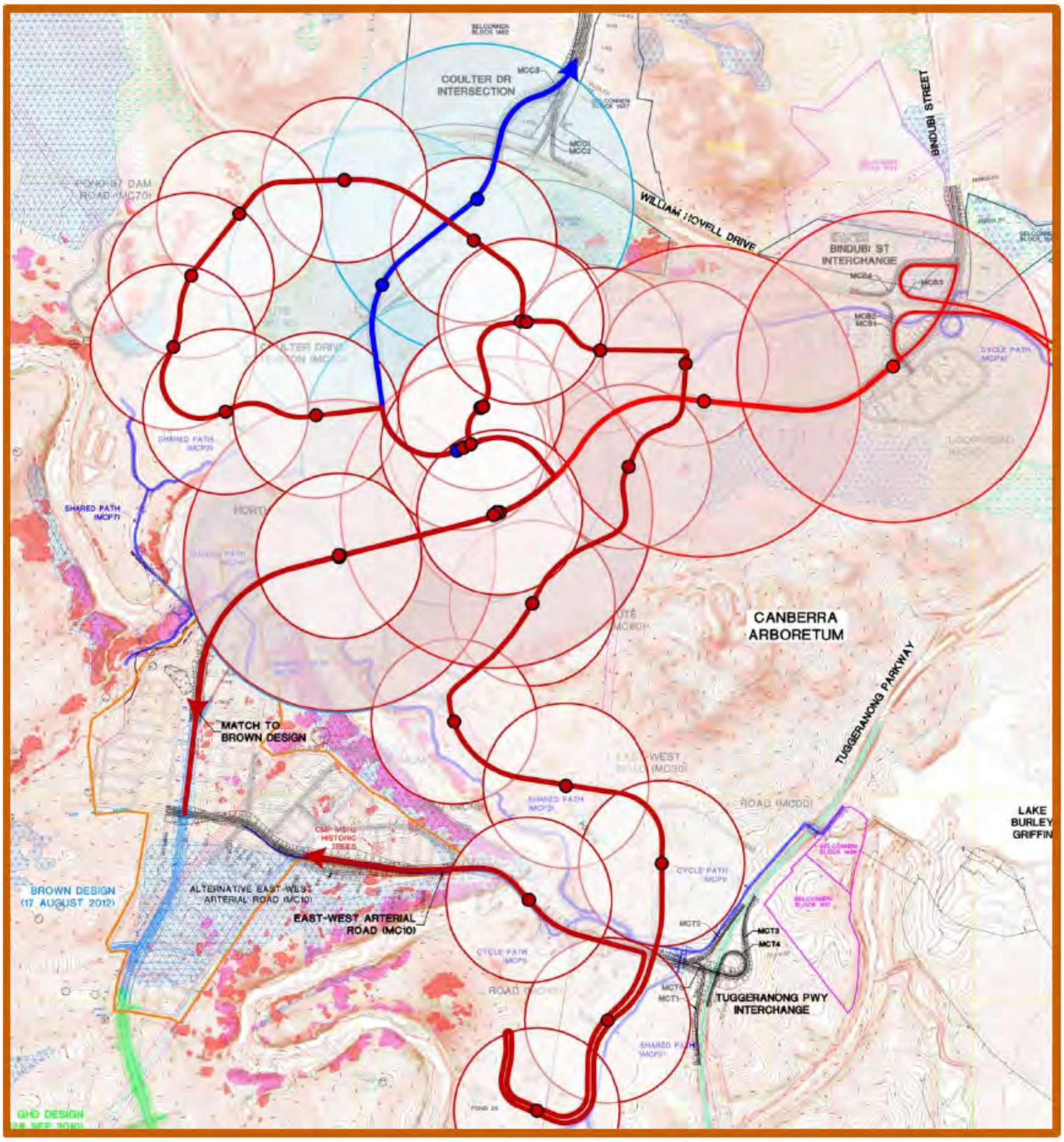


Figure 146: All Bus Routes and Stops (Assumed Maximum Walking Distance = 750 m for Rapid routes and 400 m for local routes)

7.2 Public Transport Mode Share

The bus stops and routes shown in Figure 146 were modelled in the strategic transport model to predict the potential public transport mode share if these stops and routes are implemented.

The strategic transport model forecasts public transport usage based on the difference in generalised cost between the available modes, which are bus and car in this model.

Table 15 shows the forecast mode share for the 2016, 2021 and 2031 AM peak hours. The Sustainable Transport Plan (STP) bases its mode share target on Journey-to-Work trips (i.e. trips made by people travelling to work, not for any other purpose). These trips are referred to as Home-Based Work trips in the strategic transport modelling results shown in Table 15.

Table 15: Predicted Public Transport Mode Share

Year	Home-Based Work		All Purposes	
	Molonglo	Canberra	Molonglo	Canberra
2016 AM	2.7%	11.3%	3.3%	8.0%
2021 AM	4.3%	9.9%	4.2%	7.3%
2031 AM	7.9%	17.5%	5.3%	10.3%

The results in Table 15 show that an increase in public transport mode share between 2016 and 2031 is expected in Molonglo and Canberra as a whole. The mode share in Molonglo falls short of the STP targets but the network as a whole meets the targets in 2031. The relatively low forecast bus mode share in Molonglo appears to be due to the constraints of the strategic model used in the forecast process. The strategic model only uses roads to determine travel distances and costs. In addition, the transport zoning structure used in Molonglo is relatively coarse as the land use planning is still ongoing. As a result of these issues, the walk distances from zone centroids to bus stops in the model are higher than may be expected in reality (where people can use footpaths and shared paths, which may not follow the road network). It is expected that John Gorton Drive, which is the main public transport corridor through Molonglo, will have high density housing along each side and will also have good footpath and shared path access to the surrounding residential areas. This will reduce the walk distances between residences and bus stops to significantly lower levels than those shown in the strategic model and is expected to result in a higher bus mode share than that shown in Table 15 when Molonglo is developed.

In the future, modifications should be made to the strategic model, including:

- Inclusion of walking routes between residential areas and bus stops located on arterial roads to better reflect the actual walking distances.
- Relocation of zone centroids based on population density (or disaggregating zones based on density), which should move more residents closer to transport corridors.

These modifications are expected to increase the accuracy of the strategic transport model in the Molonglo area and should result in a higher bus mode share than that forecast in this study.

In the wider Canberra area, there is a slight decrease in mode share in 2021. The model assumes that the 2021 and 2031 bus networks are essentially the same and represent full implementation of the SPTNP. However, it is only in the 2031 model where it is assumed that all Rapid corridors will have some form of bus priority (e.g. bus lanes, etc), which is why there is a relatively high bus mode share in this scenario. In 2021, buses are operating in general traffic and will be delayed by congestion. These delays increase the generalised cost of the bus mode and make it less attractive.

7.3 Proposed Cycleways and Shared Paths

7.3.1 Cycle Highway

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.

In the Netherlands, a footpath of different pavement colour is co-located with the veloway, with or without a separator, in areas of significant pedestrian activity. In outer urban areas, a footpath may not be provided.

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.

The Queensland Cycle Strategy states:

> *The veloway concept is about cycling infrastructure that is wide enough to cater for at least two cyclists riding side by side, with space for faster moving cyclists to safely overtake. These facilities encourage people of all ages and abilities to ride, for sports training, a social trip, or commuting. Veloways provide a very high standard cycling facility (wide path, straight alignment, good sight lines) and are intended for major cycling links where high numbers of cyclists are expected. Veloways are generally designed for higher travel speeds.*

If legislation is required for the ACT, then the potential users need to be considered and either prohibited or allowed.

Potential users of off road paths and suggested regulation include:

- Walking pedestrians (Prohibit)
- Animals including horses (Prohibit)
- Wheelchairs(Prohibit)
- Sports wheelchairs (Allow?)
- Segways (Prohibit)
- Joggers (Prohibit)
- Roller blades, skateboards, roller skates (Prohibit – note that roller blades are permitted in some parts of USA)
- Very young cyclists (Prohibit?)
- Tricycles (Prohibit)
- Motorised mobility devices, golf buggies (Prohibit)
- Cyclists (Allow)

7.3.2 Cycle Paths in Molonglo 3

Figure 147 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.

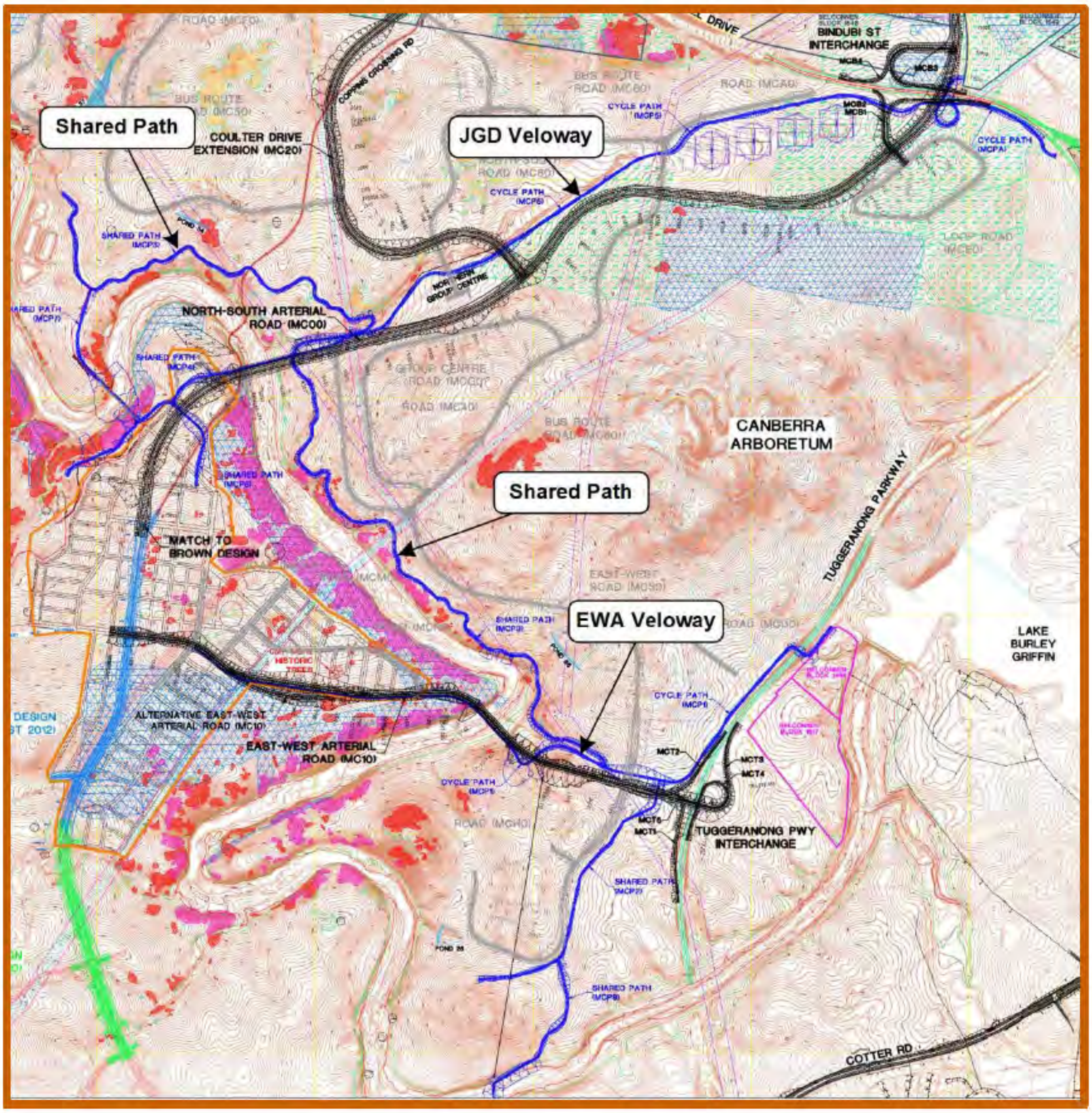


Figure 147: Proposed Off Road Paths (Blue)

The connection to the Lake Burley Griffin path from the JGD Veloway has an at grade signalised crossing of Lady Denman Drive, and relatively slow links through Glenloch Interchange.

The EWA Veloway will have speed restriction if it uses the existing underpass of Tuggeranong Parkway (west of the zoo), and a new signalised at grade crossing of Lady Denman Drive adjacent to Scrivener Dam is envisaged.

Widening and upgrading of the Lake Burley Griffin cycleway would be desirable to complement the proposed Molonglo veloways.

If these paths are designated as veloways then their cross-section should be widened to accommodate separate pedestrian paths preferably differentiated from the cycle path by a different colour and texture. The cycleway should be a very smooth surface so that cyclists will not be tempted to ride on the pedestrian areas. Where space permits, the paths should be separated so that dogs on leads and roller bladers' swinging legs do not impede cyclists.

In some areas of high pedestrian activity, footpaths on both sides of the Veloway may be desirable.

Austroads discusses veloways but does not offer design guidance. The following design criteria are suggested for the proposed veloways or cycle highways:

- Design speed: 50 km/hr
- Pavement width:
  - Cycle highway: 3.0 m (minimum)
  - Cycle highway + pedestrian path: 5.0 m

7.3.3 On-road Cycle Lanes and Footpaths

All of the proposed arterial roads include an allocation for 2.0 m on-road cycle lanes in both directions (see cross-sections in Figure 148 and Figure 149). Also included are 7.5 m wide verges, which can possibly accommodate footpaths/shared paths of up to 3.0 m wide.

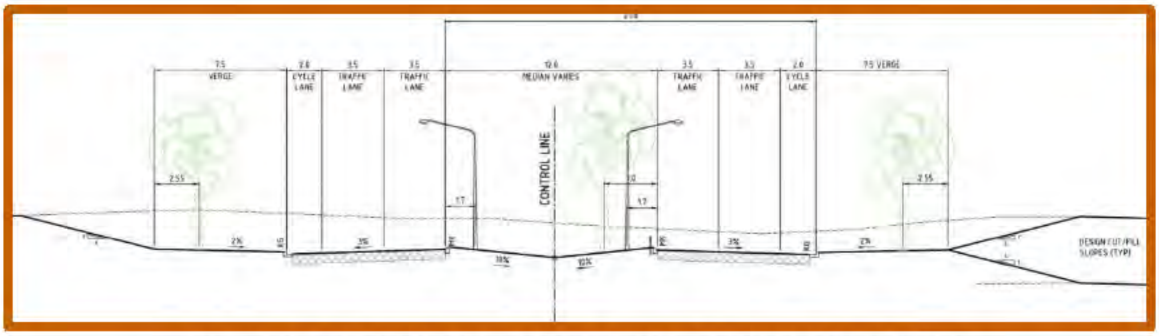


Figure 148: John Gorton Drive and Coulter Drive Extension Cross Section

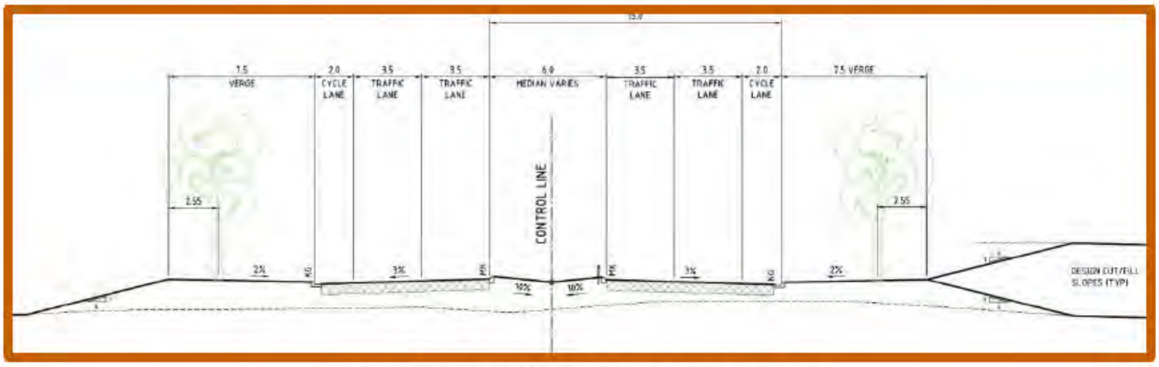


Figure 149: East-West Arterial Cross Section

7.4 Potential Cycling and Walking Mode Share

Detailed modelling of the cycling and walking mode share cannot be undertaken using the existing strategic transport model as it only models motorised trips (car as driver, car as passenger, bus and Park & Ride). A brief investigation has been carried out to approximate the potential cycle and walk mode share of trips in and around Molonglo.

Figure 150 shows the approximate proportion of each of the four primary modes based on the trip distance. The data underlying the figure is based on ABS Census (2006) Journey-to-Work.

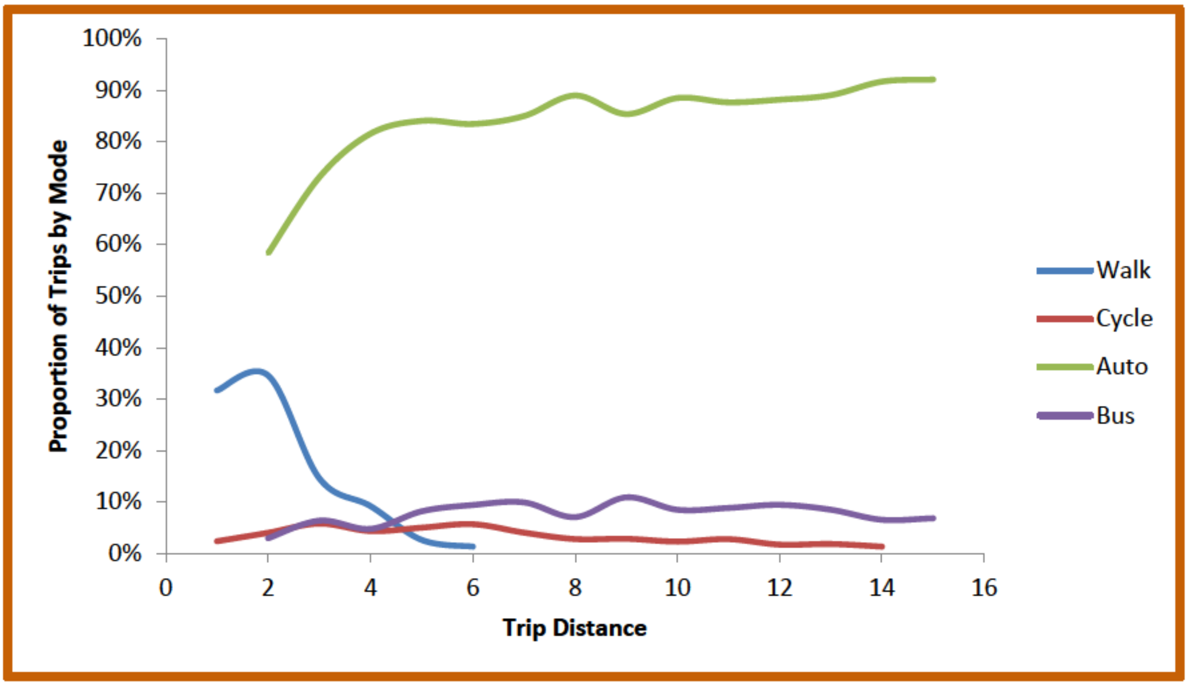


Figure 150: Mode Choice by Trip Distance (Based on ABS Census (2006))

From Figure 150, it can be seen that the proportion of trips walking to work peaks at a trip distance two kilometres with a proportion of approximately 35% and falls to 1% at a distance of approximately six kilometres. The cycling mode peaks at six kilometres with a proportion of 6% and falls to 1% at a distance of 14 kilometres.

Closer examination of the ABS Journey-to-Work data shows that 90% of walk trips are five kilometres or less in distance and 90% of cycle trips are 13 kilometres or less. The STP defines the maximum walk and cycle distances as two and ten kilometres respectively. The Journey-to-Work data shows that these distances only include 55% of walk trips and 62% of cycle trips, which could imply that the STP maximum distances need to be reviewed and updated.

Figure 151 shows the walk (two kilometres) and cycle (ten kilometres) coverage areas for the group centres in Molonglo. These coverage areas are based on the road network in the study area as it is assumed that the road network gives a reasonable indication of where footpaths are likely to be located.

High quality paths allowing good access to the town centres should be focused in these areas. Particular attention should be paid to providing safe crossing points across arterial roads around both of the centres so that pedestrians have access from surrounding suburbs. The future pedestrian and cycle network in Molonglo, especially around the group centres, should be as complete and direct as possible. The path network should be fine-grained and penetrate the centres well.

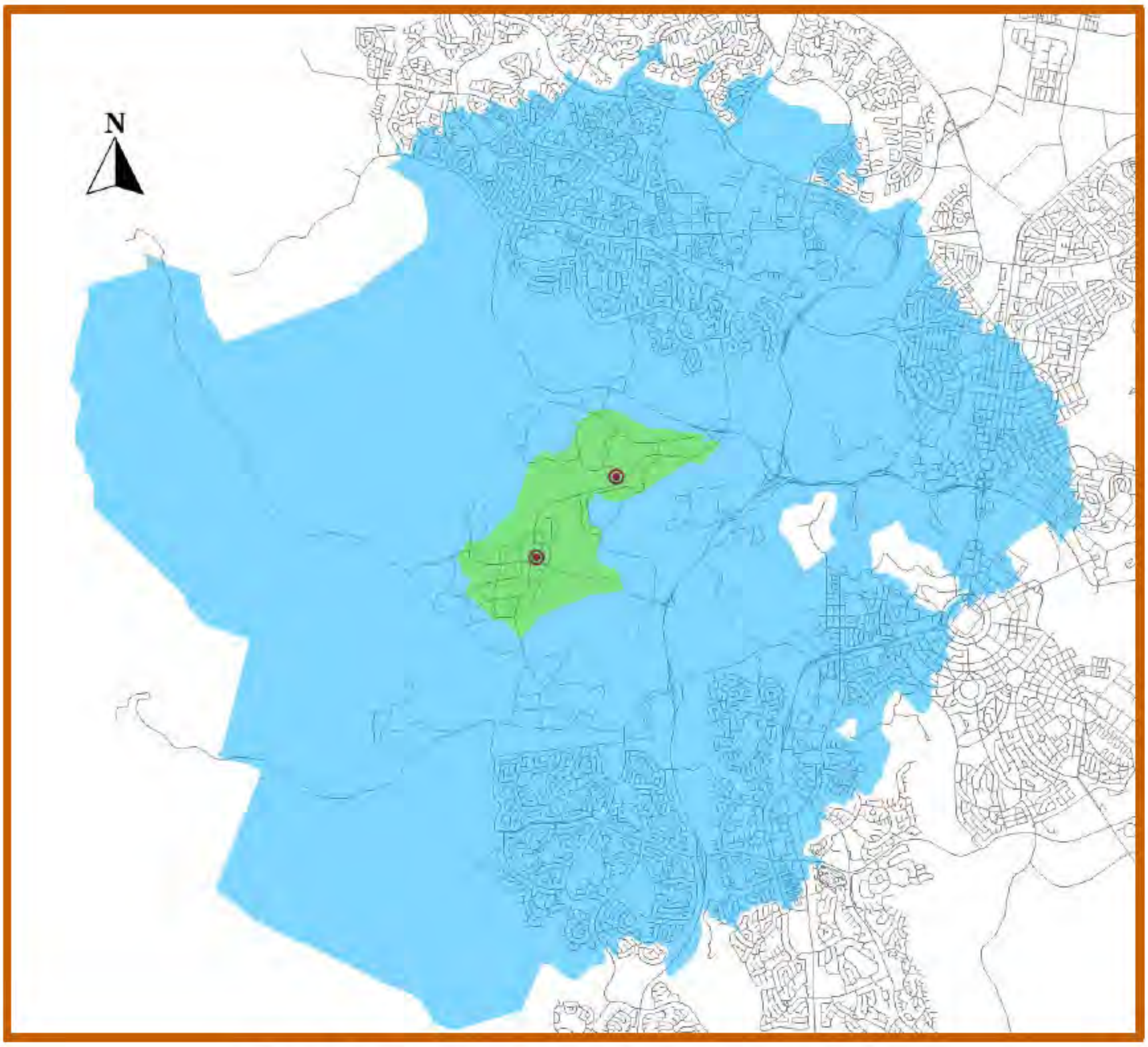


Figure 151: Walk (Green) and Cycle (Blue) Coverage Areas

Trips travelling to and from the group centres in the green area (shown in Figure 151) are expected to have a mode share of approximately 30% walk and 3% cycle. In the blue area in Figure 151, trips to and from the group centres will 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.

In addition to the high quality path network, higher density residential development in the walk catchment (shown in green in Figure 151) will mean that a relatively large proportion of the trips to and from the group centres will use the walk and cycle modes. This will reduce traffic congestion and its associated negative impacts on the group centres.

8 BRIDGE STRUCTURES

John Gorton Drive and the East-West Arterial road cross the Molonglo River within 2000 m of each other with the John Gorton Drive 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 Lizard.

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

8.1 John Gorton Drive (JGD) Bridge

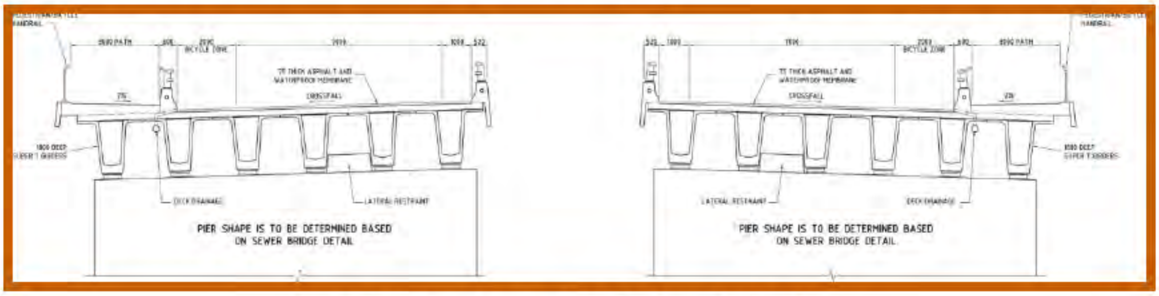


Figure 152: John Gorton Drive Bridges Typical Section

It is proposed that this pair of bridges will form a high level crossing across the Molonglo River valley. They will span the existing Cotter Road at their western end and the proposed shared path at their eastern end. The overall length of the structures would be about 290 m comprising eight 36 m spans, which is based on the preliminary bridge profile shown in Figure 153.

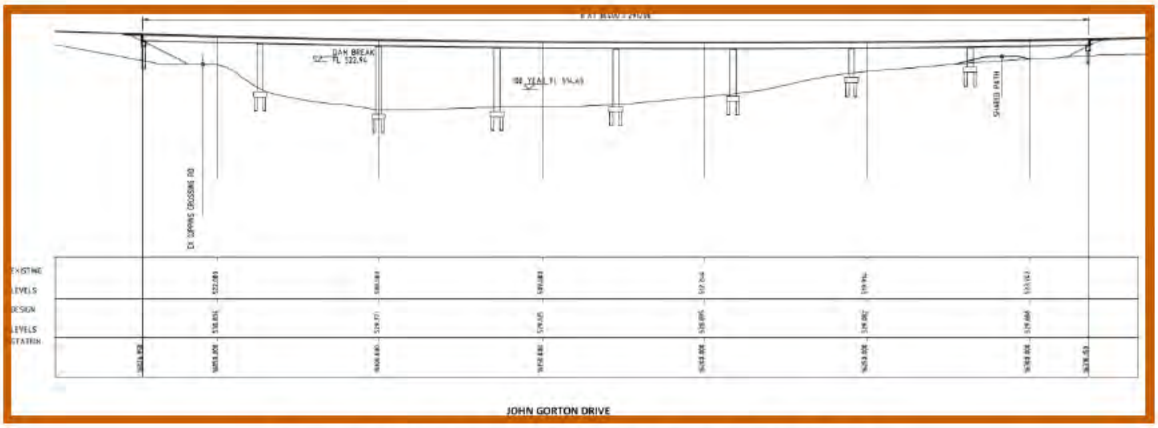


Figure 153: John Gorton Drive Preliminary Bridge Profile

8.1.1 Road Cross Section

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 carriageways, and hence the bridges, would be separated by a wide median to allow room for the possible future construction of a light rail system.

Both bridges would be set on a crossfall towards the nearside shoulder, with the footpaths falling towards the carriageway.

8.1.2 Alignment

The proposed alignment is essentially straight with the western approach curve encroaching 40 m onto the structure. This should not add any significant degree of complexity to the bridge structure.

The bridges are on a slight sag curve with its low point approximately 100 m from the eastern abutment.

8.1.3 Superstructure

The proposed span configuration will enable the superstructure to be made up of standard precast Super-T girders. At these span lengths 1.8 m deep girders would be suitable with a 200 mm thick reinforced concrete deck and asphalt surfacing on top of that. This type of superstructure is consistent with that proposed for the sewer bridge. Six girders in each span will be required to accommodate the bridge decks.

8.1.4 Substructure

The seven piers comprising the substructure elements within the river corridor will vary in height from 5 m up to about 20 m. Their form should be developed to be compatible with the sewer bridge piers currently being designed. The exact siting of the piers needs to be carefully considered to minimise as far as possible the impact on the sensitive areas within the river corridor.

Spill through type abutments are anticipated for this bridge.

All substructure elements should be designed with erosion protection.

8.1.5 Foundations

The preliminary geotechnical investigation for these bridges has provided general information about the sites. A more detailed investigation will be conducted as part of the design development for the sewer bridge. Because of the height of the structures, it is anticipated that the bridges will be subjected to high lateral loads from river flows & debris, wind and seismic forces. Bored piles socketed into rock are therefore likely to be the preferred foundation system for these bridges. The preliminary assessment indicates that there are likely to be strata of sufficient capacity to support these types of foundations at relatively shallow depths.

8.1.6 Flood Immunity

At their lowest point the superstructure soffits would be at approximately RL 527.5 m AHD, about 3.5 m above the expected dam break water level and 13 m above the anticipated 100-year flood level at the crossing site. The bridges are therefore at a level where they will be unaffected by foreseeable flood events.

8.1.7 Drainage

The runoff from the carriageways on the bridges will be piped to prevent discharge into the Molonglo River. The bridge drainage system will discharge into the road stormwater system at the eastern abutment.

8.1.8 Provision for Cyclists

As mentioned above the 2 m shoulder will accommodate on-road cycling. The bridge barriers should therefore be designed to a height of at least 1300 mm above the road surface to meet the relevant standards for accommodation of cyclists on bridges.

8.1.9 Constructability

The type of structure proposed for this site is relatively uncomplicated and uses components with which most competent contractors would be familiar. The major concern would be to minimise the impact of construction on the river corridor by limiting the amount of work to be undertaken from ground level. Although the impact of substructure works cannot be avoided it can be minimised by careful planning of work areas and access tracks. The piers, depending on their ultimate form, could be constructed using a 'jump form' technique which involves each segment being cast progressively within formwork supported directly on the segment previously cast below it.

The superstructure, which largely comprises of precast components, could be erected using an overhead gantry which would minimise the work areas required for craneage within the river valley. The girders would be erected progressively, span by span, from one end of the bridge, with the reinforced concrete deck cast to provide access to erect the next span. The second bridge could be constructed either using the same gantry or using craneage standing on the first structure.

8.1.10 Cost

Although the proposed method of bridge construction is relatively cheap the topography and access constraints will increase the cost of the works. The bridges are estimated to cost $50 million to build.

8.1.11 Construction Programme

Assuming that the two bridges are constructed as part of a single contract, they would take about 20 months to construct. The bulk of this time would be consumed in construction of the substructure. The overall duration of the works will be highly dependent upon the resources of the contractor employed to do the work. Particularly important will be the number of piling rigs employed and access to an erection gantry for efficient superstructure construction. In addition to the construction period, 12 months should be allowed for design and documentation.

If only one bridge were to be constructed the construction duration would reduce to approximately 18 months. The relatively small reduction in construction time when constructing a single bridge is due to the sharing of resources and overlapping of activities that would occur when constructing a pair of bridges together. Additionally the investment in temporary works for these bridges would be a substantial proportion of their cost and so may affect the decision to postpone the construction of the second of each pair.

8.2 East-West Arterial (EWA) Bridge

The typical section of the EWA bridge is identical to the JGD bridge shown in Figure 152. As with the JGD bridge it is proposed that this pair of bridges will also form a high level crossing across the Molonglo River valley. The overall length of the structures, at 255 m, would be slightly shorter than the John Gorton Drive bridges. They would comprise seven equal spans of 36 m, and this is based on the preliminary bridge profile shown in Figure 154.

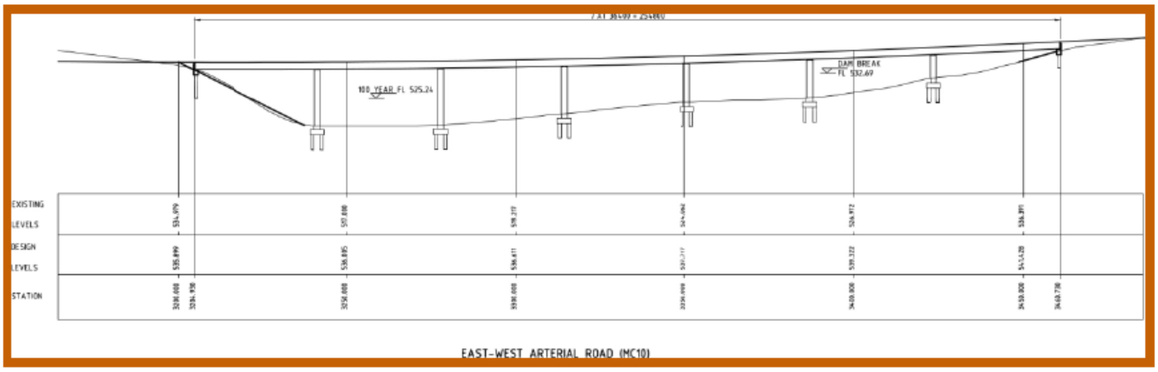


Figure 154: East-West Arterial Preliminary Bridge Profile

8.2.1 Road Cross-Section

Similar to the John Gorton Drive structures the bridges' cross sections would be 12 m wide between parapets to accommodate:

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

The carriageways, and hence the bridges, are separated by a 6 m median.

Both bridges would be set on a crossfall towards the nearside shoulder. The footpaths would fall in the opposite direction towards the carriageway.

8.2.2 Alignment

The proposed alignment is essentially straight with the western approach curve encroaching 30 m onto the structure.

The bridges are on a sag curve with its low point to the west of the crossing.

8.2.3 Superstructure

The proposed span configuration will enable the superstructure to be made up of standard precast Super-T girders. At these span lengths 1.8 m deep girders would be suitable with a 200 mm thick reinforced concrete deck and asphalt surfacing. This type of superstructure is consistent with that proposed for the sewer bridge. Six girders in each span will be required to accommodate the bridge decks.

8.2.4 Substructure

The six piers comprising the substructure elements within the river corridor will vary in height from 7 m up to about 18 m. Their form should be developed to be compatible with the sewer bridge piers currently being designed. The exact siting of the piers needs to be carefully considered to minimise as far as possible the impact on the sensitive areas within the river corridor.

Spill through type abutments are anticipated for this bridge.

All substructure elements should be designed with erosion protection.

8.2.5 Foundations

The preliminary geotechnical investigation for these bridges has provided general information about the sites. A more detailed investigation will be conducted as part of the design development for the sewer bridge. Because of the height of the structures, it is anticipated that the bridges will be subjected to high lateral loads from river flows & debris, wind and seismic forces. Bored piles socketed into rock are therefore likely to be the preferred foundation system for these bridges. The preliminary assessment indicates that there are likely to be strata of sufficient capacity to support these types of foundations at relatively shallow depths.

8.2.6 Flood Immunity

At their lowest point the superstructure soffits would be at approximately RL 533 m AHD; about 1 m above the expected dam break water level and 8 m above the anticipated 100-year flood level at the crossing site. The bridges are therefore at a level where they will be unaffected by foreseeable flood events.

8.2.7 Drainage

The runoff from the carriageways on the bridges will be piped to avoid discharge into the Molonglo River. The bridge drainage system will discharge into the road stormwater system at the western abutment.

8.2.8 Provision For Cyclists

As mentioned above the 2 m shoulder will accommodate on-road cycling. The bridge barriers should therefore be designed to a height of at least 1300 mm above the road surface to meet the relevant standards for accommodation of cyclists on bridges.

8.2.9 Constructability

This pair of bridges would be constructed in the same way as the John Gorton Drive structures. Hence some saving in temporary works cost could be envisaged by constructing the two pairs of structures at the same time; as an erection gantry used for the first set of bridges could be re-used at the second site.

8.2.10 Cost

Although the proposed method of bridge construction is relatively cheap the topography and access constraints will increase the cost of the works beyond what is normally expected for this type of construction. These bridges are estimated to cost $45 million to build.

8.2.11 Construction Programme

As with the John Gorton Drive Bridges it is expected that these bridges, constructed as a pair would take about 20 months to build, with a design and documentation period of about one year.

If only one bridge were to be constructed the construction duration would reduce to approximately 18 months, for the same reasons as discussed in Section 8.1.11 above.

Considerable resources would be required to construct the two pairs of bridges in parallel. However works could be staggered so that a total construction duration of about 26 months for the four bridges would be achievable. Additionally the investment in temporary works for these bridges would be a substantial proportion of their cost and so may affect the decision to postpone the construction of the second of each pair.

9 HYDROLOGY AND DRAINAGE

9.1 General

In this section the existing storm drainage within the catchment contributing to the proposed East-West Arterial road, John Gorton Drive and Coulter Drive Extension is described. A catchment plan is given in Figure 155.

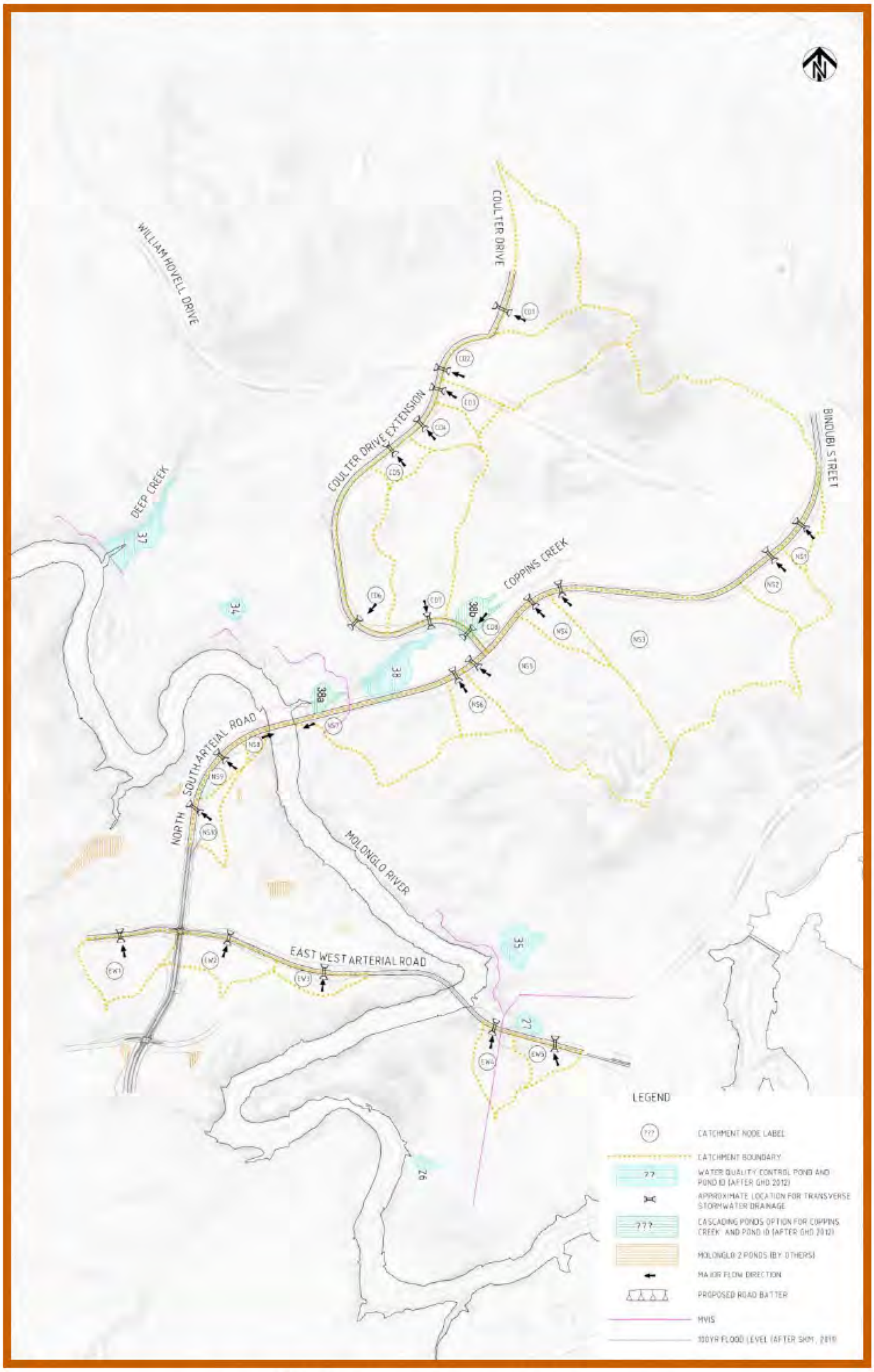


Figure 155: Catchment Plan and Node Locations

9.2 Catchment

Apart from the catchment north of William Hovell Drive, the remainder of the catchment contributing to the proposed roads mentioned above 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.

9.3 Hydrology

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.

In the current study, only hydrologic modelling was undertaken to determine the flows at critical locations of the proposed roads, under both existing and post-development catchment conditions. The hydrologic modelling was undertaken using the XP-Rafts program (XP Software 2009). Modelling was undertaken in accordance with the TaMS Design Standards for Urban Infrastructure (DSUI). Wherever possible a brief discussion on how these results compare with the GHD results has been presented. As the model nodes in the current study were positioned to suit the drainage design for the proposed roads, they do not necessarily match with the GHD model nodes. Node locations can be found in Figure 155.

9.3.1 Model Inputs

- **Catchment areas and slopes**
  Catchment boundaries were delineated using 0.5 m contours for the catchment downstream of William Hovell Drive and 2.5 m contours for the catchment upstream of William Hovell Drive. Catchment areas were measured in AutoCAD. Average catchment slopes were used, given the approximations and assumptions associated with flow path determination and catchment delineation.
- **Catchment Imperviousness**
  For the existing catchment, imperviousness was estimated from aerial image of the catchment dated May 2012.
  For post-development conditions, impervious component of each catchment was estimated using the Territory Plan to determine the current development intentions for the catchment, and assigning the following impervious percentages for the type of development proposed for the sub-catchment:

Table 16: Catchment Imperviousness

Development	Imperviousness
Suburban Areas	45%
Urban Areas	45%
Core Areas	80%
River Corridor	0%
Hills, ridges and buffer	0%
Roads	100%

9.3.2 Model Runs

The model was run for 5-year and 100-year ARIs (Average Recurrence Interval) for thirteen durations ranging from 10 minutes to 2880 minutes. Peak flows for each node were determined for their critical durations.

9.3.3 Model Results

Peak flows computed at critical locations are given in Table 17 for existing and post-development conditions.

Table 17: Peak Flows (m^3/s) at Critical Locations for Existing and Post-development Conditions

Node	Catchment Area [ha]	Existing Catchment		Post-development Catchment	
		5-year ARI	100-year ARI	5-year ARI	100-year ARI
CD1	22.7	1.6	4.1	1.6	4.1
CD2	36.5	2.4	6.2	2.4	6.2
CD3	5.3	0.5	1.3	0.5	1.3
CD4	7.9	1.4	3.1	1.8	3.5
CD5	5.0	0.4	1.0	0.8	1.6
CD6	23.6	1.3	3.6	3.2	6.5
CD7	43.7	2.1	5.8	4.7	9.7
CD8	245.0	15.4	43.4	18.2	46.5
NS1	3.0	0.2	0.5	0.2	0.5
NS2	14.1	0.9	2.3	2.1	4.3
NS3	55.8	2.2	6.4	2.6	7.3

Node	Catchment Area [ha]	Existing Catchment		Post-development Catchment	
		5-year ARI	100-year ARI	5-year ARI	100-year ARI
NS4	12.4	1.1	2.6	2.1	4.3
NS5	52.3	2.6	7.0	3.6	8.4
NS6	9.2	0.7	1.7	1.3	2.8
NS7	26.0	1.5	4.1	3.1	6.4
NS8	1.0	0.1	0.3	0.2	0.4
NS9	3.6	0.3	0.8	0.6	1.2
NS10	4.9	0.4	1.0	0.8	1.6
EW1	16.0	1.3	3.1	2.4	5.1
EW2	12.0	0.7	1.9	1.9	3.8
EW3	6.6	0.8	1.9	0.8	1.9
EW4	11.6	0.7	2.0	1.6	3.4
EW5	5.0	0.4	0.9	0.8	1.6

9.4 Water Quality

Water quality modelling was not undertaken as part of this feasibility study.

9.5 Flow Retardation

There was no comment in the GHD study regarding any need for flood retardation to reduce the post-development flows to existing flows. This is an issue which will need to be resolved prior to detailed design.

Flood retardation was therefore not modelled as part of this feasibility study.

9.6 Discussion

9.6.1 Peak Flows

Under existing conditions, peak 100-year ARI flows are below 7 m^3/s for all nodes except for node CD8. Under post-development conditions, peak 100-year ARI flows are less than 10 m^3/s for all nodes except at node CD8. At node CD8, the 100-year ARI peak flows under existing and post-development conditions are 43.4 m^3/s and 46.5 m^3/s respectively.

Peak 100-year ARI flows under post-development conditions are higher than for existing catchment conditions for all nodes except for CD1, CD2, CD3, NS1 and EW3, with maximum increases of 2.8 m^3/s and 3.9 m^3/s for 5-year and 100-year ARI events respectively. The reason for the increase in flows is that future development is proposed in the sub-catchments represented by these nodes.

At Pond 38, the peak 100-year ARI flow computed under post-development conditions was 77 m^3/s for the 60 minute duration event, compared to 85.2 m^3/s given in the GHD report. The XP-Rafts model included 18 nodes to represent the Pond 38 catchment with a total catchment area of 500 ha with 20% imperviousness.

Using the Rational Method and following clause 1.2.4 of the DSUI-Stormwater, a 100-year peak flow of 93 m^3/s, treating the 500 ha catchment as a single node. It should be noted that partial area effects are not accounted for in this calculation, as stipulated in the DSUI-Stormwater.

9.6.2 Flow Retardation

It should be noted that there will not be much opportunity, nor would it be very economical, to retard flows at each transverse drainage location. Flood retardation measures are generally targeted at locations of high flow. At node CD8, where the flow is the highest of all nodes, the increase in flow from existing to post-development conditions is only about 7%. It would not be economical provide a flood retardation facility even at this location to reduce the flow to existing level. However, as a water quality control pond (38b) has been nominated for this location, it may be feasible to convert it to a water quality/flood retardation facility. Reduced peak flows (possibly below existing levels) would reduce the drainage reserve requirement through the area downstream of Coulter Drive extension earmarked for the Northern Group Centre, and further downstream to the Molonglo River. However, further modelling will be required to determine retardation volume and flood levels at this location.

9.6.3 Water Quality

With the GHD ponds potentially impacting on the proposed roads, their physical parameters will need to be amended to eliminate or minimise their impacts on the proposed arterial roads. Water quality modelling will therefore be required during the design phase to determine the water quality improvement measures needed to achieve the applicable pollutant retention targets.

Should Pond 38b be converted to a water quality/flood retardation facility, the pond physical parameters would need to be chosen to suit the flood retardation requirements.

9.7 Potential Impacts on the Proposed Works

9.7.1 Coppins Creek

From about 2 km upstream of its confluence with Coppins Creek, to the confluence, the proposed John Gorton Drive runs parallel to Coppins Creek. The area downstream of the proposed Coulter Drive extension 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 m^3/s at Coulter Drive extension and increasing downstream) from the Coulter Drive extension 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 Coulter Drive Extension.

Node CD8 is where Coppins Creek would cross the future Coulter Drive extension. Should the cascading ponds option be adopted for Coppins Creek, a large box culvert may be provided to convey this flow across the road. However, the size of the box culvert required will need to be determined through hydraulic modelling of the Coppins Creek/Floodway, during the design phase of the project.

9.7.2 Molonglo River

Where John Gorton Drive and the East-West Arterial roads 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.

9.7.3 Water Quality Control Ponds

The single pond option by GHD for Coppins Creek (Pond 38) could have backwater effects on the Coulter Drive extension. It has been proposed to be constructed in close proximity to John Gorton Drive. If this pond option was 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 the Coulter Drive extension and the North-South-Arterial road will need to be closely examined.

In the cascading pond option by GHD, Pond 38a would impact on the proposed John Gorton Drive alignment. Pond 38b also could potentially impact on John Gorton Drivel and Coulter Drive Extension.

Pond 27 would impact on East-West Arterial. If any of these pond options was to be progressed further, preliminary embankment levels and design flood levels will need to be determined and then the pond physical parameters may need to be amended to minimise the impacts to an acceptable level. Water quality modelling will then need to be undertaken to determine the pond size requirements in light of the physical parameters feasible with minimal impact on the roads.

9.7.4 Playing Fields

Two options have been proposed for the playing fields. Both options appear to be located within natural stormwater drainage paths. The option of having the playing fields south of William Hovell Drive encroaches onto an existing farm dam, and the playing fields also lie 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.

Locating the playing fields at either location would require stormwater diversion works. Locating the playing fields south of William Hovell Drive would see the loss of the farm dam. Preliminary estimation of the 100-year ARI peak flow through the site shows that a minimum 20 m wide drainage reserve will be required for a grassed diversion channel along the northern boundary of the playing fields, with several drop structures at regular intervals to limit the velocity below 2 m/s. Alternatively, a 4×3600 mm×900 mm RCBC could be used to convey the flow underground, with the playing fields constructed above.

9.8 Summary

Through hydrologic modelling, 100-year ARI peak flows were determined to estimate the transverse drainage requirements for the proposed roads where they cross identifiable drainage lines, based on available topographic information.

Hydraulic modelling of Coppins Creek/Floodway will be required to ascertain flood levels within the creek/floodway and potential impacts on the road embankment. The culvert across Coulter Drive Extension (if the cascading ponds option is adopted for Coppins Creek) could also be sized as part of this hydraulic modelling.

All drainage design should be undertaken with an acknowledgement of the presence of potential PTWL habitats.

It would not be feasible to provide flood retardation for individual transverse drainage catchments. At node CD8, just upstream of the Coulter Drive Extension where the flow is the highest of all nodes, 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 pond nominated at this location into a water quality/flood retardation facility. Retardation volume required, flood levels and permanent pool volume required for pollutant retention will 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. Pond physical parameters will need to be finalised with acceptable impact of flood levels on the roads and to meet the minimum pollutant retention requirements.

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

10 ENVIRONMENTAL IMPACTS

10.1 Introduction

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

The *Molonglo Valley Plan for the Protection of Matters of National Environmental Significance* (NES Plan, ACTPLA October 2011) is the result of a Strategic Assessment under the *Environment Protection and Biodiversity Conservation Act, 1999*. This was undertaken by the ACT to assess, alter and approve the Molonglo Structure Plan in a way that reduces impacts on Matters of National Environmental Significance (MNES) to an acceptable level under the Act.

Implementation of the Structure Plan will also require approvals under the ACT's *Planning and Development Act* and this feasibility study endeavours to anticipate the future approval requirements under this Act. A Preliminary Risk Assessment (PRA) for the development of Stage 2A has been undertaken by NGH. While this document focuses on the first land release (part A) it contains general risk advice for the whole of Stage 2. The advice relates to the potential environment impacts that would be assessed against local ACT legislation.

Many of the impacts of development from Molonglo are being offset into a public River Park that will stretch along the river banks and lower slopes of the Molonglo Valley. This area contains the core habitat of the Pink-Tailed Worm Lizard (PTWL); this habitat is mapped and shown in Appendix A. This reserve needs to deliver on conservation and recreational opportunities while also accommodating essential infrastructure such as sewers and arterial roads. The NES Plan provides details on what key aspects of the park need to be protected from infrastructure development. In particular it contains specific requirements for protecting PTWL habitat and Box Gum Woodland.

In addition to these above key documents mapped, environmental information was provided by ESDD including habitat maps and heritage sites. The river park concept plan provide a mapped layer which was used as an overlay to check the impact of the proposed arterial roads on this plan.

Under the principles of sustainable development that has been 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.

10.2 Limitations and Exclusions

The terrain limitations and overarching Molonglo planning requirements have been considered by the design team and are not discussed in the environment section.

Ground water issues have been reviewed by a SMEC hydro-geologist. No obvious impacts on groundwater are predicted and ground water is not discussed further as a constraint to the proposal.

Aquatic issues and water quality are also not considered because no significant impacts on the Molonglo River are predicted as part of the development. The bridges are likely to fully span the main channel of the river. Riparian vegetation and habitat along the river is limited and does constitute a potential significant limitation to the development. Riparian issues are also not considered in this report.

A preliminary tree assessment will be required during the preliminary sketch plan phases of the development program. Significant trees are not discussed in this study.

The Lower Molonglo Geological Site is 3 km downstream of Coppins Crossing and will not be impacted by arterial road development. Geological heritage is not considered further in this study.

Related socio-economic issues such as climate change, fire hazard, view sheds, community perception, Mt Stromlo Observatory, public health and safety are also not discussed in this study.

Known European heritage sites have been avoided by the arterial road feasibility design. Known Aboriginal site maps have been provided.

It is assumed that the proposal will trigger at least one EIS under the ACT impact legislation because of the numerous impacts road building may cause on vegetation, habitats and threatened species. There is no further discussion of the triggers for the impact track under ACT legislation.

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 would be relatively large and, although there has been much study of the area, the biodiversity issues of the non-EPBC listed threatened species have not been reviewed in the context of the possible impacts on them and their and locations. Also, while the NES Plan clearly serves as a major conservation management outcome for ACT listed threatened species, the extent to which this occurs is yet to be reviewed in detail. Ideally this significant body of work would be accepted as the core of a reduced EIA requirement for the arterial roads proposal.

The environmental assessments undertaken have been almost exclusively desk top utilising the data provide from ACT Government sources. Field verification of the data at key locations and at a scale suitable to final road design may be required at the preliminary and final sketch plan design phases.

10.3 NES Plan Commitments

The interaction between the drafted arterial road alignments and the NES commitments has been undertaken. The MNES that require commitments through the NES Plan are:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland). Remnants of this endangered ecological community could be impacted by the arterial roads proposed in the feasibility study.
- Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT ((Natural Temperate Grassland). Remnants of this endangered ecological community only occur in the Kama Nature Reserve and are not:
  - *Aprasia parapulchella* (Pink-Tailed Worm Lizard);
  - *Polytelis swainsonii* (Superb Parrot); or
  - *Lathamus discolour* (Swift Parrot).

Key impact constraints relevant to the arterial roads feasibility study are:

- Impacts to Box-Gum Woodland will be limited to a maximum of 110 ha and a range of measures will be implemented to minimise this area of impact and protect enhance and rehabilitate nominated areas;
- Ensure that the combined impacts on high and moderate quality PTWL habitat from development within East Molonglo and construction of infrastructure within the river corridor do not exceed 27 ha and provide a range of measures to minimise this area of impact;
- Remnant patches of Box-Gum Woodland, particularly to the west of East Molonglo, provide suitable and potential habitat for the Superb and Swift Parrots. The most important outcome for these birds is the establishment of the Kama Nature Reserve. However the additional protection of Box-Gum Woodland prescribed in patches C, H, N, I, L, M and P (as detailed in the NES Plan – see Figure 156) and minimising impacts on patches D and T will benefit Superb and Swift Parrots.

10.3.1 Commonwealth Negotiated EPBC Outcomes

To address these NES requirements SMEC has avoided these habitats and their offset areas. SMEC has also kept a running total of all the habitat hectares consumed by the feasibility design to check the development against the NES Plan requirements. This has been achieved by totalling the area of overlap between the two mapped habitats (as provided by ESDD) and the areas of arterial road and cycleway from the design.

Total habitat area impacted by the feasibility study arterial road design is outlined in Table 18.

Table 18: Habitat loss [ha] as a result of arterial roads proposal

Infrastructure	PTWL (high)	PTWL (medium)	EPBC Box Gum	ACT Box Gum
Road	0.1	0.5	3.8	15.1
Shared User Path	<0.1	<0.1	<.01	<0.1
Speed Cycleway	<0.1	<0.1	<0.1	<0.1
TOTAL	**0.2**	**0.6**	**3.9**	**15.2**
Total loss allowed in NES Plan	27 ha		110 ha	N/A
Loss as a result of arterial roads	2.9%		3.5%	N/A

Impacts that would result from the implementation of the arterial roads as proposed in this feasibility study amount to approximately 3.5% and 2.9% of the Box-Gum Woodland and Pink-Tailed Worm Lizard habitat loss budget allocated in the NES plan respectively.

This could be further reduced during the PSP and FSP stages by tailoring of the standard cut and fill batters currently supporting the proposed alignments.

Where possible the road design has avoided the agreed 20 m buffer distance to PTWL habitat. However, this has only been a general approach. This issue will require refinement during the PSP and FSP design stages, where impact reduction measures can be tailored to individual sites.

At the time of writing it is not known how much of the budget for Molonglo is already allocated. The amount consumed by the feasibility design is expected to be a very small proportion of the remaining budget.

10.4 Preliminary Risk Assessment

10.4.1 Introduction

This 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 reports on location specific risks and activity related risks. It looks at key unmitigated risks and where possible makes recommendations about ways to manage and reduce these risks.

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.

Namely these are:

- *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native* Grassland (Box-Gum Woodland). Note that ACT and nationally listed communities are defined differently.
- *Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT* (Natural Temperate Grassland). Note that ACT and nationally listed communities are defined differently.
- *Aprasia parapulchella* (Pink-tailed Worm Lizard).
- Polytelis swainsonii (Superb Parrot).
- Lathamus discolour (Swift Parrot).

Negotiated outcomes include a set number of hectares of habitat allowed to be cleared by the whole Molonglo development, offset reserves and conservation management agreements.

10.4.2 Outstanding ACT Environmental Issues

The remnant ACT legislatively protected biodiversity identified in the PRA as possible constraints to development in Molonglo Valley Stage 2 are listed and addressed below:

- *ACT Box Gum Woodland*. As shown in Appendix A, the proposal impacts on this protected community in the vicinity of offset area GG, around the Bindubi Street intersection and in an area just south of the Coulter Dive intersection. The PRA and communication with CPR suggests the quality of this woodland is mostly low. None the less this level of impact will most likely require resolution in an EIS.
- *Woodland Connectivity*. The proposal may impact on recognised corridors in the Bindubi Street area, although this issue on its own is unlikely to trigger the impact track. This issue is discussed further in Section 10.7.4.2.
- *Vegetation clearing*. The proposal will clear significant tracks of native vegetation. Much of it is in low condition. This issue will need to be resolved in further EIA work during the PSP and FSP stages.
- *Tree hollows*. Clearing of tree hollows relates to the protection of threatened species habitat. In particular the PRA identifies that threatened Brown treecreepers and Superb Parrots are important users of tree hollows in Molonglo. As stated in the PRA the central area of the Molonglo Valley is a well-known for its hollow bearing trees that are utilised by woodland birds, especially Superb Parrots. This area is not affected by the arterial roads proposal. None the less a risk remains that the proposal will clear trees with hollows in the areas outside the scope of the NES plan. Following further studies of the final alignment this issue may need to be resolved in further EIA work during the PSP and FSP stages.
- *Threatened plants*. The PRA identifies two threatened plants, Button Wrinkle Wort (*Rutidosis leptorynchoides*) and Small Purple Pea (*Swansonia recta*). These may be found in the development area. Although these species are Commonwealth listed they were not included in the NES Plan. This indicates that the Commonwealth does not consider the development to pose a significant threat to these species even though they may be present in the area. Following further studies of the final alignment this issue may need to be resolved in further EIA work during the PSP and FSP stages.
- *Threatened birds*. The PRA identifies that Regent Honey Eater, Painted Honey Eater, Brown Tree Creeper and Little Eagle are recorded in the Molonglo Valley. Regent Honey Eater is a Commonwealth listed species but is not considered in the

NES Plan. This indicates that the Commonwealth does not consider the development to pose a significant threat to these species even though they may be present in the area. Following further studies of the final alignment this issue may need to be resolved in further EIA work during the PSP and FSP stages.

- *Perunga Grasshopper*. Although this invertebrate is listed in the ACT as vulnerable. it is found in a wide range of native grassland and native pasture areas. The proposed alignment is unlikely to have a significant impact on the *Perunga Grasshopper*. However, the status of the grasshopper in the Molonglo Valley may need to be assessed in the EIA for the future suburban development to ensure viability in the region.
- Aboriginal heritage has not been shown on the mapping for confidentiality reasons. It can be said however that 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
  - In and around Glenloch Interchange, many of which have already been salvaged as part of the Gungahlin Drive Extension projects
    These issues may need to be resolved in further EUA work during the PSP and FSP stages.
- Two European heritage sites are shown on the map and are not impacted by the proposed road alignments.

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 of the Park, such as PTWL habitat and Box-Gum Woodland, also serves 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 potential conflict with horse riding trails. This is discussed in the feasibility report. It is understood that the final refinement of boundaries for the River park will be undertaken in parallel with the evolution of Molonglo infrastructure design. None the less impacts on the future Park as a result of arterial road development may need to be resolved in EIA during the PSP and FSP stages.

10.6 Contamination

Regarding contamination, Coffey (2005) identified a number of areas of concern that may be possible constraints to the development of Stage 2. These include the Coppins Crossing Sewage Sludge Ponds, sheep dips, a forestry plantation block, a waste oil depot and land fill areas. From an examination of Figure 8 it can be seen these issues are unlikely to constrain the proposed development.

The risk of contaminated land is also the subject of a commercial in confidence report by AECOM (2010) which is discussed in the PRA. The PRA states no registered contaminated sites are recorded in the Stage 2 area.

It is understood that a detailed Phase 2 assessment of the Stage 2 area is being undertaken and until this is completed and made available, the arterial road feasibility study cannot comment further on the issue of contamination as a potential constraint to arterial road development.

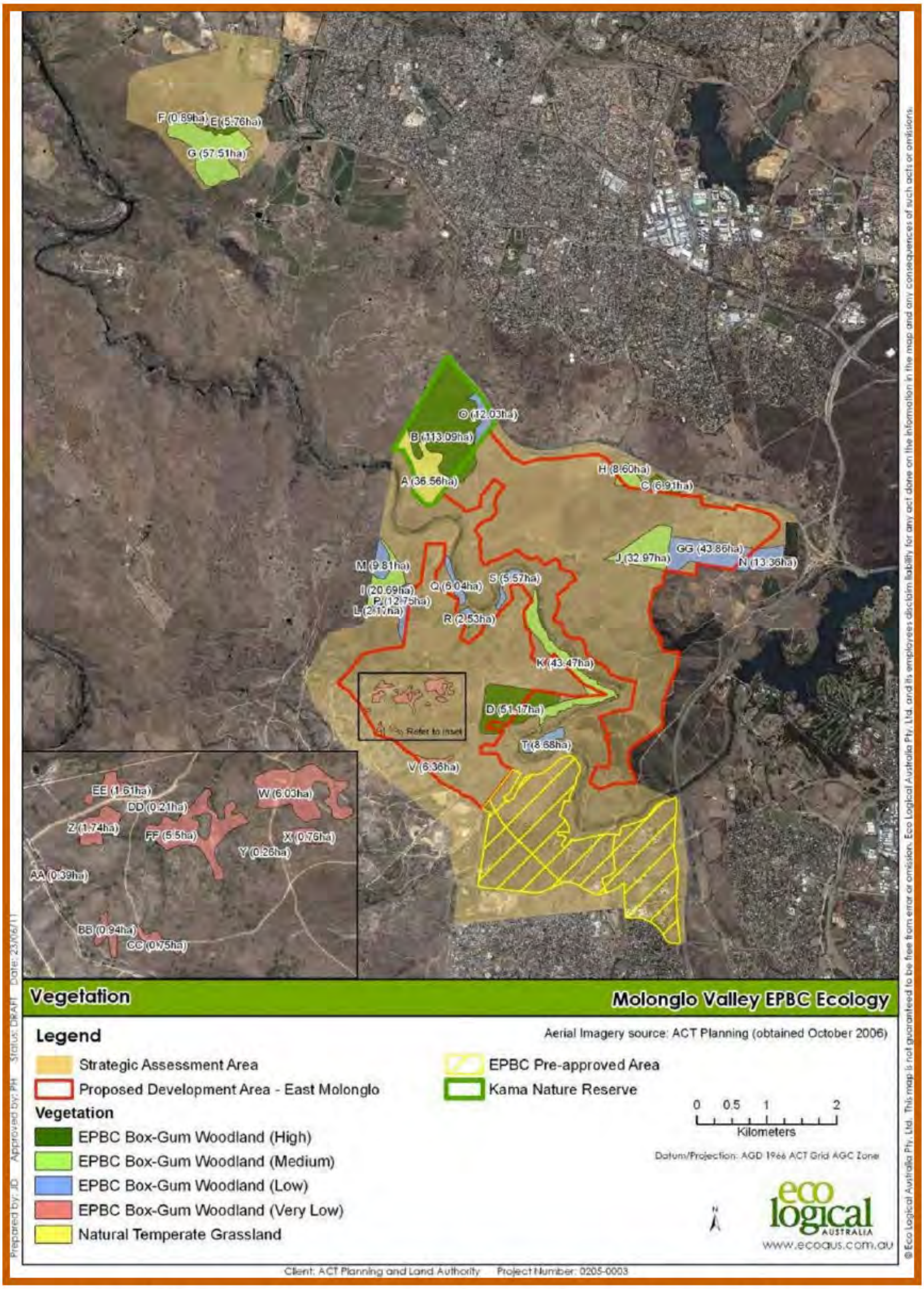


Figure 156: Box-Gum Woodland and Natural Temperate Grassland (Source: NES Plan p7)

10.7 Review of Road Design Against Environmental Constraints

10.7.1 First Design Iteration

In the first design iteration the design team mapped the most suitable routes that resulted in the least disturbance to the environmental constraints. To test the interaction between all associated infrastructure and the environment the shared path and connector roads were also added to the mapping in suitable locations.

For the first design iteration, or initial design analysis, the approach was for the environmental team to establish with the design engineers where the arterial road alignments can be moved freely; can be moved if mitigation measures are implemented; or cannot be moved without major compromise of the existing environmental strategies and NES conditions of approval. The design engineers were able to avoid almost all of the identified NES constraints in the first iteration so revisions involving mitigation and major compromise options were not required.

10.7.2 Second Design Iteration

In the second design iteration, or draft concept design, the environmental team undertook a detailed review of the alignments generated in the first iteration and consulted with key stakeholders. This information was provided back to the design team.

A major analysis required during this phase was the development of a suite of alignment options for the East West Bridge location. A number of other issues were also addressed including impacts on the PTWL buffer zones and adjacent EPBC Woodland in future reserve areas.

10.7.3 Consultation

Consultation with Dr. Will Osborne, TAMSD River Park development team and Conservation Planning and Research (CPR) was undertaken on the second design iteration.

10.7.3.1 Consultation with Dr. Will Osborne

Key issues were raised during the second iteration consultation with Dr. Will Osborne:

- **Eastern bridge crossing.** A primary concern was raised concerning the alignment of the East-West Arterial where it crosses the river in the south east quarter of the study area. Dr. Osborne advised of very high densities of animals in the warmer northern facing slopes and on the crest of the saddle, whereas there were very few animals found in habitat in the cooler south-eastern side of the saddle. Dr. Osborne requested that an investigation of an alignment further south away from the high density population, closer to the original alignment shown on the River Park Plan and other plans, was undertaken. This alignment requires more consumption of mapped habitat but locally the outcome is potentially better for PTWL because it protects one of the largest populations associated with more intact and contiguous habitat. (*Response: Several different alignments were tested – see Section 10.7.4.1.*)
- **20 m buffer.** In the north-eastern quarter of the project area near the Kama Nature Reserve there was a collector road that appeared to impinge on the 20 m buffer zone of some moderate habitat. This should be adjusted. It was also noted that the fire management (inner and outer asset protection zones) buffer to Kama should also be shown and planned for in the designs. In the vicinity of the pedestrian/sewer link bridge (near Coppins Crossing) it was noted that the bike path may encroach on the 20 m buffer of PTWL habitat. It was also noted that in this area existing tracks were used, but it was still seen as an issue worth checking for here and generally across the study area. (*Response: The collector roads were nominally provided in the feasibility road mapping simply to provide context. Final road and suburb design would resolve this issue.*)

Dr. Osborne made additional comments:

- **Bridges.** Avoid construction of bridge piers in habitat and design them to allow maximum water and sunlight penetration; consider using steel mesh for pedestrian facilities if they pass through habitat areas. (*Response: advice passed on to Government.*)
- **Minimise footprint.** Footprint of development should be planned to be minimal in habitat areas. (*Response: As per NES Plan. Advice passed on to Government.*)
- **Rehabilitation.** Although as yet un-trialled, PTWL habitat rehabilitation techniques are available and these should be noted, considered and planned for at the earliest stages. Amongst other things this involves the placement of medium sized rocks and the planting of Kangaroo Grass and Yellow Buttons. A list of suitable species will be available in the Management Plan for the Molonglo Valley reserve areas and is available from the Institute for Applied Ecology (W. Osborne). (*Response: Although rehabilitation is many stages in the future it is seen as worthwhile to carry this information through the preliminary planning stages of Molonglo urban development so that opportunities to carry out this work in the future is not be lost.*)

10.7.3.2 Consultation with Molonglo River Park Implementation Team

Key issues raised in the consultation with the Molonglo River Park Implementation Team at TAMSD were:

- **East-West River crossing.** This alignment had been moved north of its original alignment as shown on the Structure Plan, to avoid PTWL habitat and better fit to the geography of the eastern side of the river valley. The Molonglo River Park Implementation Team at TAMSD prefers a route closer to what is shown on the River Park Concept Plan. This is to comply with wildlife ecologist, Dr. Will Osborne's request to move the alignment of the East West Arterial road south and away from an area of highly occupied habitat. (*Response: Several different alignments were tested – see Section 10.7.4.1.*)
- **Bicycle path in woodland.** The River Park Implementation Team raised concerns regarding the proposed cycle highway alignment on the south side of the East-West Arterial transecting high quality Box Gum Woodland. The path was aligned through woodland set aside for the reserve at the expense of Box Gum Woodland to be developed closer to the Molonglo 2 Group Centre. In checking the realignment suggested by Dr. Osborne the River Park Implementation Team requested that a new alignment for the cycle highway be explored that does not impact the Box Gum Woodland (referred to in the NES Plan as Patch D) south of the proposed East West Arterial. (*Response: Cycle path alignments were provided mainly for context to ensure supporting infrastructure was allowed for in the design. This cycle path has however been re-routed to avoid this woodland in the reserve.*)
- **Bicycle path loop on ridge.** The River Park Implementation team had concerns for a cycle path looping at the end of the peninsula on the west side of the river just before the main bridge for the East-West arterial. The team understood the need to afford this commuting route the correct grades; however they requested for the alignment to be revised to reduce impacts if possible. (*Response: Cycle path alignments were provided mainly for context to ensure supporting infrastructure was allowed for in the design. This cycle path has however been re-routed to avoid this habitat area.*)
- **Equestrian Trail.** There is a proposed equestrian trail alignment along the north side of the river, parallel to the proposed cycle highway. This is shown on the Final Draft River Park Concept Plan. The implementation team mentioned that the cycle highway should be sensitively sited away from the equestrian trail as these two recreation uses are not compatible – some horses can be spooked by bicycles. Additionally the Bicentennial National Trail intersects with the equestrian trails of the area. This trail and other equestrian trails should be shown and accommodated on future proposed road plans. (*Response: The equestrian trail has been shown on the feasibility plans, however final alignment needs to be determined outside of this study.*)
- **Concept Park Boundaries.** At least two minor park boundary changes have occurred since issue of the most recent version SMEC has been issued. These boundary locations do not appear to have any impact on the arterial road alignments and associated infrastructure, but the latest boundary is expected from ESDD. (*Response: at the time of writing the latest reserve boundaries have been shown.*)

10.7.3.3 Consultation with TAMSD Conservation Planning and Research (CPR)

Key issues raised by CPR were:

- **NES Plan.** In general CPR is of the view that the NES plan serves most ACT conservation interests. For example the grassy woodland offsets and reserves that have been established to protect Pink-Tailed Worm Lizard (PTWL) will also serve to protect Perunga Grasshopper, an ACT threatened species which is also found in these areas. (*Response: No action required.*)
- **River crossings and bridges.** CPR has no major concerns with the river crossing points. Michael Mulvaney walked the east-west route and is comfortable with the preferred (black) alignment agreed with Dr. Osborne. (*Response: No action required.*)
- **Connectivity and EPBC woodlands.** CPR has ongoing concerns regarding the protection of remnant EPBC woodlands, particularly those remnants with large habitat trees and those remnants in areas where the ACT Woodland Restoration Project requires plantings and protection measures. This is the case at the Bindubi Street intersection where mature trees within a historic stock reserve and an adjoining EPBC Woodland at the Bindubi Street – William Hovell Drive intersection are part of the restoration plan and may be impacted by any proposal to introduce sports ovals in this area. (*Response: Intersection and oval options have been explored as separate to the main arterial road feasibility designs, and the presence of local constraints has been identified.*)
- **Friends of Aranda Bushland.** CPR has provided a letter from Jon Stanhope stating his support for this group in its desire to have the Aranda Snow Gums historic site and surrounds added into the Black Mountain Reserve. The presence of significant woodland and community expectations are likely to be a significant constraint to development of ovals in this area. The letter contains a map of the area of interest. Kangaroos are also expected to be an issue for arterial road development in this area. (*Response: Intersection and oval options have been explored as separate to the main arterial road feasibility designs, and the presence of local constraints has been identified.*)
- **Previously proposed oval location.** CPR identified that they had previously provided support for the development of ovals in the south of the study area in regenerating pine forest nearer to Scrivener Dam. (*Response: Intersection and oval options have been explored as separate to the main arterial road feasibility designs, and the presence of local constraints has been identified.*)

Additional comments from CPR were:

- **Public open space.** CPR has a general concern that road and urban development will spread weed, sediment and nutrient impact into the allocated public open spaces. These open spaces serve to provide habitat connectivity for woodland birds between the river corridor and other conservation hubs such as the arboretum. The arboretum is expected to provide good foraging for birds because of the diversity of trees and other flowering plants. Attention to detail in the construction and monitoring of the infrastructure will be required. (*Response: advice passed on to ACT Government in this report.*)
- **Equestrian Trail.** There is a proposed equestrian trail alignment along the north side of the river parallel to the proposed cycleway. CPR has no concerns regarding the width that both bike and horse trails may require as long as the alignments are away from the identified habitats in the corridor reserve and the impacts can be contained during and after construction. (*Response: No action required.*)
- **Asset protection zones.** It is noted that asset protection zones for Molonglo are not yet agreed with some areas such as Kama Nature Reserve potentially requiring an additional 300 m plus the nominal 30 m offset to suburbs because of the density of the woodlands in these areas. This issue is currently with Emergency Services Authority (ESA). (*Response: This issue sits with ESA.*)

As identified in italics above where possible these issues were addressed in the third and final design iteration. This is discussed below.

In summary CPR comments that there are no insurmountable environmental issues with respect to the proposed road designs. The key issues relate to the design and location of works at the Coulter Drive and Bindubi Street interchanges, the clearance of native (or planted) vegetation that these interchanges and the impact that this will have on the east-west movement of wildlife. Currently a Woodland Restoration program is being implemented to restore a continuous link of wildlife dispersal habitat from Black Mountain to the Murrumbidgee and Molonglo Rivers. CPR desire for the road works not to disrupt this linkage or at the very least to include ameliorative measures, such as additional planting and protection of paddock trees, such that the linkage can continue to function.

10.7.4 Third Design Iteration

The third and final design iteration milestone, or final concept design, was reviewed for compliance with the above consultation suggestions and the NES Plan requirements.

10.7.4.1 East-West Bridge Alignment

The alignment of the East West arterial bridge was in examined in detail. Three additional options were analysed (see Appendix A) in an attempt to move the alignment further south as suggested by Dr. Osborne. Two of options required either a much longer bridge or significant additional earthworks on the eastern side. A third “in-between” option was found to be acceptable but did require additional earthworks and did not fully avoid the north facing slopes.

In response to this, Dr. Osborne undertook a detailed field examination of the sites in question and concluded that the original alignment as proposed in the second iteration, and shown now as the preferred east-west bridge alignment, was acceptable as long as comprehensive rehabilitation and connectivity works are undertaken, and existing habitats were fully protected from construction impacts, particularly sedimentation and other site runoff.

10.7.4.2 Habitat Connectivity

A map of local habitat connectivity for the north eastern quarter of the study area was provided by CPR and is included in Figure 157. The map shows that there are medium habitat connectivity values in the Bindubi Street – William Hovell Drive intersection area that is also being investigated for the possible location of sports ovals. SMEC is of the view at this early stage that if core remnant EPBC woodlands could be protected, the proposed development's impacts on habitat connectivity along this particular part of the Black Mountain to Murrumbidgee corridor could be mitigated by a specific local program of native plantings and other habitat restoration, protection and enhancement actions.

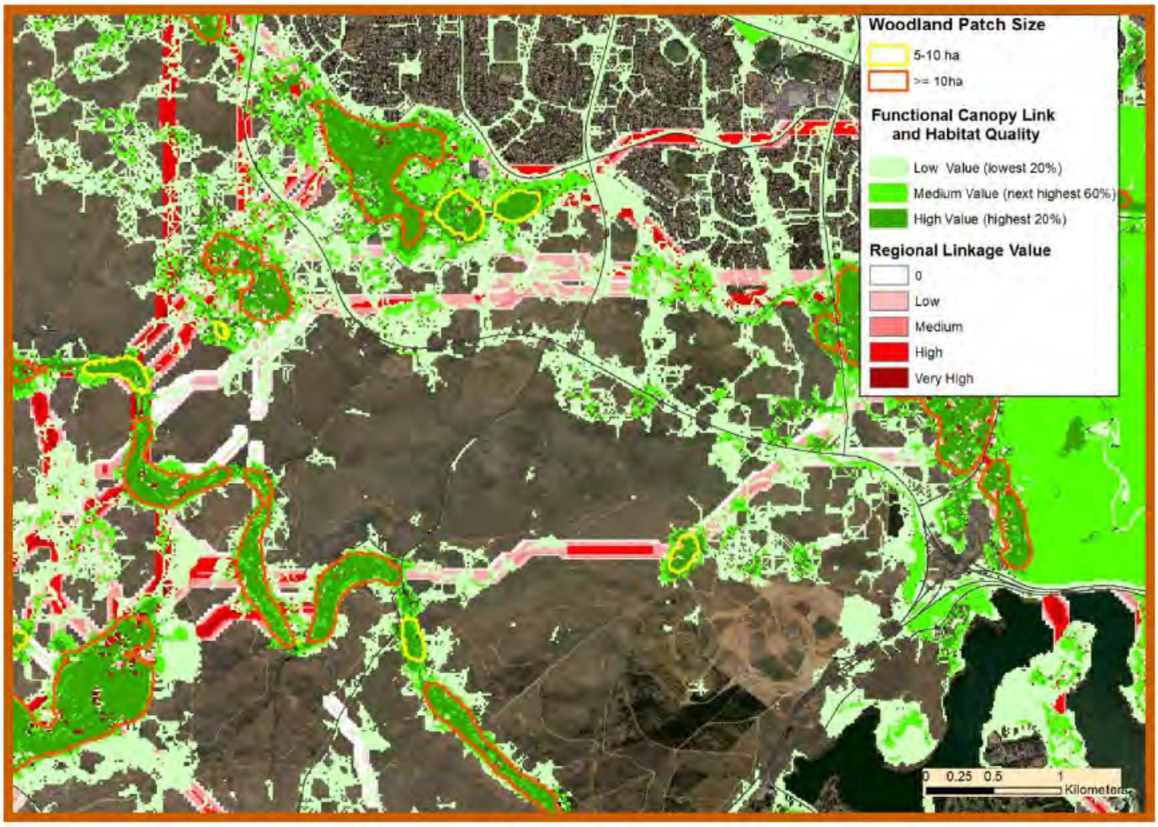


Figure 157: Habitat Connectivity

10.8 Summary

10.8.1 MNES Obligations

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. The alignment meets the NES Plan obligations of the ACT Government to avoid impacts on MNES in the first instance.

The impacts that would result from the implementation of the arterial roads as proposed in this feasibility study amount to less than 3.5% and 2.9% of the Box-Gum Woodland and Pink-Tailed Worm Lizard habitat loss budget allocated in the NES plan respectively.

10.8.2 Preliminary Risk Assessment and ACT Environment Issues

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. Although, 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. 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.

10.8.3 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 of the Park, 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 potential conflict with horse riding trails.

10.8.4 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 and the Pinnacles and beyond 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 Government and non-Government stakeholders.

10.8.5 Consultations

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.

10.8.6 Environmental Conclusion

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.

Consultation is needed during the program of road development as stakeholder concerns remain especially for the implementation phase where construction impacts may affect adjacent conservation reserves and threatened species and their buffer zones.

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.

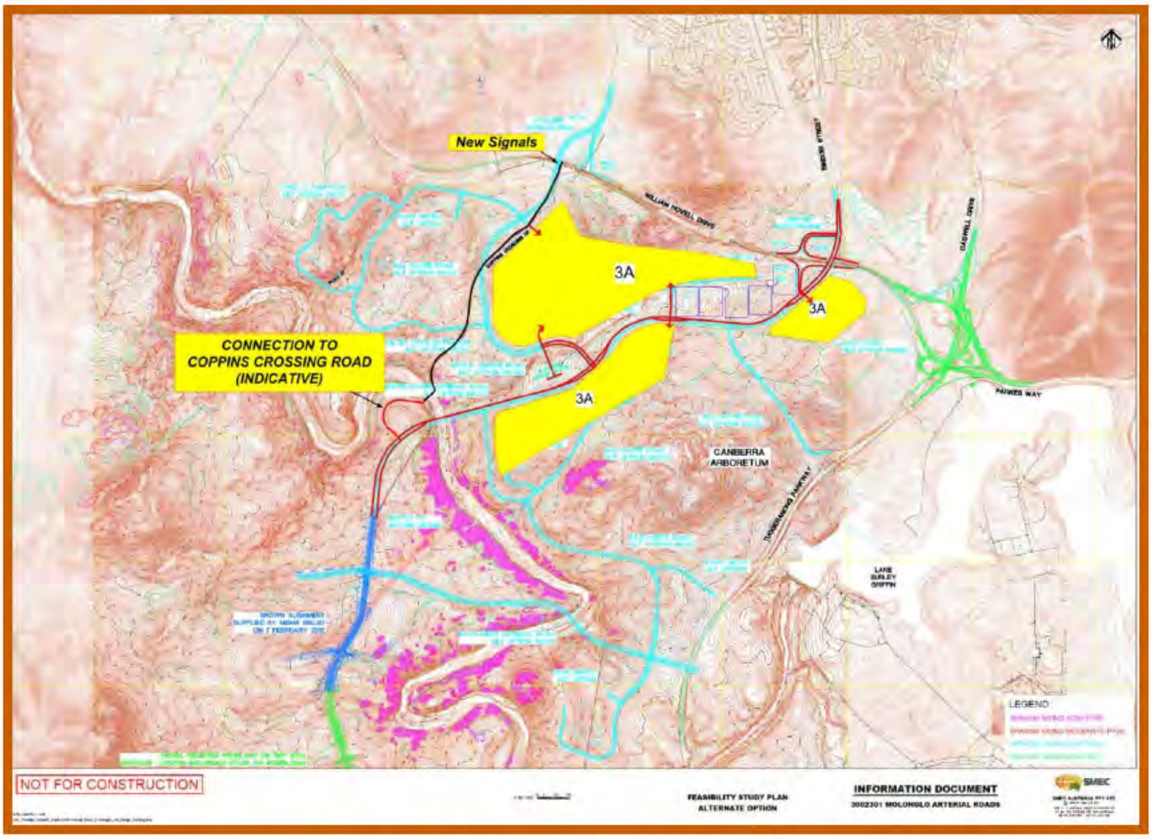


Figure 158: Proposed Molonglo Stage 3A

As shown in Figure 158, the initial development of Molonglo 3 (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 will facilitate the provision of a high quality public transport link as soon as possible for Molonglo 1 and Molonglo 2 residents as well as the new Molonglo 3 development. The land around John Gorton Drive is expected to be relatively high value and should be high density to provide increased access to the public transport spine on John Gorton Drive.

The new alignment of John Gorton Drive feeding Parkes Way provides a direct route to the CBD employment area that is of similar convenience to using the Tuggeranong Parkway and Parkes Way.

The expensive East-West Arterial link and associated upgrades to the Tuggeranong Parkway are deferred to Stage 3D.

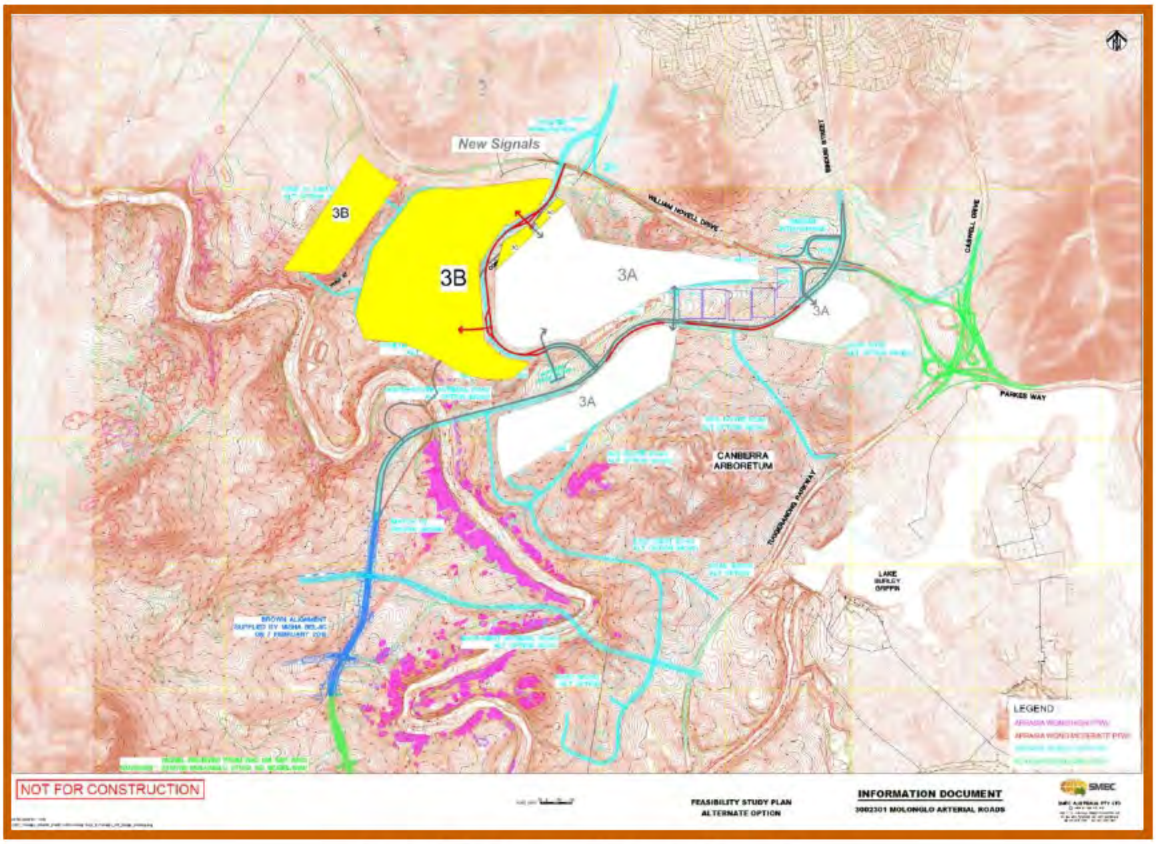


Figure 159: Proposed Molonglo Stage 3B

As shown in Figure 159, 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.

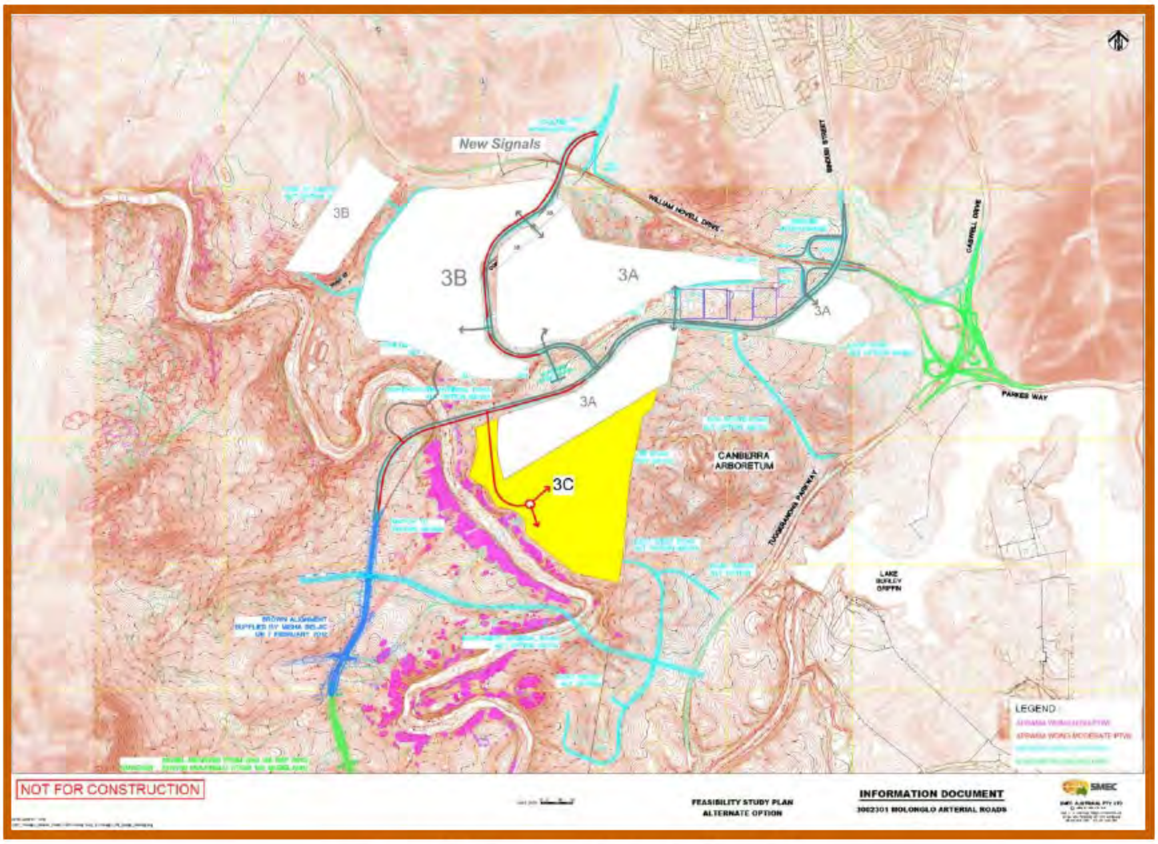


Figure 160: Proposed Molonglo Stage 3C

Figure 160 shows the proposed Stage 3C, which 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.

The proposed final stage (Stage 3D) of the Molonglo 3 arterial road network is illustrated in Figure 161.

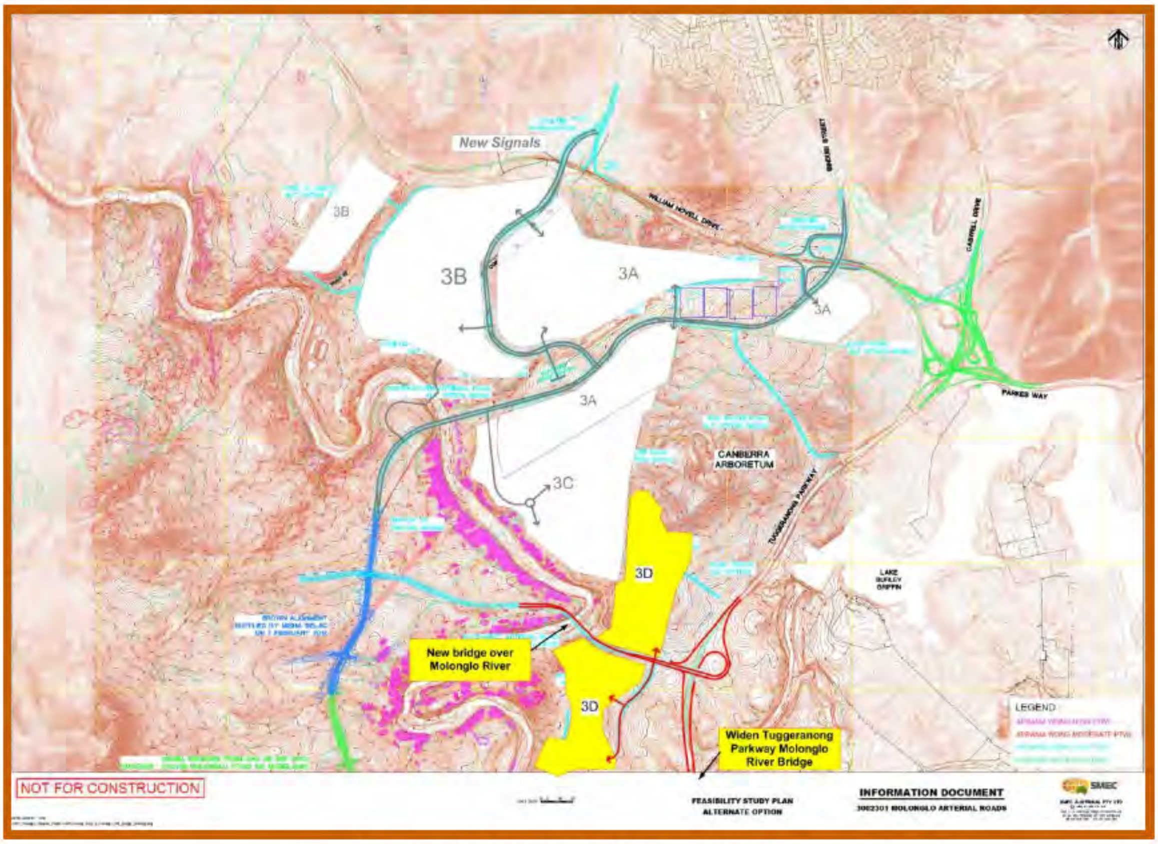


Figure 161: Proposed Molonglo Stage 3D

The development of 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.

A decision to connect the East-West Arterial to the Tuggeranong Parkway should be deferred until actual traffic demand and public transport patronage can be observed, and the costs and benefits established. In particular, the traffic volumes on the Tuggeranong Parkway would affect the improvements that may be required if the East-West Arterial connection were made.

Another option to improve network security without upgrading the Tuggeranong Parkway would be to connect the East-West Arterial to Lady Denman Drive at Scrivener Dam (with no ramps to the Tuggeranong Parkway). While this options is currently not favoured by the NCA, the situation may change in the future.

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.)**

12.1 Assumptions

The majority of the feasibility stage costs for the arterial roads have been based on calculations for all salient road features, resulting in overall construction cost per linear metre. Costs for underground services, clearing and grubbing, landscaping, road signs and street lighting have been based on costs per linear metre established from the construction costs detailed in the Molonglo Infrastructure Stage 1D and Stage 2 projects (John Gorton Drive).

It is noted that some conditions with cost implications faced by these two projects may not affect all of the proposed arterial roads in Molonglo, i.e. the underground services section of the cost estimate on these two projects allows for installation of trunk services, resulting in higher costs. Without detailed analysis on service demand requirements, this is the only option for estimating servicing costs.

In addition to the above, the following assumptions have been made:

- Construction to take place in 8 separate RFT tender packages for the purposes of estimating mobilisation and site establishment costs;
- Additional TTM costs have been accounted for the 3 packages working with live traffic, namely Bindubi Interchange, Tuggeranong Parkway Interchange and the Coulter Drive Intersection works;
- A full depth asphalt pavement profile has been assumed following consultation with the client, with a cost of $\$98/m^2$ based on the "*John Gorton Drive Extension to Molonglo 2 Forward Design*" report produced by Brown Consulting (July 2012);
- General earthworks rate is based on the rate from Molonglo Stage 1D; and
- Based on the vertical geometry of the proposed road alignments, the works are fill deficient. An import fill rate of $\$25/m^3$ has been incorporated for such costs, however it is noted that depending on the location of an available fill supply site, there is a risk present that the cost could be higher.

The following bridges and interchanges are included in the estimate:

- Bridge 01 – John Gorton Drive (crossing Coppins Cross Road and Molonglo River);
- Bridge 02 – East-West Arterial Road (crossing Molonglo River);
- Tuggeranong Parkway Interchange overpass bridge; and
- Bindubi Street Interchange overpass bridge.

Preliminary costs for the bridge structures have been based on the proposed structural system, bridge lengths and typical cross sections shown earlier in Figure 152.

12.2 Sensitivity Analysis

A sensitivity analysis of the projected costs has been completed through a comparison of costs per linear metre from construction costs detailed for the Molonglo Stage 1D and Molonglo Stage 2 projects.

A summary of the comparisons is provided in Table 19.

Table 19: Comparison of Costs per Linear Metre Across Similar Projects (All Amounts Ex. GST)

Project	Molonglo Stage 1D Construction Rate	Molonglo Stage 2 Construction Rate	Molonglo FS Adopted Rate
Length [km]	1.38	1.46	14.12
Earthworks [$/m]	$1,992	$3,485	$2,328
Underground Services [$/m]	$3,231	$2,577	$3,231
Road Furniture [$/m]	$732	$523	$732
Landscape [$/m]	$375	$493	$375
Street Lighting [$/m]	$106	$87	$58
Total Civil Works [$/m]	**$12,423**	**$13,949**	**$9,575**

12.3 Summary

Based on the assumptions detailed previously, the total cost estimate for construction and delivery of the project, including 30% contingency, is **$361,486,169 (GST Excl.)** Details of the cost breakdown are provided in Table 20.

Table 20: Schedule of Costs

Section	Description	Base Estimate
0	Preliminaries	$967,278
1	Provision for Traffic	$900,000
2	Earthworks	$32,873,919
3	Underground Services	$45,627,710
4	Flexible Pavement Construction	$28,644,723
6	Concrete Kerbs Footpaths and Minor Works	$5,364,468
7	Road Furniture	$817,542
8	Incidental Works	$1,418,143
9	Landscape	$10,342,462
10	Road Signs	$739,920
11	Pavement Marking	$262,578
13	Traffic Signals	$1,943,032
14	Street Lighting	$5,291,243
15	John Gorton Drive Bridge	$51,175,488
16	East-West Arterial Bridge	$44,763,264
17	Tuggeranong Interchange Bridge	$7,673,400
18	Bindubi Interchange Bridge	$17,568,000
Sub Total		**$256,373,170**
Contingency (30%)		$76,911,951
Consultancy Fees (3%)		$7,691,195
Construction Superintendence (3%)		$7,691,195
Contract Administration (SSP) (4%)		$10,254,927
Insurance (1%)		$2,563,732
CONSTRUCTION AND DESIGN COST ESTIMATE (GST Excl.)		**$361,486,169**

13 CONCLUSIONS AND RECOMMENDATIONS

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.

13.2 Traffic Modelling and Traffic Analysis

13.2.1 Strategic Modelling

13.2.1.1 2016 AM Peak Period

One scenario was tested for the 2016 AM peak period, essentially a baseline "existing" model. 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.

13.2.1.2 2021 AM Peak Period

In the 2021 AM peak period two staging options were investigated for the connection between the Molonglo 2 Group Centre and William Hovell Drive; either at Coulter Drive or at Bindubi Street. The strategic model analysis suggests that on the roads that do not differ between the two scenarios, the difference in traffic flows 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.

13.2.1.3 2031 AM Peak Period

In the 2031 AM peak period seven scenarios were investigated. Scenario 1 (Base) provides the most complete connectivity between Molonglo and the existing road network, and thus results in better utilisation of the East-West Arterial and a more even distribution of traffic on to the surrounding road network. It also requires no additional road works outside Molonglo, as Scenarios 4, 5 and 6 do.

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.

As there is no scenario that is clearly better in terms of traffic impacts on external roads, it was decided that Scenario 1 should be accepted as the preferred option for more detailed traffic analysis.

13.2.2 Traffic Operational Analysis

The intersection modelling was conducted for the AM and PM weekday peak periods in both 2021 and 2031.

13.2.2.1 2021

The traffic assessment indicates that connecting Coulter Drive Extension to William Hovell Drive first will require significant work, and the intersection of William Hovell Drive – Bindubi Street will require upgrades to handle the additional traffic. On the other hand, a folded diamond interchange at William Hovell Drive – John Gorton Drive/Bindubi Street would work equally well in the interim, and provide an avenue for upgrades by 2031 with little modification. For this reason the option to connect John Gorton Drive to William Hovell Drive at the location of the existing Bindubi Street intersection is preferred.

13.2.2.2 2031

The criteria chosen for the intersection models was to develop a layout that provided acceptable performance for each option. As a result a direct performance comparison isn't possible, therefore the intersections have been assessed in terms of practicality.

- William Hovell Drive – Coulter Drive
  The Quadrant option is preferred as achieving acceptable performance is impractical with the Staggered T and Four-way options due to the heavy volumes in the north-east quadrant of the junction.
- William Hovell Drive – John Gorton Drive/Bindubi Street
  Each of the options provides acceptable performance. The Folded Diamond option is preferable as it maximises the spacing between this interchange and Glenloch Interchange and enables development of sporting facilities south of William Hovell Drive.
- Tuggeranong Parkway – East-West Arterial
  Acceptable performance can be achieved with a practical intersection design in all scenarios.

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.

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 truck cycle path on the eastern side on 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.

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.

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.

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 less than 4% and 2% of the Box-Gum Woodland and Pink-Tailed Worm Lizard habitat loss budget allocated in the NES plan respectively.

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 and the Pinnacles and beyond 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 Government and non-Government stakeholders.

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.

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.

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.)**

APPENDIX A PROPOSED ARTERIAL ROAD NETWORK

APPENDIX B PLAN AND LONGITUDINAL SECTION DRAWINGS (ARTERIAL ROADS)

APPENDIX C DRAINAGE CATCHMENT PLAN