BEFORE THE HEARING COMMISSIONERS
AT WAIPA DISTRICT COUNCIL

IN THE MATTER of the Resource Management Act 1991 (RMA)

AND

IN THE MATTER of submissions and further submissions on Plan Change 13

STATEMENT OF EVIDENCE OF JUDITH VICTORIA MAKINSON FOR SUBMITTER 28: MR GEOFF MAUNSELL
11 June 2021

INTRODUCTION

1 My full name is Judith Victoria Makinson. I am the Transportation Engineering Manager for CKL.

2 I hold a Bachelor's degree in civil engineering and a Master's degree in transport engineering and planning from the University of Salford (UK). I am a Chartered Professional Engineer and am a Chartered Member of Engineering New Zealand. I am also a Chartered Engineer in the United Kingdom and a Member of the Institution of Civil Engineers. I have over 20 years' experience working as a transportation engineer in both New Zealand and the United Kingdom with Arup, WSP Group, Gifford, TDG, Stantec and CKL. I am also qualified as an Independent Hearing Commissioner and recently sat on the panel considering the Te Ahu a Turanga State Highway 3 Manawatu Gorge Road replacement project.

3 I confirm that I have read and am familiar with the Code of Conduct for Expert Witnesses in the current (2014) Environment Court Practice Note. I agree to comply with this Code of Conduct in giving evidence to this hearing and have done so in preparing this written brief. The evidence I am giving is within my area of expertise, except where I state I am relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I understand it is my duty to assist the hearing committee impartially on relevant matters within my area of expertise and that I am not an advocate for the party which has engaged me.

4 I have undertaken a site visit and am familiar with the site and its surrounds.

SCOPE OF EVIDENCE

5 In presenting my evidence I have reviewed and relied upon the following technical assessments undertaken by others:

a) '3796 Cambridge Road / Proposed C4 Growth Cell - Traffic Comments' by Ms Tara Hills of Direction Traffic Design, 4th December 2020; and

b) ‘C4 Growth Cell Transportation Assessment’ by Mr Vinish Prakash of Gray Matter, 20 December 2019.

6 I am satisfied that the technical information provided within these documents is essentially correct, unless otherwise noted, whilst acknowledging that there are differences in opinion between Ms Hills, Mr Prakash and myself in relation to how best to apply this information to developing a suitable road network to serve the C4 growth cell.

7 My evidence focuses on:

a) the policy setting for providing network connectivity;

b) network connectivity in the local context;

c) network operations; and

d) design standards relating to the proposed access.

8 I have attached Ms Hill’s and Mr Prakash’s Transportation Assessments (“TA”) as Appendix A and B respectively for ease of reference.

NETWORK CONNECTIVITY - POLICY SETTING

9 The Government Policy Statement on Land Transport 2021 (“GPS”) is the overarching transportation policy document which guides all other regional and district level transport strategies and plans. It sets the direction for the next 10 years, with the strategic priorities being identified as:

a) Safety - developing a transport network where nobody is killed or injured;

b) Better travel options - providing people with better transport options to access social and economic opportunities;

c) Improving freight connections - improving freight connections for economic development; and

d) Climate change - developing a low carbon transport system that supports emissions reductions while improving safety and inclusive access[1].

10 These strategic priorities in turn lead to a transport outcomes framework which has the following five aims[2]:

(a) Inclusive access;

(b) Economic prosperity;

(c) Healthy and safe people;

(d) Environmental sustainability; and

(e) Resilience and security

11 The GPS goes on to recognise that resilience and security are outcomes of both the Safety and Better Travel Outcomes strategic directions as follows:

"…fewer disruptions from crashes and supporting alternatives to key routes and modes will improve the resilience of the network. Safer integrated designs can improve resilience of assets, which in turn enhances communities' and agencies' response to and recovery from unexpected events"[3]

and

"Supporting alternative key routes and modes will improve the resilience of the network. Better and more diverse travel options can reduce localised resilience risk for communities."[4]

12 'Arataki' is the Waka Kotahi New Zealand Transport Agency ("Waka Kotahi") strategic document setting out their vision for the next 10 years. Within the Waikato Regional Summary, it identifies improving the urban form as a high priority and tackling climate change as a medium priority. Specific focus points include:

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[1] 'Government Policy Statement on Land Transport 2021'Section 2.1 Figure 1
[2] 'Government Policy Statement on Land Transport 2021' Section 2.1 Figure 2
[3] 'Government Policy Statement on Land Transport 2021' Section 2.2 Strategic Priority: Safety
[4] 'Government Policy Statement on Land Transport 2021' Section 2.3 Strategic Priority: Better Travel Options

"Across the region, we will engage with planning processes with a goal of delivering urban development that….maintains or improves the safety and efficiency of the transport system." [5]

and

"We will focus on …..maintaining system resilience.."[6]

13 The Draft Waikato Regional Land Transport Plan 2021 - 2051("RLTP") has been out to public consultation, with a final decision on the Draft RLTP scheduled to be made on 24th June 2021. The RLTP acknowledges a change in national transport policy direction, referencing Waka Kotahi's 'Arataki' document and also specifically noting the following:

"moving from a land transport network perspective to a place-based approach that ensures integrated land use and transport planning"

and

"emphasis on improving urban form and liveability and transposing urban mobility by ensuring better transport choices"[7]

14 The RLTP identifies the strategic objectives as including:

"strategic corridors and economic development - an efficient and resilient land transport system that advances regional economic wellbeing and supports liveable urban areas now and in the future"

and

"integrated land use and transport planning - ensuring that collaborative spatial-based approached to decision-making continue to drive the best outcomes for our communities."[8]

15 It goes on to identify a hierarchy of interventions with the first being to:

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[5] Waka Kotahi Arataki Version 2 - Waikato, Areas of Focus: Waikato 2021 - 2031, Improve Urban Form, page 50

[6] [6] Waka Kotahi Arataki Version 2 - Waikato, Areas of Focus: Waikato 2021 - 2031, Tackle Climate Change, page 51

[7] Waikato Regional Land Transport Plan 2021-2031, Section 1.3.1 National Policy Drivers, page 15.

[8] Waikato Regional Land Transport Plan 2021-2031, Section 1.4.1 Our Vision and Objectives, page 18.

"Plan and develop an integrated land-use and transport pattern that maximises use of existing network capacity, reduces travel demand and supports local choice."[9]

16 Keeping people and freight moving and reducing the adverse effects of congestion and delay are a secondary priority. Map 2[10] of the RLTP identifies Cambridge Road as an arterial route within the regional context. Figure 12[11] does not include it as a key freight route and considers the state highway network only. Figure 12 identifies routes in bands, with the lowest being 1 - 250 heavy commercial vehicles per day. Taking the average daily traffic volumes of Cambridge Road as 7,200vpd[12] of which 11% heavy commercial vehicle ("HCV"), that suggest that Cambridge Road could be expected to carry around 792 HCVs per day, with this traffic having a local to district level access function rather than strategic. This is recognised within the RLTP as follows:

"The rural road network also plays an important role in the efficient movement of freight from production to processing sites, domestic distribution centres and seaports."[13]

17 The GPS, Arataki and RLTP have all been written since the completion and adoption of the Waipa Operative District Plan Novemeber 2016 ("ODP"). However, 'Section 16: Transportation' of the ODP includes objectives and policies which align with the new national and regional policy direction, as well as those which may be less aligned.

18 'Section 16 .1 Introduction' recognises the need for integrated land use and transport planning and the need for network connectivity as follows:

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[9] Waikato Regional Land Transport Plan 2021-2031, Section 3.3 The Issues of Population and Land Transport Growth on our Strategic Transport Corridors, Figure 10

[10] Waikato Regional Land Transport Plan 2021-2031, Section 2.2 Our Regional Transport System, Map 2: Function of Key Strategic Road and Rail Corridors in the Waikato Region

[11] Waikato Regional Land Transport Plan 2021-2031, Section 3.4 The Impact of Freight Growth on Our Strategic Transport Corridors, Figure 12: Freight Volumes in the Waikato.

[12] Ms Hills' TA, last paragraph, page 2 and Mr Prakash's TA Table 1

[13] Waikato Regional Land Transport Plan 2021-2031, Section 3.4 The Impact of Freight Growth on Our Strategic Transport Corridors, page 37

"…The integration of land use and transport needs to ensure that the pattern of land uses and the land transport system will provide a safe and efficient network for all road users as they undertake their daily trips" [14]

and

"Collectively, the outcomes sought will contribute to an affordable, integrated safe, responsive and sustainable transport system… This will establish effective local and regional connectivity for private vehicles and public transport…." [15]

19 Transport related issues identified within the ODP include:

"Some developments and subdivisions are not readily accessible to alternative modes of transport such as buses" [16]

and

"New development and subdivision has the potential to compromise transport options for future growth areas if connections to the future growth area are not incorporated into development design"[17]

and

"Development and subdivision can compromise the function and efficiency of the transport system"[18]

and

"Previously some developments and subdivisions have provided limited options for accessing local facilities"[19]

20 The following objectives and policies of the ODP support the new direction of the GPS and RLTP:

"All new development, subdivision and transport infrastructure shall be designed and developed to contribute to a sustainable, safe, integrated

[14] Waipa Operative District Plan November 2016, Section 16.1.4
[15] Waipa Operative District Plan November 2016, Section 16.1.8
[16] Waipa Operative District Plan November 2016, Section 16.2.1
[17] Waipa Operative District Plan November 2016, Section 16.2.5
[18] Waipa Operative District Plan November 2016, Section 16.2.7
[19] Waipa Operative District Plan November 2016, Section 16.2.8

and efficient (including energy efficient network design) and affordable multi-modal land transport system"[20]

and

" Development, subdivision and transport infrastructure shall be designed and located to:
a) minimise energy consumption….

b) accommodate and encourage alternative modes of transport; and'

c) give effect to the road hierarchy; and

d) contribute to ….a safe and efficient road network and efficient movement of freight"[21]

and

"Accommodate future transport network connections and walking, cyclin and passenger transport"[22]

"Development, subdivision and transport infrastructure shall be located, designed and managed to:

a) Minimise conflicts on and across arterial routes and provide appropriate access…"[23]

21 'NZS4404: 2010 Land Development and Subdivision Infrastructure' ("NZS4404") also pre-dates the GPS, Arataki and RLTP, however it identifies network connectivity as a key feature of successful subdivision:

"Network connectivity shall be designed to achieve:

a) shorter travel distances;

b) an increased number of alternative routes for all types of users; increased opportunity for interaction; improved access to public transport, cycling walking and access to destinations"[24]

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[20] Waipa Operative District Plan November 2016, Section 16.3.1
[21] Waipa Operative District Plan November 2016, Section 16.3.1.1
[22] Waipa Operative District Plan November 2016, Section 16.3.1.2 (b)
[23] Waipa Operative District Plan November 2016, Section 16.3.2.1 (a)
[24] 'NZS4404: 2010 Land Development and Subdivision Infrastructure' Section 3.2.5 Network Connectivity

22 Section 3.3[25] of Mr Prakash's TA clearly states that an intersection on Cambridge Road to serve the northern part of the C4 growth cell, such as that being sought by Mr Maunsell, was initially considered but was discarded following consultation with Waipa District Council. Mr Prakash recognises the travel time saving of providing the intersection but does not consider any other potential benefits. The supporting evidence for discarding a northern access point was:

"It would introduce a new intersection on the major arterial network which is inconsistent with good traffic engineering practice. The intersection would also increase delay and increase the risk of crashed for trips along Cambridge Road."

23 Section 5.5.15 of the Section 42A report states:

"…Council's Consultant Engineer, Mr Richard Bax, and Council's Transportation Manager, Mr Bryan Hudson, have considered the information provided by Ms Hills, and notes [sic] that the addition of an intersection as shown on the submission was considered early in the Structure Plan development. Given the topography along Cambridge Road, the traffic volume including the number of heavy vehicles, and the minimal difference in travel time which would be achieved through the additional intersection, both Mr Bax and Mr Hudson conclude that there is no significant benefit to including an additional intersection as shown in the submission."

24 In my opinion, there are a number of matters that both of these conclusions fail to consider:

(a) The GPS strategic direction and framework outcomes focusing on inclusiveness, accessibility and network resilience;

(b) Arataki's focus on urban form to develop safe, efficient and resilient road networks;

(c) The RLTP focus on promoting accessibility; and

(d) the ODP policy direction in the same vein.

[25] Paragraph 2

25 As currently proposed by Council, approximately 17ha of the C4 growth cell housing would be served by a single connection to a collector road network at Silverwood Lane. From here, residents would have options to either access Cambridge Road or continue through the subdivision to then access Lamb Street. Assuming 1,020[26] dwellings are delivered over the approximately 41ha of developable land (i.e. excluding gullies and 3838 Cambridge Road), some 428[27]households would be accessed from a single intersection.

26 In comparison, the southern section of the C4 growth cell would be anticipated to include 592[28] dwellings, with three points of access i.e. two new intersections direct to Lamb Street and one at Silverwood Lane. This equates to one intersection for approximately every 200 dwellings. The principles of network connectivity and resilience have been applied to this southern section of the C4 growth cell but do not appear to have been applied in the same way to the northern section.

27 Having a single point of access also does not allow for good public transport network planning. Public transport networks operate most efficiently when they are through routes i.e. no looping around a subdivision to get out at the same point they entered. Whilst there are limited public transport services in Cambridge, the lack of through network for the northern section of the C4 growth cell does no respond to the GPS, Arataki, RLTP ODP policies of:

(a) having a strategic aim of providing for better travel options;

(b) climate change;

(c) providing for inclusive access;

(d) promoting network resilience and security;

(e) considering urban form and liveability; and

(f) accommodating and encouraging alternative modes of transport.

[26] Mr Prakash TA Section 3.2, Table 2
[27] Mr Prakash TA Section 3.2, Table 3
[28] Mr Prakash TA Section 3.2, Table 3

NETWORK CONNECTIVITY - LOCAL CONTEXT

28 I have considered the local context for network connectivity within new and planned subdivisions within and around Cambridge. The locations of the sites I have considered are shown on Figure 1, with aerial images of each area being provide din Appendix C. I have tabulated my observations in relation to approximate development area, number of households and number of access points in Table 1.

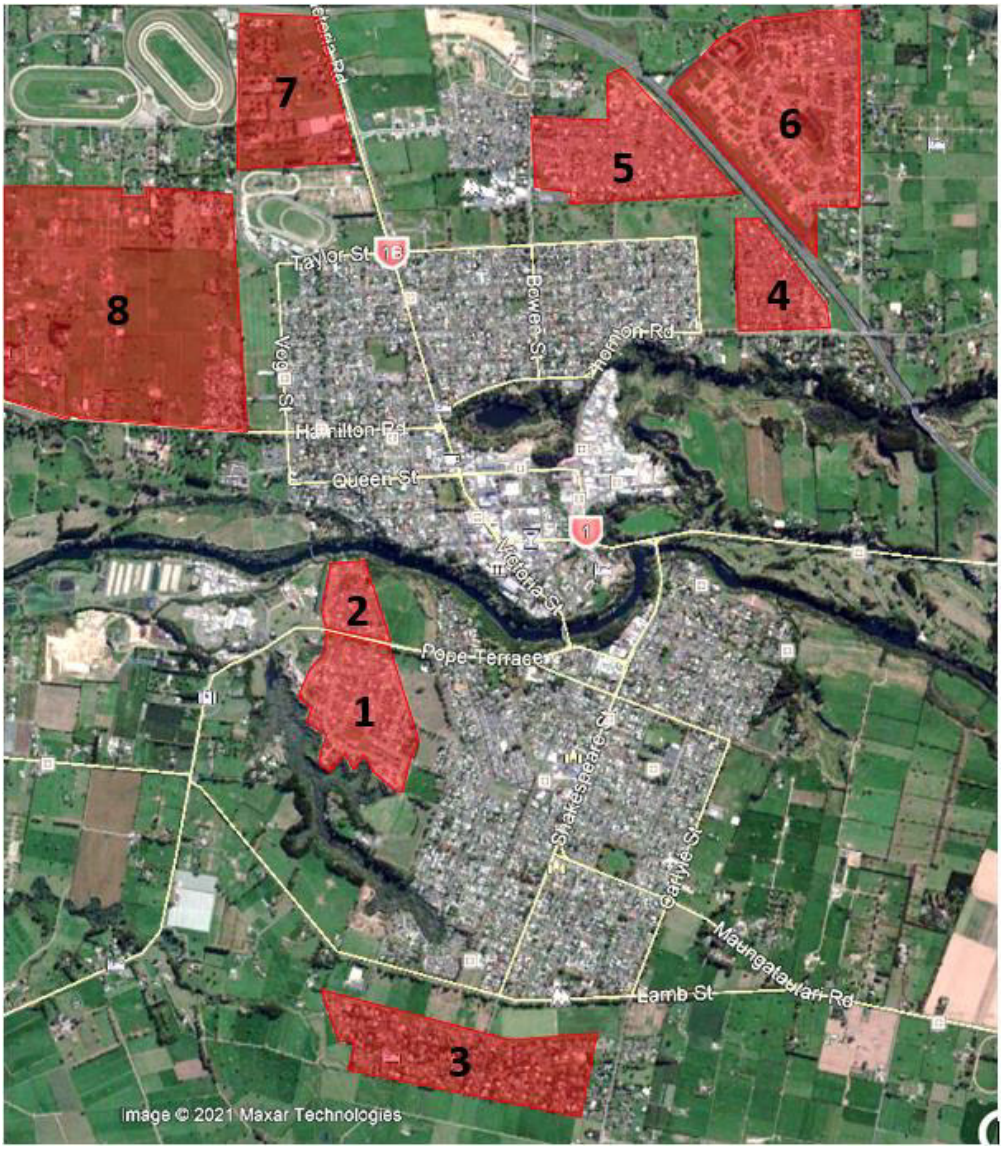

Figure 1: Cambridge Park

Table 1: Assessment of Existing Residential Subdivision Network Connectivity

Location	Approx. Subdivision Area	Approx. Number of Households	Number of Connections	Road frontage status[29]
1.Cambridge Park	34ha	180 - 200	2	Cambridge Road - Major arterial, 7,700vpd, 50km/h, 13% HCV Thompson Street - Local, 280vpd, 50km/h, 5.2% HCV
2.Ihimaera Terrace	12ha	120	1	Cambridge Road - Major arterial, 7,700vpd, 50km/h, 13% HCV
3.Milton Street	42ha	150 -160	2	Lamb Street - Minor arterial 2,800vpd, 80km/h, 6.8% HCV
4.Oaklands Drive	18ha	150	1	Thornton Road - Collector , 5,200vpd, 50km/h 6.8% HCV
5.Tulip Drive	43ha	350	2	Swayne Road - Collector (1), 2,500vpd, 50km/h, 5.5% HCV Robinson Street - Collector (1), 3.200vpd, 50km/h, 5.5% HCV
6.St Kilda	73ha	250 - 300	3	Watkins Road - Local (1) 200vpd, 50km/h, 8% HCV St Kilda Road - Collector (2), 3,510vpd, 50km/h, 6% HCV
7.C1 Structure Plan[30]	35ha	Target of 440	3	Victoria Road - Minor arterial (2), 9.730vpd, 80km/h, 5% HCV Norfolk Drive extension - Collector (1) - not yet built
8.C2 Structure Plan[31]	210ha	Target of 2,500	13	Cambridge Road - Major arterial (2 existing, 3 new) 8,000vpd, 80km/h, 10% HCV All others to new collector roads or allowing for connections to future growth areas

[29] Waipa Operative District Plan November 2016 Appendix T5 - Road Hierarchy
[30] Waipa Operative District Plan Appendix S19 - Cambridge C1, C2/C3 Structure Plans, Figure 4
[31] Waipa Operative District Plan Appendix S19 - Cambridge C1, C2/C3 Structure Plans, Figure 4

29 From Table 1, it is clear that in the local context, residential subdivision in Cambridge typically has one access point for every 100 households with the range being from one access per 75 - 80 households to one access per 190 households. The proposed C4 Structure Plan has one access point for every approximately 200 households in the southern part of the site. This is generally consistent with the lower end of connectivity per household existing in Cambridge. The degree of connectivity current proposed by Council in relation to the norther section of the C4 growth cell is significantly lower than this with an expected 428 households being accessed from a single intersection. Should an event occur which precludes use of Silverwood Lane, these households have no alternative form of access. Of the residential areas identified as having only one means of road access, Ihimaera Terrace was developed around 2008, and Oaklands Drive was developed pre 2006. These developments reflect the outcomes expected at the time and not current best practice thinking as evidenced by the GPS, Arataki and the RLTP.

30 It is also clear that Cambridge Road along the C2 growth cell frontage has the same general characteristics as the section along the C4 growth cell in that they both:

(a) are major arterial roads;

(b) carry some 7,200vpd (C4) to 8,000vpd (C2);

(c) have 11% (C4) to 10%(C2) HCVs i.e. around 790 HCVs per day (C4) to 800 HCVs per day (C2);

(d) are straight and level; and

(e) operate under an 80km/h speed limit.

31 It is also clear that there is an intention within Council to treat them differently; Cambridge Road along the C2 frontage is likely to be urbanised with the introduction of more intersections and may have a reduced speed limit but Cambridge Road along the C4 frontage is to be protected as an arterial route with a priority for traffic and freight movements, despite having the same general characteristics as the C2 section.

32 In my opinion, there is a similar lack of direct urbanisation on the opposite side of the road and whilst I accept the C3 growth cell opposite the C2 area implies a more urban setting than is currently anticipated facing the C4 growth cell, when considering the detail, the C3 growth cell interface with Cambridge Road is the St Peter's School Zone, open space and Te Awa retirement village. As such, I consider it unlikely that the C3 growth cell is would give a significantly different 'feel' to the road environment compared to the one opposite the C4 growth cell.

33 I conclude that there is inconsistency in the transport network planning applied to the C4 growth cell in the context of existing and proposed residential subdivision and development areas in terms of connectivity to existing road networks and the justification used to dismiss an additional access intersection as proposed by Mr Maunsell.

NETWORK OPERATIONS

34 The S42A report identifies that Mr Bax and Mr Hudson are of the opinion that allowing the additional intersection serving the northern part of the C4 growth cell would have a minimal effect on journey tome for residents and it therefore not warranted. I agree. The difference of 750m travel distance, assuming half of that distance is at 80km/h on Cambridge Road, half is at 50km/h within the subdivision and allowing a 2 second - 8 second delay for negotiating each of the two roundabouts long the route[32] would increase overall journey time by approximately 57 seconds to 1 minute 9 seconds.

35 Mr Prakash assess that in the morning peak hour, 80% of traffic associated with the C4 growth cell would head north along Cambridge Road[33]. This is the shortest route to Cambridge and I consider this assignment of traffic to the external road network to be appropriate. What is less clear is why, in Table 5, the assignment is reversed in the PM peak hour with 80% travelling to and from the south via Lamb Street. Given the SIDRA modelling presented in his TA[34] represents

[32] Taken from Mr Prakash TA, Table 8 for Roundabout A and applied to all intersections for simplicity.
[33] Mr Prakash TA Section 3.3 Table 4 and paragraphs 5 and 6
[34] Mr Prakash TA Section 3.4.2, Table 7

the AM peak hour expected operations, I consider that the 80% travel demand to and from the north is more representative outcome and assumes that the apparent difference in Table 5 is a drafting error.

36 I agree that people are unlikely to notice an increase of around 1 minute on overall travel time if driving to Cambridge or beyond. However, given the conclusion of Mr Bax and Mr Hudson that this level of delay is not significant enough in terms of network performance to warrant the access intersection proposed by Mr Maunsell, the overall delay that would accrue to the network for trips made to and from the subdivision needs to be considered. Applying a trip generation rate of 10.9 trips per household per day[35] to 428 households in the northern section of the C4 growth cell only, and following the 80% northbound travel demand assessed by Mr Prakash gives a daily 'development' traffic demand of 3,732vpd. I have simplified my assessment and discounted traffic from the southern area which might also use this intersection. If each of those trips is delayed by 57 seconds to 1 minute 9 seconds, the overall delay per day would be around 59 hours to 72 hours.

37 I have applied this same logic to the effects reducing the speed limit along Cambridge Road from the current start of 50km/h speed limit on Cambridge Road, past site, to Kaipaki Road, a distance of approximately 1.5km. The outcome of my assessment is given in Table 2. For simplicity, I have taken no account of the existing 65km/h speed advisory sign on the bend in Cambridge Road or the vertical alignment along the northern boundary of the C4 growth cell where an uphill gradient is likely to reduce HCV speeds to below 80km/h. I have also assessed a potential scenario where the access intersection takes the form of a roundabout.

[35] Mr Prakash TA Section 3.3 Table 3

Table 2: Travel Time Effects from Reduced Speed Limit

Speed Limit	Time take to travel 1km	Time to travel 1.5km	Increase compared to 80km existing travel speed	Increase allowing 8s for intersection delay
80km/h	45 seconds	1 minute 8 seconds	0	8 seconds
70km/h	51 seconds	1 minute 17 seconds	9 seconds	17 seconds
60km/h	1 minute	1 minute 30 seconds	22 seconds	30 seconds
50km/h	1.2 minutes	1 minute 48 seconds	40 seconds	48 seconds

38 It is clear from Table 2 that the effect of reducing the speed limit on Cambridge Road on individual vehicles is likely to be minimal, ranging from 9 seconds to 40 seconds per vehicle for existing traffic on Cambridge Road.

39 I have repeated my assessment allowing for a roundabout at a new intersection serving the northern section of C4. Whilst I agree with Ms Hills' assessment that a t-intersection with right turn lane should have sufficient capacity to accommodate expected demands, I have considered a roundabout as a worst case. As set our earlier, I have taken a simplistic approach for contextual purposes only and have applied the delay anticipated by the new Lamb Street roundabouts as per Mr Prakash's TA and applied this to a new intersection, i.e. allowed for 8 seconds delay for all through traffic. In this scenario, the delay per vehicle is some 17 seconds to 48 seconds, compared to the 57 seconds t 1 minute 9 seconds assessed by Mr Bax and Mr Hudson as being acceptable in connection with accessing the northern section of the C4 growth cell.

40 I have also considered the total daily demand for all traffic on Cambridge Road. Applying this level of delay to the existing 7,200vpd on Cambridge Road would lead to a total daily network delay of 18

hours to 80 hours. The level of total delay per day when considering the entire traffic demand on Cambridge Road if a 50km/h speed limit was imposed would be generally comparable to that contemplated as minimal by Mr Bax and Mr Hudson. If a 60km/h speed limit were to be adopted as is proposed for Lamb Street, the overall daily network delay resulting would be some 44 hours. This is approximately 60% to 75% of the level of delay that is assumed as being acceptable in the context of providing access to the proposed C4 growth cell.

41 I would expect a further roundabout on Cambridge Road to add some 16 - 20 hours additional delay to the sum of through traffic delay. Adding this to the speed reduction delay would increase overall daily delay on Cambridge Road to 60 to 64 hours per day for a 60km/hr speed limit. This is significantly less than the 59 hours to 72 hours which is the outcome of not allowing a second access to the northern section of the C4 growth cell.

42 I conclude from my assessment that, whilst not dependent on a reduced speed limit on Cambridge Road, the impact of any such reduction to a 60km/h limit would be negligible for individual vehicles already on the network and would be less than the delay effect for residents of the growth cell if a second access to Cambridge Road is not provided. To replicate the level of effect of this omission, the speed limit on Cambridge Road would need to be reduced to 50km/h.

43 It is my opinion that there is again an inconsistency in how access to the growth cell is being assessed and the justifications used to dismiss the proposed access intersection.

COMPLIANCE WITH STANDARDS

44 Ms Hills undertook a technical assessment of visibility and separation distances of the proposed northern C4 access intersection in relation to the standards applying to the existing 80km/h speed limit. She concluded that:

(a) there is sufficient visibility to exceed the required standards[36];

(b) the required spacing of 90m between intersections on the same side of the road can be met;[37] and

(c) there will be failure in relation to separation distances to 2 existing crossings that would remain[38].

45 Comparing the standards, it is clear that there in inconsistency between RITS and the ODP. RITS requires intersections on arterial roads to be 90m apart, however the ODP requires 100m separation between vehicle crossings in an 80km/h speed zone, from either other crossings or intersections. This implies that it is acceptable to have intersections carrying high volumes of traffic closer together than it is to have vehicle crossings which may be carrying 10vpd, as in the case of a rural residential property.

46 In is TA, Mr Prakash identifies similar failures in separation distance on Lamb Street and concludes that these are not significant. I accept that Lamb Street carries less traffic than Cambridge Road, however, Cambridge Road is also flat, straight and has excellent visibility in both directions. There is also a good degree of speed compliance with the 85th percentile speeds being slightly above the speed limit, as is typical. From Ms Hills' data, the average vehicle speed is 80km/h in both directions.

47 As such, I agree with Mr Prakash and conclude that a failure in separation distance between a low volume vehicle crossing and an otherwise compliant intersection, with excellent visibility at both, has a less than minor effect.

CONCLUSIONS

48 There has been a significant shift in land transport policy at both a national and regional level, with planning for the future, supporting travel mode choice supported by appropriate urban forms and

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[36] Austroads Guide to Road Design Part 4 A: Unsignalised and Signalised Intersections, Section 3.2.2, Table 3 and Ms Hills' TA Table 2
[37] Waikato Regional Infrastructure Technical Specification Section 3.3.9.7, Table 3
[38] Waikato Operative District Plan November 2016, Section 16.2.4.5 and Ms Hills' TA 'Separation Distances' page 10

ensuring network resilience taking precedence over road network capacity considerations. It is my opinion that this shift has not been fully appreciated in the decision making by Council in relation to their rejection of Mr Maunsell's proposal for a second means of access to the northern section of the C4 growth cell and I do not agree with the conclusion reached by Mr Prakash that providing access from an arterial road is *"inconsistent with good traffic engineering".*[39]

49 Having a single point of access to serve some 428 households is out of context with residential subdivision within Cambridge, both existing and those allowed for under the C1, C2 and C3 growth cells. Providing only one way in or out also does not provide network resilience should an unforeseen event occur at this access location, nor does it support future efficiency public transport network planning.

50 I agree with Mr Bax and Mr Hudson that the travel time saving afforded to future residents of the northern section of the C4 growth cell is no significant. Applying the same level of significance to delay caused by a potential reduction in speed limit on Cambridge Road to 60km/h, I conclude that this would also not be significant and therefore do not consider there to be a sound network management argument against provision of the intersection as sought by Mr Maunsell.

51 I agree with Ms Hills' assessment that the proposed access intersection can comply with intersection spacing and visblity requirements. I also agree that there would be a non-compliance in relation to separation from two low volume vehicle crossings. I also agree with Mr Prakash's conclusions that such a non-compliance is not significant in relation to Lamb Street, or, in my opinion, on Cambridge Road given it is flat and straight at this point.

52 Overall, it is my opinion that there are significant inconsistencies in how the additional access from Cambridge Road has been assessed when considered in the context of current policy, applicable design standards and the local context of Cambridge. It is also my opinion that provision of the second access would provide significant benefits in terms of network connectivity, resilience and planning for the future and that

[39] Mr Prakash TA Section 3.3, paragraph 2

there is no reason why it should not be allowed for as part of the C4 Growth Cell Structure Plan.

Judith Makinson

CKL

11 June 2021

Appendix A - Direction Traffic Design Transportation Assessment - Ms Tara Hills

DIRECTION TRAFFIC DESIGN
2 Balfour Crescent, Riverlea, Hamilton
tara.hills@directiontd.co.nz

4th December 2020

Geoff Maunsell
3796 Cambridge Road
Cambridge
Sent via email to: maunsell@outlook.co.nz

Attention: Geoff Maunsell

Dear Geoff,

3796 Cambridge Road/Proposed C4 Growth Cell
Traffic Comments

This letter comments on the suitability of a new intersection to access the proposed C4 growth cell. Waipa District Council's existing C4 plan is shown in Figure 1. Access to the northern portion of the C4 area is shown on this plan to be entirely via Silverwood Lane.

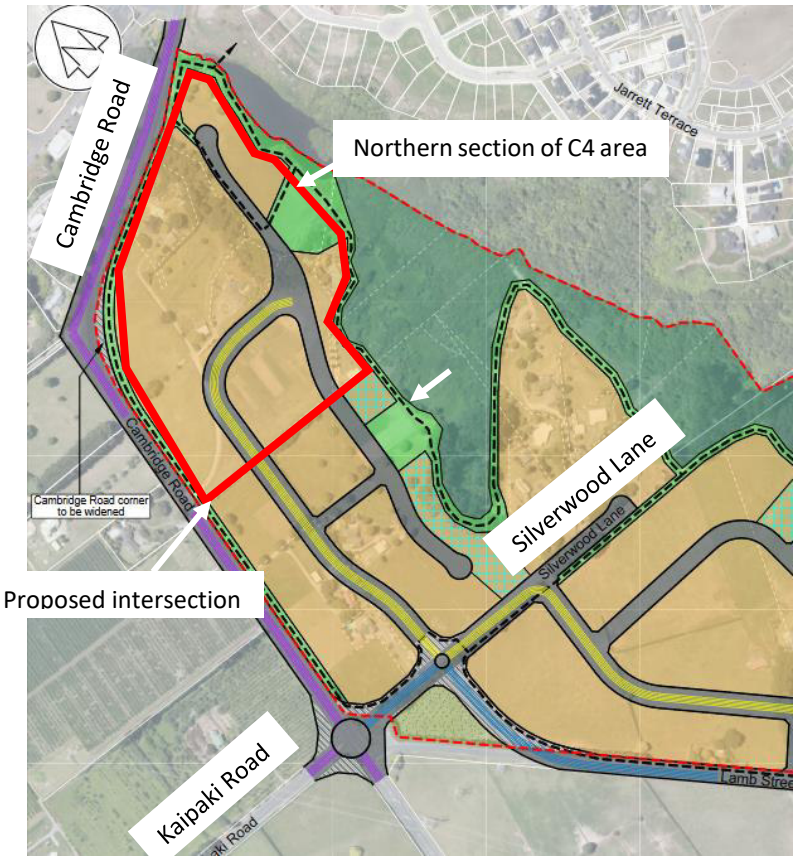

Figure 1: Existing C4 Plan

The owners of 3796 Cambridge Road consider the proposed C4 layout to be undesirable as it forces all site traffic to detour through the Kaipaki/Silverwood intersection. An alternative layout which provides improved access to the northern part of the C4 area is shown in Figure 2.

Figure 2: Proposed scheme plan for 3796 Cambridge Road

Issues associated with creating a new access road include intersection safety, capacity, design and alignment with the road hierarchy. These matters are discussed in this letter. A discussion on the appropriate speed limit for Cambridge Road is also provided.

Existing Road Data

Cambridge Road is a major arterial road which connects Cambridge with Hamilton and Te Awamutu. Leamington residents typically use Kaipaki Road to access Hamilton rather than State Highway 1, as the Kaipaki Road route avoids the need to drive through the centre of Cambridge. Peak hour traffic flows on Cambridge Road are therefore relatively evenly balanced as users include commuters accessing both Hamilton and Cambridge.

The average annual daily traffic (AADT) flow is 7200 vehicles per day (vpd) with 11% heavy commercial vehicles (HCVs) (Mobile Road 2020 estimate). The peak hour flow measured during a site visit was 637 vehicles per hour (vph). The peak hour flow was split 51:49 for northbound:southbound traffic in the am peak period. The site visit was undertaken on the 30th November 2020 with the traffic count undertaken from 7:30 to 8:30 am. The traffic count

data is attached to this letter. An assumed growth rate of 2.5% has therefore been used for this road. This assumed rate uses average growth rates in the Waka Kotahi New Zealand Transport Agency Economic evaluation manual for arterial roads in Waikato urban and rural areas (2 and 3% respectively).

Cambridge Road has a posted speed limit of 80 km/h and an operating speed of 84 km/h for northbound traffic and 82 km/h for southbound traffic. The site speed data is attached to this letter.

The New Zealand Transport Agency Crash Analysis System (CAS) has two reported crashes in the vicinity of the site in the last five years, as shown in Figure 3. There were also two crashes at the Kaipaki Road intersection, and 14 crashes on the corner to the north of the site.

Figure 3: Crash locations

Of the two crashes in the vicinity of the site, both were loss of control crashes. One crash involved a northbound and the other a southbound vehicle. The crashes resulted in no injuries, and one crash occurred in wet conditions. Both crashes occurred prior to 2019, when the speed limit in this area was 100 km/h.

Of the two crashes at Kaipaki Road, one was a turning crash with suspected alcohol which resulted in a serious injury. The other crash involved a driver under the influence of alcohol and a pedestrian, resulting in a minor injury. Again, both crashes occurred prior to 2019.

Of the 14 crashes on the corner to the north of the site, all but one were loss of control crashes, 11 of the 14 involved southbound vehicles, all crashes occurred in wet conditions, and only one crash has occurred since the speed limit was reduced (on the 4th November 2019). One crash resulted in two fatalities, four resulted in serious injuries, two resulted in minor injuries and eight resulted in no injuries. It is noted that Mobile Road shows that a reseal of this area is proposed in the 2020/2021 season.

The crash history indicates that the speed limit reduction has reduced crash numbers in the vicinity of the site. No particular safety issues are present in the direct vicinity of the site.

Trip Generation

All site traffic to the north of the intersection and just to the south of it, is expected to use the proposed intersection for all movements. Traffic generated by land to the south of the proposed intersection is expected to use the proposed intersection to travel to and from the north, and to use the Kaipaki intersection to travel to and from the south, as indicated in Figure 4. This is a relatively coarse model, but is considered to be sufficient for this initial assessment.

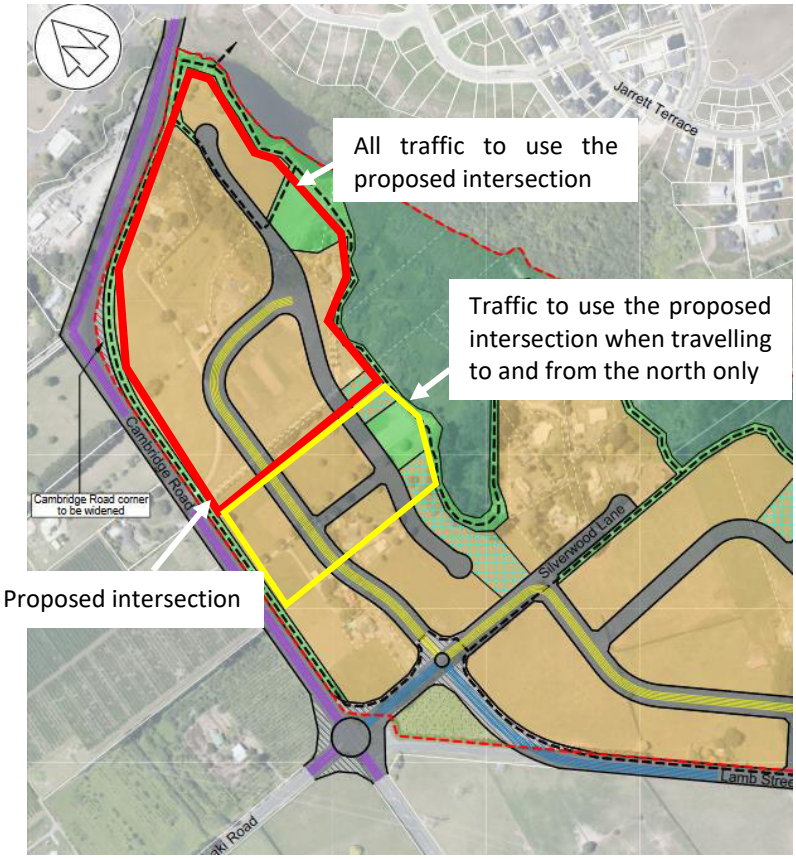

Figure 4: Land serviced by new intersection

The initial scheme plan for the site (provided in Figure 2) shows 66 residential lots in the northern area. It is estimated that full development of this area would yield a further 40 lots, giving a total of 106 lots. Using a similar development rate to the south of the intersection gives a further 40 dwellings expected to use this intersection to travel to/from the north. For sensitivity testing a higher development density of 130% of the initial estimate has been used.

The Waka Kotahi/NZ Transport Agency Research Report 453 “Trips and parking related to land use” gives the trip generation rate for urban dwellings of 1.2 trips/unit.

Flow diagrams using the different development rates for the peak hours are provided in Figure 5.

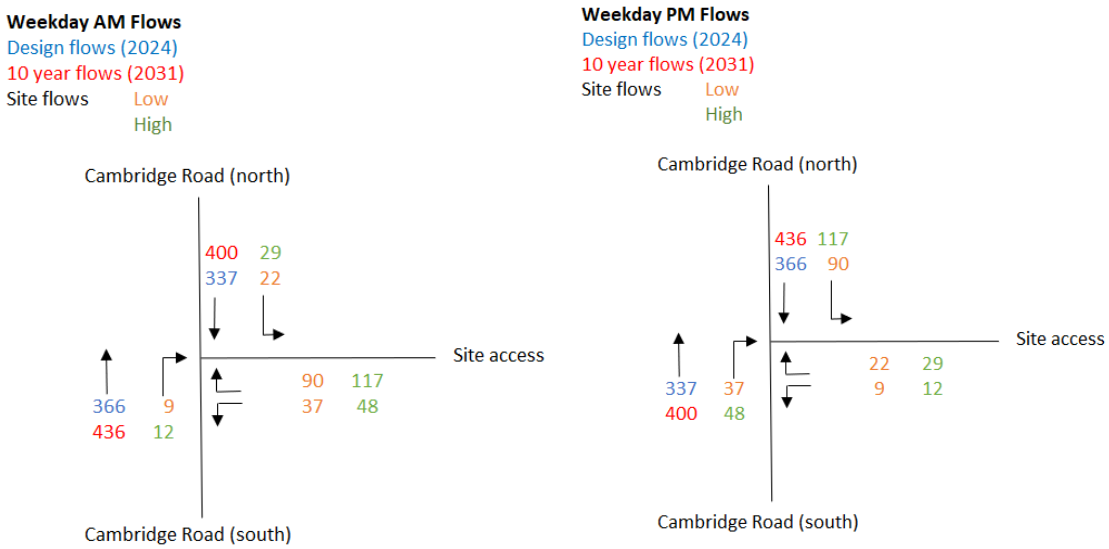

Figure 5: Site flow diagrams

Proposed Intersection Location

The proposed location is Cambridge Road RP 0/19.973. This location is directly opposite the access to 3783 Cambridge Road. The location is a compromise between obtaining maximum sight distances, optimising separation distances, and providing the benefit of improved connectivity to the site.

Figure 6: Proposed access location – 3794 Cambridge Road

Internal Design

Consideration could be given to extending the new road accessing the site. This would provide improved connectivity on both sides of this road. This configuration is indicated in Figure 7,

Figure 7: Potential internal reconfiguration

The District Plan required roading dimensions from Volume 2 Part 3 Table 1 of the Waipa District Development and Subdivision Manual are provided in provided in Table 1 of this letter.

Table 1: Required road dimensions

Type & Description	Road Reserve Width (m)	Carriage-way Width (m)	Lane Width (m)	Cycleway Width	Street Parking Widths	Kerb/Edging Type	Front Berm, Street Tree, Swale, Lighting Recessed Parking and Bus Stops	Footpath Width (m)	Back Berm / Utility Corridor [1] (iii)
Collector	25m	15m	2 @ 3.5m	Both sides @1.5m	1 park per lot @ 2.5m wide	Barrier	Both Sides	2 @ 1.5m	Both Sides @ 2.1m min
Local: Through Road	21m	11m	2 @ 3m	Shared Environment	1 park per lot @ 2.5m	Barrier	Both Sides	2 @ 1.5m	Both Sides @ 2.1m
Local: Cul-de-sac									
i) >150m in length	21m	11m	2 @ 3m	Shared Environment	0.75 parks per lot @ 2.5m wide	Barrier	Both Sides	2 @ 1.5m	Both Sides @ 2.1m min
ii) <149m in length	21m	11m	2 @ 3m	Shared Environment	0.75 parks per lot @ 2.5m wide	Barrier or Mountable	One Side only	1 @ 1.5m	Both Sides @ 2.1m min
Service Lanes (2) (Max. length 150m)	5.5m	3m	1 @ 3m One-way only	Shared Environment	Not Permitted	Mountable	Not Permitted	Not Required	One side @ 2.1m min.
Private ROW's									
i) 2 – 3 Lots	4m	3m	Single Lane	Not Applicable	Not Permitted	Barrier, Mountable or Flush	Not Applicable	Not Applicable	Not Applicable
ii) 4 – 6 Lots	6m	5m	Single Lane	Not Applicable	Not Permitted	As above	Not Applicable	Not Applicable	Not Applicable

The current C4 layout includes a north/south collector road from Silverwood Lane north. The collector road designation may not be necessary with the proposed site design. Alternatively, the road in from the proposed intersection and a connection between this road through to Silverwood Lane may be designated as collector road. This road hierarchy is indicated on Figure 8. The final site layout will also need to tie in with the proposed layout to the south of the site.

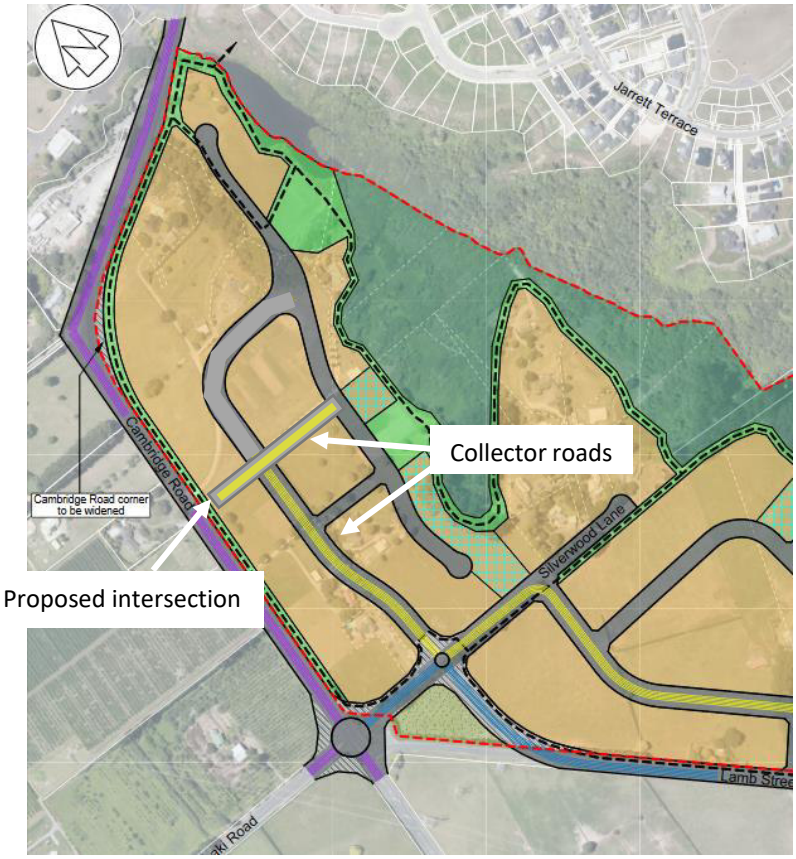

Figure 8: Potential road hierarchy

Sight Distances

The sight distances at the proposed intersection are acceptable. The operating speed of vehicles approaching the site is 84 km/h for northbound traffic and 82 km/h for southbound traffic. The required arterial road sight distances for these operating speeds is 203 m to the south, and 182 m to the north. These sight distances are met on site, as detailed in Table 2 and shown in Figures 9 to 12.

Table 2: Sight distances at the proposed intersection

Direction	Side of Road	Available Sight Distance	Operating Speed	Required Sight Distance
To the north	Intersection	200 m	82 km/h	182 m
	Opposite	210 m		
To the south	Intersection	300+ m	84 km/h	203 m
	Opposite	300+ m		

Note: Sight distances were measured to the centre of the approaching traffic lane, to and from a height of 1.15 m above the road level. Measurements from the intersection were taken 5 m back from the centre of the nearest lane (3.25 m from the edge line). Measurements from the opposite side of the road were taken from the edgeline.

The 200 m sight distance from the proposed intersection to the north is currently restricted by the "Luxury Cottages" sign in the road reserve. However, the potential sight distance without this sign does not increase when considering the sight distance over road reserve only.

Figure 9: Sight distance from proposed intersection to the north

Figure 10: Sight distance from proposed intersection to the south

Figure 11: Sight distance from opposite the proposed intersection to the north

Figure 12: Sight distance from opposite the proposed intersection to the south

Separation Distances

The intersection separation distances at the proposed intersection are acceptable, however the access to intersection distance does not meet the required criteria.

The 80 km/h posted speed requires a 100 m access to intersection separation distance. Accesses within this distance include the following:

- 3783 Cambridge Road – directly opposite the proposed intersection.
- 3796 Cambridge Road – 15 m north of the proposed intersection, on the same side of the road.
- 3791 Cambridge Road – 85 m north of the proposed intersection, on the opposite side of the road.
- 3774 Cambridge Road – 95 m south of the proposed intersection, on the same side of the road.

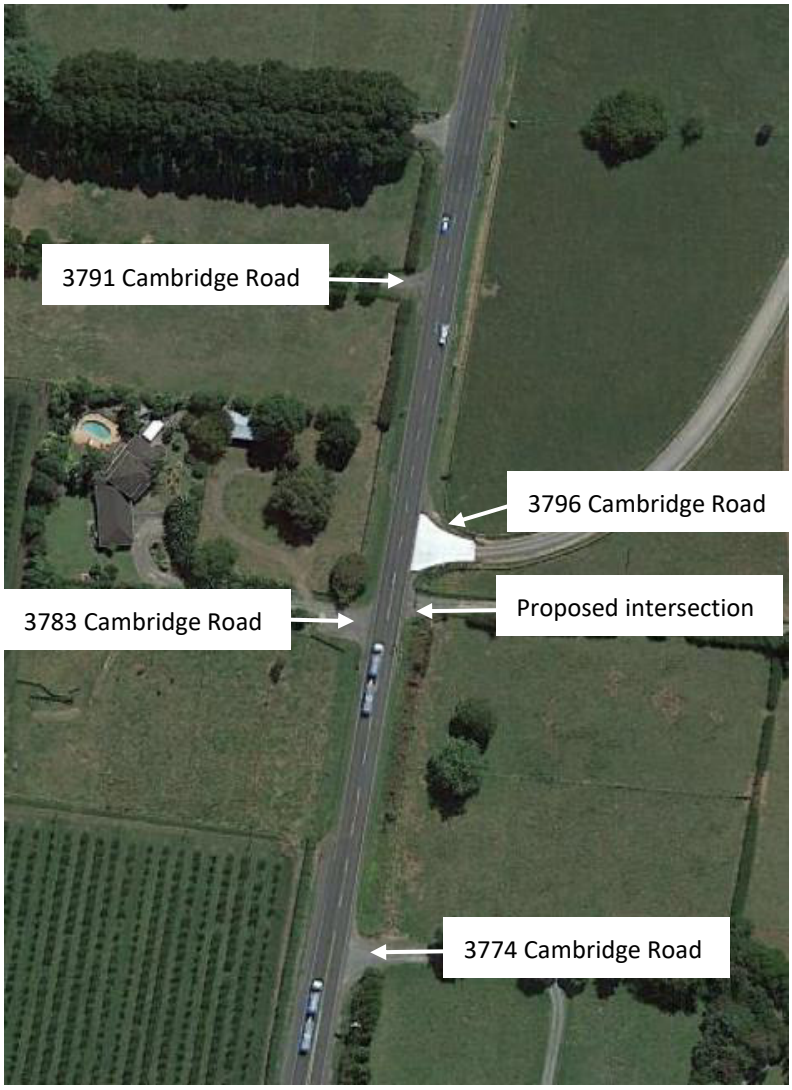

Figure 13: Access separation distances

As part of the site development the existing 3796 Cambridge Road access will be closed. It is also anticipated that 3774 Cambridge Road will be closed when the adjacent land is developed. The access at 3791 Cambridge Road is considered to represent a relatively minor shortfall in separation distance (100 m required and 85 m provided). It is also noted that if the speed limit drops to 60 km/h following development of the C4 area, then the required separation distance will only be 30 m. This leaves 3783 Cambridge Road as the adjacent access of most concern. While staggering intersections is good design practice, for accesses a better design where separation distance cannot be met is to locate them directly opposite adjacent accesses/intersections. This design reduces the number of conflict points along a road and the potential for blocked sight distances from vehicles waiting to turn right off the main road.

The Waipa District Development and Subdivision Manual requires intersections to be spaced 90 m apart on arterial roads. The proposed intersection will be approximately 310 m from the Kaipaki Road intersection, meeting this criterion.

Intersection Design

Austroads Guide to Traffic Management Part 6 (2020) Figure 3.25 (provided in Figure 14 of this letter) indicates that a right turn bay will be required at this site over the likely range of development densities. The threshold where a right turn bay is not required is approximately five right turn in vehicles in the peak hour – approximately 21 dwellings (21 x 0.8 in x 0.36 from the south /1.2 trips/dwelling).

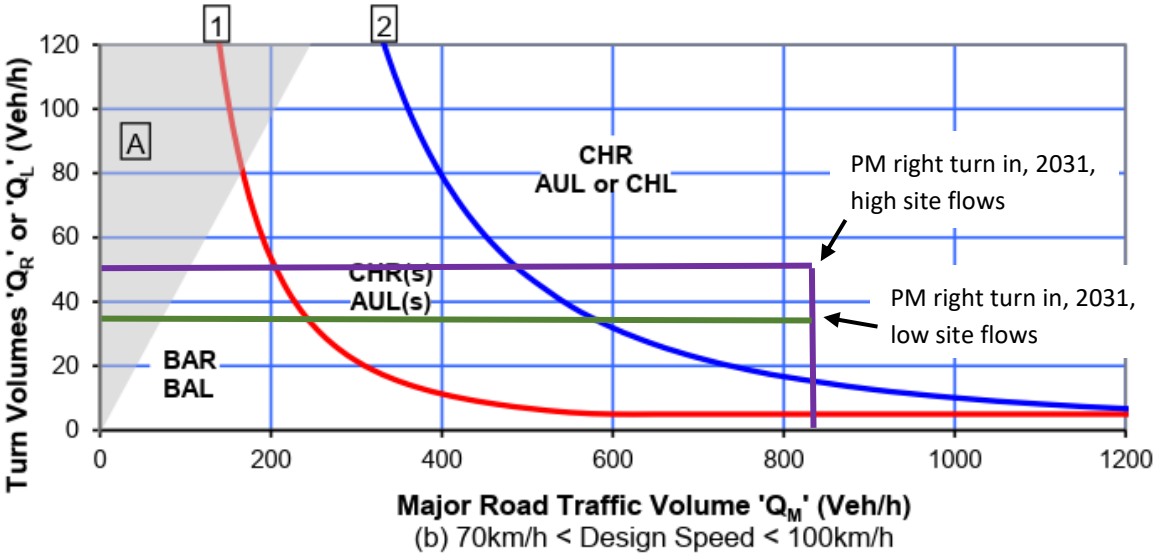

Figure 14: Austroads AGTM Part 6 (2020) Figure 3.25 – turning warrants

Intersection Capacity

An initial check of intersection capacity has been made using Tanner's graph for the right turn out movement (Figure 15). This graph indicates that average delay for right turn out vehicles will be between five to six seconds for the 2031 AM development scenarios. This delay is considered to be acceptable, and unlikely to result in any capacity issues in the medium-term horizon.

Delays are expected to become unacceptable when the peak hour traffic volume on Cambridge Road exceeds approximately 2000 vph, giving average delays of greater than 40 seconds. At current growth rates this traffic volume would take over 37 years to achieve. When delays become unacceptable the proposed intersection would either need to prevent right turn out movements or be converted to a roundabout. Preventing right turn out movements could be achieved by installed a central median to the south of the intersection, requiring right turn out traffic to turn around at the proposed Kaipaki roundabout instead.

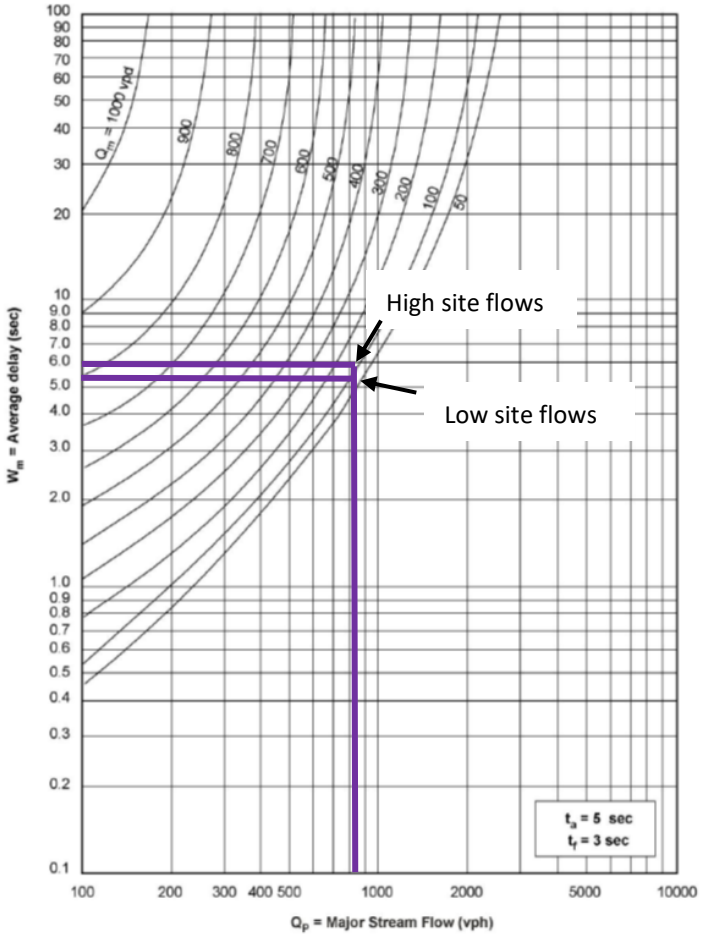

Figure 15: Tanner graph (1962) for right turn out movement

Alignment with Road Hierarchy

It is noted that the Gray Matter report "C4 Growth Cell Transportation Assessment" dated 20th December 2019 considered an intersection at a similar location to that proposed in this letter. Gray Matter advised that *"providing another intersection on Cambridge Road would minimise travel distance for trips to/from Area A. However, it would introduce a new intersection on the major arterial network which is inconsistent with good traffic engineering practice. The intersection would also increase delay and increase the risk of crashes for trips along Cambridge Road.*"

Cambridge Road is a major arterial road, and therefore primarily has a movement rather than access function. However, with the development of the C4 area and construction of the Kaipaki Road roundabout, this length of Cambridge Road will become more urban, supporting the provision of occasional side intersections. The intersection form would be a priority intersection with a right turn bay. This design would have minimal impacts on through traffic on Cambridge Road.

The creation of a new conflict point is not ideal from a safety perspective. However, without the new intersection northbound traffic will have to travel through two intersections instead of one, and travel an additional 1 km. The increased risk exposure for site traffic is considered to counter the adverse effect from the proposed new conflict point.

The extra travel time per trip for northbound vehicles from areas north of the proposed intersection is approximately 1.2 minutes per trip (1 km at 50 km/h). This detour will be frustrating for drivers and will result in increased travel costs. Using passenger car vehicle operating costs of 21.8 cents/km from the NZTA Monetised benefits and costs manual for 50 km/h, gives a yearly cost of approximately $92,000 without the additional intersection (106 lots x 10.9 trips/lot x 365 x $0.128).

The proposed intersection will have the added benefit of decreasing traffic volumes through the Kaipaki Road intersection, increasing the time before this intersection needs to be upgraded.

Cambridge Road Speed Limit

The Waka Kotahi/NZTA speed management guide indicates that urban arterial roads should have a speed limit of 50 km/h, with 60-80 km/h appropriate where there are fewer intersections and mode separation for active users, appropriate to this site. The higher value of 60-80 km/h is considered appropriate for this site following development of the C4 area.

The MegaMaps safe and appropriate speed limit for this section of Cambridge Road is 60 km/h. It is currently listed as being in the top 10% of DSi saving network sections, however this is based on the previous speed limit of 100 km/h. It is recommended that Council consider reducing the speed limit on this section of Cambridge Road to 60 km/h following development of the northern part of the C4 growth cell.

Conclusions and Recommendations

The provision of a new intersection to access the northern part of the C4 growth cell will improve accessibility to this area and reduce travel times and costs. No adverse safety or capacity effects are anticipated as a result of the new intersection. The proposed intersection location has good sight distances and an appropriate location and design to accommodate an adjacent access on the opposite side of the road. The required design for the intersection will include a full right turn bay.

It is recommended that Council consider reducing the speed limit on this section of Cambridge Road to 60 km/h following development of the northern part of the C4 growth cell.

Please contact the undersigned if you have any queries regarding this matter.

Yours sincerely

Tara Hills
Senior Traffic Engineer
MSc, CMEngNZ, CPEng

Attached:

- Scheme Plan
- Traffic count data
- Operating speed data
- CAS data

Traffic Count Data

Location: 3794 Cambridge Road
Client: Geoff Maunsell
Job Number: 20041
Date: 30/11/2020
Time: 7:30 to 8:30 am
Weather: Overcast

Time		Hamilton Road		Matos Segedin Drive			
From	To	Northbound	Southbound	Right in	Left out	Right out	Left in
7:30	7:35	18	34	4	4	0	3
7:35	7:40	22	35	5	5	3	3
7:40	7:45	31	30	4	2	1	5
7:45	7:50	26	27	10	1	3	4
7:50	7:55	36	34	5	4	2	7
7:55	8:00	35	26	5	3		3
8:00	8:05	26	23	4	4		2
8:05	8:10	34	25	3	3	1	1
8:10	8:15	15	37	3	2	1	2
8:15	8:20	32	35	4	2	2	1
8:20	8:25	30	25	3	6	1	1
8:25	8:30	39	30	3	2	2	2
Hourly Total		**304**	**292**	**44**	**29**	**13**	**28**
Hourly flow at site		**332**	**305**				
Design flows (2024)		366	337				
10 Year Flows (2031)		436	400				
Growth rate		2.50%	per year				
Directional split		**51%**	**49%**	**64%**	**To north**	**36%**	**To south**
AM in:out split				**80%**	**Out**	**20%**	**In**
AM Site flows (low)							
	Northern (66)			9	37	65	16
	Southern (30)					25	6
	Total			9	37	90	22
AM Site flows (high)							
	Northern (130)			12	48	85	21
	Southern (55)					32	8
	Total			12	48	117	29

Operating Speed Data

Location: 3794 Cambridge Road
Client: Geoff Maunsell
Job Number: 20041
Date: 30/11/2020
Time: 7:00 to 7:30 am
Weather: Overcast

	Northbound	Southbound
	79	86
	113	78
	83	82
	78	82
	82	95
	78	81
	78	76
	68	77
	74	79
	82	78
	88	81
	80	81
	73	79
	77	81
	80	94
	72	77
	78	78
	79	76
	79	72
	77	71
	81	81
	65	75
	79	77
	76	81
	78	85
	80	78
	87	74
	84	81
	86	75
	81	79
85th Percentile	**84**	**82**
Standard deviation	8.0	5.3
Sample	30	30
Standard error	1.5	1.0

CAS Data

CODED CR	Crash road	FEATURE	Dista	Dir	Side road	ID	Date	Day o	Time	Description of events	Crash factors	Surfac	Natural lig	Weather	Junction	Control	Cra	Cra	Cras
Site crashes																			
1134224	CAMBRIDGE ROAD		300	N	KAIPAKI ROAD	201748038	21/08/2017	Mon	9:10	Car/Wagon1 SDB on Cambridge road lost control; went off road to right, Car/Wagon1 hit non specific ditch	CAR/WAGON1, other inattentive, other inexperience, other lost control, wrong pedal/foot slipped	Dry	Overcast	Fine	Nil (Defau	Unknown	0	0	0
1103247	CAMBRIDGE ROAD		310	N	KAIPAKI ROAD	201655453	15/10/2016	Sat	8:00	Car/Wagon1 NDB on CAMBRIDGE ROAD lost control; went off road to left, Car/Wagon1 hit non specific fence, non specific pole	CAR/WAGON1, too far left	Wet	Overcast	Null	Nil (Defau	Unknown	0	0	0
Kaipaki Road crashes																			
1071028	CAMBRIDGE ROAD			I	LAMB ST	201612620	30/04/2016	Sat	15:55	Car/Wagon1 SDB on CAMBRIDGE ROAD hit Car/Wagon2 turning right onto AXROAD from the left, Car/Wagon1 hit non specific fence, non specific pole	CAR/WAGON2, alcohol suspected, did not check/notice another party from other dirn, failed to give way at priority traffic control	Dry	Overcast	Fine	T Junction	Stop	0	1	0
1074672	LAMB ST			I	SILVERWOOD LANE	201616320	6/07/2016	Wed	18:45	Car/Wagon1 NDB on Lamb Street hit Pedestrian2 (Age 22)	CAR/WAGON1, alcohol test above limit or test refused, emotionally upset/road rage CAR/WAGON3, emotionally upset/road rage, PEDESTRIAN2, miscellaneous	Dry	Twilight	Fine	T Junction	Stop	0	0	1
Corner to north of site																			
1200569	CAMBRIDGE RD (TE A		290	W	MATOS SEGEDIN DRIVE	201965597	3/09/2019	Tue	21:07	Truck1 EDB on CAMBRIDGE ROAD, LEAMINGTON, WAIPA missed inters or end of road, Truck1 hit bank	TRUCK1, alcohol suspected, cutting corner on bend, drugs suspected, inappropriate speed for road conditions, ENV: other street lighting	Wet	Dark	Light rain	Nil (Defau	Unknown	0	1	0
1194801	CAMBRIDGE RD (TE A		325	W	MATOS SEGEDIN DRIVE	201959948	24/02/2019	Sun	10:03	Car/Wagon1 NDB on CAMBRIDGE ROAD, LEAMINGTON, WAIPA lost control turning right; went off road to left, Car/Wagon1 hit armco (w-section steel)	CAR/WAGON1, alcohol test below limit, inappropriate speed for road conditions, while returning to seal from unsealed shoulder	Wet	Bright sun	Fine	Nil (Defau	Unknown	0	0	0
1198760	CAMBRIDGE RD (TE A		320	W	MATOS SEGEDIN DRIVE	201963834	20/08/2019	Tue	6:30	Car/Wagon1 SDB on CAMBRIDGE ROAD, LEAMINGTON, WAIPA lost control turning left; went off road to left, Car/Wagon1 hit power pole	CAR/WAGON1, alcohol test below limit, inappropriate speed for road conditions, other lost control	Wet	Dark	Mist or Fo	Nil (Defau	Unknown	0	1	0
1179641	CAMBRIDGE RD (TE A		360	S	MATOS SEGEDIN DRIVE	201951757	8/03/2019	Fri	17:10	Car/Wagon1 NDB on CAMBRIDGE ROAD, LEAMINGTON, WAIPA lost control turning right; went off road to left, Car/Wagon1 hit wire rope barrier	CAR/WAGON1, alcohol test below limit, lost control - road conditions, ENV: slippery road due to rain	Wet	Overcast	Light rain	Nil (Defau	Unknown	0	0	1

1068844	CAMBRIDGE ROAD	420	W	MATOS SEGEDIN DRIVE	201610410	9/02/2016	Tue	18:10	Car/Wagon1 NDB on CAMBRIDGE ROAD lost control turning right, Car/Wagon1 hit non specific fence	CAR/WAGON1, lost control - road conditions, ENV: slippery road due to rain	Wet	Overcast	Fine	Nil (Defau	Unknown	0	1	0
1070346	CAMBRIDGE ROAD	400	W	MATOS SEGEDIN DRIVE	201611930	2/04/2016	Sat	4:15	Car/Wagon1 NDB on CAMBRIDGE ROAD lost control turning right, Car/Wagon1 hit non specific cliff, non specific fence, non specific other,	CAR/WAGON1, lost control when turning, swung wide on bend	Wet	Dark	Light rain	Nil (Defau	Unknown	0	0	1
1080963	CAMBRIDGE ROAD	370	W	MATOS SEGEDIN DRIVE	201632845	1/03/2016	Tue	8:40	Car/Wagon1 EDB on CAMBRIDGE ROAD lost control turning right, Car/Wagon1 hit non specific cliff, non specific embankment, non specific fence,	CAR/WAGON1, inappropriate speed for road conditions, lost control under braking, new driver/under instruction, ENV: barriers necessary, slippery road due to rain	Wet	Overcast	Light rain	Nil (Defau	Unknown	0	0	0
1143946	CAMBRIDGE ROAD	400	W	MATOS SEGEDIN DRIVE	201757903	26/12/2017	Tue	8:55	Car/Wagon1 NDB on Cambridge road lost control turning right, Car/Wagon1 hit non specific cliff	CAR/WAGON1, cutting corner on bend, other attention diverted	Wet	Overcast	Light rain	Nil (Defau	Unknown	0	0	0
1128736	CAMBRIDGE ROAD	390	W	MATOS SEGEDIN DRIVE	201742466	23/06/2017	Fri	23:21	Car/Wagon1 NDB on Cambridge Rd lost control turning right, Car/Wagon1 hit non specific cliff	CAR/WAGON1, alcohol suspected, drugs suspected, lost control when turning,	Wet	Dark	Fine	Nil (Defau	Unknown	0	0	0
1221086	CAMBRIDGE ROAD	446	S	MATOS SEGEDIN DRIVE	2020146458	22/02/2020	Sat	17:39	Ute1 WDB on CAMBRIDGE ROAD lost control on curve and hit Truck2 head on, Ute1 hit hedge	TRUCK2, alcohol test below limit UTE1, lost control when turning	Wet	Overcast	Fine	Nil (Defau	Nil	2	1	1
1123691	CAMBRIDGE ROAD	390	W	MATOS SEGEDIN DRIVE	201737337	14/04/2017	Fri	20:30	Car/Wagon1 NDB on Cambridge lost control turning right, Car/Wagon1 hit non specific pole, non specific ditch	CAR/WAGON1, lost control when turning, ENV: slippery road due to rain	Wet	Dark	Light rain	Nil (Defau	Unknown	0	0	0
1082338	CAMBRIDGE ROAD	410	W	MATOS SEGEDIN DRIVE	201634244	14/03/2016	Mon	13:10	Car/Wagon1 SDB on CAMBRIDGE ROAD lost control turning left	CAR/WAGON1, alcohol test below limit, lost control - road conditions, ENV: slippery road due to rain	Wet	Overcast	Light rain	Nil (Defau	Unknown	0	0	0
1101901	CAMBRIDGE ROAD	360	W	MATOS SEGEDIN DRIVE	201654070	25/11/2016	Fri	16:00	Car/Wagon1 EDB on Cambridge road lost control turning right, Car/Wagon1 hit non specific cliff	CAR/WAGON1, lost control when turning, ENV: slippery road due to rain	Wet	Overcast	Light rain	Nil (Defau	Unknown	0	0	0
1116801	CAMBRIDGE ROAD	400	W	MATOS SEGEDIN DRIVE	201730397	13/01/2017	Fri	2:20	Car/Wagon1 NDB on Cambridge Rd lost control turning right, Car/Wagon1 hit non specific cliff	CAR/WAGON1, failed to notice bend in road, lost control when turning	Wet	Dark	Light rain	Nil (Defau	Unknown	0	0	0

Appendix B - Gray Matter Traffic Design Transportation Assessment - Mr Vinish Prakash

C4 Growth Cell
Transportation Assessment

Waipa District Council

ISSUE 1, 20 DECEMBER 2019

C4 Growth Cell
Transportation Assessment

Waipa District Council

Prepared by: .....

Vinish Prakash

Approved by: .....

Alastair Black

ISSUE 1, 20 DECEMBER 2019

2 Alfred Street
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Hamilton, 3214
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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Background

Gray Matter Ltd has been engaged by Waipa District Council to prepare an Integrated Transport Assessment (ITA) to inform development of and assess the transportation impacts of the C4 Structure Plan. The site is located within the Waipa District just outside of Cambridge. The site is currently zoned rural. The C4 residential structure plan area is identified in the Waipa 2050 Growth Strategy and included in Appendix S1 of the District Plan.

Trip Generation

We understand that the Growth Cell could provide approximately 1,020 dwellings. Based on 85th percentile published trip generation rates the development could generate approximately 11,100 veh/day and 1,200 veh/hr.

We anticipate that most vehicles will be travelling towards Cambridge during the morning peak and returning via Cambridge during the afternoon peak. Some residents may commute to Hamilton via Kaipaki Road or to Te Awamutu via Cambridge Road.

Proposed Intersections

New intersections will be required on Lamb Street and Cambridge Road. The locations indicated in the structure plan layout (attached at Appendix 1) are based on providing minimum sight distance from the intersection and minimum separation of 90m from other intersections. The locations are based on there being no direct access from the development to the proposed roundabout at the Kaipaki Road/Cambridge Road/Lamb Street intersection. To provide safe and efficient access we recommend the structure plan includes two intersections on Lamb Street. Given the relatively high volume of traffic at the intersections we prefer that these intersections are formed as roundabouts.

Lamb Street/Kaipaki Road/Cambridge Road Intersection

Given the expected increase in traffic at the Lamb St/ Kaipaki Road/Cambridge Road intersection, a roundabout is the most appropriate form of intersection at this location. A roundabout provides a safe system solution consistent with Vision Zero and would provide a rural/urban threshold. It would be desirable to construct the roundabout prior to any development within the C4 structure plan. However, constructing the roundabout after Area C (or 300 lots) is developed and prior to any development in Area A and B is acceptable.

Recommended Infrastructure

We recommend that the following infrastructure is implemented as part of the C4 structure plan:

- A roundabout at the Kaipaki Road/Cambridge Road/Lamb Street intersection;
- 3m wide shared path on Lamb Street and Cambridge Road with links through the development;
- Roundabouts at new intersections on Lamb Street;
- Roundabout at the Lamb Street/ Shakespeare Street intersection;
- Upgrading Lamb Street and Cambridge Road to arterial road standards; and
- Walking and cycling connection via 3838 Cambridge Road.

1. INTRODUCTION

1.1. Background

Gray Matter Ltd has been engaged by Waipa District Council (Waipa DC) to prepare an Integrated Transport Assessment (ITA) to inform development of and assess the transportation impacts of Waipa DC's C4 Structure Plan.

1.2. Purpose and Basis of this Report

The purpose of this ITA is to assess the traffic and transportation impacts of the proposed development on the surrounding area.

This ITA presents an assessment of the likely traffic and transportation issues associated with the C4 structure plan. It comprises:

- A summary description of the site, and comments on the surrounding road network, including function and traffic volumes;
- Comments on the proposal, including traffic generation and access;
- Concept designs for the main intersections and typical cross-section for the arterial network;
- Evaluation of the likely traffic impacts; and
- Conclusions, including a summary of impacts and recommendations.

2. SITE AND SURROUNDING NETWORK

2.1. Site Description

The site is located within the Waipa District just outside of Cambridge. The site is currently zoned rural. The C4 residential structure plan area is identified in the Waipa 2050 Growth Strategy and included in Appendix S1 of the District Plan. The Growth Cell is intended for residential development on the Leamington side of Cambridge. Development of the growth cell is anticipated before 2035.

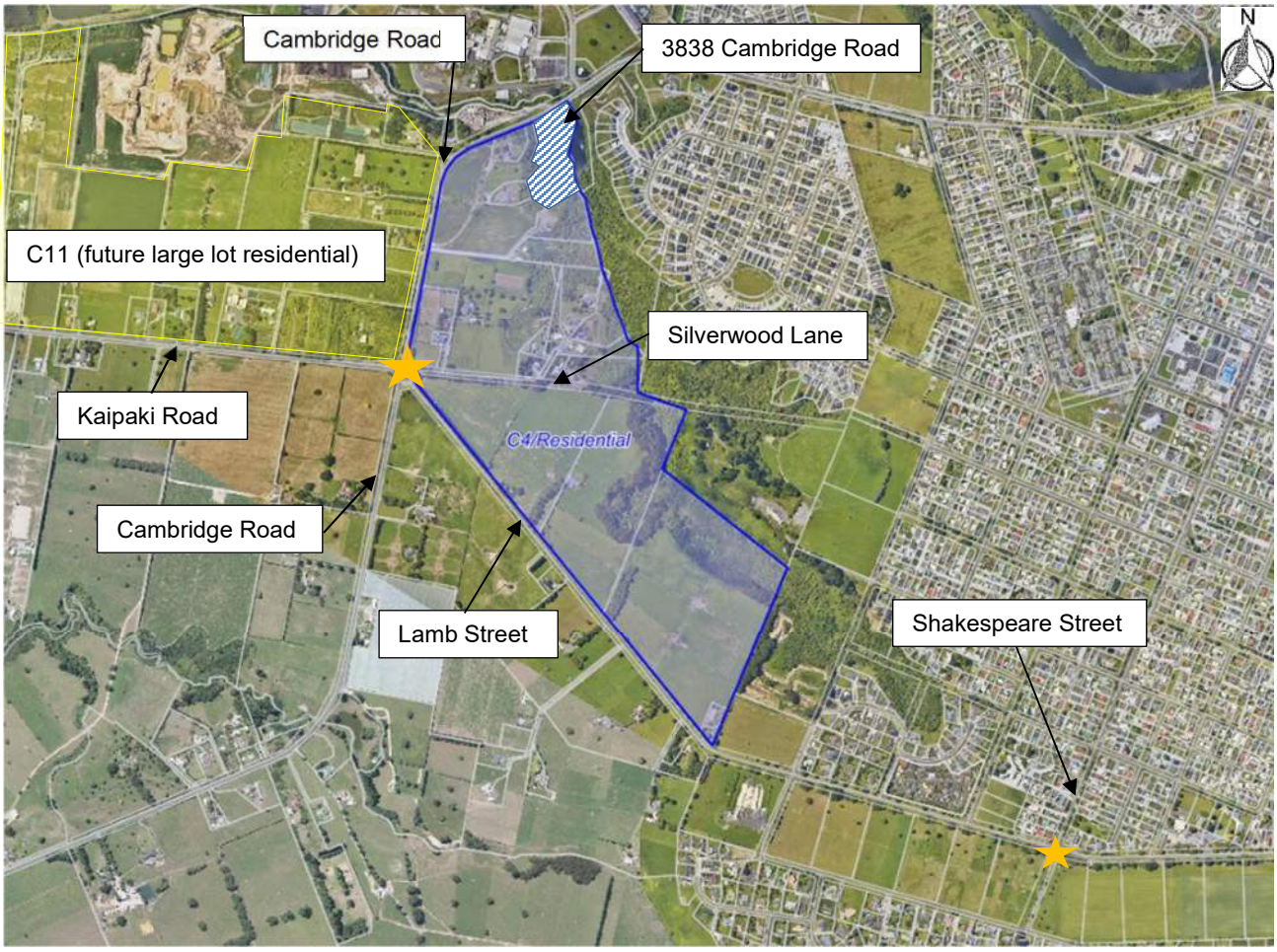


Figure 1: Site Locality

The site is bounded by Lamb Street and Cambridge Road. Silverwood Lane is entirely within the Structure Plan area.

The C11 growth cell is located west of Cambridge Road and is planned for development beyond 2035. That growth cell is intended for large lot residential development with capacity for approximately 258 dwellings.

2.2. Transport Network

The transport network surrounding the site consists of the following roads:

Road Name	Speed Limit (as at 4 November 2019)	Road Hierarchy	ONRC	Traffic Volume[1]	% HCV
Cambridge Road	80km/h	Major Arterial	Arterial	7,200 veh/day	11%
Lamb Street	80km/h	Minor Arterial	Primary Collector	2,800 veh/day	6.7%
Kaipaki Road	100 km/h	Minor Arterial	Primary Collector: Route Consistency	3,200 veh/day	10.2%
Silverwood Lane	80km/h	Local Road	Access	76 veh/day	0%
Shakespeare Street	50km/h	Minor Arterial	Primary Collector	4,955 veh/day	5.5%

Table 1: Transport Network

2.3. Crash History

We have completed a search of NZTA's crash analysis system (CAS) for crashes from 2015-2019 along Cambridge Road, Lamb Street, at the Lamb Street/Cambridge Road/Kaipaki Road/Silverwood Lane intersection and at the Lamb Street/Shakespeare Street intersection.

There have been three reported crashes at the Lamb Street/Cambridge Road/Kaipaki Road/ Silverwood Lane intersection. Two crashes have been minor injury crashes with one crash a serious injury crash. The reported crashes all appear to be related to the Lamb Street leg. We note that one minor injury crash was related to poor driver behaviour rather than the road environment.

There have been two minor injury crashes at the Lamb Street/Shakespeare Street intersection. The crashes were a result of vehicles failing stop at the intersection.

There have been two loss of control crashes on Cambridge Road north of the Kaipaki Rd/Cambridge Rd/Lamb St intersection near the horizontal curve which is posted with a 65km/h curve advisory sign. Both crashes and appear related to vehicles driving too fast for the conditions. Both crashes occurred in wet conditions.

There has been an injury crash every 1.6 years at the Lamb Street/Cambridge Road/Kaipaki Road/Silverwood Lane intersection and one crash every 2.5 years at the Lamb Street/Shakespeare Street intersection. The actual injury crash rate is slightly higher than the predicted crash rate for these intersections and this would be expected to increase with more traffic using the intersections in the future.

[1] https://mobileroad.org/desktop.html

2.4. Lamb Street Existing Cross Section

Lamb Street is a minor arterial road and has ONRC classification of primary collector. The posted speed limit is 80km/h but would likely reduce to 60km/h with development of the structure plan and associated roundabouts. The existing road reserve is 20.1m wide. The existing carriageway is approximately 7.9m wide and consists of two lanes and narrow (<0.5m) shoulders.

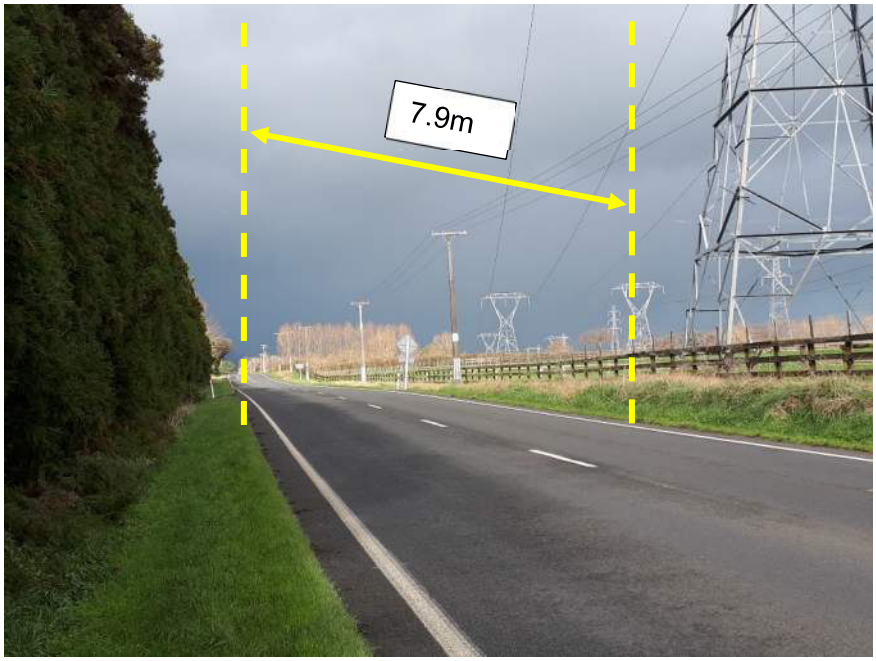


Figure 2: Existing Lamb Street carriageway

2.5. Cambridge Road Existing Cross Section

Cambridge Road is a major arterial road in the District Plan and has an ONRC classification of an arterial road. The carriageway is approximately 8.5m wide and consists of two traffic lanes and shoulders. There are right turn bays on Cambridge Road for turning into Kaipaki Road and Lamb Street and a left turn lane on Cambridge Road (south) for turning into Kaipaki Road.

2.6. Access to 3838 Cambridge Road

The vehicle crossing for access to 3838 Cambridge Road is located approximately 100m west of Matos Segedin Drive and opposite an industrial vehicle crossing (garden supplies business). There are right turn bays on Cambridge Road into Matos Segedin Drive and the garden supplies business vehicle crossing. Visibility is restricted by the horizontal and vertical alignment of Cambridge Road. The right turn bay at the industrial vehicle crossing makes access to this property potentially confusing for vehicles turning right.

Clearway Consulting completed an assessment[2] for 3838 Cambridge Road which included an assessment of speed and crashes on Cambridge Road. At the time of the assessment the speed limit on this section of Cambridge Road was 100km/h. The assessment concluded that there may be some justification for lowering the speed limit to 70km/h or 80km/h. We note that the speed limit has changed to 80km/h as part of the recent Waipa Speed Limits Bylaw update.

2.7. Lamb Street/ Kaipaki Road/ Cambridge Road Intersection

The existing intersection is a staggered “T” intersection. There is approximately 35m separation between the two intersections. The intersections are stop controlled on both the Kaipaki Road and Lamb Street approaches.

[2] Speed Limits 3838 Cambridge Road, Cambridge – Urban Village Property Limited (20 February 2014)

There are right turn bays on Cambridge Road for movements into Kaipaki Road and Lamb Street. There is a left turn deceleration lane for movements into Kaipaki Road from Cambridge Road. Silverwood Lane currently forms a “T” intersection with Lamb Street. The existing intersection layout is shown in Figure 3 below.

Based on crash prediction models[3] the estimated crash rate for the intersection is 0.334 injury crashes/year or an injury crash approximately every 3 years, we note that there have been three crashes at the intersection within the last five years (or 1.6 injury crashes/year). The intersection is performing poorer than expected.

Figure 3: Kaipaki Road/Cambridge Road/Lamb Street Intersection

2.8. Silverwood Lane/Lamb Street intersection

Silverwood Lane is local road which forms a stop controlled priority intersection with Lamb Street. There is approximately 30m separation from the Cambridge Road intersection. This does not meet minimum separation requirements for the current posted speed of 100km/h.

The traffic volume on Silverwood Lane is estimated to be 76veh/day, equivalent to trip generation for approximately eight residential dwellings. Silverwood Lane will require realignment due to the proposed roundabout and residential development within the structure plan.

[3] NZTA Crash Estimation Compendium

Figure 4: Existing Silverwood Lane Intersection

2.9. Lamb Street/ Shakespeare Street

The existing crossroads intersection is priority controlled with stop control on the Shakespeare Street approaches. There have been two crashes within the last five years relating to vehicles on Shakespeare Street failing to give way. There is likely to be an increase in movements at the intersection due to development within the structure plan resulting in more trips to the Leamington Village and school via Lamb Street.

During a site visit we noted that there have been some minor improvements such as kerb and channel. Given the proximity of the intersection to the school it would be prudent to provide a safe form of intersection whilst controlling speeds at the intersection.

Figure 5: Existing Shakespeare Street Intersection

2.10. Walking and Cycling

There are currently no walking or cycling facilities located near the C4 growth cell. There is a footpath on Lamb Street east of Rawlings Place which provides a connection to Leamington School and an existing path on Cambridge Road which terminates on Cambridge Road approximately 320m east of the Matos Segedin Drive/Cambridge Rd intersection.

3. THE PROPOSAL

3.1. Description

The C4 Growth Cell is identified in the Waipa District Growth Strategy. Through Plan Change 5 to the Waipa District Plan it has been confirmed as a Residential Zone with the timeframe for development being “now to 2035”. We understand that Growth Cell C4 could accommodate 1,020 lots.

3.2. Trip Generation

We understand that the Growth Cell could provide approximately 1,020 dwellings. The NZTA Research Report 453 (RR453) provides trip generation rates for various residential activities. The 85th percentile trip generation rates and trip generation for dwellings are summarised in Table 2 based on 1,020 lots.

Activity	Units	Peak hour		Daily	
		Rate	Trips (veh/hr)	Rate	Trips (veh/day)
Dwelling (inner suburban)	1,020	1.2/unit	1,224	10.9/unit	11,118

Table 2: 85th Percentile Trip Generation

We have based our assessment on trip generation rates for inner suburban dwellings. As the site is slightly remote from Leamington, the daily trip generation could be less. For the purposes of this assessment we have assessed trip generation as approximately 11,100 veh/day and 1,200 veh/hr.

Our assessment of trip generation is based on one dwelling per lot. There is a risk that trip generation could be higher if the lots were developed as duplexes. We understand that the estimate of 1,020 lots is a conservative estimate and likely to be less once other infrastructure such as stormwater treatment wetlands, parks and open spaces have been identified.

3.3. Trip Distribution

As the subdivision layout is not yet available, we have divided the proposed residential area into three broad catchments. However, all access will via two intersections on Lamb Street.

We have considered providing access to Area A directly to Cambridge Road via a new intersection (indicated by the blue star on Figure 6). Following consultation with Waipa DC this intersection has not been included. Council’s preference is that the Lamb Street/ Kaipaki Road/ Cambridge Road intersection is developed to provide access to the C4 and C11 structure plan areas. Providing another intersection on Cambridge Road would minimise travel distance for trips to/from Area A. However, it would introduce a new intersection on the major arterial network which is inconsistent with good traffic engineering practice. The intersection would also increase delay and increase the risk of crashes for trips along Cambridge Road.

The catchments are summarised in the figure and table below.

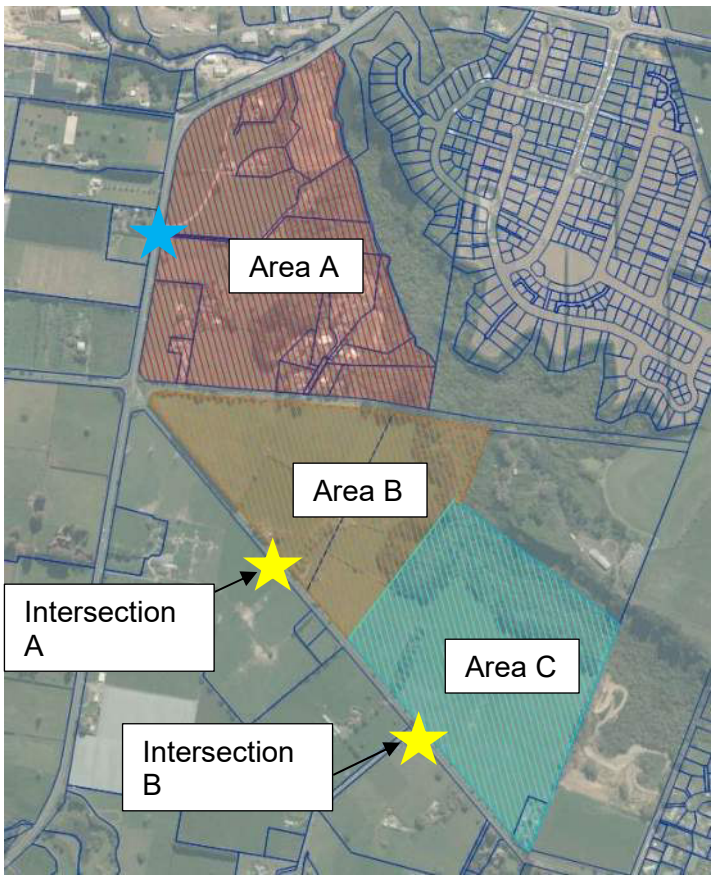


Figure 6: Development Areas (yellow star = possible intersections)

Based on the areas shown in Figure 6 we have distributed the total vehicle trips at the intersection based on percentage of land area as shown in Table 3 below.

Area	% Land Area	Lots (% of 1020 lots)	Daily trips (10.9/unit)	Peak hour (1.2/unit)
Area A	42%	428	4,665	514
Area B	28%	286	3,117	343
Area C	30%	306	3,335	367
Total		1,020	11,117	1,224

Table 3: Anticipated trip generation at intersections

We anticipate that most vehicles will be travelling towards Cambridge during the morning peak and returning via Cambridge during the afternoon peak. Some residents may commute to Hamilton via Kaipaki Road or to Te Awamutu via Cambridge Road.

The shortest route into Cambridge is north via Cambridge Road. This will require right turns out of the intersections including the Lamb St/Cambridge Rd/Kaipaki Rd intersection as well. Given that Leamington School is located south of the site we anticipate some trips to Cambridge will be via Shakespeare Street (left turn at the intersections).

Based on the above assumptions we have summarised the peak hour movements for each intersection in Table 4 (AM peak) and Table 5 (PM peak).

Intersection	AM Peak Total	Exiting (80%)		Entering (20%)	
		Left out (20%)	Right out (80%)	Left in (80%)	Right in (20%)
Intersection A	857 veh/hr	137 veh/hr	549 veh/hr	137 veh/hr	35 veh/hr
Intersection B	367 veh/hr	59 veh/hr	235 veh/hr	59 veh/hr	15 veh/hr
Total	1,224 veh/hr	196 veh/hr	784 veh/hr	196 veh/hr	50 veh/hr

Table 4: AM Peak volumes

Intersection	PM Peak Total	Exiting (20%)		Entering (80%)	
		Left out (80%)	Right out (20%)	Left in (20%)	Right in (80%)
Intersection A	857 veh/hr	137 veh/hr	35 veh/hr	137 veh/hr	549 veh/hr
Intersection B	367 veh/hr	59 veh/hr	15 veh/hr	59 veh/hr	235 veh/hr
Total	1,224 veh/hr	196 veh/hr	50 veh/hr	196 veh/hr	784 veh/hr

Table 5: PM Peak volumes

3.4. Structure Plan Access

3.4.1. Proposed Intersections

New intersections will be required on Lamb Street to serve the proposed development. The posted speed limit on both Lamb Street and Cambridge Road was reduced to 80km/h in November 2019. Therefore, we have used a design speed of 90km/h for new intersection the concept design

As part of future works, we recommend that the posted speed limit on Lamb Street is changed to 50km/h or 60km/h depending on the form of the intersections and level of direct property access.

We have summarised the intersection spacing and sight distance requirements for a 90km/h design speed in Table 6. We note that the Regional Infrastructure Technical Specification (RITS) requirement for intersection spacing is based on road hierarchy rather than speed environment.

Criteria	Reference	90km/h	Comment
Safe Intersection Sight Distance	Austroads Part 4A	214m	Based on reaction time of 2.0 seconds
Vehicle crossing separation to intersection	Waipa District Plan	200m	
Intersection spacing – same side	RITS	90m	Based on spacing for arterial roads
Intersection spacing opposite side	RITS	45m	Based on spacing for arterial roads

Table 6: Intersection design criteria

We understand Council's preference is for two intersections on Lamb Street with no direct access to Cambridge Road. Our preferred locations are shown in Figure 7 below. The locations are based on providing minimum sight distance from the intersection and minimum separation of 90m to other intersections. The layout assumes that there will be no access to the structure plan area via the Kaipaki Road/Cambridge Road/Lamb Street intersection or Cambridge Road. If an access to the C4 Growth Cell were provided at the Kaipaki Road/ Cambridge Road /Lamb Street intersection, then it is likely that only one intersection on Lamb Street would be required.

There are existing residential vehicle crossings located on the opposite side of Lamb Street which may not meet minimum separation to the new intersections. The vehicle crossings are low volume and the non-compliance is unlikely to result in significant adverse safety effects.

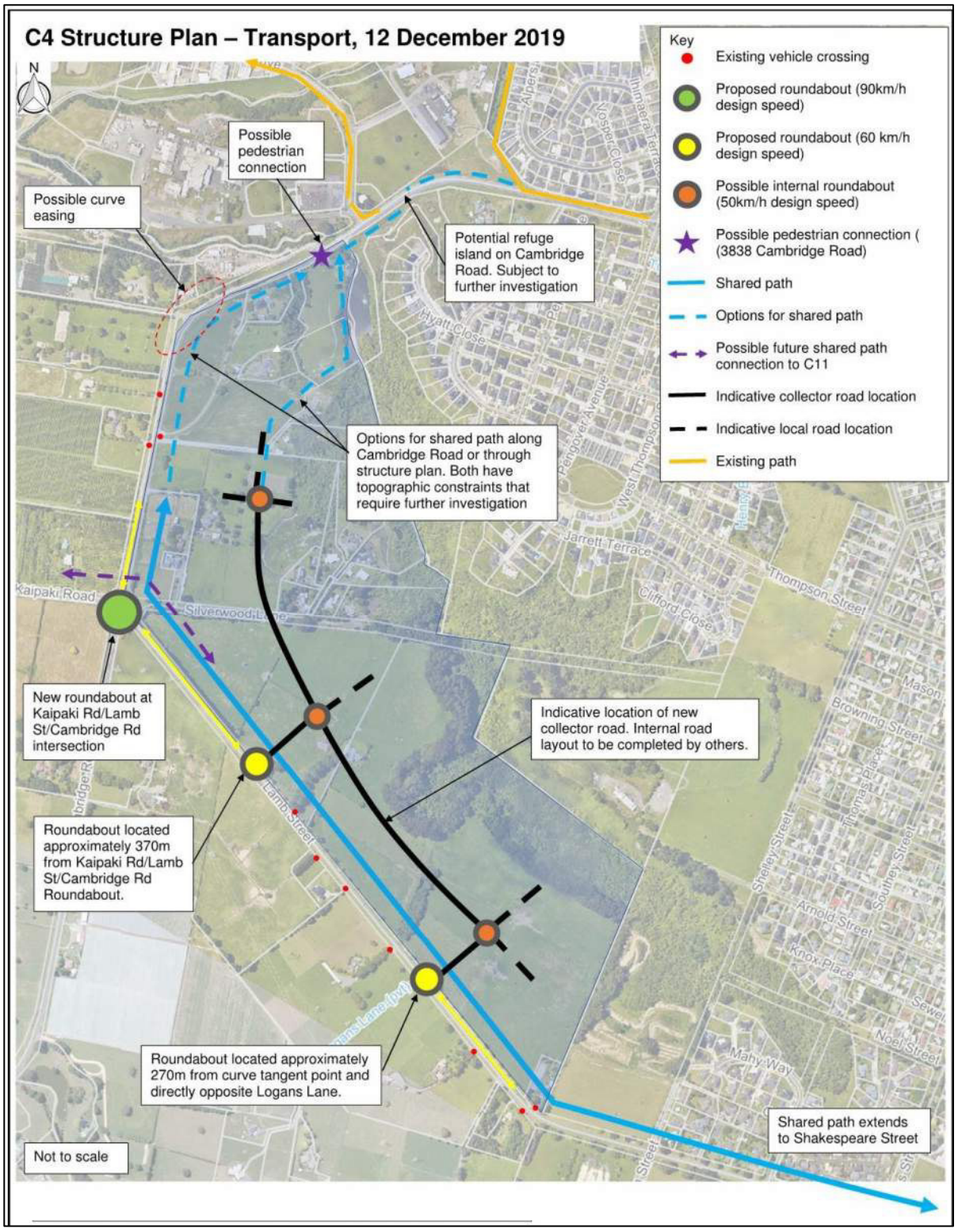


Figure 7: Structure Plan – Transport Layout (refer Appendix 1 for larger copy)

3.4.2. Arterial/ Collector Road Intersections

Austroads Guide to Traffic Management provides guidance on intersection traffic controls based on road hierarchy. Lamb Street is a minor arterial road, meaning that roundabouts and priority-controlled intersections are the most appropriate forms of intersection.

Road type	Primary arterial	Secondary arterial	Collector and local crossing road	Local street
Roundabouts				
Primary arterial	A	A	X	X
Secondary arterial	A	A	A	X
Collector & local crossing road	X	A	A	O
Local street	X	X	O	O
Traffic signals				
Primary arterial	O	O	O	X
Secondary arterial	O	O	O	X
Collector & local crossing road	O	O	X	X
Local street	X	X	X	X
***Stop* signs or *give way* signs**				
Primary arterial urban/(rural)	X/(X)	X/(O)	A	A
Secondary arterial urban/(rural)	X/(O)	X/(O)	A	A
Collector & local crossing road	A	A	A	A
Local street	A	A	A	A

A = Most likely to be an appropriate treatment
O = May be an appropriate treatment
X = Usually an inappropriate treatment.

Figure 8: Austroads Guide to Traffic Management – Intersections, Interchanges and Crossings (Table 2.6 – suitability of types of traffic control)

Austroads[4] provides guidance on warrants for turning treatments at priority-controlled intersections. The peak hour right turning volumes are likely to exceed 20 veh/hr and the Lamb Street peak hour volume is 308 veh/hr therefore, a right turn treatment is required at each of the intersections.

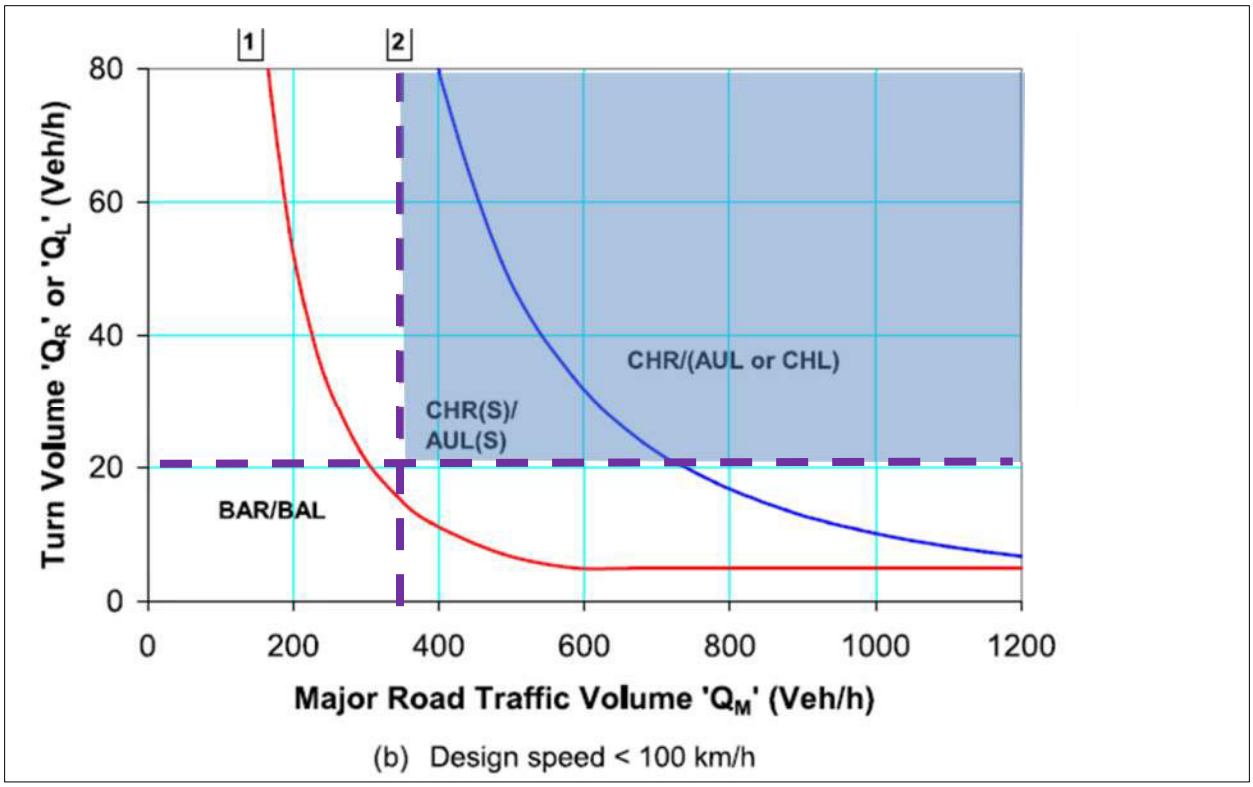


Figure 9: Austroads Turn Warrants

We have completed SIDRA traffic modelling for Intersection A which is likely to generate the most traffic during AM peak. We have tested both a priority-controlled intersection and a roundabout.

[4] Guide to Road Design Part 4: Intersections and Crossings – Figure A 10

We have assumed that 11% of AADT occurs during peak time on Lamb Street (308 veh/hr) and allowed for a 50:50 directional split on Lamb Street (154 veh/hr northbound and 154 veh/hr southbound).

The SIDRA modelling for the priority-controlled intersection shows delays and queues of just under 30sec/veh and 95%ile queues of just under 180m. The delays and queues are related to the high number of vehicles turning right out of the intersection. In practice, drivers may turn left-out to avoid long delays. Long delays can lead to driver frustration and crashes.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Lamb St (NB)												
2	T1	154	10.0	0.084	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
3	R2	35	10.0	0.028	5.7	LOS A	0.1	0.9	0.39	0.57	0.39	45.2
Approach		189	10.0	0.084	1.1	NA	0.1	0.9	0.07	0.11	0.07	49.0
East: New Road A												
4	L2	137	10.0	0.921	21.5	LOS C	23.6	179.5	0.86	1.77	2.97	36.3
6	R2	549	10.0	0.921	27.8	LOS D	23.6	179.5	0.86	1.77	2.97	36.0
Approach		686	10.0	0.921	26.6	LOS D	23.6	179.5	0.86	1.77	2.97	36.1
North: Lamb St (SB)												
7	L2	137	10.0	0.163	4.7	LOS A	0.0	0.0	0.00	0.25	0.00	47.9
8	T1	154	10.0	0.163	0.0	LOS A	0.0	0.0	0.00	0.25	0.00	48.5
Approach		291	10.0	0.163	2.2	NA	0.0	0.0	0.00	0.25	0.00	48.3
All Vehicles		1166	10.0	0.921	16.4	NA	23.6	179.5	0.52	1.12	1.76	40.4

Table 7: SIDRA Modelling – Movement Summary

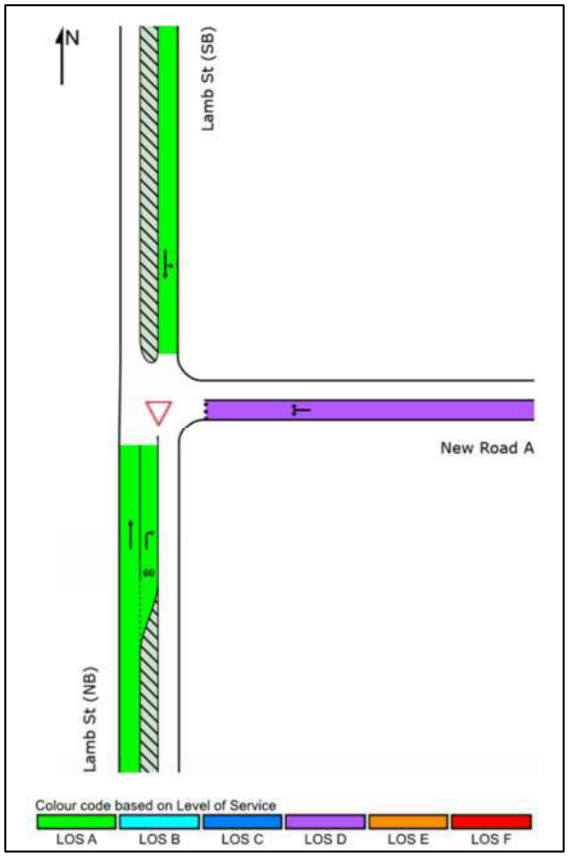


Figure 10: LOS Diagram - Priority Controlled Intersection

A roundabout is more efficient for all legs with the intersection operating at Level of Service (LOS) A. The roundabout will provide a safer intersection when compared to a priority-controlled intersection.

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Lamb St (NB)												
2	T1	154	10.0	0.221	5.3	LOS A	1.5	11.4	0.73	0.67	0.73	47.2
3	R2	35	10.0	0.221	11.1	LOS B	1.5	11.4	0.73	0.67	0.73	47.8
Approach		189	10.0	0.221	6.4	LOS A	1.5	11.4	0.73	0.67	0.73	47.4
East: New Road A												
4	L2	137	10.0	0.523	3.6	LOS A	4.7	35.3	0.53	0.59	0.53	45.2
6	R2	549	10.0	0.523	8.9	LOS A	4.7	35.3	0.53	0.59	0.53	47.0
Approach		686	10.0	0.523	7.8	LOS A	4.7	35.3	0.53	0.59	0.53	46.6
North: Lamb St (SB)												
7	L2	137	10.0	0.193	2.4	LOS A	1.4	11.0	0.20	0.27	0.20	48.4
8	T1	154	10.0	0.193	1.9	LOS A	1.4	11.0	0.20	0.27	0.20	49.9
Approach		291	10.0	0.193	2.2	LOS A	1.4	11.0	0.20	0.27	0.20	49.2
All Vehicles		1166	10.0	0.523	6.2	LOS A	4.7	35.3	0.48	0.52	0.48	47.3

Table 8: SIDRA Modelling – Movement Summary

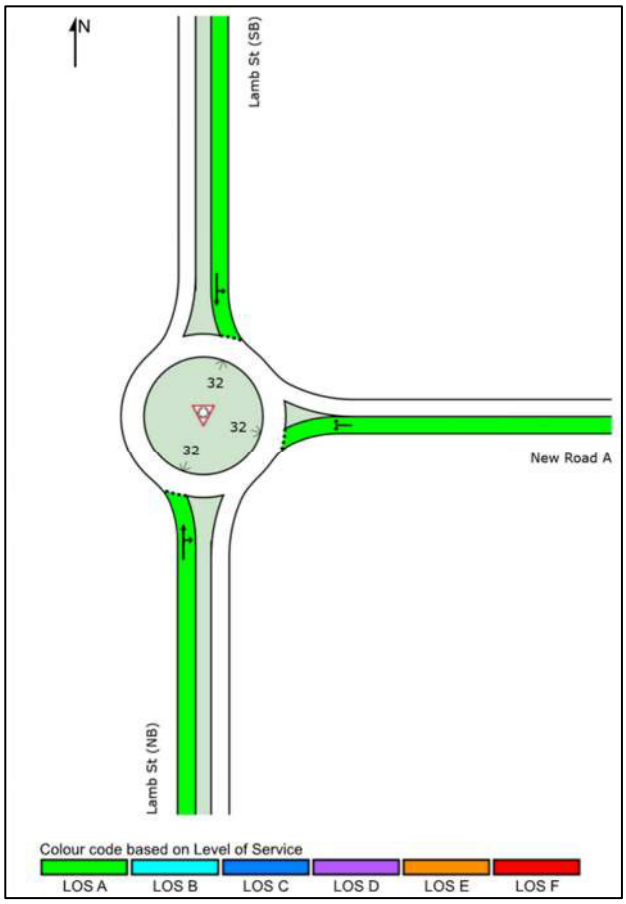


Figure 11: LOS Diagram - Roundabout

Given the relatively high volume of traffic at the intersections and better safety performance we prefer that the intersections are formed as roundabouts.

We have completed a generic concept design for an arterial road/collector road roundabout based on the design criteria summarised in Table 9. The concept layout is based on a 16m central island radius which is suitable for a design speed of 70km/h. The concept layout indicates a possible fourth leg if required (e.g. Logans Lane).

Criteria	
Design Speed	70 km/h
Central Island Radius	16m
Circulating width (single Lane)	7m
Inscribed circle diameter (ICD)	46m
Criterion 2 visibility	70m
Design vehicle	Semi-trailer

Table 9: Roundabout Design Criteria - collector road intersections

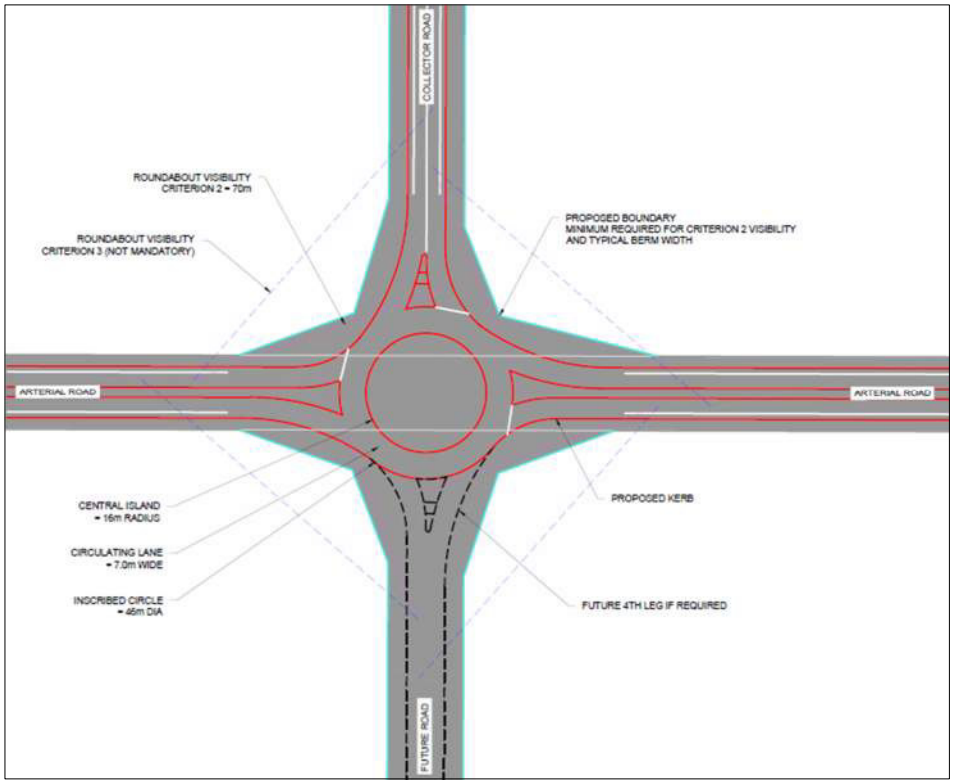


Figure 12: Typical arterial/collector road roundabout (also refer to Appendix 2)

3.5. Minor Arterial Cross Section (Lamb Street and Cambridge Road)

The District Plan does not provide specific design criteria for an arterial road.

We recommend that the Lamb Street and Cambridge Road cross-sections include two 3.5m lanes, 1.5m shoulders/on-road cycle lane on both sides and a 3m wide shared path on the development side. Typically, the District Plan[5] requires 2.1m wide utility corridor on both sides for residential roads. The proposed cross-section allows for a 2.5m wide utility corridor on the development side and a 4.6m wide berm on the opposite side of the road to allow for drainage swale or future footpath.

[5] Waipa District Plan Appendix T4 – Criteria for Public and Private Roads.

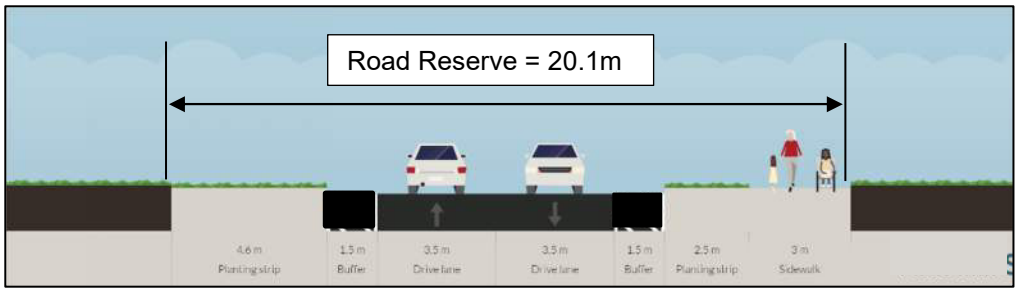


Figure 13: Proposed Cross Section for Lamb Street and Cambridge Road

Providing direct property access to a minor arterial is not consistent with its primary mobility function. We do note that the ONRC classification is Primary Collector which generally have a higher degree of property access. Providing direct property access to Lamb Street is likely to be acceptable if the posted speed on Lamb Street reduces to 50km/h.

3.6. Lamb Street/ Kaipaki Road/ Cambridge Road Intersection

3.6.1. Intersection Form

Given the increase in traffic volumes at this intersection, a roundabout appears to be the most appropriate form of intersection rather than a signalised intersection. A roundabout provides a safe system solution consistent with Vision Zero and would provide a rural/urban threshold.

The difference in safety performance between other intersections in particular traffic signals is mainly attributable to the higher potential speed of vehicles that are possible at a signalised intersection. A well-designed roundabout will achieve lower relative speeds through geometric design and should therefore experience less severe injuries when crashes do occur. In addition, the number of conflict points is greatly reduced from 32 at traffic signals to 16 at a multi-lane roundabout (for four leg intersections).

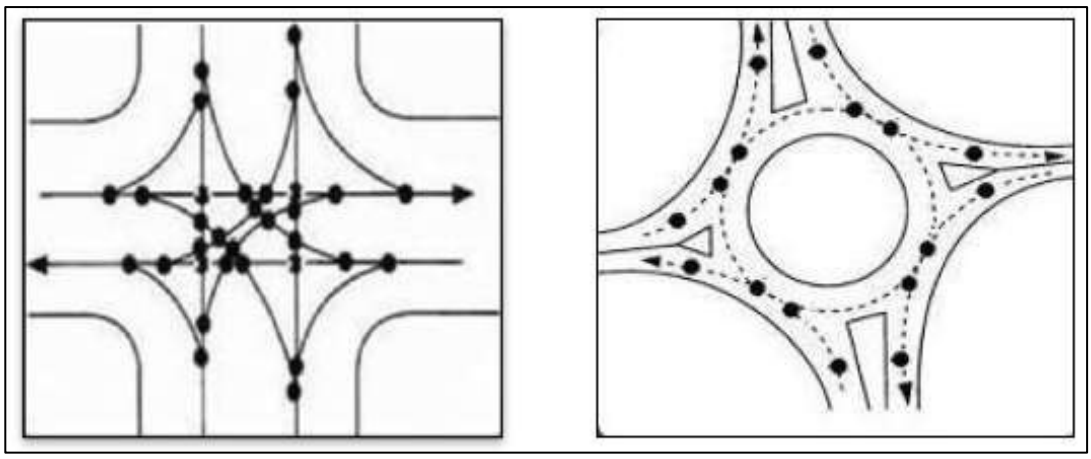


Figure 14: Vehicle conflict points. Traffic signals = 32 conflict points, multi-lane roundabout = 16 (Source: NZ Transport Agency Research Report 476)

It is important to note that most of the research is specifically relevant to urban areas with speed limits ≤50km/hr and focused on intersections with daily traffic volumes >20,000vpd. The research found that no pedestrian fatality was reported at any roundabout in New Zealand during 2005-2008, compared to 11 at traffic signal intersections. This could be a result of a reduced exposure if pedestrians are avoiding roundabouts and crossing elsewhere.

We have completed concept design for a single lane roundabout at the Kaipaki Road/Lamb Street/Cambridge Road intersection. The roundabout is based on the following design criteria.

Criteria	
Design Speed	90km/h (refer to table shown on drawing for approach design speeds)
Central Island Radius	22m
Circulating width (single Lane)	6.5m
Inscribed circle diameter (ICD)	57m
Criterion 2 visibility	70m (50km/h approach speed)
Design vehicle	Semi-trailer

Table 10: Roundabout Design Criteria

The following roundabout options have been considered (refer Appendix 2):

- Option 1: Five leg roundabout (including Silverwood Lane as a fifth leg);
- Option 2: Four leg roundabout (no Silverwood Lane approach) (two sub-options); and
- Option 3: Four leg roundabout (realigned Lamb Street approach).

Our assessment indicates that an appropriately designed roundabout can be provided as this intersection. The final location will be confirmed during detailed design. The location of the central island could be shifted which would result in affecting different properties (e.g. land take within the structure plan vs on Kaipaki Road). Our preference is to optimise the roundabout geometry by shifting the central island towards Kaipaki Road.

Land acquisition will be required for all options to comply with criterion 2 visibility. The concept plans show criterion 3 visibility requirements. This is not mandatory and could be achieved with additional land take. We note that providing visibility beyond criterion 3 can result in higher roundabout approach speeds and higher impact speeds.

Options 1 and 2A show a small radius curve (50km/h) on Cambridge Road (south) as the alignment is constrained by existing boundaries and power pylon. The approach curve could be improved during detailed design which would result in earlier visibility to the central island for approaching drivers. Option 2B results in better approach geometry when compared to the other options but requires land on Kaipaki Road.

We understand that Council's preference is a roundabout with no direct access to the structure plan. Providing a connection to Silverwood Lane at the roundabout provides more direct access to the structure plan and may reduce the need for multiple roundabouts on Lamb Street.

3.6.2. Option Assessment

We have assessed the following roundabout layouts using a high/medium/low assessment scale for a range of criteria:

- Option 1: Five leg roundabout (including Silverwood Lane as a fifth leg);
- Option 2: Four leg roundabout (no Silverwood Lane approach) (two sub-options); and
- Option 3: Four leg roundabout (realigned Lamb Street approach).

Option 2B , a four leg roundabout is the preferred option. Option 3 would be acceptable and is likely to operate efficiently and safely. The final configuration of the roundabout would be subject to detailed design.

3.6.3. Timing of Roundabout

We have completed SIDRA modelling for the existing staggered T intersection to determine when a roundabout is required at the Kaipaki Road/Cambridge Road/Lamb Street intersection. We have modelled the following three AM peak scenarios:

- Scenario A: Baseline using WRTM 2021 traffic volumes;
- Scenario B: Baseline + full development of Area C (306 lots);
- Scenario C: Baseline + full development of Area A (428 lots) and Area B (286 lots);

Scenario A operates at LOS A on both the Kaipkai Road and Lamb Street approaches. Scenario B with the addition of development traffic from Area C results in LOS B on Lamb Street. There appears to be sufficient capacity at the intersection to accommodate traffic from Area C. Adding development from Area A and Area B (Scenario C) results in LOS F on Lamb Street and LOS C on Kaipaki Road.

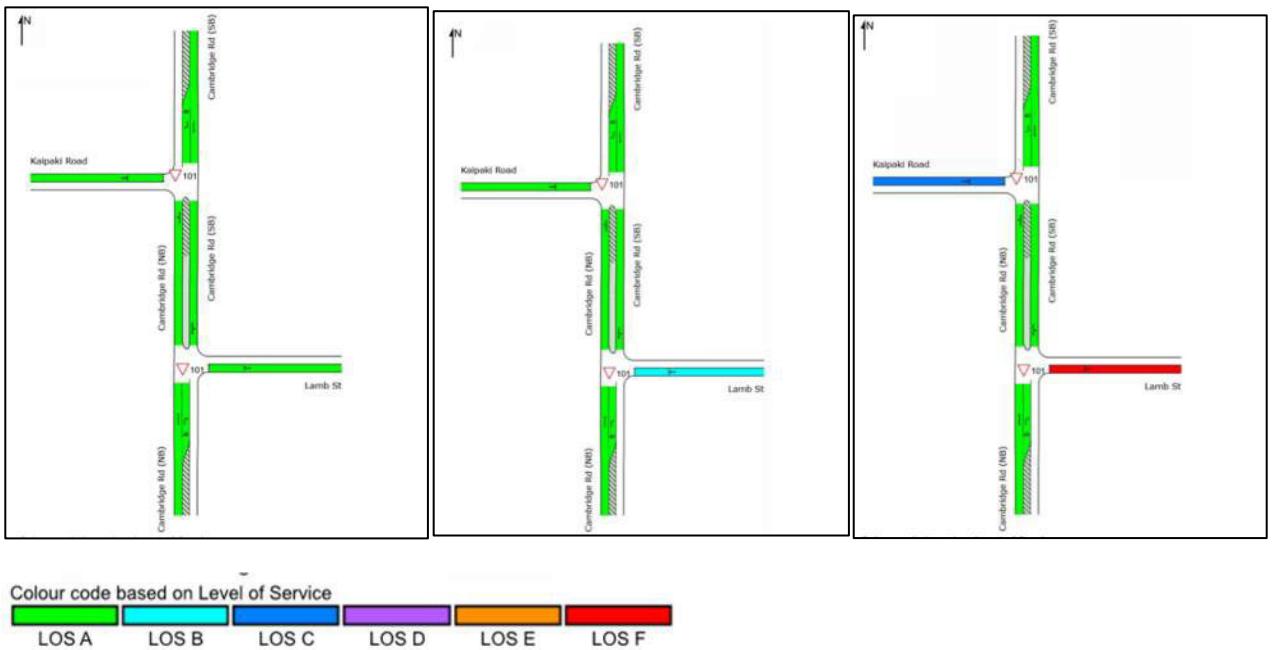


Figure 1: Lane LOS (left = Scenario A, middle = Scenario B, right = Scenario C)

We understand that it is likely that Area C will be developed first and there appears to be sufficient capacity at the existing staggered T intersection to accommodate development traffic from Area C (assumed to be 306 lots). Adding traffic from Area A and Area B results in poor LOS on Lamb Street and less than desirable LOS on Kaipaki Road. Adverse safety effects are also likely.

We note that Cambridge Road is a major arterial road and there are likely to be efficiency and safety effects during the construction of the roundabout which will result in traffic being dispersed to other parts of the traffic network during the construction period. It would be desirable to construct the

roundabout prior to development within the C4 structure plan to avoid additional development traffic being dispersed to other parts of the network during the construction period.

As mentioned above a well-designed roundabout is generally a safer intersection form compared to priority controlled intersections. SIDRA modelling indicates that there is sufficient capacity at the staggered-T intersection to accommodate development traffic from Area C. It would be desirable to construct the roundabout prior to development within the C4 structure plan. However, constructing the roundabout once Area C (or approximately 300 lots) is developed but prior to any development in Area A and B is acceptable.

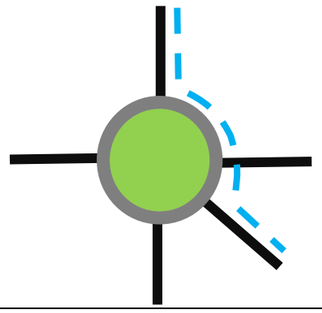
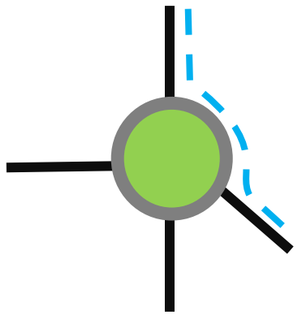
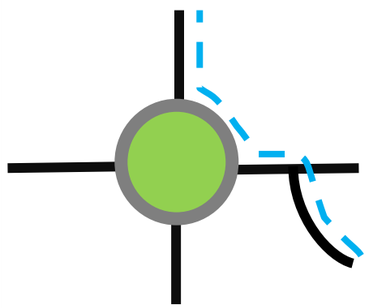
Option	Layout (blue line = shared path)	Safety	Efficiency	Cost	Pedestrians	Summary
Option 1: Five Leg roundabout (Cambridge Rd/ Kaipaki Rd/ Lamb St/ Silverwood Ln) Concept option attached at Appendix 2		**Low** • More roundabout approaches result in less desirable approach leg separation. • Introduces additional conflict points to this intersection	**Medium** • Provides direct access (gateway) to the structure plan • May only required one new intersection on Lamb Street. • Minimal impact on alignment of Lamb Street	**Medium** • Will require upgrading Silverwood Lane to accommodate increase in traffic (currently used for residential access only). • Likely to be more expensive than Option 2.	**Medium** • Will require an at grade pedestrian crossing at Silverwood Lane to provide a pedestrian connection from Lamb St to Cambridge Road (north).	**Undesirable** This option provides direct access to the structure plan. This option is likely to result in fewer intersections on Cambridge Road and Lamb Street. Increased risk of crashes at 5-leg roundabout.
Option 2: Four Leg roundabout (Cambridge Rd/ Kaipaki Rd/ Lamb St) Different options for land take are attached at Appendix 2 (Option 2A and 2B).		**Medium** • Results in two relatively close approaches (Cambridge Rd (south) and Lamb St), but complying visibility provided. • Maybe challenging for less familiar users due to closely spaced approaches.	**Low** • Provides no direct access from roundabout to structure plan • Likely to require two roundabouts on Lamb St introducing additional delay to that corridor	**Medium** • Likely to be the cheapest roundabout option, but requires two roundabouts on Lamb St	**High** • No at grade crossing required for a pedestrian connection from Lamb St to Cambridge Road (north)	**Option 2B Preferred** The option results in no direct access to the structure plan, requiring other infrastructure be provided. Access to the structure plan will be via new roundabouts on Lamb Street. Issues related to closely spaced approaches can be managed.
Option 3: Four Leg roundabout (Cambridge Rd/ Kaipaki Rd/ Silverwood Ln and re-align Lamb St) We have not yet completed a concept design for this option.		**High** • Provides the best roundabout layout in terms of approach geometry as the approach legs intersect at 90° • Only four roundabout approach legs, results in simpler roundabout geometry. • Likely to result in a safer roundabout layout compared to Options 1 and 2.	**High** • Provides direct access (gateway) to the structure plan • Only one roundabout on Lamb Street will be required.	**High** • Requires realigning Lamb Street – higher construction costs and greater property impact • Will require upgrading Silverwood Lane to accommodate increase in traffic (currently used for residential access only) • Likely to be the most expensive option • Realignment of Lamb Street results in inefficient land use in south east corner of roundabout (i.e. reduces subdivision yield).	**Medium** • Will require an at grade pedestrian crossing at Silverwood Lane to provide a pedestrian connection from Lamb St to Cambridge Road (north).	**Acceptable** This option provides direct access to the structure plan area. This option results in more desirable approach geometry, but is likely to be the most expensive option. Due to cost and inefficient land impacts this option is not preferred.

Table 11: Roundabout Option Assessment (blue dashed line = walking/cycling route)

3.7. Lamb Street/Shakespeare Street

Provided that safe walking and cycling facilities can be provided, a roundabout is our preferred option for this intersection. We have completed a concept design based on a 60km/h design speed, 10m central island radius, 6.3m wide circulating lane and large rigid truck design vehicle.

A pedestrian crossing facility is required on Shakespeare Street (north) to allow for a shared path connection along Lamb Street to Leamington School. Given that the intersection is located near a school we recommend considering implementing physical speed management such as raised safety platforms on the roundabout approaches. The raised safety platforms would also provide a crossing point for pedestrians.

There are vehicle crossings located near the intersection which may limit the length of splitter islands. This should be investigated during detailed design.

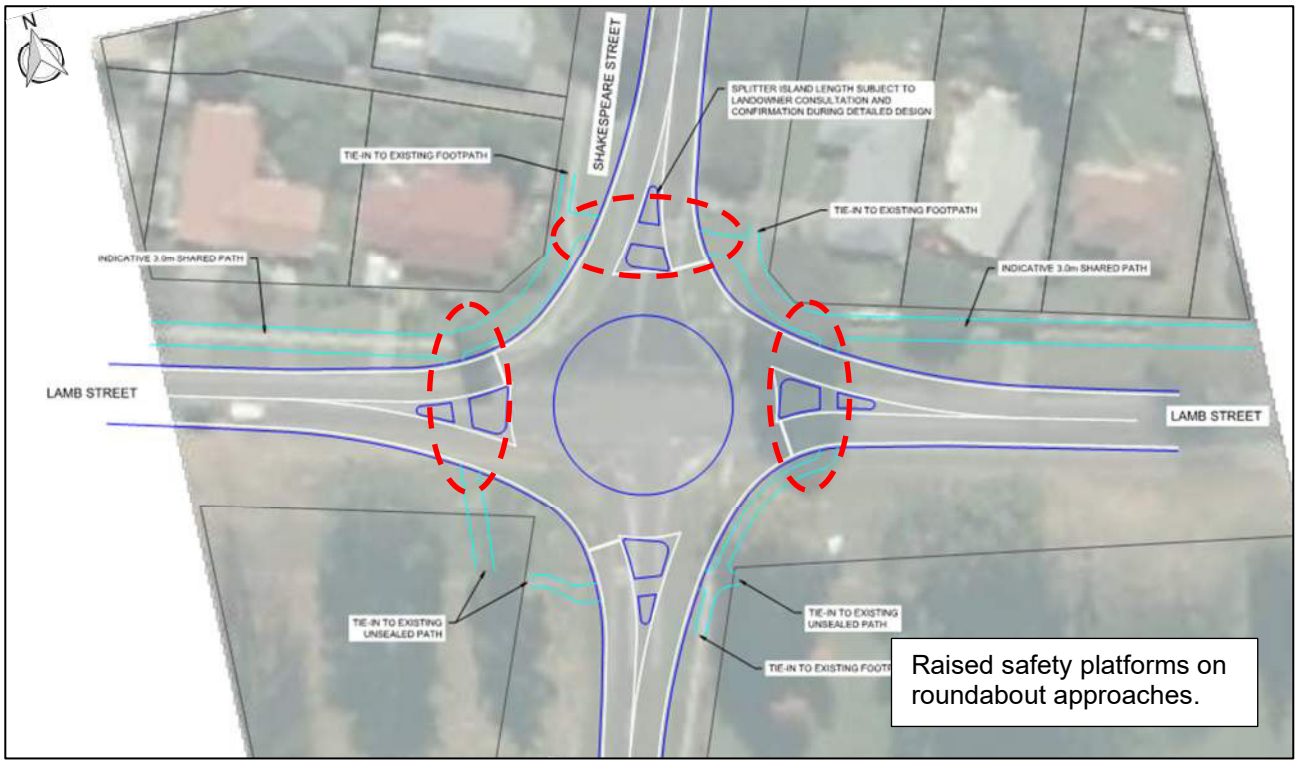


Figure 15: Lamb Street/Shakespeare Street intersection concept design

3.8. Walking and Cycling

There is likely to be an increase in walking and cycling on Lamb Street. We recommend that a shared path be provided on the development side of Lamb Street. This could be extended to provide a continuous path along Maungatautari Road to Lake Karapiro.

There are two options for a connection on Cambridge Road north of Kaipaki Road. One option is to continue the path along Cambridge Road, the other option is to provide a shared path through the development joining at 3838 Cambridge Road.

Our concept plans do not show pedestrian connections at the Cambridge Road roundabout. At this stage there is no demand for a crossing point on Cambridge Road or Lamb Street until the C11 growth cell is developed. A crossing point could be provided on Cambridge Road to provide connectivity to the future C11 growth cell.

3.9. Access to 3838 Cambridge Road

Providing a connection between 3838 Cambridge Road to the remainder of the structure plan area is likely to be very difficult due to the steep topography. The only form of access appears to be direct to Cambridge Road. The posted speed of 80km/h requires 203m sight distance[6].. The current vehicle crossing location does not comply with sight distance requirements for an 80km/h posted speed. There is unlikely to be any location that provides complying sight distance.

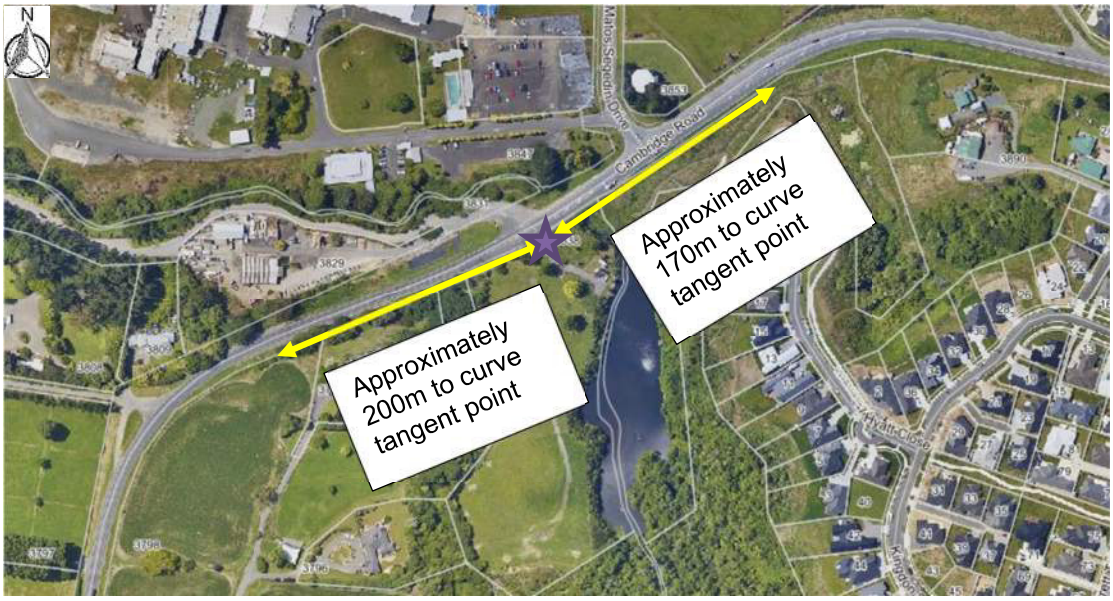


Figure 16: 3838 Cambridge Road Access (purple star = vehicle crossing)

The location of the right turn bay for access into the industrial site makes right turns in and out of 3838 Cambridge Road confusing and difficult. However, the current vehicle crossing is located directly opposite the crossing on the northern side of Cambridge Road (effectively forming a low volume crossroads intersection).

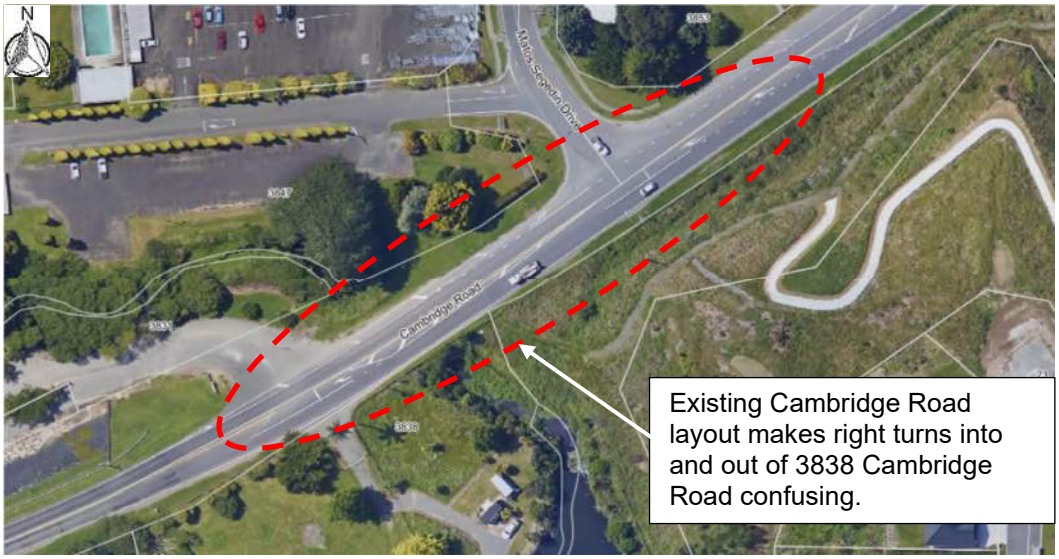


Figure 17: 3838 Cambridge Road Access (purple star = vehicle crossing)

The adverse effects of providing vehicle access to Cambridge Road will depend on the nature of the activity and trip generation of that activity. Given the location and concerns about access, it appears best suited to low trip generating activities. An alternative, could be to restrict access to left-in/left-

[6] NZTA Planning Policy Manual – Appendix 5B, Table App5B/1

out. However, this may limit use of the property and result in in appropriate u-turns elsewhere on the network.

As noted elsewhere, there is the potential for the shared path to join Cambridge Road in this area. Further investigation is required to confirm the most appropriate location for a pedestrian crossing facility.

3.10. Internal Road Layout

The internal road layout will consist of a collector road and local roads for access to individual lots. The final road layout has not been confirmed yet. The District Plan provides guidance on cross sections for residential collector roads. We recommend that the internal roads are designed to these standards.

Type and description	Road reserve width	Carriageway Width	Lane Width	Cycleway width	Street Parking widths	Kerb	Berm swale etc	Path	Utilities
Collector	25m	15m	2 x 3.5m	Both sides 1.5m	1 park per lot @ 2.5m wide	Barrier	Both sides	2 x 1.5m	Both sides 2.1m min

Table 12: Waipa District Collector Road Standards (Appendix T4)

We recommend that all internal collector road intersections are designed to allow for a central throat island. The island width should be at least 1.8m wide to shelter pedestrians. Roundabouts or raised safety platforms are preferred at crossroads intersections.

The final layout of internal intersections will need to be confirmed at detailed design stage and should include:

- Intersection design in accordance with the RITS and current design best practice.
- Providing minimum safe intersection sight distance based on the proposed internal road posted speed.
- Providing channelisation at the intersection with throat islands.
- All marking and signs are in accordance with the Traffic Control Devices Rule and MOTSAM.
- Providing appropriate street lighting at the intersections.

3.11. Parking

We anticipate that on-site parking will be provided for each lot. The District Plan requires 1 parking space per lot.

District Plan Appendix T4 recommends that residential collector road and local roads provide one on-street space per lot. The requirement for cul-de-sac is 0.75 parking spaces per lot. We recommend that each structure plan road provides sufficient on street parking. The use of recessed parking is increasingly common in residential subdivisions.

4. DISCUSSION

4.1. Efficiency

The proposed structure plan will result in an additional 1,020 lots generating approximately 11,100 veh/day.

Assuming 80% of traffic heads north to Cambridge, the traffic volume on Cambridge Road will increase in by approximately 8,900veh/day. The proposal is likely to more than double the existing traffic volume on Cambridge Road with approximately 16,000veh/day once the structure plan is fully developed.

We have completed SIDRA modelling for Intersection A on Lamb Street for both a roundabout and a priority-controlled intersection. The Sidra modelling indicates that there are likely to be delays and queues on the structure plan road during the AM peak if the intersection is formed as a priority-controlled intersection. A roundabout is more efficient and safer than a priority-controlled intersection.

We recommend that Lamb Street and Cambridge Road are upgraded to accommodate the additional traffic. Our preferred cross-section is shown below.

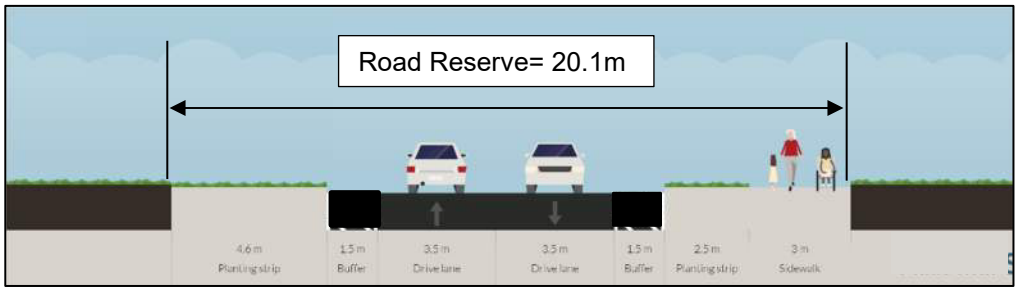


Figure 18: Proposed Cross Section for Lamb Street and Cambridge Road

4.2. Safety

There will be an increase in turning movements on Lamb Street and at the Kaipaki Road/ Cambridge Road/ Lamb Street intersection. The increase in turning movements increases the risk of crashes.

The existing staggered-T intersection could accommodate traffic from Area C (or approximately 300 lots) but is unlikely to safely accommodate traffic from the entire development. Typically, well designed roundabouts are safer compared to priority-controlled intersections as there are less conflict points and speeds are generally controlled with approach and entry geometry. Upgrading the existing intersection to a roundabout will result in a safer form of intersection.

It would be desirable to construct the roundabout prior to development within the C4 structure plan. However, constructing the roundabout once Area C (approximately 306 lots) is developed and prior to any development in Area A and B is acceptable.

4.3. Internal Road Layout

We recommend that the internal road layout is designed to meet the District Plan requirements. We anticipate that the roads forming intersections with Lamb Street and Cambridge Road are likely to be collector roads with the other roads formed to local residential road standards.

4.4. Walking and Cycling

We recommend that a shared path is provided from Leamington School to the structure plan. Further investigation is required to determine the feasibility of a shared path north of the Kaipaki Road intersection on Cambridge Road. There appears to be two options for a shared path. One option

would be a shared path within the road reserve on Cambridge Road and the other option is a shared path connection within the development to 3838 Cambridge Road.

5. CONCLUSION

5.1. Summary

The C4 growth cell could yield approximately 1,020 lots. Based on typical trip generation rates this could generate approximately 11,100 veh/day and 1,200 veh/hr. The existing Kaipaki Road/ Cambridge Road/ Lamb Street intersection is not considered appropriate to accommodate all the additional traffic. Therefore, we recommend that the intersection is upgraded to a roundabout.

The structure plan should include an internal collector road that joins the arterial network at a series of roundabouts.

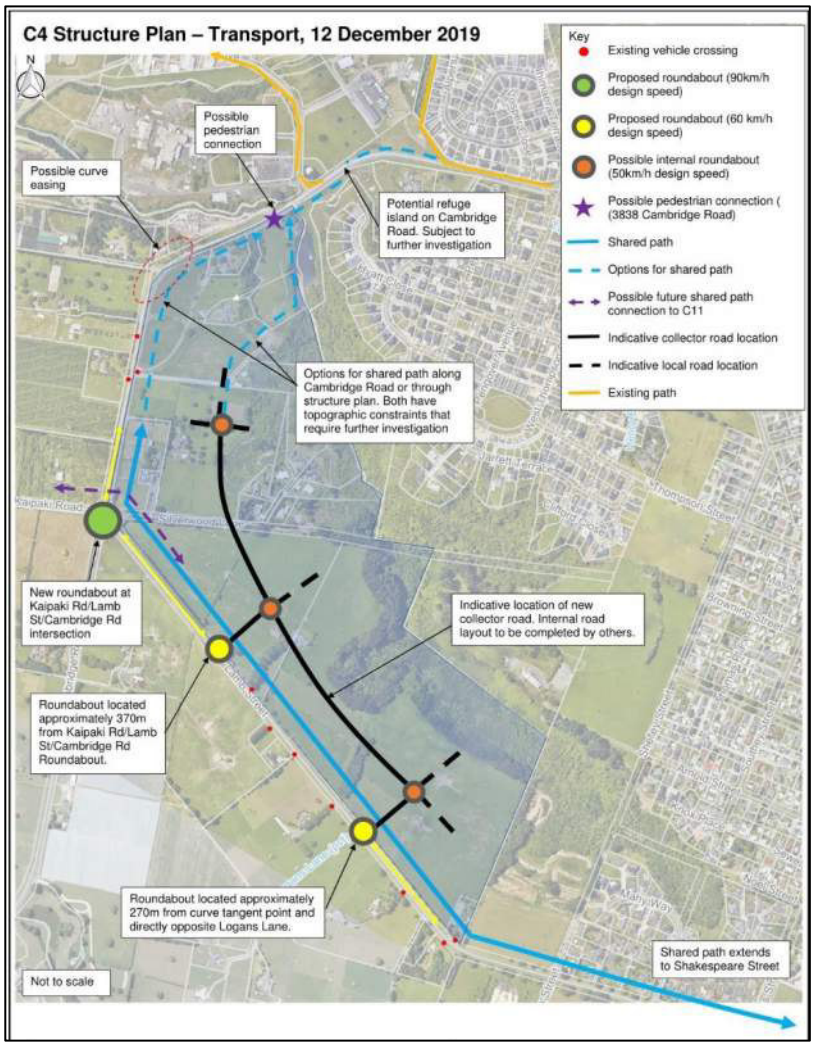


Figure 19: Structure Plan – Transport Layout (refer Appendix for larger copy))

5.2. Recommendations and Conclusion

Based on providing 1,020 lots the following transport infrastructure is required:

- A roundabout at the Kaipaki Road/Cambridge Road/Lamb Street intersection;
- 3m wide shared path on Lamb Street and Cambridge Road with links through the development;
- Roundabouts at new intersections on Lamb Street;
- Roundabout at the Lamb Street/ Shakespeare Street intersection;
- Upgrading Lamb Street and Cambridge Road to arterial road standards; and
- Walking and cycling connection via 3838 Cambridge Road.

Provided that the infrastructure improvements are staged in a way to suit the development, the transport effects of residential development in the C4 growth cell are likely to be acceptable.

APPENDICES

Appendix 1: Structure Plan layout

C4 Structure Plan – Transport, 12 December 2019

Possible pedestrian connection

Possible curve easing

Potential refuge island on Cambridge Road. Subject to further investigation

Options for shared path along Cambridge Road or through structure plan. Both have topographic constraints that require further investigation

New roundabout at Kaipaki Rd/Lamb St/Cambridge Rd intersection

Indicative location of new collector road. Internal road layout to be completed by others.

Roundabout located approximately 370m from Kaipaki Rd/Lamb St/Cambridge Rd Roundabout.

Roundabout located approximately 270m from curve tangent point and directly opposite Logans Lane.

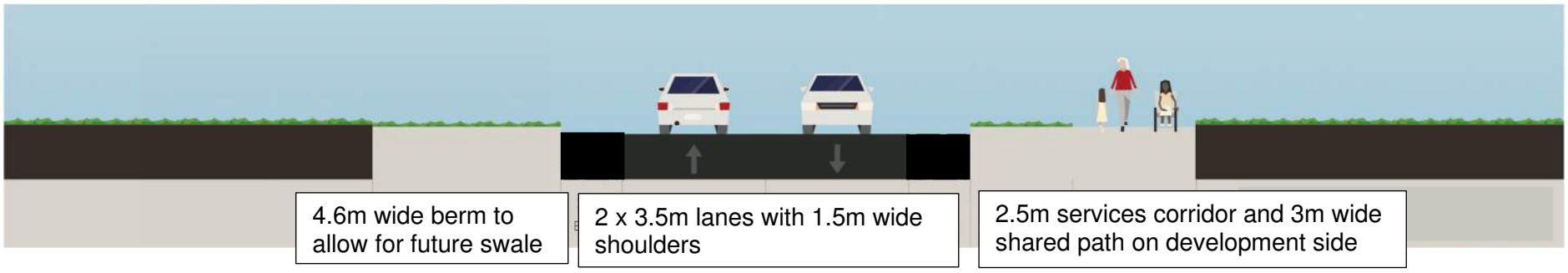
Shared path extends to Shakespeare Street

Not to scale

Key

- Existing vehicle crossing
- Proposed roundabout (90km/h design speed)
- Proposed roundabout (60 km/h design speed)
- Possible internal roundabout (50km/h design speed)
- Possible pedestrian connection (3838 Cambridge Road)
- Shared path
- Options for shared path
- Possible future shared path connection to C11
- Indicative collector road location
- Indicative local road location
- Existing path

Lamb St and Cambridge Rd (north of Kaipaki Rd) typical cross section



4.6m wide berm to allow for future swale

2 x 3.5m lanes with 1.5m wide shoulders

2.5m services corridor and 3m wide shared path on development side

Appendix 2: Intersection Concept Drawings

0mm 100mm 200mm

NOTES:
1. THIS PLAN IS A CONCEPT ONLY, BASED ON AERIAL PHOTOS AND LINZ BOUNDARY INFORMATION.
2. FINAL INTERSECTION LAYOUT AND LAND REQUIREMENTS WILL BE SUBJECT TO TOPO SURVEY AND DETAILED DESIGN.
3. REFER TO SEPARATE TABLE FOR FUTURE SPEED ZONE CHANGES AND DESIGN SPEEDS.

SPEEDS (km/h)	Cambridge Rd	Kaipaki Rd	Lamb St
Current posted speed	100	100	100
Proposed speed limit	80	100	80
Design Speed	90	110	90

SILVERWOOD LANE

N

LAMB STREET

PROPOSED BOUNDARY
LAND REQUIRED = 1260m2

PROPOSED BOUNDARY
LAND REQUIRED = 1395m2

CAMBRIDGE ROAD

CIRCULATING LANE
= 6.5m WIDE

CENTRAL ISLAND
= 22m RADIUS

INSCRIBED CIRCLE
= 57m DIA

CURRENT ROAD DESIGN CONSTRAINED BY PROPERTY BOUNDARY.
ROAD CENTRELINE RADIUS COULD BE IMPROVED, HOWEVER LAND PURCHASE MAY BE REQUIRED.

FUTURE ROAD UPGRADE
CONSTRAINED BY POWER PYLON
AND ROAD SAFETY BARRIER

CAMBRIDGE ROAD

PROPOSED BUNDS TO RESTRICT THROUGH VISIBILITY

KAIPAKI ROAD

FEATURES KEY

- PROPOSED KERB
- PROPOSED ROADMARKING
- PROPOSED BUND
- PROPOSED BOUNDARY
- VISIBILITY (CRITERION 2)
- VISIBILITY (CRITERION 3 - NOT MANDATORY)

PROPOSED ROUNDABOUT CONCEPT - OPTION 1 LAMB ST / CAMBRIDGE RD / KAIPAKI RD

REF	AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D. MILLS		08 / 19
DRAWN	D. MILLS	V. PRAKASH	09 / 19

RECOMMENDED _____ DATE _/_/_

APPROVED _____ DATE _/_/_

OFFICE: gray matter

CLIENT: Waipa DISTRICT COUNCIL

PROJECT: WAIPA DISTRICT COUNCIL
C4 STRUCTURE PLAN

SHEET TITLE: LAMB ST / CAMBRIDGE RD / KAIPAKI RD
PROPOSED ROUNDABOUT CONCEPT - OPTION 1

STATUS: CONCEPT
GEODEITIC & VERTICAL DATUM: NZGD2000
PLAN NUMBER: 05_142_100_O
SHEET: Sketch 1
SCALE: 1:1000 (@ A3)
REVISION: R0

CAD FILE: K:\AP\05\142_100\PLANS\SKETCH.DWG

ORIGINAL SIZE A3

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NOTES:
1. THIS PLAN IS A CONCEPT ONLY, BASED ON AERIAL PHOTOS AND LINZ BOUNDARY INFORMATION.
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3. REFER TO SEPARATE TABLE FOR FUTURE SPEED ZONE CHANGES AND DESIGN SPEEDS.

SPEEDS (km/h)	Cambridge Rd	Kaipaki Rd	Lamb St
Current posted speed	100	100	100
Proposed speed limit	80	100	80
Design Speed	90	110	90

N

SILVERWOOD LANE

LAMB STREET

PROPOSED CULDESAC.
SILVERWOOD LANE ACCESS TO BE PROVIDED VIA NEW ROAD FROM LAMB ST

PROPOSED BOUNDARY
LAND REQUIRED = 1195m2

PROPOSED BUND TO RESTRICT THROUGH VISIBILITY

PROPOSED BOUNDARY
LAND REQUIRED = 1395m2

ROUNDABOUT VISIBILITY
CRITERION 2 = 70m

ROUNDABOUT VISIBILITY
CRITERION 3 (NOT MANDATORY)

CURRENT ROAD DESIGN CONSTRAINED BY PROPERTY BOUNDARY.
ROAD CENTRELINE RADIUS COULD BE IMPROVED, HOWEVER LAND PURCHASE MAY BE REQUIRED.

FUTURE ROAD UPGRADE
CONSTRAINED BY POWER PYLON

CAMBRIDGE ROAD

CIRCULATING LANE
= 6.5m WIDE

CENTRAL ISLAND
= 22m RADIUS

INSCRIBED CIRCLE
= 57m DIA

PROPOSED KERB

PROPOSED BUNDS TO RESTRICT THROUGH VISIBILITY

KAIPAKI ROAD

FEATURES KEY

- PROPOSED KERB
- PROPOSED ROADMARKING
- PROPOSED BUND
- PROPOSED BOUNDARY
- VISIBILITY (CRITERION 2)
- VISIBILITY (CRITERION 3 - NOT MANDATORY)

REF	AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D. MILLS		08 / 19
DRAWN	D. MILLS	V. PRAKASH	09 / 19

RECOMMENDED _____ DATE _/_/_

APPROVED _____ DATE _/_/_

OFFICE: gray matter

CLIENT: Waipa DISTRICT COUNCIL

PROJECT: WAIPA DISTRICT COUNCIL
C4 STRUCTURE PLAN

SHEET TITLE: LAMB ST / CAMBRIDGE RD / KAIPAKI RD
PROPOSED ROUNDABOUT CONCEPT - OPTION 2A

STATUS: CONCEPT
GEODETIC & VERTICAL DATUM: NZGD2000
PLAN NUMBER: 05_142_100_O
SHEET: Sketch 2
SCALE: 1:1000 (@ A3)
REVISION: R0

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ORIGINAL SIZE A3

PROPOSED ROUNDABOUT CONCEPT - OPTION 2A LAMB ST / CAMBRIDGE RD / KAIPAKI RD

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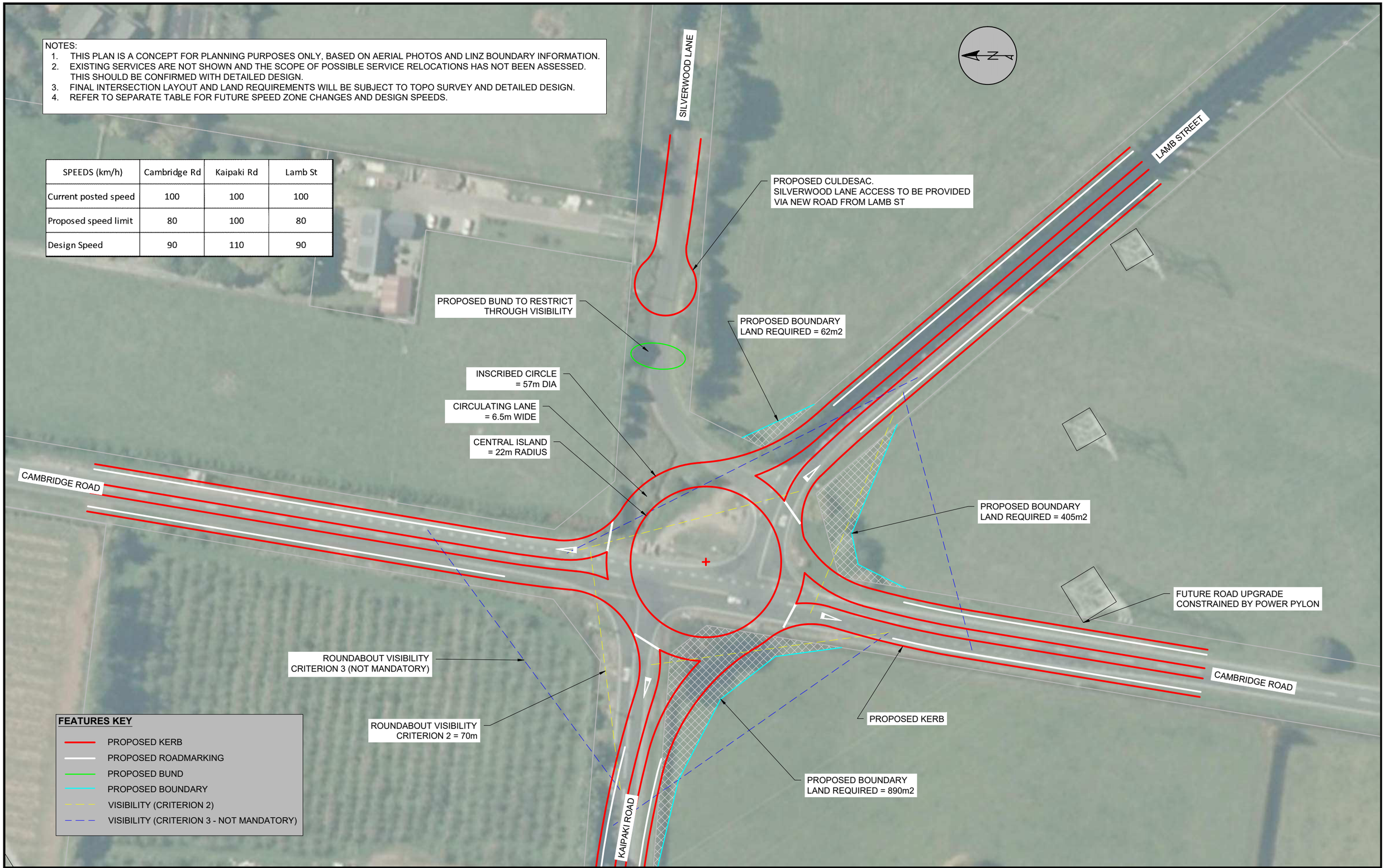
NOTES:
1. THIS PLAN IS A CONCEPT FOR PLANNING PURPOSES ONLY, BASED ON AERIAL PHOTOS AND LINZ BOUNDARY INFORMATION.
2. EXISTING SERVICES ARE NOT SHOWN AND THE SCOPE OF POSSIBLE SERVICE RELOCATIONS HAS NOT BEEN ASSESSED. THIS SHOULD BE CONFIRMED WITH DETAILED DESIGN.
3. FINAL INTERSECTION LAYOUT AND LAND REQUIREMENTS WILL BE SUBJECT TO TOPO SURVEY AND DETAILED DESIGN.
4. REFER TO SEPARATE TABLE FOR FUTURE SPEED ZONE CHANGES AND DESIGN SPEEDS.

SPEEDS (km/h)	Cambridge Rd	Kaipaki Rd	Lamb St
Current posted speed	100	100	100
Proposed speed limit	80	100	80
Design Speed	90	110	90



REF	AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D. MILLS		08 / 19
DRAWN	D. MILLS	V. PRAKASH	09 / 19

RECOMMENDED _____ DATE _/_/_

APPROVED _____ DATE _/_/_

OFFICE: gray matter

CLIENT: Waipa DISTRICT COUNCIL

PROJECT: WAIPA DISTRICT COUNCIL
C4 STRUCTURE PLAN

SHEET TITLE: LAMB ST / CAMBRIDGE RD / KAIPAKI RD
PROPOSED ROUNDABOUT CONCEPT - OPTION 2B

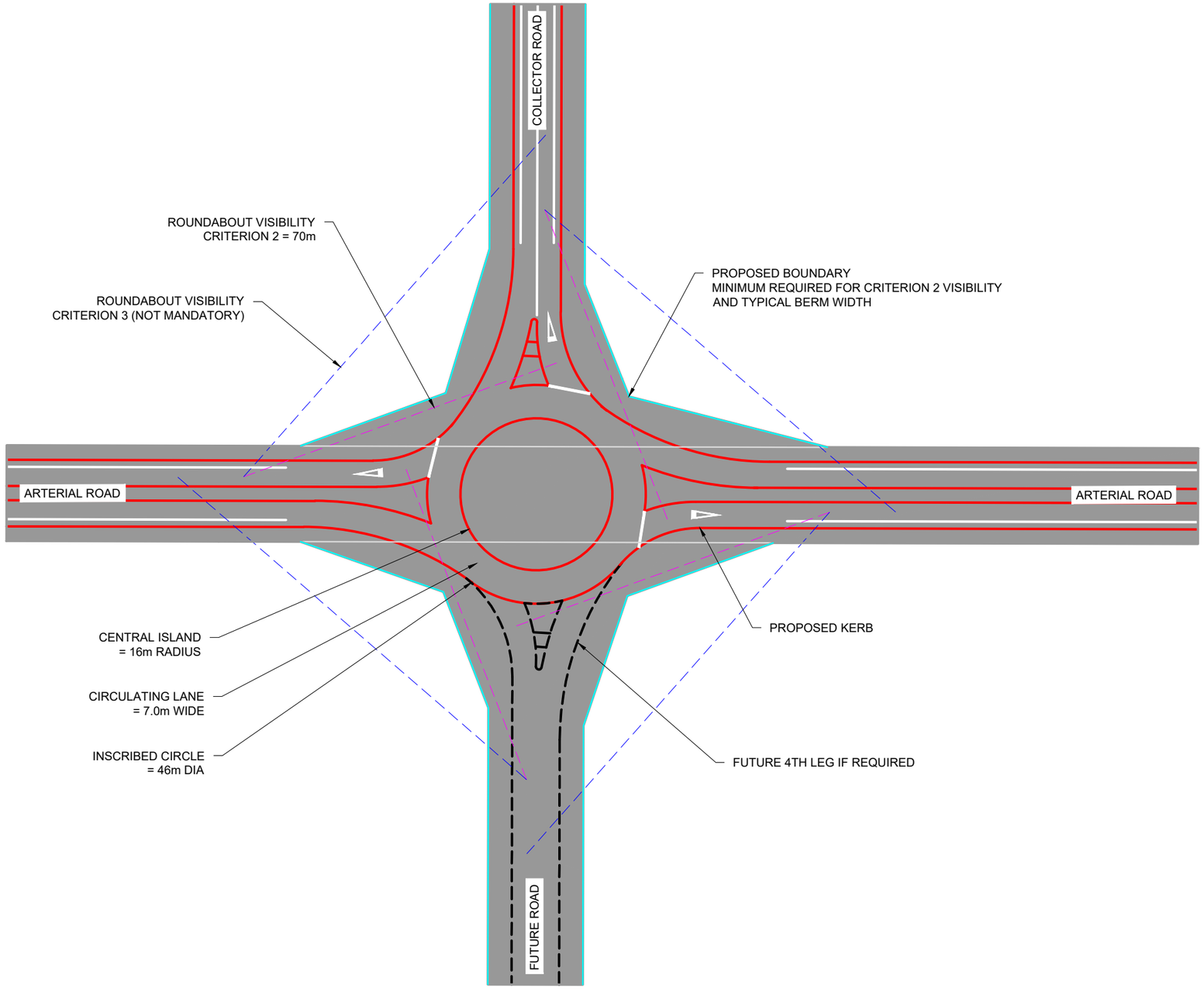
STATUS: CONCEPT
GEODETIC & VERTICAL DATUM: NZGD2000
PLAN NUMBER: 05_142_100_O
SHEET: Sketch 3
SCALE: 1:1000 (@ A3)
REVISION: R0

ORIGINAL SIZE A3

PROPOSED ROUNDABOUT CONCEPT - OPTION 2B LAMB ST / CAMBRIDGE RD / KAIPAKI RD

C:\DRS_KAIPAKI_CAMBRIDGE\05_142_100_O_SKETCH OPTION3B.DWG

NOTES:
1. THIS PLAN IS A CONCEPT FOR PLANNING PURPOSES ONLY, BASED ON AERIAL PHOTOS AND LINZ BOUNDARY INFORMATION.
2. EXISTING SERVICES ARE NOT SHOWN AND THE SCOPE OF POSSIBLE SERVICE RELOCATIONS HAS NOT BEEN ASSESSED. THIS SHOULD BE CONFIRMED WITH DETAILED DESIGN.
3. FINAL INTERSECTION LAYOUT AND LAND REQUIREMENTS WILL BE SUBJECT TO TOPO SURVEY AND DETAILED DESIGN.



FEATURES KEY

- PROPOSED KERB
- PROPOSED ROADMARKING
- PROPOSED BOUNDARY
- VISIBILITY (CRITERION 2)
- VISIBILITY (CRITERION 3 - NOT MANDATORY)

REF	AMENDMENT	APP'D	DATE

	BY	CHECKED	DATE
DESIGN	D. MILLS		10 / 19
DRAWN	D. MILLS	V. PRAKASH	10 / 19

RECOMMENDED _____ DATE _/_/_

APPROVED _____ DATE _/_/_

OFFICE: gray matter

CLIENT: Waipa DISTRICT COUNCIL

PROJECT: WAIPA DISTRICT COUNCIL
C4 STRUCTURE PLAN

SHEET TITLE: ARTERIAL ROAD / FUTURE COLLECTOR ROAD INTERSECTION
PROPOSED ROUNDABOUT CONCEPT - TYPICAL LAYOUT

STATUS: CONCEPT
GEODETIC & VERTICAL DATUM: NZGD2000
PLAN NUMBER: 05_142_100_O
SHEET: Sketch 4
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REVISION: R0

CAD FILE: C:\USERS\MBRYAN\DESKTOP\ROUNDABOUT CONCEPT.DWG

ORIGINAL SIZE A3

PROPOSED ROUNDABOUT CONCEPT - TYPICAL LAYOUT ARTERIAL ROAD / FUTURE COLLECTOR ROAD INTERSECTION

Appendix C - Residential Subdivision Aerials

Figure 1: Cambridge Park

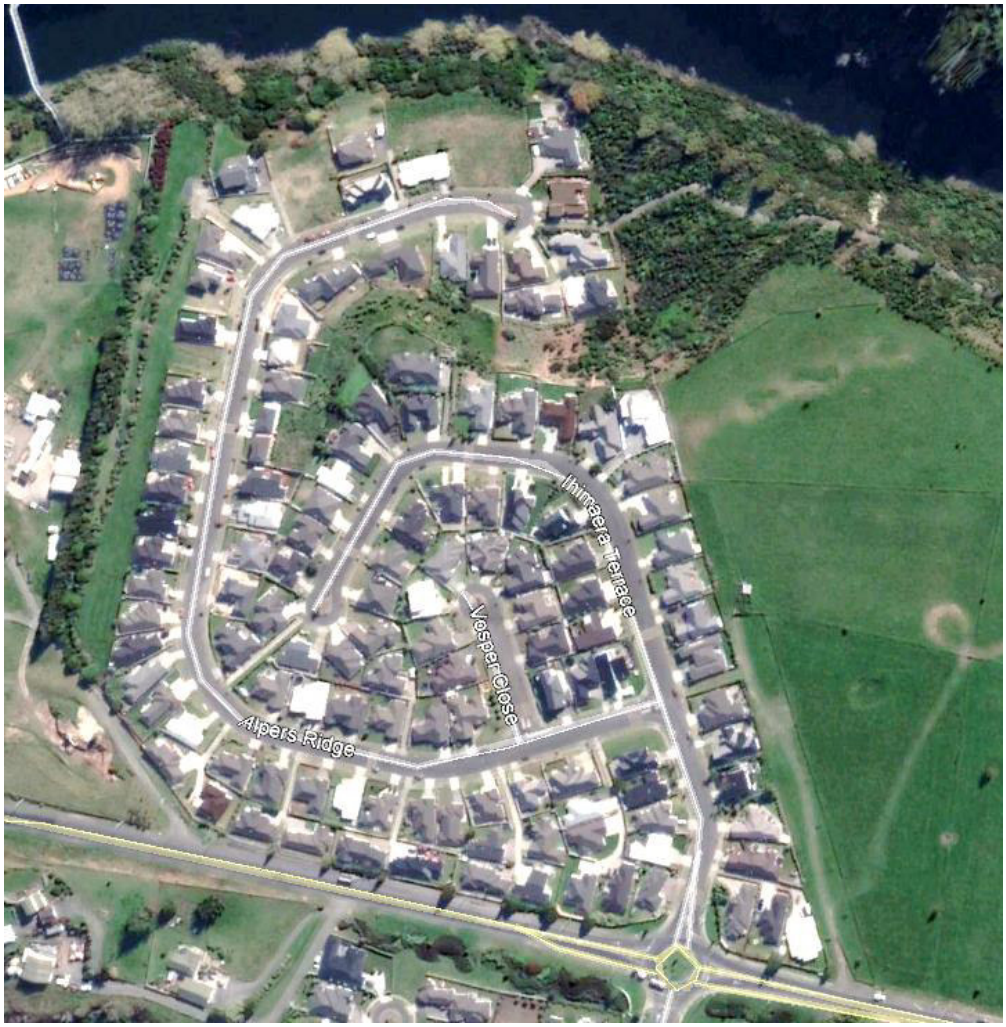

Figure 2: Ihimaera Terrace

Figure 3: Milton Street

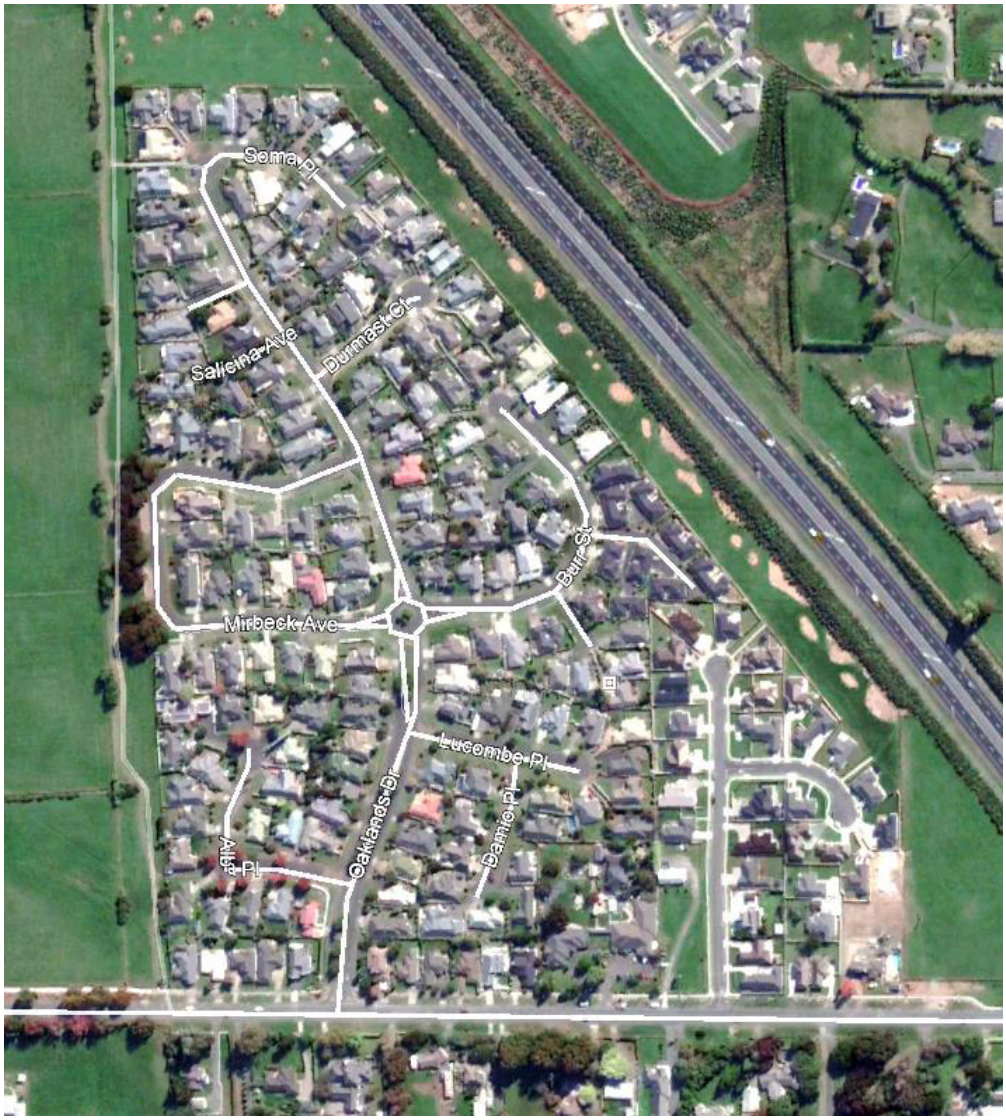

Figure 4: Oaklands Drive

Figure 5: Tulip Drive

Figure 6: St Kilda

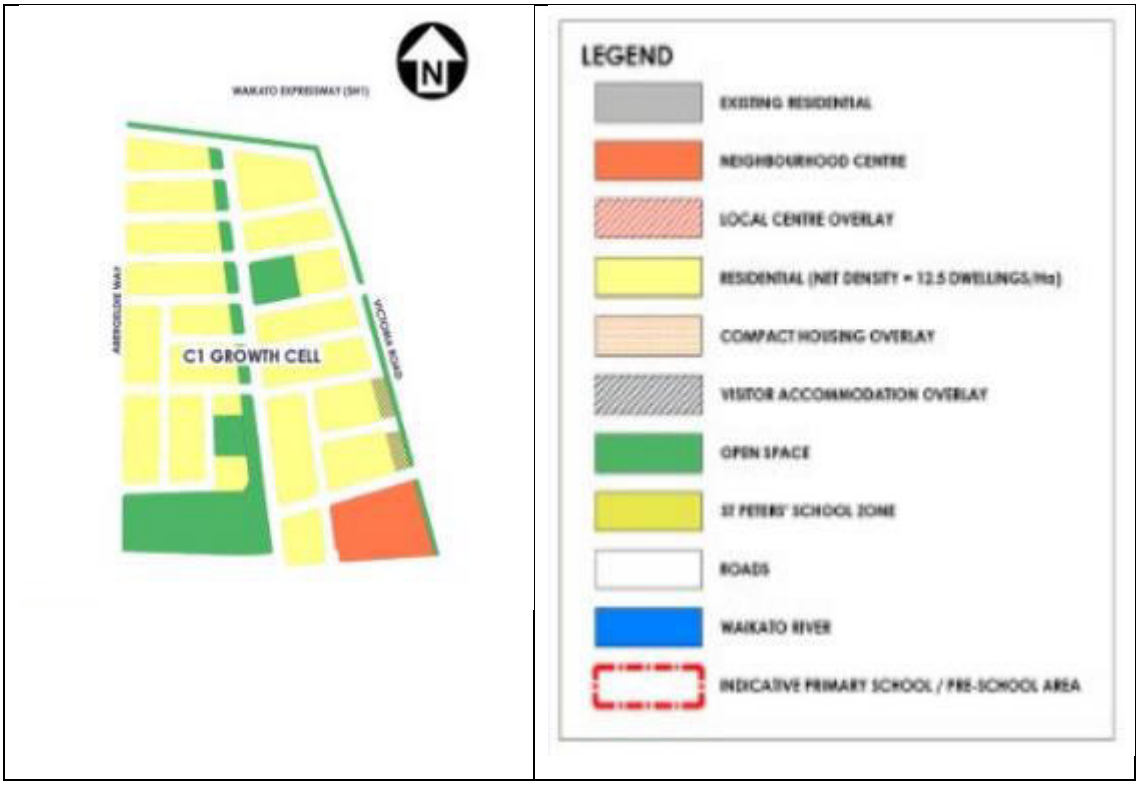

Figure 7: C1 Structure Plan

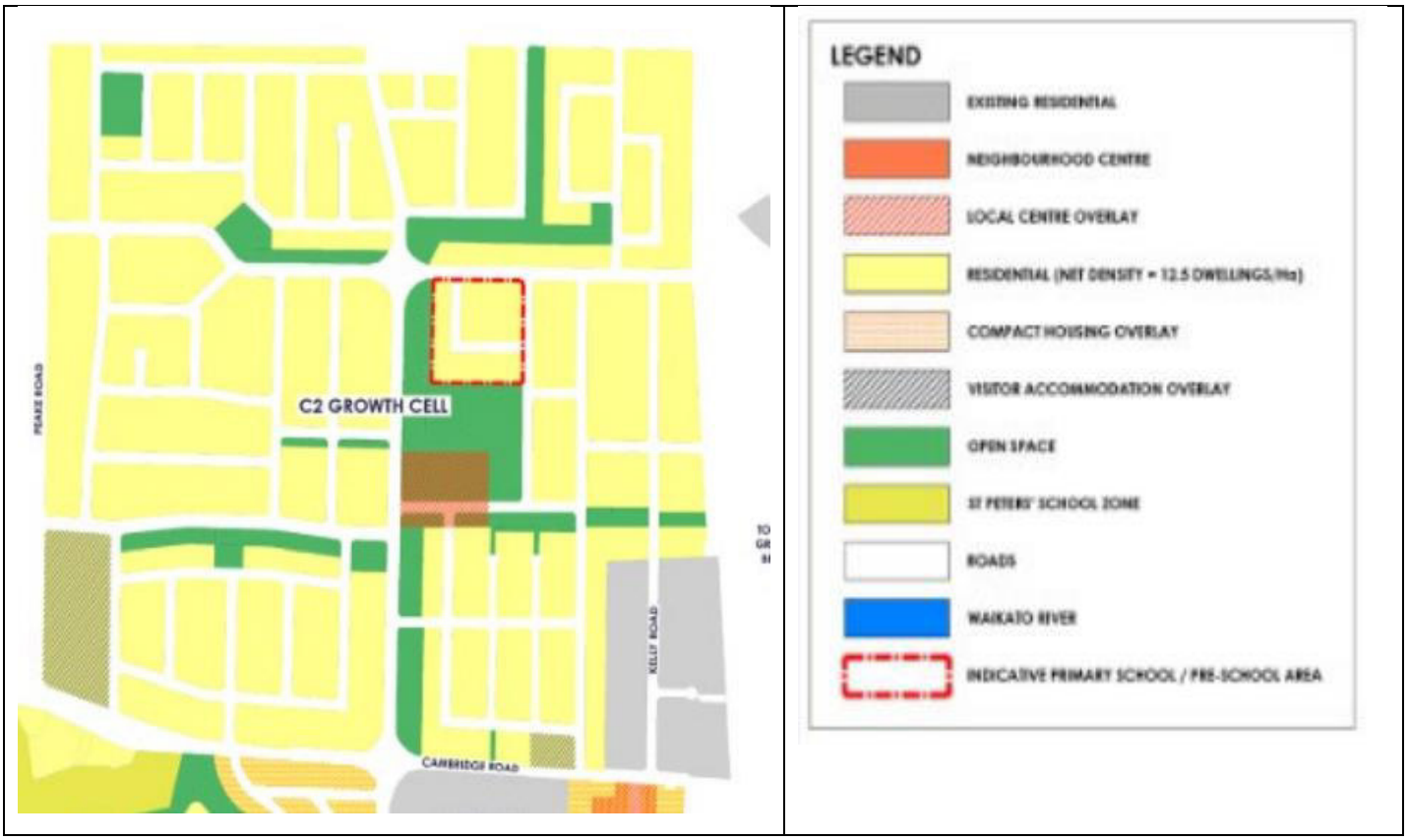

Figure 8: C2 Structure Plan