CAMBRAY consulting
Traffic Engineering and Transport Planning

Windsor Bridge Replacement Project

Traffic Review of Information Provided by the Applicant (Roads and Maritime Services)

FINAL REPORT

Prepared for NSW Department of Planning and Infrastructure

15 August 2013

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1.0 Introduction

Roads and Maritime Services (RMS) is seeking project approval from the NSW Department of Planning and Infrastructure for the Windsor Bridge replacement project. RMS has prepared an Environmental Impact Statement (EIS) and a number of technical reports to support their application for this project.

Cambray Consulting was engaged by NSW Department of Planning and Infrastructure to assist in the assessment of the application information provided by RMS, focussing specifically on the traffic issues relating to the proposal.

1.1 Scope of Services

Our review has included the following tasks:

(a) Two site visits to Windsor to observe current road conditions, constraints, and opportunities;
(b) A review of the relevant publicly available project documentation, including:
    i. The Options Report (August 2011);
    ii. The Traffic Modelling and Evaluation of Options - Preliminary Report (August 2011);
    iii. The Community Issues Report (October 2011);
    iv. The Traffic and Transport Chapter in the Project Environmental Impact Statement (EIS), and the Traffic and Transport Working Paper within the EIS (November 2012);
    v. The Submissions Report prepared by RMS in response to issues raised in submissions (April 2013);
    vi. Various other documents such as meeting minutes, presentations, community updates and information sheets;
(c) Meeting with representatives from NSW Department of Planning and Infrastructure;
(d) Preparation of a preliminary list of additional information which we suggested be sought from the applicant, to enable more thorough and informed consideration of the information provided (see **Appendix A**);
(e) A broad review of additional information prepared by RMS in response to the above request, received on 16 May 2013. A summary of RMS' responses is included as **Appendix B**;
(f) Sensitivity / option testing of modelling for key intersections;
(g) A broad review of additional information prepared by RMS (provided by NSW Department of Planning and Infrastructure to Cambray Consulting on 29 July 2013);
(h) High level consideration of some potential alternatives to the currently preferred option;
(i) Recommendations on clarifications to be sought from RMS on a number of traffic-related issues, as well as suggested 'next steps'.

This report provides a summary of the results of the above tasks and investigations.

1.2 Limits of Report

This report takes into account the particular instructions and requirements of our client. Cambray Consulting has taken care in the preparation of this report, however it neither accepts liability nor responsibility whatsoever in respect of:

- Any use of this report by any third party;
- Any third party whose interests may be affected by any decision made regarding the contents of this report; and/or
- Any conclusion drawn resulting from omission or lack of full disclosure by our client, our clients' consultants, or any other parties.

The information in this report focuses on traffic and transport related issues, and suggestions and recommendations have been made accordingly. We recognise the importance of achieving a balance between transport needs, social and heritage impacts, ecological, engineering and cost constraints, and therefore any suggestions or recommendations we have made should be considered by the decision makers, with reference to representatives from all relevant disciplines, as well as the local community.

2.0 Review of Application - Traffic Documents and Supporting Information Prepared by RMS

A number of documents and reports addressing traffic and transport related issues were prepared by RMS throughout the various stages of this project. The documents which we have reviewed, and which are publicly available on the RMS Road Projects website, are listed in **Table 2.0** below. A link to each of the documents is also provided in this table.

Further information which has been provided to us, which we understand is not currently publicly available, has been appended to this report. References to these appendices are provided in the relevant sections of this report.

Table 2.0: List of Documents Reviewed and Links to Documents

Document / Information	Date	Link to Document
The Options Report	August 2011	http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/windsor_bridge_options_report_aug2011.pdf
The Traffic Modelling and Evaluation of Options - Preliminary Report	August 2011	http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/tech_reports_aug2011/traffic_modelling_and_evaluation_options_preliminary_report_aug11.pdf
The Community Issues Report	October 2011	http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/windsor_bridge_issues_report_oct2011.pdf
The Project Environmental Impact Statement (EIS), Assessment of key issues - Traffic and transport (Chapter 7.3)	November 2012	http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_1/windsor_bridge_EIS_chapter_7_3_traffic_transport_nov2012.pdf
The Project Environmental Impact Statement (EIS), Traffic and Transport Working Paper (Working Paper 4)	November 2012	Part 1: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_1_nov2012.pdf Part 2: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_2_nov2012.pdf Part 3: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_3_nov2012.pdf

Document / Information	Date	Link to Document
The Submissions Report	April 2013	Part 1: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_toch2.pdf Part 2: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch3.pdf Part 3: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch4.pdf Part 4: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch5toappendixa.pdf Part 5: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb.pdf Part 6: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_1.pdf Part 7: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_2.pdf Part 8: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_3.pdf Part 9: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_4.pdf Part 10: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixc.pdf Part 11: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixd.pdf Part 12: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixe.pdf Part 13: http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixf_g.pdf

We have considered the contents and conclusions of the documents listed above, and our comments and suggestions are provided in the following sections.

2.1 Options Report (published August 2011)

Link to Document:
http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/windsor_bridge_options_report_aug2011.pdf

The Options Report, which was published in August 2011, includes the following:

- Background information and site context;
- A description of the options that were considered;
- A high level comparison of the nine options against one another and the project objectives;
- The outcomes of an economic analysis of all nine options;
- A summary of the outcomes of the Stakeholder Workshop on Options (18 September 2009), during which options for further consideration were identified (Option 1, Option 3, and Option 6);
- Descriptions of refinements to Option 1, Option 3, and Option 6; and
- Identification of the preferred option (i.e. Option 1).

At the stakeholder workshop held on 18 September 2009, we understand that the participants were asked to consider the nine options and identify the positive and negative aspects of each. The evaluation was carried out in two stages – an initial review to exclude options that did not meet the selection criteria, and a second more detailed consideration to rank the remaining options. A summary of the outcomes of this workshop is provided below, and our opinions on these outcomes are provided in the following sections.

Table 2.1: Summary of Outcomes of Stakeholder Workshop on Options (18 September 2009)

Option	Description	Outcome (Review 1)	Outcome (Review 2)
Option 1	High level – 35 metre downstream of existing bridge	Assessed further by the group	Assessed further by the group
Option 2	Low level - 35 metre downstream of existing bridge	Assessed further by the group	Assessed further by the group
Option 3	High level - 10 metre upstream of existing bridge	Not favoured by group due to severance of town and loss of its unique character	Option 3 was not originally considered favourably due to constructability issues within Thompson Square. However a number of alterations to the design of the new bridge were suggested to address the issues that previously were of concern.
Option 4	From Windsor Road, along Macquarie Street and then along Baker Street	Not favoured by group due to severance of town and loss of its unique character	-
Option 5	From Windsor Road, along Macquarie Street and then along Kable Street	Not favoured by group due to severance of town and loss of its unique character	-
Option 6	From Windsor Road via new T-intersection north of Pitt Town Road and via new alignment east of Palmer Street	Assessed further by the group	Assessed further by the group
Option 7	From Windsor Road along Court and North Streets and then along Palmer Street	Assessed further by the group	The group considered that option 7 would have major heritage impacts and create potential **traffic safety issues** and recommended that it not be considered further.

Option	Description	Outcome (Review 1)	Outcome (Review 2)
Option 8	From Windsor Road along Pitt Town Road, Bathurst Street, Punt Road and then on a new greenfield route to cross the Hawkesbury River to meet King Road and then to Wilberforce Road	Removed from further consideration due to capital cost	-
Option 9A	Refurbish existing bridge – deck only	Assessed further by the group	The group considered that option 9A would not meet project objectives and recommended that it not be considered further.
Option 9B	Refurbish existing bridge – more comprehensively	Assessed further by the group	The group considered that option 9B would not meet project objectives and recommended that it not be considered further.

In summary, it appears that it was determined relatively early on in the process (i.e. in 2009) that only Option 1, Option 2, Option 3 and Option 6 warranted further consideration. From the information provided to us, it appears that the group recommended that the remaining options not be considered primarily on heritage or cost grounds, rather than traffic considerations. Notwithstanding this, traffic modelling of all of these options was undertaken under the *'Traffic Modelling and Evaluation of Options'* assessment (discussed further in the following section).

Our opinions on the options which the group recommended not be considered further are provided following.

2.1.1 Options 4 and 5

We agree that Option 4 and Option 5, which involve a major traffic route which runs through the centre of town (through or adjacent to the George Street pedestrian mall), are likely to be undesirable from a traffic perspective. We consider it appropriate from a traffic perspective that these options were not considered further.

2.1.2 Option 7

We note that the group determined that Option 7 (see **Figure 2.1.2a** below) would have 'major heritage impacts' and would create 'potential traffic safety issues', and it was determined not to consider this option further on the basis of these two issues.

This option, which involves a replacement bridge aligned with Palmer Street (and upgrades along the Court Street / North Street route to access this bridge), proposed the signalisation of the Windsor Road / Court Street intersection to cater for increased traffic movements into and out of Court Street under this scheme.

Figure 2.1.2a: Option 7 (from Options Poster)

It appears (from the *Traffic Modelling and Evaluation of Options - Preliminary Report*) that the 'traffic safety issues' referred to by the applicant relate to the proximity of the (proposed signalised) Windsor Road / Court Street intersection, to the existing Windsor Road / Macquarie Street signals.

However in our opinion:

- the signalisation of the Windsor Road / Court Street intersection may be feasible, provided the signal phasing and timing arrangements of both intersections are carefully considered. Coordination of the phasing at these closely spaced intersections may enable the queuing issues identified by the applicant to be avoided or at least minimised; and
- the current Windsor Road / Court Street intersection is less than desirable from a safety perspective due to existing sightline issues, and the signalisation of this intersection may in fact enable these existing issues to be addressed.

Based upon the traffic modelling of Option 7 provided by RMS (i.e. 2009 AM and PM VISSIM micro-simulation modelling), it appears as though the heaviest movements at these intersections are expected to be (see **Figure 2.1.2b** below):

- Movement 1: Windsor Road (northbound) to Macquarie Street
- Movement 2: Windsor Road (northbound) to Court Street
- Movement 3: Court Street to Windsor Road (southbound)
- Movement 4: Court Street to Macquarie Street
- Movement 5: Macquarie Street to Court Street

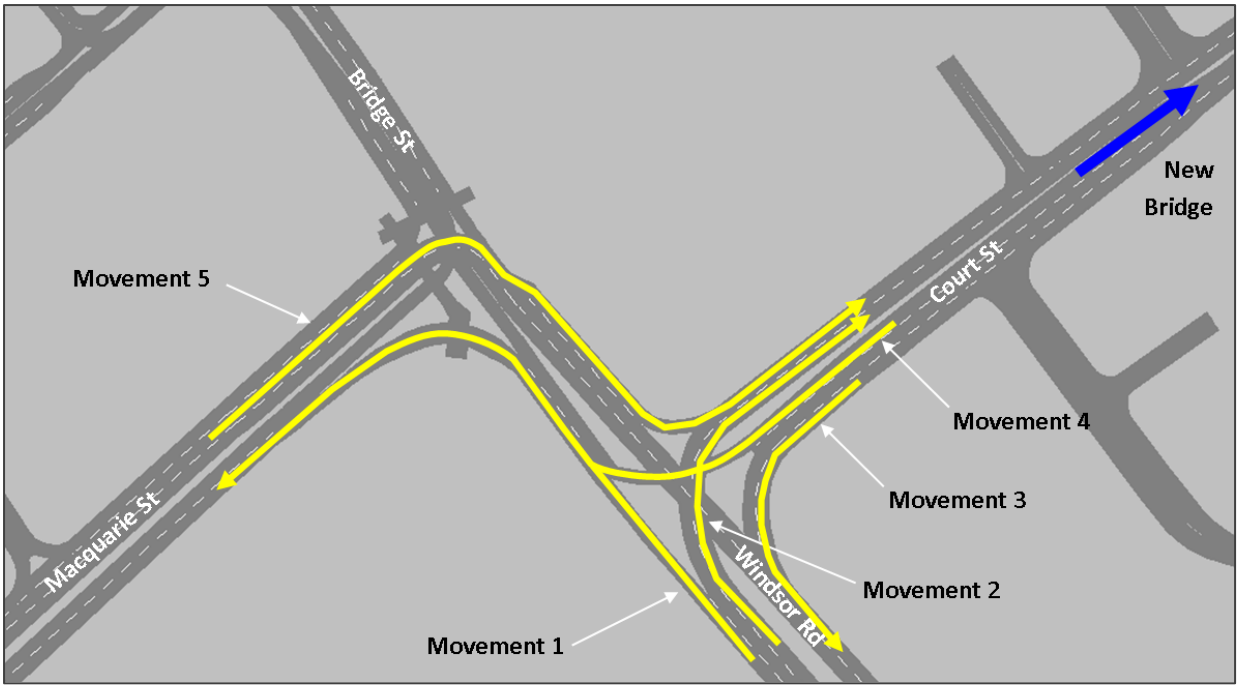


Figure 2.1.2b: Option 7 – Heavy Movements at Macquarie Street and Court Street Intersections

We have considered the likelihood of queuing as a result of these heavy movements, and our comments are as follows:

Movement 1: The left turn into Macquarie Street is a continuous movement (opposed only by a zebra crossing), and therefore we expect that queuing back is unlikely to be an issue for this movement

Movement 2: Two right turn lanes into Court Street are proposed under this option, therefore there would be reasonable capacity for this movement. In addition, there is no upstream intersection in close proximity on Windsor Road, therefore we expect that queuing back is unlikely to be an issue for this movement.

Movement 3: Two left turn lanes from Court Street are proposed under this option, therefore there would be reasonable capacity for this movement. In addition, there is no major upstream intersection in close proximity on Court Street, therefore we expect that queuing back is unlikely to be an issue for this movement.

Movement 4: After the right turn from Court Street, the left turn into Macquarie Street is a continuous movement (opposed only by a zebra crossing), and therefore we expect that queuing back is unlikely to be an issue for this movement.

Movement 5: We expect that the signal phasing of these two intersections could be coordinated for this movement, to minimise the likelihood that the left turn into Court Street queues back to the Macquarie Street intersection.

In summary, based upon the information we have been provided with, we consider that Option 7 may warrant further consideration, from a traffic perspective.

In addition, we believe that there are alternative options which could be considered and/or modelled, including:

- Reducing the proposed Court Street / North Street to a two-lane, two-way cross-section (as opposed to a four-lane, two-way cross-section) to reduce costs and property impacts; and/or
- Realigning Macquarie Street to form a four-way intersection with Court Street, as shown diagrammatically in **Figure 2.1.2c** below.

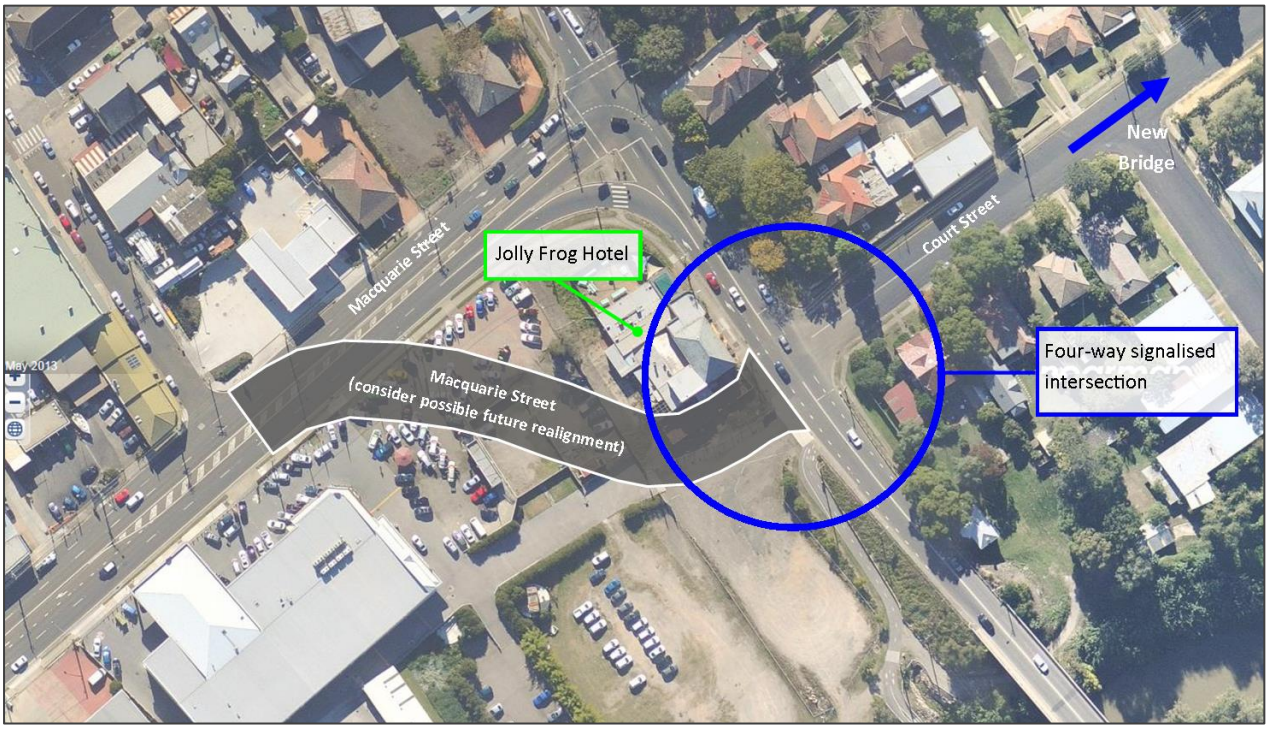


Figure 2.1.2c: Option 7 – Possible Future Alignment of Macquarie Street (Concept Only)

The realignment of Macquarie Street as shown in the figure above would clearly have property impacts. It is understood that the Jolly Frog Hotel (formerly the Windsor Tavern) is of local heritage significance (see **Figure 2.1.2d** below), however we also understand that this hotel is currently not operational, and is considered by some to be somewhat of an 'eyesore' and in need of restoration.

There may be an opportunity to realign Macquarie Street to form a four-way intersection with Court Street, minimising impact upon the Jolly Frog Hotel. The Court Street and Macquarie Street intersection approaches could potentially be offset whilst still operating as part of a single intersection. This may avoid or at least minimise physical impact upon the Jolly Frog Hotel.

We would suggest that this arrangement could be considered as a possible future road realignment, whereby the government could seek to progressively acquire the land required. This could effectively be 'Stage 2' of Option 7, which could be delivered if and when the operation of the closely spaced intersections of Court Street and Macquarie Street (under 'Stage 1' of Option 7) becomes unmanageable.

We acknowledge however that this option would increase traffic volumes past a number of residential properties on Court Street and North Street, as well as several heritage / cultural precincts and properties, and this would be a key consideration of this option.

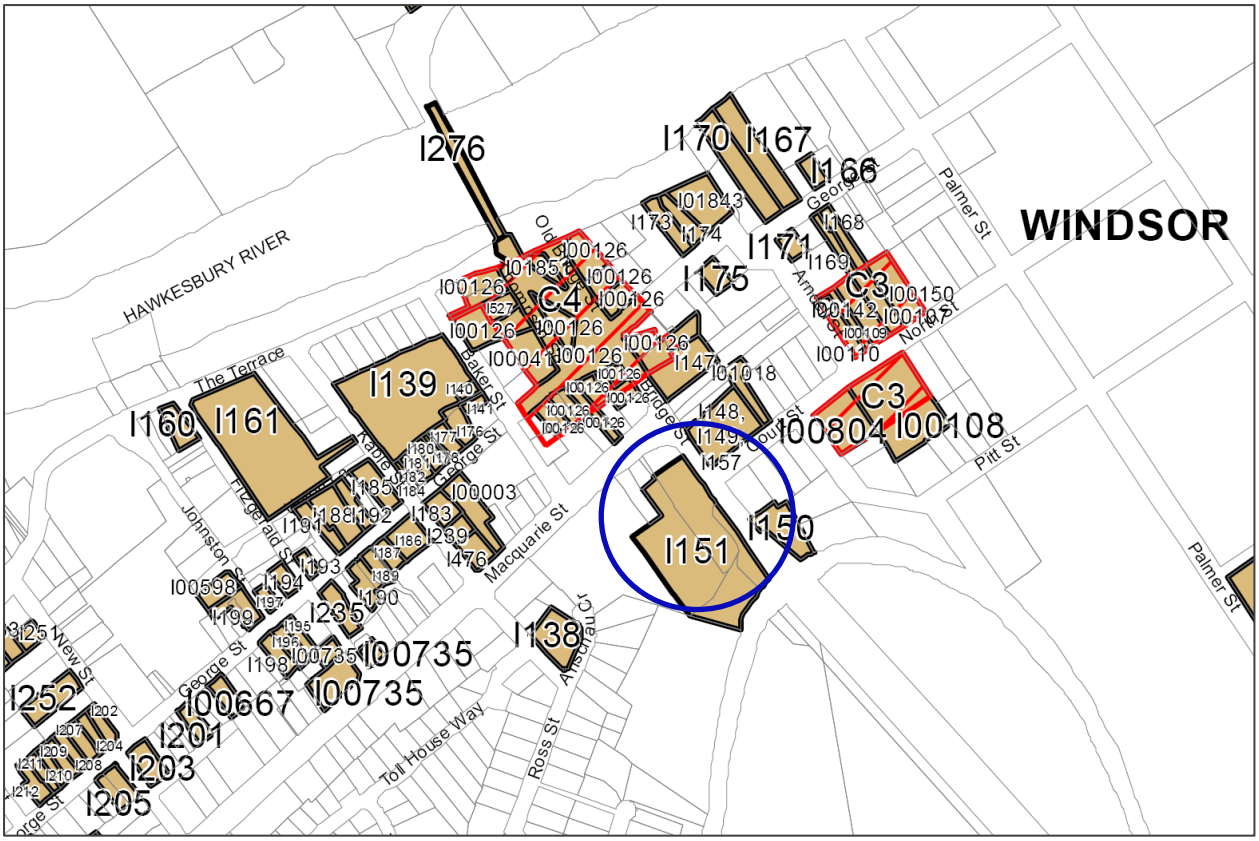


Figure 2.1.2d: Heritage Map - Sheet HER_008DB, Hawkesbury Local Environmental Plan 2012

2.1.3 Option 8

Whilst limited information has been provided to us on the performance of Option 8, our initial opinion is that this option would significantly increase travel distance to cross the river, and would be likely to be cost prohibitive due to the extent of new/upgraded road required. We consider it appropriate from a traffic perspective that Option 8 was not considered further.

2.1.4 Option 9

Option 9A and Option 9B both involve refurbishment of the existing bridge. We understand that the stakeholder group concluded that these options did not warrant further consideration as they 'would not meet project objectives'.

The project objectives as stated in the Options Report are as follows:

1. To improve safety for motorists, pedestrians, and cyclists
2. To improve traffic and transport efficiency
3. To improve the level of flood immunity
4. To meet long term community needs
5. To minimise the impact on the heritage and character of the local area
6. To be a cost effective and an affordable outcome

We acknowledge that retaining the existing river crossing (in isolation) may not be an acceptable long-term solution for a number of reasons. However many of the options investigated (including the preferred Option 1) involve the major traffic route running through town, where there are significant constraints upon upgrades to the intersections which would 'feed' the bridge. These options may therefore only defer the need for an alternative river crossing further out of town, not do away with it all together. This has been acknowledged by RMS in a number of the documents that have been prepared to support the application for the bridge replacement.

In our opinion there may be alternatives to the preferred option warranting consideration, which involve retaining and refurbishing the existing bridge in the short term, and seeking to provide an additional river crossing (or bypass) in the longer term. The existing bridge could then be used by traffic heading towards Freemans Reach / Glossodia (which is essentially local traffic), whilst allowing through and heavy vehicle traffic to bypass Windsor (protecting the town from the intrusive effects of through traffic) and possibly allowing a lower load limit to be placed on the existing bridge, potentially extending it serviceability. This is discussed further in Section 3.4.

Additionally, we believe that if not already been considered, alternatives to Option 9 along the lines of those described following could be investigated:

(Alternative) Option 9C

Stage 1

- a separate pedestrian / cyclist bridge is constructed adjacent to the existing bridge, or an additional pathway is retro-fitted to the existing bridge to replace the existing sub-standard pathway;
- the existing bridge is refurbished for vehicular traffic; and
- the intersections north and south of the bridge are upgraded to increase capacity and better cater for pedestrians.

Stage 2

- options for a future additional river crossing further out of town, to cater for through traffic and heavy vehicles, are investigated.

(Alternative) Option 9D

Stage 1

- a bypass route involving a river crossing further out of town is constructed, to cater for through traffic and heavy vehicles.

Stage 2

- a separate pedestrian / cyclist bridge is constructed adjacent to the existing bridge, or an additional pathway is retro-fitted to the existing bridge to replace the existing sub-standard pathway;
- the existing bridge is refurbished for vehicular traffic; and
- the intersections north and south of the bridge are upgraded to increase capacity and better cater for pedestrians.

Whilst potentially more expensive in the short term, the above options may enable the project objectives to be achieved for a longer period of time than the currently preferred option, while at the same time minimising the impact on the heritage and character of the local area.

The benefit of Alternative Option 9D is that all traffic could potentially be diverted over the new bridge while refurbishment of the existing bridge is undertaken, to minimise disruption and traffic management associated with such works.

In relation to the refurbishment of the existing bridge, we understand that the current traffic lanes are approximately 3.05m wide. Whilst traffic lanes widths of 3.5m are generally desirable, Austroads Part 3 and the RTA Supplement to this guideline suggest a lane width of 3.0m – 3.3m may be acceptable for general traffic lanes on urban arterial roads which are low speed, and where truck volumes are low.

Therefore we believe that it may be feasible for the current carriageway width to be maintained, if the bridge is restricted to light vehicle traffic and a 50km/hr speed limit is imposed.

Importantly, we note that the proposed future cross-section of the bridge (comprising one northbound lane and two southbound lanes) would provide traffic lanes of approximately 3.3m width, rather than the 3.5m which is generally considered desirable in unconstrained situations.

Finally, we note that the traffic volumes forecast by RMS up to 2026 (summarised in **Table 2.1.4** below) should be able to be accommodated on a two-lane bridge, which should have an unconstrained capacity as high as approximately 1,800 – 2,000 vehicles per hour per lane (depending upon a number of design factors).

Table 2.1.4: RMS Forecast Traffic Volumes over Windsor Bridge*

Design Year	AM Peak		PM Peak	
	Northbound	Southbound	Northbound	Southbound
2021	462	1373	1464	592
2026	573	1516	1606	680

* Source: RMS SIDRA Models: *2021 Wilberforce_Freemans Reach_Mac Park entrance_20121113.sip* and *2026 Wilberforce_Freemans Reach_Mac Park entrance_20121113.sip*

Based upon the above traffic volumes forecast by RMS, we would question whether a bridge with a three-lane (ultimate) cross-section (i.e. the preferred option), is required until some time beyond 2026, even assuming the intersections either side are able to convey such traffic volumes.

And whilst the proposed ultimate configuration of the bridge is one northbound lane and two southbound lanes, the highest volume forecast by RMS is in fact the northbound volume during the PM peak. This implies to us that the additional southbound capacity may be intended to accommodate the southbound queue back from the George Street intersection, rather than purely to provide additional capacity over the bridge itself (although this should be confirmed with RMS).

We believe that this lends support to the suggestion that alternative options involving a river crossing further out of town may warrant further consideration. That is, by avoiding the constrained intersections on either side of the existing bridge, it may be possible to provide a new two-lane bypass bridge, rather than a three-lane bridge, particularly if the existing bridge can be retained for local (weight restricted) traffic. And if it is possible to retain the existing bridge for local traffic movement between Windsor Town and Freemans Reach / Glossodia, this would also noticeably reduce the demand on such a bypass bridge, allowing both bridges to operate with spare capacity for a greater period.

2.1.5 Summary

In summary, our opinions on each of the originally identified options (from a traffic perspective) are as follows:

Table 2.1.5: Cambray Consulting Opinions – Originally Identified Options

Option	Description	Outcome of Stakeholder Workshop	Cambray Consulting Opinion
Option 1	High level – 35 metre downstream of existing bridge	Assessed further by the group	Agree that this option warrants further consideration
Option 2	Low level - 35 metre downstream of existing bridge	Assessed further by the group	Agree that this option warrants further consideration
Option 3	High level - 10 metre upstream of existing bridge	Assessed further by the group	Agree that this option warrants further consideration

Option	Description	Outcome of Stakeholder Workshop	Cambray Consulting Opinion
Option 4	From Windsor Road, along Macquarie Street and then along Baker Street	Not favoured by group	Agree that this option may not warrant further consideration
Option 5	From Windsor Road, along Macquarie Street and then along Kable Street	Not favoured by group	Agree that this option may not warrant further consideration
Option 6	From Windsor Road via new T-intersection north of Pitt Town Road and via new alignment east of Palmer Street	Assessed further by the group	Agree that this option warrants further consideration
Option 7	From Windsor Road along Court and North Streets and then along Palmer Street	Not favoured by group	**This option and/or alternatives to this option may warrant further consideration**
Option 8	From Windsor Road along Pitt Town Road, Bathurst Street, Punt Road and then on a new greenfield route to cross the Hawkesbury River to meet King Road and then to Wilberforce Road	Not favoured by group	Agreed that this option may not warrant further consideration
Option 9A	Refurbish existing bridge – deck only	Not favoured by group	**This option and/or alternatives to this option may warrant further consideration**
Option 9B	Refurbish existing bridge – more comprehensively	Not favoured by group	**This option and/or alternatives to this option may warrant further consideration**

That is, we believe that the following options and/or alternatives to these options, may warrant further consideration:

- Option 1
- Option 2
- Option 3
- Option 6
- Option 7
- Option 9

2.2 The Traffic Modelling and Evaluation of Options - Preliminary Report (August 2011)

Link to Document:
http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/tech_reports_aug2011/traffic_modelling_and_evaluation_options_preliminary_report_aug11.pdf

This report provides a broad comparison of the operational performance of the nine options, modelled using the micro-simulation modelling package VISSIM. It compares network-wide performance results (total travel time and average speed) for the 2009 AM and PM peaks only. That is, no future year modelling appears to have been undertaken as part of this comparison of the nine originally identified options.

The study concluded that 'little improvement could be made upon the total vehicle travel time and speed for each option as compared to the existing conditions', however it does not appear that option testing was undertaken to endeavour to improve travel times.

We understand that further modelling was carried out on Options 1 and 6 only, to determine whether these options could accommodate 2026 traffic volumes. We assume that only these options were modelled as the remaining options had previously been determined not to warrant further consideration by the stakeholder group (with the exception of Option 2 which from a traffic modelling perspective is the same as Option 1, but has a low level bridge rather than a high level bridge).

It is unclear why there was no further modelling undertaken on Option 3, which was identified as an option which warranted further consideration in the Options Report (as discussed in Section 2.1). While the initial modelling results indicate a slightly lower average network speed for Option 3 than Option 1 and Option 6 during the 2009 morning peak, they indicate a slightly higher average network speed during the 2009 evening peak.

We understand that the results of the Option 1 and Option 6 modelling were then used to complete a cost-benefit assessment. It was subsequently determined by RMS that Option 1 'performed the best'.

In our opinion, a more thorough modelling exercise considering additional options and/or sub-options of the nine originally identified options may have been warranted as part of the 'Evaluation of Options' exercise. While additional work and analyses may have been undertaken, the results of such work have not been provided to us.

In addition, it is not clear whether the cost-benefit assessment considered that:

- some of the options may have a longer 'life' than others, or in other words, that the options involving the major traffic route through town may only defer the need for an additional river crossing or bypass, not do away with it altogether; and
- a new two-lane bypass bridge, rather than a three-lane bridge, could potentially be adequate for the options involving a river crossing further out of town.

We believe that the above are important considerations in any comparison of the options.

2.3 The Community Issues Report (published October 2011)

Link to Document:
http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/windsor_bridge_issues_report_oct2011.pdf

This Community Issues Report describes the communication and consultation activities undertaken from August 2011 to September 2011, regarding the preferred option. It provides a summary of the issues raised in written submissions, workshops, online forum comments and discussions during this period.

A total of 72 submissions were received between August 2011 and September 2011 on the preferred option, in response to the community update released in August 2011 which described the preliminary design of the preferred option and invited community feedback.

At this time, the preferred option proposed a signalised intersection at the Wilberforce Road / Freemans Reach Road intersection (see **Figure 2.3** below), rather than a roundabout as is now proposed in the preferred option. It also proposed the staging of the delivery of the project as shown in the figure below. The preferred option now includes the signalisation of the Bridge Street / George Street intersection as part of the delivery of the new bridge rather than during Stage 2 of the project.

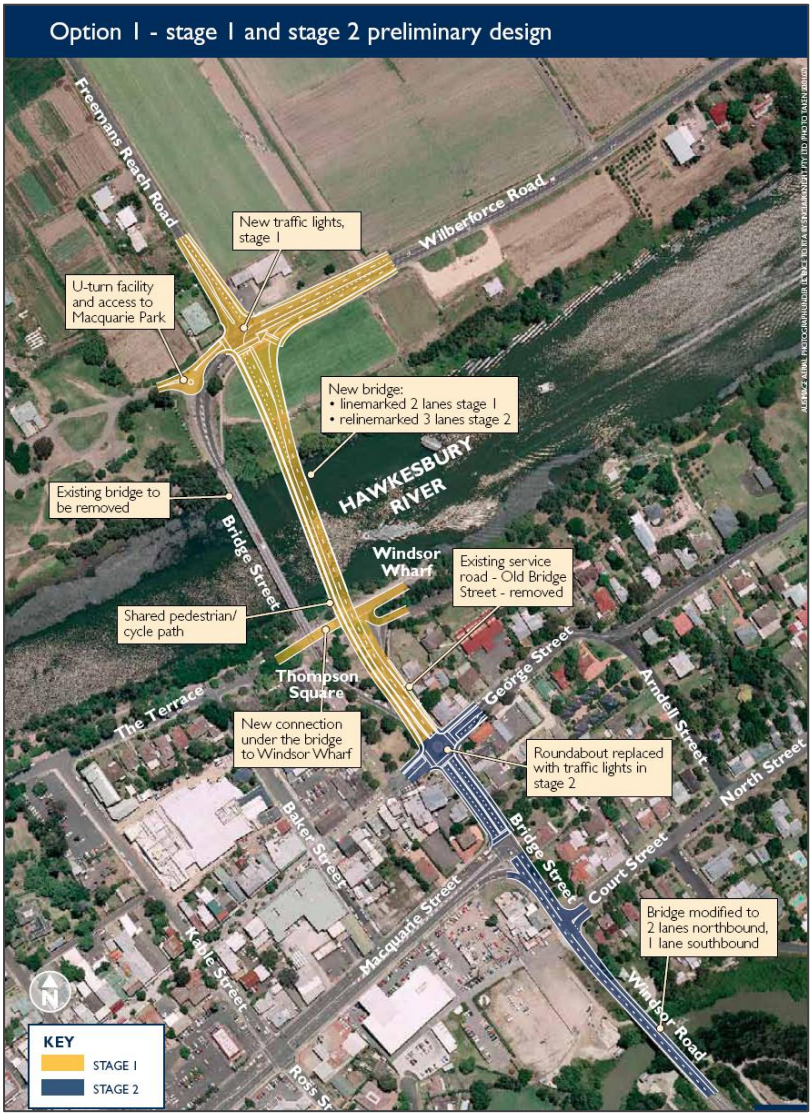


Figure 2.3: Preferred Option (Option 1) as at October 2011

Traffic Issues

Traffic issues were raised in 58 submissions. The Community Issues Report summarises these issues as follows:

1. *Volume of traffic during and outside peak hours.*
2. *Potential increase in the number of heavy vehicles using the bridge (e.g. semitrailers) as a result of the proposal.*
3. *Congestion caused by existing infrastructure (e.g. the roundabout at the corner of George Street and Windsor Road).*
4. *Doubts that the preferred option would alleviate current congestion issues experienced in the township. This is mainly due to proposed lane numbers and traffic management features both on and at either ends of the bridge.*
5. *Concern over the roundabout located at the corner of George Street and Bridge Street as potentially causing both traffic and safety issues, particularly during peak periods.*
6. *The steep incline heading southbound through Windsor is currently felt to be hazardous for drivers (particularly heavy vehicles) due to delays at the roundabout at the George Street-Bridge Street intersection.*
7. *During peak periods traffic is banked up halfway to Wilberforce along Wilberforce Road and a similar distance towards Freemans Reach on Freemans Reach Road. This congestion was seen to only be amplified by the erection of traffic lights.*
8. *Trucks 'choking' the roads through Windsor – they need to bypass the town through an alternative route.*
9. *A bridge with a wider road would encourage more traffic and lead to further congestion and traffic issues.*
10. *Drivers bypass the roundabout at George Street and Bridge Street by driving through backstreets ("rat running").*
11. *Concern regarding traffic during construction.*
12. *Due to the traffic queues on Bridge Street it is lucky if three vehicles are able to turn left from Macquarie Street onto Bridge Street at the traffic lights.*
13. *The traffic in Windsor seems to be worse on Tuesdays and Thursdays.*
14. *Because people are so frustrated with the traffic delays at North Richmond they are taking a detour to Wilberforce Road and crossing the Hawkesbury River via Windsor Bridge. This is why there is so much traffic in the Windsor area as people are avoiding crossing the North Richmond Bridge.*
15. *The increase in traffic would pollute the area with traffic fumes.*

RMS states in this report that they will " *undertake a traffic and transport assessment for the preferred option. This assessment will inform the preparation of the environmental impact statement and the concept design.*

The traffic and transport assessment will:

- *Examine the potential impact of the preferred option on traffic and transport during both construction and operation.*
- *Address requirements issued by the Director-General of the Department of Planning and Infrastructure."*

Safety Issues

Safety was raised as an issue in 15 submissions. The Community Issues Report summarises these issues as follows:

Pedestrian safety

1. *There is no pedestrian crossing proposed at the intersection of Bridge Street and George Street in current designs.*
2. *Pedestrian safety due to the lack of crossing facilities at the roundabout location.*
3. *During peak periods pedestrians are often weaving through traffic stopped at the intersection of Bridge Street and George Street.*
4. *No safe pedestrian access is proposed to popular areas such as the music store (corner of Bridge Street and George Street) and Thompson Square.*

Motorist safety

Motorist safety was raised as an issue, particularly travelling southbound from Freemans Reach and Wilberforce roads. Issues included:

1. *Peak hour congestion causes southbound drivers reaching the roundabout to give way for long periods, therefore delaying the traffic behind them. This is an issue due to the steep incline on Bridge Street and can be particularly dangerous for southbound heavy vehicles idling for an extended amount of time.*
2. *Respondents expressed support for the roundabout to be removed at the intersection of George Street and Windsor Road as part of the proposed works and replaced with traffic lights. However, drivers can experience limited vision due to a crest in the road and this reduces their ability to react quickly at a red light.*

The implementation of a reduced speed limit or warning sign before the crest on Windsor Road at the intersection of George Street was suggested to counteract the above issues.

Our general comments on the issues raised in the submissions, and the extent to which the preferred option addresses these issues, are as follows:

Congestion Issues / Increased Traffic

As identified in some of the submissions, there are existing congestion issues as a result of the limited capacity of the intersections feeding the existing bridge. Addressing these congestion issues requires the provision of additional capacity along this route (i.e. primarily at the intersections), which may in turn attract more traffic onto this route. This 'rebalancing' of traffic demand is a possible effect of any road upgrade project.

In our opinion, the preferred option may add limited capacity to the route, as the Windsor Street / Macquarie Street intersection is one of the current key capacity constraints along this route, and no upgrades to this intersection are proposed as part of the project.

We therefore expect that the extent to which traffic would divert from other routes across the river onto this route may be relatively limited under the current proposal. However we believe that the operation of this intersection both now and into the future requires careful consideration as part of this project.

The Bridge Street / George Street Roundabout

The proposal now includes the signalisation of the Bridge Street / George Street intersection as part of the delivery of the new bridge, therefore we believe that the proposal addresses the operation of this intersection in the short to medium term. However we believe that there may be other alternatives for upgrading this intersection without necessarily demolishing the existing bridge. These are discussed in Section 3 of this report.

The Wilberforce Road / Freemans Reach Road Intersection

The preferred option involves the conversion of this T-intersection to a roundabout, which should alleviate both capacity and safety issues. However we believe that there may be other alternatives for upgrading this intersection without necessarily demolishing the existing bridge. These are discussed in Section 3 of this report.

Windsor 'Bypass' Option

We agree that 'bypass' options may warrant further consideration, based upon the information we have reviewed. Our suggestions regarding possible bypass options, and the merits of such options, are outlined in Section 3.4 of this report.

Traffic Management during Construction Activities

We note that RMS states that the traffic and transport assessment undertaken for the EIS will examine the potential impact of the preferred option on traffic and transport during both construction and operation. Whilst we note that there is a section in the Traffic and Transport Working Paper in the EIS on 'Construction', this information focuses more

so on construction traffic, rather than impacts upon general traffic as a result of construction activities (i.e. road closures, diversions, traffic management, etc.).

Given that the preferred option would involve construction activities in Windsor town, we believe that the impact of construction activities upon traffic within the town should be an important consideration. And whilst we acknowledge that the intention may be to develop a detailed Construction Traffic Management Plan in future stages of the project, in our opinion, the impact of the construction activities should perhaps have been a stronger consideration in the original Options Assessment.

2.4 The Project Environmental Impact Statement (EIS) (November 2012)

Links to Documents:

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_1/windsor_bridge_EIS_chapter_7_3_traffic_transport_nov2012.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_1_nov2012.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_2_nov2012.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/eis/volume_4/windsor_bridge_traffic_and_transport_working_paper_part_3_nov2012.pdf

We have reviewed the relevant sections of the Project Environmental Impact Statement (EIS), which include the Traffic and Transport Chapter (Chapter 7.3), and the Traffic and Transport Working Paper (Working Paper 4). These documents are largely a compilation of the information contained within the previous traffic reports (i.e. the Options Report and the Traffic Modelling and Evaluation of Options - Preliminary Report), with the exception of two key modifications (see **Figure 2.4** below):

- the proposal to upgrade the Wilberforce Road / Freemans Reach Road intersection to a dual circulating lane roundabout, rather than a signalised intersection as proposed in previous documents; and
- the proposal to signalise the Bridge Street / George Street intersection at the same time as the construction of the new bridge (rather than at a later date as part of 'Stage 2' of the project).

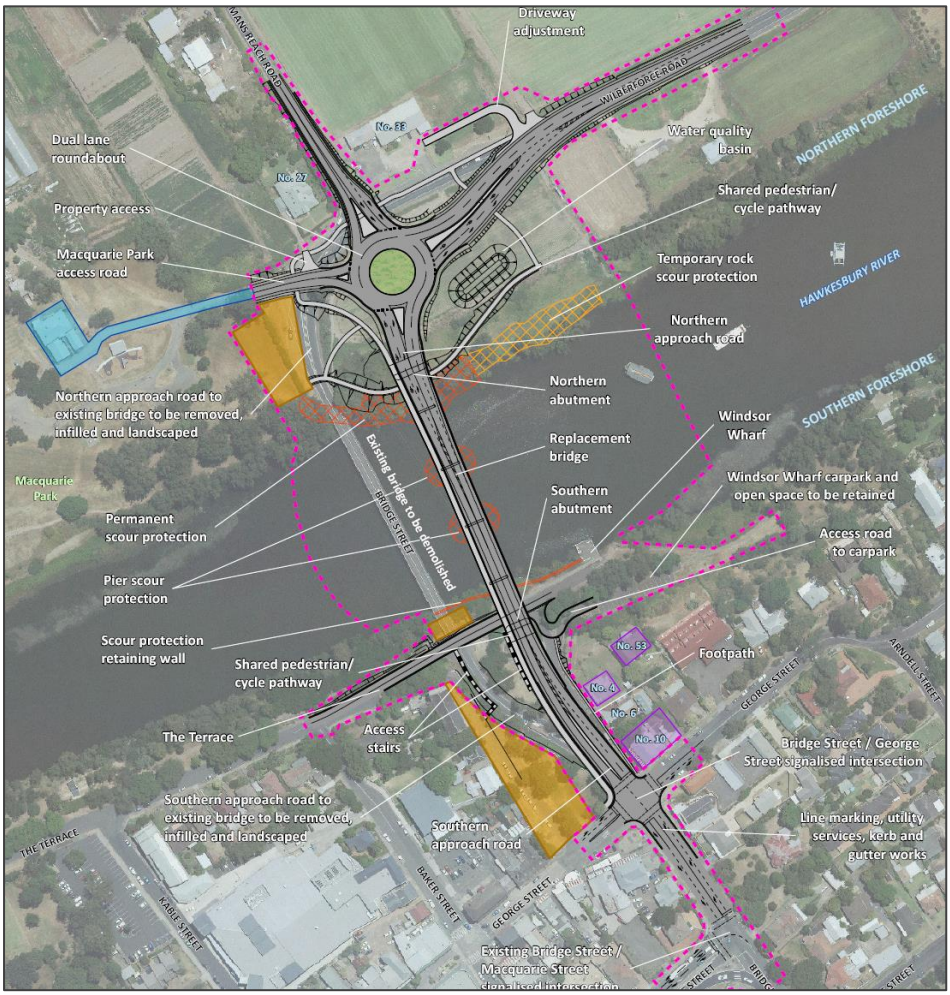


Figure 2.4: Preferred Option in EIS

Our comments on specific sections of this document are provided in the following sections.

Road network performance – Existing Intersection operation

The EIS states that the results of intersection modelling show that:

1. the Bridge Street / George Street intersection is operating well with acceptable delays and some spare capacity;
2. the Bridge Street / Macquarie Street intersection is operating near desired maximum capacity; and
3. the Wilberforce Road / Freemans Reach Road intersection is performing unsatisfactorily, which is consistent with community observations of long queue lengths and delays in peak periods.

Our understanding however is that all three of these intersections currently operate outside acceptable limits during peak periods, and therefore we consider that validation of the base models should be completed.

There are a number of possible reasons the results of the modelling may not reflect the observed conditions.

The EIS states that the analysis was based on counts of turning volumes collected at the Bridge Street / George Street and Wilberforce Road / Freemans Reach Road intersections on Wednesday 7 December 2011, and SCATS data for the Bridge Street / Macquarie Street intersection on the same day.

We expect however that due to traffic congestion during peak periods, actual traffic demand at these intersections may be greater than the recorded and modelled traffic volumes. That is, traffic which is not able to proceed through the intersection (i.e. latent demand) may not have been accounted for in the modelling.

Also, loop detectors which collect SCATS data (which we understand was used for modelling of the Bridge Street / Macquarie Street intersection) typically undercount in congested conditions. It also appears that there is no SCATS data for the northbound left turn movement at this intersection (one of the heaviest movements), due to the lack of a loop detector in this lane.

We would suggest that it would be prudent to validate base traffic models against observed conditions.

Finally, the effect of motorists taking alternative routes to avoid congested movements (such as the left turn from Macquarie Street instead using Court Street / Arndell Street / George Street to access Bridge Street) may influence the results of the traffic modelling. We believe that such movements should be 'reassigned' under the option modelling, however it does not appear as though this adjustment has been made.

Crash Data

It is noted that of the 16 crashes in the vicinity of the Windsor Bridge from 2005 – 2009, 11 crashes were at the Bridge Street / Freemans Reach Road intersection.

The details of each of the specific incidents are not provided in the EIS. However based upon our observations on-site as well as our understanding of the operation of this intersection during peak periods, we expect that some of these incidents may have been a result of motorists turning right from Freemans Reach Road accepting small gaps in oncoming traffic, due to lengthy delays exiting onto Bridge Street. Upgrading this intersection (as proposed under the current proposal) should alleviate this issue.

We note however that no crash data is provided for Bridge Street / Windsor Road south of George Street. We would be interested to review crash data at the Windsor Road / Court Street intersection in particular, given the limited sightlines for the right-turn movement from Court Street into Bridge Street.

Pedestrian and Cycle networks

This section of the EIS identifies the Bridge Street / George Street roundabout as a 'significant safety risk' for pedestrians due to the limited protection provided from vehicular traffic, as well as the fact that the intersection is

located at the top of a crest and therefore sight distances between pedestrians and motorists are poor. The proposal to signalise this intersection should address this issue.

Development of Preferred Option

This section of the EIS reiterates that the traffic modelling indicates that the following intersections are operating at or outside acceptable limits:

- The Wilberforce Road / Freemans Reach Road intersection; and
- The Bridge Street / Macquarie Street intersection are.

However it then goes on to discuss options to upgrade only:

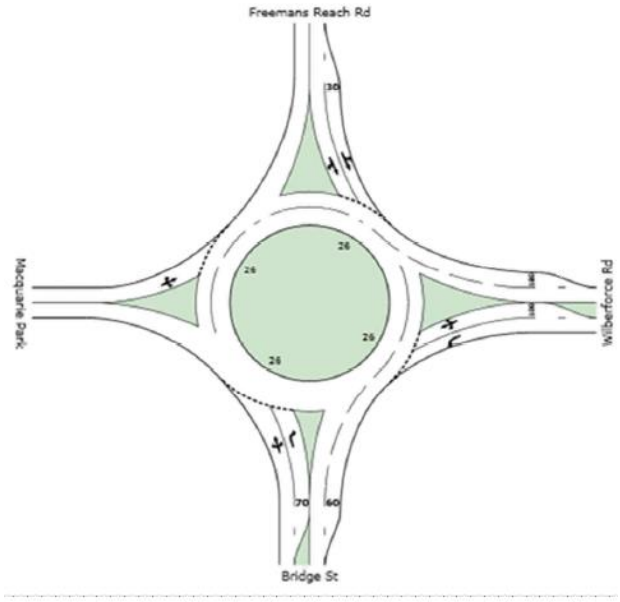
- The Wilberforce Road / Freemans Reach Road intersection; and
- The Bridge Street / George Street intersection.

In other words, it suggests that the Bridge Street / Macquarie Street intersection is operating outside acceptable limits, but does not offer any solutions to address this issue. Given that this intersection would feed the new bridge under the preferred option, it is our opinion that measures to improve the capacity of this intersection should be a key objective of this project.

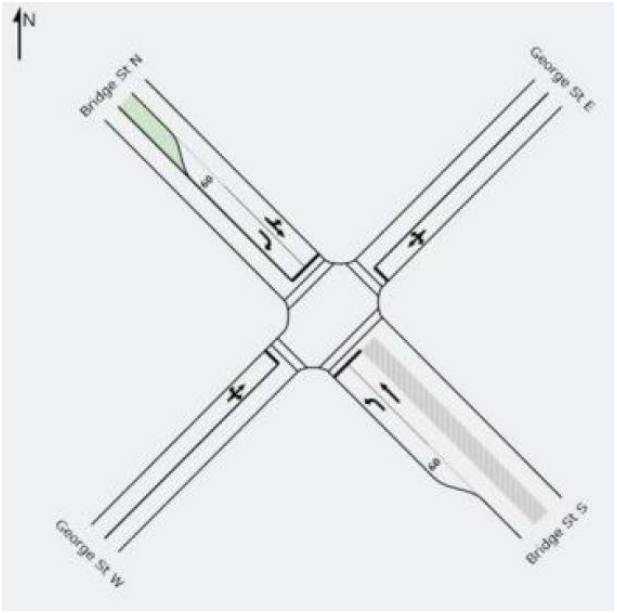
The EIS provides a number of options which were tested as part of the development of the preferred option, at the following intersections:

- Wilberforce Road / Freemans Reach Road; and
- Bridge Street / George Street.

The preferred options identified for each of these intersections in the EIS are shown below.



Wilberforce Road / Freemans Reach Road intersection
Preferred Option - Option 6



Bridge Street / George Street intersection
Preferred Option - Option 4

As outlined in Section 3, we have identified a number of possible alternatives to the preferred treatments at these intersections, which may warrant further consideration.

Design Life Analysis - Bridge Street / George Street intersection

The EIS presents the results of a Design Life Analysis (DLA) undertaken for the Bridge Street / George Street intersection. The purpose of a DLA is to forecast the maximum number of years for which an intersection would be likely to operate within acceptable limits. The summary table provided in the EIS is copied below for reference.

Table 4-5 Bridge Street / George Street - Intersection performance for each option tested

Peak	Existing (roundabout)		Option 1	Option 2	Option 3	Option 4
	Latest year at which level of service C or better	The Worst movement	Latest year at which level of service of whole intersection is C or better			
AM	2031	Bridge Street north	2030	2030	2030	2030
PM	2016	George Street west	2021	2028	2024	2021

Source: Project EIS, Working Paper 4

The EIS states that the performance criteria used to determine acceptable level of service is level of service C or better. We have reviewed the SIDRA models of these intersections prepared by RMS, and make the following comments. In particular, reference has been made to the results of the Option 4 (preferred option) analysis for the 2021 PM peak period, a summary of which has been copied for reference overleaf.

1. While the model results indicate an overall intersection level of service (LOS) C, there are several movements for which the predicted performance is substantially worse than LOS C. For example, the southbound right turn from Bridge Street into George Street is predicted to operate at LOS F.

2. While we agree that LOS is a useful performance criteria for comparing options, we believe that it is also very important to consider other performance criteria, such as the predicted queues for certain movements. In particular, we note the following:

    a. The predicted 95th percentile queue for the northbound through movement on Bridge Street is approximately 450m. In other words, the modelling undertaken by RMS indicates that during the 2021 PM peak period, only 5 years after the anticipated completion of the project, the northbound queue on Bridge Street from the George Street intersection Is predicted to extend as far back as the Macquarie Street intersection, over the Fitzroy Bridge, to approximately 150m south of the Fitzroy Bridge, during the design peak hour; and

    b. The predicted 95th percentile queue for the southbound through movement on Bridge Street is approximately 300m. In other words, the modelling undertaken by RMS indicates that during the 2021 PM peak period, only 5 years after the anticipated completion of the project, the southbound queue on Bridge Street from the George Street intersection Is predicted to extend as far back as the proposed new bridge, almost to the Macquarie Park access, during the design peak hour.

    In our opinion, this does not represent an acceptable level of operation for the 5 year design horizon. In our experience it is standard practice for developments to be required to demonstrate acceptable road network performance for the 10 year post-opening scenario, and road planning is often undertaken with the 20 year design horizon in mind. Given the impact and significance of this particular project, we would recommend that consideration needs to be given to achieving acceptable intersection operation for at least the 10 year design horizon. If this is not possible due to the current constraints upon intersection upgrades, we believe that this lends support to the suggestion that alternative and/or future options involving a river crossing further out of town may warrant further consideration.

Results from RMS SIDRA Model - Bridge Street / George Street Intersection
2021 PM Peak - Option 4 (Preferred Option)
Model File: BridgeSt_GeorgeSt_Scenarios_DLA_NR.sip

MOVEMENT SUMMARY

Site: Bridge Street / George Street PM signals_withRT - Option4

Bridge Street / George Street PM signals
Right Turn onto Bridge Street South
DLA - OPTION 4
Signals - Fixed Time Cycle Time = 150 seconds (Practical Cycle Time)
Design Life Analysis (Final Year): Results for 10 years

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Bridge St S											
21	L	17	6.7	0.035	20.7	LOS B	0.3	2.6	0.30	0.67	37.2
22	T	777	5.6	0.958	42.1	LOS C	62.0	454.9	0.98	1.04	26.6
Approach		794	5.6	0.958	41.6	LOS C	62.0	454.9	0.97	1.03	26.8
North East: George St E											
24	L	29	3.8	0.959	58.8	LOS E	40.2	301.4	0.95	1.04	21.5
25	T	36	0.0	0.959	51.5	LOS D	40.2	301.4	0.95	1.00	20.9
26	R	398	9.5	0.959	59.0	LOS E	40.2	301.4	0.95	1.04	21.5
Approach		463	8.4	0.959	58.4	LOS E	40.2	301.4	0.95	1.03	21.5
North West: Bridge St N											
27	L	7	0.0	0.469	23.9	LOS B	11.8	87.1	0.46	1.03	36.5
28	T	370	7.0	0.469	16.4	LOS B	11.8	87.1	0.46	0.41	40.0
29	R	180	1.2	0.892	82.8	LOS F	13.7	97.2	1.00	1.08	17.5
Approach		557	5.0	0.892	37.9	LOS C	13.7	97.2	0.64	0.63	28.6
South West: George St W											
30	L	293	4.6	0.365	17.3	LOS B	7.0	50.4	0.30	0.71	24.2
31	T	13	0.0	0.365	10.0	LOS A	7.0	50.4	0.30	0.26	26.1
32	R	38	0.0	0.365	17.2	LOS B	7.0	50.4	0.30	0.73	24.1
Approach		345	3.9	0.365	17.0	LOS B	7.0	50.4	0.30	0.70	24.2
All Vehicles		2158	5.8	0.959	40.3	LOS C	62.0	454.9	0.77	0.87	25.6

In addition, we note that a different method appears to have been used in the design life analysis (DLA) for the existing intersection configuration, than that used for the four options which were assessed by RMS. We have adjusted the modelling to apply the same DLA method to the existing intersection configuration as that applied in the option testing, and the results for the critical PM peak period indicate that the intersection is predicted to reach LOS C in 2018, not 2016 as reported in the EIS.

In other words, based upon the modelling undertaken by RMS and the DLA method adopted by RMS, the proposed upgrade to the Bridge Street / George Street intersection is predicted to provide only an additional three (3) years of intersection 'life' over and above that of the existing intersection configuration.

Whilst we acknowledge that the signalisation of this intersection would enable pedestrian crossing provisions to be substantially improved, we suggest that alternative treatments providing additional traffic capacity should be considered. Again, if this is not possible due to the current constraints upon intersection upgrades, we believe that this lends support to the suggestion that alternative and/or future options involving a river crossing further out of town may warrant further consideration.

2.5 The Submissions Report (published April 2013)

Links to Documents:

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_toch2.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch3.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch4.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_ch5toappendixa.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_1.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_2.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_3.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixb_att1_4.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixc.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixd.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixe.pdf

http://www.rta.nsw.gov.au/roadprojects/projects/sydney_region/western_sydney/windsor_bridge/documents/submissions_report/windsor_bridge_submissionspir_appendixf_g.pdf

The Submissions Report was prepared by RMS to respond to issues raised in submissions and during consultation for the EIS. A total of 101 submissions were received in response to the exhibition of the EIS, including six government agency submissions and 95 submissions from the community.

The main traffic-related issued raised in the community submissions are summarised in the Submissions Report as follows:

- *Objection to the project on the grounds that it does not provide a long-term solution for traffic issues and will allow increasing volumes of through traffic and heavy vehicles to impact the heritage precinct of Windsor.*
- *Objection to the project on the grounds that there is not sufficient justification for it to proceed due to a perceived lack of benefits and significant adverse impacts.*
- *Objection to the project and support for an alternative route to avoid impacts on Thompson Square and remove through traffic and heavy vehicles from Windsor town centre.*

Our comments on traffic-related information provided in the Submissions Report are provided following.

2.5.1 Chapter 2: Response to Issues

Alternatives to the Project (Section 2.4)

In this section of the Submissions Report, RMS provides high-level reasons for not further considering a number of alternatives to the preferred option which were suggested in submissions. Such options include:

- Other 'bypass' options and alternative crossing locations (including the Rickabys Line Option)
- Refurbishment of the existing bridge
- Upgrading intersections only
- Construction of a tunnel

We agree that the construction of a tunnel is unlikely to be a viable option for a number of reasons, however it does not appear as though further consideration has been given to the other alternatives (with the exception of the Rickabys Line Option) which in our opinion may offer a feasible alternative to the preferred option.

The Rickabys Line Option has been assessed by RMS in further detail in response to the submissions. Our comments on this assessment are outlined in our comments on Chapter 4 of the Submissions Report.

RMS does state however that 'an alternative route around Windsor may be considered in the future depending on growth in traffic numbers and local congestion.' In our opinion, such a route should be considered as part of this project. The intersections which would feed the bridge under the preferred option will have a limited 'life' and upgrade options for these intersections are limited due to surrounding properties of heritage significant. Rather than constructing a three-lane (ultimate) bridge which has more traffic capacity than the roads and intersections feeding it, we would suggest considering alternative bridge crossing locations which may provide adequate traffic capacity for a longer period of time (e.g. a bypass option). This is discussed further in Section 3.4.

Through Traffic and Heavy Vehicles (Section 2.8.1)

This section of the Submissions Report explains how RMS does not expect that the project would increase through traffic or heavy vehicles volumes through Windsor. It specifically discusses the movements between Windsor and Singleton, which is approximately 180km to the north of Windsor via Putty Road.

We agree that the delivery of a new river crossing at Windsor would be very unlikely to attract regional (through) traffic from alternative north-south routes such as the Pacific Motorway. However given current congestion issues at Richmond during peak periods, we expect that there may be a diversion of traffic from the Richmond River Crossing of the Hawkesbury River to the Windsor Bridge Crossing, if the capacity of the Windsor route is increased through intersection and/or bridge upgrades as part of the project. That is, if the delivery of the project reduces congestion through Windsor such that there is a travel time saving of a few minutes for traffic on this route, traffic which currently uses Richmond Bridge may divert onto the Windsor Bridge route, to avoid the congestion which currently occurs at Richmond during peak periods.

We note however that RMS is also planning to upgrade the Richmond Bridge and its approach roads to alleviate congestion. Such an upgrade may reduce the relative attractiveness of the Windsor Bridge route, in which case we would expect the increase in traffic volumes through Windsor as a result of the project would be marginal.

Growth in Traffic Volumes (Section 2.8.2)

RMS states in this section in the Submissions Report that "the proposed intersection improvements and an initial two lane bridge configuration would provide acceptable traffic performance immediately and into the future."

We note however that the modelling of the Bridge Street / George Street intersection and the Bridge Street / Macquarie Street intersection undertaken by RMS indicates that:

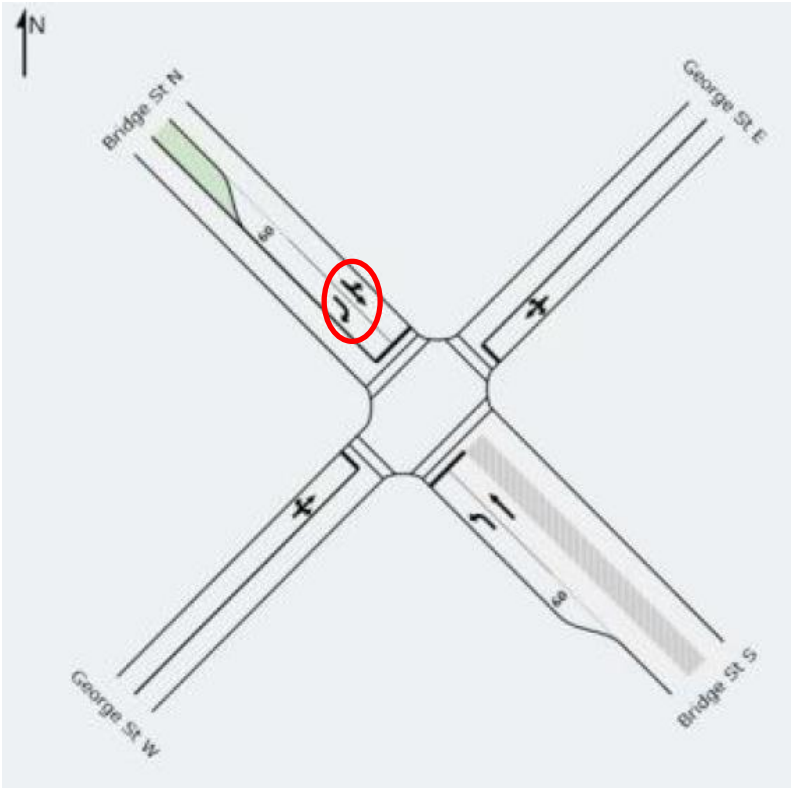
- The Bridge Street / George Street intersection is expected to be operating very close to acceptable limits of operation at the assumed year of opening of the project (2016), with limited spare capacity; and

- The Bridge Street / Macquarie Street intersection is expected to be operating outside of acceptable limits of operation at the assumed year of opening of the project (2016).

Right turn from Bridge Street north into George Street West (Section 2.8.3)
This section of the report responds to the submissions which raised concerns with the possible future banning of the southbound right turn movement from Bridge Street into George Street.

It states that "a right turn movement for southbound traffic on Bridge Street north to George Street west would initially be permitted, with a shared turning lane provided."

Whilst the VISSIM modelling indicates a shared southbound through / right turn lane, we note that the SIDRA modelling provided indicates that the preferred intersection arrangement (Option 4, shown below) will provide a dedicated southbound right turn lane, rather than a shared turning lane as described in the Submissions Report. We would suggest requesting clarification from RMS on this issue.



Bridge Street / George Street intersection
Preferred Option - Option 4

Performance of the Macquarie Street Intersection (Section 2.8.5)
This section of the Submissions Report addresses respondents' concerns regarding the performance of the Macquarie Street Intersection. We agree that the EIS does not adequately address this intersection, and further consideration should be given to its future operation given that it will 'meter' traffic to and from the bridge.

As previously discussed, we note that the summary of the results of the analysis for this intersection (provided in Chapter 4 of the submissions report) indicate that this intersection is predicted to operate outside of acceptable limits of operation at the assumed year of opening of the project. This is discussed further in our response to Chapter 4, below.

Performance of the Freemans Reach Road/ Wilberforce Road Intersection (Section 2.8.6)

One concern raised by a respondent relates to the short lane downstream of the proposed roundabout, on the approach to the bridge. The conversion of the bridge to two southbound lanes would avoid the short downstream lane (i.e. the merge from two lanes to one lane), however given that the roundabout would 'meter' this traffic, we would question whether this would be required from a capacity perspective.

Notwithstanding the above, we have considered alternatives to the preferred arrangement for this intersection, which are discussed in Section 3.0.

Design speed of the project (Section 2.8.10)

This section of the Submissions Report suggests that a 50km/hr design speed has been adopted to enable the height of the bridge to be lowered, however we understand however that the current proposal is for the high level bridge. We would suggest requesting clarification from RMS on this issue.

2.5.2 Chapter 4: Rickabys Line Option

This section of the Submissions Report provides further information on the Rickabys Line Option (referred to as the 'alternative'), which involves refurbishing and retaining the existing bridge for light traffic and building an alternative river crossing route to the west of Windsor. It states that overall, the alternative and the project are predicted to provide similar levels of service for major turning movements at all intersections, with a few exceptions.

The results of the modelling for the proposal however indicate poor levels of service for the Bridge Street / Macquarie Street intersection (see below). Further, it appears as though this analysis assumes the southbound right turn movement into George Street is not banned. Banning this movement would put further pressure on the Bridge Street / Macquarie Street intersection, however there do not appear to be any solutions offered to address the capacity issues at this intersection under the proposal.

Table 4-1 Traffic performance (Level of Service) of the project and the Rickabys Line option for key turning movements

		2016 AM		2026 AM		2016 PM		2026 PM	
From	**To**	**Project**	**Alternative**	**Project**	**Alternative**	**Project**	**Alternative**	**Project**	**Alternative**
Macquarie Street/Bridge Street intersection									
Bridge Street N	Bridge Street S	**A**	**B**	**A**	**B**	A	A	A	A
Bridge Street N	Macquarie Street	**B**	**D**	**B**	**D**	C	D	C	D
Macquarie Street	Bridge Street N	A	A	A	A	**B**	**B**	**F**	**D**
Macquarie Street	Bridge Street S	**C**	**C**	**D**	**C**	C	C	F	E
Bridge Street S	Macquarie Street	A	A	A	A	**A**	**A**	**F**	**A**
Bridge Street S	Bridge Street N	B	B	C	C	**B**	**B**	**F**	**C**
George Street/ Bridge Street intersection									
Bridge Street N	George Street E	A	A	B	D	A	A	B	A
Bridge Street N	Bridge Street S	**B**	**B**	**C**	**D**	B	A	B	A
Bridge Street N	George Street W	B	A	C	D	D	A	F	A
Bridge Street S	George Street W	A	A	A	A	B	A	F	A
Bridge Street S	Bridge Street N	A	A	A	A	**B**	**A**	**B**	**A**
Bridge Street S	George Street E	-	A	-	A	-	A	-	A
Northern intersection									
Freemans Reach Road	Wilberforce Road W/ Bridge Street	**A**	**C**	**B**	**C**	A	D	A	E
Wilberforce Road W	Freemans Reach Road	A	A	A	A	**B**	**A**	**A**	**A**
Wilberforce Road	Rickabys Line	-	**A**	-	**A**	-	B	-	B
Wilberforce Road	Bridge Street	**A**	**A**	**A**	**A**	A	A	A	A
Bridge Street	Freemans Reach Road	A	-	A		**A**		**B**	-
Bridge Street	Wilberforce Road	A	C	A	D	**A**	**B**	**B**	**B**
Rickabys Line	Wilberforce Road	-	A	-	B	-	**C**	-	**F**

In our opinion, it would be prudent to provide further consideration to the operation of the Bridge Street / George Street intersection and the Bridge Street / Macquarie Street intersection, to ensure that the benefits of a new bridge under the preferred option, are able to be realised.

2.6 Additional Information Received - May 2013

The following sections outline our comments on, and the results of our high level review of the additional information provided by the applicant, which we received on 16 May 2013.

2.6.1 Item 1: Background Traffic Count Data

The Background Traffic Count Data provided by RMS is included as **Appendix C**. A high level review of the traffic count data has been undertaken, and initial comments are as follows:

2009 Traffic Surveys

Intersection Counts at the following intersections have been provided:

1. Hawkesbury Valley Way / Moses Street
2. Hawkesbury Valley Way / George Street
3. Hawkesbury Valley Way / Macquarie Street
4. George Street / Baker Street
5. George Street / Bridge Street
6. Windsor Road / Macquarie Street
7. Freemans Reach Road / Wilberforce Road
8. Johnson Street / The Terrace
9. Kable Street / The Terrace
10. New Street / The Terrace
11. George Street / Suffolk Street / New Street
12. Fitzgerald Street / The Terrace
13. Kable Street / Carpark Access
14. Hawkesbury Valley Way / Macquarie Street
15. Windsor Road / Macquarie Street / Court Street
16. Macquarie Street / Kable Street
17. Day Street / Medical Centre Access
18. Macquarie Street / Day Street
19. Macquarie Street / Suffolk Street
20. Macquarie Street / Fitzgerald Street
21. George Street / Fitzgerald Street

We note however that there appear to be multiple traffic counts for some intersections with different results / volumes. An example of this is the Hawkesbury Valley Way / Macquarie Street intersection, for which the summary volume figures for the morning period are copied overleaf.

Whilst these two figures appear to provide the results of traffic counts undertaken at the same intersection on the same day, we note that the total intersection volumes presented in each of these figures is quite different (i.e. 2769vph in Count 1, and 3040vph in Count 2, for the time period from 8:00am – 9:00am). Note the orientation of the intersection in each of these figures is different.

We would suggest requesting that RMS review the historic background traffic data used in the development of models, to ensure that:

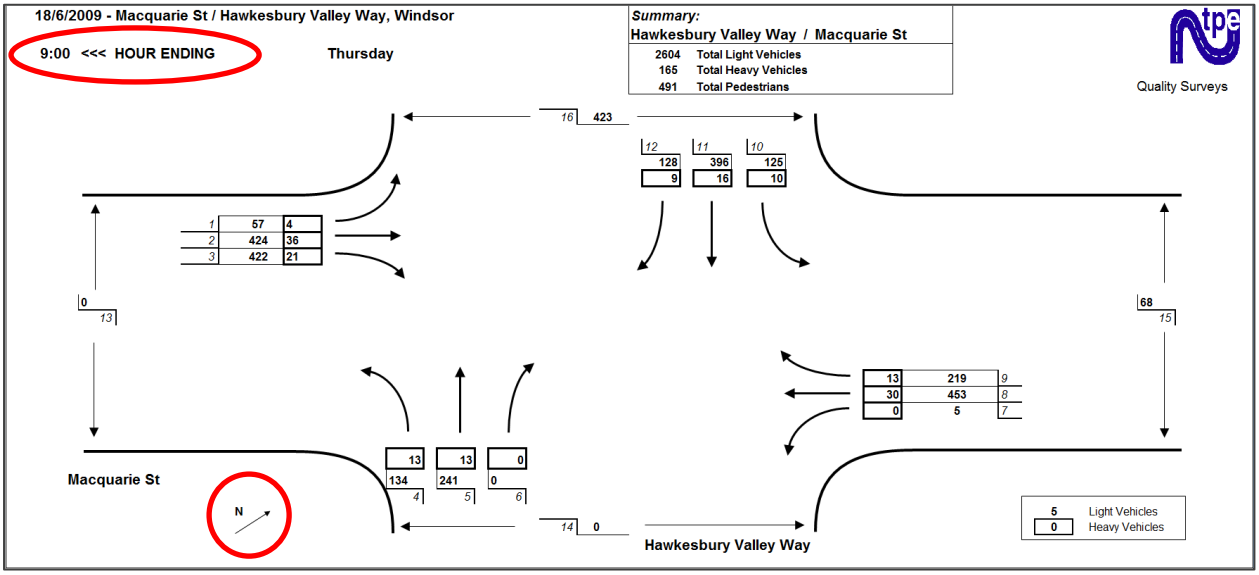
- where multiple traffic counts for the one intersection exist, these counts are consistent or any discrepancies are able to be explained;
- traffic counts at adjacent intersections are compared, to check that upstream and downstream traffic volumes are consistent, or that any significant differences are explainable (e.g. result from intermediate accesses to major developments);

- significant traffic diversion or 'rat-running' which is occurring to avoid congested intersections or movements is identified.

Count 1

Hawkesbury Valley Way / Macquarie Street intersection

From RMS File: 091623Intersection Report2.xls

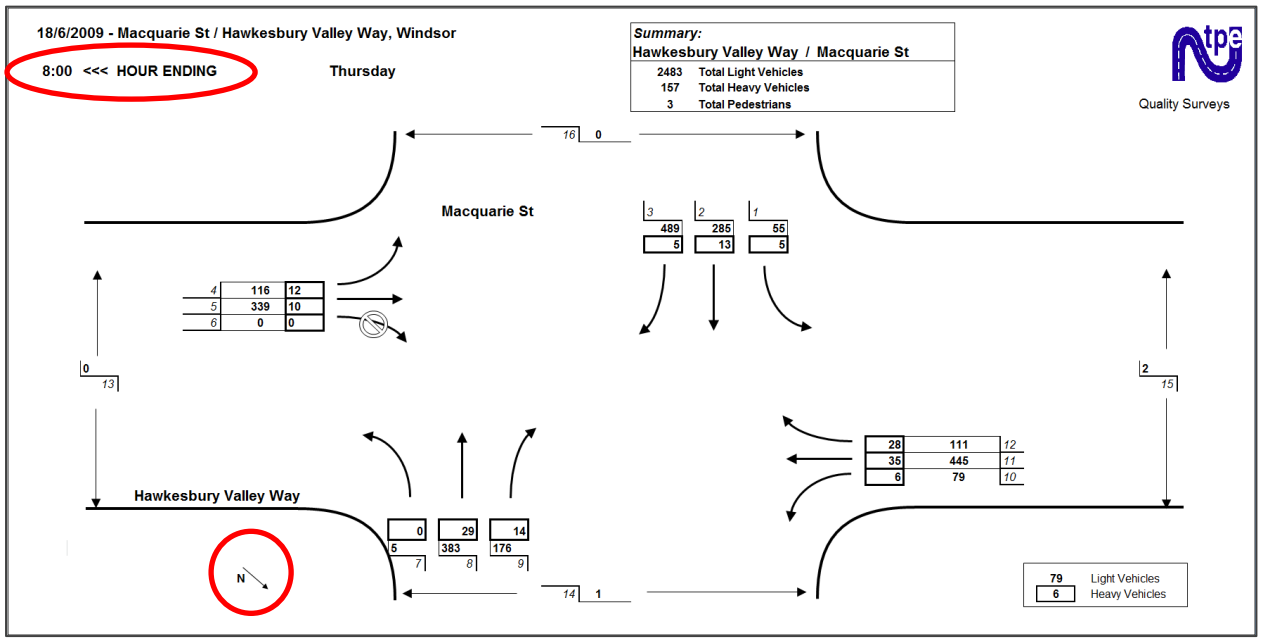


All Vehicles	1	2	3	4	5	6	7	8	9	10	11	12	Total Vehicles 15 MIN HOUR	
07:15	20	65	107	24	75	0	14	16	18	20	22	24	405	
07:30	17	84	156	36	100	0	1	83	38	28	101	17	661	
07:45	8	62	105	34	68	0	1	107	58	23	75	23	564	
08:00	9	89	100	30	66 <	0	1 <	114	47	30	107	24	617	2247
08:15	9	96	114 <	44	54	0	0	112	50	29	118	37	663	2505
08:30	17	127	109	36	56	0	3	119	57	41	103	35	703	2547
08:45	15	111	118	34	65	0	0	117	59	41	112 <	32	704	2687
09:00	20	126	102	33	79	0	2	135 <	66	24	79	33	699	2769 <
09:15	15	97 <	82	38	70	0	2	103	64	42 <	76	40	629	2735
09:30	21	110	55	38	71	0	2	104	67	30	64	35	597	2629
09:45	24 <	77	81	40	67	0	4	101	65 <	33	58	48 <	598	2523
10:00	18	54	72	41 <	80	0	0	85	52	36	84	25	547	2371

Count 2

Hawkesbury Valley Way / Macquarie Street intersection

From RMS File: 091623Intersection Report4.xls



All Vehicles	1	2	3	4	5	6	7	8	9	10	11	12	Total Vehicles 15 MIN HOUR	
07:15	21	53	119	22	92	0	1	66	37	19	121	34	585	
07:30	16	72	131	30	84	0	1	122	58	15	94	29	652	
07:45	7	79	123	35	88	0	1	86	42	24	151	28	664	
08:00	16	94	121	41	85	0	2	138	53	27	114	48	739	2640
08:15	19	117	121 <	54	60	0	2	110	50	46	116	38	733	2788
08:30	23	130	110	36	89	0	2	117	69	36	126 <	39	777	2913
08:45	21	97	116	50	97	0	2	139 <	63	41	104	39	769	3018
09:00	29	131 <	114	49 <	92	0	5	109	58	34 <	100	40	761	3040 <
09:15	26	94	72	44	74 <	0	4	104	69 <	28	71	35	621	2928
09:30	24	109	57	43	75	0	3 <	98	66	40	70	49	634	2785
09:45	26 <	82	67	43	60	0	0	85	61	45	80	44 <	593	2609
10:00	18	59	64	36	66	0	1	76	63 <	28	70	37	518	2366

2011 SCATS Data

SCATS Data (traffic count data collected by the loop detectors in the pavement) is provided for the Macquarie Street / Bridge Street intersection only. We make the following comments in relation to this data:

- the data appears to be from Wednesday 6 December 2011;
- the PM peak is shown to be 3:30 – 4:30pm, however the PM peak in the 2009 manual count was identified to be 4:15 – 5:15pm;
- there is no northbound left turn volume provided in the SCATS data (presumably given that there is no loop detector for this movement as it is a continuous lane);
- In our experience, loop detectors generally undercount in congested conditions, when traffic is queuing on the detectors.

We have undertaken a comparison of the 2011 SCATS traffic count data against the 2009 manual traffic count at the Macquarie Street / Bridge Street intersection, and the results are outlined in **Table 2.6.1a** below.

Table 2.6.1a: Total Intersection Volumes*, Macquarie Street / Bridge Street

Time Period	2009 Manual Count	2011 SCATS Count
AM Peak 8:00am – 9:00am	1,663	1,581
PM Peak 4:15pm – 5:15pm	1,958	1,647

*Note: These volumes exclude the volume for the northbound left turn movement, as this volume is not provided in the SCATS data

As indicated in the table above, the 2011 SCATS traffic count data indicates volumes which are quite a bit lower than the 2009 manual counts for the PM peak hour. We suspect that this may be due to the congested conditions at the intersection. It may be therefore be worthwhile to undertake a new manual traffic count at this intersection, if these volumes are to be used as the basis for traffic modelling for the project.

2011 Traffic Surveys

These traffic counts are for the following intersections:

- Freemans Reach Road / Wilberforce Road
- George Street / Bridge Street

We note that these counts were undertaken on 12 July 2011, which we understand was during the NSW school holidays (4 July 2011 – 16 July 2011). Generally school holiday periods should be avoided when doing traffic counts, as the traffic conditions are generally not representative of 'typical' conditions. It may be therefore be worthwhile to undertake new manual traffic counts at these intersections, if these volumes are to be used as the basis for traffic modelling for the project.

RMS Count Station Data

This appears to be permanent RMS count data recorded on Windsor Road, in the vicinity of Macquarie Street, from 2006 to 2011. The data (summarised in the table below) indicates a substantial reduction in traffic on Windsor Road in 2008, presumably due to delivery of the Windsor Flood Evacuation Route. It is not clear however what caused the spike in 2010 Average Annual Weekday Traffic Volume (AAWT) on Windsor Road, and we would suggest seeking further information from RMS on this.

Table 2.6.1b: Summary of RMS Count Station Data Windsor Road near Macquarie Street

Year	Average Annual Weekday Traffic Volume (AAWT)
2006	34,144
2007	33,924
2008	19,489
2009	19,718
2010	27,658
2011	20,741

2.6.2 Item 2: Results of Origin – Destination Surveys

RMS provided a substantial amount of data collected during the origin – destination surveys. This data, which is included as **Appendix D**, is from surveys undertaken on Thursday 18 June 2009, during the following periods:

- 7:00am – 9:00am; and
- 3:00pm – 5:00pm.

The survey involved observations of vehicle number plates at six external and three internal survey sites, as detailed below:

External Stations

1	Wilberforce Road	north of Freemans Reach Road
2	Freemans Reach Road	west of Wilberforce Road
3	Windsor Road	north of Pitt Town Rd
4	Hawkesbury Valley Way	east of Day Street
5	Macquarie Street	south of Hawkesbury Valley Way
6	Richmond Road	west of Moses Street

Internal Stations

10	The Terrace	south of New Street
11	George Street	south of Suffolk Street
12	Macquarie Street	south of Suffolk Street

We have considered the data provided, however we have been unable to replicate the results summary as outlined in the *Traffic Modelling and Evaluation of Options - Preliminary Report* (extract provided below). We would suggest requesting that RMS provide clarification on how these results were calculated from the data provided.

Table 2.1: Origin-destination survey results

Trip Type	AM Peak	PM Peak
Through	64%	51%
Arriving from outside the study area	17%	19%
Departing from inside the study area	12%	20%
Within the study area	6%	9%

Source: Traffic modelling and evaluation of options - preliminary report – August 2011

2.6.3 Item 3: Outputs from Sydney Strategic Transport Model (SSTM)

The outputs from the Sydney Strategic Transport Model (SSTM) provided by RMS are included as **Appendix E**, and are summarised in **Table 2.6.3** below.

Table 2.6.3: Summary of Traffic Volumes on Bridge From SSTM – AM Peak (7am – 9am)

Year	Northbound	Southbound	Total
2007	793	1720	2513
2016	1013	2203	3216
2026	1268	2555	3823
2031	1516	2695	4211

We make the following comments on the traffic volumes

- The 2012 Bridge Count indicates 761 northbound and **2208 southbound** in the AM two-hour peak, i.e. the recently recorded volume is consistent with the forecast 2016 volume.
- The EIS suggests growth was applied to achieve 2021 and 2026 volumes (17.3% and 25.3% growth on 2011 volumes), however no 2011 volume plots have been provided.
- No PM peak traffic volumes from the SSTM appear to have been provided.

We would suggest requesting clarification from RMS on the above matters.

2.6.4 Item 4: Information Regarding Possible Future Development in Region

The information provided by RMS in response to our enquiry regarding the possible / assumed future development in the region is included as **Appendix F**, and summarised below:

Jacaranda Ponds Residential Development, Glossodia

The Jacaranda Ponds development involves construction of up to 580 additional dwellings at Glossodia. However, it could be some time before this development is fully occupied, conceivably around 10 years.

Our Comments:

- 580 dwellings generate approximately 5250 trips per day, or 1050 trips in the peak 2 hour period.
- We note that the volumes from SSTM show an increase in volumes on Freemans Reach Road of only approximately 500 trips in the peak 2 hour AM period from 2007 to 2026. This implies a reasonable proportion of traffic from the Jacaranda Ponds Residential Development may be expected to travel to North Richmond rather than Windsor for local services/attractions, (assuming the SSTM model includes the Jacaranda Ponds Residential Development).

Tinda Creek Sand Quarry.

This quarry is located approximately 70 kilometres north of Windsor adjacent to Putty Road. The quarry operators are seeking an increase in the size of the quarry as well as an increase in the annual sand extraction rate from 125,000 to 400,000 tonnes per year, which would result in an additional 52 truck movements (26 southbound and 26 northbound) a day when the quarry is operating at full capacity (in approximately 2 years).

Our Comments:

- Under the proposal, this development would increase heavy vehicle traffic volumes through Windsor Town, although not substantially (based upon the information provided by RMS).

RMS advises that apart from the Jacaranda Ponds and Tinda Creek Sand Quarry developments, there are no other known substantial residential subdivisions or traffic generating developments that would generate substantial traffic across Windsor Bridge. It is therefore inferred that the traffic growth which is anticipated is likely to be primarily a result of increased through traffic and/or regional traffic movements. In other words, over time, the proportion of through or regional traffic, of the total volume of traffic using the bridge, is expected to increase.

2.6.5 Item 5: Windsor Town Centre Traffic Study

This report, which was prepared by Christopher Hallam & Associates on behalf of Hawkesbury City Council, is included for reference as **Appendix G**. We have read through this document and the key points of relevance to the project are summarised following:

Existing Intersection Operation

- The Macquarie Street / Bridge Street intersection was modelled to have a reasonable level of service (LOS B) in the critical peaks periods, however it was noted that some of the model results do not accurately reflect observations made on-site (e.g. the modelled queue for the left-turn movement from Macquarie Street to Bridge Street was shorter than that observed).
- There is an 'accident problem' at the Macquarie Street / Bridge Street intersection with vehicles making a right turn from Bridge Street North 'colliding' with northbound through vehicles from Bridge Street South. It was noted in this report that these conflicts can occur in the filtered right turn.
- The report recommends reviewing the traffic signal timing at Macquarie Street/Bridge Street junction with a view to increasing Green time to Macquarie Street traffic, in particular the left turn into Bridge Street. Our understanding however is that this issue may be more a function of traffic queuing back from the George Street roundabout, in which case increasing the green time for this movement would offer little benefit.
- The George Street / Bridge Street intersection was modelled to have a 'very good level of service' (i.e. LOS A) for the AM and PM peak periods. We note that this is somewhat inconsistent with the RMS modelling which indicates a LOS C for some movements during the PM peak, as well as our understanding of the observed operation of the intersection during this period.
- The Court Street / Bridge Street intersection modelling indicates significant levels of delay for the right turn movement from Court Street into Bridge Street. The level of service for this movement (LOS F) indicates an 'unsatisfactory situation' with the movement 'over-capacity.' In our opinion, these delays, combined with the restricted sightlines for this movement, may result in safety issues for this movement. The report concludes this intersection should be a consideration of the Windsor Bridge replacement project.
- Several priority-controlled intersections along Macquarie Street (including Fitzgerald Street and Suffolk Street) are experiencing significant delays for the exit movements from the minor roads in particular. We expect that the options for the project which involve a river crossing to the west of Windsor town (e.g. the Rickabys Line option) would increase traffic volumes on Macquarie Street, possibly exacerbating this issue. It may therefore be necessary to signalise some of the priority-controlled intersections along Macquarie Street, and/or restrict movements at some of these intersections. Notwithstanding this, our view however is that Macquarie Street is better suited to carrying higher traffic volumes than the Bridge Street route (under the preferred option).
- This report suggests that several of the intersections along Hawkesbury Valley Way are operating at or outside acceptable limits of operation. The critical intersections include the George Street signals, the Macquarie Street signals, and the Moses Street/Cox Street priority controlled intersection. Again, we expect that the options for the project which involve a river crossing to the west of Windsor town (e.g. the Rickabys Line option) would increase traffic volumes at these intersections, possibly exacerbating these issues. It may therefore be necessary to undertake upgrade works to increase capacity at these intersections, if an option involving a river crossing to the west of Windsor town is pursued. Notwithstanding this, our view however is that Hawkesbury Valley Way is better suited to carrying higher traffic volumes than the Bridge Street route (under the preferred option).

Accident History, Bridge Street

- There have been a number of accidents at the Bridge Street / Macquarie Street intersection. The report suggests that the main type of accident at this junction involved vehicles making a right turn from Bridge Street (North) into Macquarie Street, colliding with northbound vehicles from Bridge Street (South). There were eight accidents of this type. The report suggests that changing the signal phasing to run the right turn as a protected movement only (i.e. not a filter movement) would reduce the possibility of this conflict, however recommends that this amendment not be made to the resulting reduction in intersection capacity. We note however that the VISSIM modelling provided appears to have removed the filter right turn movement.
- The report states that there were only four minor accidents at the Court Street junction, with two involving vehicles apparently making right turns into the Jolly Frog Hotel parking area. Notwithstanding this, we recommend that this intersection be investigated in light of the extensive delays for right turn movements from Court Street, and to check that appropriate sight distances are achieved for all movements. Depending upon the option which is pursued for the bridge and the permitted movements at the Bridge Street / George Street intersection, it may be possible to ban the right-turn out from Court Street to alleviate safety concerns for this movement.

Traffic Route Choice

- The report suggests that traffic demand through Windsor is increased because peak period delays approaching and through North Richmond are causing drivers with destinations at Kurrajong and beyond to divert via Freemans Reach (i.e. use the Windsor Bridge rather than the Richmond Bridge).

Pedestrian Facilities

- The report references the Hawkesbury Mobility Plan 2010, which suggests that the redesign of intersection of the Bridge Street / George Street (e.g. signals) be investigated to better cater for pedestrian movement. The preferred option proposes the signalisation of this intersection therefore addresses this issue.

2.6.6 Item 6: Working Files to Calculate Forecast Traffic Volumes

We have taken a high level look at the data provided by RMS. Whilst we have not been able to follow all of the processes and all calculations given the quantity of the data and the complexity of the spreadsheets, we make the following comments on this information (included for reference as **Appendix H**):

Sidra Analysis

- The following notes are included in the 'Bridge and Intersection Analysis' spreadsheet:
    - Bridge Street / Macquarie Street signals
        - *SIDRA input hasn't been checked, may need to change e.g. proportion of cars using middle and right lanes to go north from Bridge St S*
        - *Assumption about left turns may be incorrect*
    - Bridge Street / George Street roundabout
        - *Queue lengths are much shorter than indicated by community and survey observations*
    - Wilberforce Road (Bridge Street) / Freemans Reach Road give way
        - *May not account for queueing over Windsor Bridge due to Bridge St / George St intersection*

  It is not clear whether the above issues with the modelling were subsequently resolved and/or addressed, and we would suggest requesting clarification from RMS on these issues.

Capacity Calculations

The 'Bridge and Intersection Analysis' spreadsheet includes capacity calculations for the existing bridge and different cross-sections for a new bridge. Using the method adopted by RMS, calculated capacities are a function of:

- Traffic lane widths;
- Lateral clearances;
- The proportion of heavy vehicles; and
- The grade of the roadway.

A summary of the results of the results of the RMS calculations is provided in the table below.

Table 2.6.6: Summary of Bridge Capacity Calculations in RMS working files

	Calculated Capacity
New 2 lane bridge	1425 vehicles per lane per hour
New 3 lane bridge	1425 vehicles per lane per hour
New 4 lane bridge	1050 vehicles per lane per hour*
Current 2 lane bridge	900 vehicles per lane per hour

* not calculated in spreadsheet but has been calculated using the same method (fw = 0.7)

These capacity calculations all assumed a heavy vehicle percentage of 20%, however we note that the EIS reports (in Section 7.3) that the heavy vehicle percentage just south of the bridge is 7%. Applying this percentage provides the following capacity estimates:

- New 2 lane bridge 1600 vehicles per lane per hour
- New 3 lane bridge 1600 vehicles per lane per hour
- New 4 lane bridge 1180 vehicles per lane per hour
- **Current 2 lane bridge 1000 vehicles per lane per hour**

We have cross-checked the calculated capacity for the existing bridge against the recorded flows. The bridge counts provided by RMS, which were undertaken in 2012, indicated the following throughput on the bridge:

- 1378 vehicles per hour (northbound) – recorded Monday 12 March (5:00pm – 6:00pm)
- 1165 vehicles per hour (southbound) – recorded Monday 12 March (8:00am – 9:00am)

It appears as though the results of the capacity calculations underestimated the capacity of the existing bridge by up to almost 40%, and similarly, may have underestimated the capacity of the proposed new bridge under the various configurations.

Growth Rates

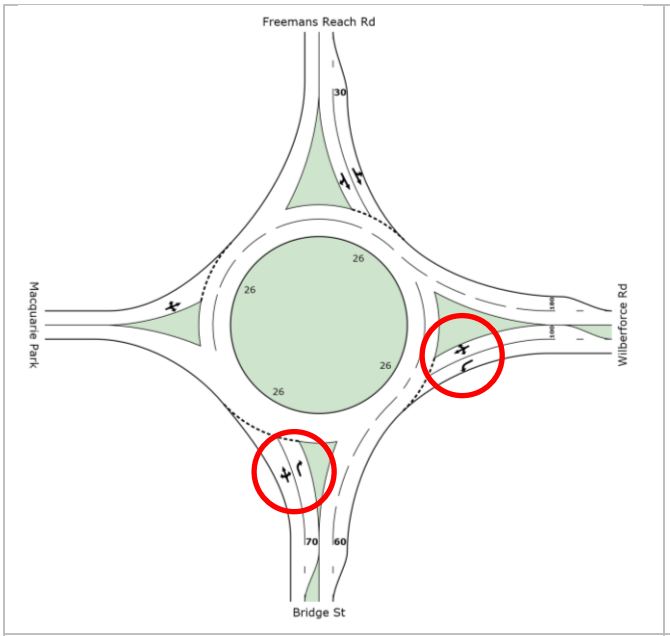
- The traffic growth rates in the *Traffic profile calculations* spreadsheet (approximately 1.3% – 1.6% per annum compound) are lower than those implied in the SSTM model outputs provided (included for reference as **Appendix E**), which indicate a growth rate of approximately 3% per annum compound from 2007 to 2016. We would suggest requesting clarification from RMS on this issue.

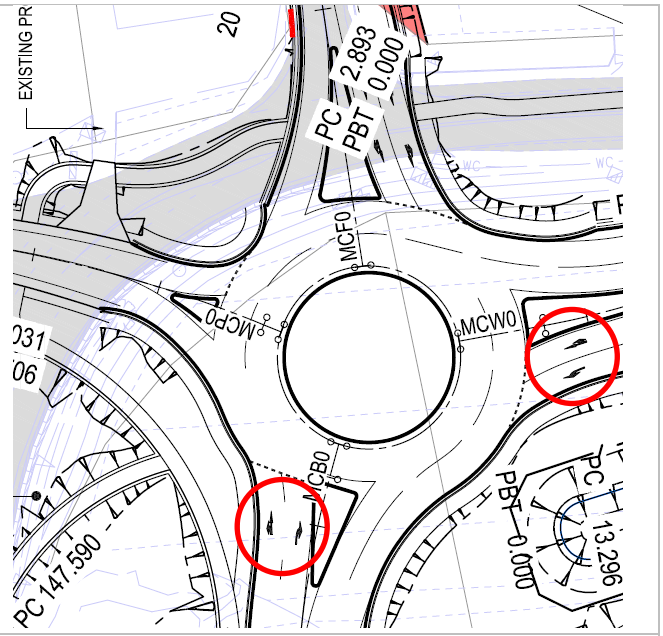
2.6.7 Item 7: SIDRA Model Files and Outputs

A high level review of the SIDRA model files has been completed, and our comments are as follows:

Wilberforce Road / Freemans Reach Road Intersection

The configuration of the proposed roundabout at Wilberforce Road / Freemans Reach Road in the SIDRA model (the results of which are included in the EIS) does not appear to be consistent with that shown in the concept design, in terms of the approach lane designation (see figures below). We have adjusted the models to reflect the EIS layout, and the results (intersection degree of saturation) are summarised below.



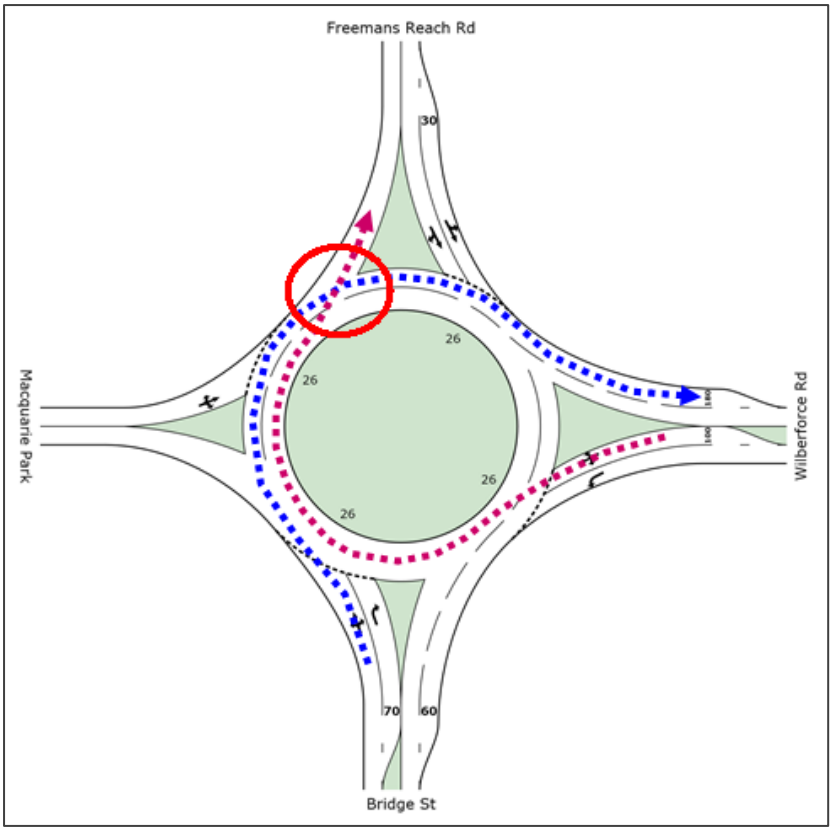


SIDRA Model Intersection Configuration (EIS)	**Concept Design**
Modelled DOS (2021 AM Peak): **65.3%**	Modelled DOS (2021 AM Peak): **80.0%**
Modelled DOS (2021 PM Peak): **46.5%**	Modelled DOS (2021 PM Peak): **49.8%**
Modelled DOS (2026 AM Peak): **75.4%**	Modelled DOS (2026 AM Peak): **90.4%**
Modelled DOS (2026 PM Peak): **51.3%**	Modelled DOS (2026 PM Peak): **53.7%**

Note: Acceptable performance for a roundabout **<85%**

We expect that the movements may be different in the concept design, due to conflicting movements on the roundabout if the lane designation was to be as assumed in the SIDRA modelling (see figure below).

It would appear as though the SIDRA modelling may not have been updated to reflect the amended lane designations as shown in the Concept Design. This however is just our assumption and should be confirmed with RMS.



Conflicting Movements – EIS SIDRA Model Configuration

Note: While this arrangement is legally acceptable and does occur at some roundabouts, it is preferable to avoid this arrangement where possible.

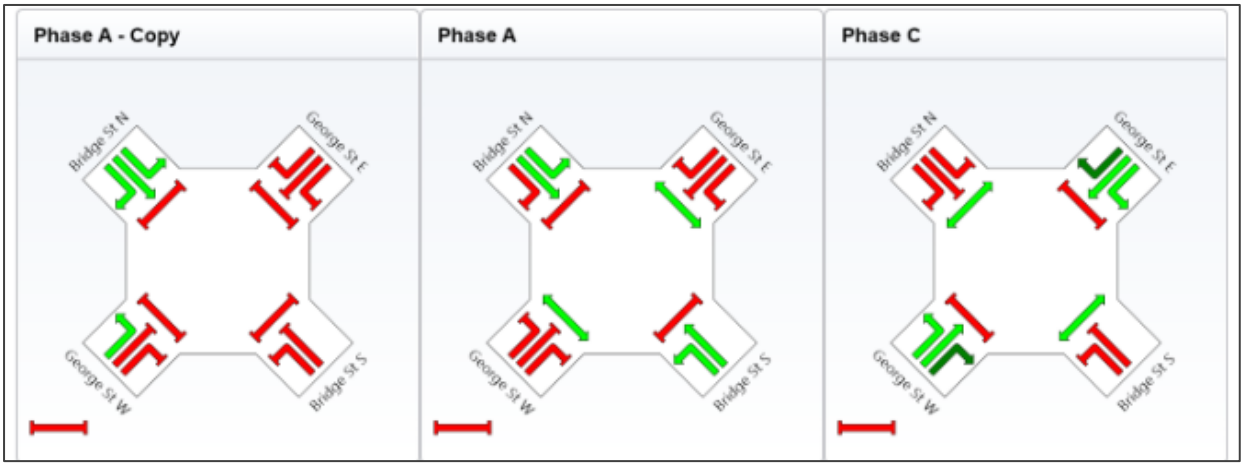
Bridge Street / George Street Intersection

Several options have been modelled for this intersection, but most involve phasing arrangements which include:

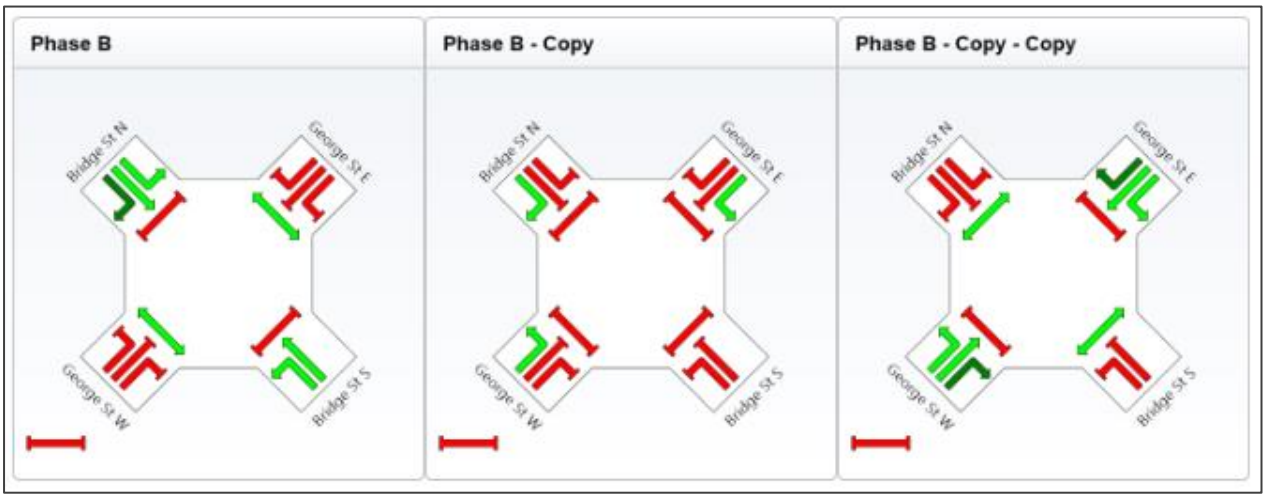
- Filter right turn movements from shared lanes; and/or
- Right turn movements filtering through pedestrian movements.

It appears as though the 'preferred option' assumed the following phasing arrangements:

AM Peak



PM Peak



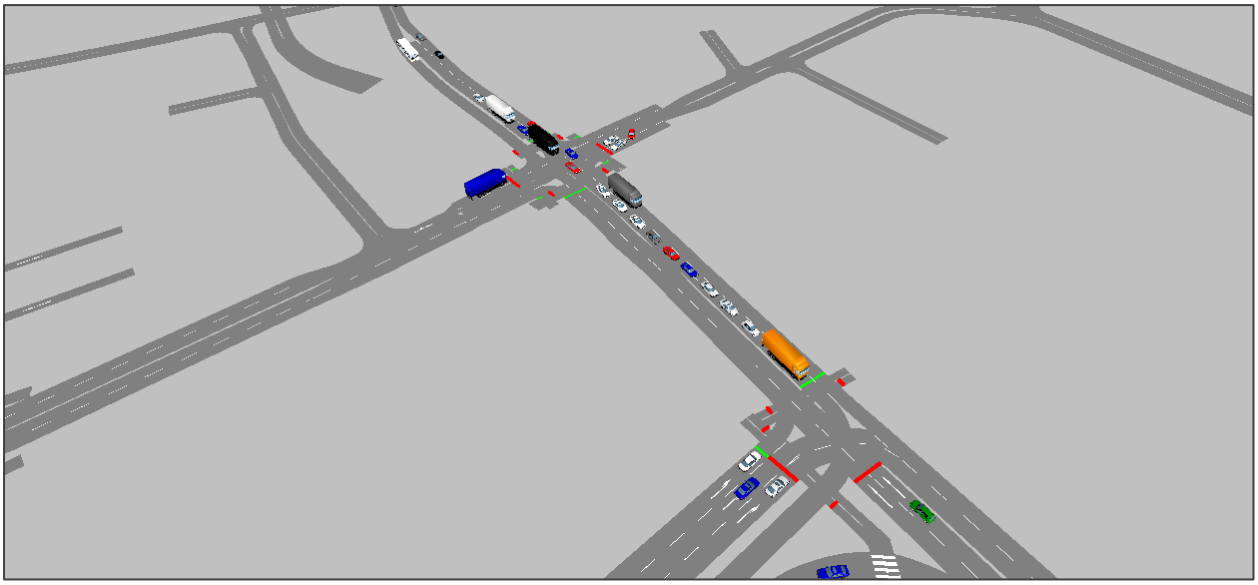
We would recommend that alternative phasing arrangements, which do not include filter right turn movements from shared lanes or right turn movements filtering through pedestrian movements, be pursued if possible.

2.6.8 Item 8: VISSIM Model Files

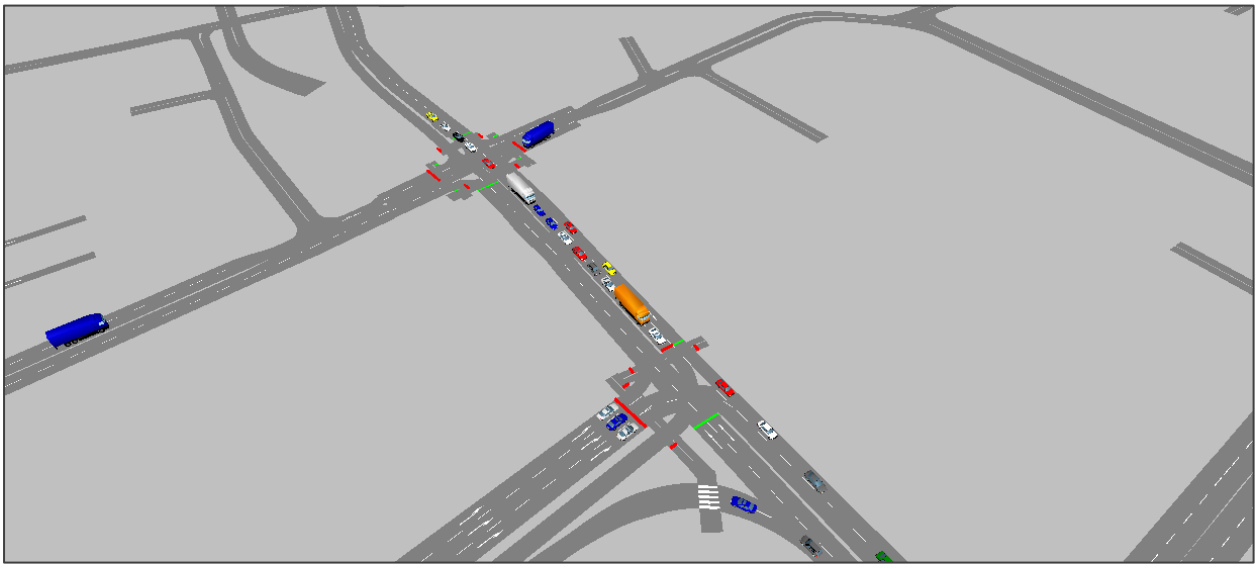
We have been provided with several hundred VISSIM files, and therefore it has not been possible to undertake a thorough review of every file. Notwithstanding this, we have made the following general observations:

- The VISSIM modelling for all options (i.e. 'Stage 1' modelling) is for the 2009 design year only, i.e. no future year modelling had been undertaken. Subsequent stages of modelling (i.e. considering Option1 and 6 only) considered the 2009 and 2026 design years.
- Access through Woolworths has been modelled as two-way, however we understand that the actual arrangement is one-way (eastbound). This would affect arrival / departure routes and the results of the modelling and may affect model results at the Bridge Street / George Street intersection and the Bridge Street / Macquarie Street intersection.
- Suffolk Street has been modelled as two-way, however it operates as one-way (southbound).
- It appears as though vehicle actuated signal control appears to have been used, assuming a 100 second cycle time at all signalised intersections.
- A two phase signal arrangement has been assumed at the Bridge Street / George Street intersection. We would recommend that alternative phasing arrangements which do not include filter right turn movements from shared lanes or right turn movements filtering through pedestrian movements, be pursued if possible.
- As indicated in the figures overleaf, the (future) additional southbound lane on the bridge would appear to offer little benefit other than to accommodate traffic queuing back from the George Street and/or the Macquarie Street intersections.
- It appears as though the following vehicle speeds on the bridge have been applied:
    - 60km/hr northbound; and
    - 80km/hr southbound.

  These speeds should be adjusted to reflect the speed assumed in the design of the preferred option (50km/hr).



EIS Modelling (C:\TEMP\Active Project Files\Windsor Bridge, NSW\Transfer\Incoming\13-06-17)
RT Closed – AM Peak
Single SB lane on Bridge



EIS Modelling (C:\TEMP\Active Project Files\Windsor Bridge, NSW\Transfer\Incoming\13-06-17)
RT Closed – AM Peak
Two SB lanes on Bridge

2.6.9 Item 9: Model Validation

RMS response: *No report was produced. For the base model, the performance predicted by VISSIM was discussed with RMS traffic commanders, with detailed knowledge of the area and its traffic.*

We would suggest that it would be prudent to undertake base model validation, to maximise the reliability and robustness of future year modelling, which has been used to inform the planning of the project.

2.6.10 Item 10: Comparison of SIDRA and VISSIM Model Results

RMS' response (see **Appendix I**) states that the algorithms used by SIDRA and VISSIM are fundamentally different, and that the methodology and assumptions for deriving intersection delay and queues differs so greatly between the two software packages that it would be inappropriate to directly compare their respective results.

While we acknowledge that these are two different packages which may be used for quite different applications, we believe that there are still meaningful comparisons which could be drawn between the results from the two modelling methods (such as intersection approach queues where they are not affected by queuing from other intersections).

2.6.11 Item 11: Further Information regarding Modelling of Option 8 (SSTM)

Very little information provided in response to this item (SSTM 2007 PM peak volume plot only, which is included as **Appendix J**). The Preliminary Traffic Modelling Report (Evaluation of Options) Report states that the Option 8 resulted in a large increase in travel costs on the community, and the Options Report states that this option was not pursued because of capital cost, however no supporting information appears to have been provided.

2.6.12 Item 12: Information Supporting Concept Design Intersection Geometry

The information provided by RMS in response to this request is included for reference as **Appendix K**.

As previously discussed, we note that the lane designation at the proposed northern roundabout in the Concept Design is different to that in the modelling undertakes as part of the EIS.

We have undertaken a high level review of the configuration of this roundabout against the relevant design requirements (see **Figure 2.6.12** overleaf). A summary of the results of this assessment is provided in **Table 2.6.12** below.

Table 2.6.12: Roundabout Design Parameters

	Reference	Requirement	Proposed (RMS Concept Design)
Minimum inscribed circle radii (R_1)	Table 1, RTA Supplement	19.5m absolute min 25.0m desirable min	25m approx
Splitter island entry arc (R_3)	Table 2, RTA Supplement	17.0m minimum 100.0m maximum*	**Southern approach: 400m approx** Eastern approach: 75m approx
Layout circle radius (R_2)	Table 3, RTA Supplement	17.11 – 17.27m	**Not shown**
Entry width (W_1)	Table 4, RTA Supplement	8.0m maximum	8.0m
Entry kerb line arc (R_4)	Step 4, RTA Supplement $R_4 = R_3 – W_1$	9.0m minimum 92.0m maximum*	Southern approach: 35m approx Eastern approach: 35m approx
Splitter island exit arc (R_5)	Step 5, RTA Supplement $R_5 > R_3$	If geometry permits, the exit can be straight.	Southern approach: 400m approx Eastern approach: 250m approx
Exit width (W_2)	Table 5, RTA Supplement	8.0m minimum	8.0m
Exit kerb line arc (R_6)	Step 6, RTA Supplement $R_6 = R_5 – W_2$	If geometry permits, the exit can be straight.	Southern approach: 30m approx Eastern approach: 60m approx
Circulation carriageway width (W_3)	Table 6, RTA Supplement	11.7m	11.7m approx
Central island (R_7)	Step 7, RTA Supplement $R_7 = R_1 – W_3$	13.3m	13.3m approx

* Note: The entry can be straight if it is preceded by a tangential curve not greater than 100 m radius, and satisfactory deflection can be provided to exits.

In summary, the roundabout design appears to be generally in accordance with RTA requirements (subject to checking deflection), with the exception of the splitter island entry arc (R_3) on the southern approach. This should not exceed 100m, to limit the speed of vehicles entering the roundabout.

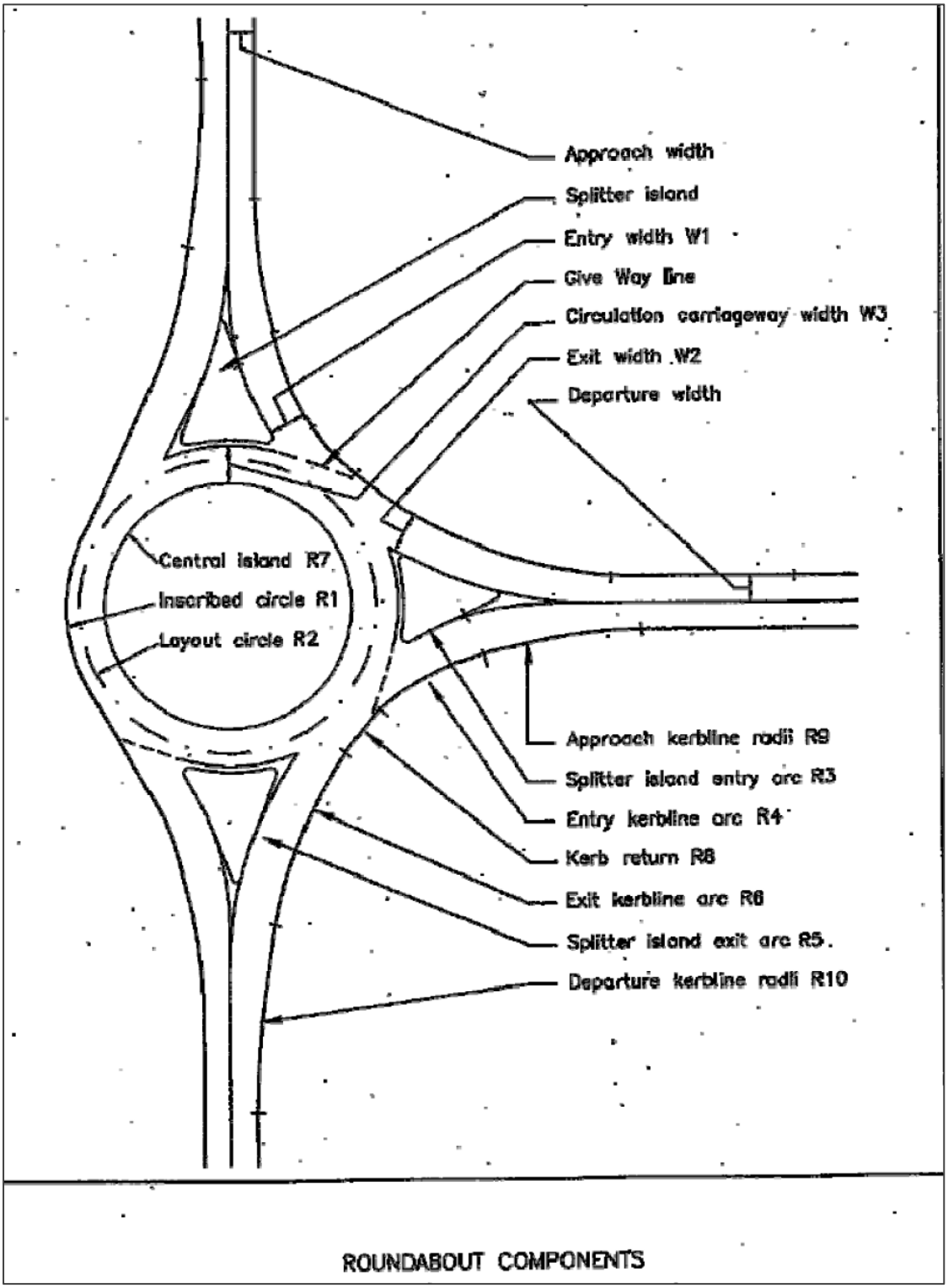


Figure 2.6.12a: Roundabout Components

We have also checked the manoeuvring of a B-Double vehicle through this roundabout (see **Figure 2.6.12b**), and the results indciate the geometry is adequate to cater for these vehicles.

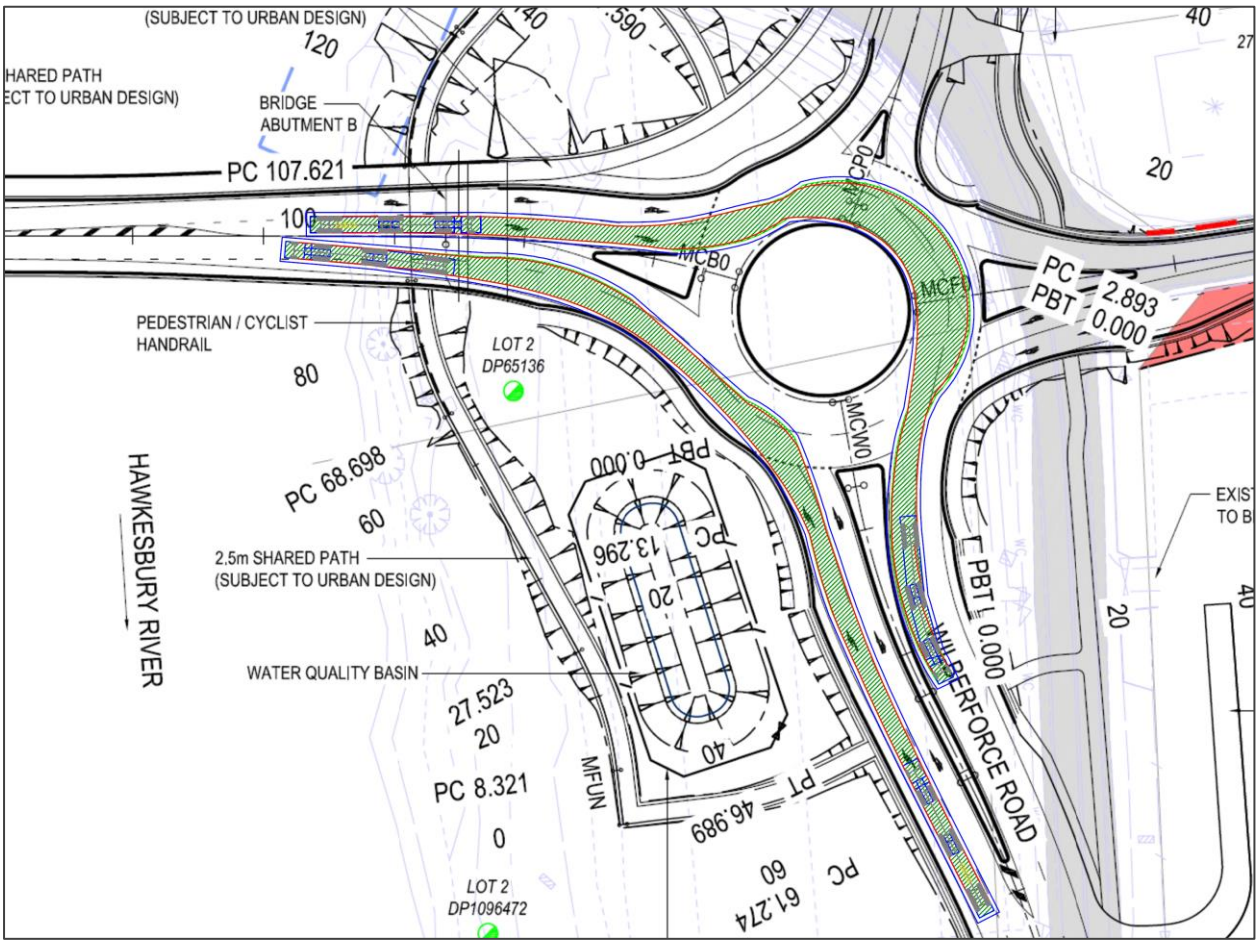


Figure 2.6.12b: B-Double Manoeuvring through Proposed Northern Roundabout

2.6.13 Item 13: Concept Design Longitudinal Sections

The information provided by RMS in response to this request is included for reference in **Appendix K.**

We note that a design speed of 50km/h has been adopted for the horizontal and vertical alignments for the proposed bridge replacement and associated approach roadworks. In our experience, the adopted design speed is often 10km/hr above the posted speed limit which is 60km/hr for light vehicles in this instance (40km/hr for trucks and buses). That is, we would expect that a design speed of 70km/hr may be appropriate in this instance, provided the 60km/hr speed limit for light vehicles is retained.

Also, we note that the VISSIM modelling undertaken appears to assume the following vehicle speeds on the bridge:

- 60km/hr northbound; and
- 80km/hr southbound.

We would request seeking clarification from RMS on this issue.

2.6.14 Item 14: Alternatives considered for Access to Windsor Wharf

The information provided by RMS in response to this request is included for reference as **Appendix L**.

RMS has provided information on a number of options to provide coach parking to the west of the bridge. Whilst several of these options seem feasible, it is understood that RMS has raised the level of the bridge in the preferred option primarily to cater for coach traffic under the bridge. In light of the fact that there seem to be other alternatives (which do not appear to have been disregarded), it is unclear why the level of the bridge in the preferred option has been raised to cater for coaches under the bridge, unless there are other reasons for doing so.

2.6.15 Item 15: Justification that Existing Intersections Cannot be Upgraded

The information provided by RMS in response to this request is included for reference as **Appendix M**.

In RMS' response, there is reference to an 'attached sketch' which does not appear to have been included in the information we have received. Limited justification that existing intersections cannot be upgraded has been provided.

Refer to the following sections in which we have considered (at a very high level) possible alternatives to the 'preferred treatment' including options to upgrade the Wilberforce Road / Freemans Reach Road intersection and the Bridge Street / George Street intersection, whilst retaining the existing bridge.

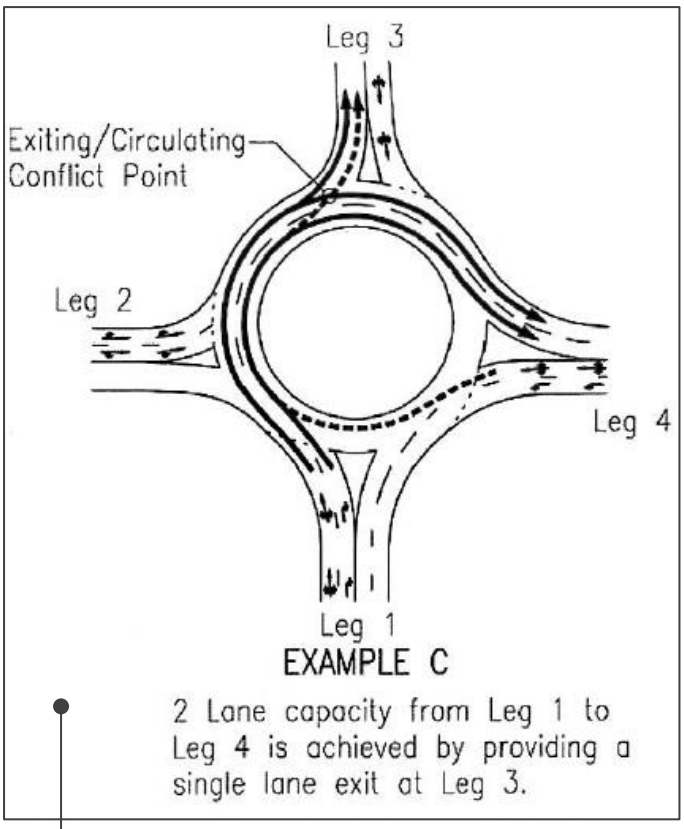
2.7 Additional Information Received July 2013

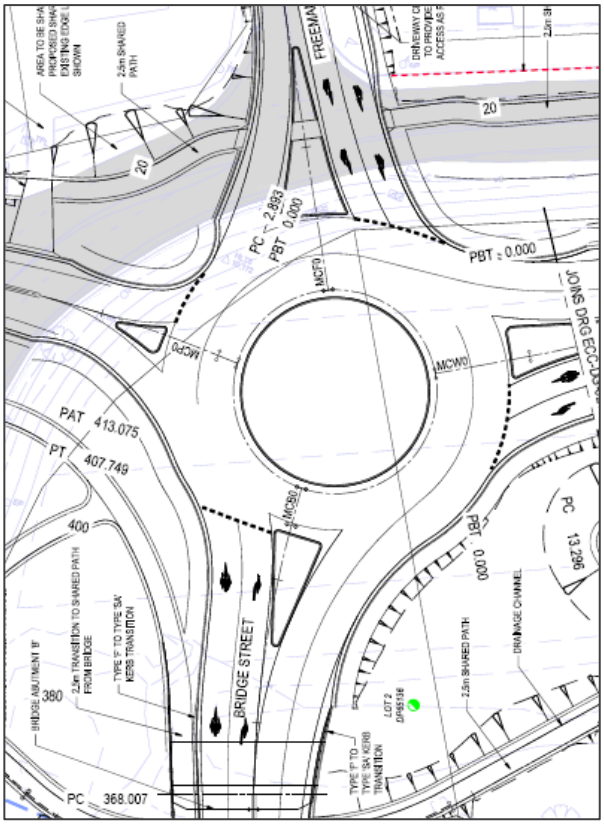
Additional information was provided to us on 29 July 2013. This information is included as **Appendix N**, and includes additional responses to queries regarding:

- RMS' position that existing intersections (Wilberforce Road / Freemans Reach Road and Bridge Street / George Street) cannot be upgraded, retaining the existing bridge;
- The level of the proposed bridge, and height clearance to access Windsor Wharf;
- Comparing SIDRA and VISSIM model results using the same performance criteria; and
- Clarification on the lane designation at the Freemans Reach Road / Wilberforce Road roundabout.

Our initial comments on the information provided are as follows:

- We acknowledge that there are considerable constraints upon the upgrade of the intersections to the north and south of the bridge, however we believe that there may be feasible options which increase intersection capacity whilst retaining the existing bridge, as discussed in the following sections. Notwithstanding this, we expect that there may not be a need to undertake significant intersection upgrades, if a bypass option is pursued. As previously discussed, if the necessary intersection upgrades are not possible due to the current constraints, we believe that this lends support to the suggestion that alternative and/or future options involving a river crossing further out of town may warrant further consideration.
- The concept design previously provided to us, which showed a different lane designation at the Wilberforce Road / Freemans Reach Road roundabout to the EIS, was labelled as the 100% concept design (not the 80% concept design as indicated in RMS' response). Notwithstanding this, we note that the lane designation for the Wilberforce Road / Freemans Reach Road roundabout in the amended concept design provided by RMS is now consistent with that shown in the EIS and Submissions Report. However we also note that this configuration is undesirable according to Austroads Guide to Road Design Part 4B: Roundabouts, due to the possible conflict point as shown in the figure below. Austroads states that this geometry "should not be used for the design of new roundabouts". The RTA supplement to this guideline appear to be consistent with the Austroads guide in this respect.





Concept Design provided by RMS

Desirably the geometry in these examples should not be used for the design of new roundabouts. If the examples shown in this figure were existing roundabouts, they would require 'spiral' line marking. Without the use of 'spiral' line marking, exiting/circulating conflicts are compounded at single lane exits adjacent to two circulating lanes.

Extract from Austroads Guide to Road Design Part 4B: Roundabouts

3.0 Potential Alternatives to Preferred Treatment

3.1 Alternative 1: Retain Existing Bridge and Upgrade Adjacent Intersections

We have considered at a high level possible alternative to the preferred option, which involve upgrading the intersections north and south of the bridge, while retaining the existing bridge. Concept sketches of these treatments are provided in the following sections.

3.1.1 Northern Intersection

We acknowledge that one of the key issues with the upgrade of the Wilberforce Road / Freemans Reach Road intersection is the level difference between the existing bridge and this intersection. We understand that the existing bridge is at approximately 7.1m AHD, and Freemans Reach Road at the intersection is at about 10m AHD.

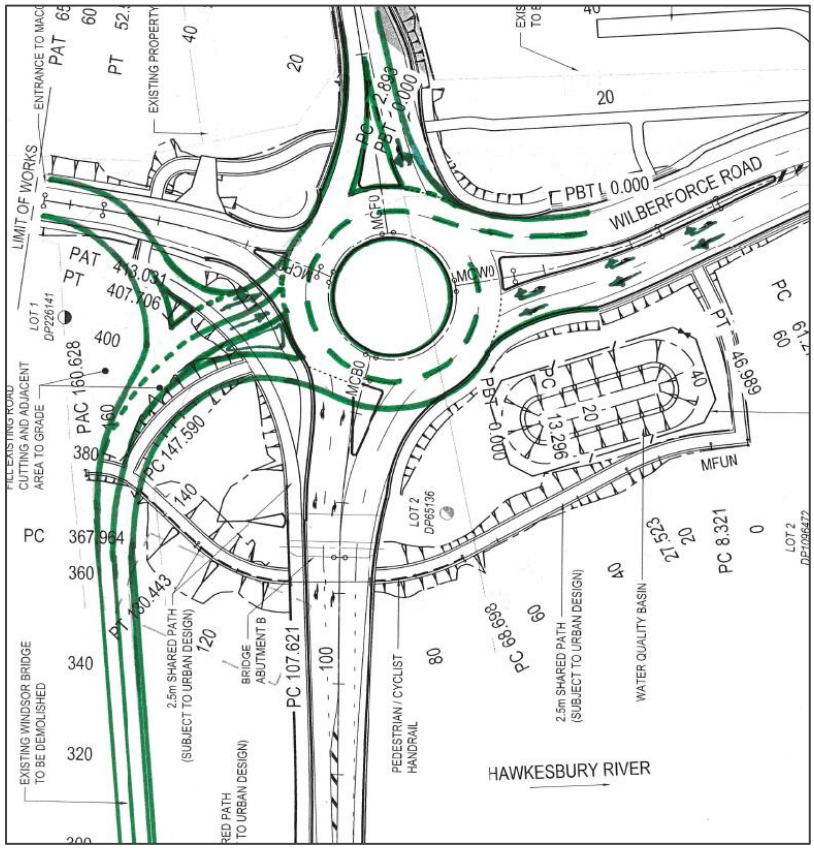
However we note that grading across a roundabout at around 3 – 4% is achievable in some instances (see Austroads Roundabouts Section 4.10.1), and therefore expect that an acceptable arrangement should be able to be engineered, to deal with the level difference between the bridge and the intersection.

In addition, we note that a suggested modified 'Rickabys Line' option (see **Appendix O**) proposes raising the northern end of the bridge by 1.2m, to approximately 8.3 AHD. This would substantially improve the grading issues at the interface between the bridge and the Wilberforce Road / Freemans Reach Road intersection.

With this in mond, concept sketches of possible options for the upgrade of this intersection are provided following.

3.1.1.1 Concept Sketches

Dual Circulating Lane Roundabout in Same Location as EIS Concept



CONCEPT SKETCH ONLY

This concept sketch shows a dual-circulating lane arrangement (similar to the EIS concept) tying into the existing bridge. The Macquarie Park approach leg has been removed, but access to the park could be provided via a left-in and left-out access onto the bridge approach.

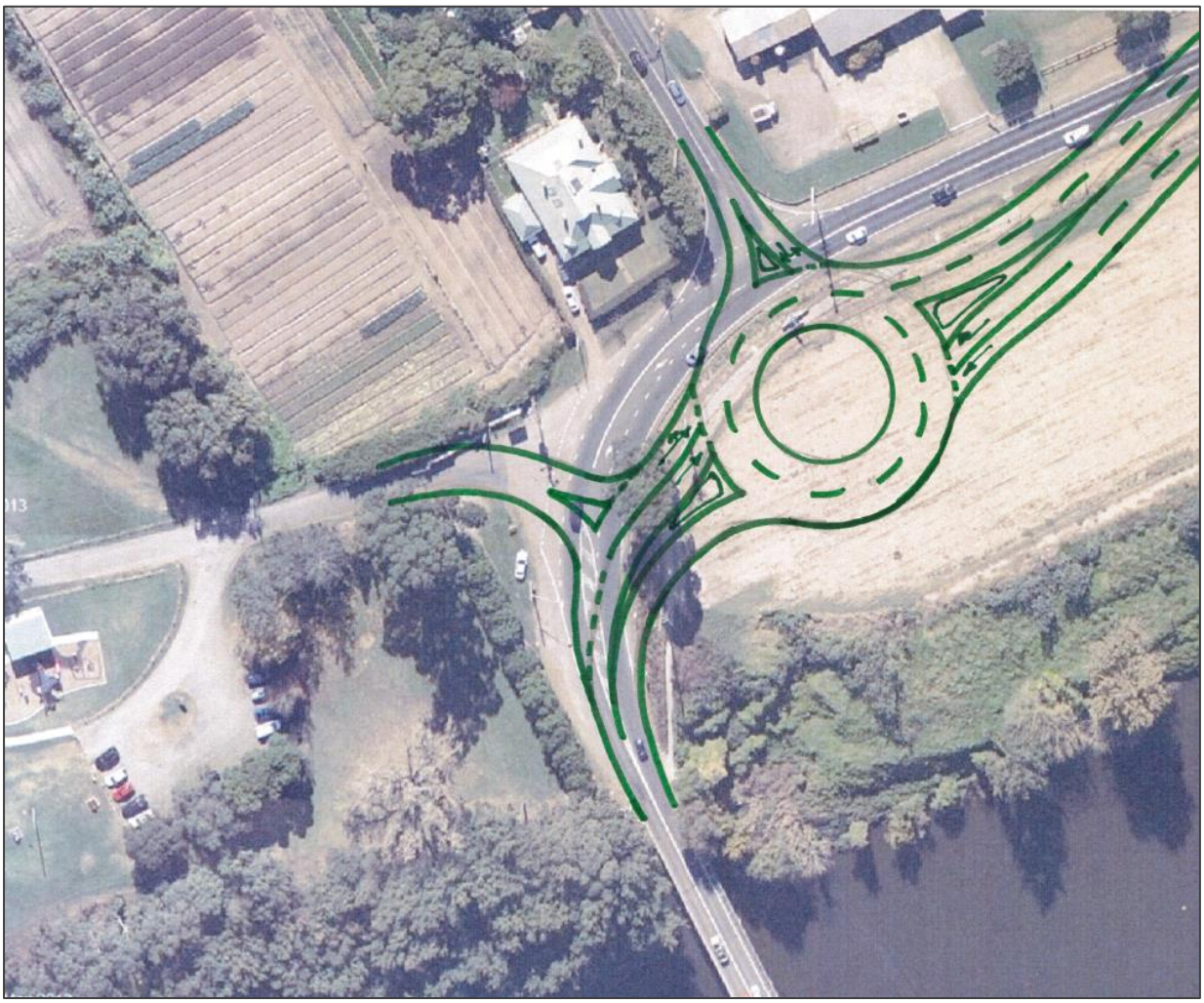
Alternatively, some provision may be able to be made for a short turn pocket to allow the right turn into the Macquarie Park. The right turn out of Macquarie Park is not necessary, as traffic seeking to head southbound could do so after undertaking a u-turn around the roundabout.

The lane designation at the roundabout has been modified from the EIS concept to provide a single departure lane onto the bridge.

As an alternative, this roundabout could potentially be provided as a single-circulating lane roundabout with single lane approaches.

The expected performance of the roundabouts discussed above, is presented in the following sections.

Dual Circulating Lane Roundabout Further to North
(compared with EIS Scheme)



CONCEPT SKETCH ONLY

This concept sketch shows a dual-circulating lane arrangement (similar to the EIS concept) tying into the existing bridge. The roundabout has been located further to the north however, primarily to ease the geometry of the departure lane from the roundabout to the bridge (southbound).

Again, the Macquarie Park approach leg has been removed, but access to the park could be provided via a left-in and left-out access onto the bridge approach. Alternatively, some provision may be able to be made for a short turn pocket to allow the right turn into the Macquarie Park. The right turn out of Macquarie Park is not necessary, as traffic seeking to head southbound could do so after undertaking a u-turn around the roundabout.

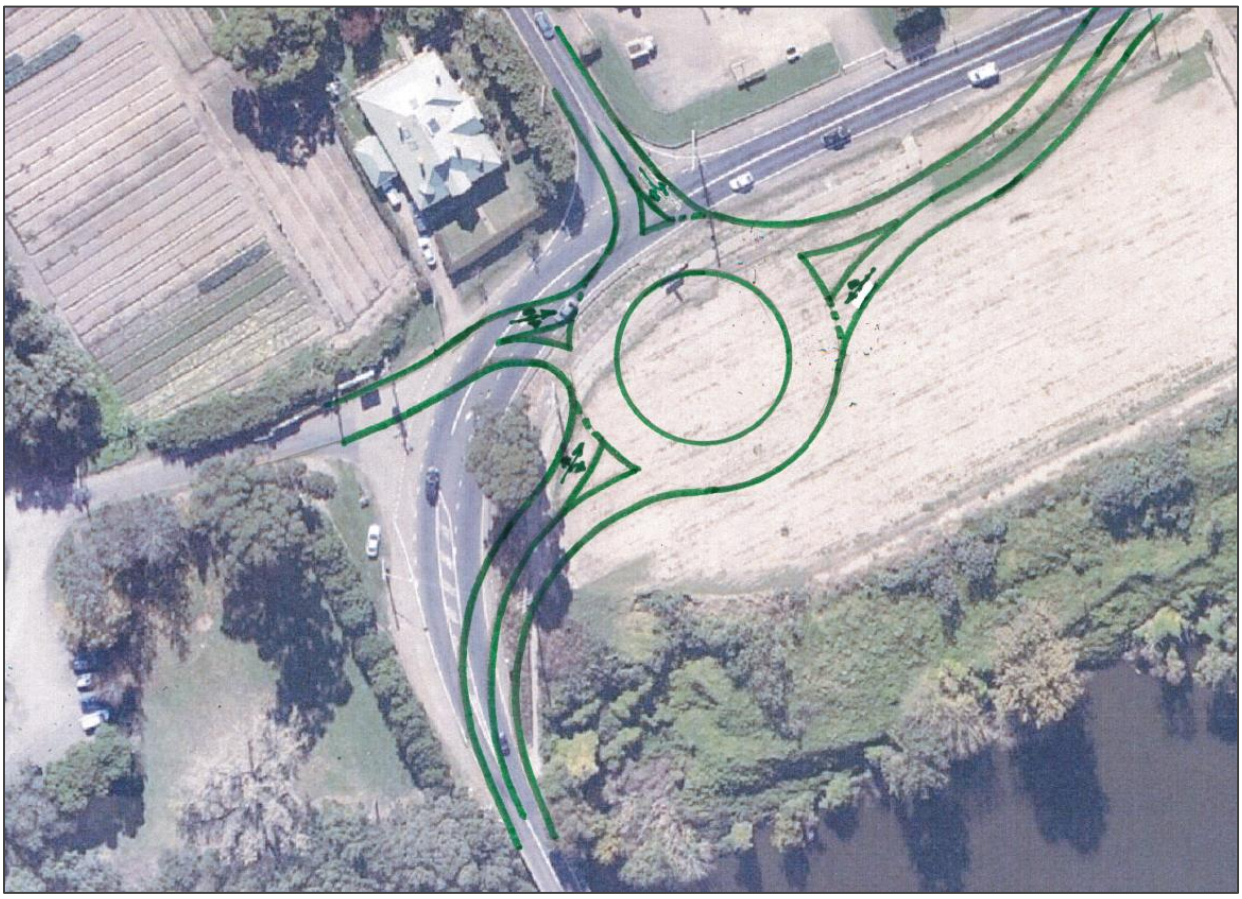
The lane designation at the roundabout has been modified from the EIS concept to provide a single departure lane onto the bridge.

As an alternative, this roundabout could potentially be provided as a single-circulating lane roundabout with single lane approaches.

The expected performance of the roundabouts discussed above, is presented in the following sections.

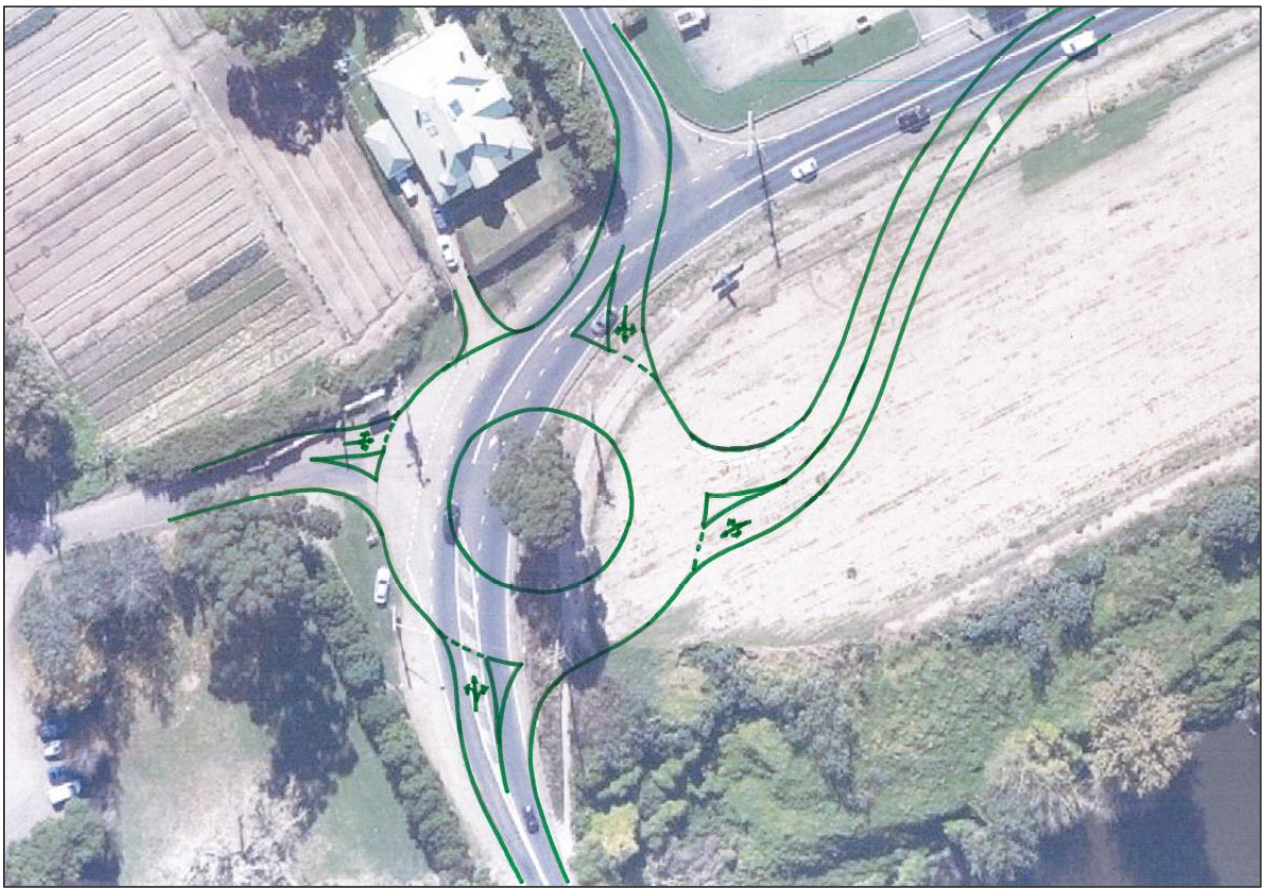
Single Circulating Lane Roundabout

Layout Option 1



CONCEPT SKETCH ONLY – not to scale

Layout Option 2



CONCEPT SKETCH ONLY – not to scale

The concept sketches above show single-circulating lane roundabouts tying into the existing bridge. The large diameter of the roundabout (similar to the EIS concept) has been retained in both options to enable four approaches to the roundabout to be provided. This would maintain access to/from the park from all directions.

These arrangements may not ultimately be feasible due to existing physical and (design) geometrical constraints, but it is suggested that they may warrant further consideration. We expect that the position (and hence the configuration) of the roundabout may be driven primarily by the grading of each roundabout leg.

The expected performance of the roundabouts discussed above is presented in the following sections.

Seagull Intersection

CONCEPT SKETCH ONLY

This concept sketch shows a 'seagull' treatment, which provides for a staged right turn movement from Freemans Reach Road. It enables through traffic on Wilberforce Road travelling towards the bridge to flow unimpeded (unlike the roundabout options), until the merge with the traffic that has turned right from Freemans Reach Road, just upstream of the bridge. This is a significant benefit of this treatment, given that this is the heaviest movement at this intersection during the AM peak period.

A key consideration for this option however will be sightlines for the following movements:

- The right turn from Freemans Reach Road towards the bridge; and
- The right turn from Wilberforce Road into Freemans Reach Road (although this is expected to be a very low volume movement).

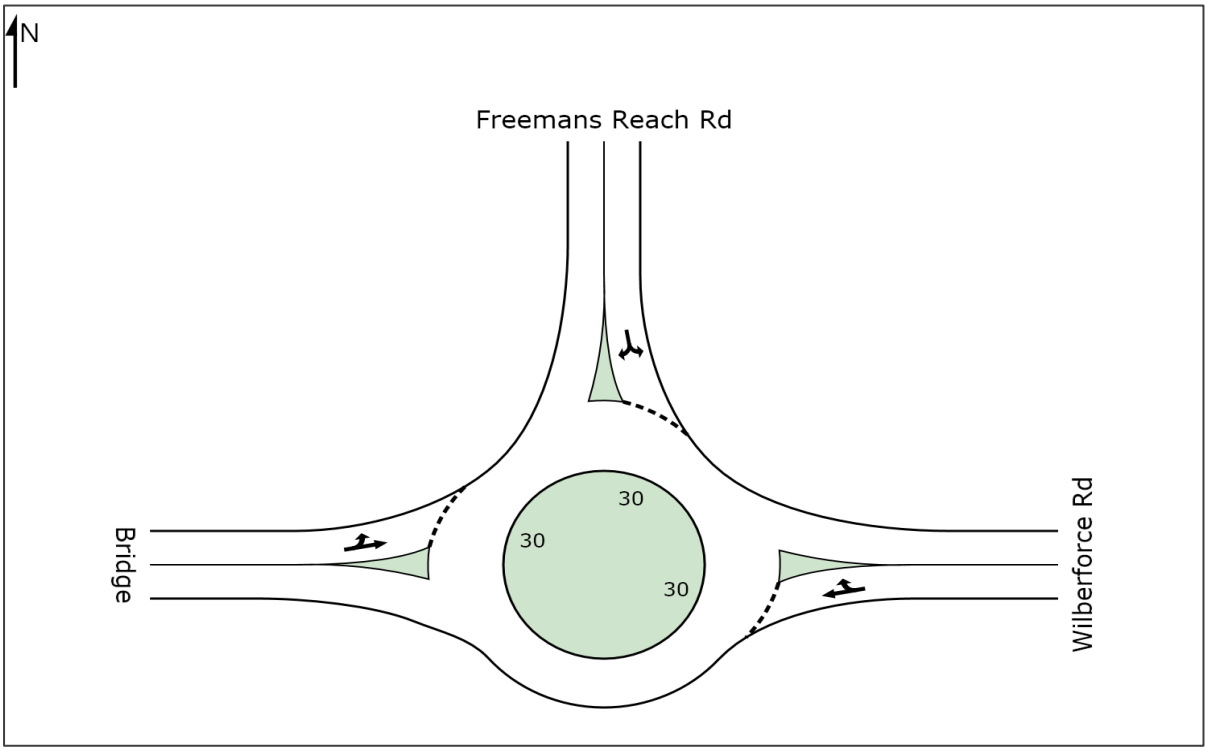
Whilst sightlines for both of these movements are limited currently, and the previous roundabout options address this issue, it is expected that sightlines for these movements could be improved by cutting back the embankment on the inside of the bend, and possibly adjusting the vertical and horizontal alignment of Wilberforce Road between Freemans Reach Road and the bridge. This would need to be confirmed as part of a concept / detailed design process.

3.1.1.2 Results of Modelling

The three intersection configurations as discussed in the previous section have been modelled, using the SIDRA models prepared by RMS. The modelling results provided below are for the 2021 design year (AM and PM peak), consistent with the design year which has been reported upon in the EIS.

Single Circulating Lane Roundabout

(Cambray Reference: Option Test 1)



MOVEMENT SUMMARY

Site: EIS layout - AM peak_ACC OPTION TEST 1

Wilberforce Road / Freemans Reach Road SKM/Emme AM two lane
2021
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilberforce Rd											
5	T	934	6.2	0.854	12.9	LOS A	15.7	115.5	0.99	1.09	42.8
6	R	1	0.0	0.854	20.9	LOS B	15.7	115.5	0.99	1.10	40.8
Approach		935	6.2	0.854	12.9	LOS A	15.7	115.5	0.99	1.09	42.8
North: Freemans Reach Rd											
7	L	1	0.0	0.361	7.1	LOS A	2.1	15.0	0.50	0.59	48.0
9	R	435	4.4	0.361	10.4	LOS A	2.1	15.0	0.50	0.70	44.0
Approach		436	4.4	0.361	10.4	LOS A	2.1	15.0	0.50	0.70	44.0
West: Bridge											
10	L	153	17.6	0.292	3.0	LOS A	2.1	17.0	0.02	0.34	39.1
11	T	305	20.3	0.292	1.8	LOS A	2.1	17.0	0.02	0.18	41.7
Approach		458	19.4	0.292	2.2	LOS A	2.1	17.0	0.02	0.24	40.8
All Vehicles		1829	9.1	0.854	9.6	LOS A	15.7	115.5	0.63	0.78	42.9

MOVEMENT SUMMARY

Site: EIS layout - PM peak_ACC OPTION TEST 1

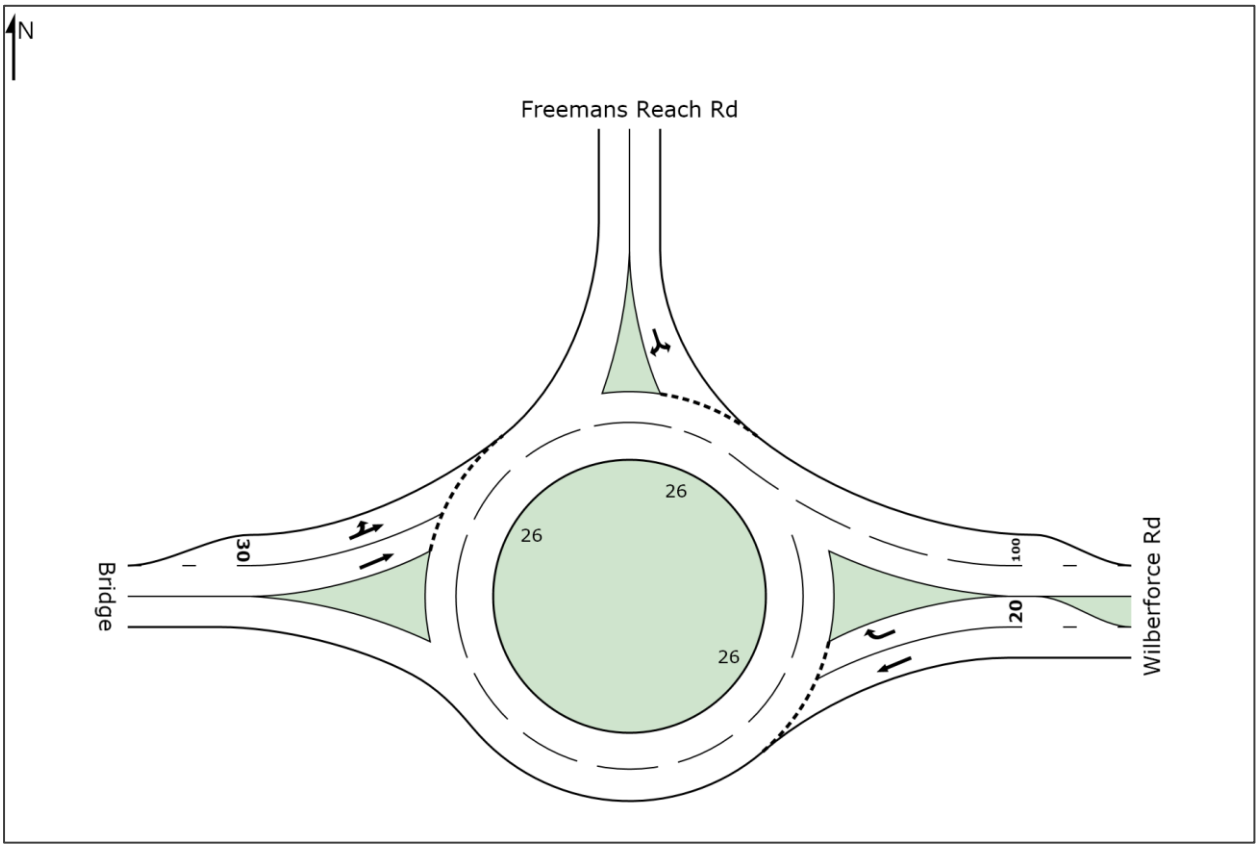
Wilberforce Road / Freemans Reach Road SKM/Emme AM two lane
2021
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilberforce Rd											
5	T	393	6.0	0.306	4.1	LOS A	1.9	14.1	0.42	0.41	50.3
6	R	3	0.0	0.306	12.0	LOS A	1.9	14.1	0.42	0.85	46.8
Approach		396	6.0	0.306	4.1	LOS A	1.9	14.1	0.42	0.41	50.3
North: Freemans Reach Rd											
7	L	1	0.0	0.217	9.6	LOS A	1.3	9.2	0.69	0.73	46.5
9	R	196	2.0	0.217	12.9	LOS A	1.3	9.2	0.69	0.79	42.5
Approach		197	2.0	0.217	12.8	LOS A	1.3	9.2	0.69	0.79	42.5
West: Bridge											
10	L	681	4.0	0.815	2.9	LOS A	16.6	120.5	0.09	0.32	38.4
11	T	779	5.0	0.815	1.7	LOS A	16.6	120.5	0.09	0.18	40.7
Approach		1460	4.5	0.815	2.2	LOS A	16.6	120.5	0.09	0.25	39.6
All Vehicles		2053	4.6	0.815	3.6	LOS A	16.6	120.5	0.21	0.33	43.3

The above results indicate that a single circulating lane roundabout is expected to perform generally within acceptable capacity limits during the 2021 AM and PM peak periods (LOS A and LOS B), however queuing on Wilberforce Road approach during the AM peak is expected to be extensive, as is queuing on the bridge approach to the roundabout during the PM peak.

Dual Circulating Lane Roundabout
(Cambray Reference: Option Test 2)



MOVEMENT SUMMARY

Site: EIS layout - AM peak_ACC OPTION TEST 2

Wilberforce Road / Freemans Reach Road SKM/Emme AM two lane 2021
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Wilberforce Rd											
5	T	934	6.2	0.793	9.1	LOS A	10.4	76.9	0.84	0.90	46.5
6	R	1	0.0	0.002	13.0	LOS A	0.0	0.0	0.45	0.62	44.7
Approach		935	6.2	0.793	9.1	LOS A	10.4	76.9	0.84	0.90	46.5
North: Freemans Reach Rd											
7	L	1	0.0	0.405	7.3	LOS A	2.0	14.4	0.46	0.61	48.2
9	R	435	4.4	0.405	10.5	LOS A	2.0	14.4	0.46	0.72	44.2
Approach		436	4.4	0.405	10.5	LOS A	2.0	14.4	0.46	0.72	44.2
West: Bridge											
10	L	153	17.6	0.163	3.8	LOS A	0.5	3.8	0.58	0.20	32.7
11	T	305	20.3	0.195	2.3	LOS A	0.9	7.1	0.01	0.24	40.9
Approach		458	19.4	0.195	2.8	LOS A	0.9	7.1	0.20	0.23	37.8
All Vehicles		1829	9.1	0.793	7.9	LOS A	10.4	76.9	0.59	0.69	44.7

MOVEMENT SUMMARY

Site: EIS layout - PM peak_ACC OPTION TEST 2

Wilberforce Road / Freemans Reach Road SKM/Emme AM two lane
2021
Roundabout

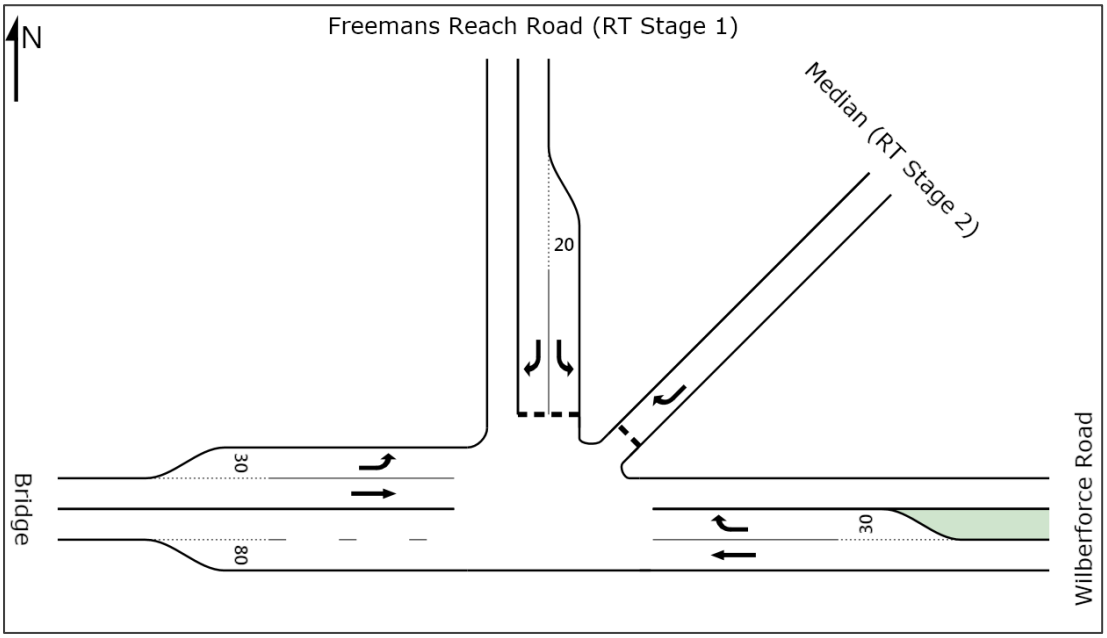
Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilberforce Rd											
5	T	393	6.0	0.291	4.2	LOS A	1.5	11.2	0.35	0.42	50.4
6	R	3	0.0	0.005	12.0	LOS A	0.0	0.1	0.31	0.63	45.3
Approach		396	6.0	0.291	4.3	LOS A	1.5	11.2	0.35	0.42	50.4
North: Freemans Reach Rd											
7	L	1	0.0	0.239	9.7	LOS A	1.2	8.5	0.63	0.74	46.6
9	R	196	2.0	0.239	12.9	LOS A	1.2	8.5	0.63	0.82	42.6
Approach		197	2.0	0.239	12.8	LOS A	1.2	8.5	0.63	0.82	42.6
West: Bridge											
10	L	681	4.0	0.577	4.1	LOS A	2.5	18.2	1.00	0.13	29.6
11	T	779	5.0	0.435	2.1	LOS A	2.5	18.0	0.03	0.24	40.7
Approach		1460	4.5	0.577	3.0	LOS A	2.5	18.2	0.48	0.19	34.7
All Vehicles		2053	4.6	0.577	4.2	LOS A	2.5	18.2	0.47	0.29	40.4

The above results indicate that a dual circulating lane roundabout is expected to perform well within acceptable capacity limits during the 2021 AM and PM peak periods (LOS A). The modelling predicts some queuing on the Wilberforce Road approach during the AM peak (10 – 11 vehicles), however the queuing on the bridge approach to the roundabout during the PM peak is expected to be well within acceptable limits (2 – 3 vehicles).

Seagull Treatment

(Cambray Reference: Option Test 3)



Note: The layout shown above does not reflect the physical layout of the intersection, but reflects the method used to model the 'staged' right turn movement from the minor approach at a seagull intersection[1].

MOVEMENT SUMMARY

Site: Seagull - AM_ACC OPTION TEST 3

Wilberforce Road / Freemans Reach Road
2021
Seagull Treatment
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilberforce Road											
5	T	934	6.2	0.498	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	1	0.0	0.001	10.2	LOS B	0.0	0.0	0.46	0.60	46.8
Approach		935	6.2	0.498	0.0	NA	0.0	0.0	0.00	0.00	60.0
North East: Median (RT Stage 2)											
26	R	435	4.4	0.242	6.6	X	X	X	X	0.56	50.9
Approach		435	4.4	0.242	6.6	NA	0.0	0.0	0.00	0.56	50.9
North: Freemans Reach Road (RT Stage 1)											
7	L	1	0.0	0.001	10.1	LOS B	0.0	0.0	0.42	0.60	46.9
9	R	435	4.4	0.655	15.7	LOS C	5.9	42.7	0.69	1.09	42.0
Approach		436	4.4	0.655	15.7	LOS C	5.9	42.7	0.69	1.09	42.0
West: Bridge											
10	L	153	17.6	0.093	8.8	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	305	20.3	0.177	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		458	19.4	0.177	3.0	NA	0.0	0.0	0.00	0.22	55.8
All Vehicles		2264	8.2	0.655	4.9	NA	5.9	42.7	0.13	0.36	53.0

1 http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.sidrasolutions.com%2FDocuments%2FSIDRAIntersection_UnsigStagedMovements_LH.pdf&ei=EASoUcvyEqWYiAfIhoHwDQ&usg=AFQjCNGCVmd9j3SJS8ZvPRwYkL1v3-lHqQ&sig2=vDkswlquQ6un6bNkE2utCQ

MOVEMENT SUMMARY

Site: Seagull - PM_ACC
OPTION TEST 3

Wilberforce Road / Freemans Reach Road
2021
Seagull Treatment
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Wilberforce Road											
5	T	393	6.0	0.209	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	3	0.0	0.011	21.1	LOS C	0.0	0.3	0.82	0.89	37.9
Approach		396	6.0	0.209	0.2	NA	0.0	0.3	0.01	0.01	59.7
North East: Median (RT Stage 2)											
26	R	196	0.0	0.106	6.5	X	X	X	X	0.56	50.9
Approach		196	0.0	0.106	6.5	NA	0.0	0.0	0.00	0.56	50.9
North: Freemans Reach Road (RT Stage 1)											
7	L	1	0.0	0.003	17.2	LOS C	0.0	0.1	0.73	0.76	40.7
9	R	196	2.0	0.675	29.3	LOS D	3.7	26.4	0.89	1.18	33.2
Approach		197	2.0	0.675	29.3	LOS D	3.7	26.4	0.89	1.18	33.2
West: Bridge											
10	L	681	4.0	0.377	8.3	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	779	5.0	0.412	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1460	4.5	0.412	3.9	NA	0.0	0.0	0.00	0.31	54.3
All Vehicles		2249	4.2	0.675	5.7	NA	3.7	26.4	0.08	0.35	51.9

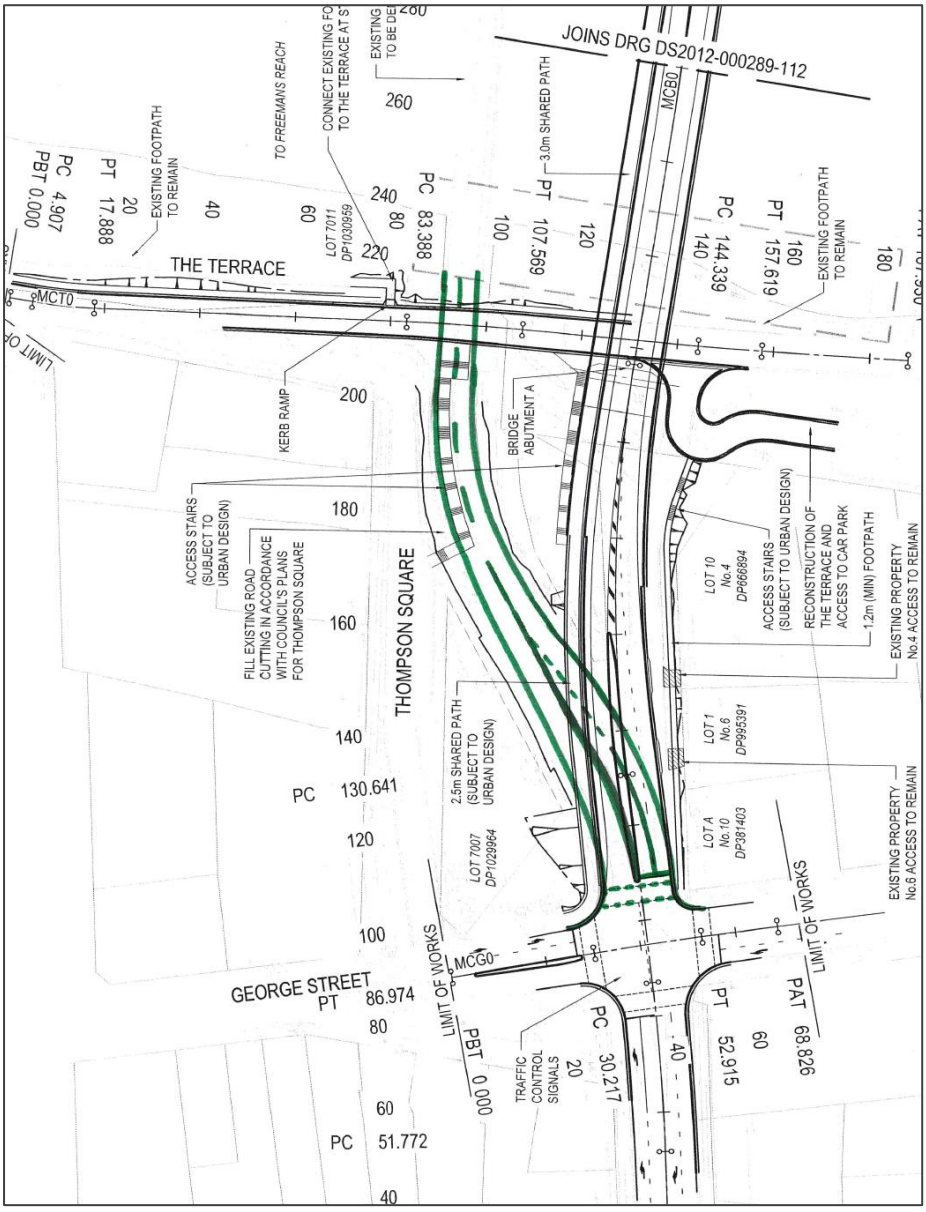
The above results indicate that a seagull treatment is expected to perform at a reasonable level of operation during the 2021 AM peak period and the 2021 PM peak period. Whilst levels of service C and D are indicated, queues and delays for the critical movements are likely to be within acceptable limits, as is the intersection degree of saturation.

Note: Assuming that the George Street / Windsor Road intersection is signalised, northbound traffic on the bridge will tend to arrive in platoons. This will create gaps in traffic opposing that turning from Freemans Reach Road onto Wilberforce Road, which should improve the performance of this movement. A 15% 'Extra Bunching' factor has been assumed to reflect this effect.

3.1.2 Southern Intersection

Subject to checking sightlines for southbound traffic approaching the George Street intersection (towards the back of a queue on this northern approach), it would appear feasible for the upgraded intersection as described in the EIS to tie into the existing alignment of Bridge Street, as shown in the concept sketch below. We would assume that the vertical alignment of the northern intersection approach could be adjusted to help address sightline issues (as discussed in the Applicant's response to Item 15 from the Additional Information Request), while following the existing horizontal alignment of Bridge Street. If necessary, cutting back the embankment on the inside of the bend may also improve sightlines towards the intersection for southbound traffic.

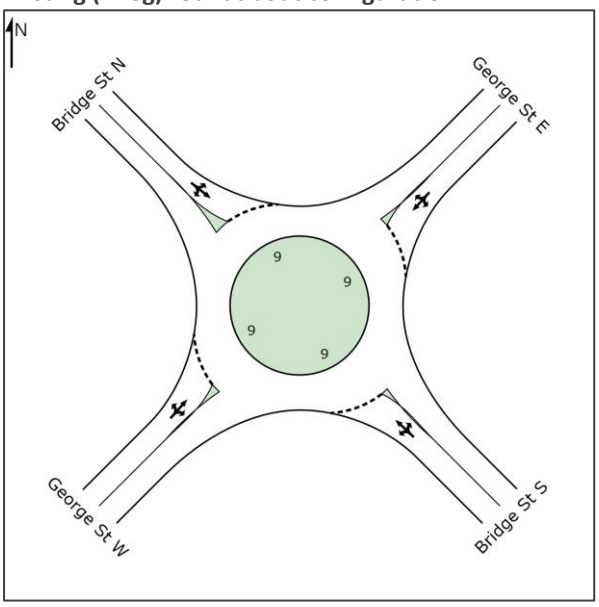
Notwithstanding the above, we note that some of the VISSIM / SIDRA models of this intersection permit the southbound right turn as a permitted (i.e. filter or unprotected) movement. Based upon our on-site observations, we suggest that the sight distance for this movement towards opposing (northbound) traffic should be assessed if it has not already been.



CONCEPT SKETCH ONLY

We have also considered the impact of closing the eastern approach of this roundabout (George Street East). This would require works at the Court Street intersection to cater for the movements to/from this catchment to the east of Bridge Street. To enable a comparison of the impact of this modification upon the capacity of the intersection, the results of 2011 PM peak modelling for the existing (4-leg) roundabout configuration, and the 3-leg configuration, are provided following:

Existing (4-leg) roundabout configuration



MOVEMENT SUMMARY

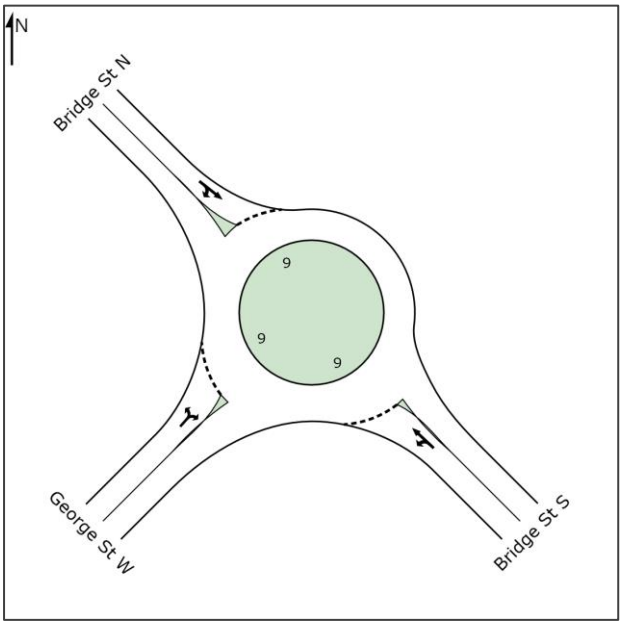
Site: Bridge Street / George Street, Windsor PM Peak

Bridge Street / George Street, Windsor AM Peak
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Bridge St S											
21	L	14	7.1	0.778	16.2	LOS B	10.6	78.3	0.77	1.05	41.0
22	T	643	5.9	0.797	16.0	LOS B	10.6	78.3	0.77	1.02	41.8
23	R	2	0.0	0.667	18.9	LOS B	10.6	78.3	0.77	1.10	39.3
Approach		659	5.9	0.797	16.0	LOS B	10.6	78.3	0.77	1.03	41.7
North East: George St E											
24	L	25	4.0	0.455	10.5	LOS A	3.6	27.2	0.68	0.81	40.9
25	T	32	0.0	0.457	8.7	LOS A	3.6	27.2	0.68	0.76	40.6
26	R	323	10.5	0.455	13.9	LOS A	3.6	27.2	0.68	0.87	39.1
Approach		380	9.2	0.455	13.3	LOS A	3.6	27.2	0.68	0.86	39.3
North West: Bridge St N											
27	L	6	0.0	0.333	7.1	LOS A	3.4	24.6	0.26	0.57	48.1
28	T	293	7.5	0.334	7.2	LOS A	3.4	24.6	0.26	0.51	49.0
29	R	159	1.3	0.335	10.3	LOS A	3.4	24.6	0.26	0.72	45.5
Approach		458	5.2	0.335	8.3	LOS A	3.4	24.6	0.26	0.58	47.7
South West: George St W											
30	L	251	4.8	0.602	24.4	LOS B	7.7	55.9	1.00	1.19	19.5
31	T	12	0.0	0.600	22.5	LOS B	7.7	55.9	1.00	1.19	17.8
32	R	34	0.0	0.607	27.4	LOS B	7.7	55.9	1.00	1.19	19.2
Approach		297	4.0	0.602	24.6	LOS B	7.7	55.9	1.00	1.19	19.4
All Vehicles		1794	6.1	0.797	14.9	LOS B	10.6	78.3	0.66	0.90	39.7

3-leg roundabout configuration



MOVEMENT SUMMARY

Site: Bridge Street / George Street, Windsor PM Peak_ACC closed eastern approach

Bridge Street / George Street, Windsor AM Peak
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Bridge St S											
21	L	14	7.1	0.530	8.2	LOS A	3.3	24.3	0.32	0.67	47.9
22	T	643	5.9	0.530	8.0	LOS A	3.3	24.3	0.32	0.59	48.8
Approach		657	5.9	0.530	8.0	LOS A	3.3	24.3	0.32	0.59	48.8
North West: Bridge St N											
28	T	293	7.5	0.314	7.1	LOS A	2.5	18.0	0.20	0.50	49.3
29	R	159	1.3	0.314	10.1	LOS A	2.5	18.0	0.20	0.74	45.7
Approach		452	5.3	0.314	8.2	LOS A	2.5	18.0	0.20	0.59	48.0
South West: George St W											
30	L	251	4.8	0.355	12.4	LOS A	3.2	23.1	0.83	0.75	28.3
32	R	34	0.0	0.355	15.4	LOS B	3.2	23.1	0.83	0.78	26.8
Approach		285	4.2	0.355	12.8	LOS A	3.2	23.1	0.83	0.75	28.1
All Vehicles		1394	5.4	0.530	9.0	LOS A	3.3	24.3	0.39	0.62	45.7

The above results indicate that the closure of the eastern leg of the Bridge Street / George Street (provided adequate access for the catchment is provided at Court Street) would improve the operation of this roundabout quite substantially. We have undertaken a design life analysis (DLA) of this option using the method applied by RMS, and the results are summarised below (as an addition to the table summarising the results of the RMS DLA in the EIS).

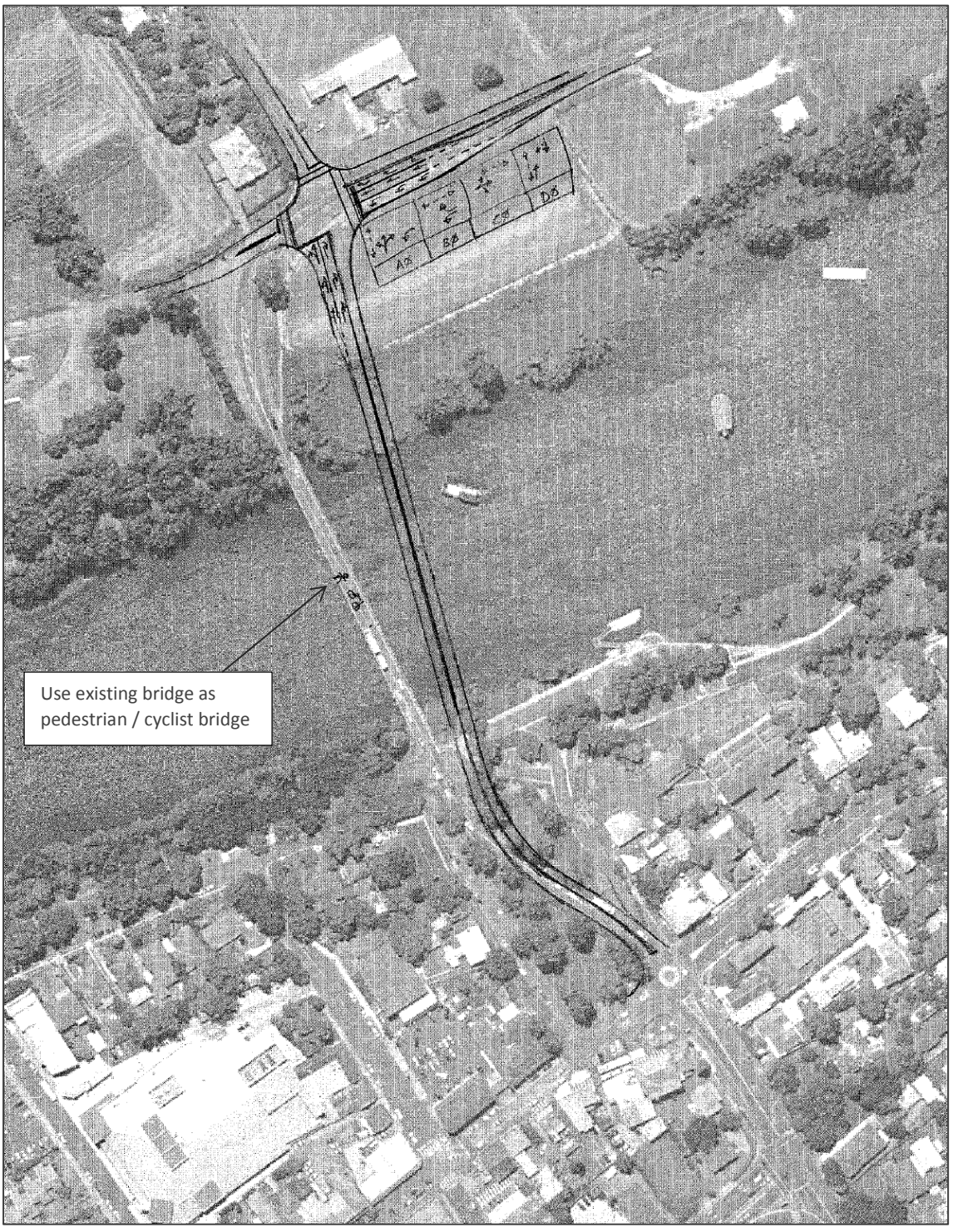
Peak	Existing (roundabout)		Option 1	Option 2	Option 3	Option 4	3-leg configuration
	Latest year at which level of service C or better	The Worst movement	Latest year at which level of service of whole intersection is C or better				
AM	2031	Bridge Street north	2030	2030	2030	2030	**2030**
PM	2016	George Street west	2021	2028	2024	2021	**2030**

On the basis of the above results of the design life analysis, and assuming adequate access for the catchment to the east of Bridge Street is able to be provided at Court Street we would suggest that this option may warrant further consideration.

3.2 Alternative 2: Construct New Bridge Adjacent to Existing Bridge and Upgrade Intersections

The following sketches were prepared during the consideration of options to construct a new bridge adjacent to the existing bridge, and upgrade the intersections to the north and south of the bridge. Whilst we expect that the first concept may have an unacceptable impact upon Thompson Square, the second and third concepts, or some variation of these concepts (involving a roundabout at Freemans Reach Road rather than a signalised intersection) may warrant further consideration.

CONCEPT SKETCH ONLY

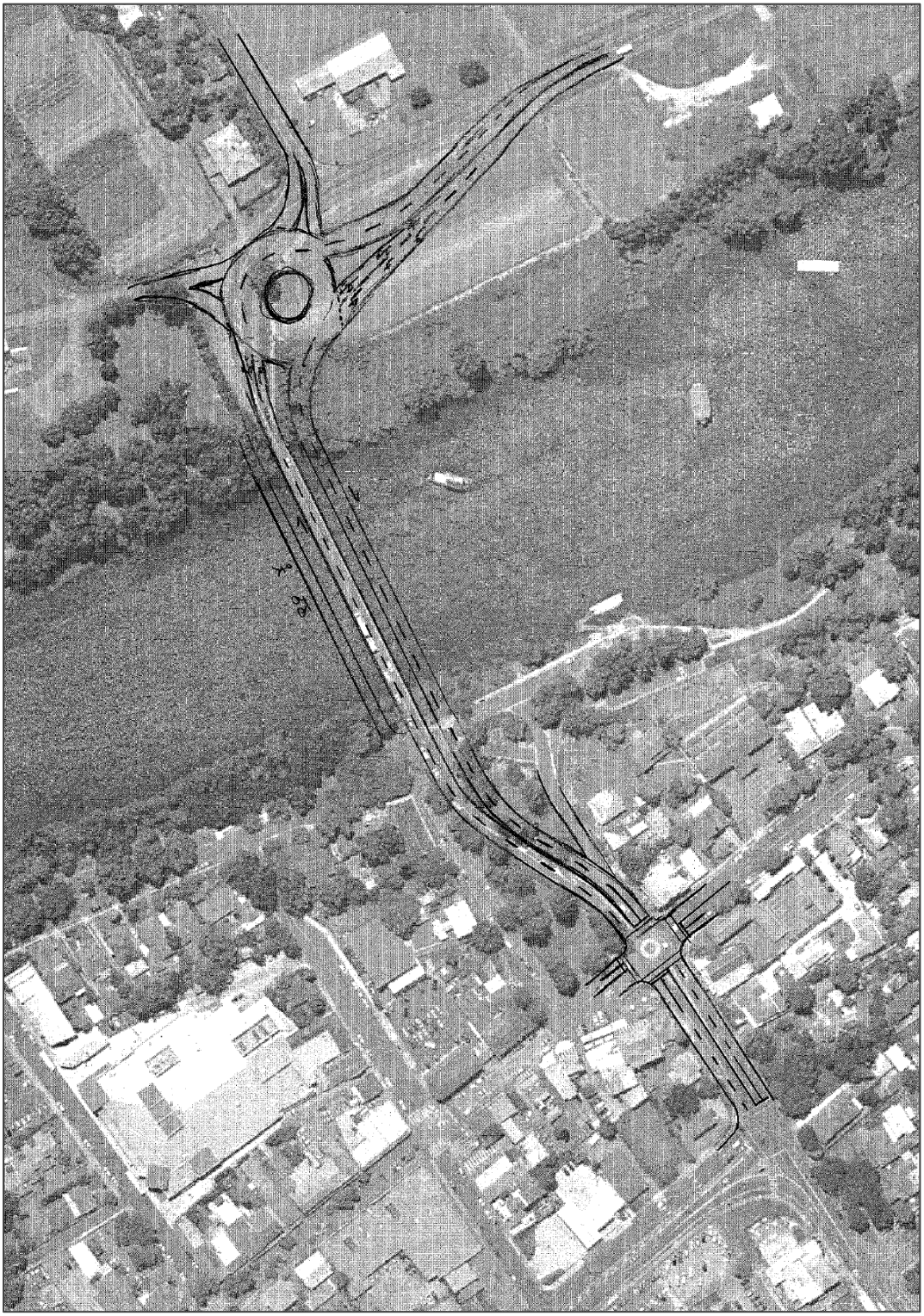


CONCEPT SKETCH ONLY

CONCEPT SKETCH ONLY

3.3 Alternative 3: Duplicate Existing Bridge and Upgrade Intersections

We have considered at a high level the possibility of retaining the existing bridge for northbound traffic, and duplicating the bridge for southbound traffic (see below). We acknowledge however that this arrangement may have an unacceptable impact upon Thompson Square



CONCEPT SKETCH ONLY

3.4 Alternative 4: Broader Network Options (Maintaining Existing Bridge)

3.4.1 Realignment of Freemans Reach Road

It appears as though the Wilberforce Road / Freemans Reach Road intersection creates some issues, which in turn may have driven the location of the bridge in several of the options which were developed and considered by the applicant. That is, this intersection may have played unnecessarily heavily on the options development.

We have taken a look at land ownership using the *SIX Maps* NSW Government Database, to see if there is an unused road reserve which could be used to realign Freemans Reach Road. There does not appear to be any, however it may be possible to acquire a single additional property (noting the turf farm paddock which we understand has already been acquired, was part of the property opposite on Wilberforce Road).

It appears that acquiring land opposite the current bridge alignment to create a 4-way intersection (on the exiting bridge alignment) has some promise (see Figure **3.4.1a** and Figure **3.4.1b** below).

Alternatively, Freemans Reach Road could be realigned to the east as shown in **Figure 3.4.1c**, forming a three-way intersection with Wilberforce Road.

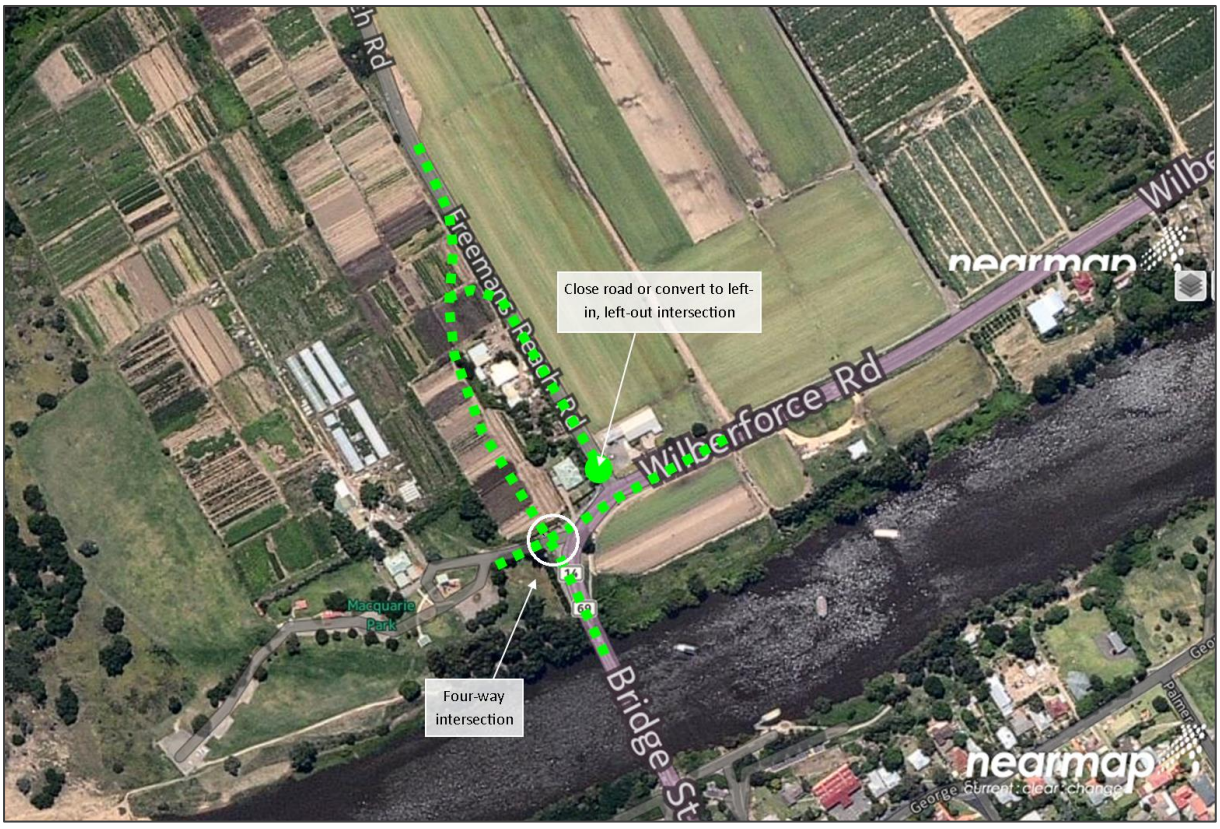


Figure 3.4.1a: Freemans Reach Road Realignment Option 1

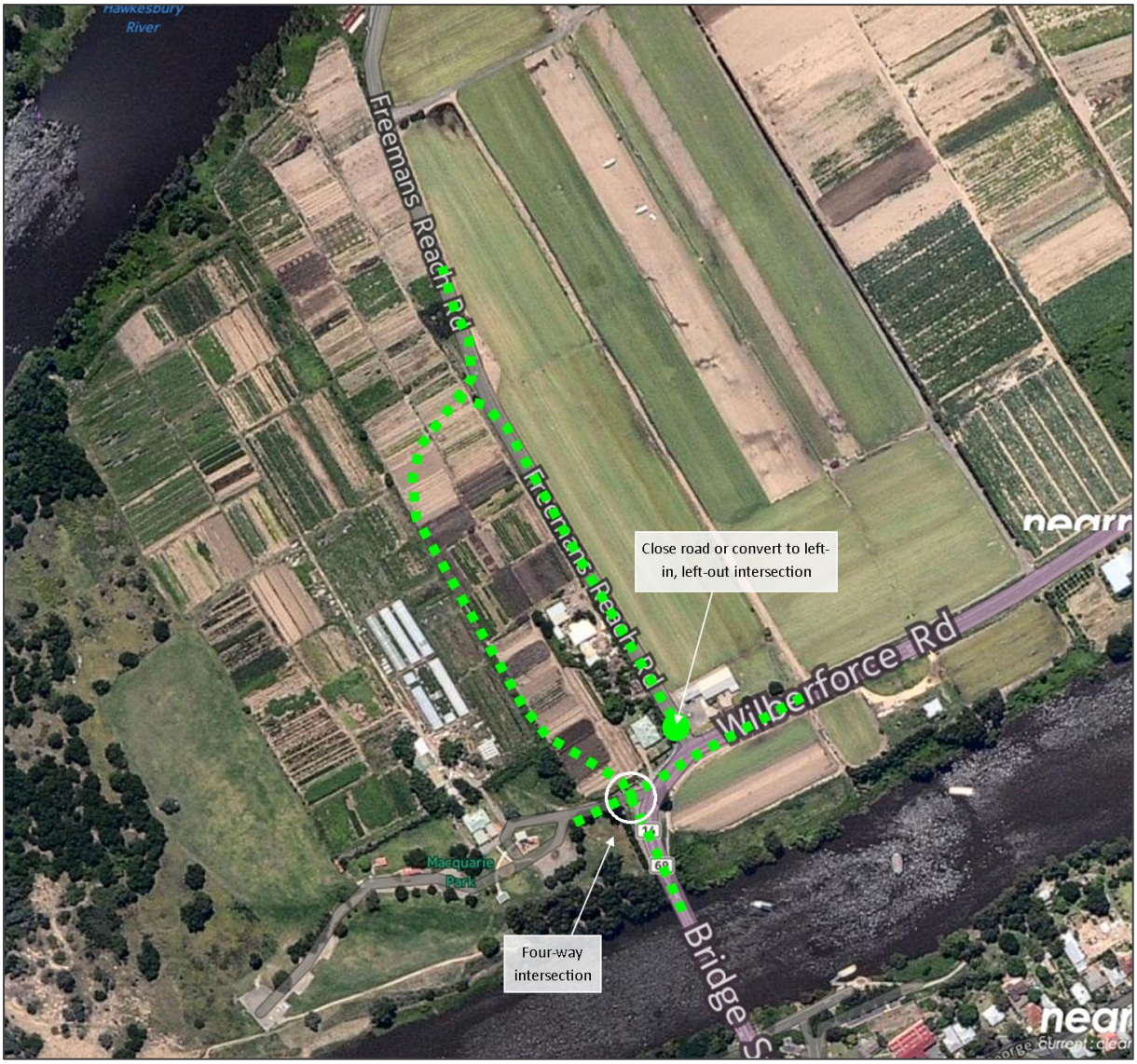


Figure 3.4.1b: Freemans Reach Road Realignment Option 2

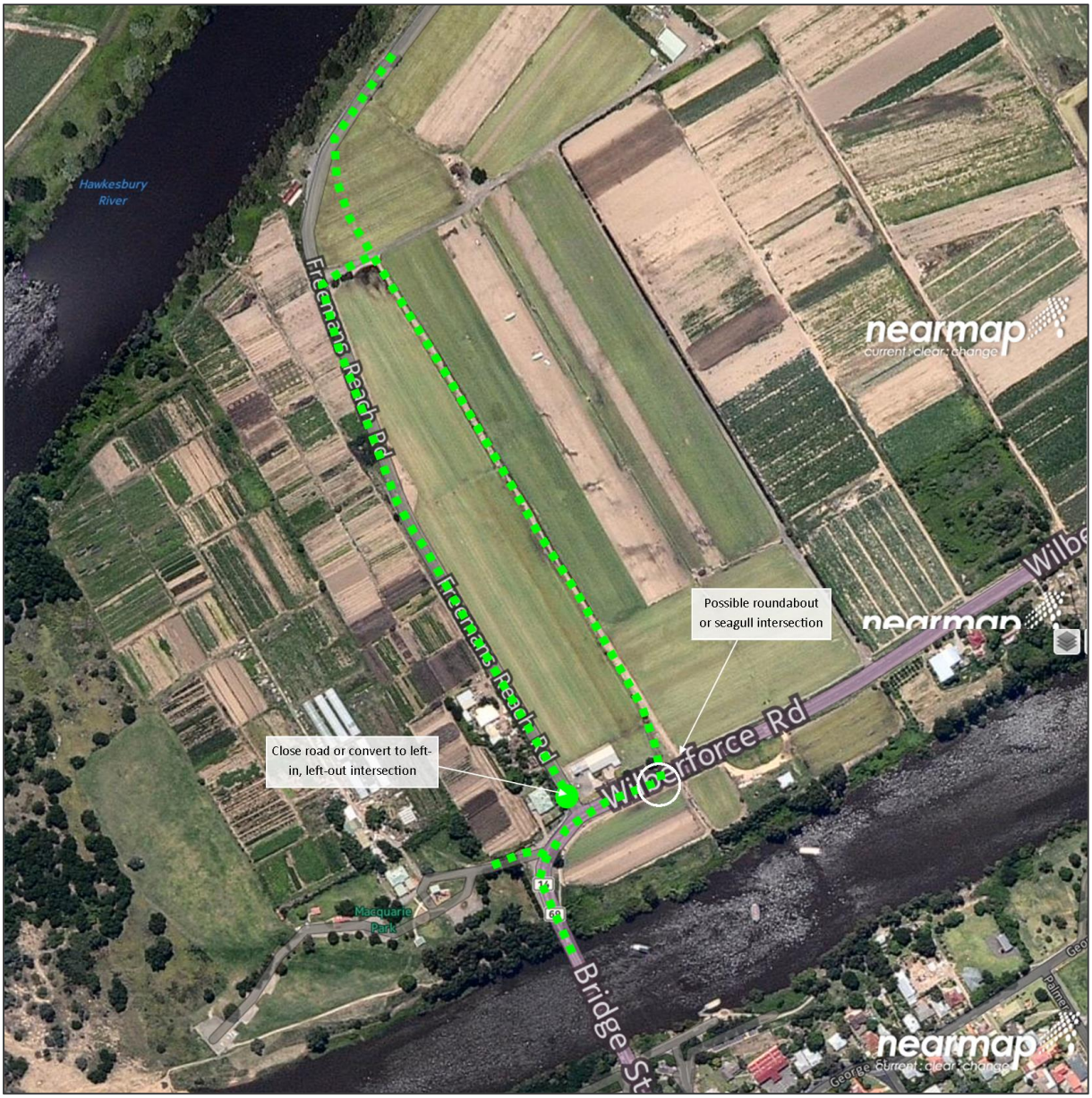


Figure 3.4.1c: Freemans Reach Road Realignment Option 3

3.4.2 Longer Term 'Bypass' Options

We have considered some possible longer term 'bypass' options, which are shown diagrammatically in **Figure 3.4.2**. While each option no doubt has a number of issues which would need to be addressed, ultimately providing a bridge some distance away from Windsor Town should enable a two lane bridge to be provided, given that Wilberforce Road is only two lanes and can therefore handle or deliver no more than two lanes of traffic.

If the current bridge was to be retained for local traffic, this could offer a good result all-round. The new bridge could take B-doubles and heavy vehicles away from town, allowing a load limit to be imposed on the existing bridge to possibly extend its life, minimise the effects of heavy vehicles on the town, and retain local connectivity.

The existing bridge could still be used by traffic heading to Freemans Reach Road (which is essentially local traffic), whilst allowing through traffic to bypass Windsor, protecting the town from the intrusive effects of heavy through traffic (both volumes and vehicle size).

Depending on the proximity of the 'bypass' route relative to the town, Macquarie Street traffic could continue to use the existing bridge (although heavy vehicles could be directed to use the new bridge).

Assuming the current bridge could be retained and its 'life' extended in the near term, the delivery of a 'bypass' option could be considered for the medium to long term, allowing government to progressively acquire or seek to preserve the land required for its delivery.

We would be interested to see some fully considered and costed options along the lines of those shown in **Figure 3.4.2**, to understand the extent of any savings in maintaining a river crossing close to the town, versus a bypass option. This comparison should also take into consideration that due to the limitations on intersection upgrades within the town, the former option (i.e. maintaining a river crossing close to the town) may only defer the need for a bypass, not do away with it all together.

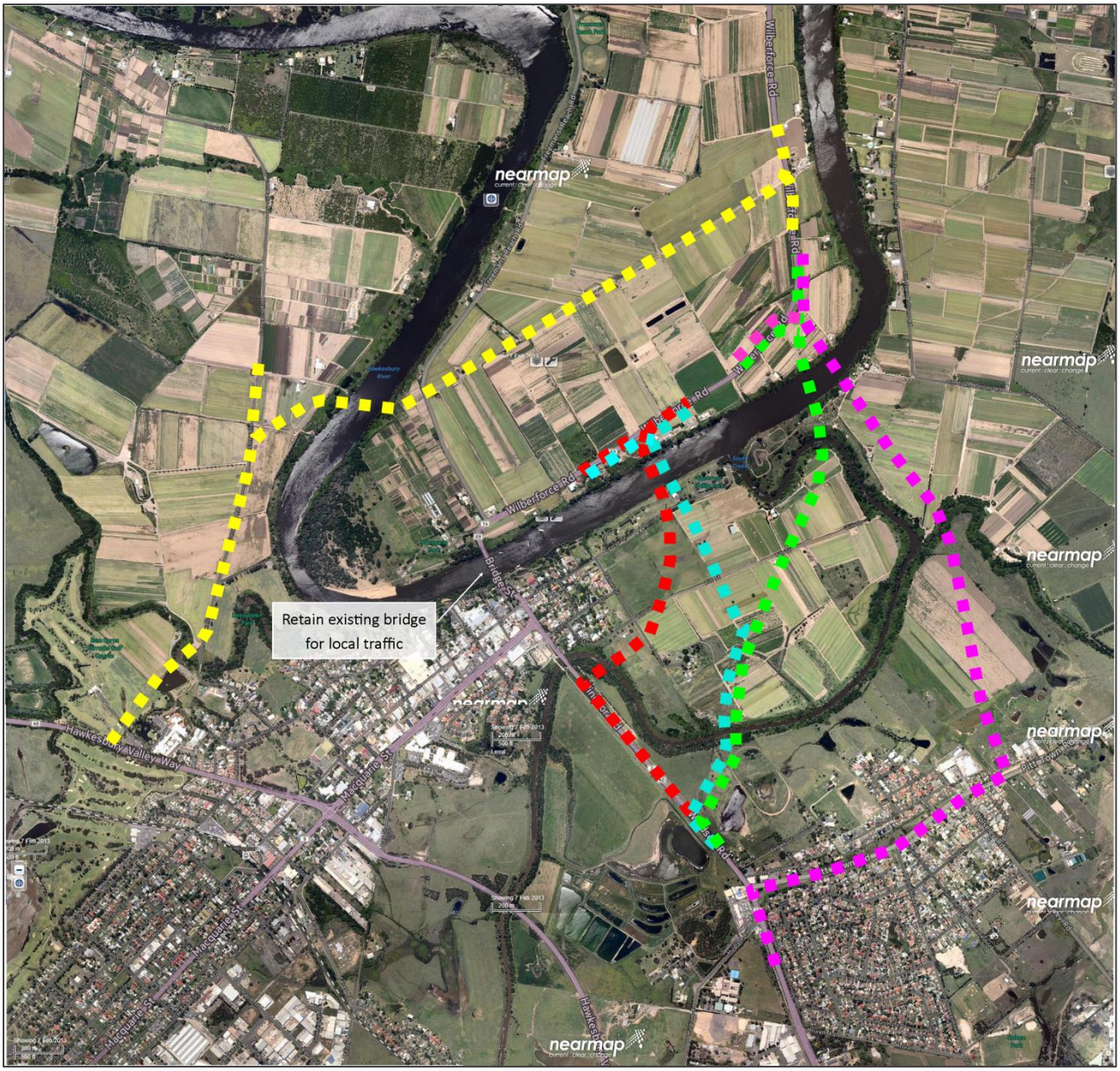


Figure 3.4.2: Possible Windsor 'Bypass' Options

3.5 Comments on Modified Rickabys Line Option

We note that a modified Rickabys Line Route Option has been suggested by Ray Wedgewood (see **Appendix O**). This option involves the realignment of the route to the north of the Macquarie Park Restaurant, rather than to the south, as previously proposed (see **Figure 3.5** below).

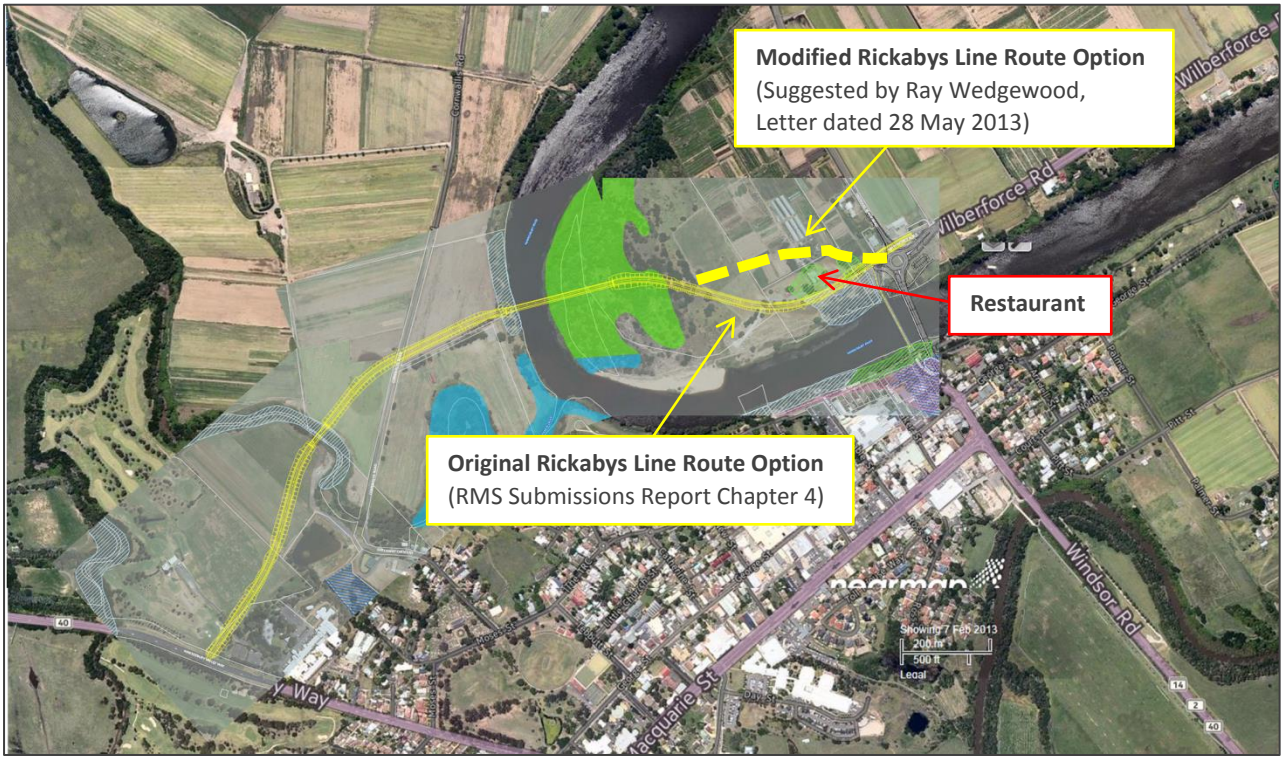


Figure 3.5: Alignment of Modified Rickabys Line Option

We concur that this option warrants further consideration, particularly if it is feasible to raise the northern end of the existing bridge by 1.2m as suggested in this submission by Ray Wedgewood.

A key benefit of this option is that it would provide direct access to the Windsor Flood Evacuation Route (Hawkesbury Valley Way).

We note that this option would be likely to increase traffic demand on Macquarie Street and Hawkesbury Valley Way, and upgrades to intersections along these roads may be required to cater for this existing demand. However provided that such intersection upgrades are able to be accommodated, we would expect that this arrangement may have a substantially longer 'life' than the currently preferred option (from a capacity perspective).

4.0 Conclusion and Recommendations

A number of queries and recommendations have been made in this document, in relation to the work that has been undertaken by RMS on this project. These queries and recommendations are detailed in the relevant sections throughout this report.

In summary, based upon the information provided to us, it appears that the scope throughout much of the duration of the project has focussed on justifying the preferred option, as opposed to undertaking a thorough investigation into alternative options.

In our opinion, there may be other options which were discarded prematurely, or for which 'sub-options' may be feasible. Additionally, there may be alternatives which offer a better long term solution, which can be staged, and perhaps make better use of the funds being invested into the construction of a new bridge.

We suggest that it may be prudent to 'step back' and undertake a broader study to investigate long term solutions, and once a preferred long term solution is identified, consider a staged approach or interim treatments to progressively deliver that long term solution. This would avoid investing substantial funds into a traffic route which will have a limited 'life' due to constrained intersection capacity on the roads feeding the bridge.

Notwithstanding the above, we recognise the importance of achieving a balance between transport needs, social and heritage impacts, ecological, engineering and cost constraints, and therefore any suggestions or recommendations we have made should be considered by the decision makers, with reference to representatives from all relevant disciplines, as well as the local community.