BEFORE THE HEARINGS COMMISSIONERS FOR THE WAIKATO DISTRICT COUNCIL

UNDER	the Resource Management Act 1991
AND	
IN THE MATTER	of hearing submissions and further submissions on the Proposed Waikato District Plan
	Hearing 25 – Zone extents
PARTIES REPRESENTED	**CSL TRUST & TOP END PROPERTIES (89)**

STATEMENT OF TRANSPORT EVIDENCE FROM LEO DONALD HILLS FOR CSL TRUST & TOP END PROPERTIES (89)

February 2021

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MAY IT PLEASE THE PANEL

INTRODUCTION

1. My full name is Leo Donald Hills. I am a Director at the firm Commute Transportation Consultants Ltd (Commute).

Qualifications and experience

2. I hold a Master of Civil Engineering (2000) and a Bachelor of Engineering with Honours (1996), both from the University of Auckland.

3. I am a Chartered Professional Engineer (CPEng) and a Chartered Member of Engineering New Zealand (CMEngNZ).

4. I am a director of Commute Transportation Limited (Commute) and have over 23 years' experience as a specialist traffic and transportation engineer. During that time, I have been engaged by local authorities and private companies/individuals to advise on traffic and development issues covering safety, management and planning matters of many kinds.

Involvement in project

5. I am providing Transport evidence in relation to the proposed rezoning sought by CSL Trust and Top End Properties[1] of land at 179, 203 & 205 Helenslee Road located in Pokeno (referred to as **"the site"**).

6. Commute prepared the Integrated Transportation Assessment Report (ITA) for this application dated 24th September 2018.

7. I am familiar with the application site and the surrounding locality. I have read the relevant part of the application material; submissions; and the Section 42A Report.

[1] Submitter 89

Scope of Evidence

8. My evidence assesses the transport and traffic effects of the proposed rezoning at the site sought by CSL Trust and Top end properties[2].

9. My evidence relies on and should be read in conjunction with that of:

    a. The Integrated Transportation Assessment (**ITA**) prepared by Commute for the rezoning proposal, dated September 2018 (except in the situation where my evidence specifically outlines any amendments to that outlined in the ITA).

    b. The Pokeno Intersection Assessment Report prepared by Beca (**BECA report**), dated 21st December 2016.

Code of Conduct

10. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2014) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

PROPOSAL AND EXISTING ENVIRONMENT

Proposal

11. The subject properties comprising a total area of some 95 ha is bounded by Helenslee Road to the east and Ridge Road to the west. The subject site largely consists of farmland with several dwellings scattered throughout the site (approximately two dwellings).

12. The site is located approximately 53 km south of Auckland, and 72 km north of Hamilton, therefore is still in a commutable distance from both these cities.

[2] Submitter 89

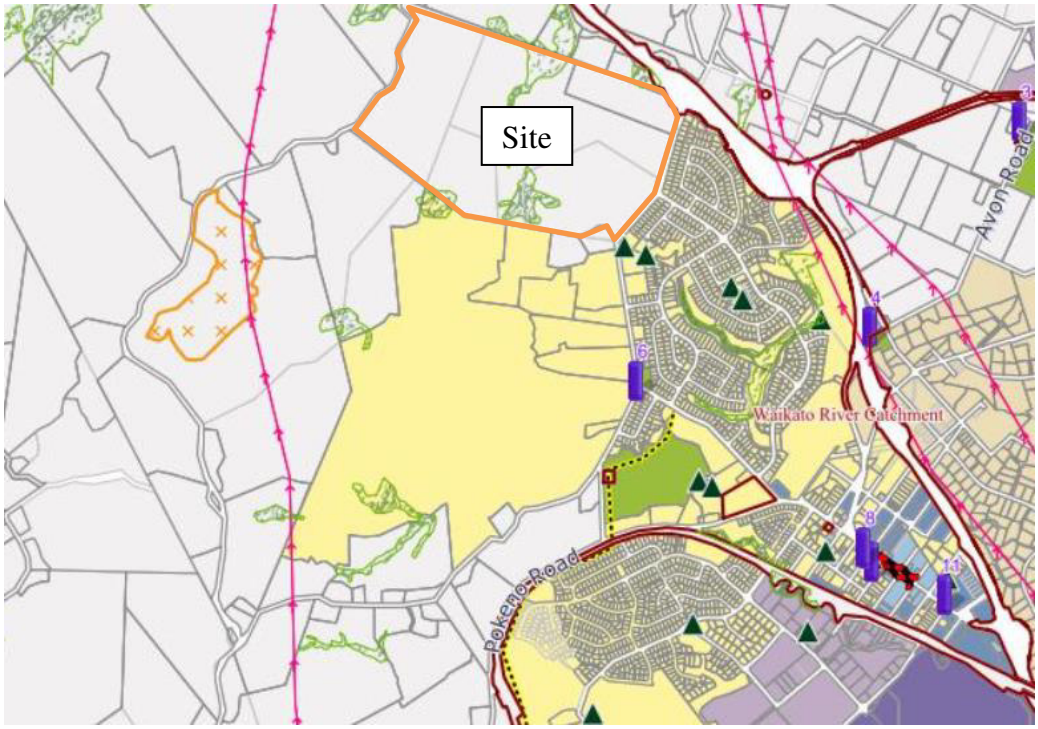
13. The site is currently zoned "Rural" under the Operative District Plan (**ODP**) and Proposed District Plan (**PDP**) respectively and is located directly west of the Pokeno Structure Plan boundary line.

14. The **rezoning proposal** seeks to alter the existing zoning of the site from 'Rural' to Residential and Country Living zoning. The **rezoning proposal** has the potential to enable the development of 413 dwellings (likely to be established in stages) plus an associated neighbourhood centre. I note that during the preparation of the ITA, a total of 414 dwellings were being considered at the site.

15. A hierarchy of roads will be provided to support the development and will connect to the existing road network via four potential connections. In addition, two connections are being considered to the south of the site and will connect to a potential residential development being considered at 53 Munro Road (by Pokeno West Limited[3]).

16. The zoning of the site within the **PDP** is shown in Figure 1 below.

Figure 1: Proposed District Plan zoning



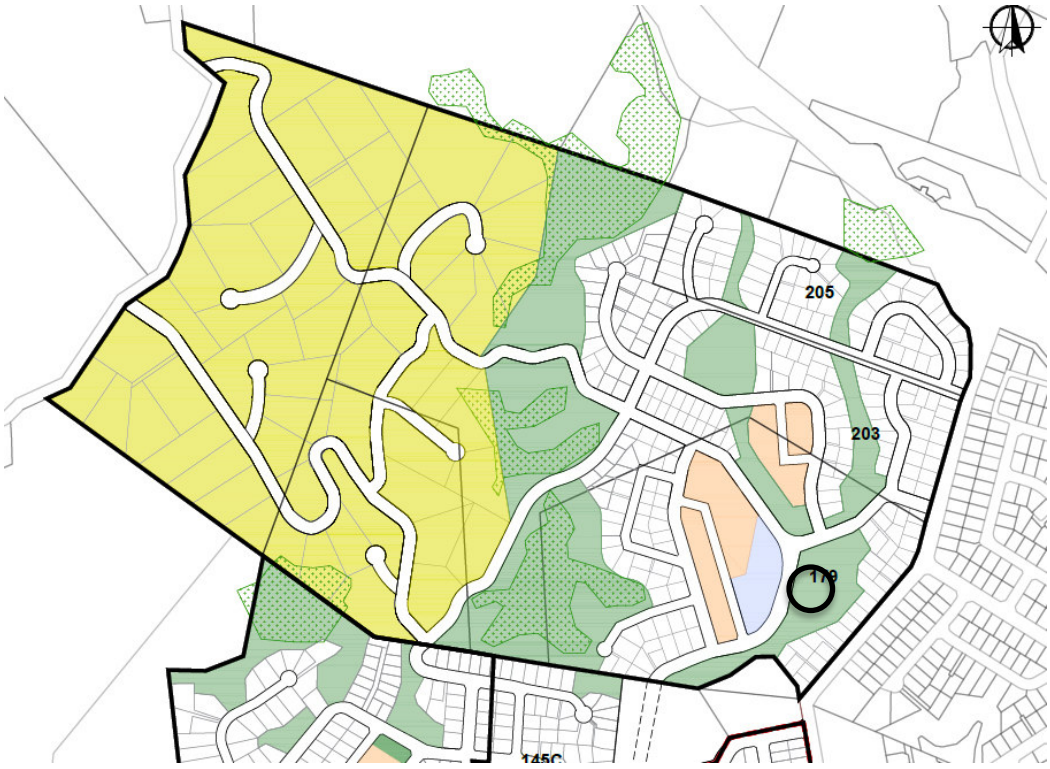
[3] Submitter 97 and further submitter 1261

17. As shown in the above figure, the neighbouring site zoning varies in each direction, with the land to the east and south of the site zoned as Residential. West, north and southwest of the site, the land is zoned as Rural (similar to the zoning of the site in the **ODP** and **PDP** respectively). I note that a similar application has been made to rezone the land located directly to the south of the site at 53 Munro Road from Rural to Residential zoning. The zoning request for that site essentially aligns with the zoning shown in the **PDP**.

18. A concept roading layout of the site has been developed and is provided in Figure 2 below including the location of the four potential connections to the existing road network on Helenslee Road and Ridge Road respectively. I note that the location of the road network is subject to further design (to be undertaken as part of subsequent assessments) and therefore at this stage is considered a 'concept' only and is not anticipated to be incorporated into the district plan review process.

19. I note that the concept roading layout shown in Figure 2 below is essentially the same as that assessed as part of the ITA, however the extent of neighbourhood centre varies slightly.

Figure 2: Concept roading and lot layout



LOCAL TRANSPORT ENVIRONMENT

Walking and cycling

20. There are currently very limited walking and cycling provisions available near the vicinity of the site.

21. Helenslee Road and Munro Road provide a footpath along the eastern side of the road, largely where residential development has occurred. No footpaths are currently provided on Ridge Road or Helenslee Road (fronting the site).

22. Further information regarding the pedestrian and cycling facilities are provided in Section 2.4 and 2.5 respectively of the ITA.

Public transport

23. There are currently very limited public transport services operating near the vicinity of the site. The known existing services cater for regional and sub-regional users rather than localised movement (e.g. within the Pokeno town centre).

24. Further information regarding the bus services available are provided in Section 2.3.2 of the ITA.

Road network

25. Figure 3 shows the existing road network near the vicinity of the site.

Figure 3: Existing road network

26. **The Site** has frontage onto Helenslee Road to the east and Ridge Road to the west. The following sections provide a brief description of each road, largely extracted from the ITA.

    a. Helenslee Road runs in a general north-south direction, connecting to the SH1 Razorback interchange (north facing ramps only) to the north and Pokeno Road to the south. Helenslee Road provides a single lane in each direction, separated by a centreline marking, and provides intermittent right turn bays at some intersections to facilitate vehicles turning right into adjacent side roads. Primarily where residential development has occurred, a pedestrian footpath is provided along the eastern side of the road. On the 2nd April 2018 the speed limit on Munro Road changed from 100 km/hr to 60 km/hr.

    b. Ridge Road is located along the western boundary of the site and extends between Nikau Road / the SH1 Northbound and southbound ramps to the north and Whangarata Road to the south. Ridge Road comprises a windy horizontal terrain, providing a single lane in either direction separated by centreline pavement

markings. The Ridge Road quarry is located south of the site along Ridge Road. The posted speed limit on Ridge Road is 80 km/hr (previously 100 km/hr).

c. Munro Road runs in a general north-south direction connecting to Pokeno Road to the south via a give-way controlled "T" intersection and Helenslee Road to the north. Munro Road provides a single lane in both directions and generally does not provide centreline or edge line markings (south of Huia Road). A one-way bridge is located on Munro Road just north of the intersection with Huia Road. On the 2nd April 2018 the speed limit on Munro Road changed from 100 km/hr to 60 km/hr.

d. Pokeno Road extends in a general east-west direction connecting to Great South Road to the east and Whangarata Road to the west. Pokeno Road extends past the Pokeno School and provides a pedestrian footpath along the southern side of the road (east of the Pokeno School). On the 2nd April 2018, the speed limit along Pokeno Road (between 100 m west of Munro Road to near 62 Pokeno Road reduced from 100 km/hr to 80 km/hr and east of this to 40-60 km/hr.

Traffic volumes

27. As outlined in Section 2.6 of the **ITA**, daily link volumes have been extracted from the **BECA report** (dated 2016). The Waikato District Council (**WDC**) also provide traffic volumes near the vicinity of the site therefore I have used the most up to date (known) count information available, this includes:

Table 1: Traffic volumes extracted from WDC

Road	Location	Date	ADT (vehicles per day)
Helenslee Road	Between Galston and Mark Ball Drive	2016	964
	Between Pokeno Road and Hill Park Drive	2019	1,621

Ridge Road	Between Quarry entrance (power pole LHS) and SH1 off-ramp	2015	745
Munro Road	Between Thomason Crescent Road and Helenslee Road	2019	1,279
Pokeno Road	Between Great South Road and Ford Street	2016	2,616
	Between Helenslee Road and Bridge (1st abutment)	2017	3,377

28. I note that based on an aerial view of the wider Pokeno area in October 2020[4], the extent of land located within the PSP area is still developing therefore these traffic volumes are expected to increase to that existing.

Figure 4: Aerial view of Pokeno

[4] Near maps image dated October 2020

OVERVIEW OF THE POKENO INTERSECTION ASSESSMENT REPORT (BECA REPORT)

29. The **BECA report** provides an assessment of the operation of intersections within Pokeno under the then current and future traffic demands and considers the appropriate future intersection forms for the future years 2022 and 2040. The **BECA report** provides an estimate of the level of traffic volumes predicted at each intersection for the future year 2022 and 2040 and the type of control warranted for various intersections within Pokeno.

30. The **BECA report** was provided to Commute from the Waikato District Council **(WDC)** for the purpose of assisting in assessing the intersection forms required in Pokeno for the future years (2022 & 2040).

31. Throughout the **ITA**, the **BECA report** has largely been used to reference any existing or future traffic volumes estimated near the vicinity of the site.

32. I note that an initial review of the **ITA** was undertaken by Arrive (dated 6th September 2018) and was provided as part of the Pokeno Village Holdings Limited submission (dated 9th October 2018). Section 7 of the document outlined that Arrive had previously undertaken a review of the **BECA report** which summarised the following: "*Our conclusion was that the future traffic volumes used in the Beca report were excessive, and that the recommendations for changes to intersections were based on incorrect data and incomplete assessment*". If (as that submission suggests), the volumes outlined within the **BECA report** are excessive, the volumes used in the modelling in the **ITA** (and my evidence) are overrepresented for the future years and therefore the intersection forms / upgrades are conservative. As such, it is my opinion that the analysis undertaken in the **ITA** are essentially a worst case.

CHANGES TO THE PROPOSAL SINCE SUBMISSION

33. Since the assessment of the **rezoning proposal** and preparation of the **ITA** (dated 24th September 2018), the following changes have been adopted:

    a. Very minor reduction in the potential number of dwellings from 414 to 413 (indicative).

b. I note that some double counting was included within the traffic volumes detailed in the **ITA** and therefore a revised assessment has been undertaken of Section 7-9 of the **ITA** and is provided in **Attachment A** of my evidence.

ASSESSMENT OF EFFECTS (SAFETY / ACTIVE MODES)

Road safety record

34. I have undertaken an updated assessment of the surrounding area's road safety record using the New Zealand Transport Agency (NZTA) Crash Analysis System (CAS) database for crashes within the site's vicinity over the five-year period 2015-2019 including all available data for 2020. The study area included all crashes recorded including the following roads:

    a. Helenslee Road

    b. Ridge Road

    c. Munro Road

    d. Huia Road

    e. Pokeno Road (between Ridge Road and Great South Road)

    f. Great South Road (between McDonald Road and the SH1 NBD ramps)

    g. SH1 Razorback Road, Great South Road, Pokeno Road and Nikau Road interchange (ramps only)

35. I note that the study area included within this evidence is significantly wider than that provided within the **ITA** which considers the crash history on Helenslee Road and Ridge Road within the vicinity of the site only.

36. In summary, a total of 48 crashes have been identified within the study area. These crashes are summarised in Table 2 below.

Table 2: Summary of crashes (2015-2020)

Location	No. of crashes / predominant crash type	Injuries
Helenslee Road & Helenslee Road / Munro Road intersection	8 crashes 75% loss of control 1 crash at the Munro Road / Helenslee Road intersection (fatigue was listed as a contributing factor)	5 minor injury related
Ridge Road & Nikau Road / Ridge Road intersection	7 crashes on Ridge Road 100% loss of control 1 missed intersection crash at Nikau Road / Ridge Road intersection (drug listed as contributing factor)	1 fatal injury related crash & 3 minor injury related crashes
Pokeno Road	17 crashes 65% loss of control	1 serious injury related crashes (total 3 injuries) 5 minor injury related crashes
Great South Road	4 crashes	1 minor injury related crash
Razorback Road	2 crashes 100% loss of control	1 fatal injury related crash
Great South Road / Pokeno Road SH1 ramps	8 crashes 100% loss of control	4 minor injury related crashes
Summary	48 crashes	2 fatal crashes 1 serious crash

		18 minor injury crashes

37. Based on the above, a number of crashes have occurred within the general Pokeno area and are largely related to vehicles losing control (70%). Further, it is identified that a number of crashes have been reported along Pokeno Road (west of the intersection with Munro Road) and at the bend on Helenslee Road (near the northern boundary of the site). As the surrounding area develops, this will urbanise these areas that are currently generally rural in nature thus both reducing speed limit and improving overall road design.

Public transport

38. Currently Pokeno is not well served by public transport.

39. Section 10.2.1 of the **ITA** outlines several recommendations for public transport services within Pokeno, including:

    a. Bus services to the southern elected rail stations in Auckland, operating on the hour between 6:00am – 9am;

    b. Local public transport services: bus route starting from the Pokeno town centre which passes through **the site**, the Helenslee residential block (located directly east of the site) and concludes back at the town centre. Of note, some thought should be given to connecting Tuakau and Pokeno via some means of public transport to encourage residents travelling to and from these destinations to utilise the public transport network;

    c. Lastly, given the recent improvements of connections between Hamilton and Pokeno (the Waikato expressway) the reduced travel time between the two areas is likely to encourage residents to commute to Hamilton. As such, consideration of an express bus route should be given for residents commuting between Pokeno and Hamilton.

40. In addition, I note that a number of projects are being considered within reasonable vicinity of the site, including the Papakura to Bombay Stage 1 improvements; this is expected to include a third lane in each direction

between Papakura and just north of Ramarama as well as a shared walking and cycling path and allow for future dedicated public transport services. Stage 3 of this project will involve extending these provisions south to Bombay.

41. The NZ Upgrade Programme will provide funding for three projects that support growth – the extension of the electrified rail network from Papakura to Pukekohe, two new stations at Drury and a third line between Wiri and Quay Park (central Auckland).

42. Both Drury and Pukekohe are within some 15-minute driving distance from Pokeno. In this regard, with a significant portion of residents expected to commute to and from the north there is potential for **the site** as well as the surrounding area to benefit from the upgrades outlined above if the appropriate connector services can be provided. For example, I consider the following provisions should be considered when assessing the potential public transport provisions within Pokeno (in addition to that outlined within the **ITA**):

    a. Provision of a bus route from Pokeno to Pukekohe and Drury / Manukau respectively that operates at regular frequencies during the peak hours to encourage residents to utilise the Drury / Manukau or Pukekohe train line services. The recommended bus route should pass through the Pokeno town centre, **the site** as well as the Helenslee residential block (located directly east of **the site**). Consideration should be given to incorporating the other plan changes located within the area.

    b. Appropriate walking and cycling connections should be provided to these public transport facilities (e.g. to bus stops) to encourage active mode share within Pokeno.

43. The above recommendations are indicative and should be considered in conjunction with the community and any future land use developments to ensure the correct commuter areas are being incorporated.

Active modes

44. Section 6 of the **ITA** outlines the cycle provisions proposed within and near the vicinity of **the site** (indicative). This indicates that the proposal intends to

retain the planned cycling nature of the area by providing a 3 m shared path along all proposed primary roads within the potential residential development. The shared path is expected to link to the shared path within the planned road network at 53 Munro Road.

45. As I have outlined in the **ITA**, the proposal should continue the shared path along the western side of Helenslee Road, along the site boundary, to encourage the use of other modes of transport for local trips.

46. Appropriate walking and cycling connections should be provided to connect the residential developments being considered within Pokeno to the town centre as well potential public transport facilities (e.g. to bus stops) to encourage active mode share within Pokeno.

47. In my opinion, given the level of development being considered within Pokeno, it is important to plan now for a comprehensive walking / cycling and public transport network to ensure that any development that occurs within the area does not preclude active mode facilities being provided.

ASSESSMENT OF TRAFFIC / TRANSPORTATION EFFECTS

General

48. Section 7-9 of the **ITA** outlines an assessment of the potential trip generation at **the site**, and includes the distribution of these volumes on the surrounding road network and the potential intersection controls / layout required at the surrounding intersections to cater for the future volumes.

49. For that assessment, traffic volumes were extracted from the **BECA report** to assess the performance of the surrounding intersections for the future years 2022 and 2040 (with the potential development volumes).

50. As noted above the number of dwellings has reduced slightly (413 vs. 414) and further the proposed future traffic volumes outlined within the **ITA** (including the potential development) included some double counting and therefore I have revised Section 7-9 of the **ITA** accordingly. This is provided in **Attachment A** of my evidence and supersedes Section 7-9 of the **ITA**.

Trip generation

51. The RTA Guide is commonly used by traffic engineering practitioners in Australasia to assess the traffic generating potential of various land uses. In New Zealand, the RTA Guide is frequently used for assessing residential developments. The proposed size of the residential dwellings are considered to be best represented by "dwelling houses" in the RTA Guide. For these types of dwellings, the RTA predicts trip generation rates of 0.85 trips / dwelling in the peak hours.

52. Using the trip generation rates detailed above (0.85 trips / dwelling), results in a total anticipated trip generation of 351 vehicles per hour (vph) for the 413 dwellings. This is outlined in Table 2 below.

Table 3: Potential trip generation

Activity	Number of dwellings (indicative)	RTA trip rate	Peak hour trip generation
179, 203 & 205 Helenslee Road (the site)	413	0.85 trips per dwelling during the peak hour	351
Total	413 dwellings		351 trips

Trip distribution

53. All trips associated with the potential 413 dwellings at the subject have been added to the existing road network.

54. The revised modelling results are provided in **Attachment A** of this evidence and now includes an assessment of the existing SH1 Razorback Road off-ramp interchange (with the potential development volumes).

55. In addition, sensitivity testing has been undertaken which considers the following assessment,

    a. a 2040 scenario (with development) which in comparison to the **ITA**, assumes:

        i. a higher proportion of volumes travel to and from Auckland (60% vs. 35% in original assessment).

ii. 20% of movements travel to / from the Pokeno and Waikato (Tuakau) areas respectively.

56. Table 4 outlines the level of traffic expected to travel to and from the wider areas.

Table 4: Directional split of vehicle movements (sensitivity)

Activity	To/from Auckland	Total trips	Directional split of vehicle movements
Auckland	60%	351 trips	211 trips
Pokeno	20%		70 trips
Waikato / Tuakau	20%		70 trips
		Total	**351 trips**

57. The total 351 trips have been distributed at each of the four potential connections at the site.

58. Table 5 outlines the assumptions made when distributing trips at the site.

Table 5: Distribution of trips at each intersection (internal)

Activity	To/from Auckland	To/from Pokeno/Waikato	To/from Pokeno/Waikato
Intersection 1 (northern intersection on Ridge Road)	7.5%	-	50%
Intersection 2 (southern intersection on Ridge Road)	7.5%	-	50%
Intersection 3 (northern intersection on Helenslee Road)	42.5%	50%	-
Intersection 4 (southern intersection on Helenslee Road)	42.5%	50%	-

	100%	100%	100%

59. The following assumptions have been made in relation to trips to and from the surrounding areas:

- For trips to and from Auckland (60%): 85% of vehicles are expected to utilise the Razorback Road interchange and 15% the SH1 Nikau Road interchange to connect to SH1.

- For trips to and from Hamilton and the Pokeno Town Centre (20%): vehicles will likely utilise Helenslee Road to connect to Pokeno Road. It is however noted that, should a connection be provided onto Ridge Road, any trips travelling towards Hamilton (estimated some 35 trips) have the option of utilising the SH1 Nikau Road interchange (south facing ramps), however for the purpose of this assessment all trips are expected to travel south via Helenslee Road (worst case).

- For trips to and from Tuakau (20%): vehicles are expected to utilise the Ridge Road connections only (assuming these are provided).

- Typical residential inbound / outbound splits of 20% / 80% in the morning peak hour 80% / 20% in the evening peak hour are assumed.

- The Razorback Road (off-ramp) intersection has been assessed using the volumes predicted to the north of the site for the future year 2040. The **BECA report** does not provide traffic volumes along Ridge Road for the future years. As such, the through volume counts undertaken on Ridge Road in 2015 have been used to estimate the through movement along this corridor (i.e. some 40 vehicles per hour in each direction).

53 Munro Road rezoning request

60. I note that a submission has been made to rezone the area of land located directly to the south of the site (Submission 97) from Rural zoning to Residential zoning to allow for the development of some 1377 lots (indicative).

61. Given that this information is known and the travel patterns of that site are likely similar to that of **the site**, I have included the potential volumes generated by both sites (i.e. at 179, 203 & 205 Helenslee Road and 53 Munro Road).

62. The level of vehicle movements generated by the adjacent site has been distributed in a similar manner to that outlined above, which the exception of:

    - For trips to and from Auckland (60%): The adjacent site provides connections onto Helenslee Road to the east only and no connection onto Ridge Road therefore vehicle movements associated with the development within that site (to/from Auckland) are assumed to utilise the Razorback Road interchange only to connect to SH1.

    - Traffic volumes associated with the neighbouring site are included as through volumes only at potential intersections 3&4 (shown in Figure 5 below) on Helenslee Road i.e. for the purpose of this assessment, the traffic volumes associated with the neighbouring development are not expected to turn to and from **the site**.

63. Using the trip distribution assumptions detailed above, the following provides an assessment of the following key intersections and identifies the typical layout required to cater for these volumes.

64. The following intersections located south of the site (connecting to Pokeno / Tuakau and further southern suburbs) have been included:

    - Helenslee Road / Munro Road (give-way control)

    - Pokeno Road / Helenslee Road (give-way control)

    - Munro Road / Pokeno Road (give-way control)

- Hitchen Road / Pokeno Road (give-way control)
- Great South Road / Pokeno Road (give-way control)
- Great South Road / SH1 Northbound on-ramp

65. The following intersections located north of the site (connecting to Auckland and further northern suburbs) have been included:

    - SH1 Southbound off-ramp Razorback off-ramp / Razorback Road (stop control)

66. All four potential intersections (1 - 4) proposed at **the site** have been assessed for the future year 2040 (as shown in Figure 5 below). Figure 6 outlines the existing and potential intersections in relation to **the site**. I note that a wider assessment of the surrounding intersections has been undertaken as part of this evidence (as opposed to that outlined within the **ITA** which included the site access intersections, Munro Road / Helenslee Road intersection and Pokeno Road / Helenslee Road intersection only).

Figure 5:Location of intersections connecting to the site (Intersection 1-4)

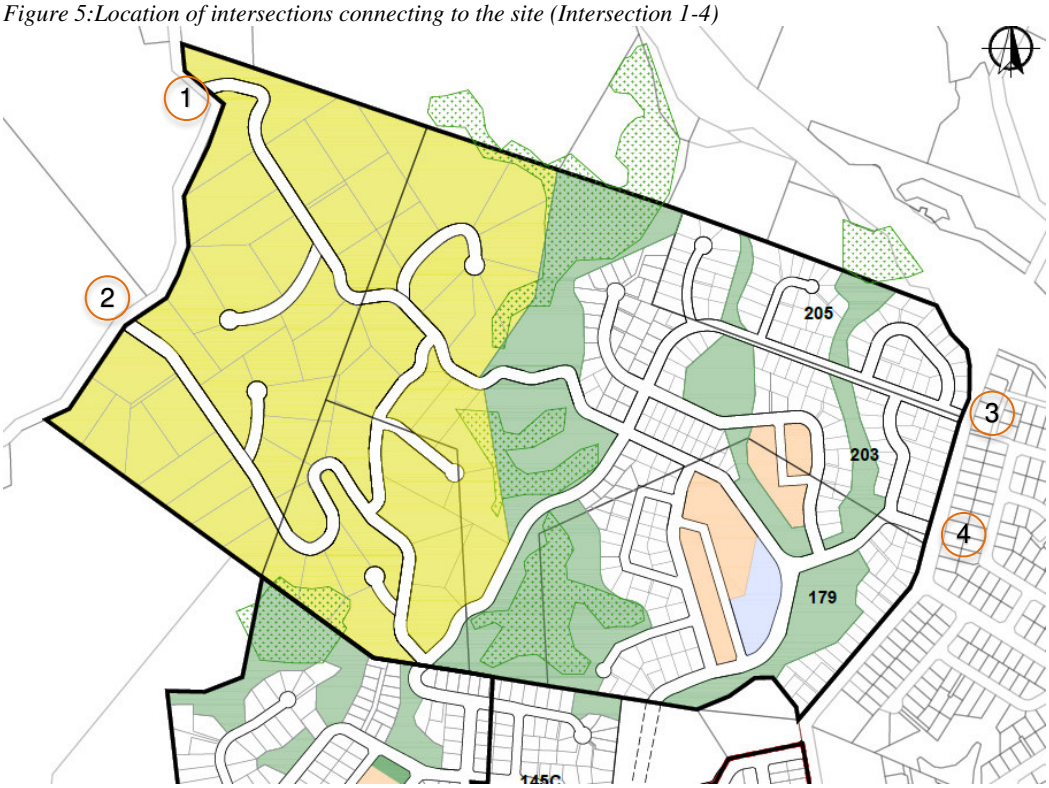
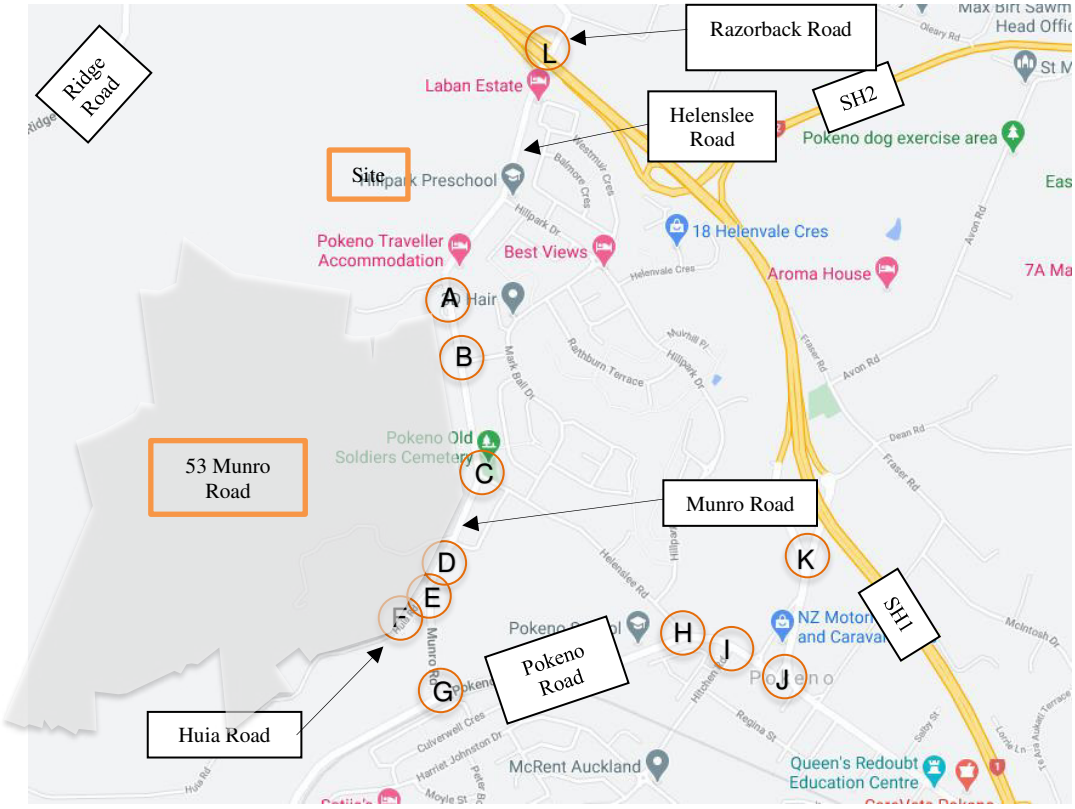


Figure 6:Location of intersections near the vicinity of the site (Intersection A-L)



Intersection modelling

67. The traffic effects of the sites trip generation have been assessed using the traffic modelling software SIDRA. The results presented in **Attachment A and B** include the Degree of Saturation, which is a measure of available capacity and the Level of Service ("LOS"), which is a generalised function of delay. LOS A and B are very good and indicative of free-flow conditions; C is good; D is acceptable; and E and F are indicative of congestion and unstable conditions.

68. For priority (sign) controlled intersections, a degree of saturation of less than 0.8 is considered to be acceptable. Of note, a degree of saturation of 0.85 is the typical threshold of a roundabout.

69. It is important to note that this evidence only assesses the traffic effects at the key local intersections, considered relevant to the proposal and any

intersection layouts outlined in this report are indicative only and subject to change of demand.

70. The SIDRA results of the sensitivity analysis are detailed in **Attachment B**. Table 6 summarises the expected performance of the existing intersections for the future year 2040 (including development), this includes:

    a. Degree of saturation of intersection during the peak hours;

    b. Level of service (LOS) range for all approaches

    c. Worst performing approach / lane (based on the 95%ile back of queue length.

71. It is noted that the upgraded layouts considered as part of the original ITA have generally been used for the purpose of these assessments. Table 6 summaries the SIDRA results.

Table 6: Summary of SIDRA results – sensitivity analysis (2040 with upgrades)

Intersection (2040)	Control		Intersection degree of saturation (DoS)	LOS range	Worst performing approach / lane (based on 95%ile back of queue length)
Intersection 1 Site access 1/ Ridge Road (northern)	Give-way control	AM	0.035	A	Eastern approach (Site) Queue length=0.9m DoS=0.032 LOS A
		PM	0.043	A	Southern approach (Ridge Road) Queue length=1.2m DoS=0.043 LOS A
Intersection 2 Site access 2/ Ridge Road (southern)	Give-way control	AM	0.041	A	Eastern approach (Site) Queue length=0.9m DoS=0.032 LOS A
		PM	0.057	A	Southern approach (Ridge Road) Queue length=1.3m DoS=0.057 LOS A
Intersection 3		AM	0.478	A - D	Western approach (Site Road) Queue length=9.0m

Site access 3/ Helenslee Road (northern)		Give-way control				DoS=0.345 LOS B/D
			PM	0.576	A - D	Northern approach (Helenslee Road) Queue length=14.9m DoS=0.576 LOS A/B
Intersection 4 Site access 4 / Helenslee Road (southern)		Give-way control	AM	0.442	A - D	Western approach (Site Road) Queue length=7.7m DoS=0.298 LOS B/D
			PM	0.541	A - D	Northern approach (Helenslee Road) Queue length=13.8m DoS=0.541 LOS A
A	53 Munro Road access / Helenslee Road	Give-way control	AM	0.370	A-B	Western approach (Site) Queue length=7.3m DoS=0.258 LOS A
			PM	0.537	A-B	Northern approach (Helenslee Rd) Queue length=24.9m DoS=0.537 LOS A/B
B	53 Munro Road access / Helenslee Road / Gateshead Road	Roundabout	AM	0.486	A-B	Northern approach (Helenslee Rd) Queue length=31.9m DoS=0.452 LOS A
			PM	0.613	A-B	Northern approach (Helenslee Rd) Queue length=52.8m DoS=0.613 LOS A
C	53 Munro Road access / Helenslee Road / Munro Road		AM	0.583	C-E	Northern (LT) approach (Helenslee Rd) Queue length=127.5m DoS=0.583 LOS C
			PM	0.580	D-E	Northern (TH) approach (Helenslee Rd) Queue length=108.6m DoS=0.565 LOS D
D	53 Munro Road		AM	0.131	A	Western approach (Site) Queue length=3.0m DoS=0.118 LOS A

	access / Munro Road		PM	0.194	A	Northern approach (Munro Road) Queue length=5.1m DoS=0.194 LOS A
E	Munro Road / Huia Road		AM	0.167	A	Western approach (Huia Road) Queue length=2.8m DoS=0.115 LOS A
			PM	0.211	A	Northern approach (Munro Road) Queue length=4.8m DoS=0.164 LOS A
F	Huia Road / 53 Munro Road access		AM	0.109	A	Northern approach (Site) Queue length=3.4m DoS=0.109 LOS A
			PM	0.102	A	Eastern approach (Huia Road) Queue length=3.7m DoS=0.102 LOS A
G	Munro Road / Pokeno Road	Existing (give-way control)	AM	0.347	A	Northern approach (Munro Road) Queue length=9.9m DoS=0.347 LOS A
			PM	0.440	A-B	Eastern approach (Pokeno Road) Queue length=19.7m DoS=0.440 LOS A/B
		Potential future (roundabout)	AM	0.454	A-B	Eastern approach (Pokeno Road) Queue length=27.4m DoS=0.454 LOS A/B
			PM	0.559	A-B	Western approach (Pokeno Road) Queue length=44.3m DoS=0.559 LOS A
H	Helenslee Road /	Signals	AM	0.533	A-D	Northern approach (Helenslee Road) Queue length=111.1m DoS=0.533 LOS B-D

	Pokeno Road		PM	0.903	A-E	Western approach (Pokeno Road) Queue length=109.3m DoS=0.903 LOS E
I	Mclean Road / Pokeno Road	Signals	AM	0.611	A-D	Eastern approach RT (Pokeno Road) Queue length=85.8m DoS=0.611 LOS B-C
			PM	0.889	A-E	Southern approach RT (Hitchen Road) Queue length=92.6 m DoS=0.889 LOS E
J	Pokeno Road / Great South Road (signals)	Signals	AM	0.607	A-D	Northern approach LT (Great South Road) Queue length=121.7m DoS=0.543 LOS C
			PM	0.805	A-D	Eastern approach RT (Pokeno Road) Queue length=186.8.0 m DoS=0.772 LOS C
K	SH1 Great South Road (on-ramp) (roundabout)	Roundabout	AM	0.499	A-B	Northern approach (Great South Road) Queue length=33.3 m DoS=0.454 LOS A
			PM	0.793	A-B	Southern approach LT (Great South Road) Queue length=81.4m DoS=0.793 LOS A
L	Razorback Road interchange (SH1-off ramp only)	Stop-control	AM	0.062	A	Northern approach (SH1-off ramp) Queue length=1.2m DoS=0.062 LOS A
			PM	0.199	A	Northern approach (SH1-off ramp) Queue length=4.4m DoS=0.199 LOS A
			AM	0.344	A	Northern approach (SH1-off ramp) Queue length=8.8m DoS=0.344 LOS A

			PM	0.601	A	Northern approach (SH1-off ramp) Queue length=26.9m DoS=0.601 LOS A

Modelling Summary

72. Based on the above, the following is concluded:

a. widening is likely required along several approaches to accommodate additional lanes to cater for the future traffic volumes, this includes:

i. 53 Munro Road access / Helenslee Road / Munro Road intersection

ii. Pokeno Road / Helenslee Road intersection

iii. Pokeno Road / Mclean Street intersection

iv. Great South Road / Pokeno Road intersection

v. SH1 on-ramp / Great South Road intersection

b. Right turn bays are likely required at several intersections (subject to demand for right turn movement);

c. A number of signalised intersections are required along Pokeno Road. In this regard, the phasing time with nearby intersections should be synced to improve the performance of these intersections and reduce delays and congestion.

d. In my opinion, should further traffic be added onto Ridge Road, consideration should be given to reducing the speed limit along the road and any connections proposed to the site should provide appropriate mitigation (e.g. widening, right turn bay) to mitigate vehicles turning to and from the site obstructing through traffic (specifically trucks travelling to and from the quarry). This can be determined at later resource consent stages and through detailed design.

73. It is important to note that my evidence only assesses the traffic effects at the key local intersections, considered relevant to the rezoning proposal. The traffic generated by this rezoning proposal has been taken into account. However, I understand that there are several other submissions seeking rezoning within Pokeno (including residential). It is difficult to ascertain the number or size of these submissions, the traffic expected to be generated, the traffic patterns and therefore the traffic effects to the wider surrounding road network.

74. In this regard I consider that, at this point in time, Council's 42A Framework report provides the best basis for determining the appropriate future environment. In the report the Council appears to be supporting rezoning of the various growth cells for Pokeno identified in Waikato 2070 and listed in Appendix 8 to the section 42A report.

75. My assessments have shown that there are likely upgrades required for intersections / roads in the wider Pokeno area to serve cumulative development. In my opinion these upgrades (other than ones directly related to gain access to individual sites) should be constructed by the Council as part of its management of the network with any contribution from CSL Trust & Top End Properties Limited being paid through the development charges or targeted rates. I consider this to be consistent with the fact that upgrades are the result of cumulative effects from multiple sites (and so hard to attribute to any one rezoning).

76. Significantly, from my analysis, while there are intersection upgrades required relating to this (and other zone requests), there are engineering solutions that could be found in the future (ie intersection upgrades) to enable the rezoning to occur.

COUNCIL S42A REPORT

77. The section 42A framework report has very little discussion about roading and transport however there is discussion of Waikato 2070 (from paragraphs 123 onwards) and the servicing required for the Growth Nodes. The report describes how Council (including its roading team) is currently preparing Asset Management Plans to inform the 30-year Infrastructure Plan and the Long-Term Plan (LTP) and is considering the growth capacity and timing of

growth cells to determine servicing and costs. The LTP process will determine the exact timing of projects and the developments contributions that are levied to pay for them.

78. This aligns with my comments above where I consider there are upgrades required to the wider network, however these upgrades should be constructed by the Council as part of its management and upgrade of the transport network with any contribution from CSL Trust & Top End Properties Limited (and other areas) being paid through the development charges or targeted rates.

CONCLUSION

79. Based on the modelling and assessment outlined in the ITA and my evidence, I consider that the full extent of development enabled by plan change can be appropriately supported by the existing and upgraded road network (as I have detailed above), to maintain appropriate levels of safety and efficiency on the surrounding road network.

80. While there are intersection upgrades required relating to this (and other zone requests), there are engineering solutions that could be found in the future to enable the rezoning to occur.

81. Accordingly, I conclude that there is no traffic engineering or transportation planning reason to preclude acceptance of the proposed rezoning.

Leo Hills
Commute

17 Debruary 2021

ATTACHMENT A – REVISED SIDRA ANALYSIS

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179,203&205 HELENSLEE ROAD REVISED MODELLING NOTE

The following provides a revised assessment of Section 7-9 of an Integrated Transport Assessment (ITA) prepared by Commute (dated 24th September 2018) for a proposed plan change (PPC) at 179&205 Helenslee Road (referred to as the **original ITA**). This report supersedes these sections of the original ITA.

1 TRIP GENERATION

1.1 GUIDELINES

The RTA Guide[1] provides traffic generation rates that are considered to be appropriately applied to the potential residential facility at 179, 203 & 205 Helenslee Road in Pokeno.

The potential residential units were assessed and is most similar to in concept / location of a 'dwelling house'. As such, the RTA Guide predicts a peak hour trip rate of 0.85 trips / dwelling and daily trip rate of 9 trips / dwelling.

1.2 PROPOSED LEVEL OF TRIP GENERATION

1.2.1 RESIDENTIAL COMPONENT

The likely trip generation for the site is defined as follows:

Activity	RTA Rate	Number / GFA	Peak Hour Vehicle Trips	Daily vehicle Trips
Dwelling House	*'0.85 trips / dwelling for peak hour & 9.0 trips / dwelling for daily trips'*	413 x lots	351	3,717

As shown above, the proposed development is likely to generate in the order of 351 trips during the peak hour and 3,717 trips daily.

1.2.2 LOCAL CENTRE (SHOPS)

The local centre proposed as part of the potential development will be located within the centre of the residential development. As such, it is considered that these shops will typically cater for the surrounding residential dwellings (e.g. local convenience store / café) and is not likely to generate

[1] The Roads and Traffic Authority of New South Wales – Guide to Traffic Generating Developments (RTA)

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additional vehicle movements external to the site and therefore has not been assessed within the following sections.

1.3 POKENO INTERSECTION ASSESSMENT VOLUMES

The PSP paramics model volumes were used to inform the PSP and have been accepted by the Waikato District Council. Section 3.1 of the Pokeno Intersection Assessment[2] report outlines that the "*intersection traffic volumes were extracted from the 2022 Paramics model, with some redistribution to accommodate the following differences between the current assumptions and those in the model:*

- *Ford Street was not closed in the model*
- *The NIMT crossing was modelled as High Street, not Mclean Street*
- *Hill Park Drive was modelled as connecting directly to Pokeno Road, whereas it has been built intersecting with Helenslee Road."*

The Pokeno Intersection Assessment report also identified two new developments comprising a total of 430 dwellings which are expected to be completed in parallel with the PSP. Both developments are expected to be fully completed by 2040. In this regard, it is understood that the future year 2040 traffic demands have been estimated by combining the 2022 PSP Paramics model with traffic demands from two new developments (totalling 430 additional residential dwellings), as well as background traffic growth. The 2022 scenario traffic volumes outlined in the Pokeno Intersection Assessment report has been estimated by taking half of the full development traffic volumes. For the purpose of this assessment, the 2040 traffic volumes have been used as the base scenario (without development scenario).

1.4 SURVEYED VOLUMES

The Pokeno Intersection Assessment report does not provide any traffic volume data for the SH1 Razorback Road interchange. As such, traffic surveys have been undertaken at the Razorback Road SH1 (off-ramp) / Razorback Road intersection during the morning and afternoon commuter peak hours to understand the existing level of volumes at this intersection (as shown in Figure 1 below).

[2] Pokeno Intersection Assessment report (2016) prepared by BECA

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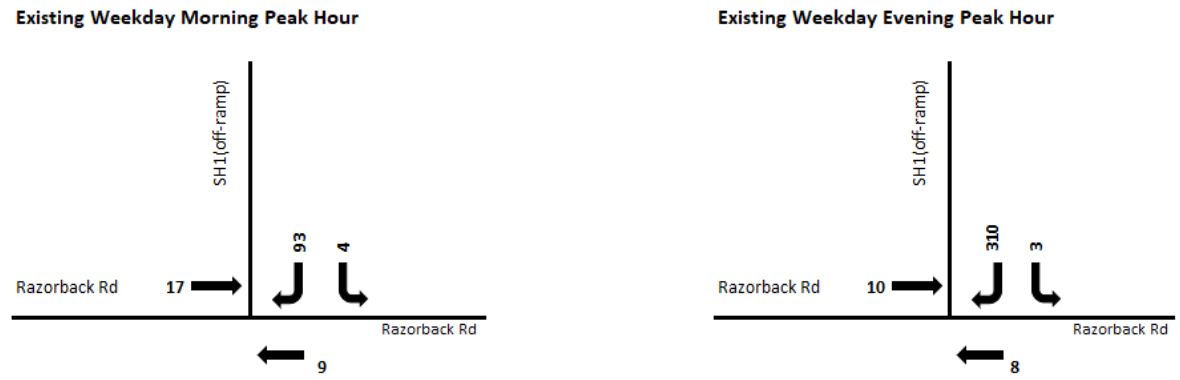
Figure 1: Razorback Road (off-ramp) / Razorback Road interchange 2020 survey results



2 NETWORK ANALYSIS

2.1 GENERAL

The Pokeno Intersection Assessment report provides indicative intersection forms for the year 2022 and 2040 for existing intersections within Pokeno. That assessment has been undertaken using the existing surveyed volumes and the volumes estimated for the future year 2022 and 2040 respectively and is shown in Figure 2 below.

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Figure 2: Traffic volumes extracted from the Beca report for the year 2022 and 2040

Table 6: Modelled Daily Traffic Flows

Modelled Approach VPD	Approach					Warrant
2016	**N**	**E**	**S**	**W**	**Total**	
Pokeno Road / Munro Road	400	1,100	-	1,600	3,100	Give-way
Pokeno Road / Helenslee Road	600	1,400	-	1,300	3,300	Give-way
Pokeno Road / McLean Street	-	-	-	-	0	Give-way
Pokeno Road / Great South Road	1,100	-	1,900	1,200	4,200	Give-way
Great South Road / SH1 NB On-Ramp	1,700	-	1,400	5	3,100	Give-way
½ Development, 2022	**N**	**E**	**S**	**W**	**Total**	
Pokeno Road / Munro Road	800	2,900	-	3,500	7,200	Give-way / Roundabout
Pokeno Road / Helenslee Road	1800	4,100	-	2,900	8,800	Signals/Roundabout
Pokeno Road / McLean Street	-	4,900	2,700	3,500	11,100	Signals/Roundabout
Pokeno Road / Great South Road	5,700	-	5,100	5,300	16,100	Signals/Roundabout
Great South Road / SH1 NB On-Ramp	3,700	100	6,000	0	9,800	Signals/Roundabout
Full Development, 2040	**N**	**E**	**S**	**W**	**Total**	
Pokeno Road / Munro Road	1,100	4,800	-	5,300	11,200	Give-way / Roundabout
Pokeno Road / Helenslee Road	3,000	6,700	-	4,600	14,300	Signals/Roundabout
Pokeno Road / McLean Street	-	9,900	5,400	7,100	22,400	Signals/Roundabout
Pokeno Road / Great South Road	10,400	-	8,400	9,400	28,200	Signals/Roundabout
Great South Road / SH1 NB On-Ramp	5,600	200	11,100	0	16,900	Signals/Roundabout

As shown above, all the intersections (potentially excluding the Pokeno Road / Munro Road intersection) will require some form of mitigation by the year 2022. Of note, no detailed designs / layouts of these intersections are available.

As such the following sections assess the intersection layouts required to cater for the future development volumes (planned and proposed) for the year 2040. It is noted that the recommended intersection layouts outlined in this report are indicative only and subject to change of demand.

In this regard, an assessment on the surrounding road network has been undertaken using SIDRA analysis to determine the intersection performance as a result of the predicted traffic volumes for the years 2040. The four new (indicative) intersections (Intersection A-D as shown in Figure 3 below) are included within the assessment. Furthermore, the key surrounding (existing) intersections have been included in this assessment:

- Helenslee Road / Munro Road intersection (E)
- Pokeno Road / Helenslee Road intersection (F); and
- SH1 Razorback Road interchange (off-ramp) (G).

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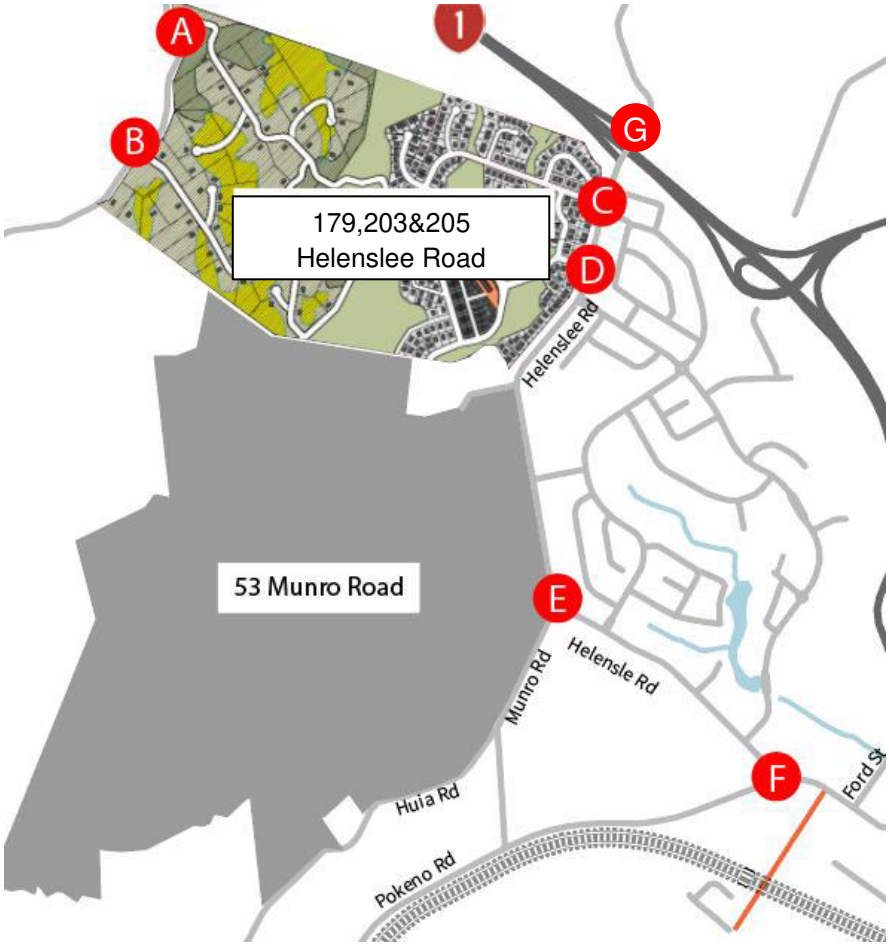
The 53 Munro Road ITA already outlines the recommended intersection forms (indicative) to cater for the base scenario volumes as well as the planned residential development at 53 Munro road for the year 2040. As such, for the purpose of this assessment, the recommended intersection layout for the above intersections will be extracted from the ITA, to determine where any further mitigation is required as part of the additional volumes. It is noted that the recommended intersection layouts outlined in this report are indicative only and subject to change of demand.

Figure 3 sets out the location of each intersection in relation to the surrounding environment.

Figure 3: Location of intersections near the vicinity of the site



2.2 TRIP DISTRIBUTION / MODEL GENERATION

2.2.1 PROPOSED DEVELOPMENT DISTRIBUTION ASSUMPTIONS

All trips associated with the 413 dwellings have been added to the existing road network.

The RTA Guide suggests that 80% of the trips by a residential development during the morning peak hour are exit movements and 20% are entry movements with the reverse

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occurring during the afternoon peak hour. Therefore, a total of 281 egress movements and 70 ingress movements are expected during the morning peak hour respectively with the reverse occurring during the afternoon peak hour.

Traffic distribution rates from the Pokeno Intersection Assessment report were calibrated to represent the directional vehicle movement proportions to and from Auckland, Pokeno/ Hamilton and Waikato (west) during the morning peak hour (with the reverse expected during the afternoon peak hour); this is outlined in Table 1 below.

Table 1: AM peak distribution

Direction	Waikato west (Tuakau)	Pokeno/ Hamilton	Auckland	TOTAL
To/ from	20%	45%	35%	100%
Total no. of trips	70 trips	158 trips	123 trips	351 trips

As can be seen above, during the morning peak hour the majority of commuters are expected to travel to Pokeno/ Hamilton and Auckland with a small proportion of residents expected to commute to the wider Waikato region.

Furthermore, vehicle movements to and from the site (during the morning and afternoon peak hour) have been distributed via the four proposed intersections (A-D) based on the origin/ destination of the trip; this is outlined in Table 2-4 below.

Table 2: Proportion of Waikato west (Tuakau) vehicle movements at intersections

Origin/ destination	Intersection used	% split of Waikato (west) based trips
Waikato west (Tuakau)	Int A	50%
	Int B	50%
	Total	**100%**

Table 3: Proportion of Pokeno/ Hamilton vehicle movements at intersections

Origin/ destination	Intersection	% of Pokeno/ Hamilton based trips
Pokeno/ Hamilton	Int C	50%
	Int D	50%
	Total	**100%**

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Table 4: Proportion of Auckland vehicle movements at intersections

Origin/ destination	Intersection	% of Auckland based trips
Auckland	Int A	8%
	Int B	8%
	Int C	42%
	Int D	42%
	Total	**100%**

As shown above, the direction of the vehicle movements and the route that commuters were likely to take was determined according to their destinations (Auckland, Pokeno/ Hamilton and Waikato). When distributing traffic at each of the proposed intersections, the following assumptions were made:

- For trips to and from Auckland
  - Vehicles from the "Residential' zone are expected to use the SH1 Razorback Road interchange via Helenslee Road when travelling to and from Auckland.
  - Vehicles from the 'Country Living' zone are expected to use the SH1 Ridge Road interchange via Ridge Road when travelling to/ from Auckland.
- For trips to and from Hamilton and the Pokeno town centre;
  - All vehicles leaving the site will head south along Helenslee Road towards the town centre or SH1 southbound on-ramp (vice versa for vehicle movements into the site).
- For trips to and from Waikato (west);
  - All vehicles leaving the site will head south along Ridge Road towards Whangarata Road with the reverse occurring for vehicles entering the site from west.

In summary, the trips generated by the potential residential development at the site comprising of some 413 dwellings can be distributed accordingly to the inbound / outbound percentage (80% / 20% split) to estimate the number of vehicles travelling into and out of the site for each morning and afternoon peak hours. The directional proportions calibrated from the Pokeno Intersection Assessment report (shown in Table 1 above) can then be used to determine the number of trips expected to travel to and from Auckland, Pokeno and Waikato (west) during the morning and afternoon peak hours which are shown in Table 5 and Table 6 below.

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Table 5: Morning peak hour distribution

Activity	Auckland	Pokeno/ Hamilton	Waikato (west)	Total
In from	25	32	14	71
Out to	98	126	56	280

Table 6: Afternoon peak hour distribution

Activity	Auckland	Pokeno	Waikato (west)	Total
In from	98	126	56	280
Out to	25	32	14	71

As shown above, the morning peak hour vehicle movement consists of a total of 71 inbound movements and 280 outbound movements with the reverse occurring during the afternoon peak hour.

3 ASSESSMENT OF EFFECTS

3.1 ASSESSMENT METHODOLOGY

The traffic effects of the potential development have been assessed using the traffic modelling software SIDRA Intersection. The results presented in this report include the Degree of Saturation, which is a measure of available capacity and the Level of Service ("LOS), which is a generalised function of delay. For signal-controlled intersections, a Degree of Saturation less than 0.9 is considered acceptable. LOS A and B are very good and indicative of free-flow conditions; C is good; D is acceptable; and E and F are indicative of congestion and unstable conditions.

As noted, this assessment assesses the intersection layout required to cater for the impact of the potential residential development on the surrounding road network and if the additional volumes trigger a change to the intersection form than that recommended in the Pokeno Intersection Assessment report. The recommended intersection layouts outlined in this report are indicative only and subject to change of demand.

Of note, for the purpose of this assessment, the traffic volumes have been assessed for the future year 2040 for which the full development (comprising 413 dwellings) have been included (potential scenario).

3.2 INTERSECTION A & B – SITE ENTRANCE / RIDGE ROAD (NORTHERN INTERSECTION)

Two new intersections are proposed along Ridge Road (one northern and southern connection respectively) as part of the potential residential subdivision. It is noted that there are no traffic volumes provided for Ridge Road in the Pokeno Intersection Assessment Report. Furthermore, there is no accurate information regarding the potential development that may occur along Ridge Road in the

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near future. As such, the performance of the proposed intersection has been assessed based on existing (through) traffic volumes[3].

These intersections will be give-way controlled with priority afforded to traffic along Ridge Road. The general layout of the intersection is set out in Figure 4 below.

Figure 4: Intersection A & B – Potential layout (indicative)

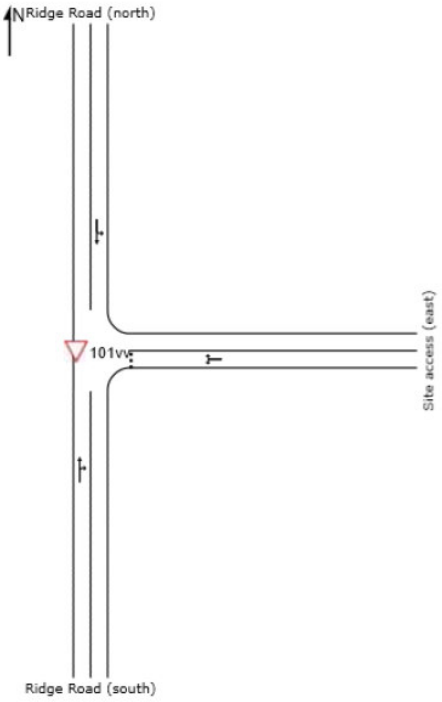

Figure 5 and Figure 6 shows the expected performance of Intersection A during the morning and afternoon peak hour respectively, for the future year 2040 below.

[3]Waikato District Council - RAMM Traffic and Loading data - July 2018

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Figure 5: Intersection A movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101vv [Site access 1 / Ridge Road AM Northern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	49	10.0	0.031	0.0	LOS A	0.0	0.3	0.04	0.08	59.1
3	R2	7	5.0	0.031	5.6	LOS A	0.0	0.3	0.04	0.08	56.7
Approach		57	9.4	0.031	0.8	NA	0.0	0.3	0.04	0.08	58.8
East: Site access (east)											
4	L2	29	10.0	0.026	5.8	LOS A	0.1	0.7	0.12	0.55	52.8
6	R2	7	5.0	0.026	5.9	LOS A	0.1	0.7	0.12	0.55	52.5
Approach		37	9.0	0.026	5.8	LOS A	0.1	0.7	0.12	0.55	52.8
North: Ridge Road (north)											
7	L2	2	5.0	0.025	5.6	LOS A	0.0	0.0	0.00	0.03	57.9
8	T1	44	10.0	0.025	0.0	LOS A	0.0	0.0	0.00	0.03	59.7
Approach		46	9.8	0.025	0.3	NA	0.0	0.0	0.00	0.03	59.6
All Vehicles		140	9.4	0.031	1.9	NA	0.1	0.7	0.05	0.18	57.3

Figure 6: Intersection A movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101vv [Site access 1 / Ridge Road PM Northern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	44	10.0	0.042	0.1	LOS A	0.2	1.1	0.11	0.23	57.4
3	R2	29	5.0	0.042	5.7	LOS A	0.2	1.1	0.11	0.23	55.1
Approach		74	8.0	0.042	2.3	NA	0.2	1.1	0.11	0.23	56.5
East: Site access (east)											
4	L2	7	5.0	0.007	5.7	LOS A	0.0	0.2	0.13	0.54	53.0
6	R2	2	5.0	0.007	5.9	LOS A	0.0	0.2	0.13	0.54	52.5
Approach		9	5.0	0.007	5.8	LOS A	0.0	0.2	0.13	0.54	52.9
North: Ridge Road (north)											
7	L2	7	5.0	0.031	5.6	LOS A	0.0	0.0	0.00	0.08	57.4
8	T1	49	10.0	0.031	0.0	LOS A	0.0	0.0	0.00	0.08	59.3
Approach		57	9.4	0.031	0.7	NA	0.0	0.0	0.00	0.08	59.0
All Vehicles		140	8.3	0.042	1.9	NA	0.2	1.1	0.07	0.19	57.2

As shown above, all movements operate at a LOS A during the morning and afternoon peak hour respectively. The maximum average delay is 5.9 seconds and occurs at the eastern approach (within the site). The maximum 95%ile back of queue length is 1.1 m (less than 1 vehicle) and the maximum degree of saturation for any approach is 0.042. Based on the potential traffic volumes predicted at this intersection, the proposed layout is considered adequate to cater for the predicted traffic volumes in 2040.

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It is noted that the intersection should be reassessed at detailed design stage, to determine whether or not further development has occurred along Ridge Road (resulting in significant increases of through movement along Ridge Road), and the final detailed design for the intersection (e.g. right turn bays / sight distance).

Figure 7 and Figure 8 shows the expected performance of Intersection B during the morning and afternoon peak hour respectively, for the future year 2040.

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Figure 7: Intersection B - movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101vv [Site access 2 / Ridge Road AM Southern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	49	10.0	0.032	0.0	LOS A	0.0	0.3	0.05	0.08	59.1
3	R2	7	5.0	0.032	5.7	LOS A	0.0	0.3	0.05	0.08	56.6
Approach		57	9.4	0.032	0.8	NA	0.0	0.3	0.05	0.08	58.7
East: Site access (east)											
4	L2	29	10.0	0.027	5.9	LOS A	0.1	0.8	0.16	0.54	52.7
6	R2	7	5.0	0.027	6.0	LOS A	0.1	0.8	0.16	0.54	52.4
Approach		37	9.0	0.027	5.9	LOS A	0.1	0.8	0.16	0.54	52.6
North: Ridge Road (north)											
7	L2	2	5.0	0.040	5.6	LOS A	0.0	0.0	0.00	0.02	57.9
8	T1	72	10.0	0.040	0.0	LOS A	0.0	0.0	0.00	0.02	59.8
Approach		74	9.9	0.040	0.2	NA	0.0	0.0	0.00	0.02	59.8
All Vehicles		167	9.5	0.040	1.6	NA	0.1	0.8	0.05	0.15	57.7

Figure 8: Intersection B - movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101vv [Site access 2 / Ridge Road PM Southern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	72	10.0	0.057	0.1	LOS A	0.2	1.2	0.09	0.17	58.1
3	R2	29	5.0	0.057	5.7	LOS A	0.2	1.2	0.09	0.17	55.7
Approach		101	8.5	0.057	1.7	NA	0.2	1.2	0.09	0.17	57.3
East: Site access (east)											
4	L2	7	5.0	0.007	5.7	LOS A	0.0	0.2	0.12	0.55	53.0
6	R2	2	5.0	0.007	6.0	LOS A	0.0	0.2	0.12	0.55	52.5
Approach		9	5.0	0.007	5.8	LOS A	0.0	0.2	0.12	0.55	52.9
North: Ridge Road (north)											
7	L2	7	5.0	0.031	5.6	LOS A	0.0	0.0	0.00	0.08	57.4
8	T1	49	10.0	0.031	0.0	LOS A	0.0	0.0	0.00	0.08	59.3
Approach		57	9.4	0.031	0.7	NA	0.0	0.0	0.00	0.08	59.0
All Vehicles		167	8.6	0.057	1.6	NA	0.2	1.2	0.06	0.16	57.6

As shown above, all movements operate at a LOS A during the morning and afternoon peak hour respectively. The maximum average delay is 6.0 seconds and occurs at the eastern approach (within the site). The maximum 95%ile back of queue length is 1.2 m (less than 1 vehicle) and the maximum degree of saturation for any approach is 0.057. Based on the potential traffic volumes predicted at this intersection, the proposed layout is considered adequate for the predicted traffic volumes in 2040.

Similar to Intersection A, it is noted that the intersection should be reassessed at detailed design stage, to determine whether or not further development has occurred along Ridge Road (resulting in

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significant increases of through movement along Ridge Road), and the final detailed design for the intersection (e.g. right turn bays / sight distance).

3.3 INTERSECTION C – SITE ENTRANCE / HELENSLEE ROAD CONNECTION

This is a new intersection that will be established as part of the potential residential subdivision and as such no layout is outlined in the Pokeno Intersection Assessment report.

This intersection will be give-way controlled with priority afforded to traffic along Helenslee Road. The layout of the intersection is set out in Figure 9 below.

Figure 9: Intersection B layout (Indicative)

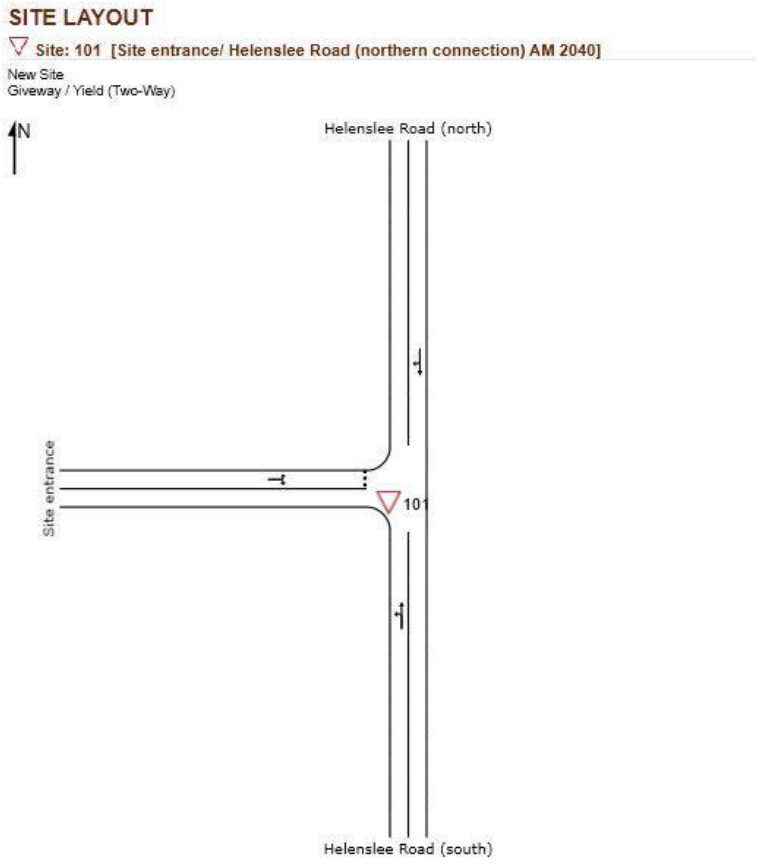

Figure 10 and Figure 11 show the expected performance of Intersection C during the morning and afternoon peak hours respectively, for the future year 2040.

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Figure 10: Intersection C movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Site access 3/ Helenslee Road AM Northern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	17	5.0	0.343	5.6	LOS A	0.0	0.0	0.00	0.02	57.9
2	T1	631	5.0	0.343	0.0	LOS A	0.0	0.0	0.00	0.02	59.8
Approach		647	5.0	0.343	0.2	NA	0.0	0.0	0.00	0.02	59.7
North: Helenslee Road (north)											
8	T1	469	5.0	0.262	0.2	LOS A	0.2	1.4	0.05	0.01	59.6
9	R2	11	5.0	0.262	10.0	LOS A	0.2	1.4	0.05	0.01	57.1
Approach		480	5.0	0.262	0.4	NA	0.2	1.4	0.05	0.01	59.5
West: Site access											
10	L2	44	5.0	0.262	9.5	LOS A	0.9	6.8	0.72	0.92	47.7
12	R2	66	5.0	0.262	16.5	LOS C	0.9	6.8	0.72	0.92	47.3
Approach		111	5.0	0.262	13.7	LOS B	0.9	6.8	0.72	0.92	47.5
All Vehicles		1238	5.0	0.343	1.5	NA	0.9	6.8	0.08	0.10	58.3

Figure 11: Intersection C movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Site access 3/ Helenslee Road PM Northern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	66	5.0	0.227	5.6	LOS A	0.0	0.0	0.00	0.09	57.3
2	T1	359	5.0	0.227	0.0	LOS A	0.0	0.0	0.00	0.09	59.1
Approach		425	5.0	0.227	0.9	NA	0.0	0.0	0.00	0.09	58.8
North: Helenslee Road (north)											
8	T1	745	5.0	0.435	0.4	LOS A	0.8	6.0	0.10	0.04	59.2
9	R2	44	5.0	0.435	8.6	LOS A	0.8	6.0	0.10	0.04	56.7
Approach		789	5.0	0.435	0.8	NA	0.8	6.0	0.10	0.04	59.1
West: Site access											
10	L2	11	5.0	0.071	6.9	LOS A	0.2	1.6	0.63	0.78	48.1
12	R2	17	5.0	0.071	17.0	LOS C	0.2	1.6	0.63	0.78	47.7
Approach		27	5.0	0.071	13.1	LOS B	0.2	1.6	0.63	0.78	47.8
All Vehicles		1242	5.0	0.435	1.1	NA	0.8	6.0	0.08	0.07	58.7

As shown above, the majority of lanes operate at a LOS A during the morning and afternoon peak hour respectively; this excludes the right turn movement on the western approach (site access) which is expected to operate at LOS C. This particular movement experiences a maximum delay of 17.0 seconds (afternoon peak) and 95%tile queue of 7.0 m (1 vehicle).

Based on the above assessment, a give-way controlled intersection is considered adequate to cater for the proposed traffic volumes at this intersection.

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To ensure minimal disruption to Helenslee Road, it is recommended that this intersection be designed and constructed with a right turn bay on Helenslee Road into the site (similar to the existing Hillpark Drive / Helenslee Road intersection located some 80m to the south of this intersection) and have two approach lanes on the new subject road.

3.4 INTERSECTION D – SITE ENTRANCE / HELENSLEE ROAD CONNECTION

This is a new intersection that will be established as part of the potential residential subdivision and as such no layout is outlined in the Pokeno Intersection Assessment report.

This intersection will be give-way controlled with priority to traffic along Helenslee Road. The layout of the intersection is set out in Figure 12 below.

Figure 12: Intersection D - potential layout (indicative)

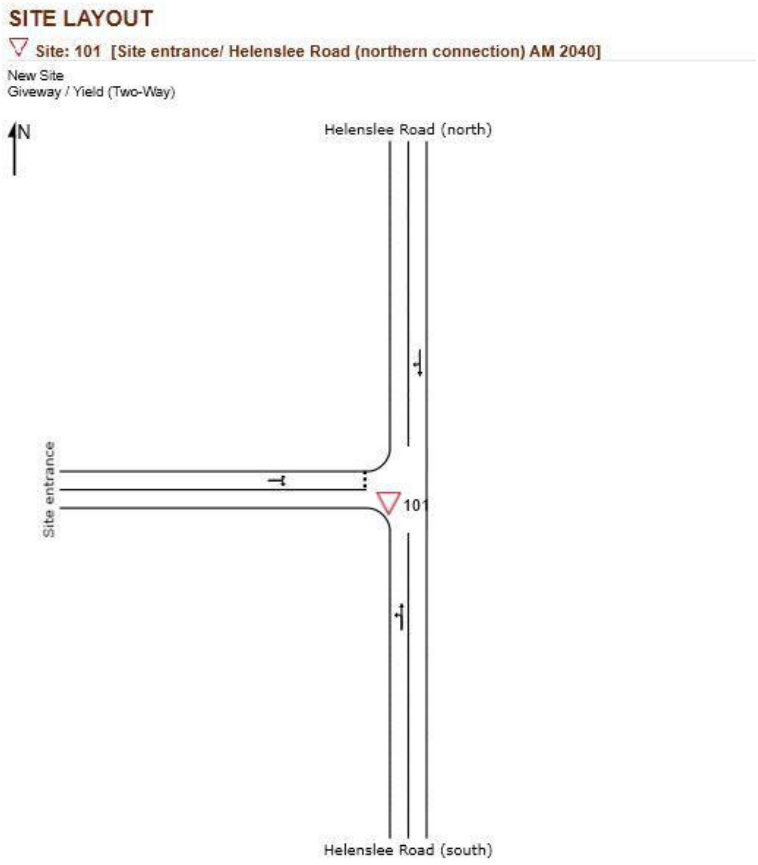

Figure 10 and Figure 11 show the expected performance of Intersection D during the morning and afternoon peak hours respectively, for the future year 2040.

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Figure 13: Intersection D movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Site access 4/ Helenslee Road AM Southern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	17	5.0	0.329	5.6	LOS A	0.0	0.0	0.00	0.02	57.9
2	T1	603	5.0	0.329	0.0	LOS A	0.0	0.0	0.00	0.02	59.8
Approach		620	5.0	0.329	0.2	NA	0.0	0.0	0.00	0.02	59.7
North: Helenslee Road (north)											
8	T1	524	5.0	0.290	0.2	LOS A	0.2	1.4	0.04	0.01	59.6
9	R2	11	5.0	0.290	9.9	LOS A	0.2	1.4	0.04	0.01	57.1
Approach		535	5.0	0.290	0.4	NA	0.2	1.4	0.04	0.01	59.6
West: Site access											
10	L2	44	5.0	0.265	9.3	LOS A	0.9	6.9	0.72	0.92	47.7
12	R2	66	5.0	0.265	16.8	LOS C	0.9	6.9	0.72	0.92	47.2
Approach		111	5.0	0.265	13.8	LOS B	0.9	6.9	0.72	0.92	47.4
All Vehicles		1265	5.0	0.329	1.5	NA	0.9	6.9	0.08	0.09	58.3

Figure 14: Intersection D movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Site access 4/ Helenslee Road PM Southern intersection - revised]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	66	5.0	0.257	5.6	LOS A	0.0	0.0	0.00	0.08	57.4
2	T1	415	5.0	0.257	0.0	LOS A	0.0	0.0	0.00	0.08	59.2
Approach		481	5.0	0.257	0.8	NA	0.0	0.0	0.00	0.08	58.9
North: Helenslee Road (north)											
8	T1	718	5.0	0.423	0.4	LOS A	0.9	6.4	0.11	0.04	59.1
9	R2	44	5.0	0.423	9.1	LOS A	0.9	6.4	0.11	0.04	56.6
Approach		762	5.0	0.423	0.9	NA	0.9	6.4	0.11	0.04	58.9
West: Site access											
10	L2	11	5.0	0.074	7.2	LOS A	0.2	1.6	0.66	0.80	47.9
12	R2	17	5.0	0.074	17.4	LOS C	0.2	1.6	0.66	0.80	47.4
Approach		27	5.0	0.074	13.5	LOS B	0.2	1.6	0.66	0.80	47.6
All Vehicles		1271	5.0	0.423	1.2	NA	0.9	6.4	0.08	0.07	58.6

Similar to Intersection C, the majority of lanes operate at a LOS A during the morning and afternoon peak hour respectively; this excludes the right turn movement on the western approach (site access) which is expected to operate at LOS C. This particular movement experiences a maximum delay of 17.4 seconds (afternoon peak) and 95%tile queue of 7.0 m (1 vehicle).

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Based on the above assessment, a give-way controlled intersection is considered adequate to cater for the proposed traffic volumes at this intersection.

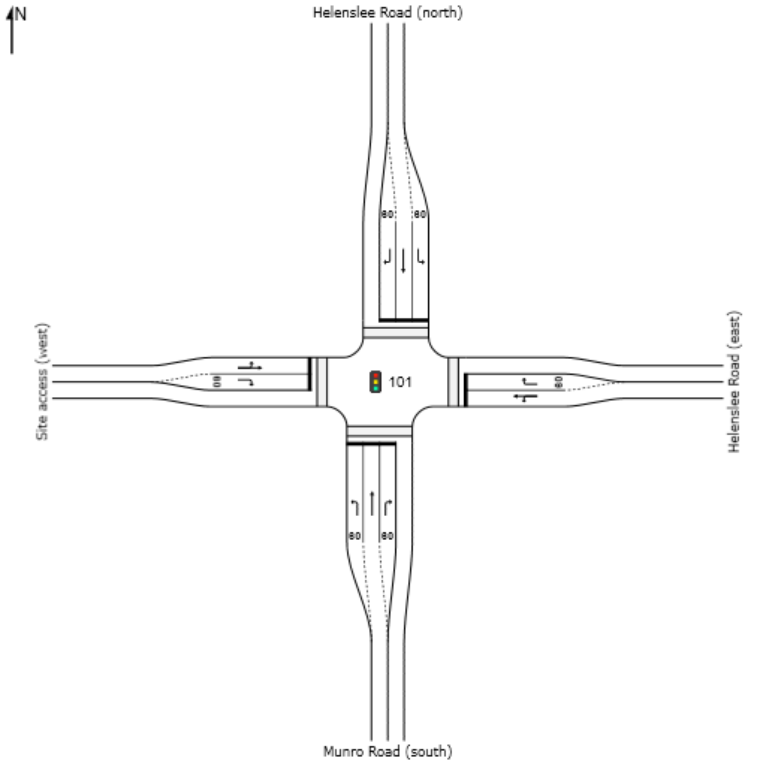
To ensure minimal disruption to Helenslee Road, it is recommended that this intersection be designed and constructed with a right turn bay on Helenslee Road into the site (similar to the existing Hillpark Drive / Helenslee Road intersection located some 80m to the south of this intersection) and have two approach lanes on the new subject road.

3.5 HELENSLEE ROAD / MUNRO ROAD (PLANNED)

As outlined in the 53 Munro Road ITA, upgrades are planned at the Munro Road/ Helenslee Road intersection as part of that development. The recommended layout of the intersection for the year 2040 is shown in Figure 15 below.

The intersection will be signalised as part of the 53 Munro Road residential development, with an additional western approach connecting to that site.

Figure 15: Intersection E - indicative layout



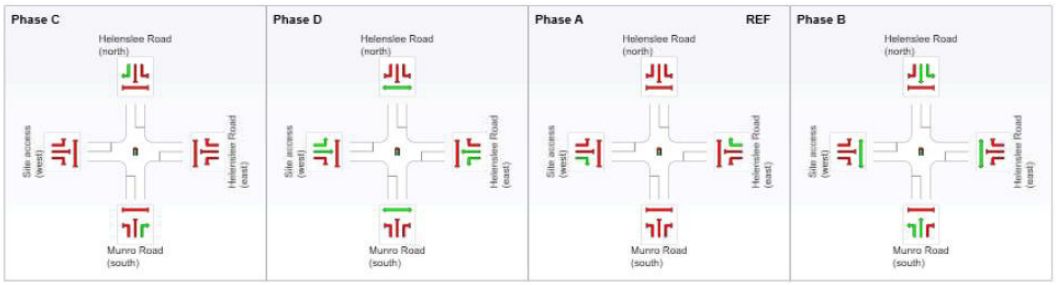


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Figure 16 and Figure 17 shows the planned performance of Intersection E for the morning and afternoon peak hours respectively, for the future year 2040.

Figure 16: Intersection E movement summary 2040 AM – planned

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	22	5.0	0.030	28.0	LOS C	0.8	5.5	0.62	0.68	40.3
2	T1	215	5.0	0.278	25.2	LOS C	8.3	60.5	0.71	0.60	42.4
3	R2	36	5.0	0.399	69.5	LOS E	2.2	15.9	1.00	0.73	27.5
Approach		273	5.0	0.399	31.2	LOS C	8.3	60.5	0.74	0.62	39.4
East: Helenslee Road (east)											
4	L2	4	5.0	0.102	45.2	LOS D	2.0	14.6	0.83	0.64	35.5
5	T1	39	5.0	0.102	39.6	LOS D	2.0	14.6	0.83	0.64	36.2
6	R2	193	5.0	0.716	60.7	LOS E	11.3	82.3	1.00	0.85	29.6
Approach		236	5.0	0.716	57.0	LOS E	11.3	82.3	0.97	0.81	30.6
North: Helenslee Road (north)											
7	L2	461	5.0	0.705	35.9	LOS D	21.4	156.1	0.85	0.84	37.0
8	T1	162	5.0	0.210	24.4	LOS C	6.1	44.2	0.69	0.57	42.8
9	R2	22	5.0	0.247	68.6	LOS E	1.3	9.7	0.99	0.71	27.7
Approach		645	5.0	0.705	34.1	LOS C	21.4	156.1	0.82	0.77	37.9
West: Site access (west)											
10	L2	119	5.0	0.704	52.7	LOS D	15.8	115.7	0.98	0.85	32.6
11	T1	169	5.0	0.704	47.1	LOS D	15.8	115.7	0.98	0.85	33.2
12	R2	40	5.0	0.149	54.0	LOS D	2.1	15.1	0.90	0.73	31.3
Approach		328	5.0	0.704	49.9	LOS D	15.8	115.7	0.97	0.83	32.7
All Vehicles		1482	5.0	0.716	40.7	LOS D	21.4	156.1	0.86	0.76	35.6

Figure 17: Intersection E movement summary 2040 PM - planned

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	56	5.0	0.113	40.4	LOS D	2.4	17.7	0.78	0.73	35.4
2	T1	164	5.0	0.316	37.1	LOS D	7.6	55.7	0.84	0.69	37.2
3	R2	23	5.0	0.103	56.5	LOS E	1.2	8.9	0.92	0.71	30.5
Approach		243	5.0	0.316	39.7	LOS D	7.6	55.7	0.83	0.70	36.1
East: Helenslee Road (east)											
4	L2	14	5.0	0.627	61.2	LOS E	8.5	61.9	1.00	0.81	30.7
5	T1	134	5.0	0.627	55.6	LOS E	8.5	61.9	1.00	0.81	31.3
6	R2	317	5.0	0.627	43.2	LOS D	15.6	114.0	0.90	0.83	34.5
Approach		464	5.0	0.627	47.3	LOS D	15.6	114.0	0.93	0.82	33.4
North: Helenslee Road (north)											
7	L2	175	5.0	0.354	43.3	LOS D	8.2	60.1	0.85	0.79	34.5
8	T1	302	5.0	0.619	40.5	LOS D	15.3	111.8	0.92	0.78	36.0
9	R2	139	5.0	0.620	61.2	LOS E	8.0	58.4	1.00	0.81	29.4
Approach		616	5.0	0.620	46.0	LOS D	15.3	111.8	0.92	0.79	33.8
West: Site access (west)											
10	L2	28	5.0	0.261	58.0	LOS E	3.3	23.8	0.94	0.74	31.0
11	T1	32	5.0	0.261	52.4	LOS D	3.3	23.8	0.94	0.74	31.5
12	R2	22	5.0	0.040	36.4	LOS D	0.9	6.5	0.73	0.69	36.9
Approach		82	5.0	0.261	50.0	LOS D	3.3	23.8	0.89	0.72	32.6
All Vehicles		1405	5.0	0.627	45.6	LOS D	15.6	114.0	0.90	0.78	34.0

Figure 18 and Figure 19 show the expected performance of Intersection E (with development) for the morning and afternoon peak hours respectively, for the future year 2040.

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Figure 18: Intersection E movement summary 2040 AM_potential

MOVEMENT SUMMARY

Site: 101 [Revised test Int C 2040 AM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	22	5.0	0.028	25.5	LOS C	0.7	5.2	0.59	0.67	41.4
2	T1	215	5.0	0.257	22.4	LOS C	7.8	57.0	0.67	0.57	43.8
3	R2	36	5.0	0.399	69.5	LOS E	2.2	15.9	1.00	0.73	27.5
Approach		273	5.0	0.399	28.8	LOS C	7.8	57.0	0.71	0.60	40.5
East: Helenslee Road (east)											
4	L2	4	5.0	0.120	48.9	LOS D	2.1	15.3	0.86	0.66	34.3
5	T1	39	5.0	0.120	43.3	LOS D	2.1	15.3	0.86	0.66	34.9
6	R2	226	5.0	0.841	67.0	LOS E	14.3	104.7	1.00	0.93	28.2
Approach		269	5.0	0.841	63.3	LOS E	14.3	104.7	0.98	0.88	29.1
North: Helenslee Road (north)											
7	L2	595	5.0	0.855	43.4	LOS D	32.7	239.0	0.90	0.91	34.4
8	T1	162	5.0	0.194	21.7	LOS C	5.7	41.6	0.65	0.54	44.2
9	R2	22	5.0	0.247	68.6	LOS E	1.3	9.7	0.99	0.71	27.7
Approach		779	5.0	0.855	39.6	LOS D	32.7	239.0	0.85	0.83	35.8
West: 53 Munro Road site access (west)											
10	L2	119	5.0	0.831	62.3	LOS E	17.8	129.7	1.00	0.96	30.0
11	T1	169	5.0	0.831	56.7	LOS E	17.8	129.7	1.00	0.96	30.5
12	R2	40	5.0	0.149	54.0	LOS D	2.1	15.1	0.90	0.73	31.3
Approach		328	5.0	0.831	58.4	LOS E	17.8	129.7	0.99	0.93	30.4
All Vehicles		1649	5.0	0.855	45.4	LOS D	32.7	239.0	0.87	0.82	34.0

Figure 19: Intersection E movement summary 2040 PM_ potential

MOVEMENT SUMMARY

Site: 101 [Revised test Int C 2040 PM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	56	5.0	0.133	44.8	LOS D	2.6	18.9	0.83	0.74	34.0
2	T1	164	5.0	0.373	41.8	LOS D	8.1	59.2	0.89	0.73	35.6
3	R2	23	5.0	0.129	60.0	LOS E	1.3	9.3	0.94	0.71	29.6
Approach		243	5.0	0.373	44.2	LOS D	8.1	59.2	0.88	0.73	34.5
East: Helenslee Road (east)											
4	L2	14	5.0	0.724	65.1	LOS E	8.9	64.8	1.00	0.86	29.8
5	T1	134	5.0	0.724	59.5	LOS E	8.9	64.8	1.00	0.86	30.2
6	R2	451	5.0	0.759	38.6	LOS D	21.9	159.6	0.87	0.85	36.1
Approach		598	5.0	0.759	43.9	LOS D	21.9	159.6	0.90	0.85	34.4
North: Helenslee Road (north)											
7	L2	208	5.0	0.498	49.0	LOS D	10.7	78.0	0.92	0.81	32.7
8	T1	302	5.0	0.771	48.4	LOS D	17.0	124.2	0.97	0.88	33.4
9	R2	139	5.0	0.775	67.8	LOS E	8.6	62.9	1.00	0.87	27.9
Approach		649	5.0	0.775	52.7	LOS D	17.0	124.2	0.96	0.86	31.8
West: 53 Munro Road site access (west)											
10	L2	28	5.0	0.301	60.3	LOS E	3.3	24.4	0.96	0.74	30.4
11	T1	32	5.0	0.301	54.7	LOS D	3.3	24.4	0.96	0.74	30.9
12	R2	22	5.0	0.031	29.3	LOS C	0.8	5.7	0.64	0.68	39.7
Approach		82	5.0	0.301	49.8	LOS D	3.3	24.4	0.87	0.72	32.7
All Vehicles		1573	5.0	0.775	47.9	LOS D	21.9	159.6	0.92	0.83	33.2

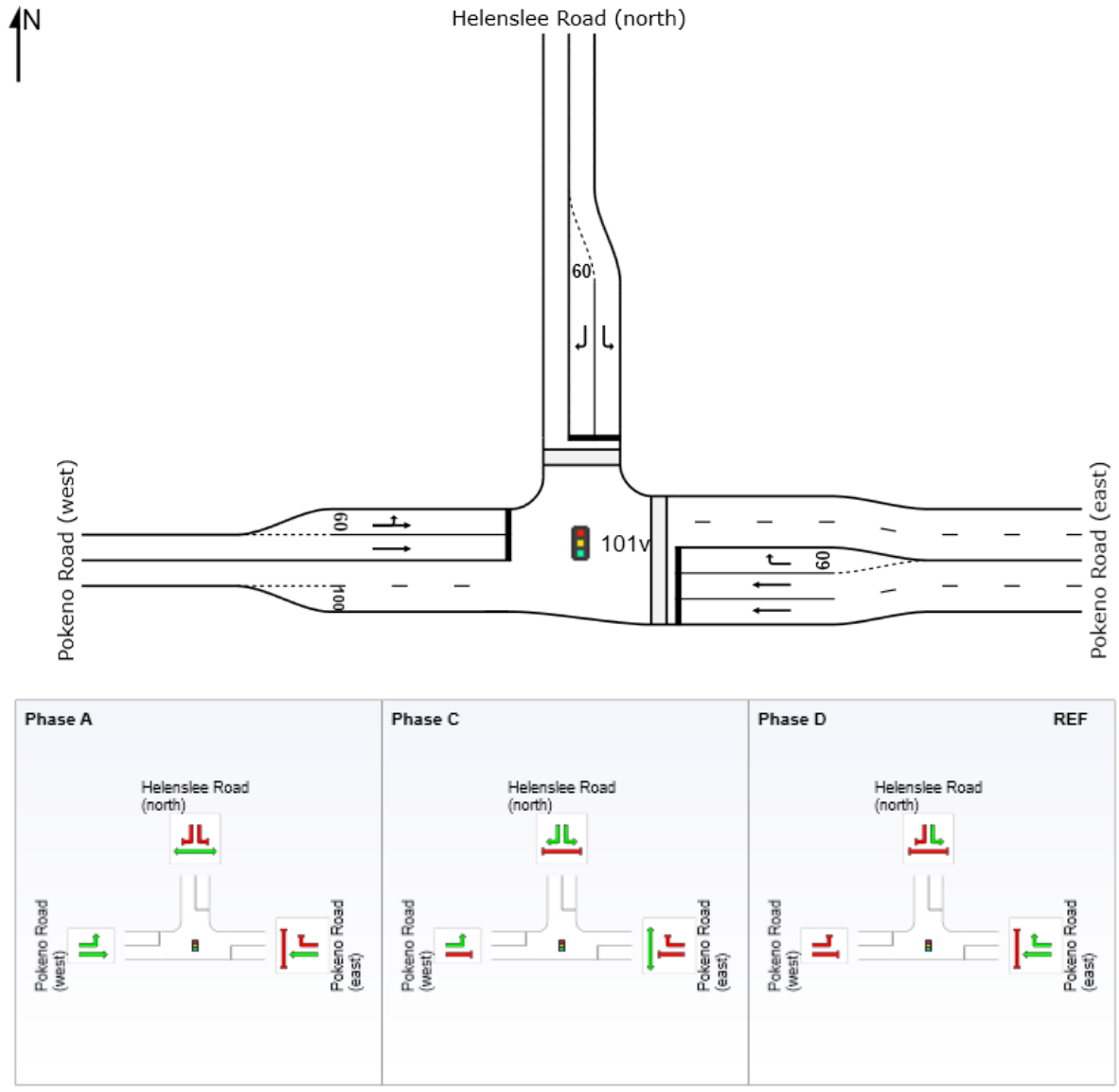
As shown above, during the morning peak hour, the maximum degree of saturation of the intersection increases from 0.716 (planned) to 0.855 as a result of the additional traffic volumes therefore still operates below capacity (0.9). During the afternoon peak hour, the maximum degree of saturation increases from 0.627 to 0.775 as a result of the development. The maximum 95%ile back of queue is 239 m and occurs on the northern approach (during the morning peak hour); the degree of saturation for this approach is 0.855 and operates at a LOS D.

Based on the above modelling, the planned signalised intersection is expected to operate near capacity by the future year 2040. However, it is considered that as the public transport provision near the vicinity of the site enhances, there is potential for the level of congestion to reduce as more trips are attributed towards public transport as opposed to private vehicles.

3.6 INTERSECTION F – HELENSLEE / POKENO ROAD INTERSECTION

As outlined in the 53 Munro Road ITA, upgrades are required at the Helenslee Road/ Pokeno Road intersection as a result of the increasing traffic volumes. This is in alignment with the Pokeno Intersection Assessment report which states that a signal/ roundabout intersection form is warranted for the 2022 and 2040 at the Helenslee Road/ Pokeno Road intersection. The recommended layout of the intersection for the year 2040 is shown in Figure 20 below.

Figure 20: Intersection F potential layout



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As such, with the additional traffic volumes generated by the potential residential development, the expected performance of the intersection for the future year 2040 (AM and PM) is outlined in Figure 21 and Figure 22 below.

Figure 21: Intersection F - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	434	5.0	0.199	0.3	LOS A	0.3	2.4	0.03	0.02	59.7
6	R2	282	5.0	0.335	12.9	LOS B	4.0	29.3	0.31	0.66	48.3
Approach		716	5.0	0.335	5.3	LOS A	4.0	29.3	0.14	0.27	54.6
North: Helenslee Road (north)											
7	L2	868	5.0	0.757	17.5	LOS B	27.6	201.8	0.72	0.82	45.5
9	R2	37	5.0	0.158	48.3	LOS D	1.6	12.0	0.92	0.73	32.8
Approach		905	5.0	0.757	18.8	LOS B	27.6	201.8	0.72	0.82	44.8
West: Pokeno Road (west)											
10	L2	25	5.0	0.755	47.2	LOS D	15.2	110.9	0.99	0.90	34.8
11	T1	603	5.0	0.755	41.8	LOS D	15.2	110.9	0.99	0.90	35.5
Approach		628	5.0	0.755	42.1	LOS D	15.2	110.9	0.99	0.90	35.4
All Vehicles		2249	5.0	0.757	21.0	LOS C	27.6	201.8	0.61	0.67	44.1

Figure 22: Intersection F - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	676	5.0	0.310	0.3	LOS A	0.6	4.4	0.03	0.03	59.7
6	R2	695	5.0	0.717	9.6	LOS A	9.5	69.3	0.30	0.68	50.4
Approach		1371	5.0	0.717	5.0	LOS A	9.5	69.3	0.17	0.36	54.6
North: Helenslee Road (north)											
7	L2	288	5.0	0.220	10.2	LOS B	4.4	32.4	0.34	0.68	50.1
9	R2	17	5.0	0.072	47.5	LOS D	0.7	5.4	0.91	0.69	33.0
Approach		305	5.0	0.220	12.2	LOS B	4.4	32.4	0.38	0.68	48.7
West: Pokeno Road (west)											
10	L2	24	5.0	0.914	66.3	LOS E	15.5	112.8	1.00	1.09	29.4
11	T1	496	5.0	0.914	60.6	LOS E	15.5	112.8	1.00	1.09	30.0
Approach		520	5.0	0.914	60.9	LOS E	15.5	112.8	1.00	1.09	30.0
All Vehicles		2196	5.0	0.914	19.3	LOS B	15.5	112.8	0.39	0.57	45.1

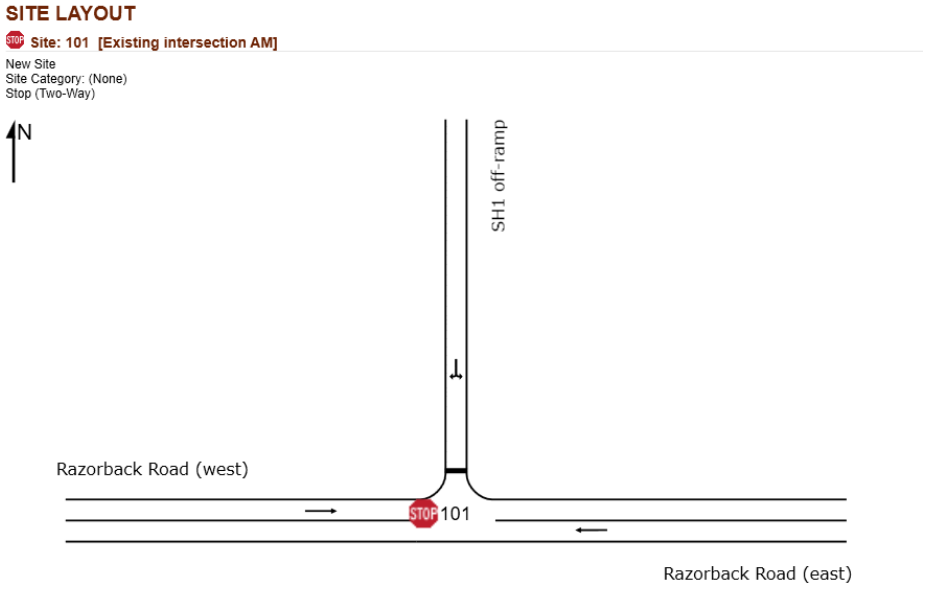
As shown above, the majority of lanes perform at a LOS A or D; this excludes the western approach which is expected to operate at LOS E during the afternoon peak hour. The maximum degree of saturation for this approach is 0.755 (LOS D) during the morning peak hour and 0.914 (LOS E) during the afternoon peak hour therefore indicating that some level of congestion is expected at this approach by the year 2040. For this particular movement, the maximum 95%ile back of queue is 112.8 m and occurs during the afternoon peak hour.

3.7 INTERSECTION G – SH1 RAZORBACK ROAD OFF-RAMP

The Razorback Road off-ramp is currently stop-controlled with priority afforded to traffic along Razorback Road. Traffic surveys were undertaken at this intersection on Wednesday 28th October 2020 during the morning and afternoon commuter peak hours; the results of this are provided in Figure 1 above.

The existing layout of the SH1 off-ramp / Razorback Road intersection is shown in Figure 23 below.

Figure 23: Intersection G - existing layout



To assess the performance of this intersection for the future year 2040, it is conservatively assumed that 90% of volumes travelling to and from the north are expected to turn to and from SH1 ramps respectively and 10% continues via Razorback Road (east of the SH1 ramps); this results in a significant number of vehicles turning right onto Razorback Road during the afternoon peak hour (from the off-ramp).

Figure 24: Intersection G - Movement summary 2020 AM_ Existing

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	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Razorback Road (east)												
5	T1	9	5.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		9	5.0	0.005	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	4	5.0	0.062	7.7	LOS A	0.2	1.2	0.06	0.96	0.06	45.1
9	R2	98	5.0	0.062	7.1	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
Approach		102	5.0	0.062	7.2	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
West: Razorback Road (west)												
11	T1	18	5.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		18	5.0	0.009	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		129	5.0	0.062	5.7	NA	0.2	1.2	0.05	0.76	0.05	45.7

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Figure 25: Intersection G - Movement summary 2020 PM_ Existing

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
East: Razorback Road (east)												
5	T1	8	5.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		8	5.0	0.004	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	3	5.0	0.199	7.7	LOS A	0.6	4.4	0.05	0.97	0.05	45.2
9	R2	326	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
Approach		329	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
West: Razorback Road (west)												
11	T1	11	5.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		11	5.0	0.006	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		348	5.0	0.199	6.8	NA	0.6	4.4	0.05	0.91	0.05	44.9

Figure 26 and Figure 27 shows the expected performance of the intersection during the morning and afternoon peak hours respectively, for the future year 2040.

Figure 26: Intersection G - Movement summary 2040 AM_ potential

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
East: Razorback Road (east)												
5	T1	48	5.0	0.026	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		48	5.0	0.026	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	6	5.0	0.279	8.0	LOS A	0.9	6.7	0.17	0.92	0.17	45.2
9	R2	432	5.0	0.279	7.3	LOS A	0.9	6.7	0.17	0.92	0.17	44.6
Approach		438	5.0	0.279	7.4	LOS A	0.9	6.7	0.17	0.92	0.17	44.6
West: Razorback Road (west)												
11	T1	68	5.0	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		68	5.0	0.036	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		555	5.0	0.279	5.8	NA	0.9	6.7	0.13	0.73	0.13	45.6

Figure 27: Intersection G - Movement summary 2040 PM_ potential

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
East: Razorback Road (east)												
5	T1	79	5.0	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		79	5.0	0.042	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	5	5.0	0.456	7.9	LOS A	1.8	13.5	0.20	0.91	0.20	45.2
9	R2	711	5.0	0.456	7.4	LOS A	1.8	13.5	0.20	0.91	0.20	44.6
Approach		716	5.0	0.456	7.4	LOS A	1.8	13.5	0.20	0.91	0.20	44.6
West: Razorback Road (west)												
11	T1	37	5.0	0.020	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		37	5.0	0.020	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		832	5.0	0.456	6.4	NA	1.8	13.5	0.17	0.78	0.17	45.3

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Using the volumes assumed near the northern end of **the site** for the future year 2040, the modelling results indicate a maximum degree of saturation of 0.456 during the afternoon peak hour on the northern approach. The maximum 95%ile back of queue on the off-ramp is 13.5 m (2 vehicles). The off-ramp is some 190 m in length therefore this level of queuing is not expected to interfere with SH1 through traffic.

ATTACHMENT B - SIDRA ANALYSIS_SENSITIVITY TEST RESULTS

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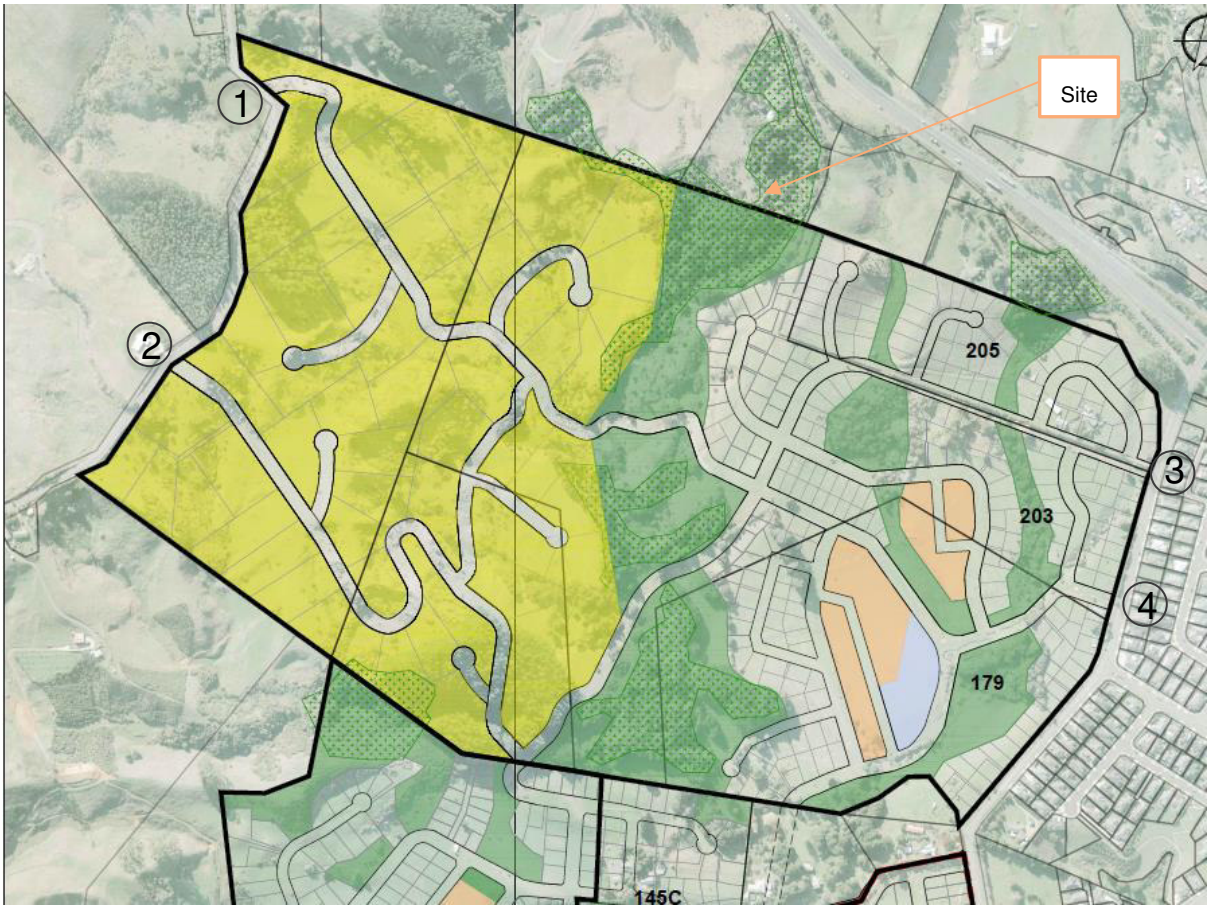
179,203&205 HELENSLEE ROAD SENSITIVITY ANALYSIS RESULTS

The following memo outlines the results of a sensitivity assessment undertaken as part of a rezoning request proposed at 179,203&205 Helenslee Road, Pokeno. This document supplements the Transport evidence[1] provided for the site (dated 17th February 2021) and should be read in conjunction with that document.

1 GENERAL

Figure 1 and Figure 2 outlines the location of each intersection assessed in relation to the site.

Figure 1: Location of Intersection 1-4 in relation to the site



[1] Statement of transport evidence from Leo Donald Hills for Pokeno West Limited (97)

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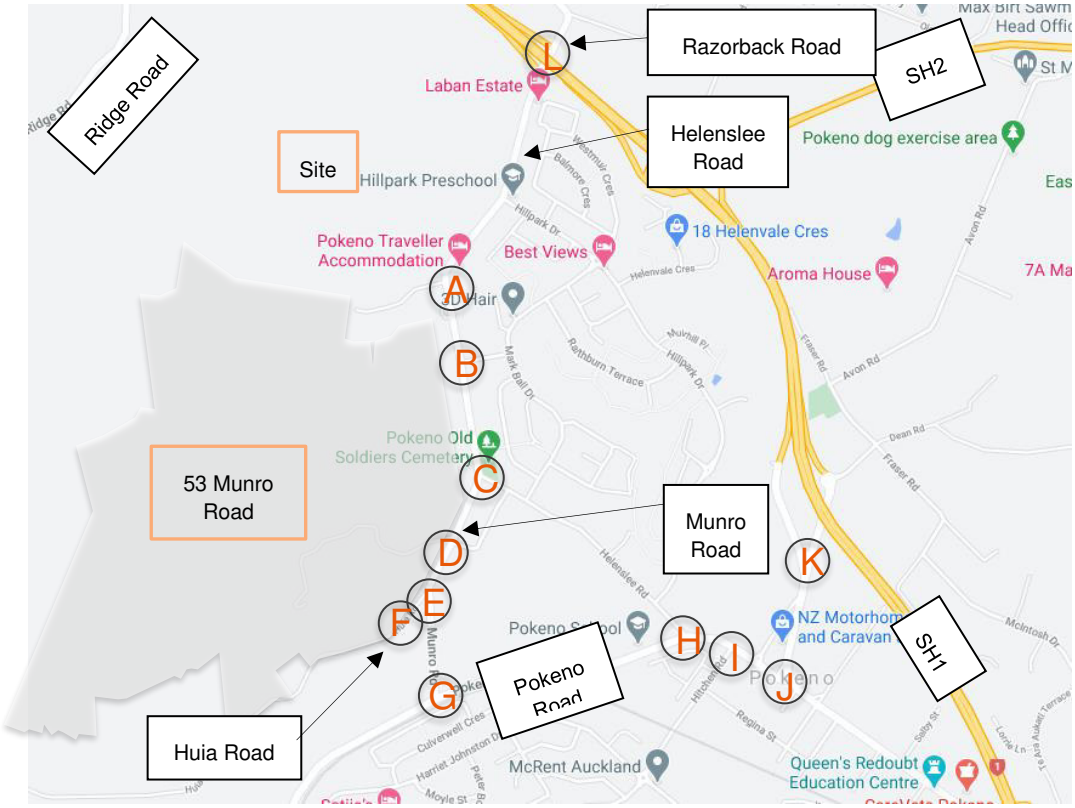
Figure 2: Location of intersections in relation to the site (Intersections A-L)



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2 MOVEMENT SUMMARY RESULTS

2.1 SITE ACCESS 1 / RIDGE ROAD (NORTHERN INTERSECTION)

Figure 3: Site access 1 / Ridge Road layout (indicative)

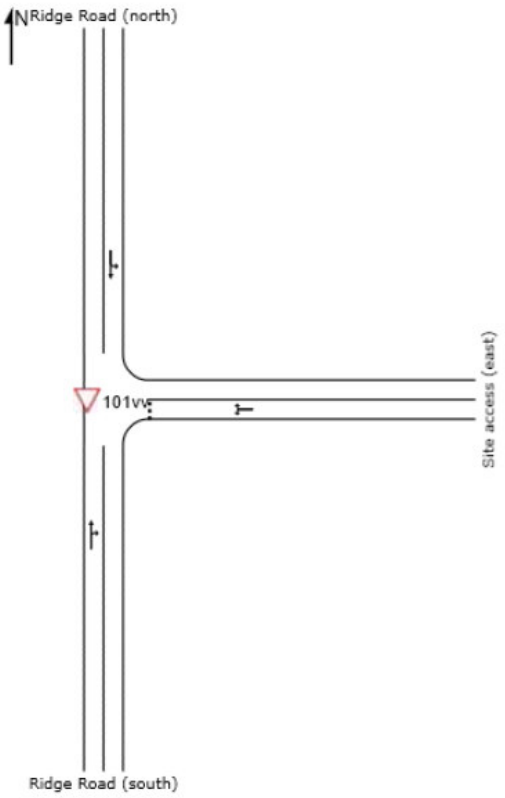

Figure 4: Intersection 1 - Movement summary 2040 AM

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	56	10.0	0.035	0.0	LOS A	0.0	0.3	0.04	0.07	59.2
3	R2	7	5.0	0.035	5.7	LOS A	0.0	0.3	0.04	0.07	56.7
Approach		63	9.4	0.035	0.7	NA	0.0	0.3	0.04	0.07	58.9
East: Site access (east)											
4	L2	29	10.0	0.032	5.8	LOS A	0.1	0.9	0.13	0.55	52.8
6	R2	14	5.0	0.032	5.9	LOS A	0.1	0.9	0.13	0.55	52.5
Approach		43	8.4	0.032	5.8	LOS A	0.1	0.9	0.13	0.55	52.7
North: Ridge Road (north)											
7	L2	3	5.0	0.026	5.6	LOS A	0.0	0.0	0.00	0.04	57.8
8	T1	45	10.0	0.026	0.0	LOS A	0.0	0.0	0.00	0.04	59.6
Approach		48	9.7	0.026	0.4	NA	0.0	0.0	0.00	0.04	59.5
All Vehicles		155	9.2	0.035	2.0	NA	0.1	0.9	0.05	0.19	57.2

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Figure 5: Intersection 1 - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	45	10.0	0.043	0.1	LOS A	0.2	1.2	0.13	0.23	57.4
3	R2	29	5.0	0.043	5.7	LOS A	0.2	1.2	0.13	0.23	55.1
Approach		75	8.0	0.043	2.3	NA	0.2	1.2	0.13	0.23	56.5
East: Site access (east)											
4	L2	7	5.0	0.008	5.8	LOS A	0.0	0.2	0.14	0.55	53.0
6	R2	3	5.0	0.008	6.0	LOS A	0.0	0.2	0.14	0.55	52.5
Approach		11	5.0	0.008	5.8	LOS A	0.0	0.2	0.14	0.55	52.8
North: Ridge Road (north)											
7	L2	14	5.0	0.038	5.6	LOS A	0.0	0.0	0.00	0.12	57.1
8	T1	56	10.0	0.038	0.0	LOS A	0.0	0.0	0.00	0.12	58.9
Approach		69	9.0	0.038	1.1	NA	0.0	0.0	0.00	0.12	58.5
All Vehicles		155	8.3	0.043	2.0	NA	0.2	1.2	0.07	0.20	57.1

Intersection 1 is a new intersection being considered on Ridge Road as part of the potential residential development at the site. A give-way control layout has been used to assess the performance of this intersection.

In summary, using the estimated existing through volumes on Ridge Road, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours respectively. A maximum queue length of 2 m (less than one vehicle) occurs during the afternoon peak hour on the southern approach and the maximum degree of saturation on any approach is 0.043.

2.2 SITE ACCESS 2 / RIDGE ROAD (SOUTHERN INTERSECTION)

Figure 6: Site access 2 / Ridge Road layout (indicative)

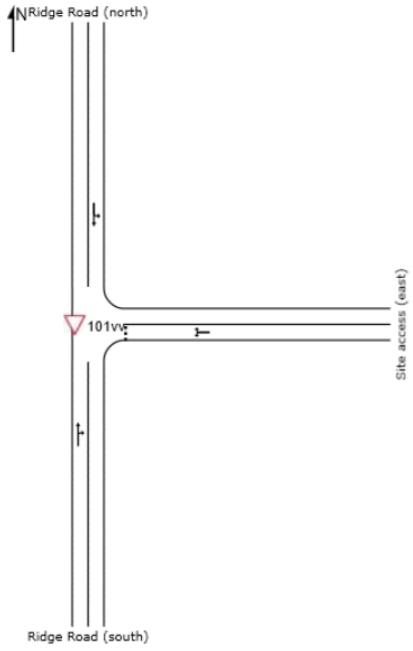

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Figure 7: Intersection 2 - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	49	10.0	0.032	0.0	LOS A	0.0	0.3	0.05	0.08	59.1
3	R2	7	5.0	0.032	5.7	LOS A	0.0	0.3	0.05	0.08	56.6
Approach		57	9.4	0.032	0.8	NA	0.0	0.3	0.05	0.08	58.7
East: Site access (east)											
4	L2	29	10.0	0.032	5.9	LOS A	0.1	0.9	0.17	0.55	52.7
6	R2	14	5.0	0.032	6.0	LOS A	0.1	0.9	0.17	0.55	52.4
Approach		43	8.4	0.032	5.9	LOS A	0.1	0.9	0.17	0.55	52.6
North: Ridge Road (north)											
7	L2	3	5.0	0.041	5.6	LOS A	0.0	0.0	0.00	0.03	57.9
8	T1	72	10.0	0.041	0.0	LOS A	0.0	0.0	0.00	0.03	59.7
Approach		75	9.8	0.041	0.2	NA	0.0	0.0	0.00	0.03	59.7
All Vehicles		175	9.3	0.041	1.8	NA	0.1	0.9	0.06	0.17	57.5

Figure 8: Intersection 2 - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Ridge Road (south)											
2	T1	72	10.0	0.057	0.1	LOS A	0.2	1.3	0.10	0.17	58.0
3	R2	29	5.0	0.057	5.7	LOS A	0.2	1.3	0.10	0.17	55.7
Approach		101	8.5	0.057	1.7	NA	0.2	1.3	0.10	0.17	57.3
East: Site access (east)											
4	L2	7	5.0	0.008	5.7	LOS A	0.0	0.2	0.13	0.55	53.0
6	R2	3	5.0	0.008	6.1	LOS A	0.0	0.2	0.13	0.55	52.5
Approach		11	5.0	0.008	5.8	LOS A	0.0	0.2	0.13	0.55	52.9
North: Ridge Road (north)											
7	L2	14	5.0	0.035	5.6	LOS A	0.0	0.0	0.00	0.13	57.0
8	T1	49	10.0	0.035	0.0	LOS A	0.0	0.0	0.00	0.13	58.8
Approach		63	8.9	0.035	1.2	NA	0.0	0.0	0.00	0.13	58.4
All Vehicles		175	8.5	0.057	1.8	NA	0.2	1.3	0.06	0.18	57.4

Intersection 2 is a new intersection being considered on Ridge Road as part of the potential residential development at the site. A give-way control layout has been used to assess the performance of this intersection.

In summary, using the estimated existing through volumes on Ridge Road, the modelling indicates that the lanes are likely to perform at a LOS A during the morning and afternoon peak hours respectively. A maximum queue length of 2 m (less than one vehicle) occurs during the afternoon peak hour and the maximum degree of saturation on any approach is 0.057.

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2.3 SITE ACCESS 3 / HELENSLEE ROAD (NORTHERN INTERSECTION)

Figure 9: Site access 3 / Helenslee Road layout (indicative)

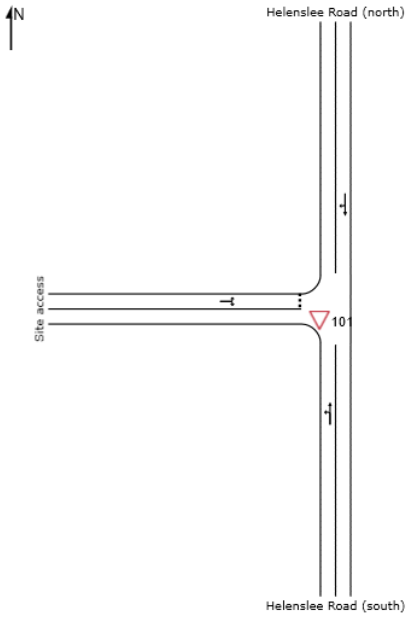

Figure 10: Intersection 3 - Movement summary 2040 AM

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	7	5.0	0.478	5.7	LOS A	0.0	0.0	0.00	0.00	57.9
2	T1	895	5.0	0.478	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
Approach		902	5.0	0.478	0.1	NA	0.0	0.0	0.00	0.00	59.8
North: Helenslee Road (north)											
8	T1	560	5.0	0.333	0.9	LOS A	0.7	5.2	0.12	0.02	58.7
9	R2	19	5.0	0.333	15.1	LOS C	0.7	5.2	0.12	0.02	56.3
Approach		579	5.0	0.333	1.4	NA	0.7	5.2	0.12	0.02	58.6
West: Site access											
10	L2	76	5.0	0.345	14.1	LOS B	1.2	9.0	0.83	0.98	44.8
12	R2	29	5.0	0.345	30.9	LOS D	1.2	9.0	0.83	0.98	44.4
Approach		105	5.0	0.345	18.8	LOS C	1.2	9.0	0.83	0.98	44.7
All Vehicles		1586	5.0	0.478	1.8	NA	1.2	9.0	0.10	0.08	58.1

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Figure 11: Intersection 3 - Movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	29	5.0	0.244	5.6	LOS A	0.0	0.0	0.00	0.04	57.7
2	T1	431	5.0	0.244	0.0	LOS A	0.0	0.0	0.00	0.04	59.6
Approach		460	5.0	0.244	0.4	NA	0.0	0.0	0.00	0.04	59.5
North: Helenslee Road (north)											
8	T1	951	5.0	0.576	0.8	LOS A	2.0	14.9	0.17	0.05	58.6
9	R2	76	5.0	0.576	10.2	LOS B	2.0	14.9	0.17	0.05	56.2
Approach		1026	5.0	0.576	1.5	NA	2.0	14.9	0.17	0.05	58.4
West: Site access											
10	L2	19	5.0	0.071	7.3	LOS A	0.2	1.6	0.61	0.74	47.9
12	R2	7	5.0	0.071	29.2	LOS D	0.2	1.6	0.61	0.74	47.5
Approach		26	5.0	0.071	13.4	LOS B	0.2	1.6	0.61	0.74	47.8
All Vehicles		1513	5.0	0.576	1.4	NA	2.0	14.9	0.12	0.06	58.5

Intersection 3 is a new intersection being considered on Helenslee Road as part of the potential residential development at the site. A give-way control layout has been used to assess the performance of this intersection.

In summary, using the future through volumes predicted along Helenslee Road for the future year 2040, the modelling indicates the lanes are likely to perform at a LOS A, B or C during the morning and afternoon peak hours respectively; this excludes the right turn movement on the western approach (site access) which is expected to operate at a LOS D. The maximum degree of saturation for this approach is 0.345 therefore it is expected to operate below capacity.

2.4 SITE ACCESS 4 / HELENSLEE ROAD (SOUTHERN INTERSECTION)

Figure 12: Site access 4 / Helenslee Road layout (indicative)

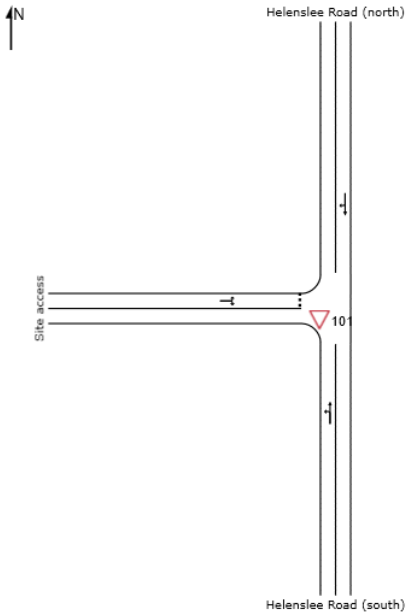

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Figure 13: Intersection 4 - Movement summary 2040 AM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	7	5.0	0.442	5.7	LOS A	0.0	0.0	0.00	0.01	58.0
2	T1	826	5.0	0.442	0.1	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		834	5.0	0.442	0.1	NA	0.0	0.0	0.00	0.01	59.8
North: Helenslee Road (north)											
8	T1	571	5.0	0.334	0.7	LOS A	0.6	4.4	0.10	0.02	58.9
9	R2	19	5.0	0.334	13.6	LOS B	0.6	4.4	0.10	0.02	56.5
Approach		589	5.0	0.334	1.1	NA	0.6	4.4	0.10	0.02	58.9
West: Site access											
10	L2	76	5.0	0.298	12.3	LOS B	1.1	7.7	0.79	0.95	46.2
12	R2	29	5.0	0.298	26.6	LOS D	1.1	7.7	0.79	0.95	45.8
Approach		105	5.0	0.298	16.3	LOS C	1.1	7.7	0.79	0.95	46.1
All Vehicles		1528	5.0	0.442	1.6	NA	1.1	7.7	0.09	0.08	58.2

Figure 14: Intersection 4 - movement summary 2040 PM

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road (south)											
1	L2	29	5.0	0.250	5.6	LOS A	0.0	0.0	0.00	0.04	57.7
2	T1	441	5.0	0.250	0.0	LOS A	0.0	0.0	0.00	0.04	59.6
Approach		471	5.0	0.250	0.4	NA	0.0	0.0	0.00	0.04	59.5
North: Helenslee Road (north)											
8	T1	883	5.0	0.541	0.8	LOS A	1.9	13.8	0.17	0.06	58.5
9	R2	76	5.0	0.541	9.9	LOS A	1.9	13.8	0.17	0.06	56.1
Approach		959	5.0	0.541	1.5	NA	1.9	13.8	0.17	0.06	58.3
West: Site access											
10	L2	19	5.0	0.064	7.3	LOS A	0.2	1.4	0.59	0.73	48.6
12	R2	7	5.0	0.064	25.5	LOS D	0.2	1.4	0.59	0.73	48.1
Approach		26	5.0	0.064	12.4	LOS B	0.2	1.4	0.59	0.73	48.4
All Vehicles		1456	5.0	0.541	1.3	NA	1.9	13.8	0.12	0.06	58.5

Intersection 4 is a new intersection being considered on Helenslee Road as part of the potential residential development at the site. A give-way control layout has been used to assess the performance of this intersection.

In summary, using the future through volumes predicted along Helenslee Road for the future year 2040, the modelling indicates that the lanes are likely to perform at a LOS A or B during the morning and afternoon peak hours respectively; this excludes the right turn movement on the western approach (site access) which is expected to operate at a LOS D. The maximum degree of saturation for this approach is 0.298 therefore it is expected to operate below capacity.

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2.5 INTERSECTION A – 53 MUNRO ROAD / HELENSLEE ROAD

Figure 15: Intersection A layout (indicative)

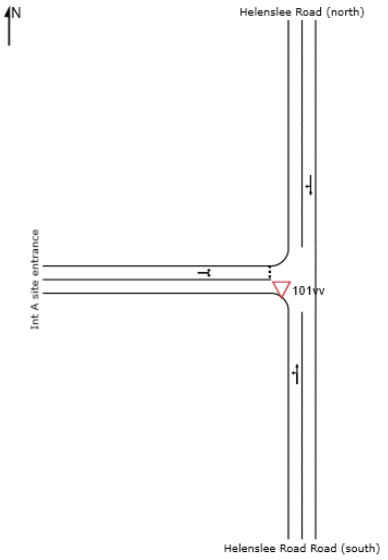

Figure 16: Intersection A - Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101vv [Sensitivity test Int A 2040 AM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	13	5.0	0.370	5.6	LOS A	0.0	0.0	0.00	0.01	57.9
2	T1	686	5.0	0.370	0.1	LOS A	0.0	0.0	0.00	0.01	59.8
Approach		699	5.0	0.370	0.2	NA	0.0	0.0	0.00	0.01	59.8
North: Helenslee Road (north)											
8	T1	563	5.0	0.347	0.8	LOS A	0.9	6.4	0.15	0.04	58.6
9	R2	37	5.0	0.347	11.3	LOS B	0.9	6.4	0.15	0.04	56.2
Approach		600	5.0	0.347	1.5	NA	0.9	6.4	0.15	0.04	58.4
West: 53 Munro Road site entrance											
10	L2	147	5.0	0.258	9.9	LOS A	1.0	7.3	0.62	0.86	50.5
12	R2	49	5.0	0.258	8.4	LOS A	1.0	7.3	0.62	0.86	50.0
Approach		197	5.0	0.258	9.5	LOS A	1.0	7.3	0.62	0.86	50.4
All Vehicles		1496	5.0	0.370	1.9	NA	1.0	7.3	0.14	0.14	57.8

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Figure 17: Intersection A - Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101vv [Sensitivity test Int A 2040 PM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	49	5.0	0.257	5.6	LOS A	0.0	0.0	0.00	0.06	57.5
2	T1	434	5.0	0.257	0.0	LOS A	0.0	0.0	0.00	0.06	59.4
Approach		483	5.0	0.257	0.6	NA	0.0	0.0	0.00	0.06	59.2
North: Helenslee Road (north)											
8	T1	742	5.0	0.537	1.6	LOS A	3.4	24.9	0.33	0.13	57.2
9	R2	147	5.0	0.537	10.0	LOS B	3.4	24.9	0.33	0.13	54.9
Approach		889	5.0	0.537	3.0	NA	3.4	24.9	0.33	0.13	56.8
West: 53 Munro Road site access											
10	L2	37	5.0	0.051	7.3	LOS A	0.2	1.3	0.43	0.68	51.9
12	R2	13	5.0	0.051	8.2	LOS A	0.2	1.3	0.43	0.68	51.4
Approach		49	5.0	0.051	7.5	LOS A	0.2	1.3	0.43	0.68	51.8
All Vehicles		1422	5.0	0.537	2.4	NA	3.4	24.9	0.22	0.13	57.4

This is a new intersection being considered as part of the potential residential development at the neighbouring site (53 Munro Road). A give-way control layout has been used to assess the performance of the intersection.

In summary, using the volumes predicted at the intersection for the future year 2040 indicates that the lanes are likely to perform at a Level of service (LOS) A or B during the morning and afternoon peak hours respectively. A maximum 95%ile back of queue length of 24.9 m (3-4 vehicles) occurs during the afternoon peak hour on the northern approach (Helenslee Road); the degree of saturation for this approach is 0.537.

The maximum degree of the saturation for the overall intersection is 0.537 therefore is below capacity (0.8).

It is noted that the level of right turn movements predicted at this intersection potentially warrants a right turn bay on Helenslee Road. In this regard, this will need to be considered during the design stage of the intersection at subsequent stages as part of that development.

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2.6 INTERSECTION B – SITE ACCESS/ HELENSLEE ROAD / GATESHEAD ROAD

Figure 18: Intersection B layout (indicative)

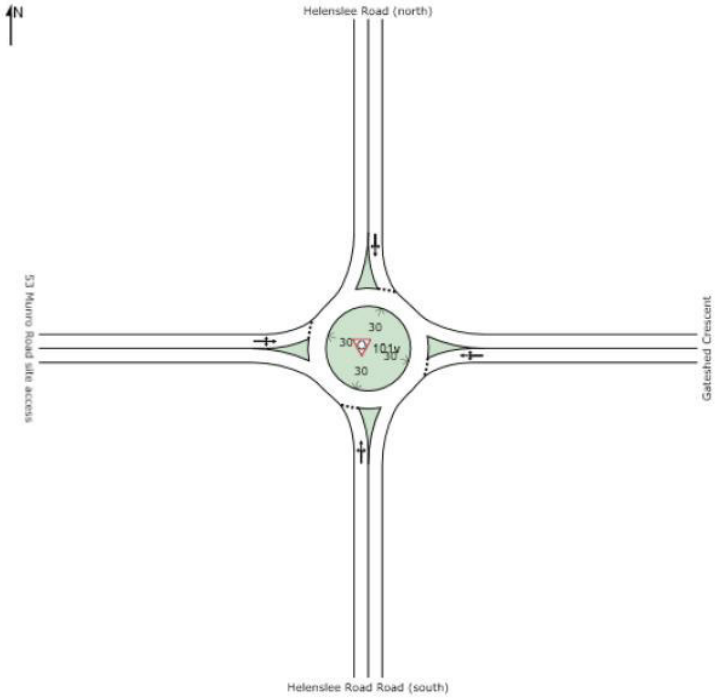

Figure 19: Intersection B - Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int B 2040 AM]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	13	5.0	0.486	5.0	LOS A	4.3	31.7	0.60	0.52	53.6
2	T1	551	5.0	0.486	4.8	LOS A	4.3	31.7	0.60	0.52	55.2
3	R2	13	5.0	0.486	10.7	LOS B	4.3	31.7	0.60	0.52	55.4
Approach		576	5.0	0.486	4.9	LOS A	4.3	31.7	0.60	0.52	55.2
East: Gateshed Crescent											
4	L2	49	5.0	0.268	8.5	LOS A	1.8	13.2	0.79	0.82	49.6
5	T1	1	5.0	0.268	8.3	LOS A	1.8	13.2	0.79	0.82	50.9
6	R2	147	5.0	0.268	14.3	LOS B	1.8	13.2	0.79	0.82	51.0
Approach		198	5.0	0.268	12.8	LOS B	1.8	13.2	0.79	0.82	50.7
North: Helenslee Road (north)											
7	L2	37	5.0	0.452	3.9	LOS A	4.4	31.9	0.35	0.39	54.7
8	T1	576	5.0	0.452	3.7	LOS A	4.4	31.9	0.35	0.39	56.3
9	R2	37	5.0	0.452	9.6	LOS A	4.4	31.9	0.35	0.39	56.5
Approach		649	5.0	0.452	4.0	LOS A	4.4	31.9	0.35	0.39	56.2
West: 53 Munro Road site access											
10	L2	147	5.0	0.293	9.1	LOS A	2.1	15.1	0.84	0.84	50.9
11	T1	1	5.0	0.293	8.9	LOS A	2.1	15.1	0.84	0.84	52.3
12	R2	49	5.0	0.293	14.8	LOS B	2.1	15.1	0.84	0.84	52.5
Approach		198	5.0	0.293	10.5	LOS B	2.1	15.1	0.84	0.84	51.3
All Vehicles		1621	5.0	0.486	6.2	LOS A	4.4	31.9	0.55	0.54	54.5

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Figure 20: Intersection B - Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int B 2040 PM]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Helenslee Road Road (south)											
1	L2	49	5.0	0.454	5.0	LOS A	3.7	27.2	0.55	0.53	53.7
2	T1	446	5.0	0.454	4.7	LOS A	3.7	27.2	0.55	0.53	55.3
3	R2	49	5.0	0.454	10.7	LOS B	3.7	27.2	0.55	0.53	55.4
Approach		545	5.0	0.454	5.3	LOS A	3.7	27.2	0.55	0.53	55.1
East: Gateshed Crescent											
4	L2	13	5.0	0.078	9.0	LOS A	0.5	3.7	0.79	0.76	49.3
5	T1	1	5.0	0.078	8.7	LOS A	0.5	3.7	0.79	0.76	50.7
6	R2	37	5.0	0.078	14.7	LOS B	0.5	3.7	0.79	0.76	50.8
Approach		51	5.0	0.078	13.1	LOS B	0.5	3.7	0.79	0.76	50.4
North: Helenslee Road (north)											
7	L2	147	5.0	0.613	4.1	LOS A	7.2	52.8	0.42	0.43	54.0
8	T1	606	5.0	0.613	3.8	LOS A	7.2	52.8	0.42	0.43	55.6
9	R2	147	5.0	0.613	9.8	LOS A	7.2	52.8	0.42	0.43	55.8
Approach		901	5.0	0.613	4.8	LOS A	7.2	52.8	0.42	0.43	55.4
West: 53 Munro Road site access											
10	L2	37	5.0	0.062	6.7	LOS A	0.4	2.8	0.67	0.66	52.6
11	T1	1	5.0	0.062	6.5	LOS A	0.4	2.8	0.67	0.66	54.2
12	R2	13	5.0	0.062	12.4	LOS B	0.4	2.8	0.67	0.66	54.3
Approach		51	5.0	0.062	8.1	LOS A	0.4	2.8	0.67	0.66	53.1
All Vehicles		1547	5.0	0.613	5.4	LOS A	7.2	52.8	0.49	0.49	55.0

This intersection is currently a give-way controlled 'T' intersection with priority afforded to traffic along Helenslee Road. The neighbouring site (at 53 Munro Road) intends to establish a connection to the existing Gateshead Crescent / Helenslee Road intersection from the west thereby forming a crossroad intersection. Should this occur, the control of the intersection is proposed to be upgraded to a roundabout control intersection. For the purpose of this assessment, a single lane roundabout has been used to assess the performance of this intersection for the future year 2040.

It is noted that the turning volumes to and from Gateshead Road were estimated using the turning volumes to/from the neighbouring site as these were unknown.

In summary, using the volumes predicted at the intersection for the future year 2040 indicates that the lanes are likely to perform at a Level of service A or B during the morning and afternoon peak hours. A maximum 95%ile back of queue length of 52.8m (7-8 vehicles) occurs during the afternoon peak hour on the northern approach (Helenslee Road); the degree of saturation for this approach is 0.613 therefore is below capacity (0.85).

As such, a single lane roundabout is considered sufficient to cater for the turning volumes proposed at this intersection.

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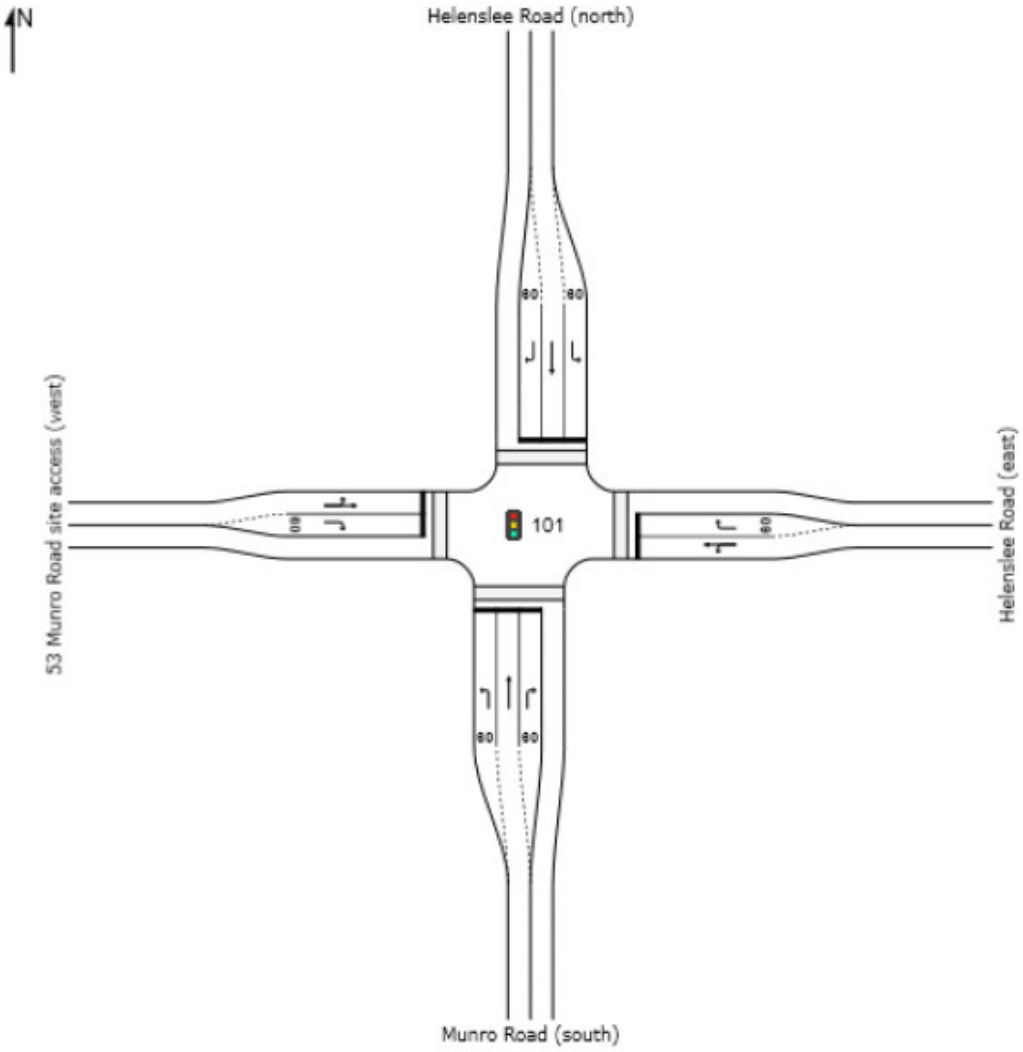
2.7 INTERSECTION C – SITE ACCESS / HELENSLEE ROAD / MUNRO ROAD

Figure 21: Intersection C layout (indicative)



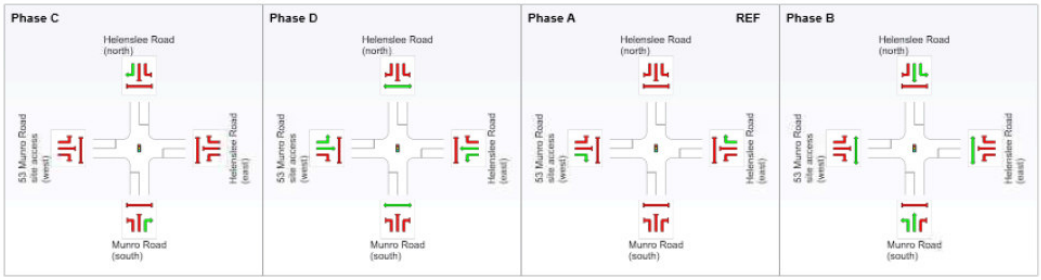


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Figure 22: Intersection C - movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int C 2040 AM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	13	5.0	0.017	27.2	LOS C	0.4	3.1	0.61	0.66	40.6
2	T1	234	5.0	0.297	24.8	LOS C	9.0	65.7	0.71	0.60	42.6
3	R2	28	5.0	0.317	69.0	LOS E	1.7	12.6	1.00	0.72	27.6
Approach		275	5.0	0.317	29.5	LOS C	9.0	65.7	0.73	0.62	40.3
East: Helenslee Road (east)											
4	L2	2	5.0	0.041	47.9	LOS D	0.7	5.1	0.84	0.61	34.5
5	T1	13	5.0	0.041	42.3	LOS D	0.7	5.1	0.84	0.61	35.1
6	R2	181	5.0	0.577	55.5	LOS E	9.9	72.5	0.97	0.81	30.9
Approach		196	5.0	0.577	54.6	LOS D	9.9	72.5	0.96	0.80	31.2
North: Helenslee Road (north)											
7	L2	400	5.0	0.583	33.7	LOS C	17.5	127.5	0.80	0.82	37.9
8	T1	187	5.0	0.238	24.1	LOS C	7.0	51.2	0.69	0.57	43.0
9	R2	37	5.0	0.411	69.5	LOS E	2.2	16.4	1.00	0.73	27.5
Approach		624	5.0	0.583	32.9	LOS C	17.5	127.5	0.78	0.74	38.4
West: 53 Munro Road site access (west)											
10	L2	147	5.0	0.565	53.7	LOS D	10.6	77.5	0.96	0.81	31.8
11	T1	49	5.0	0.565	48.1	LOS D	10.6	77.5	0.96	0.81	32.3
12	R2	49	5.0	0.158	51.2	LOS D	2.5	18.1	0.89	0.74	32.1
Approach		246	5.0	0.565	52.1	LOS D	10.6	77.5	0.94	0.80	31.9
All Vehicles		1341	5.0	0.583	38.9	LOS D	17.5	127.5	0.83	0.73	36.2

Figure 23: Intersection C - movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int C 2040 PM]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	49	5.0	0.095	38.6	LOS D	2.1	15.3	0.76	0.72	36.0
2	T1	167	5.0	0.304	35.5	LOS D	7.6	55.4	0.82	0.68	37.9
3	R2	23	5.0	0.091	54.3	LOS D	1.2	8.7	0.90	0.71	31.1
Approach		240	5.0	0.304	37.9	LOS D	7.6	55.4	0.82	0.69	36.7
East: Helenslee Road (east)											
4	L2	9	5.0	0.291	60.2	LOS E	3.3	23.9	0.96	0.73	30.9
5	T1	49	5.0	0.291	54.6	LOS D	3.3	23.9	0.96	0.73	31.4
6	R2	292	5.0	0.558	44.4	LOS D	14.5	105.8	0.90	0.83	34.1
Approach		351	5.0	0.558	46.3	LOS D	14.5	105.8	0.91	0.81	33.6
North: Helenslee Road (north)											
7	L2	171	5.0	0.326	41.4	LOS D	7.8	57.0	0.83	0.78	35.1
8	T1	301	5.0	0.565	38.6	LOS D	14.9	108.6	0.90	0.77	36.7
9	R2	147	5.0	0.580	58.9	LOS E	8.3	60.6	0.98	0.81	29.9
Approach		619	5.0	0.580	44.2	LOS D	14.9	108.6	0.90	0.78	34.4
West: 53 Munro Road site access (west)											
10	L2	37	5.0	0.251	60.0	LOS E	2.7	20.0	0.95	0.74	30.1
11	T1	13	5.0	0.251	54.4	LOS D	2.7	20.0	0.95	0.74	30.6
12	R2	13	5.0	0.024	37.7	LOS D	0.5	3.8	0.74	0.67	36.4
Approach		62	5.0	0.251	54.3	LOS D	2.7	20.0	0.91	0.72	31.3
All Vehicles		1272	5.0	0.580	44.1	LOS D	14.9	108.6	0.89	0.77	34.4

The Munro Road / Helenslee Road intersection is currently give-way controlled with priority afforded to traffic along Helenslee Road. The neighbouring site (at 53 Munro Road) intends to establish a connection to the Munro Road / Helenslee Road intersection from the west. As a result, the proposed intersection will be upgraded to a signalised intersection.

In summary, using the volumes predicted at this intersection for the future year 2040, the modelling results suggest a maximum queue length of 127.5 m on the northern approach (Helenslee Road) during the morning peak hour and 108.6 m during the afternoon peak hour respectively. The

maximum degree of saturation for this approach is 0.583 therefore indicating this intersection operates below capacity (0.9). It is noted that several lanes are expected to operate at a LOS E; the degree of saturation for these approaches is well below capacity of 0.9 therefore is considered acceptable.

The Pokeno Village Holdings Limited submission included a report prepared by Arrive (dated 9th October 2018) which indicates the level of volumes provided in the **BECA report** (for which is used in the above assessment) are excessive. If the Arrive report is correct, the volumes at the intersections will be lower than that predicted and therefore a lower scale of mitigation could be sufficient.

2.8 INTERSECTION D – SITE ACCESS / MUNRO ROAD

Figure 24: Intersection D layout (indicative)

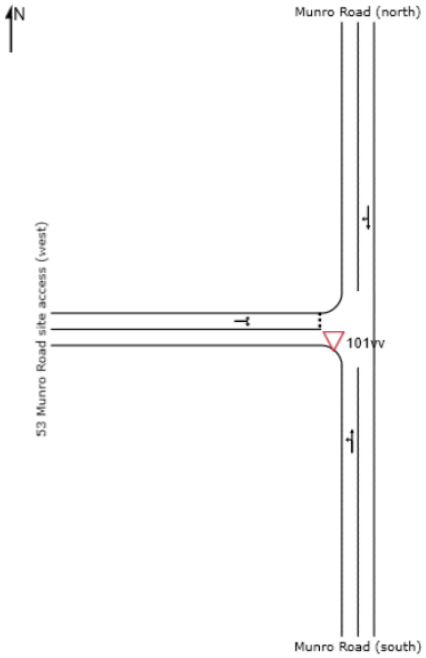

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Figure 25: Intersection D - Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101vv [Sensitivity test Int D 2040 AM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	22	5.0	0.113	5.6	LOS A	0.0	0.0	0.00	0.06	57.6
2	T1	191	5.0	0.113	0.0	LOS A	0.0	0.0	0.00	0.06	59.4
Approach		213	5.0	0.113	0.6	NA	0.0	0.0	0.00	0.06	59.2
North: Munro Road (north)											
8	T1	218	5.0	0.131	0.1	LOS A	0.2	1.2	0.07	0.05	59.2
9	R2	21	5.0	0.131	6.3	LOS A	0.2	1.2	0.07	0.05	56.7
Approach		239	5.0	0.131	0.7	NA	0.2	1.2	0.07	0.05	59.0
West: 53 Munro Road site access (west)											
10	L2	84	5.0	0.118	6.3	LOS A	0.4	3.0	0.27	0.61	52.6
12	R2	88	5.0	0.118	6.1	LOS A	0.4	3.0	0.27	0.61	52.1
Approach		173	5.0	0.118	6.2	LOS A	0.4	3.0	0.27	0.61	52.4
All Vehicles		624	5.0	0.131	2.2	NA	0.4	3.0	0.10	0.21	57.1

Figure 26: Intersection D - Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101vv [Sensitivity test Int D 2040 PM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	88	5.0	0.165	5.6	LOS A	0.0	0.0	0.00	0.17	56.6
2	T1	218	5.0	0.165	0.0	LOS A	0.0	0.0	0.00	0.17	58.4
Approach		306	5.0	0.165	1.6	NA	0.0	0.0	0.00	0.17	57.9
North: Munro Road (north)											
8	T1	240	5.0	0.194	0.6	LOS A	0.7	5.1	0.26	0.17	57.6
9	R2	84	5.0	0.194	6.9	LOS A	0.7	5.1	0.26	0.17	55.3
Approach		324	5.0	0.194	2.2	NA	0.7	5.1	0.26	0.17	57.0
West: 53 Munro Road site access (west)											
10	L2	21	5.0	0.031	6.3	LOS A	0.1	0.7	0.28	0.60	52.6
12	R2	22	5.0	0.031	6.2	LOS A	0.1	0.7	0.28	0.60	52.1
Approach		43	5.0	0.031	6.3	LOS A	0.1	0.7	0.28	0.60	52.3
All Vehicles		674	5.0	0.194	2.2	NA	0.7	5.1	0.14	0.20	57.1

A give-way control layout has been used to assess the performance of this potential intersection.

In summary, using the volumes predicted at the intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a Level of service A during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.194 therefore is it is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages as part of that development.

2.9 INTERSECTION E – MUNRO ROAD / HUIA ROAD

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Figure 27: Intersection E layout (indicative)

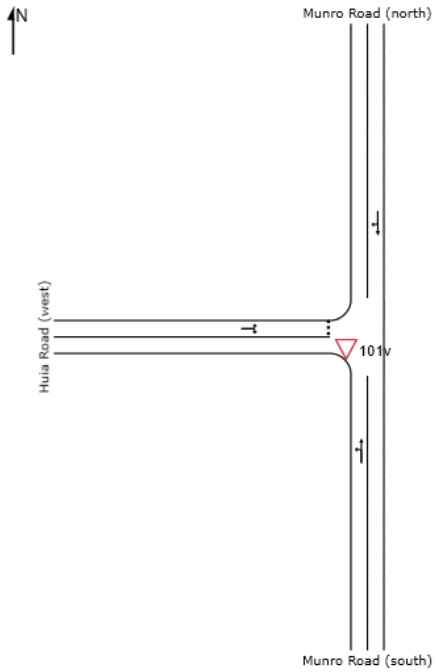

Figure 28: Intersection E Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int E 2040 AM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	29	5.0	0.090	5.6	LOS A	0.0	0.0	0.00	0.10	57.2
2	T1	139	5.0	0.090	0.0	LOS A	0.0	0.0	0.00	0.10	59.0
Approach		168	5.0	0.090	1.0	NA	0.0	0.0	0.00	0.10	58.7
North: Munro Road (north)											
8	T1	288	5.0	0.167	0.1	LOS A	0.2	1.2	0.05	0.04	59.4
9	R2	20	5.0	0.167	6.2	LOS A	0.2	1.2	0.05	0.04	57.0
Approach		308	5.0	0.167	0.5	NA	0.2	1.2	0.05	0.04	59.3
West: Huia Road (west)											
10	L2	74	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.8
12	R2	99	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.2
Approach		173	5.0	0.115	6.1	LOS A	0.4	2.8	0.23	0.60	52.5
All Vehicles		649	5.0	0.167	2.1	NA	0.4	2.8	0.08	0.21	57.2

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Figure 29: Intersection E Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int E 2040 PM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: Munro Road (south)											
1	L2	104	5.0	0.211	5.6	LOS A	0.0	0.0	0.00	0.16	56.7
2	T1	288	5.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.16	58.5
Approach		393	5.0	0.211	1.5	NA	0.0	0.0	0.00	0.16	58.1
North: Munro Road (north)											
8	T1	187	5.0	0.164	0.9	LOS A	0.7	4.8	0.31	0.19	57.3
9	R2	75	5.0	0.164	7.3	LOS A	0.7	4.8	0.31	0.19	55.0
Approach		262	5.0	0.164	2.7	NA	0.7	4.8	0.31	0.19	56.6
West: Huia Road (west)											
10	L2	19	5.0	0.032	6.6	LOS A	0.1	0.7	0.32	0.62	52.5
12	R2	24	5.0	0.032	6.2	LOS A	0.1	0.7	0.32	0.62	52.0
Approach		43	5.0	0.032	6.4	LOS A	0.1	0.7	0.32	0.62	52.2
All Vehicles		698	5.0	0.211	2.3	NA	0.7	4.8	0.14	0.20	57.1

The Munro Road / Huia Road intersection is a priority-controlled intersection with priority afforded to traffic along Munro Road.

In summary, using the existing layout (give-way control) and the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are likely to perform at a Level of service A during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.211 therefore is it is expected to perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Munro Road; this will need to be considered at subsequent stages as part of that development.

2.10 INTERSECTION F – 53 MUNRO ROAD SITE ACCESS / HUIA ROAD

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Figure 30: Intersection F layout (indicative)

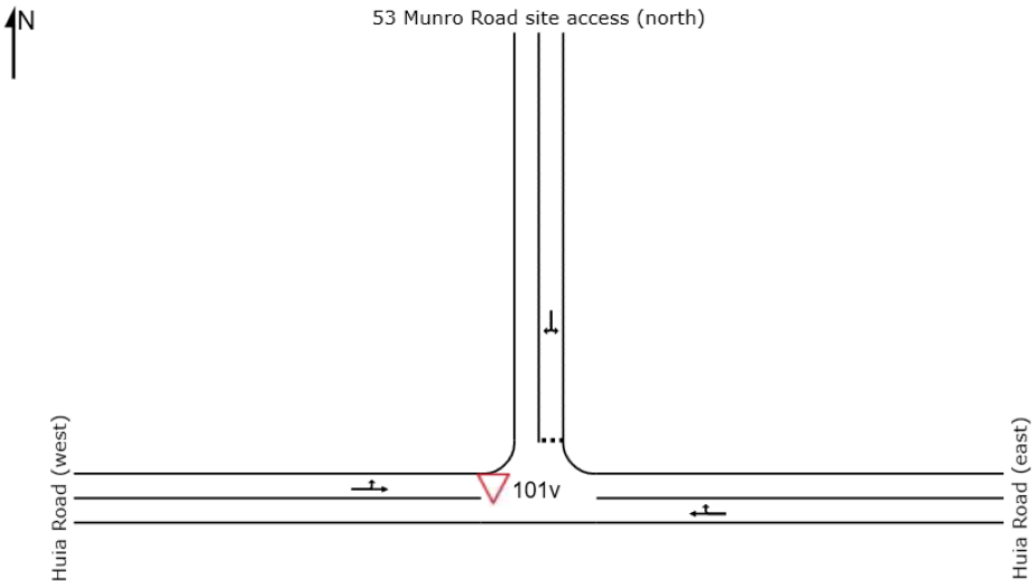

Figure 31: Intersection F Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int F 2040 AM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.028	0.0	LOS A	0.1	0.9	0.02	0.52	55.6
6	R2	43	5.0	0.028	5.5	LOS A	0.1	0.9	0.02	0.52	53.4
Approach		49	5.0	0.028	4.8	NA	0.1	0.9	0.02	0.52	53.7
North: 53 Munro Road site access (north)											
7	L2	173	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	53.4
9	R2	1	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	52.8
Approach		174	5.0	0.109	5.6	LOS A	0.5	3.4	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		225	5.0	0.109	5.4	NA	0.5	3.4	0.01	0.56	53.5

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Figure 32: Intersection F Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int F 2040 PM]

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Huia Road (east)											
5	T1	6	5.0	0.102	0.0	LOS A	0.5	3.7	0.02	0.57	55.1
6	R2	173	5.0	0.102	5.5	LOS A	0.5	3.7	0.02	0.57	53.0
Approach		179	5.0	0.102	5.3	NA	0.5	3.7	0.02	0.57	53.1
North: 53 Munro Road site access (west)											
7	L2	43	5.0	0.028	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
9	R2	1	5.0	0.028	5.7	LOS A	0.1	0.8	0.01	0.57	52.9
Approach		44	5.0	0.028	5.6	LOS A	0.1	0.8	0.01	0.57	53.4
West: Huia Road (west)											
10	L2	1	5.0	0.001	5.6	LOS A	0.0	0.0	0.00	0.29	55.7
11	T1	1	5.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.29	57.4
Approach		2	5.0	0.001	2.8	NA	0.0	0.0	0.00	0.29	56.5
All Vehicles		225	5.0	0.102	5.4	NA	0.5	3.7	0.02	0.57	53.2

This intersection forms one of the five potential connections to the neighbouring site at 53 Munro Road. A give-way control layout has been used to assess the performance of this intersection.

In summary, using the volumes predicted at this intersection for the future year 2040, the modelling indicates that all lanes are expected to operate at a LOS A during the morning and afternoon peak hour respectively.

The maximum degree of saturation of the intersection is 0.109 thereby indicating that the intersection will perform well below capacity (0.8).

Similar to Intersection A, there is potential for the level of right turn movements at this intersection to warrant a right turn bay on Huia Road; this will need to be considered at subsequent stages as part of that development.

2.11 INTERSECTION G – MUNRO ROAD / POKENO ROAD (EXISTING LAYOUT)

Figure 33: Intersection G existing layout (indicative)

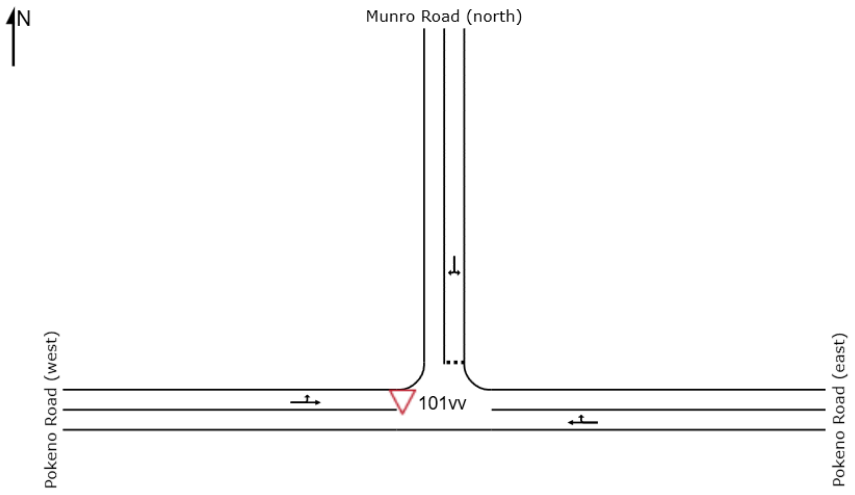

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Figure 34: Intersection G Movement summary 2040 AM

MOVEMENT SUMMARY

▽ **Site: 101vv [Sensitivity test Int G 2040 AM Existing layout]**

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.262	0.4	LOS A	0.4	3.2	0.11	0.04	59.1
6	R2	27	5.0	0.262	9.3	LOS A	0.4	3.2	0.11	0.04	56.6
Approach		463	5.0	0.262	1.0	NA	0.4	3.2	0.11	0.04	58.9
North: Munro Road (north)											
7	L2	95	5.0	0.347	8.2	LOS A	1.4	9.9	0.50	0.82	51.7
9	R2	292	5.0	0.347	7.6	LOS A	1.4	9.9	0.50	0.82	51.2
Approach		386	5.0	0.347	7.8	LOS A	1.4	9.9	0.50	0.82	51.4
West: Pokeno Road (west)											
10	L2	141	5.0	0.317	5.6	LOS A	0.0	0.0	0.00	0.14	56.8
11	T1	451	5.0	0.317	0.0	LOS A	0.0	0.0	0.00	0.14	58.6
Approach		592	5.0	0.317	1.4	NA	0.0	0.0	0.00	0.14	58.2
All Vehicles		1441	5.0	0.347	3.0	NA	1.4	9.9	0.17	0.29	56.4

Figure 35: Intersection G Movement summary 2040 PM

MOVEMENT SUMMARY

▽ **Site: 101vv [Sensitivity test Int G 2040 PM Existing layout]**

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	567	5.0	0.440	2.6	LOS A	2.7	19.7	0.39	0.11	56.2
6	R2	93	5.0	0.440	13.2	LOS B	2.7	19.7	0.39	0.11	54.0
Approach		660	5.0	0.440	4.1	NA	2.7	19.7	0.39	0.11	55.9
North: Munro Road (north)											
7	L2	29	5.0	0.228	7.9	LOS A	0.7	5.1	0.56	0.83	51.5
9	R2	183	5.0	0.228	8.2	LOS A	0.7	5.1	0.56	0.83	51.0
Approach		213	5.0	0.228	8.1	LOS A	0.7	5.1	0.56	0.83	51.1
West: Pokeno Road (west)											
10	L2	299	5.0	0.416	5.7	LOS A	0.0	0.0	0.00	0.23	56.1
11	T1	471	5.0	0.416	0.1	LOS A	0.0	0.0	0.00	0.23	57.8
Approach		769	5.0	0.416	2.2	NA	0.0	0.0	0.00	0.23	57.1
All Vehicles		1642	5.0	0.440	3.7	NA	2.7	19.7	0.23	0.26	55.8

The Munro Road / Pokeno Road intersection is currently give-way controlled. The **BECA report** indicates that this intersection warrants a give-way control (existing) or roundabout by the year 2022 and 2040. In this regard, two model runs have been undertaken for this intersection and include the existing layout (give-way control) and roundabout control respectively.

In summary, using the existing layout and the volumes predicted at this intersection for the year 2040, the modelling results indicate that the lanes are likely to perform at a Level of service A or B during the morning and afternoon peak hours. The maximum degree of saturation of the intersection is 0.440 thereby indicating that the intersection operates below capacity (0.8) and a give-way control layout can serve the proposed volumes from a capacity perspective.

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2.12 INTERSECTION G - MUNRO ROAD / POKENO ROAD (POTENTIAL LAYOUT)

Figure 36: Intersection G potential layout (indicative)

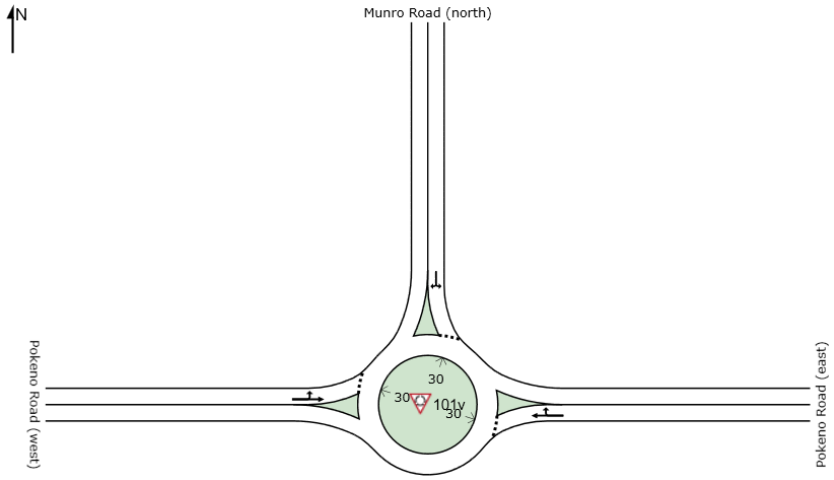

Figure 37: Intersection G Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int G 2040 AM rab]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	436	5.0	0.454	5.6	LOS A	3.8	27.4	0.70	0.61	54.6
6	R2	27	5.0	0.454	11.6	LOS B	3.8	27.4	0.70	0.61	54.7
Approach		463	5.0	0.454	6.0	LOS A	3.8	27.4	0.70	0.61	54.6
North: Munro Road (north)											
7	L2	95	5.0	0.423	7.1	LOS A	3.0	22.2	0.73	0.78	50.5
9	R2	292	5.0	0.423	12.9	LOS B	3.0	22.2	0.73	0.78	52.0
Approach		386	5.0	0.423	11.5	LOS B	3.0	22.2	0.73	0.78	51.6
West: Pokeno Road (west)											
10	L2	141	5.0	0.380	3.6	LOS A	3.5	25.7	0.21	0.35	55.6
11	T1	451	5.0	0.380	3.3	LOS A	3.5	25.7	0.21	0.35	57.3
Approach		592	5.0	0.380	3.4	LOS A	3.5	25.7	0.21	0.35	56.9
All Vehicles		1441	5.0	0.454	6.4	LOS A	3.8	27.4	0.51	0.55	54.6

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Figure 38: Intersection G Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int G 2040 PM rab]

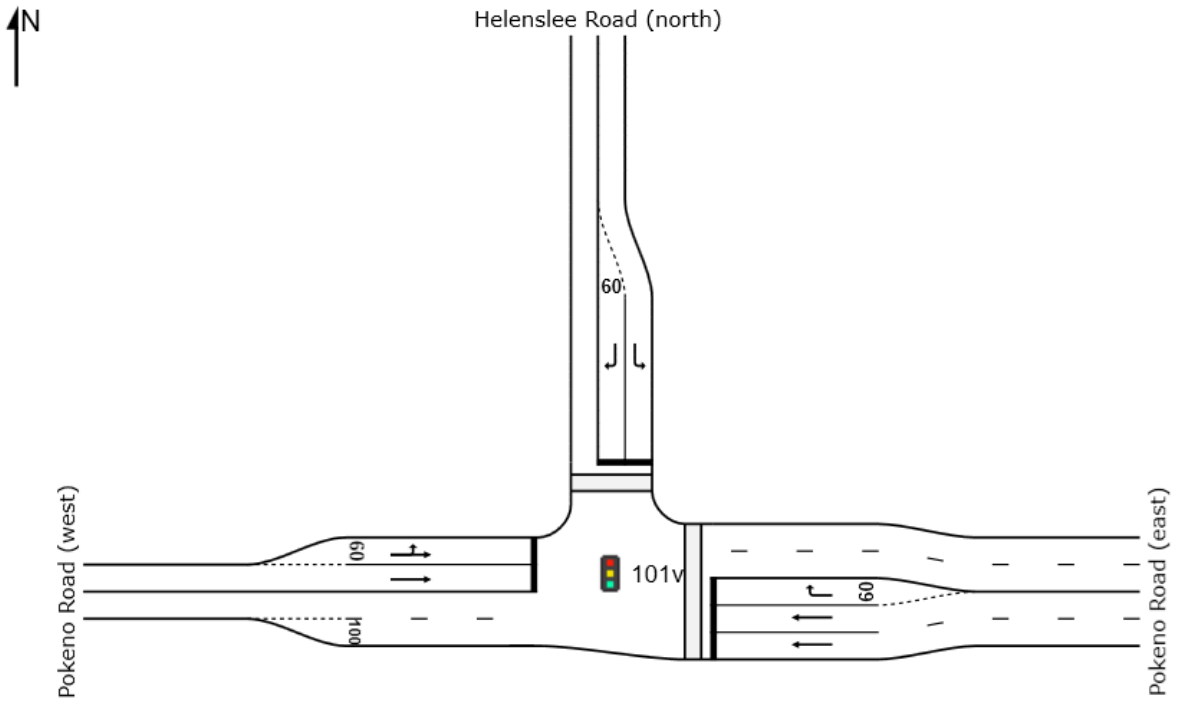
New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	567	5.0	0.553	4.9	LOS A	5.4	39.6	0.65	0.55	54.6
6	R2	93	5.0	0.553	10.8	LOS B	5.4	39.6	0.65	0.55	54.8
Approach		660	5.0	0.553	5.7	LOS A	5.4	39.6	0.65	0.55	54.6
North: Munro Road (north)											
7	L2	29	5.0	0.246	6.7	LOS A	1.7	12.1	0.70	0.76	50.4
9	R2	183	5.0	0.246	12.4	LOS B	1.7	12.1	0.70	0.76	51.9
Approach		213	5.0	0.246	11.7	LOS B	1.7	12.1	0.70	0.76	51.7
West: Pokeno Road (west)											
10	L2	299	5.0	0.559	4.3	LOS A	6.1	44.3	0.49	0.44	54.3
11	T1	471	5.0	0.559	4.0	LOS A	6.1	44.3	0.49	0.44	56.0
Approach		769	5.0	0.559	4.1	LOS A	6.1	44.3	0.49	0.44	55.3
All Vehicles		1642	5.0	0.559	5.7	LOS A	6.1	44.3	0.58	0.53	54.5

Using a single lane roundabout layout and the volumes predicted at this intersection for the future year 2040, the modelling results indicate that the lanes continue to perform at a LOS A or B during the peak hours. The maximum degree of saturation increases to 0.559 (afternoon peak hour) however remains within capacity (0.85). As such, a single lane roundabout is considered sufficient to cater for the volumes predicted at this intersection for the year 2040 (subject to changes in demand).

2.13 INTERSECTION H – HELENSLEE ROAD / POKENO ROAD

Figure 39: Intersection H layout (indicative)



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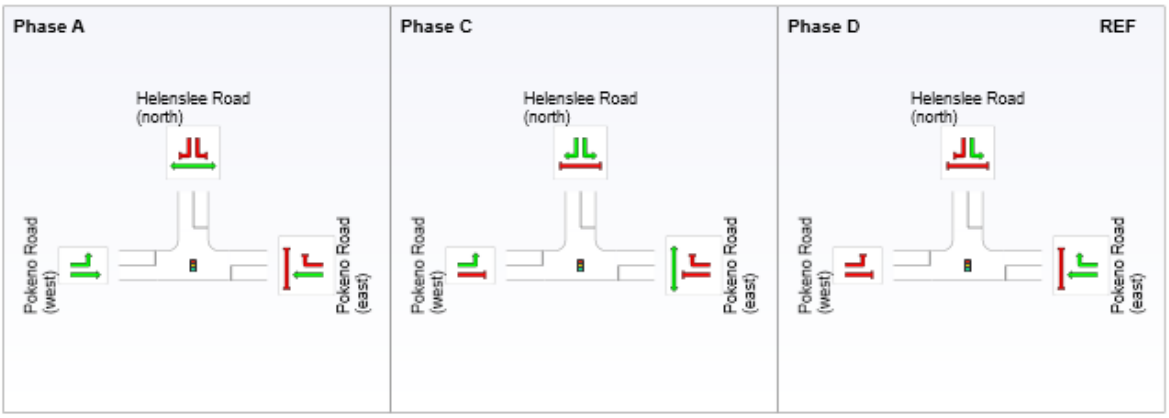

Figure 40: Intersection H Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int H 2040 AM - signals]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	421	5.0	0.193	0.3	LOS A	0.3	2.4	0.03	0.02	59.7
6	R2	209	5.0	0.285	16.9	LOS B	4.0	29.2	0.42	0.69	45.8
Approach		631	5.0	0.285	5.8	LOS A	4.0	29.2	0.16	0.24	54.2
North: Helenslee Road (north)											
7	L2	547	5.0	0.533	17.9	LOS B	15.2	111.1	0.62	0.77	45.3
9	R2	37	5.0	0.158	48.3	LOS D	1.6	12.0	0.92	0.73	32.8
Approach		584	5.0	0.533	19.8	LOS B	15.2	111.1	0.64	0.77	44.2
West: Pokeno Road (west)											
10	L2	25	5.0	0.533	38.0	LOS D	11.7	85.3	0.89	0.76	38.1
11	T1	539	5.0	0.533	32.8	LOS C	11.7	85.7	0.90	0.76	38.9
Approach		564	5.0	0.533	33.0	LOS C	11.7	85.7	0.90	0.76	38.9
All Vehicles		1779	5.0	0.533	19.0	LOS B	15.2	111.1	0.55	0.58	45.2

Figure 41: Intersection H Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int H 2040 PM - signals]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	644	5.0	0.295	0.3	LOS A	0.6	4.1	0.03	0.02	59.7
6	R2	448	5.0	0.463	8.9	LOS A	3.7	27.1	0.18	0.63	51.0
Approach		1093	5.0	0.463	3.8	LOS A	3.7	27.1	0.09	0.27	55.8
North: Helenslee Road (north)											
7	L2	229	5.0	0.175	6.1	LOS A	0.4	2.6	0.03	0.58	53.0
9	R2	17	5.0	0.072	47.5	LOS D	0.7	5.1	0.86	0.69	33.0
Approach		246	5.0	0.175	8.9	LOS A	0.7	5.1	0.09	0.59	50.9
West: Pokeno Road (west)											
10	L2	24	5.0	0.903	64.3	LOS E	15.0	109.3	1.00	1.07	29.9
11	T1	489	5.0	0.903	58.7	LOS E	15.0	109.3	1.00	1.07	30.5
Approach		514	5.0	0.903	59.0	LOS E	15.0	109.3	1.00	1.07	30.4
All Vehicles		1853	5.0	0.903	19.8	LOS B	15.0	109.3	0.34	0.54	44.9

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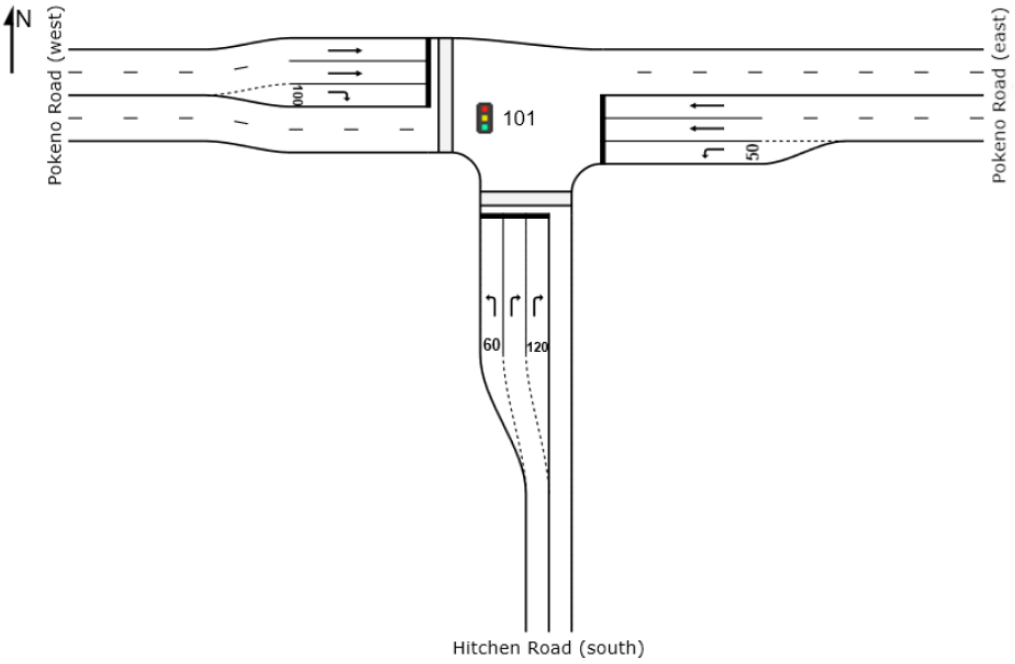
The Helenslee Road / Pokeno Road intersection is existing and controlled by a give-way control intersection. The **BECA report** indicates that this intersection warrants an upgrade to a signal or roundabout intersection form by the year 2022 and 2040.

A signalised intersection form has been used to assess the performance of this intersection.

In summary, the lanes are expected to operate at a LOS A-E. The maximum degree of saturation for any approach is 0.533 during the morning peak hour and 0.903 during the afternoon peak hour and occurs on the western approach (Pokeno Road). The maximum 95%ile back of queue length for this approach is 109.3m (15 vehicles). Based on the above assessment, this intersection is expected to experience a minor level of congestion on the western approach (0.903) during the afternoon peak hour only by the future year 2040 however is within acceptable levels.

2.14 INTERSECTION I – HITCHEN ROAD / POKENO ROAD

Figure 42: Intersection I layout (indicative)



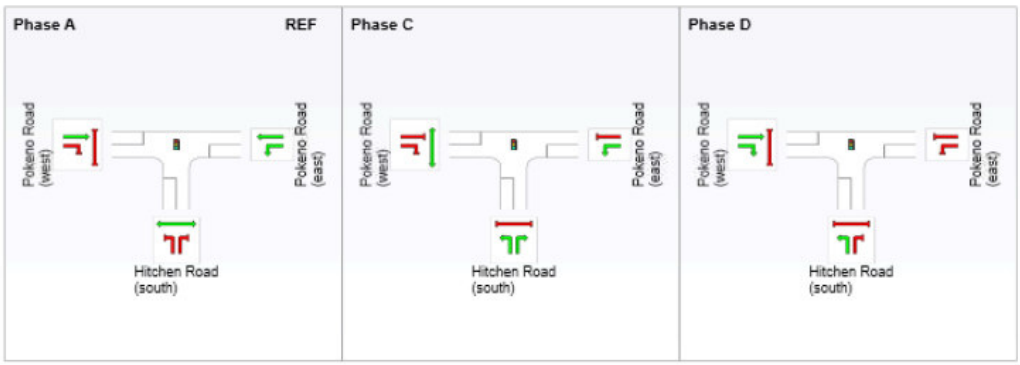


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Figure 43: Intersection I Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int I 2040 AM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	181	5.0	0.171	15.5	LOS B	4.0	28.9	0.48	0.70	46.7
3	R2	264	5.0	0.567	51.4	LOS D	6.3	46.0	0.99	0.80	32.0
Approach		445	5.0	0.567	36.8	LOS D	6.3	46.0	0.78	0.76	36.7
East: Pokeno Road (east)											
4	L2	460	5.0	0.611	18.2	LOS B	11.8	85.8	0.56	0.75	45.1
5	T1	522	5.0	0.532	26.5	LOS C	9.5	69.3	0.78	0.66	41.8
Approach		982	5.0	0.611	22.6	LOS C	11.8	85.8	0.68	0.70	43.3
West: Pokeno Road (west)											
11	T1	667	5.0	0.236	0.3	LOS A	0.4	3.0	0.03	0.02	59.7
12	R2	419	5.0	0.543	16.9	LOS B	9.5	69.1	0.50	0.72	46.0
Approach		1086	5.0	0.543	6.7	LOS A	9.5	69.1	0.21	0.29	53.5
All Vehicles		2514	5.0	0.611	18.3	LOS B	11.8	85.8	0.49	0.53	45.6

Figure 44: Intersection I Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101 [Sensitivity test Int I 2040 PM]

New Site
Signals - Fixed Time Coordinated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
South: McLean Street (south)											
1	L2	281	5.0	0.435	31.8	LOS C	10.4	76.1	0.81	0.80	38.6
3	R2	446	5.0	0.889	63.3	LOS E	12.7	92.6	1.00	0.99	29.0
Approach		727	5.0	0.889	51.1	LOS D	12.7	92.6	0.93	0.92	32.1
East: Pokeno Road (east)											
4	L2	294	5.0	0.248	6.0	LOS A	0.4	2.7	0.03	0.58	53.1
5	T1	1093	5.0	0.590	7.0	LOS A	9.4	68.4	0.38	0.34	53.8
Approach		1386	5.0	0.590	6.8	LOS A	9.4	68.4	0.31	0.39	53.6
West: Pokeno Road (west)											
11	T1	515	5.0	0.184	0.3	LOS A	0.3	2.2	0.03	0.02	59.7
12	R2	203	5.0	0.596	40.1	LOS D	8.6	62.6	0.89	0.80	35.7
Approach		718	5.0	0.596	11.6	LOS B	8.6	62.6	0.27	0.24	50.1
All Vehicles		2832	5.0	0.889	19.4	LOS B	12.7	92.6	0.46	0.49	45.1

The **BECA report** indicates that this intersection warrants signals or a roundabout control by the year 2022 (currently give-way controlled).

A signalised intersection form has been used to assess the performance of this intersection.

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Hitchen Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.611 and occurs at the left turn movement (eastern approach). This approach is expected to operate at a LOS B and comprises a 95%ile back of queue length of 86 m (11-12 vehicles);

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- During the afternoon peak hour, the maximum degree of saturation is 0.889 (LOS E) and occurs on the southern approach (right turn). The maximum 95%ile queue length for this approach is 93 m (13 vehicles).

Based on the above, with the volumes predicted for the future year 2040, the modelling results indicates that this intersection is expected to experience some level of congestion (on the right turn lane on the southern approach) however is expected to operate below capacity (0.9).

2.15 INTERSECTION J – GREAT SOUTH ROAD / POKENO ROAD

Figure 45: Intersection J layout (indicative)

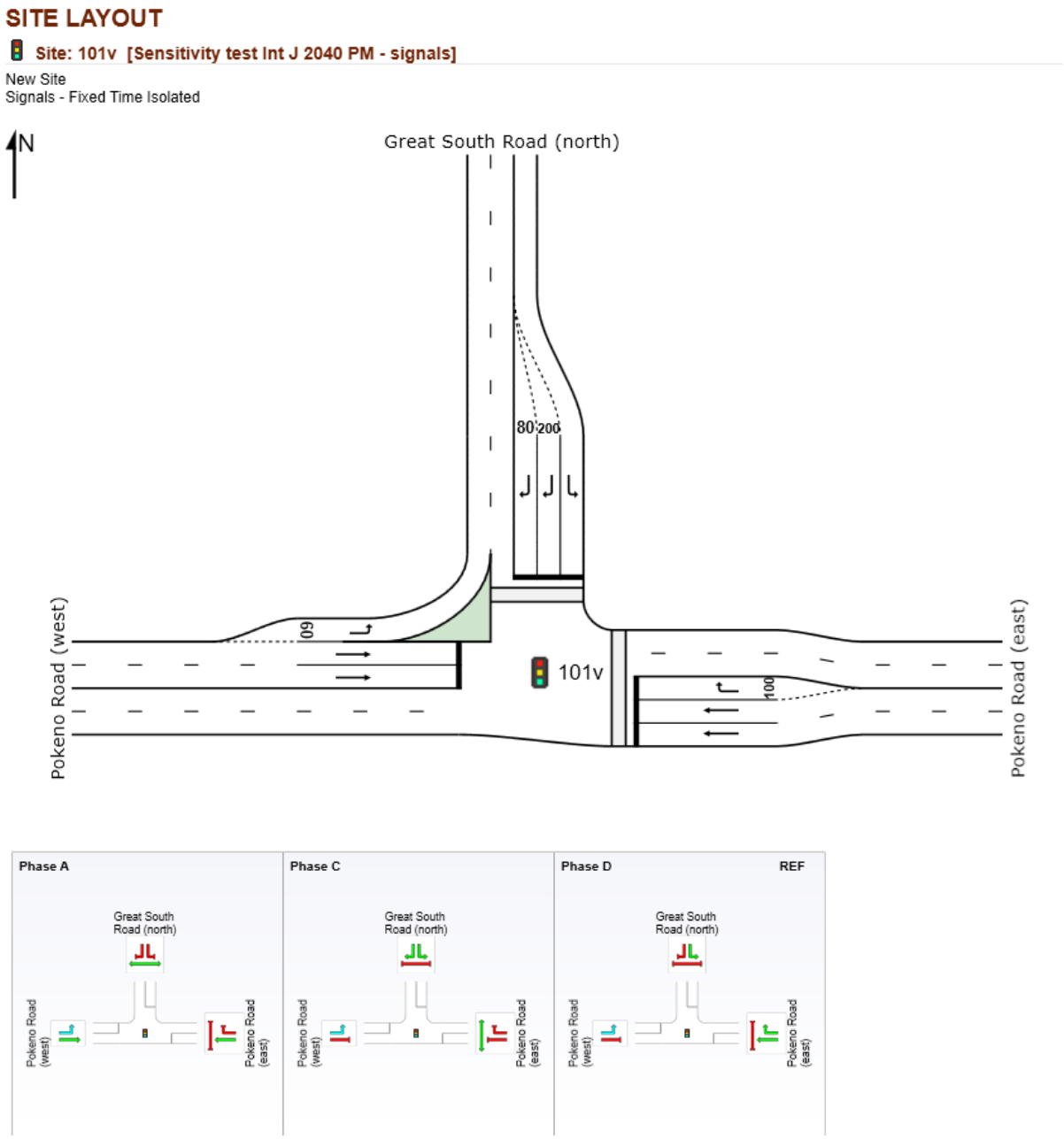

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Figure 46: Intersection J Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int J 2040 AM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	283	5.0	0.147	13.8	LOS B	3.6	26.3	0.56	0.46	49.0
6	R2	204	5.0	0.599	46.5	LOS D	9.3	68.2	0.97	0.82	33.6
Approach		487	5.0	0.599	27.5	LOS C	9.3	68.2	0.73	0.61	41.1
North: Great South Road (north)											
7	L2	603	5.0	0.543	17.2	LOS B	16.7	121.7	0.62	0.78	45.7
9	R2	793	5.0	0.597	33.1	LOS C	15.7	114.6	0.86	0.83	38.2
Approach		1396	5.0	0.597	26.2	LOS C	16.7	121.7	0.76	0.81	41.1
West: Pokeno Road (west)											
10	L2	480	5.0	0.268	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	596	5.0	0.607	35.4	LOS D	12.9	94.4	0.93	0.79	38.0
Approach		1076	5.0	0.607	22.2	LOS C	12.9	94.4	0.52	0.67	44.0
All Vehicles		2959	5.0	0.607	25.0	LOS C	16.7	121.7	0.67	0.73	42.1

Figure 47: Intersection J Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int J 2040 PM - signals]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Pokeno Road (east)											
5	T1	875	5.0	0.331	6.2	LOS A	8.2	59.7	0.42	0.37	54.5
6	R2	664	5.0	0.772	26.8	LOS C	25.6	186.8	0.84	0.86	40.9
Approach		1539	5.0	0.772	15.1	LOS B	25.6	186.8	0.60	0.58	47.7
North: Great South Road (north)											
7	L2	311	5.0	0.231	9.6	LOS A	4.5	32.8	0.32	0.67	50.5
9	R2	520	5.0	0.805	53.6	LOS D	13.4	97.9	1.00	0.92	31.5
Approach		831	5.0	0.805	37.1	LOS D	13.4	97.9	0.75	0.82	36.7
West: Pokeno Road (west)											
10	L2	872	5.0	0.486	5.7	LOS A	0.0	0.0	0.00	0.53	54.7
11	T1	321	5.0	0.654	46.9	LOS D	7.8	57.2	1.00	0.83	34.0
Approach		1193	5.0	0.654	16.8	LOS B	7.8	57.2	0.27	0.61	47.0
All Vehicles		3562	5.0	0.805	20.8	LOS C	25.6	186.8	0.52	0.65	44.4

This intersection currently operates as a give-way control intersection.

The **BECA report** identifies that this intersection warrants a roundabout or signals by the year 2022 and 2040. In this regard, a signalised intersection layout has been used to model the traffic volumes predicted at this intersection for the future year 2040.

Using the traffic volumes predicted at the intersection for the future year 2040, the modelling indicates the following:

- widening is likely required along Pokeno Road and Great South Road to accommodate additional lanes to cater for the future traffic volumes;
- during the morning peak hour, the maximum degree of saturation is 0.607 and 0.805 during the afternoon peak hour respectively;

- The maximum 95%ile queue length ranges from 121.7 m to 186.8 m during the morning and afternoon peak hour respectively.
- Based on the above, with the volumes predicted at this intersection for the future year 2040, the modelling indicates that this intersection is expected to operate below capacity (0.9).
- Based on the above, with the volumes predicted at this intersection for the future year 2040, the modelling indicates that this intersection is expected to operate below capacity (0.9).

2.16 INTERSECTION K – SH1 GREAT SOUTH ROAD (ON-RAMP) INTERCHANGE

Figure 48: Intersection K layout (indicative)

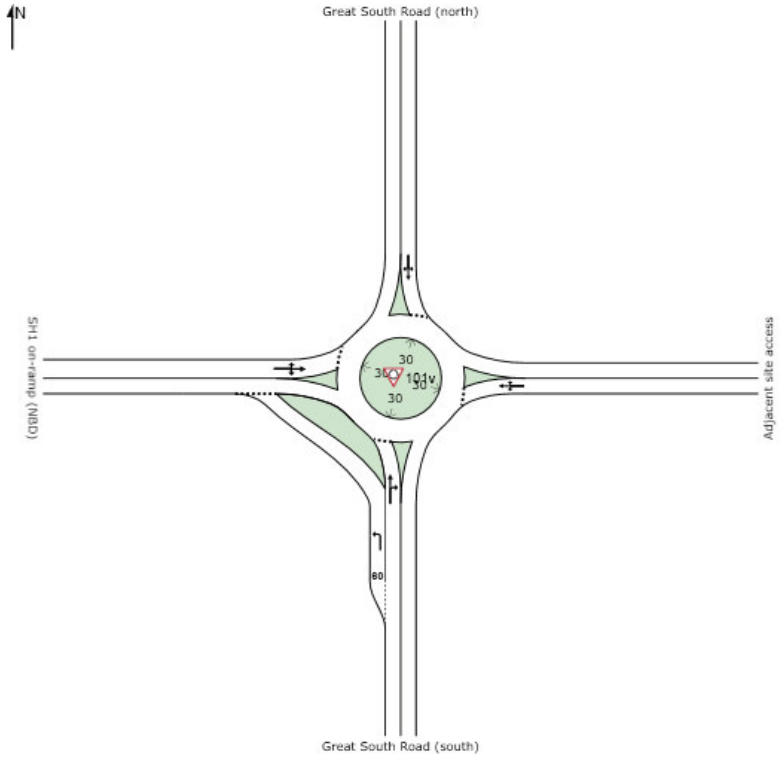

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Figure 49: Intersection K Movement summary 2040 AM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int K 2040 AM]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	107	5.0	0.086	4.9	LOS A	0.5	3.7	0.49	0.53	54.7
2	T1	618	5.0	0.499	5.5	LOS A	4.0	29.5	0.67	0.60	54.9
3	R2	11	5.0	0.499	11.5	LOS B	4.0	29.5	0.67	0.60	55.0
Approach		736	5.0	0.499	5.5	LOS A	4.0	29.5	0.64	0.59	54.8
East: Adjacent site access											
4	L2	26	5.0	0.065	8.7	LOS A	0.4	2.8	0.73	0.68	52.2
5	T1	19	5.0	0.065	8.4	LOS A	0.4	2.8	0.73	0.68	53.7
6	R2	1	5.0	0.065	14.4	LOS B	0.4	2.8	0.73	0.68	53.9
Approach		46	5.0	0.065	8.7	LOS A	0.4	2.8	0.73	0.68	52.8
North: Great South Road (north)											
7	L2	7	5.0	0.454	3.5	LOS A	4.6	33.3	0.14	0.48	54.1
8	T1	416	5.0	0.454	3.2	LOS A	4.6	33.3	0.14	0.48	55.7
9	R2	324	5.0	0.454	9.2	LOS A	4.6	33.3	0.14	0.48	55.8
Approach		747	5.0	0.454	5.8	LOS A	4.6	33.3	0.14	0.48	55.7
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	6.6	LOS A	0.0	0.2	0.69	0.55	52.3
11	T1	1	5.0	0.004	6.3	LOS A	0.0	0.2	0.69	0.55	53.8
12	R2	1	5.0	0.004	12.2	LOS B	0.0	0.2	0.69	0.55	53.9
Approach		3	5.0	0.004	8.4	LOS A	0.0	0.2	0.69	0.55	53.3
All Vehicles		1533	5.0	0.499	5.8	LOS A	4.6	33.3	0.40	0.54	55.2

Figure 50: Intersection K Movement summary 2040 PM

MOVEMENT SUMMARY

Site: 101v [Sensitivity test Int K 2040 PM]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Great South Road (south)											
1	L2	1166	5.0	0.793	5.6	LOS A	11.1	81.4	0.77	0.59	53.7
2	T1	475	5.0	0.345	4.2	LOS A	2.5	18.3	0.44	0.46	55.9
3	R2	23	5.0	0.345	10.1	LOS B	2.5	18.3	0.44	0.46	56.1
Approach		1664	5.0	0.793	5.3	LOS A	11.1	81.4	0.67	0.55	54.4
East: Adjacent site access											
4	L2	13	5.0	0.026	6.2	LOS A	0.1	1.1	0.59	0.55	53.7
5	T1	9	5.0	0.026	5.9	LOS A	0.1	1.1	0.59	0.55	55.3
6	R2	1	5.0	0.026	11.9	LOS B	0.1	1.1	0.59	0.55	55.5
Approach		23	5.0	0.026	6.3	LOS A	0.1	1.1	0.59	0.55	54.5
North: Great South Road (north)											
7	L2	18	5.0	0.318	3.6	LOS A	2.5	18.3	0.17	0.45	54.4
8	T1	312	5.0	0.318	3.3	LOS A	2.5	18.3	0.17	0.45	56.0
9	R2	165	5.0	0.318	9.3	LOS A	2.5	18.3	0.17	0.45	56.2
Approach		495	5.0	0.318	5.3	LOS A	2.5	18.3	0.17	0.45	56.0
West: SH1 on-ramp (NBD)											
10	L2	1	5.0	0.004	5.7	LOS A	0.0	0.1	0.58	0.52	52.8
11	T1	1	5.0	0.004	5.4	LOS A	0.0	0.1	0.58	0.52	54.3
12	R2	1	5.0	0.004	11.4	LOS B	0.0	0.1	0.58	0.52	54.5
Approach		3	5.0	0.004	7.5	LOS A	0.0	0.1	0.58	0.52	53.9
All Vehicles		2185	5.0	0.793	5.3	LOS A	11.1	81.4	0.56	0.53	54.7

This intersection is existing and currently allows free flow movement for vehicles turning left onto the SH1 and requires vehicles to give-way (for right turn movements). The **BECA report** identifies that this intersection requires a roundabout or signals by the year 2022 and 2040. As such, a single lane roundabout has been modelled with an additional lane provided on the southbound approach to facilitate vehicles turning left onto the SH1 northbound on-ramp.

Using the volumes predicted at this intersection for the future year 2040, the modelling indicates that the lanes are expected to perform at a Level of service A or B during the peak hours. The maximum degree of saturation is 0.793 and occurs during the afternoon peak hour on the southern approach (left turn movement onto the State highway). The 95%ile back of queue for this approach is 82 m (11-12 vehicles) with an average delay of 5.6 seconds per vehicle.

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2.17 INTERSECTION L – RAZORBACK ROAD INTERCHANGE (SH1 SOUTHBOUND OFF-RAMP)

Figure 51: Intersection L layout (indicative)

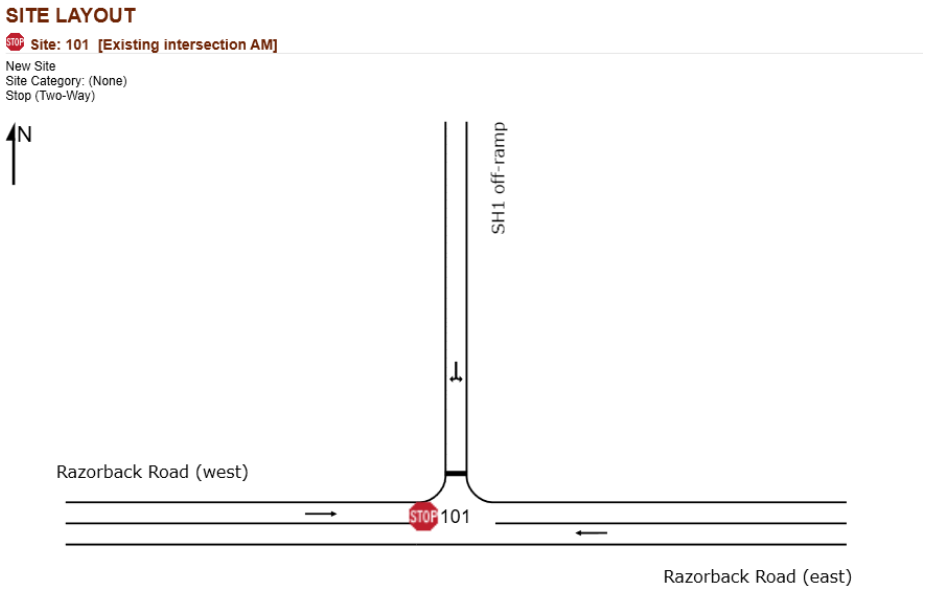

Figure 52: Intersection L Movement summary 2040 AM_ Existing

MOVEMENT SUMMARY

Site: 101 [Existing intersection AM]

New Site
Site Category: (None)
Stop (Two-Way)

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
East: Razorback Road (east)												
5	T1	9	5.0	0.005	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		9	5.0	0.005	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	4	5.0	0.062	7.7	LOS A	0.2	1.2	0.06	0.96	0.06	45.1
9	R2	98	5.0	0.062	7.1	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
Approach		102	5.0	0.062	7.2	LOS A	0.2	1.2	0.06	0.96	0.06	44.6
West: Razorback Road (west)												
11	T1	18	5.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		18	5.0	0.009	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		129	5.0	0.062	5.7	NA	0.2	1.2	0.05	0.76	0.05	45.7

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Figure 53: Intersection L Movement summary 2040 AM_ Existing

MOVEMENT SUMMARY

Site: 101 [Existing intersection PM]

New Site
Site Category: (None)
Stop (Two-Way)

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
East: Razorback Road (east)												
5	T1	8	5.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		8	5.0	0.004	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	3	5.0	0.199	7.7	LOS A	0.6	4.4	0.05	0.97	0.05	45.2
9	R2	326	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
Approach		329	5.0	0.199	7.1	LOS A	0.6	4.4	0.05	0.97	0.05	44.6
West: Razorback Road (west)												
11	T1	11	5.0	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		11	5.0	0.006	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		348	5.0	0.199	6.8	NA	0.6	4.4	0.05	0.91	0.05	44.9

Figure 54: Intersection L Movement summary 2040 AM_ Potential

MOVEMENT SUMMARY

Site: 101 [Sensitivity test_Razorback Road off-ramp intersection AM]

New Site
Site Category: (None)
Stop (Two-Way)

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
East: Razorback Road (east)												
5	T1	58	5.0	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		58	5.0	0.031	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	6	5.0	0.344	8.2	LOS A	1.2	8.8	0.21	0.91	0.21	45.2
9	R2	521	5.0	0.344	7.5	LOS A	1.2	8.8	0.21	0.91	0.21	44.6
Approach		527	5.0	0.344	7.5	LOS A	1.2	8.8	0.21	0.91	0.21	44.6
West: Razorback Road (west)												
11	T1	98	5.0	0.052	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		98	5.0	0.052	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		683	5.0	0.344	5.8	NA	1.2	8.8	0.16	0.71	0.16	45.7

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Figure 55: Intersection L Movement summary 2040 PM_ Potential

MOVEMENT SUMMARY

Site: 101 [Sensitivity test_Razorback Road off-ramp intersection PM]

New Site
Site Category: (None)
Stop (Two-Way)

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
East: Razorback Road (east)												
5	T1	103	5.0	0.055	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		103	5.0	0.055	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
North: SH1 off-ramp												
7	L2	5	5.0	0.601	8.2	LOS A	3.7	26.9	0.28	0.90	0.31	45.0
9	R2	923	5.0	0.601	7.8	LOS A	3.7	26.9	0.28	0.90	0.31	44.5
Approach		928	5.0	0.601	7.8	LOS A	3.7	26.9	0.28	0.90	0.31	44.5
West: Razorback Road (west)												
11	T1	45	5.0	0.024	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		45	5.0	0.024	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		1077	5.0	0.601	6.7	NA	3.7	26.9	0.25	0.77	0.26	45.2

The Razorback Road off-ramp is currently stop-controlled with priority afforded to traffic along Razorback Road.

Traffic surveys were undertaken at this intersection on Wednesday 28th October 2020 during the morning and afternoon commuter peak hours; the results of this are provided in **Attachment A.**

To assess the performance of this intersection for the future year 2040, it is conservatively assumed that 90% of volumes travelling to and from the north are expected to turn to and from SH1 ramps respectively and 10% continues via Razorback Road (east of the SH1 ramps); this results in a significant number of vehicles turning right onto Razorback Road during the afternoon peak hour (from the off-ramp).

Using the volumes assumed near the northern end of the site for the future year 2040, the modelling results indicate a maximum degree of saturation of 0.601 during the afternoon peak hour on the northern approach. The maximum 95%ile back of queue on the off-ramp is 27 m (3-4 vehicles). The off-ramp is some 190 m in length therefore this level of queuing is not expected to interfere with SH1 through traffic.