WILTON STRATEGIC CONCEPT FOR PROPOSED HUME HIGHWAY RAMPS

Design Report

23 OCTOBER 2017
ROADS AND MARITIME SERVICES
WILTON JUNCTION

Concept Road Design
Design Report

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REVISIONS

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EXECUTIVE SUMMARY

Arcadis has prepared a design report for the proposed north facing ramps, sub-arterial roads through the development and the duplication of the existing Niloc Bridge. Our key findings are summarised below.

Exit and Entry Ramps

- The exit ramp off the Hume Highway exits the southbound lane of the Hume Highway and connects the proposed Niloc bridge duplication.
- The exit ramp off the Hume Highway exits the southbound lane of the Hume Highway as a single land road and divides into a multilane road with two right turn lanes.
- The northbound entry ramp to the Hume Highway is a two-lane road which merges into a single lane road before connecting with the Hume Highway with ramp metering capability.
- The entry ramp connects with the highway near the proposed Niloc Bridge duplication.

Existing and proposed bridge

- The existing Niloc Bridge will be for eastbound traffic only that is traffic wishing to travel from the Bradcorp lands to Bingara Gorge.
- The existing bridge although requiring some minor modifications is structurally suitable to provide future vehicular access.
- A new bridge will be constructed on the south side of the existing Niloc Bridge.
- The new bridge accommodates west bound traffic including that exits the Hume Highway from the proposed exit ramp or traffic from Bingara Gorge that wishes to travel to the Bradcorp land.

Sub-arterial roads

- A sub-arterial road connection is provided between Hume Highway and Picton road connecting with the proposed entry and exit ramps. This road has 2 lane restricted access in both directions which extends further north beyond the intersection with the sub-arterial to Picton Road.
WILTON STRATEGIC CONCEPT FOR PROPOSED HUME HIGHWAY RAMPS

1 SCOPE

1.1 Background and context

On Wednesday 16th August 2017, Department of Planning and Environment (DPE) held a workshop meeting with Bradcorp, Transport for NSW (TfNSW), NSW Road and Maritime Service (RMS) and Arcadis. At the meeting, and detailed in the meeting minutes subsequently issued by DPE, RMS provided a clear set of steps. These steps highlighted the design process RMS required Bradcorp consultants to follow and identified some potential issues that they wanted addressed. This report consolidates the previous advice provided by Arcadis and comprehensively addresses the potential issues raised by RMS by completing the required design steps.

The report provides a strategic concept design for the proposed north facing ramps and duplication of the existing Niloc Bridge. The strategic concept design meets the Ausroads and RMS guidelines and provides a fully functioning network. It also closes out issues regarding:

- Configuration of the entry ramp to the Hume Highway to achieve the appropriate acceleration speed so as to not impact the Hume Highway
- Configuration of the exit ramp to ensure that traffic can exit the freeway without causing any potential impact to through traffic on the Hume Highway
- Confirmation of the structural adequacy of the existing Niloc Bridge
- Strategic concept design of the proposed new bridge
- Connection of the ramps through Bradcorps land via a sub-arterial to Picton Road

1.2 Location

Figure 1 Proposed development at Wilton Junction, showing road network.
1.3 Road form and function

Refer to Figure 1 for the layout drawings of the proposed road forms.

The exit ramp off the Hume Highway exits the southbound lane of the Hume Highway as a single land road and divides into a multilane road with two right turn lanes. As instructed by RMS, it also has a one left turn lane. The exit ramp has a maximum uphill grade of 6%, to ensure a reduced speed from motor vehicles as they approach the intersection.

The northbound entry ramp to the Hume Highway is a two-lane road which merges into a single lane road before connecting with the Hume Highway. The option of ramp metering has also been included to RMS standards. The road is in a 110km/h posted speed limit environment with a maximum downhill grade of 5.5% to ensure motor vehicles can gather speed before entering the motorway.

A new bridge will be constructed on the south side to the existing Niloc Bridge. The bridge accommodates traffic that exits the Hume Highway and enters the Bradcorp land. It also accommodates traffic from Bingara Gorge that wishes to travel to the Bradcorp land. The bridge will be for westbound traffic only with two lanes plus provision for on road cyclists. Furthermore, a shared path for cyclists and pedestrians will also be provided. (Refer Figure 9).

The existing Niloc Bridge will be for east bound traffic only. The bridge accommodates traffic travelling from the Bradcorp lands to the Bingara Gorge, with one lane plus provision for on road cyclists. (Refer Figure 9).

A sub-arterial road connection between Hume Highway and Picton road has 2 lanes in each direction with a median, together with restricted access. The major intersections will be configured to ensure adequate capacity and safety. (Refer to Figure 12 & Figure 13). This sub-arterial connects with a major north/south spine road in the Bradcorp development. This road has 2 lane restricted access in both directions which extends further north beyond the intersection with the sub-arterial to Picton Road. Furthermore, this road will be utilised by the majority of residence in the north of Bradcorp.

1.4 Project specific objectives

The issues and steps raised by RMS have been tabulated with the previous correspondence which address these issues, see Appendix A. A summary of Arcadis’s responses to close out these issues have been presented below.

RMS issues to be addressed in relation to use of the Niloc bridge are:

1. Structural and design verification, including remaining design life before the bridge would need replacement, a replacement strategy considering the proposed interchange design, details on the existing bridges compliance with current design requirements and works required to bring it into compliance.

Structural design verification has been undertaken regarding the structural adequacy of the existing Niloc Bridge, we refer to the report dated 14th June 2016 by Ken Maxwell Technical Director of Highway Structures for Arcadis, see Appendix D. The design of the Niloc Bridge needs to be designed to suit its function, which is a local connector road to simply connect local traffic travelling eastbound from the residential community on the western side of the Hume to the residential community on the eastern side of the Hume Highway. The report consisted of a review of the design drawings and WAE drawings together with a field inspection. The report identified and confirmed RMS previous advice that the bridge is a T44 bridge. Although the report identified that some works would be required to upgrade to current standards which will be carried out, it concludes that the bridge is “structurally suitable to provide future vehicular access”.

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2. Confirmation that the Hume Motorway can be widened under Niloc Bridge, including undertaking horizontal/vertical alignment checks within the median and bridges crossing Allens Creek.

The Hume Highway can be widened under the Niloc Bridge. The RMS design of the Niloc Bridge provides for future widening of the Hume Highway into the median. Please refer to the RMS WAE drawings included in the 14/06/16 report. The drawing is also presented in Figure 2.

![Figure 2 Future widening of Hume Highway](image)

Regarding the Allens Creek bridges, the proposed location of the north bound entry ramp is not in the vicinity of the Allens Creek Bridge and has no impact on RMS plans for widening of the Hume Highway.

3. A revised Structure Plan showing integration of the new sub-arterial road connection between Hume and Picton Road, through the Governor’s Hill and Bradcorp sites.

The revised Structure Plan showing integration of the sub-arterial road connection has been provided. We refer to our letter dated 24/8/17 and in particular Figure 1. It provides a sub-arterial road between the Hume Highway and Picton Road.

4. The south bound off ramp in the vicinity of the Niloc bridge would need to cater for all turn movements (i.e. not be restricted to right turn only as per the Bradcorp proposal).

The proposal does not preclude the option for all turn movements and the right turn only restriction can be released as instructed by RMS to allow left turn movements. Please refer to drawing no SKC104 in Appendix F.

5. Configuration of on ramps to the Hume to achieve appropriate acceleration, entry speed and avoid impacts on the flow of traffic on the Hume. Design checks required for entry and exit ramps to ensure no impact on motorway mainline and the sub-arterials. Smart Motorway service requirements to be addressed.

Refer to Appendix F for the strategic concept design drawings and subsequent sections of this report.
Further assess the proposal RMS requires:

1. A strategic level assessment/design for the Niloc Bridge. This including structural engineering certificate/assessment to demonstrate that it would meet the standard required of a sub arterial road. This would include an assessment of deficiencies and work required to improve it.

It is proposed that the existing Niloc Bridge will be for eastbound traffic only, that is traffic wishing to travel from the Bradcorp lands to Bingara Gorge. Given that the forecast ultimate traffic volume from the PB modelling is 360 vph, one lane plus provision for on road cyclists is more than adequate. A new bridge is proposed to be constructed to the south of the existing bridge to accommodate traffic that exits the freeway and enters the Bradcorp lands and traffic from Bingara Gorge that wish to travel to the Bradcorp lands. Given that the forecast ultimate westbound traffic volume from the adjusted PB modelling is 1211 vph, two lanes plus provision for on road cyclists exceeds the requirements. This adjusted volume allows for the additional traffic from the closure of the southern exit ramp and the increased traffic growth up to the year 2051. Furthermore, a shared path for cyclists and pedestrians will also be provided. Refer to point 1 above.

2. A strategic design for the interchange and on-ramps.

Refer to Appendix F for the strategic concept design drawings and subsequent sections of this report.

3. A revised sub-arterial road network design connecting Picton Road and the Hume Motorway to be added to Jacobs existing strategic road network for remodelling by Jacobs. This may need to include a direct sub-arterial road connection from the above to Menangle Road should the upgraded sub-arterial connection not resolve previously modelled traffic congestion. The Menangle Road connection to be 4 lanes, controlled access and positioned so road access is from either side.

We believe the Menangle Road connection is not required because we have enhanced the road network to ensure that the sub arterial road through the development has four lanes with a median together restricted access. In addition, the major intersections will be configured to ensure adequate capacity. This sub arterial will connect the Hume Motorway Entrance Ramp with Picton Road. It conforms to the topography of the precinct and meets the land use requirements of the development. Since the sub arterial road requested by RMS has been provided and previous modelling by PB has shown that it will perform satisfactorily, there is no need for an additional sub arterial road to Menangle Road. Please refer to point 3 above for further details. We also note that DPE have “questioned” the need for this connection given the complexity of construction over the Nepean gorge and the Nepean River and potential environmental impacts as identified by DPE in discussion point 2 contained in the minutes of the meeting held with DPE/RMS/TNSW on the 16 August 2017.

4. Remodelling of the proposed arrangement by Jacobs.

Since the enhanced sub arterial road will connect the Hume Motorway with Picton Road, and is of the appropriate standard, there is no need for additional modelling by Jacobs in relation to the rezoning of Bradcorp’s land.
1.5 Sub-arterial road connection

As outlined in the letter dated 24/08/2017 (Appendix B) and in response to the RMS Step 3, provide a “revised sub-arterial road network design connecting Picton Road and the Hume Motorway . . .” it is our strong recommendation that the existing road network is utilised with enhancements (Option 1). This option meets all requirements including exceeding the sufficient traffic capacity, meeting the restraints of topography, serving the land use needs of the development and utilising the existing assets. We note that RMS considered an option to change the location of the highway crossing further south. This was discounted because the internal spine road within the Bingara Gorge development is designed and partly constructed to connect to the Niloc Bridge in its current location. Furthermore, the land adjacent to the highway to the southeast is being developed by Lend Lease who have a development approval for both the residential development and Spine Road, including a construction certificate for the spine road up to and onto the existing Niloc Bridge. The opportunity to construct a bridge and approaches on the eastern side the location proposed by RMS is no longer viable. Furthermore, if it were to be moved further south it would become impractical due to the cutting required along the dominant ridge line on the west of the Freeway.

1.6 Speed

Speed values are shown in Table 1 and Table 2

**Table 1 Speed values for highways**

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<td>Design Speed</td>
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**Table 2 Speed values for sub-arterial roads**

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1.7 Design vehicles

Design vehicles are shown in Table 3

**Table 3 Design vehicles for proposed roads**

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<td>B-Double - Check Vehicle</td>
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<tr>
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<td>Acceleration/deceleration</td>
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<tr>
<td>Car</td>
<td>Stopping sight distance</td>
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Turn paths supporting the designs of the intersection of the exit ramp and the bridge are presented in drawing no. SKC105 in Appendix F.

1.8 Design guidelines

Network Planning Targets were considered when setting design values. The guidelines used for design are, in order of priority:

- Austroads 2009 Guide to Road Design – Part 4C: Interchange
- Road and Maritime Services, 2017 Standard Drawings Road Resign Engineering R1010 Ramp Metering, Drawing No. R1010-01 to R1010-05
- Freeway ramp signals handbook: Chapter 6 – Design of Ramp Signal Installation (2013)
2 DESIGN PLANNING

2.1 Minimum curve radius

The factors that influence the minimum curve radius are operating speed, width between the edge of travel lane and obstructions (such as safety barriers), sight distance requirements, superelevation and risk.

2.2 Traffic modelling

2.2.1 Exit ramp

Arcadis has conducted a traffic analysis and has concluded that the ramps are long enough to provide adequate storage to prevent queuing back onto the Hume Motorway. Furthermore, traffic signals at the intersection, which prioritises vehicles exiting the Hume Highway, will also be incorporated, further minimising the queue length. Finally, with the upgrade of the exit ramp to two lanes there is more than adequate capacity to deal with the predicted traffic numbers.

2.2.2 Entry ramp

The capacity of a one lane entry ramp is 2000 vph. The predicted volume quoted by RMS is 1200 vph for 2051. Arcadis’s assessment is that the length of this ramp in its current proposed location utilising the natural down grade would be in the order of 540 to 600m long. We do acknowledge if the ramp is 600m or more in length then two lanes would be required. However, RMS has requested a two-lane ramp for to provide storage for future ramp metering. Therefore, a two-lane ramp has been proposed.

2.2.3 Bridges

It is proposed that the existing Niloc Bridge will be for eastbound traffic only that is traffic wishing to travel from the Bradcorp lands to Bingara Gorge. Given that the forecast ultimate traffic volume from the PB modelling is 360 vph, one lane plus provision for on road cyclists is more than adequate. A new bridge is proposed to be constructed to the south of the existing bridge to accommodate traffic that exits the freeway and enters the Bradcorp lands and traffic from Bingara Gorge that wish to travel to the Bradcorp lands. Given that the forecast ultimate westbound traffic volume from the revised PB modelling is 1211 vph, two lanes plus provision for on road cyclists exceeds the requirements. Furthermore, a shared path for cyclists and pedestrians will also be provided.

2.2.4 Intersection A and B

Both PM and AM figures have been assessed for the 2 intersections, with the AM figures assessed to be more critical. The performance of these intersections were assessed using y-values to determine the degree of saturation. SIDRA modelling will be conducted in the future. Both intersections achieved an adequate level of service.

2.3 Road user safety features

A crash cushion is also proposed at the abutment between the existing and proposed Niloc Bridge, see Figure 3.

The relatively steep grading on the southbound exit ramp ensures motor vehicles slow down before approaching the intersection. A steep grading on the northbound exit
ramp also ensures that motors vehicles can gain adequate speed as they enter the Hume Highway.

Ramp metering with 340m of storage is also proposed on the Northbound entry ramp to allowing smooth merging manoeuvres and minimise the potential risk of vehicle collision. Ramp metering is located at an appropriate distance in accordance with RMS guidelines, see Figure 4, to ensure vehicles can gain sufficient speed before entering the Hume Highway. See Drawings R1010-05 for further detail.

![Figure 3 Proposed location of crash cushion indicatively shown](image1)

![Figure 4 Proposed ramp meter stop line indicatively shown](image2)
3 CROSS SECTION

3.1 Cross section and road space allocation

3.1.1 Typical cross section

3.1.1.1 Entry ramp

The entry ramp on to the Northbound lane of the Hume Highway has a two-lane capacity, see Figure 5, which merges into a single lane before connecting with the Hume Highway, see Figure 6. Traffic lanes have a nominal width of 3.5m. Where required, curve widening has been applied to the left and central travel lanes to allow for extra manoeuvrability and vehicle tracking (associated with heavy vehicles). The median shoulders are nominally 1m and 2m wide with the 2m shoulder providing an on-road cycle lane.

Figure 5 Entry ramp – 2 lane cross section

Figure 6 Entry ramp - 1 lane cross section

3.1.1.2 Exit ramp

The exit ramp on the Hume Highway, see Figure 7, is a taper single lane exit road which divides into a multilane road with two right turn lanes, see Figure 8. As per RMS instruction a left turn lane may be included in the future, see Appendix C. Traffic lanes have a nominal width of 3.5m. The median shoulders are nominally 1m and 2m wide with the 2m shoulder providing an on-road cycle lane.

Figure 7 Exit Ramp – Single lane exit
3.1.1.3 Proposed Niloc Bridge

A proposed bridge, see Figure 9, located on the south side to the existing Niloc Bridge provides two westbound traffic lanes. Traffic lanes have a nominal width of 3.5m. The shoulders are nominally 0.5m and 2m wide with the 2m shoulder providing an on-road cycle lane. The road provides a shared path for cyclists and pedestrians. During detailed design, the requirement for further pedestrian safety including barriers and throw screens will be assessed.

3.1.1.4 Existing Niloc Bridge

The existing bridge, see Figure 10, provides one eastbound traffic lane. The traffic lane has a nominal width of 3.5m. The shoulders are nominally 1.0m and 2.3m wide, providing an on-road cycle lane.
3.1.1.5 Sub-arterial roads

Figure 11 shows the cross section of the sub-arterial road connecting to exit ramp with the road before the bridge. The road provides 3 lanes, 2 lanes going westbound and 1 going eastbound. The traffic lane has a nominal width of 3.5m and 4.5m. The 4.5m lane includes an on-road cycle lane. The road has a 4.2m wide median which separates the southbound and northbound lanes. The road provides a pedestrian path as well as a shared path for cyclists and pedestrians. The road is similar to Figure 12 but has a grade separated median between the proposed and existing bridge to accommodate the elevation difference.

![Figure 11 Typical cross section for the sub-arterial road at the intersection of the exit ramp before the bridge](image1)

Road 1 and 2, see Figure 12, are the sub-arterial roads connecting intersection A and intersection B, see Figure 1. The road provides 3 lanes, 2 lanes going westbound and 1 going eastbound. The traffic lane has a nominal width of 3.5m and 4.5m. The 4.5m lane includes an on-road cycle lane. The road has a 4.2m wide median which separates the southbound and northbound lanes. The road provides a pedestrian path as well as a shared path for cyclists and pedestrians.

![Figure 12 Typical cross section for the sub-arterial road spanning from intersection A to B](image2)

Road 3 and 4, see Figure 13 are the sub-arterial roads connecting the proposed and existing bridges and extends to intersection A where is meets the major collector road, see Figure 1. The road provides four lanes with a median together with restricted access. The traffic lane has a nominal width of 3.5m and 4.5m. The 4.5m lane includes an on-road cycle lane. The road has a 4.2m wide median which separates the southbound and northbound lanes. The road provides a pedestrian path as well as a shared path for cyclists and pedestrians.

![Figure 13 Typical cross section for the sub-arterial road spanning from Niloc Bridge to intersection B](image3)
3.1.2 Intersection on sub-arterial road

3.1.2.1 Intersection A

The proposed design to achieve an adequate level of service are traffic signals with a left turn lane into the exit ramp and two lanes for the other flows. For the highest volume direction, south bound, we have proposed four lanes, with two through lanes, one left turning and one right turning lane. For the north bound approach, two through lanes, one left turn and one right turn are proposed. For the other legs two lanes will be used. Refer to Figure 14.

Figure 14 Intraworks sketch of intersection A
3.1.2.2 Intersection B

The preferred arrangement to maintain a satisfactory level of service is to for the westbound leg to provide two lanes for left turning traffic, one lane for through traffic and one lane for right turning traffic. For the northbound and southbound legs, both have one lane for left turning traffic, two lanes for through traffic and one lane for right turning traffic. Refer to Figure 15.

*Figure 15 Intraworks sketch of intersection B*
4 GEOMETRIC DESIGN

4.1 Zoning
A portion of land on either side of the Hume Highway to accommodate the entry and exit ramps will need to be rezoned to SP2 Infrastructure.

4.2 Vertical alignment

4.2.1 Grading

4.2.1.1 Entry ramp
Based on the Austroads Guide to Road Design Part 4C Interchange (2015) the proposed entry ramp should consist of a downhills grade assumed to be between 3 and 6% (ref. table 11.3). The northbound entry ramp was designed with a maximum downhill grade of 5.5% to ensure motor vehicles reach an adequate speed before entering the motorway.

4.2.1.2 Exit ramp
Based on the Austroads Guide to Road Design Part 4C Interchange (2015) the proposed exit ramp should have an uphill grade between 0-6% depending on the deceleration distance allowed. The southbound entry ramp was designed with a maximum grade of 6% to minimise the land acquisition required for the ramp and to ensure cars decelerate before reaching the intersection.

4.2.1.3 Exit ramp and bridge intersection
The sub-arterial road at the intersection of the exit ramp and the proposed bridge has a superelevation of 3% due to the elevation difference between the proposed bridge and the existing bridge.

4.2.2 Vertical sight distance/Stopping distance
Given the steep grades on the project due to the exit and entry ramps, both horizontal and vertical alignments need to be considered together to address stopping sight distance.

4.2.2.1 Exit ramp
The minimum visibility and sight distance requirements for entry ramps are shown in Austroads Guide to Road Design Part 4C - Interchanges (2015), Table 7.1 The following summarises a review of sight distance for the entry ramp.

- **Visibility on approach to ramp nose** – The desired minimum sight distance is 330m for an exit with a taper only. This ensure that the drivers have sufficient time to comprehend the location of the exit and diverge in a controlled manner. This is particularly important in rural areas such as the development area, where drivers are less alert relative to urban areas.

The proposed exit ramp is compliant with Austroads guidelines on the minimum visibility and sight requirements for exit ramps.
4.2.2.2 Entry ramp

The minimum visibility and sight distance requirements for entry ramps are shown in Austroads Guide to Road Design Part 4C - Interchanges (2015), Table 7.2. The following summarises a review of sight distance for the entry ramp.

- **Visibility on approach to ramp nose** - The desirable minimum sight distance is 185 m from mainline carriageway on approach to the ramp nose (i.e. 6 seconds of travel time at 110 km/h). There do not appear to be any restrictions on the sight lines to the target object height (i.e. 0.1 m raised kerb at ramp nose) from either the northbound carriageway or the ramp carriageway. There is a vertical crest curve on the northbound carriageway, however it seems to be well in advance of the proposed ramp nose and does not impede sight distance requirements.

The proposed entry ramp is compliant with Austroads guidelines on the minimum visibility and sight requirements for entry ramps.

4.2.3 Clearance

All minimum clearance requirements are compliant with RMS. Clearance requirement have also been met to allow for the future widening of the Hume Highway to 3 lanes.

4.3 Design for errant vehicles

4.3.1 Safety barriers

A rigid Medium Bridge Performance Barrier will be provided along the sides of the proposed bridge. The bridge barriers for the existing Niloc Bridge must be replaced with Medium Bridge Performance Barrier barriers as these barriers are outdated and constitute a non-conformance. A crash cushion is also proposed at the abutment between the existing and proposed Niloc Bridge.

4.3.2 Pedestrian and bicycle facilities

Both the new bridge located on the south side to the existing Niloc Bridge and the existing Niloc bridge will have a provision for on road cyclists. Furthermore, the new bridge will also provide a shared path for cyclists and pedestrians.

4.4 Bridges

4.4.1 Existing bridge

4.4.1.1 Niloc bridge detail

The existing bridge over the Hume Motorway, has the following features, based on the WAE bridge drawings:

- Two (2) span continuous post-tensioned concrete voided slab bridge, with cantilever deck slab.
- Overall bridge length between bearings at abutments is 65.000 metres.
- Carriageway width is 6.8 metres and there is no footway.
- Designed to NAASRA Bridge Design Specification (1976) for T44 standard vehicle loading.
- Deck is on a summit vertical curve.
- Minimum vertical clearance to Hume Motorway is 5.350 metres.
• Central pier is supported on a pad footing founded in rock. Founding level of footing is approximately 2.5 metres below level of Hume Motorway.

4.4.1.2 Inspection findings
An inspection of the existing bridge was conducted by Arcadis and apart from some additional later works, the bridge is structurally suitable to provide future vehicular access. This is provided the load effects do not exceed those due to T44 standard vehicle loading. Furthermore, as mentioned previously the existing steel traffic barrier railings are substandard for current design collision loads and would require upgrading to current standards if the bridge be used for future vehicular access.

For further detail regarding the investigation conducted see the memo provided in Appendix D.

4.4.2 Proposed bridge
The proposed bridge over the Hume Highway south for the existing bridge has the following design features:

• The proposed overall bridge length is 66.2 metres, comprising 2 spans, each 33.1 m long.
• 1500mm deep Super-T girders are suitable for 33m maximum span length (centre to centre of bearings).
• The Super-T girders have a 20-mm thick reinforced concrete deck slab and 75 mm thick AC wearing surface.
• No. Super-T girders per span are recommended based on 13,700mm overall deck width (outer face to outer face) for proposed Niloc Bridge
5 FACILITIES

5.1 Signposting

More detail regarding sign posting will be carried out in future designs in accordance with the appropriate standards.
## RMS issues and response

<table>
<thead>
<tr>
<th>RMS issues to be addressed in relation to use of the Niloc bridge are:</th>
<th>Response</th>
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| 1. Structural and design verification, including remaining design life before the bridge would need replacement and a replacement strategy giving consideration to the proposed interchange design, details on the existing bridges compliance with current design requirements and works required to bring it into compliance. | See Arcadis letter dated:  
• 07/09/17  
• 14/06/16 |
| 2. Confirmation that the Hume Motorway can be widened under Niloc Bridge, including undertaking horizontal/vertical alignment checks within the median and bridges crossing Allens Creek. | See Arcadis letter dated:  
• 07/09/17 |
| 3. A revised Structure Plan showing integration of the new sub-arterial road connection between Hume and Picton Road, through the Governor’s Hill and Bradcorp sites. | See Arcadis letter dated:  
• 24/08/17 |
| 4. The south bound off ramp in the vicinity of the Niloc bridge would need to cater for all turn movements (i.e. not be restricted to right turn only as per the Bradcorp proposal). | Included in this final report |
| 5. Configuration of on ramps to the Hume to achieve appropriate acceleration, entry speed and avoid impacts on the flow of traffic on the Hume. Design checks required for entry and exit ramps to ensure no impact on motorway mainline and the sub-arterials. Smart Motorway service requirements to be addressed. | Included in this final report |

### To further assess the proposal RMS requires:

| 1. A strategic level assessment/design for the Niloc Bridge. This including structural engineering certificate/assessment to demonstrate that it would meet the standard required of a sub-arterial road. This would include an assessment of deficiencies and work required to improve it. | See Arcadis letter dated:  
• 07/09/17  
• 14/06/16 |
| 2. A strategic design for the interchange and on-ramps. | Included in this final report |
| 3. A revised sub-arterial road network design connecting Picton Road and the Hume Motorway to be added to Jacobs existing strategic road network for remodelling by Jacobs. This may need to include a direct sub-arterial road connection from the above to Menangle Road should the upgraded sub-arterial connection not resolve | See Arcadis letter dated:  
• 07/09/17  
• 24/08/17 |
previously modelled traffic congestion. The Menangle Road connection to be 4 lanes, controlled access and positioned so road access is from either side

| 4. Remodelling of the proposed arrangement by Jacobs. | See Arcadis letter dated:
|  | • 07/09/17 |

**General notes:**

| 1. TfNSW/RMS suggests that DP&E needs to facilitate discussions between Bradcorp/Governers Hill to advance planning for the sub-arterial connection in the context of the Structure Plans for the two land holdings as satisfactory resolution of this item is required for RMS approval of Bradcorp’s north-facing ramps. | See attached letter from D&P:
|  | • 07/09/17 |
APPENDIX B

Arcadis letter 24/08/2017
Attn: Mr. Trent Kelly

Bradcorp Road Network

Dear Trent,

At the meeting Arcadis attended on 16 August with Bradcorp, Department of Planning (DoP), Road and Maritime Service (RMS) and Transport for NSW (TfNSW), it was noted that the Bradcorp proposed locations of new south bound Hume Hwy exit and north bound Hume Hwy entry ramps will be proceeding to exhibition. We note that the location of both entry and exit ramps do not create any conflict with the Hume Highway and we have provided advice in previous reports, in that meeting, and in this report to the effect that each of these elements meet all required technical standards. We also note that this infrastructure will be provided upfront.

Taking into account feedback from various parties, the following changes to Bradcorp’s original proposal are to be adopted:

1. The new bridge is to be constructed adjacent to the location of the existing Niloc bridge with 2 lanes travelling west.

2. Given the level of traffic travelling east into Bingara Gorge, it is adequate to utilise the existing Niloc bridge with 6.8m carriage way for this purpose.

3. The on-ramp is to be 2 lanes to allow vehicles to pass trucks or breakdowns.

The remainder of this report considers a recommended option for providing a route through Bradcorp’s land that meets the desire of RMS for it to be sub-arterial. This we believe will provide a connection from the Hume Highway at the location of the Bradcorp ramps to Picton Road as suggested by RMS.

Arcadis strongly recommend Option 1, as it provides for a simple pathway through the Bradcorp land, meets the specification for a sub-arterial road network and provides for a pragmatic design in consideration of urban design, topographic constraints and existing features of the land including the Bingara Gorge development.
Based on the traffic numbers available, this network and the proposed road configurations performs at a high level of service that provides for no congestion on Bradcorp’s northern precinct.
ROAD OPTIONS

The options investigated to incorporate a sub arterial road within Wilton West to achieve the connection from the Hume Hwy to Picton Road west of the existing interchange are:

Option 1 - utilise existing road network with enhancements.
Option 2 – develop a curvilinear road from intersection B through to Picton Rd.
Option 3 – move the intersection B and develop a curvilinear road up to Picton Rd.
Option 4 – change the location of the Highway crossing from Niloc Bridge.

Options 1, 2 and 3 all involve the utilisation of the existing Niloc Bridge as part of the road network. Option 4 considers the relocation of the Hume Hwy crossing and abandoning the Niloc Bridge.

Option 1 meets all the requirements for the provision of a sub arterial road within the Wilton West development. This route has more than adequate road capacity, (1900-2400 vph, see table on sketch titled Option 1). The appropriate intersection design will ensure satisfactory levels of service. The horizontal geometry is not convoluted. This geometry is governed by the topography. A major ridge line involving a 26 metre level change and a lake need to be accommodated. The transport needs to the school & activity node, together with the significant traffic to and from the north of the development which is a major traffic generator, also have to be met.

Option 2 utilises the existing road network but with a curvilinear road from intersection B through to Picton Rd. This option clashes with the proposed precinct lake, see attached sketch marked Option 2. The location of the lake is specifically perched so that it integrates with the surrounding topography and future land users therefore relocating the lake is not practical. Furthermore, this option does not appropriately accommodate the significant traffic volume from the north of the Bradcorp development. Therefore Option 2 is not viable.

Option 3 the curvilinear road commences prior to intersection B, effectively moving intersection B further to the south to avoid the proposed lake. With this option, the curvilinear road is shifted to the side of a ridge. Good road design involves fitting the road to the topography. The preferred location would either be along the top of a ridge line or along the toe as provided in Option 1. Like Option 2 this option does not appropriately accommodate the significant traffic volume from the north of the Bradcorp development. Therefore Option 3 is not a pragmatic solution.

Option 4 considers RMS’s Option 2 involving the relocation of the Highway crossing from Niloc Bridge to the south with a corresponding relocation of the entry and exit ramps and connection to the road network on both sides of the Hume Highway. This option is unacceptable for the following reasons:
• The internal spine road within the Lendlease development is designed and partly constructed to connect to the Niloc Bridge in its current location.

• The land adjacent to the Highway to the southeast is owned by Lendlease and has been approved for residential development. The opportunity to construct a bridge and approaches on the eastern side in this location is no longer viable.

• If it were to be moved further south it would become impractical due to the cutting required along the dominant ridge line on the west of the Freeway and the rail corridor for the Maldon—Dombarton rail line.

• The current location makes use of the existing valuable infrastructure asset of the Niloc Bridge.

In consideration of the above 4 options, Option 1 is our strongly supported recommendation as it utilises the existing proposed road network with some intersection enhancements as detailed here within, provides a sub arterial road through the development that provides the function of connecting the Hume Hwy with Picton Road. It is a pragmatic solution which has more than sufficient traffic capacity, meets the restraints of topography, serves the land use needs of the development and utilises an existing asset.
OPTION 1

Assessment of capacity of the sub arterial network

The purpose of this assessment is to evaluate the use of Road 1 (see attached sketch marked Option 1) as a sub arterial road on the western side of the Wilton development. Following discussions with DoP, RMS & TfNSW, agreement was reached that the proposed exit ramp in the vicinity of Niloc Bridge would be incorporated into the road network and the proposed south bound exit ramp, close to the Picton Rd Interchange, would be removed for the Wilton development.

The removal of the southern exit ramp would result in increased traffic using the Niloc Ramp. This analysis will assess the increased traffic resulting from this change and assess Road 1 in terms of mid-block and intersection capacity.

AM results using 2036 traffic from PB

Prior to being removed the southern ramp in the AM peak was shown as carrying 329 vehicles, 227 of which cross the Hume Highway to enter the western side. This 227 (rounded to 230) will be added to the traffic using the Niloc Ramp and travelling west over Niloc Bridge, resulting in increased traffic on western side between Niloc Bridge and the overbridge to the south.

AM peak south bound flows (maximums on these segments). Refer to Sketch SK007 for segment locations.

<table>
<thead>
<tr>
<th>Road segment</th>
<th>2036 traffic</th>
<th>Additional traffic due to removal of ramp</th>
<th>New traffic volume (vph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niloc exit ramp</td>
<td>162</td>
<td>230</td>
<td>392</td>
</tr>
<tr>
<td>1</td>
<td>615</td>
<td>230</td>
<td>845</td>
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<td>2</td>
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<tr>
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<td>369</td>
<td>80 (33% of 230)</td>
<td>449</td>
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<tr>
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<td>150 (67% of 230)</td>
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<td>1527</td>
</tr>
<tr>
<td>6</td>
<td>1248</td>
<td>150</td>
<td>1400</td>
</tr>
</tbody>
</table>

See attached sketch for identification of segments.

Note the additional 230 vph is split at Intersection B with 66% turning left and 34% heading straight.

The Road 1 will have the following configuration:

Two lanes in each direction, divided by a median, access denied, no parking in peak hours, design speed of 70 km/h, posted at 60 km/h.

Austroads states that for an urban road with interrupted flow, the mid-block capacity is 1900 vph (2 lanes, in one direction, GTM Part, Table 5.1). Given that the highest traffic volume is 1698 for road 3, the road network does have sufficient capacity.
However, further measures will be taken on segments 3 and 5 to ensure there is more than adequate capacity. These will include:

- adequate flaring at major upstream intersections
- absence of crossing or entering traffic at minor intersections
- absence of parking
- absence of right turns
- high volume flows of traffic from upstream intersections during more than one phase of a signal cycle.
- good co-ordination of traffic signals along the route.

Austroads allows an increase in capacity to 1200 to 1400 vph/lane when the above measures are implemented, therefore a total capacity of 2400 to 2800 vph.

Therefore, using the 2036 traffic modelling from PB, all of these predicted volumes are well within the capacity of the road.

**Estimated Increase in predicted Traffic based 2051 modelling**

At the meeting on 16 August 2017, RMS identified that Jacobs have undertaken traffic modelling for the year 2051. Therefore their predicted figures may be greater than the 2036 model.

Detailed traffic volumes from this model have not been provided, however a predicted volume was provided for the northbound on ramp figure of 1200 vph, which is 18% higher than the PB number of 1014. Although highly questionable that there would be such an increase throughout the development based upon increased traffic generation per dwelling, as a conservative estimate the traffic volumes from the 2036 model could be increased by 18% to reflect the 2051 model.

<table>
<thead>
<tr>
<th>Road segment</th>
<th>2036 traffic</th>
<th>Additional traffic due to removal of ramp</th>
<th>New traffic volume (vph)</th>
<th>New traffic volume + 18% (vph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niloc exit ramp</td>
<td>162</td>
<td>230</td>
<td>392</td>
<td>462</td>
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<tr>
<td>1</td>
<td>615</td>
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<td>369</td>
<td>80 (33% of 230)</td>
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<td>530</td>
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<tr>
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<td>150 (67% of 230)</td>
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<td>2004</td>
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<tr>
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<td>1248</td>
<td>150</td>
<td>1400</td>
<td>1652</td>
</tr>
</tbody>
</table>

This increase would still leave all the volumes under 1900 vph except for segment 3 which would increase to 2004 vph, which is still well within the sub arterial capacity of 2,400 to 2,800 with the additional measures described above.
Therefore, after considering the effect of the removal of the southern exit ramp and the extension of the modelling year to 2051, the capacity of Road 1 and existing network is more than adequate.

**PM Results using 2036 traffic from PB**

The traffic modelling predicts that the southern exit ramp would carry 189 vph in the PM peak. Of these 189, 146 were predicted to turn right and enter the proposed development on the western side of the Hume Highway. Therefore removal of the ramp will result in additional 146 vph using the northern exit ramp at Niloc Bridge. These 146 will travel to the southern end of the development since they would have chosen the southern exit. The table below shows the initial traffic figures with southern exit ramp and the effect of the removal of this ramp on the network. North bound flows have not been analysed since they are will not be increased by removal of the southern exit ramp.

**PM peak south bound flows (that is, flows affected by removal of southern exit ramp)**

<table>
<thead>
<tr>
<th>Road segment</th>
<th>2036 traffic</th>
<th>Addition traffic due to removal of ramp</th>
<th>New traffic volume (vph)</th>
<th>New traffic volume + 18% (vph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niloc exit ramp</td>
<td>785</td>
<td>146</td>
<td>931</td>
<td>1099</td>
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<tr>
<td>6</td>
<td>600</td>
<td>70</td>
<td>670</td>
<td>791</td>
</tr>
</tbody>
</table>

All of these predicted volumes are significantly below the AM volumes, except for the flows on the Niloc exit ramp and the first segment on the western side of the Niloc Bridge. All of these flows are below the one way capacity of the sub-arterial of 1900 vph and well below the capacity of 2400 to 2800 vph with the additional measures described above.

**INTERSECTIONS**

The two most critical intersections examined were Intersection A which is the intersection at the beginning of the entry ramp onto the Hume Highway and intersection B which is the first four way intersection on the western side after crossing Niloc Bridge.
**Intersection A**

Although a two lane roundabout could work, the land take would be high. The preferred arrangement to achieve an adequate level of service would be traffic signals with a left turn lane into the exit ramp and two lanes for the other flows. For this highest volume direction, south bound, we have proposed four lanes, with two through lanes, one left turning and one right turning lane. For the north bound approach, use two through lanes, one left turn and one right turn. For the other legs use two lanes. Refer to the attached Sketch SK008.

**Intersection B**

Both the PM figures and the AM figures have been examined and the AM figures appear to more critical. Although Sidra modelling would be appropriate when time permits, the performance of these intersections can be estimated using y values to assess the degree of saturation.

The preferred arrangement to maintain a satisfactory level of service is to for the westbound leg provide two lanes for left turning traffic and one lane for through westbound. We have proposed that the westbound leg provides two lanes for left turning traffic, two lanes straight through and one lane turning right. Then for the northbound and southbound legs both have one lane turning left, two lanes straight through and one lane turning right.Refer to the attached Sketch SK009.

Even with an 18% increase in traffic from 2036, this arrangement signalised will function satisfactorily.

**Capacity of Niloc Bridge**

The max volume eastbound on Niloc is only 363 vph. Therefore a bridge width of 6.8 m is more than adequate (1 metre right shoulder, 3.5 metre traffic lane and 2.3 left shoulder for cyclists).

**Niloc Bridge Duplication**

The duplication of the Niloc Bridge would involve the construction of a new bridge to the south of the existing bridge to carry westbound traffic and a shared pedestrian and cycle way. Given that the maximum volume westbound inclusive of the 18% increase is 1211 vph, the proposed two lanes westbound bridge is far more than adequate. This would be supplemented with a 3.0m wide shared pedestrian and cycle way.

**North bound on ramp**

The capacity of a one lane on ramp is 2000 vph. The predicted volume quoted by RMS is 1200 vph for 2051. Our assessment is that the length of this ramp in its current proposed location utilising the natural down grade would be in the order of 540 to 600m long. We do acknowledge if the ramp is 600m or more in length then two lanes would be required. However, Marco Morgante (RMS) has requested a two lane ramp
for to provide storage for future ramp metering. Therefore a two lane ramp will be proposed.

**OPTION 2**

This option utilises the existing road network but with a curvilinear road from intersection B through to Picton Rd. This option clashes with the proposed precinct lake, see attached sketch marked Option 2. The location of the lake is specifically perched so that it integrates with the surrounding topography and future land users therefore relocating the lake is not practical. Furthermore, this option does not appropriately accommodate the significant traffic volume from the north of the Bradcorp development. Therefore Option 2 is not viable.

**OPTION 3**

Option 3 the curvilinear road commences prior to intersection B, effectively moving intersection B further to the south to avoid the proposed lake. This option although it appears to be viable in plan view, the curvilinear road has shifted to being located partly on the side of a ridge. Although potentially feasible it is by no means practical to locate a road in this location. The more preferred location would be along the top of a ridge line &/or along the toe as provided in Option 1. Like Option 2 this option does not appropriately accommodate the significant traffic volume from the north of the Bradcorp development. Therefore Option 3 is not preferred.

**OPTION 4**

Option 4 considers RMS’s Option 2 involving the relocation of the Highway crossing from Niloc Bridge to the south with a corresponding relocation of the entry and exit ramps and connection to the road network on both sides of the Hume Highway.

However in our opinion the preferred location of the Hume Hwy crossing is in the current location of the existing Niloc Bridge, due to the following reasons:

- The internal spine road within the Lendlease development is designed and partly constructed to connect to the Niloc Bridge in its current location.
- The land adjacent to the Highway to the southeast is owned by Lendlease and has been approved for residential development. The opportunity to construct a bridge and approaches on the eastern side in this location is no longer viable.
- If it were to be moved further south it would become impractical due to the cutting required along the dominant ridge line on the west of the Freeway and the rail corridor for the Maldon—Dombarton rail line.
- The current location makes use of the existing valuable infrastructure asset of the Niloc Bridge.
The current proposed location of the north bound entry ramp is the preferred location, since north of the existing Niloc Bridge Hume Hwy crossing there is insufficient length to construct a high speed entry ramp due to the constraints of the environment and close proximity of a major bridge, Moolgun Creek Bridge at Allens Creek. Therefore, to provide a north bound entry ramp on the northern side of the Hume Hwy crossing would require the abandonment of Niloc Bridge and replacing it with a new crossing 200 metres plus to the south as suggested by RMS during the meeting on 16 August 2017.

In consideration of the above 4 options, Option 1 meets all requirements and is our recommended option. The utilisation of the existing proposed road network with some intersection enhancements as detailed here within, delivers a sub arterial road through the development which serves the needs of the development. This sub arterial also provides a connection between the Hume Hwy with Picton Road required by RMS for passing traffic to Picton that wish to avoid the Hume Hwy & Picton Rd Interchange. It is a pragmatic solution which has more than sufficient traffic capacity, meets the restraints of topography, serves the land use needs of the development and utilises an existing asset.

Yours sincerely

[Signature]

[Name]
Technical Director – Highways
APPENDIX C

Arcadis letter 07/09/2017
Private and Confidential
Bradcorp Wilton Park Pty Limited
230 Victoria Road
Gladesville NSW 2111
Attn: Mr Trent Kelly

7/09/2017

Wilton Regional Road Network - Meeting Minutes

Dear Trent,

We refer to the meeting minutes provided by NSW Department of Planning and Environment (DPE) for the meeting held on the 16th August 2017 and comment as follows:

- **Attendees**
  - Pat Kenny is Arcadis for Bradcorp
  - Laurie Rose Calibre for Bradcorp

- **Discussion Point 3**
  - We believe the agreement was that “there is a need for a new set of north facing on and off ramps…..”

- **Discussion Point 7**
  - **1. Structural and design verification, including remaining design life before the bridge would need replacement a replacement strategy giving consideration to the proposed interchange design, details on the existing bridges compliance with current design requirements and works required to bring it into compliance.**

  Structural design verification has been undertaken in regard to the structural adequacy of the existing Niloc Bridge, we refer to the report dated 14th June 2016 by Ken Maxwell Technical Director of Highway Structures for Arcadis. The design of the Niloc Bridge needs to be designed to suit its function, which is a local connector road to simply connect local traffic travelling eastbound from the residential community on the western Side of the Hume to the residential community on the eastern side of the Hume Hwy. The report consisted of a review of the design drawings and WAE drawings together with a field inspection. The report identified and confirmed RMS previous advice that the bridge is a T44 bridge. Although the report identified that some works would be required to upgrade to current standards which will be carried out, it concludes that the bridge is “structurally suitable to provide future vehicular access”.

  **2. Confirmation that the Hume Motorway can be widened under Niloc Bridge, including undertaking horizontal/vertical alignment checks within the median and bridges crossing Allens Creek.**

  The Hume Hwy can be widened under the Niloc Bridge. The RMS design of the Niloc Bridge provides for future widening of the Hume Hwy into the Median. Please refer to the RMS WAE drawings included in the 14/06/16 report.
In regards to the Allens Creek bridges, the proposed location of the north bound entry ramp is not in the vicinity of the Allens Creek Bridge and has no impact on RMS plans for widening of the Hume Hwy.

3. A revised Structure Plan showing integration of the new sub-arterial road connection between Hume and Picton Road, through the Governor’s Hill and Bradcorp sites. The revised Structure Plan showing integration of the sub-arterial road connection has been provided. We refer to our letter dated 24/8/17, in particular the attached Drawing SK004, titled Option1. It provides a sub-arterial road between the Hume and Picton Road.

4. The south bound off ramp in the vicinity of the Niloc bridge would need to cater for all turn movements (i.e. not be restricted to right turn only as per the Bradcorp proposal). The proposal does not preclude the option for all turn movements and the right turn only restriction can be released as instructed by RMS to allow left turn movements.
5. Configuration of on ramps to the Hume to achieve appropriate acceleration, entry speed and avoid impacts on the flow of traffic on the Hume. Design checks required for entry and exit ramps to ensure no impact on motorway mainline and the sub-arterials. Smart Motorway service requirements to be addressed.

Noted, accepted and design is underway.

- To further assess the proposal RMS requires

1. A strategic level assessment/design for the Niloc Bridge. This including structural engineering certificate/assessment to demonstrate that it would meet the standard required of a sub arterial road. This would include an assessment of deficiencies and work required to improve it.

It is proposed that the existing Niloc Bridge will be for eastbound traffic only, that is traffic wishing to travel from the Bradcorp lands to Bingara Gorge. Given that the forecast ultimate traffic volume from the PB modelling is 360 vph, one lane plus provision for on road cyclists is more than adequate. A new bridge is proposed to be constructed to the south of the existing bridge to accommodate traffic that exits the freeway and enters the Bradcorp lands and traffic from Bingara Gorge that wish to travel to the Bradcorp lands. Given that the forecast ultimate westbound traffic volume from the adjusted PB modelling is 1211 vph, two lanes plus provision for on road cyclists exceeds the requirements. This adjusted volume allows for the additional traffic from the closure of the southern exit ramp and the increased traffic growth up to the year 2051. Furthermore, a shared path for cyclists and pedestrians will also be provided. Refer to point 1 above.

2. A strategic design for the interchange and on-ramps.

Design is underway.

3. A revised sub-arterial road network design connecting Picton Road and the Hume Motorway to be added to Jacobs existing strategic road network for remodelling by Jacobs. This may need to include a direct sub-arterial road connection from the above to Menangle Road should the upgraded sub-arterial connection not resolve previously modelled traffic congestion. The Menangle Road connection to be 4 lanes, controlled access and positioned so road access is from either side.

We believe the Menangle Road connection is not required because we have enhanced the road network to ensure that the sub arterial road through the development has four lanes with a median together restricted access. In addition, the major intersections will be configured to ensure adequate capacity. This sub arterial will connect the Hume Motorway Entrance Ramp with Picton Road. It conforms to the topography of the precinct and meets the land use requirements of the development. Since the sub arterial road requested by RMS has been provided and previous modelling by PB has shown that it will perform satisfactorily, there is no need for an additional sub arterial road to Menangle Road. Please refer to point 3 above for further details. We also note that DPE have "questioned" the need for this connection given the complexity of construction over the Nepean gorge and the Nepean River and potential environmental impacts as identified by DPE in discussion point 2 contained in the minutes of the meeting held with DPE/RMS/TNSW on the 16 August 2017.
4. Remodelling of the proposed arrangement by Jacobs.

Since the enhanced sub arterial road will connect the Hume Motorway with Picton Road, and is of the appropriate standard, there is no need for additional modelling by Jacobs in relation to the rezoning of Bradcorp’s land.

Yours sincerely

[Signature]

Patrick Kenny
Technical Director - Highways
APPENDIX D

Arcadis letter 14/06/2017
Date: 14th June 2016  
To: Cameron Hay  
From: Ken Maxwell  
Subject: Niloc Bridge over Hume Motorway, Wilton

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1. Introduction

In relation to the Bingara Gorge residential development project at Wilton, NSW, a basic visual inspection of Niloc Bridge was carried out by Ken Maxwell, Technical Director, Bridges of Arcadis (Sydney office) on Friday 10th June 2016. The inspection work was carried out from bridge deck level and surrounding area.

This bridge carries a farm access road across the Hume Motorway, linking land owned by Bradcorp Holdings Pty Ltd, and is approximately 2 kilometres north of the Picton Road interchange.

The bridge was constructed by the Department of Main Roads, NSW in 1980, as part of the South Western Freeway (F5) work, in order to provide access to Niloc Pty Ltd over the F5.

Arcadis is in possession of the Work-As-Executed (WAE) drawings of Niloc Bridge, which were taken to the site to assist in the inspection work.

2. Niloc Bridge Details

The existing bridge over the Hume Motorway, known as Niloc Bridge, has the following features, based on the WAE bridge drawings:

- Two (2) span continuous post-tensioned concrete voided slab bridge, with cantilever deck slab.
- Overall bridge length between bearings at abutments is 65.000 metres.
- Carriageway width is 6.8 metres and there is no footway.
- Designed to NAASRA Bridge Design Specification (1976) for T44 standard vehicle loading.
- Deck is on a summit vertical curve.
- Minimum vertical clearance to Hume Motorway is 5.350 metres.
- Central pier is supported on a pad footing founded in rock. Founding level of footing is approximately 2.5 metres below level of Hume Motorway.

Section 4 of this document contains details of Niloc Bridge, extracted from the WAE bridge drawings.

3. Inspection Findings

The following inspection findings are reported:

- Build-up of silt and moss at edges of carriageway on deck, indicating permanently damp environment. It is noted that there are no scuppers on this bridge (refer photo 4).
- Minor surface corrosion at underside of traffic barrier post base plates (typical) – (refer photo 5).
- Patches of missing sprayed seal wearing surfaces, predominantly along centreline of carriageway (refer photo 6).
- Deck joints (elastomeric compression joint seals) at both ends of bridge covered in silt/dirt and vegetation near the traffic barriers (refer photos 7 and 8).
- Corroded vertical leg of protection angle at abutment curtain wall (both abutments) – (refer photo 9).
- Cavity in road pavement at interface with Abutment ‘A’ (western abutment) – (refer photo 10).
- Elastomeric compression joint seals (at both ends of the bridge) appeared at their limit of compression, evidenced by splitting in the elastomer at the parapet upturn area (northern parapet joint upturn, Abutment ‘A’) – (refer photo 11).
- Although not shown on the WAE drawings, a sprayed seal wearing surface (estimated 15mm thick) has been applied to the bridge deck, probably at the time of construction, but undertaken as a separate contract to the bridge works.
- Central pier now has earth mounding around it for vehicular collision protection (refer photos 1 and 3). This appears to have been constructed sometime after the bridge was constructed.
- The vertical gaps between horizontal railings of the existing steel traffic barrier have been infilled with steel ‘W’ beam sections. This appears to have been installed sometime after the bridge was constructed.

Overall, the bridge is in generally good condition for a 36 year old structure, and appears to have been constructed in accordance with the drawings, apart from some additional later work, as outlined above.

Based only on the basic visual inspection carried out, the bridge would seem structurally suitable to provide future vehicular access, provided the load effects not exceed those due to T44 standard vehicle loading.

It is anticipated that the existing steel traffic barrier railings are substandard for current design collision loads and would require upgrading to current standards if the bridge be used for future vehicular access.

Section 5 of this document contains photographs taken during the inspection work. Photos 1, 2 and 3 show overall views of Niloc Bridge.
4. Bridge Configuration
5. Inspection Photographs

Photo 1 – Niloc Bridge, northern side

Photo 2 – View across bridge, looking east
Photo 3 – Niloc Bridge, southern side

Photo 4 – Build-up of silt and moss at edge of carriageway (typical along both sides)
Photo 5 – Minor surface corrosion at underside of traffic barrier post base plates (typical throughout)

Photo 6 – Patches of missing sprayed seal wearing surfaces
Photo 7 – Elastomeric compression seal deck joint covered in silt/dirt and vegetation (Abutment ‘B’, northern side)

Photo 8 – Elastomeric compression seal deck joint covered in silt/dirt and vegetation (Abutment ‘B’, southern side)
Photo 9 – Corroded vertical leg of protection angle at abutment curtain wall (typical both abutments)

Photo 10 – Cavity in road pavement at interface with Abutment ‘A’
Photo 11 – Squashed and split elastomeric compression joint seal, northern parapet joint upturn at Abutment ‘A’
APPENDIX E

Verification checklist
Verification – That specified requirements have been fulfilled through the provision of supporting data.

**Project Name:** Wilton Entry/Exit Ramps  
**Project No.:** AA007746  
**Date:** 05/09/2017

**Verifier:** Kane Petrie  
**Project Manager:** Cameron Hay

**Type of Verification:**  
- Spot
- Comprehensive
- Independent Design

**Document/s To Be Verified** (Drawing No/s, Report/Specification/Calculation Title/No. etc)
- SKC0102 - SKC0110
- 12D String Model - "AA007746 - Wilton design 100805.12dd"  

**Scope of Verification** (Cross out those not applicable)

- Confirm compliance of design with:  
  - Design Criteria:  
  - Codes and Standards  
  - Clients needs and Requirements  
  - Adequacy of detailing and constructability

- Specific elements & calculations to be checked:  
  - Entry/Exit Ramps  
  - Proposed Overbridge

- Other items to be Verified:

**Verifier's Comments:** Confirm suitability / conformance with all design inputs of documents verified. Raise a Non Conformance Report for any major discrepancy found.

Current design confirms feasibility of proposed arrangement, and a fully conforming RMS standard design is achievable. The strategic assessment shows the design intent and the below comments are minor and can be resolved in the detailed design phase of the project.

**Attachments:**

- Checklists:  
  - Yes  
  - NA  
  - Document No

- Calculations:  
  - Yes  
  - NA  
  - Document No

- Drawings:  
  - Yes  
  - NA  
  - Document No

- Elements:  
  - Yes  
  - NA  
  - Document No

- NCR:  
  - Yes  
  - NA  
  - Document No

- Reports:  
  - Yes  
  - NA  
  - Document No

- Specifications:  
  - Yes  
  - NA  
  - Document No

- Other:  
  - Yes  
  - NA  
  - Document No

**Verification completed**  
**Verifier’s Signature:**  
**Date:** 11-09-17

**Verification comments actioned**  
**Project Manager’s Signature:**  
**Data:** 11/09/17
APPENDIX F

Strategic concept design drawings
WILTON STRATEGIC CONCEPT
FOR PROPOSED HUME HIGHWAY RAMPS

19m SEMI-TRAILER RIGHT HAND TURN 1
SCALE 1:400

19m SEMI-TRAILER RIGHT HAND TURN 2
SCALE 1:400

B-DOUBLE RIGHT HAND TURN 2
SCALE 1:400
PROPOSED NILOC BRIDGE DUPLICATION

EXISTING NILOC BRIDGE

MC02 BRIDGE SECTIONS

MC02 SUB ARTERIAL ROAD SECTION

WILTON STRATEGIC CONCEPT
FOR PROPOSED HUME HIGHWAY RAMPS

Client: Arcadis Australia Pacific Pty Limited
Level 16, 580 George Street
SYDNEY NSW 2000
ABN 76 104 485 289
Tel No: +61 2 8907 9000
Fax No: +61 2 8907 9001
arcadis.com

Date Plotted: 8 Sep 2017 - 02:45PM
File Name: F:\AA007746\E-CAD\C-Civil\B-Sketches\D-Concept Strategic Review\SKC0107-TypicalSectionsSheet2.dwg
### Vertical Curves

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<th>Monitoring String Level</th>
<th>Vertical Gradient</th>
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### Horizontal Curves

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**Scale:**

- 1:500 (Hori.)
- 1:100 (Vert.)