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1 Executive summary

The Yoogali intersection upgrade project is located in Yoogali, a small rural town in the local government area of Griffith. The project is funded under the Heavy Vehicle Safety and Productivity Program (HVSPP). The specific HVSPP objectives are to:

- increase heavy vehicle productivity by enhancing the capacity of existing roads and improving freight network connections
- improve the safety environment for heavy vehicle drivers.

The Yoogali intersection is the meeting point of four major roads – Burley Griffin Way (MR84), Mackay Avenue, Irrigation Way (MR80) and Kurrajong Avenue. The Narrandera to Griffith rail line owned by Transport for NSW (TfNSW) is immediately north of the intersection, and runs parallel to Irrigation Way and Mackay Avenue.

Four options were compared as part of this report:

- Do nothing – maintain the existing intersection
- Roundabout
- Staggered ‘T’ intersection
- Traffic signals at the intersection – integrated with railway level crossing.

The four options were reviewed with a focus on the key considerations outlined in Section 2 and evaluated using multicriteria analysis to identify the best option.

**Option D, the traffic signal option, was identified as the best option as it improves road user safety by minimising ‘short stacking’ as well as catering for all long vehicle movements.**

Although construction activities would occur near live traffic, this option ultimately offers improved traffic performance and heavy vehicle accessibility, while minimising the construction footprint.
2 Introduction

2.1 Purpose of this document

This report presents a high-level qualitative assessment of four configuration options for the Yoogali intersection. Specifically, this report:

- provides a brief project background
- describes the assessment framework by presenting key considerations
- highlights advantages and disadvantages of intersection options
- summarises the outcomes of a qualitative assessment and ranks options based on key considerations.

2.2 Project background

The Yoogali intersection upgrade project is located in Yoogali, a small rural town in the local government area of Griffith. The project is funded under the Heavy Vehicle Safety and Productivity Program (HVSPP). The specific HVSPP objectives are to:

- increase heavy vehicle productivity by enhancing the capacity of existing roads and improving freight network connections
- improve the safety environment for heavy vehicle drivers.

As illustrated in Figure 1 below, the Yoogali intersection is the meeting point of four major roads – Burley Griffin Way (MR84), Mackay Avenue, Irrigation Way (MR80) and Kurrajong Avenue. The Narrandera to Griffith rail line owned by TfNSW is immediately north of the intersection, and runs parallel to Irrigation Way and Mackay Avenue.

Figure 1 – Project area
3 Key considerations

This section presents key considerations which form the basis of the options assessment. These considerations have been referenced throughout this document and have been used to develop weighted average rankings to compare the options presented, as summarised in Section 4.

3.1 Road user safety

One of the primary concerns with the existing intersection is the short distance between the intersection and the level crossing. There is a potential risk of vehicles being struck by a train, either queuing across the level crossing or entering the crossing while a train is passing. There is also a risk of queuing from the level crossing back towards the intersection, which may create a hazard to through vehicles on Mackay Avenue.

The distance between the holding line and the level crossing is about 20 metres. This would be inadequate for storing a 19 metre semi-trailer.

St Mary’s Primary School, Yoogali, is located north of the railway line. As the school is likely to generate pedestrian and cyclist activity during peak times, options should consider these road users.

Upgrade options should focus on addressing these issues and improving road user safety.

3.2 Traffic performance

Road network performance is generally determined by intersection performance. As traffic volumes increase, intersection control levels may need to increase to provide adequate level of service. The intersection is the junction of two main roads and has the potential for a higher proportion of heavy vehicles.

Control of at grade intersections is usually provided by either priority intersections, roundabouts or traffic signals.

- Priority intersections (Give-Way or Stop Sign) are suitable for locations with low traffic volumes on the side street. If there are significant traffic volumes on movements given priority, then side streets may have long delays while vehicles are waiting for an acceptable gap. Safe sight distances are critical to the safe operation of these intersections.

- Roundabouts provide additional capacity and allow priority to be given to right turns. Lengthy delays may occur when a right turn movement is relatively high, effectively preventing entry onto the roundabout from other approaches.

- Traffic signals provide the highest level of control for at grade intersections, allowing for more equitable distribution of delay and separation of potentially dangerous conflicting traffic movements. Traffic signals also provide an opportunity to ‘flush’ queues from the nearby level crossing.

The level of intersection control is usually determined by intersection performance and road safety considerations.

3.3 Heavy vehicle accessibility

A key consideration is the improvement in heavy vehicle productivity by enhancing the capacity of existing roads and improving freight network connections. Developing an option that provides sufficient pavement area, safe queuing areas, and turn radii to enable safe and efficient heavy vehicle operation, including B-Doubles and road trains, is critical. Options should recognise heavy vehicles need more space to pass oncoming traffic, longer stopping distances, greater gaps in traffic to make safe turning movements, lower acceleration rates and more room to store in queues.
3.4 Property impacts
The need for property acquisition and adjustment are significant factors which influence the viability of the options presented in this document. Property accessibility is a key consideration, particularly along Irrigation Way.

3.5 Utility impacts
Utility infrastructure including overhead electrical, water, telecommunications and gas services exists within the vicinity of the intersection.
Upgrade options considered should minimise the scope of utility impacts and adjustments.

3.6 Environmental impacts
The existing intersection is located in Griffith City Council local government area and administered by the Griffith Local Environmental Plan (LEP) 2014.
The intersection is surrounded by a highly modified urban environment with a mix of commercial, residential and sensitive receivers. Running east to west along Mackay Avenue and Irrigation Way is the existing rail corridor. A large irrigation drain crosses perpendicular to Irrigation Way and Kurrajong Avenue.
A strand of native eucalyptus is present within the road corridor to the north of Mackay Avenue. A database search of the NSW Planning Portal Department of Planning and Environment (08/11/17) indicates pockets of terrestrial biodiversity along Kurrajong Avenue and Burley Griffin Way. There is no habitat close to the proposed works.
No Aboriginal sites or places were identified in an AIHMS database search (08/11/17) within 1 kilometre of the existing intersection.
A database search of Department of Environment and Energy Environment Protection and Biodiversity Protection (EPBC) Act Protected Matters (8/11/2107), with a 1 kilometre search buffer applied, identified four wetlands of international importance, three listed threatened ecological communities, 15 listed threatened species and 10 listed migratory species.
The environmental impacts associated with the options assessed would need to consider the interface with the above land uses and environmental constraints. Further field investigations are needed to confirm the extent of historical contamination associated with the previous service station site and potential of assessed options impacting on possible contaminants of concern.

3.7 Constructability
The existing intersection is located near a railway crossing. It is also a main thoroughfare for long vehicles, including B-Doubles and road trains, and uses a bridge structure to provide access over the irrigation drainage channel. In addition to carrying out construction next to live traffic, the above factors pose various constructability and staging challenges.
3.8 Cost

Significant costs are typically incurred when acquiring property, upgrading bridge, building new structures or pavement, relocating utilities and implementing traffic control signals. All of these items are likely costs for this project.

3.9 Community

To the south east and south west of the intersection (east of Kurrajong Avenue and Burly Griffin Way) are cleared farming paddocks. To the north of the intersection (north of Mackay Avenue) is a commercial premises and a primary school (St Marys). Directly to the west (west of Kurrajong Avenue) is a car dealership which was previously a service station.

As the intersection lies immediately east of Griffith, improving heavy vehicle accessibility could potentially stop heavy vehicles from travelling through the local community.
4 Options review

This section presents an options review based on the key considerations outlined in Section 2. The review has been used for the multicriteria analysis, as summarised in Section 4.

Option A – Maintain the existing intersection

Option A, the ‘do nothing’ scenario, is the existing intersection with no upgrade works and is shown in Figure 2. The priority intersection is met by four roads - Burley Griffin Way, Mackay Avenue, Irrigation Way and Kurrajong Avenue.

- Burley Griffin Way crosses the Narrandera to Griffith rail line about 20 metres from the intersection. The road features a splitter island and give way sign to isolate one lane in each direction.
- Mackay Avenue approaches the intersection from Griffith and features one lane in each direction with the addition of a dedicated left-turn lane.
- Irrigation Way approaches the intersection from the east and crosses an irrigation drainage channel. The overpass structure features two box culverts.
- Kurrajong Avenue approaches the intersection from the south with one lane in each direction separated by splitter islands, and give way priority.

Figure 2 - Existing Yoogali intersection
The rail line has an active level crossing with lights and bells but no booms, crossing across Burley Griffin Way. This results in 'short stacking', where vehicles stop on the railway tracks due to the short storage or stacking distance between the railway and intersection along Burley Griffin Way. This option presents significant safety issues, particularly for long vehicles as shown in Figure 3.

Figure 3 - Long vehicle queuing along Burley Griffin Way and railway crossing

The bridge over the irrigation drainage channel is about 6.5 metres wide as shown in Figure 4. The bridge is narrower than desired for heavy vehicles passing each other. The bridge safety barriers and their loading design are also based on superseded standards. This option would continue to present traffic accessibility and safety issues, particularly for heavy vehicles using the bridge.

Figure 4 - Narrow bridge over the irrigation drainage channel
This option poses no impacts to existing utility infrastructure including overhead electrical, water, telecommunications and gas services. In addition, no nearby properties would be impacted.

**Option B – Roundabout**

Option B is a roundabout configuration (see Figure 5). The roundabout includes a large diameter concrete collar that can be used by larger vehicles, and a smaller raised annulus within. This option can accommodate long vehicles including B-Doubles and road trains for through and left-turn movements, however these vehicles are not able to make turns around the roundabout due to road geometry limitations and a constrained intersection footprint.

The intersection legs along Kurrajong Avenue and Mackay Avenue, and Burley Griffin Way and Irrigation Way, are at acute angles. Pavement widening would be needed at these areas to accommodate long vehicle turn movements, which would further increase the roundabout’s footprint. This would result in additional property impacts to 126 Mackay Avenue, an intersection which further encroaches onto the railway corridor and over the irrigation drainage channel, and extensive utility impacts.

The existing bridge along Irrigation Way would need widening to allow heavy vehicles to pass each other at the same time. However, the extensive footprint needed for a roundabout configuration would be costly due to the need for a much wider bridge.

The potential ‘short stacking’ issue remains with this option, with no control over vehicles queuing or stacking across the railway crossing and a reduced distance between the holding line and the level crossing. Signals would be required to control this issue.

Roundabouts are generally considered to reduce crash severity compared with priority and signalised intersections. However, this option presents road users with other safety issues. Tall trees along the northern side of Mackay Avenue and proposed bridge parapets along Irrigation Way would limit sight lines for motorists. Wide pavement areas at the legs of the roundabout would introduce lengthy pedestrian crossing times at an unsignalised intersection, particularly across Mackay Avenue. Roundabouts are undesirable for cyclists as they generally involve merging with traffic, increasing the risk of a cyclist being hit.

Roundabouts perform better than a priority intersection and worse than traffic signals, allowing for right turn movement priority which may otherwise be delayed at priority intersections.

The key environmental aspect associated with this option is potential for work to interface with contaminants of concern associated with the previous service station site, south west of the intersection. In addition, the irrigation drainage channel would need specific environmental management measures.
Option C – Staggered ‘T’ intersection

Option C is an unsignalised staggered ‘T’ intersection (see Figure 6). This option reconfigures the intersection with a realignment of Burley Griffin Way and a ‘T’ intersection built about 200 metres south east of the existing intersection. This would shift the railway crossing further south east, converting the existing Burley Griffin Way to a cul-de-sac.

Raised splitter islands with sufficient length would define approach lanes and stop inappropriate movements for both ‘T’ intersections. This would reduce property accesses along Irrigation Way, Mackay Avenue and Kurrajong Avenue to only a left-in and left-out arrangement.

The potential ‘short stacking’ issue remains with this option, with no control over vehicles queuing or stacking across the railway crossing. This option also results in shortened queue lengths due to the railway corridor and Irrigation Way junction. Signals would be needed to control this issue.

Pavement widening would be needed to provide sufficient room for long vehicles during a left-turn movement from Kurrajong Avenue to Mackay Avenue, and Irrigation Way to Kurrajong Avenue. This would result in property impacts to 126 Mackay Avenue, widening of Irrigation Way across the irrigation drainage channel, and lengthy pedestrian crossing times at the unsignalised intersection, particularly across Mackay Avenue. In addition, the existing bridge along Irrigation Way would need widening to allow heavy vehicles to use it at the same time.

Although this option allows for offline construction with reduced impacts to live traffic at the existing intersection during the project, a significant amount of new pavement would be needed with large property impacts to private fields. Up to two new bridges would also be needed further east along Burley Griffin Way to cross the irrigation channel, resulting in significant costs.

The existing intersection allows motorists to travel between Kurrajong Avenue and Burley Griffin Way in a single movement. This option, however, introduces an extra movement, where a right and left turn would be needed to achieve the same route. This extra movement would be another challenge for large/heavy vehicles.
Staggered ‘T’ intersections improve road safety by reducing the number of conflicting movements and side impacts, which are considered to have a high injury severity. The arrangement with the ‘right then left’ removes the need for dedicated turn bays, which would be needed in a ‘left then right’ arrangement. Nevertheless, vehicles that queue along Burley Griffin Way or Kurrajong Avenue would need a sufficient gap in both traffic directions on the major thoroughfare which may make the arrangement less efficient than the ‘left then right’.

The key environmental aspect associated with this option is potential for work to impact existing surface flows and drainage, both east and west of the new alignment. This could create extra flooding issues at various locations along the new alignment and to existing farm land. To overcome such an issue, the new alignment could be raised above nearby land, however this would introduce extra costs.

This option also involves a much larger footprint and would need significantly more material to build the road formation, which would have temporary traffic impacts for fill delivery.

Environmental management measures would be needed specifically for the irrigation drainage channel.

**Figure 6: Option C – Staggered ‘T’ intersection**

**Option D – Traffic signals at the existing intersection**

Option D is a signalised intersection (see Figure 7). This option could be developed to accommodate long vehicles, including B-Doubles and road trains, for all turning movements as well as dedicated left and right turn lanes.

The legs of the intersection along Kurrajong Avenue and Mackay Avenue, and Burley Griffin Way and Irrigation Way, are at acute angles. Pavement widening would be needed at these areas to accommodate long vehicle turn movements. This may result in further property impacts to 126 Mackay Avenue. The existing bridge along Irrigation Way would also need widening to allow heavy vehicles to pass each other at the same time.
This option presents an opportunity to eliminate the ‘short stacking’ issue. The existing railway crossing is prone to vehicles stopping on the railway tracks due to short storage or stacking distance along Burley Griffin Way. By controlling southbound traffic along Burley Griffin Way immediately before the railway crossing, the risk of vehicles queuing or stacking on the railway track would be eliminated by introducing integrated road and rail traffic control signals.

The signal operation can be coordinated with the level crossing to clear any queues and prevent vehicles from using the exit that approaches the level crossing when a train is detected. All movements which feed traffic to the level crossing would be controlled with this option. The signals would need to be coordinated with train signalling to provide advanced demand warning.

The road user safety issues related to limited sight lines for motorists caused by tall trees along the northern side of Mackay Avenue and proposed bridge parapets along Irrigation Way would be mitigated by introducing traffic control signals. Although wide pavement at the legs of the intersection would increase pedestrian crossing times, signalised crossings would enable safe pedestrian access.

Although traffic management would be required during construction, this option ultimately offers improved traffic performance and heavy vehicle accessibility, while minimising the construction footprint.

Traffic signals provide the best way to distribute delays evenly across the intersection or provide priority to critical movements. It is considered the most efficient at grade intersection control for higher traffic volumes. At low traffic volumes, traffic signals may introduce extra delays.

The key environmental aspect associated with this option is potential for works to interface with contaminants of concern associated with the previous service station site, south west of the intersection. Environmental management measures would be needed specifically for the irrigation drainage channel.

The strand of planted trees along the northern side of Mackay Avenue may also need to be removed with this option should a dedicated left-turn lane be implemented.

Figure 7: Option D – Signalised Intersection
5 Qualitative assessment

The four options have been reviewed with a focus on the key considerations outlined in Section 2 and review in Section 3. In order to identify the best performing option, a multicriteria analysis was carried out by weighing such considerations based on their significance. Subsequently, each option was ranked through a collaborative effort involving a range of expert opinions from road geometric designers, senior road and traffic engineers, and environmental consultants. The options were assessed relatively and qualitatively in line with the review provided in Section 3 and the assessment outcomes are in Table 1 below.

Table 1 Multi-Criteria Assessment Outcomes

<table>
<thead>
<tr>
<th>Option</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option A – Maintain existing intersection</td>
<td>2</td>
</tr>
<tr>
<td>Option B - Roundabout</td>
<td>4</td>
</tr>
<tr>
<td>Option C – Staggered ‘T’ intersection</td>
<td>3</td>
</tr>
<tr>
<td>(unsignalised)</td>
<td></td>
</tr>
<tr>
<td>Option D – Traffic signals at existing</td>
<td>1</td>
</tr>
<tr>
<td>intersection</td>
<td></td>
</tr>
</tbody>
</table>
6 Conclusion

Option A – Maintain the existing intersection
Adopting this option results in nil impacts to the environment and nearby properties. However, the intersection would continue to present significant safety issues, particularly for long vehicles that queue along Burley Griffin Way. As heavy vehicle accessibility would continue to be restricted, heavy vehicles would maintain their travel through Griffith, resulting in high disruption to the local community. This option has been evaluated as the second best performing option, however it does not meet the project objectives.

Option B – Roundabout
This option offers the benefit of improved traffic performance when compared to the existing priority intersection, however long vehicles would be constrained when making turns around the roundabout. It therefore results in decreased performance over existing conditions for heavy vehicle accessibility.

The ‘short stacking’ issue would remain as there is no control over vehicles that queue across the railway crossing. An extensive footprint would be needed for a roundabout configuration which results in greater utility, property and environmental impacts. This would have larger costs due to the need for a wider bridge over the irrigation drainage canal. This option would be the third best performing option, but less preferred than maintaining the existing. This option does not meet the project objectives.

Option C – Staggered ‘T’ intersection
This option offers the benefits of improved road user safety when compared to the existing intersection and reduced traffic impact due to offline construction. Significant costs would be faced due to the need for extra bridges, extensive property impacts, and measures to relieve drainage issues and flooding impacts. The ‘short stacking’ issue would still remain. This option has been evaluated as the worst performing option and does not meet all of the project objectives.

Option D – Traffic signals at existing intersection
This option improves road user safety by introducing traffic control signals. The ‘short stacking’ issue would be minimised, and an intersection configuration could be developed to accommodate all long vehicle movements. This option has been evaluated as the best performing option, and can be further developed to successfully achieve road user safety requirements and heavy vehicle accessibility considerations.

A key environmental aspect associated with this option includes the potential for construction activities to interface with contaminated soil due to the previous service station site, located immediately south west of the intersection. Environmental impacts such as removing vegetation along the northern side of Mackay Avenue and impacts to nearby properties are other factors which need to be further investigated.

Although construction activities would occur online and near live traffic, this option ultimately offers improved traffic performance and heavy vehicle accessibility, while minimising the construction footprint.