Ambury Properties Limited
Sleepyhead Estate
Ohinewai

Proposed Re-Zoning & Structure Plan

INTEGRATED TRANSPORT ASSESSMENT

6 December 2019

Job Number: 145860.08

Ambury Properties Limited
Sleepyhead Estate Re-Zoning, Ohinewai
Integrated Transport Assessment

Report Prepared by:	Rhulani Baloyi	06/12/19
Checked by:	Cameron Inder	06/12/19
Approved for issue by:	Cameron Inder	06/12/19

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Bloxam Burnett & Olliver Limited
Level 4, 18 London Street
Hamilton 3240

Ph: 07 838 0144
Email: rbaloyi@bbo.co.nz

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Executive Summary

Sleepyhead Estate Rezoning

To provide for the development known as Sleepyhead Estate, Ambury Properties Limited (APL) seeks to change the zoning of approximately 178ha of land located in Ohinewai from the current rural zoning to a mix of industrial, commercial and residential zoning.

Amendments to the Proposed Waikato District Plan are sought to enable the development to occur in Ohinewai.

This Integrated Transport Assessment (ITA) supports submissions to the Proposed Waikato District Plan that seek to incorporate the proposed rezoning and embed a new Structure Plan for the Ohinewai development site into the Proposed District Plan. The ITA assesses the transportation effects of the proposal and outlines the recommended network upgrades to enable the development.

The development includes the following proposed land uses:

- Approximately 63ha of industrial land, including 23ha for the Sleepyhead Factory.
- Approximately 8.7ha of business land for a service centre, factory outlet shops and a small amount of convenience retail.
- Approximately 52ha of residential for up to 1100 homes for employees of the Sleepyhead Factory and the wider community.
- Approximately 55ha of public open space including stormwater management areas, recreational opportunities, and ecological enhancement.

When complete, the proposed development is expected to generate approximately 1,100 and 1,700 vehicle trips during the AM and PM peak hours respectively, with approximately 2% of the total peak hour trips being heavy commercial vehicles. The low percentage of HCV's generated by the development can be attributed to the provision of a rail siding with direct access from the proposed industrial area to the North Island Main Trunk (NIMT) railway line.

Proposed Transport Infrastructure

The following transport infrastructure is included as part of the proposed APL development:

- Implementation of a new rail siding which will connect the development to the NIMT railway. By shifting freight trips to the rail network instead of the road network, the number of heavy commercial vehicle trips that are expected to be generated by the proposed development will be reduced.
- Realigning Lumsden Road and Balemi Road so that the proposed rail siding crosses Lumsden Road at a safe angle with low vehicle speeds.
- The construction of five new intersections (and private accesses) on the surrounding road network to connect the new internal road network of the site.
- Providing walking and cycling links to the existing Ohinewai Village and School, and enabling safe and convenient active mode access to Huntly via future proposed linkages.

Site Access Proposals – New Intersections

The five new intersections are proposed on Tahuna Road, Lumsden Road and Balemi Road as follows:

- Three new intersections (one Left In / Left Out (LILO) and two full movement intersections) on Tahuna Road which provide access to the commercial/ retail and residential lots.
- Two new intersections (one LILO and one full intersection) on Lumsden Road to provide access to the road network around the industrial hub.
- Two heavy commercial access ways (private entranceways) on Balemi Road, providing access to the proposed NZCG factory and rail siding.

Internal Road Network

A network of internal roads is proposed to service the APL development. The internal roads are configured in a grid-network formation based around the site's geotechnical constraints, connectivity between the different land use areas, and connection to the existing external road network (Tahuna Road and Lumsden Road).

The street hierarchy has been designed to be logical, intuitive and legible. The configuration avoids the need for heavy traffic to use the residential streets while at the same time providing a high degree of connectivity between the land uses, including for active transport such as walking, cycling, scooters etc.

While the Structure Plan reflects the high level network configuration, the finer details of the road network will be refined at future subdivision stages.

Recommended Transportation Infrastructure Improvements to Support the Rezoning

Road Upgrades & Speed Environment

Tahuna Road, Lumsden Road and Balemi Road will be upgraded from the existing rural environment to a semi-urban/ industrial environment as a result of the proposed development and the resulting increased traffic movements (vehicles, pedestrians and cyclists) along all three roads.

The following road upgrades and speed limit changes are recommended:

Tahuna Road

- Reduction to 70km/h posted speed limit (or less) from the existing 100km/h speed limit, from the SH1 interchange to the eastern extents of the development.
- Provision of a kerb and channel drainage and shoulder treatment along the side of the road bordering the proposed development (i.e. eastbound carriageway).
- Provision of a shared active modes path with street lighting along the eastbound carriageway
- These are required at the time of development of the commercial lots bordering Tahuna Road.

Lumsden Road

- Reduction to 70km/h (or less) from the existing 100km/h speed limit, from Tahuna Road to 200m north of Balemi Road.

- Provision of a kerb & channel drainage treatment along the side of the road bordering the proposed development (i.e. southbound carriageway) to match the existing northbound kerb and channel.
- Provision of a shared walking and cycling path with street lighting along the southbound side of the carriageway.
- These are required at the first industrial subdivision (and prior to construction of Stage 2 of the NZCG Factory), estimated to be in development Years 1-3.

Balemi Road

- Upgrading Balemi Road (i.e. widening and sealing) to a minimum of six-metre trafficable carriageway width.
- Reduction to 70km/h (or less) from the existing 100km/h speed limit (over full length)
- Provision of a kerb & channel drainage and shoulder treatment along the side of the road bordering the proposed development (i.e. westbound carriageway).
- These upgrades are required with Stage 1 of the NZCG Factory, estimated to be in Year 1.

Road Geometric Improvements for Rail Siding

Localised changes to the alignment of Lumsden Road are required to enable the implementation of the proposed rail siding in accordance with KiwiRail standards. This includes:

- Introducing a series of back to back horizontal curves in the otherwise straight alignment, with speed reduction measures including
  - Reduced the speed limit to 70 kph (or less) via gated sign speed threshold treatments on both approaches of Lumsden Road
  - Narrowing the carriageway cross-section,
  - Implementing kerb & channel on both sides,
  - Installing roadside barriers, chevron boards and speed advisory signs
  - installing rumble strips perpendicular to traffic flow on the southbound approach prior to the first horizontal curve
- Signal control and barrier arms are recommended for the proposed level crossing due to the limited approach visibility that is available.
- These changes to the road configuration are recommended as part of the rail siding and level crossing construction works.

Intersection Upgrades

The increase of trips as a result of the development provides for impacts on the surrounding network that can be mitigated by upgrades to certain intersections as described below.

Tahuna Road & Lumsden Road intersection

- An additional right-turn lane will be required on the northern roundabout approach once approximately 1,400 peak hour trips are generated by the proposed development.
- This corresponds to full development of the industrial and commercial areas, and only partial development of the residential lots estimated to be in development Years 8-10.

Balemi Road and Lumsden Road intersection

- The eastern leg of the intersection (i.e. Balemi Road) be upgraded (i.e. widened and sealed) to a minimum six-metre trafficable carriageway width.
- The rural intersection be formed in line with the requirements set out in the Waikato District Plan and the Regional Infrastructure Technical Specifications (RITS).
- This corresponds to development of the NZCG factory estimated to be in development by Years 1-3.

Southbound off-ramp

- An additional right turning lane on southbound off ramp is required once approximately 1,700 peak hour trips are generated by the proposed development.
- This corresponds to full development of the industrial and commercial areas estimated to be in development Years 8-10.

- Note, this upgrade does not provide for walking and cycling.

Walking and Cycling Infrastructure

Approximately 250 walking and cycling trips are expected to be generated by the proposed development during the AM and PM peaks hours respectively. These trips are expected to be undertaken by:

- Students walking and cycling to/from Ohinewai Primary School, and
- Cyclists and pedestrians travelling between the proposed development, Ohinewai Village and Huntly for employment and/or recreational purposes.

Walking and cycling linkages are critical for promoting public health and reducing vehicle dependency for short trips. An extensive network of footpaths and shared paths have been provided within the development, with additional walking and cycle paths proposed on Lumsden Road and Tahuna Road.

In addition, a shared active modes path is recommended to link the proposed development to the existing Ohinewai Village, school and through to Huntly. Two options exist for connecting a shared path from the site over the SH1 expressway to Ohinewai Village, and a further two options exist for connecting the path to Huntly. For connecting over the expressway:

- Option 1 – Walking and cycling path along the SH1 Ohinewai Interchange with signal control. This requires the replacement of the NIMT overbridge with a four as well as widening the southbound off ramp embankment. Pedestrian and cyclist crossing phases will be required at the signals.

- Option 2 – A new purpose built walking and cycling bridge spanning the NIMT and SH 1 Expressway, at a location approximately 315m south of the SH1 Ohinewai Interchange.

The preferred solution needs to be determined by further detailed analysis, and the solution should be implemented prior to the completion of the first stage of residential development, estimated to be in development Years 1-3.

For walking and cycling connection to Huntly:

- Option 1: Utilising the ample space on the Ohinewai South Road (old SH 1) and current SH1 corridor that will be revoked to a Council road following the opening of the Huntly Section of Waikato Expressway in early 2020. Both corridors could be transformed to provide a segregated walking and cycling path in addition to narrowed traffic lanes and redeveloped berms
- Option2: A shared walking and cycling path be constructed on top of the eastern stopbank of the Waikato river, from Ohinewai to Huntly. This is already shown in the Waikato Blueprint as a future ambition for the district.

The preferred option and timing relative to development staging should be identified following further detailed analysis of design constraints and costs, in collaboration with Waikato District Council, NZ Transport Agency and Waikato Regional Council.

Public Transport Infrastructure

The proposed development is predicted to generate approximately 130 commuter trips during the AM and PM peaks hours. This is equivalent to providing least two in- and outbound buses during each peak period. Given this demand, public transport services are recommended for the proposed development as well as the local Ohinewai community.

Public transport is promoted within the site through the provision of a bus stop facility located within the proposed commercial precinct. The indicative location was selected based on the convenience and accessibility it offers for users, both to residents and those with employment in the site. It also offers ease of access and a circulatory route via the internal collector road network in order to minimise delays to the service.

Although current expectations of Waikato Regional Council is that future PT services should not extend into the development site, APL will not preclude such services across development stages as plans for future services could change as towns along the Waikato expressway grow in size. In the interim period before the development is completed, an alternative may be to provide a bus stop on Tahuna Road between the interchange and Lumsden Road as this would enable the bus to then U-turn at the proposed roundabout and return quickly to the expressway via the interchange on ramp.

Alternatively, given the proximity of the Huntly rail station and its services to both Hamilton and Auckland (proposed mid 2020), a park-and-ride service can be provided from the development's proposed bus stop facility to the Huntly public transport hub.

Sensitivity analysis

Sensitivity testing indicated that further road network upgrades will likely be required in cases where:

- 80% and more of the trips generated by the development travel to/ originate from the south (i.e. Huntly, Hamilton). This scenario is, however, unlikely in our opinion given the proximity of Rangiriri and Te Kauwhata to the subject site. We except that a notable portion (over 30%) of the trips generated by the proposed development will travel north given the projected population and economic growth figures for these northern townships.
- 80% and more of the trips generated by the development travel externally. It is our opinion that this scenario is unlikely to occur based on the premise that the proposed land-uses within the mixed-use development were developed with the intention of supporting the NZCG factory (i.e. a notable portion of the trips generated by the proposed development are likely to remain within the development).

The following intersection upgrades will be triggered in both cases:

1. Providing additional capacity on the northern approach of the Tahuna Road & Lumsden Road intersection. This may include implementing metering signals at the roundabout.
2. Upgrading the eastern ramp intersection to traffic signal control and providing two through-lanes for eastbound vehicles. This will entail widening the NIMT (from two lanes to four lanes) and Tahuna Road overbridges (from two lanes to at least three lanes).

Based on the sensitivity testing, intersections should be upgraded on a staged basis as traffic generation and assignment becomes realised over time.

Integration with nearby development

The ITA has considered and assessed the high level transportation effects of the other proposed land use changes outlined in submissions to the Proposed District Plan.

With the inclusion of the Shand Properties Limited submission that seeks rezoning a large area of land on the western side of the expressway to Country Living, our assessments have shown that both developments can be accommodated with targeted future infrastructure upgrades at the Ohinewai Interchange. The upgrades are necessary to ensure safety and operational effects are acceptably avoided or mitigated.

Ohinewai Lands Limited (OLL) propose a 'future development area' on a site to the south of the development site that would require a private Plan Change at some time in the future. OLL are not seeking a 'live-zone' and the development timeframes are unknown at this stage. Accordingly, it is recommended that OLL provide for their own transportation assessments at the relevant time of their proposed Plan Change, and if necessary, infrastructure upgrades are provided for at that time.

1. Introduction

1.1. Background

Ambury Properties Limited (APL) are the property-owning associate of New Zealand Comfort Group Limited (NZCG). NZCG are the manufacturer of numerous bed brands including Sleepyhead, and associated products including pillows and mattresses. NZCG seeks to relocate and consolidate their existing manufacturing operations which are currently located in several locations in Auckland, onto one site. APL envisages establishing an integrated mixed-use development ("Sleepyhead Estate") that will provide for industrial, commercial and residential activities across the site.

APL has identified a suitable area of land for this purpose on the corner of Lumsden Road and Tahuna Road in Ohinewai. This property is currently zoned rural in both the Operative Waikato District Plan and Proposed District Plan (PWDP).

APL has, via submissions to the PWDP, sought re-zoning of approximately 178ha of land located in Ohinewai from the current rural zoning to a mix of industrial, commercial and residential zoning. Development will be guided by a Structure Plan and Zoning Plan that sets out the framework for development.

1.2. Report Purpose

This report is an Integrated Transportation Assessment (ITA) completed in accordance with Appendix 5C of the NZTA Planning Policy Manual (1 August 2007). It provides an assessment of the expected trip generation and associated land transport related effects of the proposed development and identifies the necessary mitigation measures to satisfactorily address those effects.

This report has been prepared as a technical input to the overall Assessment of Environmental Effects reporting for the rezoning at Ohinewai.

1.3. Site Description and Location

The locality and extent of the site is shown in Figure 1-1 below and Appendix A.

The site is bordered by Tahuna Road to the south, Lumsden Road to the west and Balemi Road to the north. Adjacent to Lumsden Road to the west of the site lies the North Island Main Trunk railway (NIMT) and State Highway 1 (SH1).

The SH1 Ohinewai interchange is located approximately 200 metres west of the south-western boundary of the site. Ohinewai Village is located further west of the site between SH1 and the Waikato River.

The site is approximately 178ha in size and is made up of several allotments as follows:

- Allotment 405, Whangamarino Parish SO 4554;
- Lot 2 Deposited Plan, South Auckland 29288;
- Lot 1 Deposited Plan, South Auckland 29288;
- Lot 1 Deposited Plan, 474347;

- Lot 2 Deposited Plan, 474347; and
- Lot 3 Deposited Plan, 474347.

The land adjacent to the site is zoned rural, with:

- Several rural residential and lifestyle block properties located directly opposite the site on Lumsden Road, and
- A number of commercial and industrial properties, including timber processing yards and a house removal yard are located approximately two kilometres north of the site on Lumsden Road.

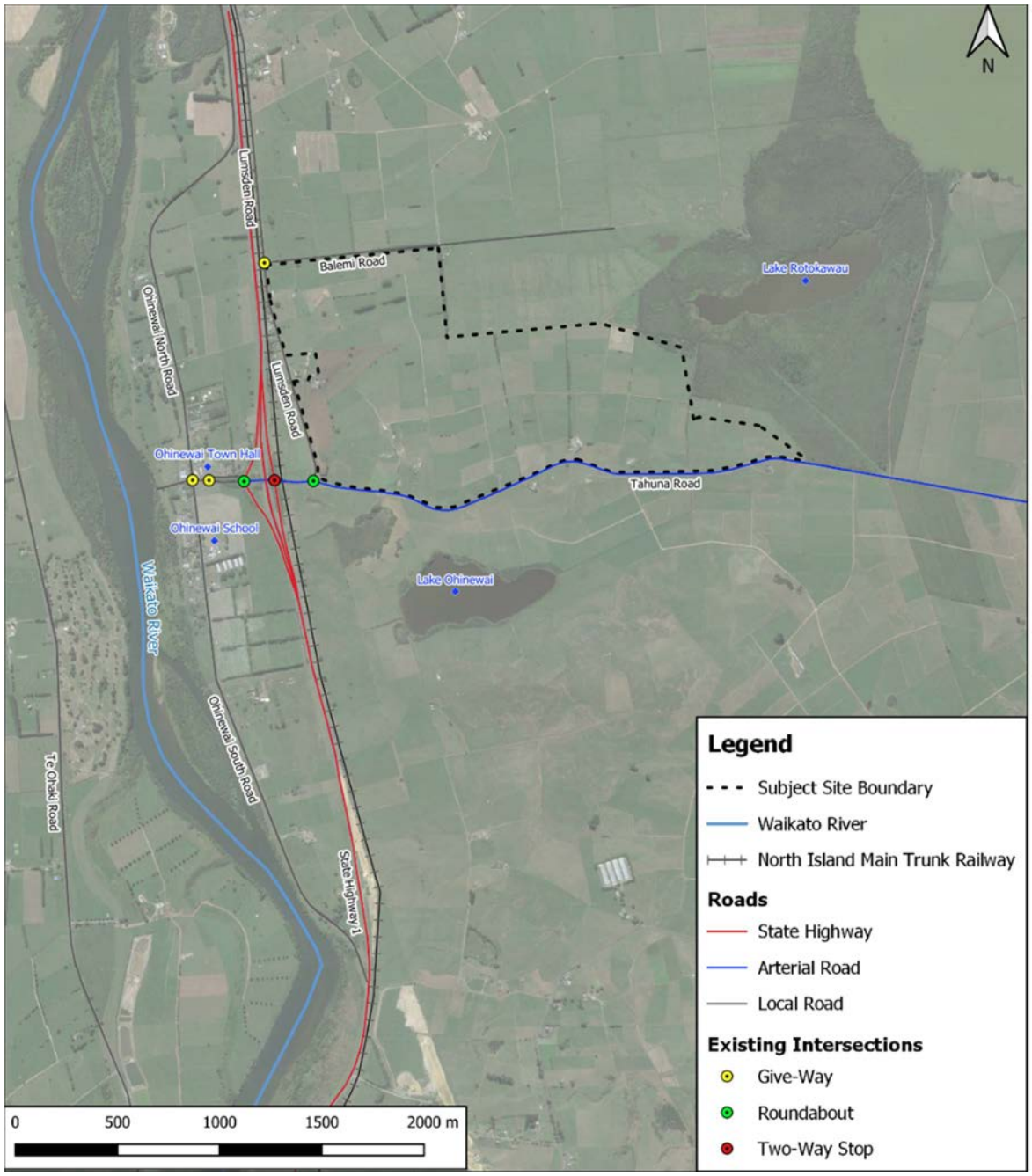

Figure 1-1: Sleepyhead Estate Locality Map

1.4. Proposal Overview

APL have developed an illustrative Masterplan which provides the basis for the Structure Plan and Zoning Plan requested across the site. The Masterplan, which is shown in Figure 1-2 and Appendix A, will continue to evolve, ensuring that it responds to opportunities and constraints as they are identified through the re-zoning process.

The following land uses are proposed within the "Sleepyhead Estate" development:

- A 63ha of industrial hub, including 23ha for the proposed NZCG Factory.
- Approximately 8.7ha of commercial development for a service centre, factory outlet shops and a small amount of convenience retail to support the Ohinewai community.
- Approximately 53ha for approximately 900 to 1100 new homes for employees of the Sleepyhead Factory and the wider community.
- Approximately 55ha of public open space including stormwater management areas, recreational opportunities, and ecological enhancement.

The following transport infrastructure proposals are included as part of the development:

- Implementation of a rail siding which will connect the proposed industrial hub to the North Island Main Trunk railway (NIMT).
- Realigning Lumsden Road and Balemi Road so that the proposed rail siding crosses Lumsden Road at a safe and acceptable angle.
- Speed management measures on Lumsden Road and Tahuna Road to reflect the environment change and increase safety for active modes.
- The construction of several new access intersections along Tahuna Road, Lumsden Road and Balemi Road.
- Providing safe and convenient walking and cycling connectivity to Ohinewai Village, School and enabling access to Huntly.

Given the extent of the proposed development enabled by the re-zoning, the proposed development will have implications for traffic movements in the area, particularly movements at the SH1 Ohinewai Interchange intersections and the intersection of Tahuna Road & Lumsden Road.

The transport effects of this proposals are considered and discussed in the following sections of this report.

Figure 1-2: Proposed Sleepyhead Estate Masterplan

2. Existing Transport Infrastructure

2.1. Existing Land Use

The site is currently in the Rural Zone under the Operative Waikato District Plan and comprises of four landholdings. The majority of the site is operating as a dairy farm, with three large lot residential and lifestyle properties located within the site, ranging from 1500m^2 to 10ha in size.

Access to the existing properties/ activities within the site is currently provided via private vehicle accesses on Tahuna Road and Lumsden Road. No public roads exist through the site.

2.2. Existing Road Network Characteristics

The existing network of roads surrounding the site is shown in Figure 2-1 and Appendix A. Access to the site will be via Tahuna Road, Lumsden Road and Balemi Road. Access beyond the local road network is via the Ohinewai Interchange off State Highway 1 (SH1).

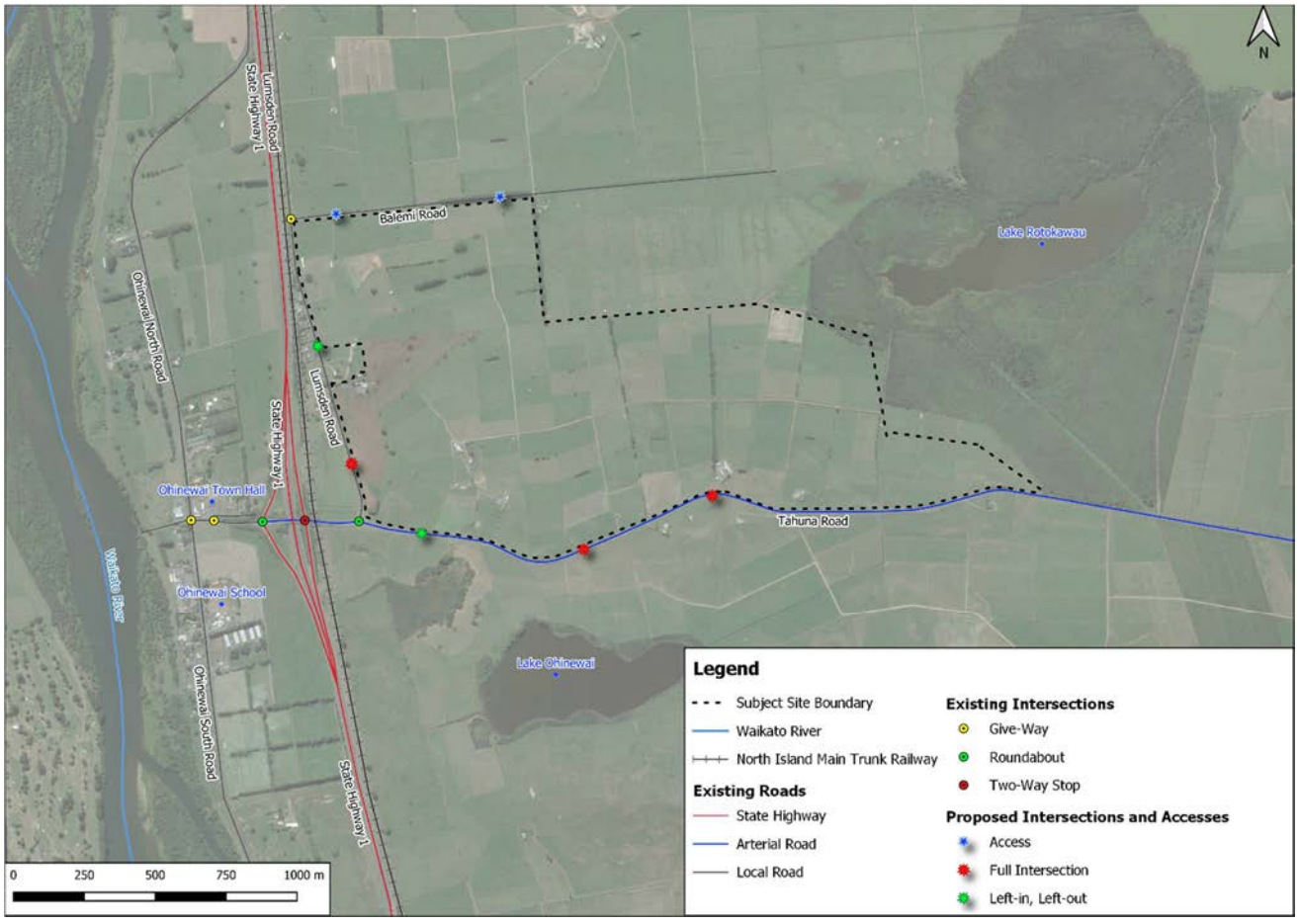

Figure 2-1: External Road Network surrounding the Site

A summary of the main characteristics of each road is provided in Table 3.1 below.

Table 2-1: Road network characteristics

	Balemi Road	Lumsden Road	Tahuna Road	SH 1 Ohinewai Interchange Ramps			
				Northbound On-ramp	Northbound Off-ramp	Southbound On-ramp	Southbound Off-ramp
Road Class[1]	Local Road	Local Road	Arterial Road	National State Highway Network			
Sealed/ Unsealed	Unsealed	Sealed	Sealed	Sealed	Sealed	Sealed	Sealed
Carriageway Width (m)	4.5m	6.6m	8m	7.1m	7.3m	7.1m	7.3m
Number of lanes	1	2	2	1	1	1	1
Speed Limit (km/h)	50	100	100	100	100	100	100
Operating Speed[2] (km/h)	No data	81.0[3]	61.6[4]	74.5[5]	63.5[6]	66.2[7]	68.0[8]

These are discussed in more detail in the following sections.

2.2.1. SH1 Ohinewai Interchange

Given the close proximity of the site to SH1 and the location of other populated areas (Hamilton, Huntly, Te Kauwhata and Auckland) access to the site from the wider road network will be primarily via the SH1 Ohinewai Interchange.

The SH1 Ohinewai Interchange ramps form part of the national state highway network built and maintained by the NZ Transport Agency (NZTA). The on- and off-ramps each provide a single traffic lane with shoulders over a seal width of approximately 7.1m and 7.3m respectively.

The eastern intersection of the interchange is controlled with a Compulsory Stop on the southbound off- ramp, while the western intersection is a 4-leg single circulating lane roundabout with two-way traffic flow on the Tahuna Road approaches only (refer to Figure 2-2).

[1] Based on the Waikato District Council (WDC) Operative District Plan
[2] 85th Percentile speed figures are based on surveyed speed data that was collected over a 15-day period in August 2019 for purposes of this project
[3] Vehicle speeds measured approximately 120m north of the Tahuna Rd & Lumsden Rd intersection
[4] Vehicles speeds measured approximately 90m west of the Tahuna Rd & Lumsden Rd intersection
[5] Vehicle speeds measured approximately 100m north of the western ramp intersection
[6] Vehicle speeds measured approximately 100m south of the western ramp intersection
[7] Vehicle speeds measures approximately 120m south of the eastern ramp intersection
[8] Vehicle speeds measured approximately 120m north of the eastern ramp intersection

The operating speed[9] along the SH1 Ohinewai interchange ramps ranges between 63km/h and 75km/h, with the highest speeds on the interchange recorded on the northbound on-ramp.[10]

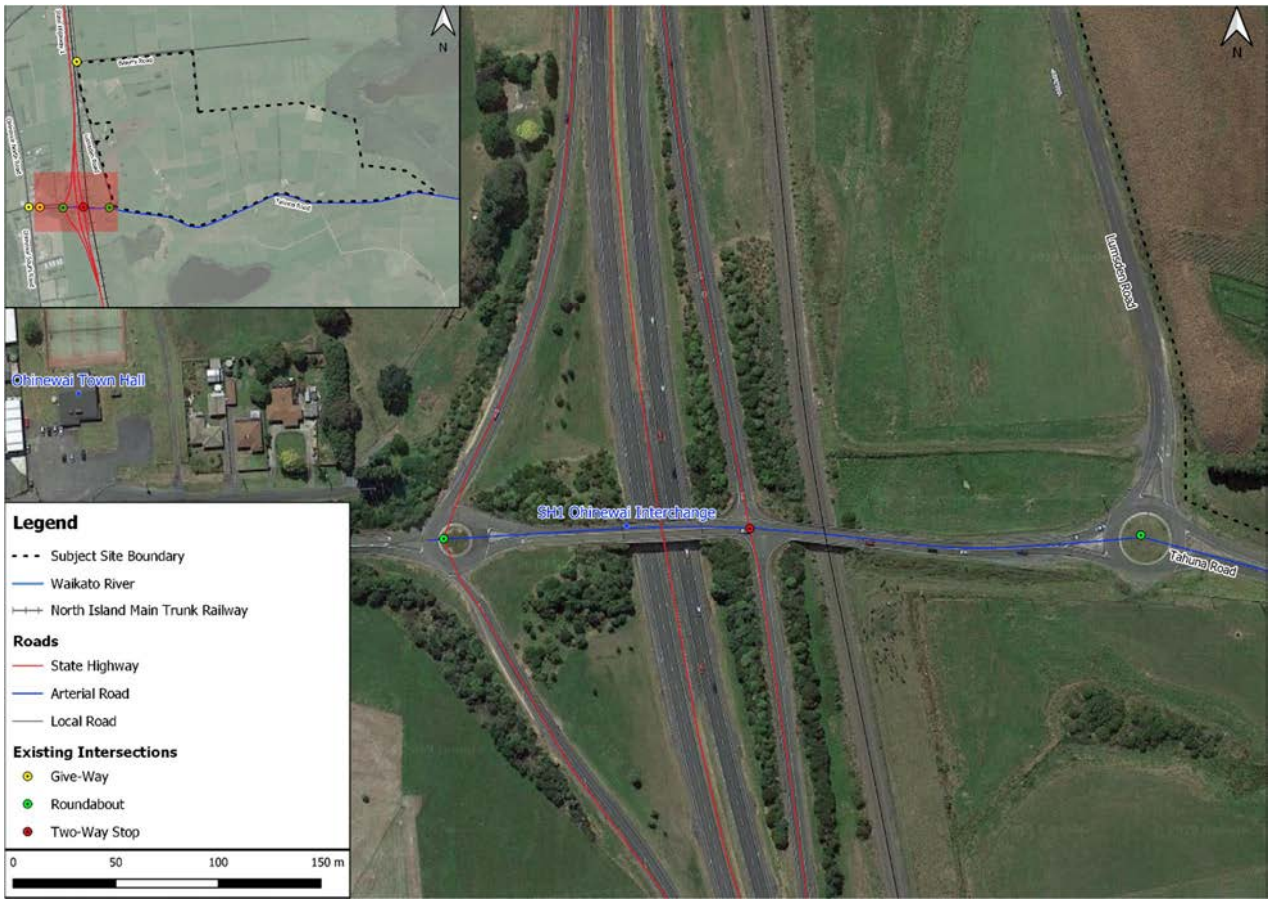

Figure 2-2: External Road Network - SH1 Ohinewai Interchange

2.2.2. Tahuna Road

As shown in Figure 2-1, all traffic to the proposed development will use Tahuna Road to either access the site directly, or to access the site via Lumsden Road and Balemi Road. Both Lumsden Road and Balemi Road are 'no exit' roads.

Tahuna Road is classified as an Arterial road in the Operative Waikato District Plan, providing east-west connectivity within the district, including a connection between SH1 and SH27 that is also used as a detour route by the NZTA. The two-lane road currently has a sealed carriageway width of approximately 8m with 0.5m wide sealed shoulders on both sides of the road (refer to Figure 2-3).

The current operating speed[11] along the section of Tahuna Road for the section of Tahuna Road between Lumsden Road and the SH1 interchange was recorded as 61.6km/h; this is

[9] 85th Percentile speed figures are based on surveyed speed data that was collected over a continuous 15-day period in August 2019 for purposes of this study

[10] Vehicles speeds were measured approximately 100m north of the western ramp intersection

[11] 85th Percentile speed figures are based on surveyed speed data that was collected over a continuous 15-day period in August 2019 for purposes of this report. Vehicle speeds were measured approximately 90m west of the Tahuna Rd & Lumsden Rd intersection

within the 100km/h posted speed limit of the road. The low speed along this section of Tahuna Road is largely due to the configuration of the Tahuna Road & Lumsden Road intersection (i.e. roundabout configuration) and the proximity of the SH1 interchange ramp intersections.

The operating speed for the section of Tahuna Road to the east of Lumsden Road intersection varied due to the winding road alignment; an 85th percentile speed of 95km/h was recorded for the section just east of the intersection with Lumsden Road, while an 85th percentile speed of 77km/h was recorded for the section of Tahuna Road near the south-eastern boundary of the proposed development. The operating speeds of the section of Tahuna Road that is bordered by the proposed developed are all within the 100km/h speed limit of the road.

Figure 2-3: Existing Road Network - Tahuna Road

2.2.3. Lumsden Road

Lumsden Road is classified as a Local Road in the Operative Waikato District Plan. This no-exit road runs along the western boundary of the site and is accessed via Tahuna Road in the south. The road currently provides access to a number of residential properties to the west of the subject site, as well as a number of commercial and industrial activities to the north of the subject site, including two timber processing plants and a house removal company yard.

The two-lane road has a seal width of approximately 6.6m and the following shoulder treatments:

- A kerb and channel on the western carriageway boundary and an earth drain/swale on the eastern carriageway boundary along the section of the road that traverses through the existing residential properties (refer to Figure 2-4), and
- Earth drains/swales on both sides of the road along the section of the road between Tahuna Road and the start of the existing residential properties (refer to Figure 2-5).

The current operating speed was recorded as 81km/h[12] between Tahuna Road and Balemi Road, which is a 100km/h posted speed limit section of road.

Figure 2-4: External Road Network - Lumsden Road looking north (section of the road past the existing residential properties)

Figure 2-5: External Road Network - Lumsden Road looking south (section of the road through the undeveloped southern section)

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Vehicle speeds were measured approximately 120m north of the Tahuna Rd & Lumsden Rd intersection

2.2.4. *Balemi Road*

Balemi Road runs along the northern boundary of the site. This no-exit road is accessed via Lumsden Road and currently provides access for a single farm property. The road is currently unsealed with an approximately 4.5m wide carriageway (refer to Figure 2-6). Because of the road's narrow width, two heavy vehicles would not be able to pass each other.

As shown in Figure 2-6, the road is currently in a poor condition, with potholes observed[13] at several locations along the road.

Figure 2-6: External Road Network - Balemi Road looking east

2.3. External Road Network Traffic Demand

2.3.1. *2019 Traffic Demand*

The current traffic demand on the local road network was derived from classified vehicle count data that was collected using automatic tube counters over a 15-day period between the 12th and 28th August 2019.

In addition to the automatic tube counters, turning movement surveys were conducted on Thursday, 8th August 2019 during the morning (07:00 to 09:00) and afternoon (16:00 to 18:00) periods, and Saturday, 17th August 2019 during the midday period (11:00 to 14:00) at the following intersections:

- SH1 Ohinewai interchange ramp intersection - western leg;
- SH1 Ohinewai interchange ramp intersection - eastern leg, and
- Tahuna Road and Lumsden Road intersection.

A summary of the local road network traffic characteristics is provided in Table 2-2 below.

[13] A site investigation was undertaken on the 7th August 2019 to observe the existing road environment, traffic operations and land-use environment within the vicinity of the site

Table 2-2: Local Road Network - 2019 Traffic Volumes

Road Section		Average Daily Traffic (ADT) (vpd)	% HCV (%)	Peak Hour Volume (vph)
Balemi Road		No data	No data	No data
Lumsden Road		555	16%	85
Tahuna Road		2,250	16%	245
SH1 Ohinewai Interchange Ramps	Northbound On-ramp	850	10%	90
	Northbound Off-ramp	445	9%	55
	Southbound On-ramp	490	9%	65
	Southbound Off-ramp	920	15%	125

The following information relates to the collected traffic data:

- The road network peak periods were between 08:00 and 09:00 for the AM peak, between 16:45 and17:45 for the PM peak, and between 11:00 and 12:00 for the Saturday peak.
- Lumsden Road has an ADT of 555 vehicles per day (2019) with heavy vehicles making up approximately 16% of the daily traffic. Approximately 15% of the daily traffic on Lumsden Road occurred during the peak hour.
- The section of Tahuna Road between SH1 and Lumsden Road has an ADT of 2,250 vehicles per day with 16% HCV. Just over 10% of the daily traffic occurred during the peak period.
- The major vehicle movements at the SH1 Ohinewai interchange were to/from north of Ohinewai (i.e. along the northbound on-ramp and the southbound off-ramp). Just over 65% of the daily traffic (ADT) at the interchange was recorded along these ramps (i.e. 65%:35% split for the northbound and southbound directions).

The 2019 traffic volumes for the AM and PM peak periods are shown in Figure 2-7 and Figure 2-8 respectively.

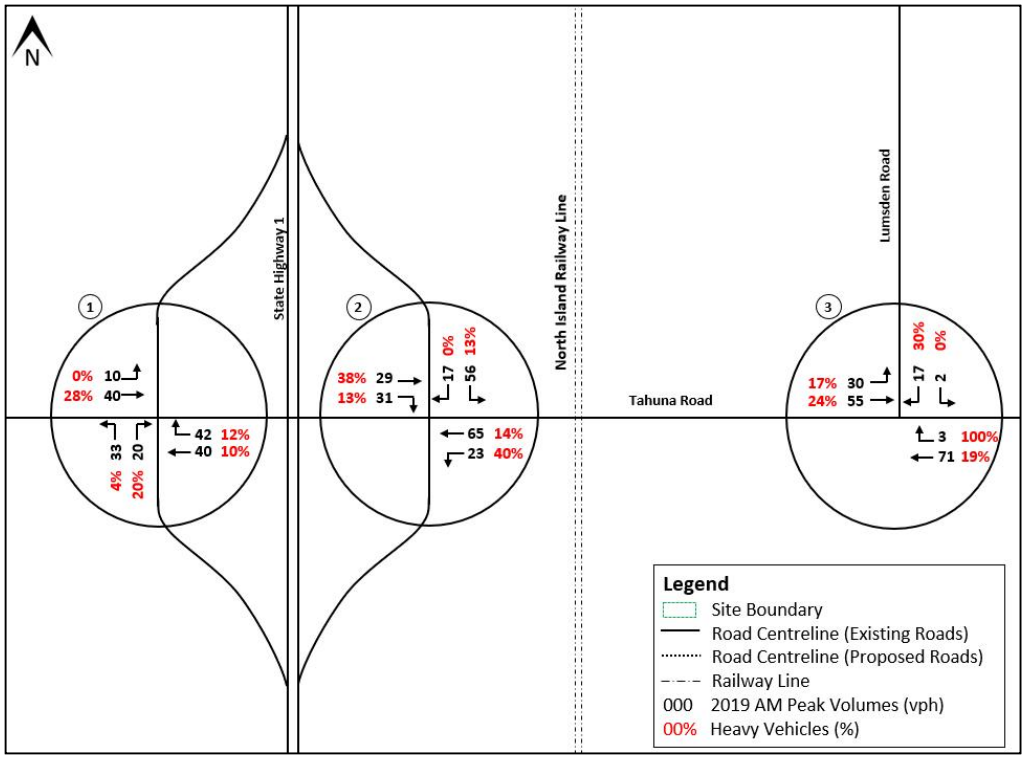


Figure 2-7: External Network Traffic Volumes - 2019 AM Peak Hour

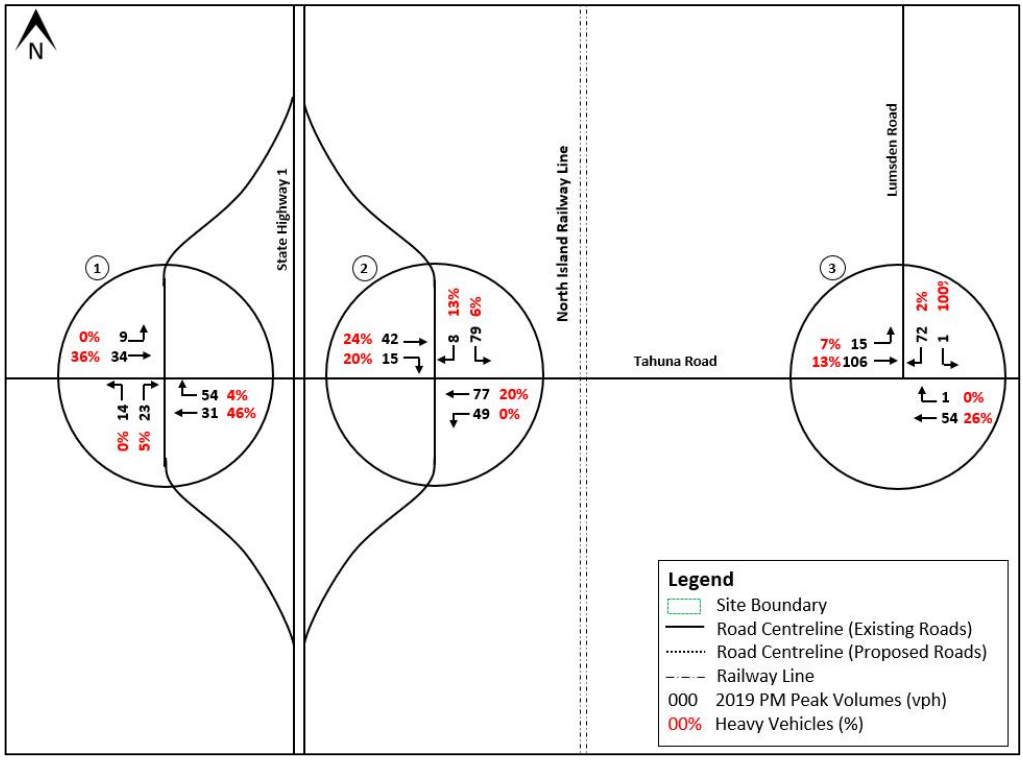


Figure 2-8: External Network Traffic Volumes - 2019 PM Peak Hour

2.3.2. *Future Traffic Demand*

The NZTA Research Report 422 (Integrated Transport Assessment Guidelines, 2010) states that:

> *"…where a comprehensive transportation study has been undertaken on a metropolitan or area-wide basis, especially as part of an urban development or growth study, then sufficient information or suitable guidance may be available to enable network travel conditions to be predicted 20 or even 30 years ahead. However, if such long-term information has not been predicted or no information is available (the case in many areas, especially smaller communities), some practical assumptions must be made from today's knowledge as to a suitable assessment year. Where no validated and comprehensive regional transportation forecasts are available, then the assessment year should not be more than 10 years ahead, given the uncertainty or predicted development and the construction of transport infrastructure after this time*."

Based on the above paragraph, and the existence of the Waikato Regional Traffic Model (WRTM) which provides trip forecasts up to 2051, a 20-year assessment period will be applicable. At the time of writing this draft report, the WRTM's validated 2031 and 2041 traffic projections for the local road network accounting for this site were not available. In the absence of the WRTM's traffic volumes a 10-year assessment period, which is based on the historic traffic growth on the adjacent road network, was used.

A 2031 future year assessment was considered instead of 2029 (application year plus 10 years) in line with the WRTM's assessment periods. The 2031 Baseline traffic volumes were derived from the 2019 traffic count data and factored using the historic traffic growth on the adjacent road network. According to the historic traffic count data, which was sourced from the NZTA and WDC, the traffic on the adjacent road network grew at an average rate of 3% per annum over the last 10-year period (2008 to 2019). The estimated future traffic demands based on the estimated annual traffic growth figure of 3% are shown in Table 2-3 below.

Table 2-3: Existing Road Network - Estimated Baseline 2031 Traffic Volumes

Road Section		2031 ADT (vpd)	2031 Peak Hour Volume (vph)
Lumsden Road		790	120
Tahuna Road		3,210	350
SH1 Ohinewai Interchange Ramps	Northbound On-ramp	1,210	130
	Northbound Off-ramp	635	80
	Southbound On-ramp	700	95
	Southbound Off-ramp	1,310	180

The estimated Baseline 2031 traffic volumes for the AM and PM peak periods are shown in Figure 2-9 and Figure 2-10 respectively. These have been derived from existing volume ratios.

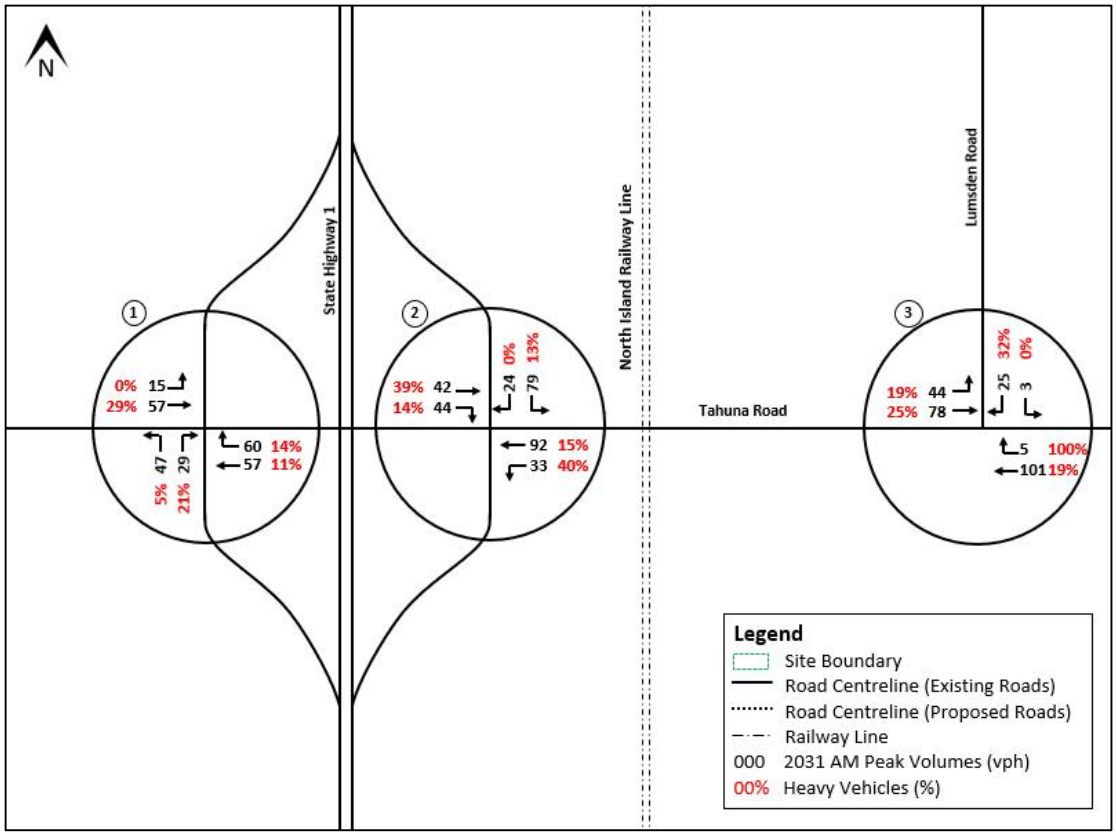


Figure 2-9: Estimated 2031 Traffic Volumes – AM Peak Hour

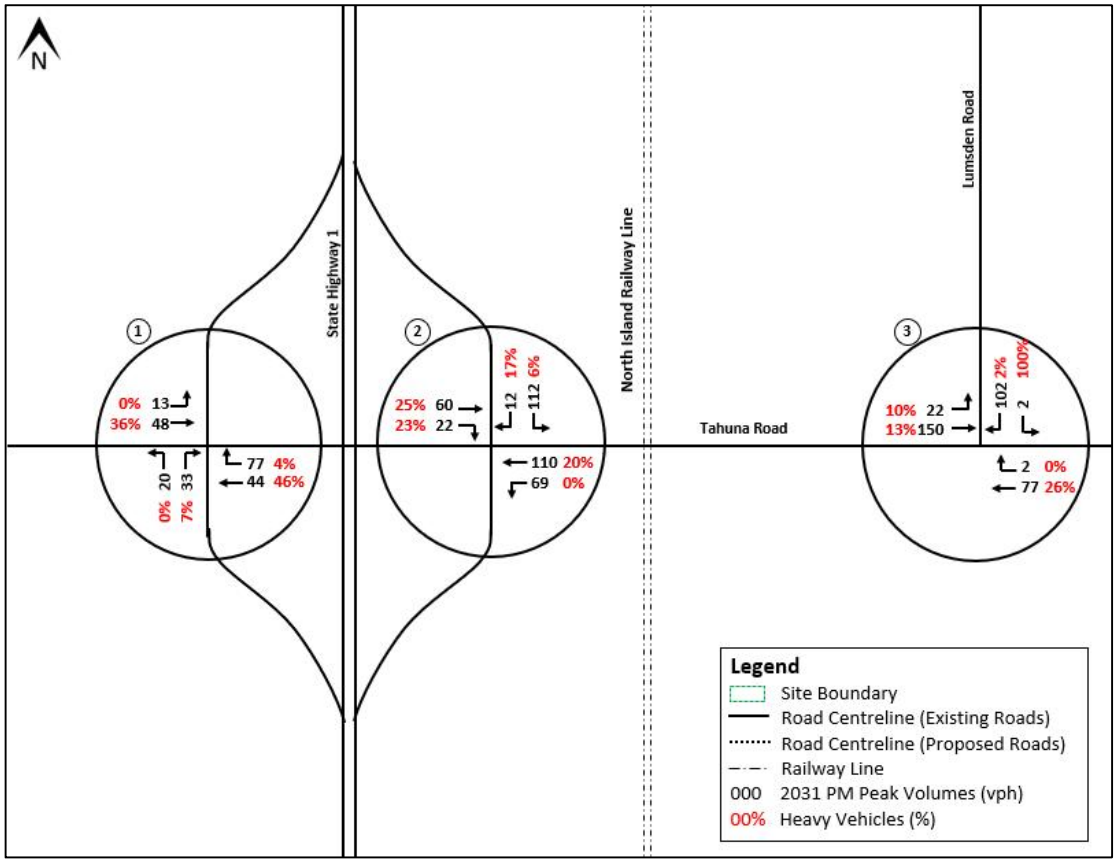


Figure 2-10: Estimated 2031 Traffic Volumes - PM Peak Hour

The estimated baseline traffic demands in Table 2-3 do not take into account any future changes to the wider road network (e.g. the implementation of the Waikato Expressway through Huntly), or future planned land uses changes/developments in the vicinity of the proposed Sleepyhead Estate Development and the wider Waikato area.

Work is proceeding at the current time to validate a 2019 WRTM in the vicinity of Ohinewai, including Te Kauwhata to the north and Huntly to the south. This will be used as a basis to inform and compare the 2031 and 2041 future year models that include the proposed Sleepyhead Estate land use.

Once available (in early 2020), the 2031 and 2041 traffic forecasts from the WRTM will be used to refine the estimated future traffic volumes provided in Table 2-3 and update sensitivity testing of effects. It is, however, expected that the estimated volumes provided in Table 2-3 will be higher than the 2031 WRTM traffic projections for the following reasons:

- With completion of the Waikato Expressway east of Huntly and Hamilton, a portion of the trips currently diverting via Tahuna Road to travel east (i.e. towards Tauranga) are expected to remain on the expressway and use alternative higher-order east-west connector roads to the south of Huntly, bypassing Tahuna Road completely.
- The planned Auckland-Hamilton passenger rail service, once implemented, may see an overall reduction in the number of private vehicle commuters along the corridor.

The estimated Baseline 2031 traffic volumes provided in Table 2-3 and in Figure 2-9 and Figure 2-10 respectively, can thus be seen as conservative.

2.4. Existing Transport Modes

2.4.1. Bus Services

Two bus services currently operate within the Ohinewai area (refer to Figure 2-11 to follow):

- The Northern Connector, a regional bus service operated by BUSIT, operates between Hamilton and Te Kauwhata. Only one bus stop, which is located at Ohinewai Town Hall west of SH1, has been provided in Ohinewai for this bus route. The bus service currently only stops in Ohinewai at the following times:
  - Northbound direction (Hamilton/ Huntly to Te Kauwhata) at 6.33pm daily (Monday to Friday – the service currently does not operate during weekends and public holidays), and
  - Southbound direction (Te Kauwhata to Hamilton/Huntly) at 7.02am daily (Monday to Friday – the service currently does not operate during weekends and public holidays).
- A local school bus service which is operated by GoBus Transport Ltd from Monday to Friday. The bus operates between Ohinewai School and the wider Ohinewai rural area. The service has a number of bus stops along Tahuna Road, two of which are located within a 2km radius of the site. One stop is located at the Ohinewai Town Hall and another is located at 440 Tahuna Road (east of the Tahuna Road and Lumsden Road roundabout) – a informal layby/ parking area is located at this location.

The existing bus stops that service the above-mentioned bus services are show in Figure 2-11 and Appendix A.

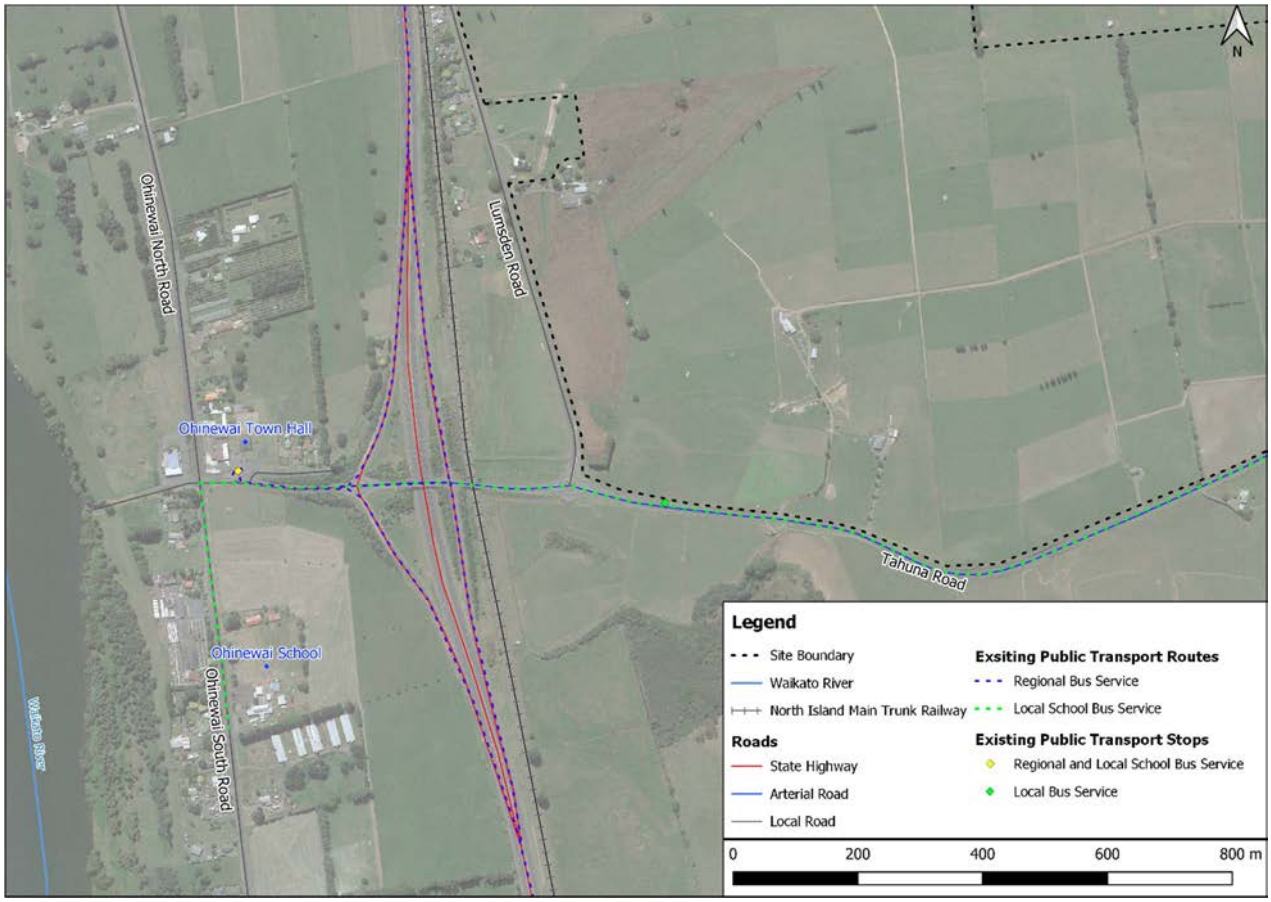


Figure 2-11: Existing Public Transport Operations in the vicinity of the site

2.4.2. Walking and Cycling

Given the current rural zoning in the area, very low volumes of pedestrians are expected to the east of the SH1 expressway and there are currently no existing pedestrian facilities in the area around Tahuna Road and Lumsden Road.

Cyclists are rarely observed in the area at present, although provision currently exists by way of cycle lanes on the shoulders of the SH1 expressway. No formal facilities have been provided for cyclists in Ohinewai or on Tahuna or Lumsden Roads.

3. Future Planned Transport Infrastructure

3.1. Future Planned Road Network

Construction of the Huntly section of the Waikato Expressway, which will connect the already completed Ohinewai section of the Expressway to the Ngaruawahia and Hamilton sections, is expected to be completed in early 2020. This section of the Expressway will bypass the Huntly and Taupiri townships to the south of the proposed development, significantly reducing congestion within the townships, improving safety and amenity for the community and providing for travel time savings, trip reliability and safety improvements on SH1.

Some change in the current observed travel patterns within the local and wider road network will likely occur once the construction of the Huntly section is completed. These changes, however minor, may affect the current operations at the SH1 Ohinewai Interchange.

3.2. Future Transport Modes

The following transport related initiatives have been identified in the Waikato District Blueprint (2019) for the Ohinewai area (refer to Figure 3-1 and Appendix A):

- Improved public transport accessibility amongst the community, including ensuring that reliable and meaningful public transport services are provided to support commuters.
- Upgrading existing cycling links along the SH1 expressway by providing cycling paths/ tracks along the Waikato River and Ohinewai South Road.
- Improving east-west connectivity for pedestrians and cyclists across the Waikato Expressway. This may require an additional bridge structure over the expressway.

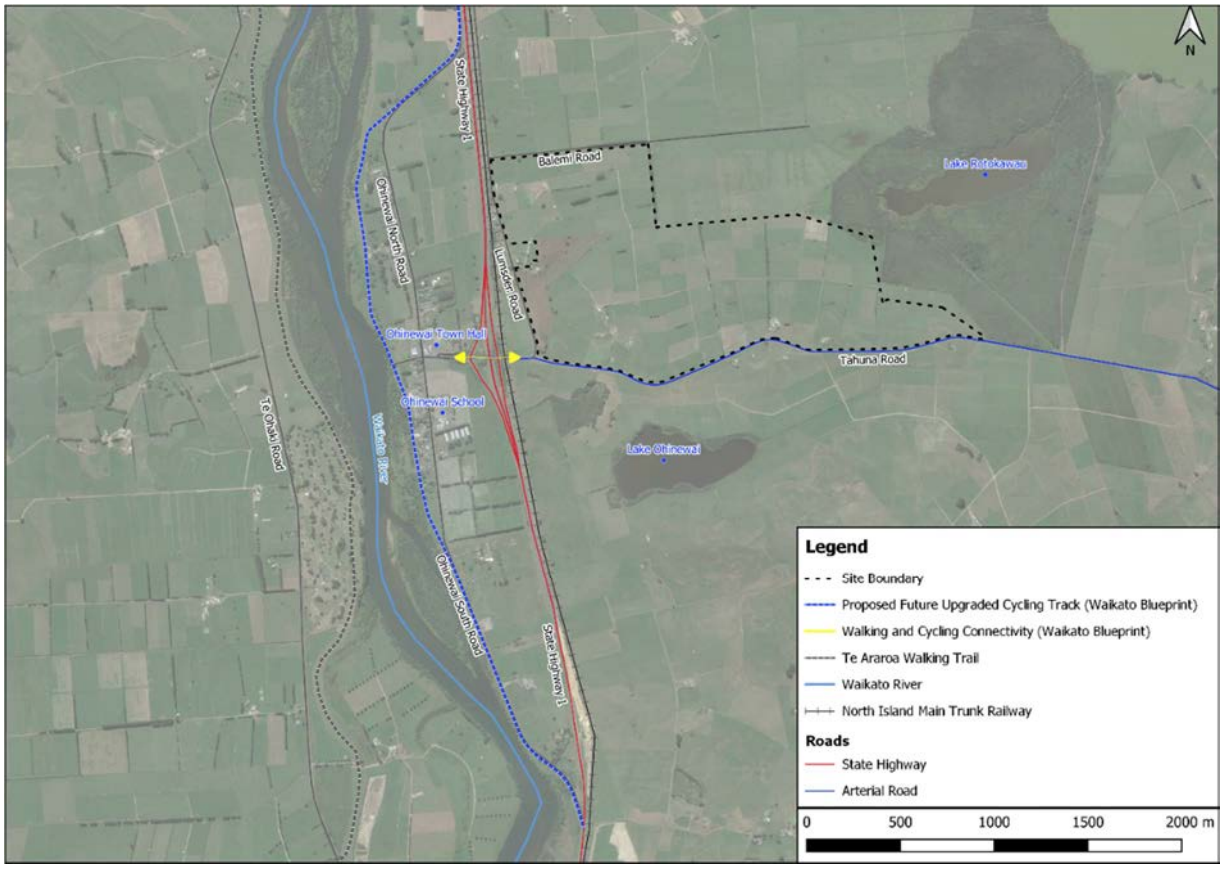


Figure 3-1: Future Planned Walking and Cycling Infrastructure (Source: Waikato Blueprint Report, 2019)

4. Road Safety Environment

Crash data for the previous ten years (2008 to 2019) was sourced from the New Zealand Transport Agency Crash Analysis System (CAS) and analysed to identify any road safety related issues within the vicinity of the proposed development.

Figure 4-1 (also provided in Appendix A) below provides heatmaps indicating the location and severity of crashes recorded on the adjacent road network within the vicinity of the proposed development over this period.

As shown in Figure 4-1, a significant number of crashes were recorded at the SH1 Ohinewai Interchange eastern ramp intersection, the majority of which were minor crashes. Other crash locations included the intersection of Tahuna Road and Lumsden Road, as well as at a number of horizontal curves located on Tahuna Road. Full crash records for each of the locations which were studied is provided in Appendix B.

The sections to follow provide the key observations made during the analysis of the crash data.

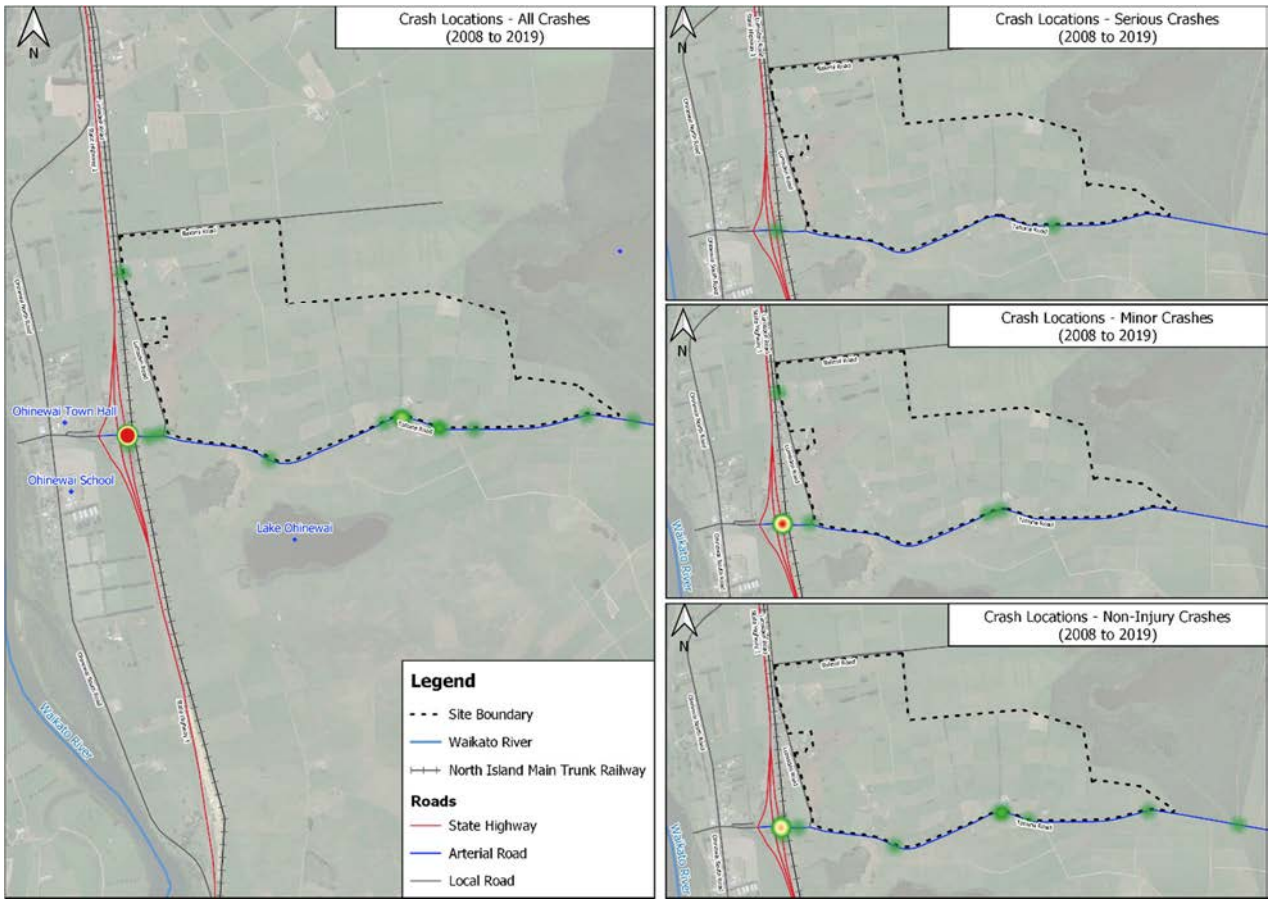


Figure 4-1: Crash locations within the vicinity of the site (2008 to 2019)

4.1. Intersections

A summary of the crash data recorded at external intersections located within the vicinity of the site is provided in Table 4-1 below.

Table 4-1: Crash summary for the previous ten years (2008 to 2019) - Intersections

Intersection	Crash Severity				Total No. of Crashes
	Fatal	Serious	Minor	Non-Injury	
SH1 Ohinewai Interchange Ramp Intersection - Western Leg	0	0	0	0	0
SH1 Ohinewai Interchange Ramp Intersection - Eastern Leg	0	1	7	6	14
Tahuna Road & Lumsden Road	0	0	1	1	2
Lumsden Road & Balemi Road	0	0	0	0	0
Total	0	1	8	7	16

The following observations were made during the analysis of the crash data:

- A total of 14 crashes were recorded at the eastern intersection of the SH1 Ohinewai Interchange in the previous ten years: one was a serious crash, seven were minor

crashes and six were non-injury crashes. Of the 14 crashes that were recorded at this intersection:

- 13 crashes were caused by drivers traveling on the southbound off-ramp that failed to stop at the stop-controlled intersection. Of these crashes, six resulted in the vehicle colliding with a moving vehicle travelling on Tahuna Road, while the remaining seven crashes resulting in the vehicle colliding with roadside barriers.
- One crash was as a result on a driver being distracted and losing control while turning left from Tahuna Road and onto the southbound on-ramp. The vehicle collided with roadside barriers.
- On the basis of the NZTA High Risk Intersection Guide (HRIG) assessment, the risk ratings for this intersection are "High" personal risk (DSIs = 175 per 100 million veh-kms), and "High" collective risk (DSI equivalents = 3.35).

- The two recorded crashes at the Tahuna Road & Lumsden Road intersection were caused by drivers losing control while navigating the roundabout during inclement weather conditions. Only one person sustained minor injuries as a result of crashes at this intersection.
- The risk ratings for this intersection are "Medium-High" personal risk (DSIs = 19 per 100 million veh-kms), and "low-Medium" collective risk (DSI equivalents = 0.3).

4.2. Road Corridors

A summary of the crash data recorded on the adjacent road corridors located within the vicinity of the site is provided in Table 4-2 to follow.

Table 4-2: Crash summary for the previous ten years (2008 to 2019) - Road Corridors

Road Section	Crash Severity				Total No. of Crashes
	Fatal	Serious	Minor	Non-Injury	
Tahuna Road between SH1 and Lumsden Road	0	0	0	0	0
Tahuna Road to the east of Lumsden Road	0	2	7	10	19
Lumsden Road between Tahuna and Lumsden Road	0	0	1	0	1
Total	0	2	8	10	20

The following observations were made during the analysis of the crash data:

- A total of 19 crashes were recorded along Tahuna Road as follows:
- 13 were single vehicle crashes were a driver lost control of the vehicle while navigating a bend. One of these crashes resulted in a serious injury, while five of these crashes resulted in minor injuries.
- Two crashes occurred as a result of a driver attempting to overtake/ being overtaken with limited sight. One of these crashes resulted in the driver sustaining minor injuries.

- Two crash occurred during inclement weather conditions were the visibility was poor and poor drainage on the road surface.
- One crash was a result of a lost load which resulted in a rear end collision while the vehicle slowed down to pick-up lost load.
- One crash was as a result of a driver colliding with a stationary vehicle which had stopped in the road shoulder. The driver sustained serious injuries.
- On the basis of the NZTA High Risk Rural Road Guide (HRIG) assessment, the risk ratings for this road section are "Medium-High" personal risk and "Medium-High" collective risk.

- The crash recorded on Lumsden Road was as a result of a driver losing control while navigating the horizontal curve located approximately 190m south of the Balemi Road intersection. The driver sustained minor injuries. On the basis of the NZTA High Risk Rural Road Guide (HRIG) assessment, the risk ratings for this road section are "Low" personal risk, and "Low" collective risk.

5. Proposed Re-Zoning & Structure Plan

5.1. Proposed Land Use Zoning

The proposed zoning and associated land uses are outlined in the Structure Plan and Zoning Plan as included as Appendix A and illustrated in the Masterplan in Figure 1-2.

The mixed-use development will comprise of industrial, business/ commercial and residential, land uses. A significant part of the development will be open space including stormwater management provisions, community facilities and ecological enhancement areas.

To inform trip generation, a summary of the indicative development within the Structure Plan area is provided in Table 5-1 below.

Table 5-1: Proposed Development Areas

Land Use	Description	Land Use Area		Estimated Yield	
		Amount	Unit	Amount	Unit
Industrial	Manufacturing Factory (to employ up to 1,500 people)	222,420	m^2	100,000	GFA m^2
	Light Industrial Lots (to employ 1 staff member per 200m^2 GFA)	323,100	m^2	133,000	GFA m^2
Commercial	Service Station and Convenience store	27,040	m^2	13,515	GFA m^2
	Retail Outlet Centre (to employ 1 staff member per 150m^2 GFA)	56,200	m^2	28,100	GFA m^2
	Community Corner Shop	630	m^2	315	GFA m^2
Community	Community Building	3,020	m^2	1,510	GFA m^2

Residential	General Density (Detached Units)	135,240	m^2	375	Dwelling Units
	Medium Density (Attached Units)	185,570	m^2	725	Dwelling Units

5.2. Proposed Speed Environment

An assessment of safe and appropriate speed on the external road network as a result of the increased traffic movements (vehicles, pedestrians and cyclists) that are expected to be generated by the proposal showed that the speed limits on the adjacent road network would be more suited to the following speed framework as set out in the following sections (refer to Figure 5-1 and Appendix A).

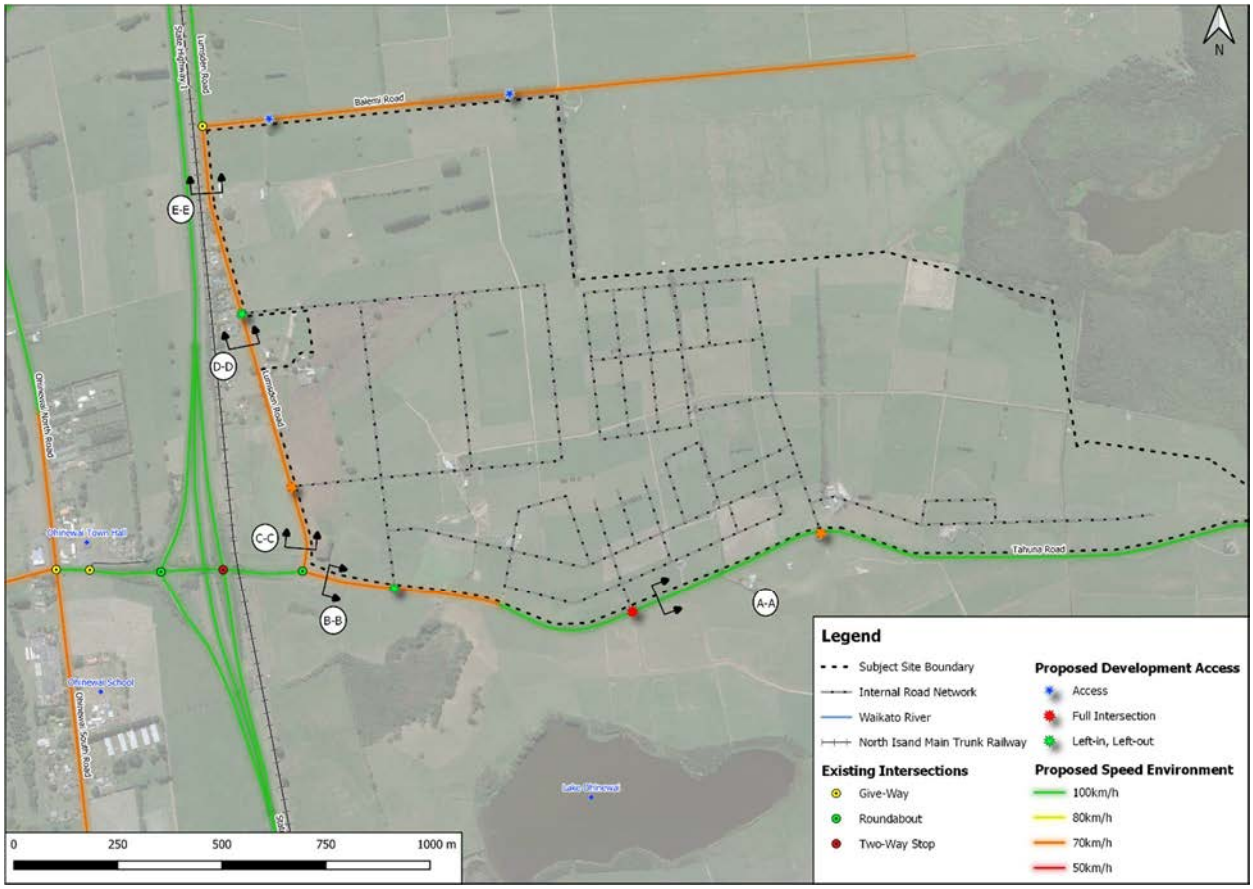


Figure 5-1: Proposed Speed Environment

5.2.1. Tahuna Road

The road environment along Tahuna Road (District Arterial) is expected to change from a rural to a semi-urban environment. The proposal is that the speed limit along the semi-urban section of the road would be changed from the existing 100km/h to 70km/h in line with the NZTA's Speed Management Guide (First Edition, 2016) and NZTA's Road and Traffic Standards (RTS) Series 17 (Setting Speed Limits).

Figure C-1 in Appendix C provides the proposed future cross-sections on Tahuna Road which are in line with the proposed speed environment. The following modifications to this road section include:

- Provision of a kerb and channel shoulder treatment along the eastbound carriageway (i.e. on the side of the road bordering the proposed development).
- Provision of a shared path along the eastbound carriageway, which is separated from the road by a 4.5m wide planted/grassed berm with street lighting.

5.2.2. *Lumsden Road*

The road environment along the site's western boundary is proposed to change from a rural character to an urban industrial environment, while the west side of the road would remain as existing with numerous residential dwellings fronting the road.

Given that the character would effectively be urbanised, it is proposed that the speed limit along the road frontage of the site reduce from the existing 100km/h to 70km/h. Figure C-2 in Appendix C provides the proposed future cross-sections on Lumsden Road which are in line with proposed speed environment. The following changes to the road cross-section are proposed:

- Provision of a 0.5m wide sealed shoulder and kerb & channel treatment along the southbound carriageway (i.e. on the side of the road bordering the proposed development).
- Provision of a shared walking and cycling path along the southbound carriageway, which is separated from the road by a 2.0m wide planted berm.

5.2.3. *Balemi Road*

The road environment along the southern boundary of Balemi Road is proposed to change from a rural to industrial environment. Given this change, it is proposed that the speed limit along the road be change from the existing 100km/h to 70km/h. Provision of a 0.5m wide sealed shoulder and kerb & channel treatment along the westbound carriageway (i.e. on the side of the road bordering the proposed development) is proposed.

5.3. Proposed Road Accesses

As shown in Figure 5-2 below, and the Structure Plan (Appendix A), access to the site is proposed via new accesses on Tahuna Road, Lumsden Road, and Balemi Road as follows:

- The primary access for the industrial hub will be via Lumsden Road (i.e. Access 4 and Access 5 as shown in Figure 5-2), with Access 1 on Tahuna Road providing secondary access for the industrial lots.
- The primary access for the central and eastern residential areas will be via Tahuna Road (i.e. Access 2 and Access 3 as shown in Figure 5-2).
- The primary access for the commercial areas within the development will be via Access 1 on Tahuna Road, and Access 4 on Lumsden Road.
- Access 6 and Access 7 will provide direct access to the industrial lots and the rail siding to the north of the proposed development.

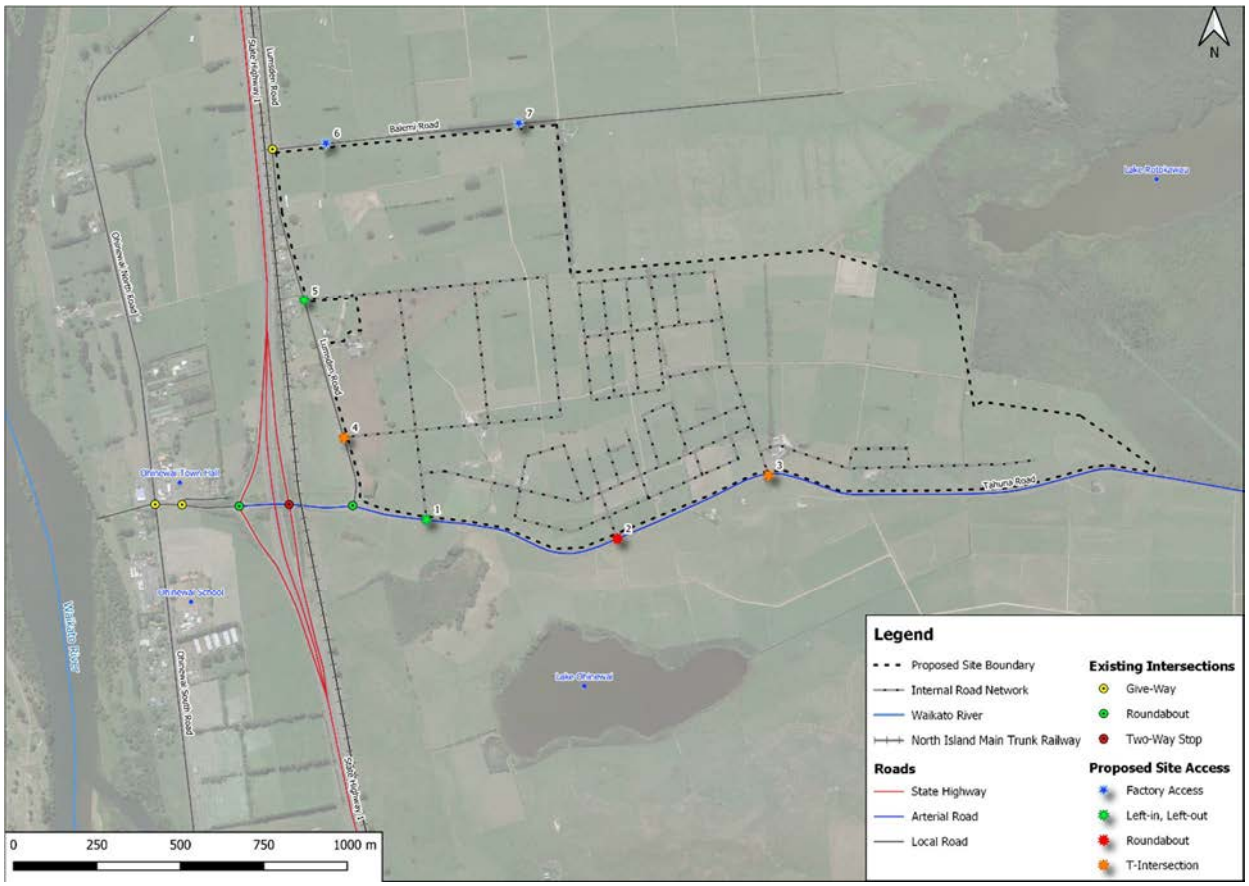


Figure 5-2: Proposed Site Access Locations

5.3.1. Access Configuration

The following preliminary configurations are proposed for each access (refer to Appendix D for the preliminary access configurations):

- Access 1: Left-in, left out access with a raised median to prevent right turn movements into/ out of the access (refer to Figure D-1 in Appendix D).
- Access 2: Single lane roundabout (refer to Figure D-2 in Appendix D).
- Access 3: T-intersection (give-way control) with a right turn median treatment (refer to Figure D-3 in Appendix D). Given the 100km/h speed environment at this location, an auxiliary left-turn lane has been provided for the western approach.
- Access 4: T-intersection (give-way control) with a right turn median treatment (refer to Figure D-4 in Appendix D).
- Access 5: Left-in, left out access (refer to Figure D-5 in Appendix D).
- Proposed Access 6: Private commercial vehicle access.
- Proposed Access 7: Private commercial vehicle access.

5.3.2. Sight Distance

The District Plan refers to the Austroads' Guide to Road Design document (Table 3.2 in Part 4A: Unsignalised and Signalised Intersections) for the minimum required safe sight distances at intersections. An assessment of the sight distance against these minimum requirements

showed that all but one access does not fully comply with the minimum sight distance requirements (the assessment was based on the existing speed environment). The sightlines looking west at Proposed Access 2, the proposed single-lane roundabout on Tahuna Road, is obstructed by a horizontal curve located less than a 100m from the access (refer to Figure 5-3).

Figure 5-3: Observed sightlines at Proposed Access 2 - looking west (Source: Google Street View)

The limited sightlines at this access can be significantly improved by changes to the horizontal alignment to the west of the intersection (refer to Figure D-2 in Appendix D for an illustration of the improved road alignment). With this improvement, the access is expected to meet the minimum sight distance requirements.

5.3.3. Separation

An assessment of the access separation against the WDC's access spacing requirements showed that all but one access will meet the minimum access spacing requirements. Proposed Access 5 is separated by approximately 70m to the nearest access on the same side of the road, and by approximately 20m to the nearest accesses on the opposite side of the road (there is also an existing access located directly across from the proposed access).

The 20m access spacing does not comply with the WDC's separation requirements which requires a separation of at least 80m for the existing speed environment (i.e. 80km/h). The access will likely generate approximately one vehicle movement per peak hour each based on typical trip generation rates of a residential dwelling. This small amount of traffic is unlikely to cause regular conflict with traffic from the site. Implementing a left-in, left-out configuration (no right turns) at Access 5 will also lessen any impact on adjacent accesses.

5.4. Rail Siding Access

5.4.1. Lumsden Road Alignment

Given the close proximity of the proposed development to the North Island Main Trunk railway (NIMT), a rail siding is proposed which will link the proposed industrial hub to the NIMT. The proposed alignment of the rail siding will cross Lumsden Road at-grade.

With the implementation of the rail siding, an s-bend will be required on Lumsden Road between the rail crossing and Balemi Road to ensure that the road and rail cross at a safe angle (i.e. between 70 degrees and 110 degrees as per KiwiRail's Engineering Services Standard document). The Balemi Road intersection will also be reconfigured to ensure that the two roads intersect at a safe angle with sufficient sight distance.

A conceptual layout of the proposed Lumsden Road alignment, which incorporates the proposed rail crossing, is shown in Figure G-1 in Appendix G. This design was based on the following standards and guideline documents and has been developed in collaboration with consultants for KiwiRail:

- Waikato Regional Infrastructure Technical Specifications (RITS) document;
- Austroads Guide to Road Design, and
- NZTA's State Highway Geometric Design Manual.

The horizontal alignment of the proposed S-bend on Lumsden Road has been developed with reference to the existing operating speed environment of 80km/h (refer Section 3.2.3). The design of the proposed horizontal curves was as follows:

- A 70km/h design speed for the two outer horizontal curves (160m curve radii with a 6% superelevation) to the north and south of the proposed rail crossing, and
- A 40 km/h design speed for the horizontal curve (45m curve radius with a 6% superelevation) to the immediate north of the proposed level crossing. Some road widening will be required at this bend to ensure that vehicles do not encroach onto the oncoming lane while navigating the bend.
- A 42.5m transition length has been provided between the two northern bends. This distance complies with the minimum transition length requirements specified in Austroads Guide to Road Design document.
- The bends were design with a 6% superelevation to compel drivers to slow down while navigating the bends.

5.4.2. Lumsden Road & Balemi Rd Intersection

The Lumsden Road & Balemi Road intersection was reconfigured as shown in Figure G-1 in Appendix G. A short section of Balemi Road was modified to ensure that Balemi Road intersects with Lumsden Road at a 90-degree angle. The following upgrades are also proposed related to the configuration and layout of Lumsden Road:

- That the T-intersection retain the existing give-way control due to the good sightlines that exist.

- The eastern leg of the intersection (i.e. Balemi Road) be upgraded (i.e. widened and sealed) to a minimum six-metre trafficable carriageway width.
- The rural intersection be formed in line with the requirements set out in the Waikato District Plan and the Regional Infrastructure Technical Specifications (RITS).

5.4.3. Level Crossing

The appropriate level crossing solution was assessed based on NZTA's Traffic Control Devices Manual (Part 9 Level Crossings). The manual specifies that the minimum requirement of any approach to a level crossing is a Give Way control in the following circumstances:

- If the approach visibility can be met, a Give Way sign must be installed.
- If the approach visibility cannot be met but the restart review (i.e. crossing visibility) can be met, a Stop sign is installed.
- If the approach visibility and restart review cannot be met, the crossing will need to be carefully assessed to determine whether active control is justified or changes to the operating conditions (e.g. restriction on road or rail speeds, limitations on vehicle lengths) need to be imposed.

The following minimum sight distances are required based on equations[14] provided in Appendix B of the NZTA Traffic Control Devices Manual (refer to Figure G-2 and Figure G-3 in Appendix G):

- Minimum required approach visibility = 68m for a vehicle travelling at 40km/h (i.e. southbound vehicles) and 71m for a vehicle travelling at 70km/h (i.e. northbound vehicles).
- Minimum required restart view (or crossing visibility) = 136m for a vehicle travelling at 40km/h (i.e. southbound vehicles) or 70km/h (i.e. northbound vehicles).

The manual also specifies the following maximum angles when approaching give way-controlled level crossings:

- To the left = 95 degrees, and
- To the right = 110 degrees.

The approach visibility for southbound vehicles looking east and west complies with the minimum requirement. The approach visibility for northbound vehicles looking to the east will likely not be met; the sightlines looking east are likely to be obscured by vegetation and the NZCG factory building. The angle of the level crossing also does not meet the maximum able requirements for give-way control. Based on this, the give-way control will not be suitable for the level crossing.

The restart review for southbound vehicles looking to the west will also not be met; because of the horizontal alignment of rail siding (150m radius bend), vehicles at the stop line will have to look over their shoulder in order to determine whether it will be safe to cross the level

[14] The calculations were based on the following:
- Design vehicle length = 25m
- Maximum train speed = 30km/h
- Angle between rail and road = 70-degrees

crossing. Based on this assessment, an active control level crossing with flashing lights, bells and barrier arms is recommended.

Figure G-4 in Appendix G provides an illustration of the typical control devices, road signage and road markings that are recommended for implementation for the level crossing. These include:

- Railway-activated control devices:
  - Flashing lights and bells (FLBs);
  - Half-arm barriers (HABs).
- Road signage:
  - Crossbuck sign (Standard WX6 sign);
  - Stop on Red Signal (RP61);
  - Level crossing ahead steam strain (WX1R and WX1L);
  - Level crossing ahead (WX3);
  - Level crossing alignment (WX40 and WX42);
- Road markings:
  - No -passing lines on all approaches to the level crossing, and
  - Pavement messages (e.g. rail x marking).

5.5. Proposed Transport Network and Hierarchy

An indicative network of internal roads to service the development has been developed as shown in Figure 5-4, in conjunction with the Structure Plan.

The internal roads are configured in a grid-network formation based around the site's geotechnical constraints, connectivity between the different land use areas, and connection to the existing external road network (Tahuna Road and Lumsden Road). The proposed development's internal road network will consist of the following collector and local roads:

- Collector roads:
  - Primary industrial road
  - Primary residential road
- Local roads:
  - Secondary industrial road
  - Secondary residential road, and
  - Low traffic volume residential street (cul-de-sac).

The street hierarchy has been designed to be logical, intuitive and legible. The configuration avoids the need for heavy traffic to use the residential streets while at the same time providing a high degree of connectivity between the land uses, including for active transport such as walking, cycling, scooters etc.

The primary residential circulation roads do not have any direct driveway accesses. These homes will be accessed by vehicles via rear lanes to assist with maximising lot areas and promoting pedestrian and cyclist connectivity and safety along the street.

While the Structure Plan reflects the network configuration, the finer details of the road network will be refined at future subdivision stages.

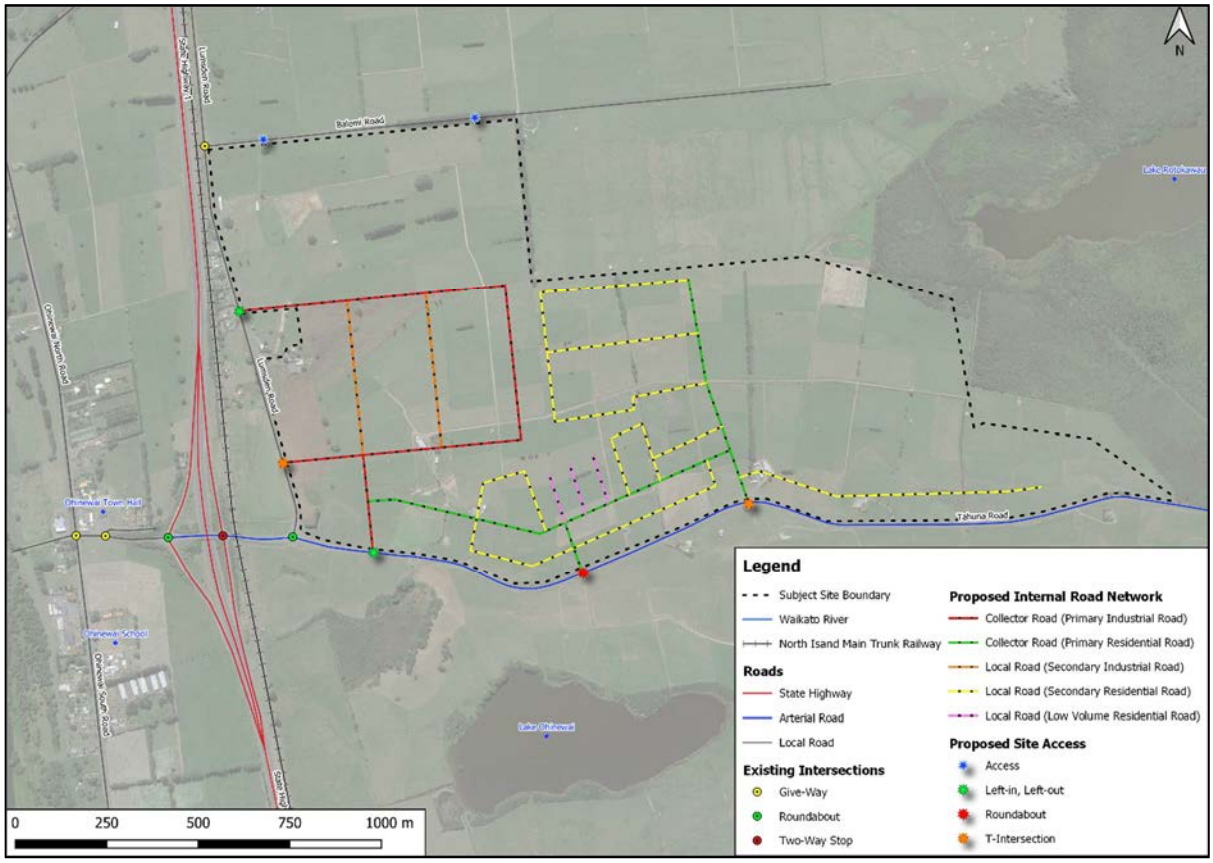


Figure 5-4: Sleepyhead Estate Street Hierarchy Plan

The indictive cross-sections of the proposed road classes are provided in Appendix C. The cross-section elements are summarised in Table 5-2 below.

Table 5-2: Summary of the Sleepyhead Estate Street Hierarchy Plan

Road Function	Estimated ADT (vpd)	Proposed Speeds	Road Reserve Width (m)	Carriage-way Width (m)	Services	Parking Provision	Pedestrians and Cyclists
Collector Roads							
Primary industrial road	3,500 - 4,500	50km/h	21.5	8.0	Provided on both sides – 1.5m berm	Not provided/ Off-street parking.	2.5m Shared paths provided on both sides
Primary residential road	2,000 – 3,000	50km/h	20.0	6.0	Provided on both sides – 2.0m	On-street parking on both sides	2.5m Shared paths provided on

Road Function	Estimated ADT (vpd)	Proposed Speeds	Road Reserve Width (m)	Carriage-way Width (m)	Services	Parking Provision	Pedestrians and Cyclists
					berm		both sides
Local Roads							
Secondary industrial road	500 - 2,500	40km/h	21.5	8.0	Provided on both sides – 1.5m berm	Not provided/ Off-street parking.	2.5m Shared paths provided on both sides
Secondary residential road	500 – 1,500	40km/h	17.0	6.0	Provided on both sides – 1.5m berm	On-street parking on both sides	1.5m footpaths provided on both sides. Cyclists to share carriageway space.
Low traffic volume residential street (cul-de-sac)	<500	30km/h	14.0	5.5 (shared carriageway)	Provided on both sides – minimum 1.5m berm	On-street parking provided on one side	1.5m footpath provided on one side. Cyclists to share carriageway space.

The proposed cross-sections were assessed against WDC's access and road performance standards (Table 4 of Appendix A of the District Plan). The road design standards provided in Table 3.2 of the New Zealand Standard 4404 (NZS4404: Land Development and Subdivision Infrastructure) were also referenced during the assessment. The following was noted during the assessment:

- The primary and secondary industrial roads do not comply with the parking provisions set out in Appendix A of the District Plan which state that parking should be provided on both sides of road. However, it is proposed as a rule that sufficient off-street parking will be provided in the adjacent industrial lots. It is recommended that this requirement be enforced in the proposed zone rules.
- The local residential roads (i.e. secondary residential road and low volume streets) do not fully comply with the standards set out in Appendix A of the District Plan; the proposed road reserve width for both road classes is narrower than the required 20m. The narrower road reserve widths can, however, be justified as follows:
  - There is significant constraint with the limited land which is developable due to the geotechnical/ ground issues. The costs associated with stabilising this land is high, so the land needs to be used as efficiently as possible. In this regard, narrower road reserves widths are proposed to allow for more housing to be developed. The intended function of the two road classes (access) is not expected to be unduly impacted by the reduced road reserve width. The reduced width will promote safer speeds and thus a safer and more user-friendly environment for active transport.

- For the secondary residential road, the 17m wide road reserve is seen as adequate as all services and road furniture can be accommodated within the road reserve. The narrower road corridor will also aid in reducing vehicle speeds along these residential roads.
- The low volume residential streets are expected to provide access for no more than 50 dwelling units, with a residential access provided every few meters. A shared urban environment is envisaged along these cul-de-sacs, with cyclists and vehicles both being accommodated within the carriageway lane. On-street parking is also proposed on one side of the road. With this roadside friction, it is intended that vehicle speeds along these streets will not exceed 30km/h. At these low speeds, the 5.5m carriageway width would be sufficient to allow two vehicles to pass each other. Additionally, all services and pedestrian facilities can be provided within the road reserve.

The overall internal road cross-section arrangement has been planned based on the managed speed environment approach. The road cross-section dimensions have been developed to match the desired speed and amenity outcomes of the road, delivering a safe speed zone environment and clear road hierarchy across the proposed development area.

5.6. Other Transport Modes

5.6.1. Public Transport

As shown in the Masterplan in Figure 1-2 (also provided in Appendix A), public transport is promoted within the site through the provision of a bus stop facility located within the proposed commercial precinct. An additional stop is proposed for the eastern residential areas - this will ensure that commuters in these areas do not have to travel longer distances (more than 1km) to access the bus service. The indicative locations (refer to Figure 5-5) are selected due to the convenience and accessibility it offers for users, both to residents and those with employment in the site. It also offers ease of access and a circulatory route via the internal collector road network in order to minimise delays to the service.

Waikato Regional Council has been consulted concerning the proposed rezoning and the potential for PT services to operate to or via Ohinewai in future. The following outlines the feedback provided by Andrew Wilson, as Manager – Public Transport Operations:

- *There are currently no definitive plans or funding for additional public transport services in the Ohinewai area.*
- *The extended regional service from Hamilton to Pukekohe is more for leisure commuters (e.g. for shopping trips, etc.) and not ideal for daily commuting (i.e. worker trips) - the service operates outside of the normal peak periods, and only stops in Ohinewai once or twice a day.*
- *It is unlikely that WRC would consider extending the service into the proposed development – this would (unnecessarily) increase travel times and is not best practice. The proposal should rather consider providing public transport facilities on the on- and off-ramps with walking and cycling paths between the proposed development and the public transport facilities.*
- *APL could consider engaging with private PT providers such as Intercity or GoBus to add Ohinewai into their existing routes.*

- *With the new Auckland-Hamilton rail service, APL could propose providing some sort of service (e.g. rideshare, park and ride, etc.) to the proposed Huntly rail station (this may likely be provided by private PT providers).*

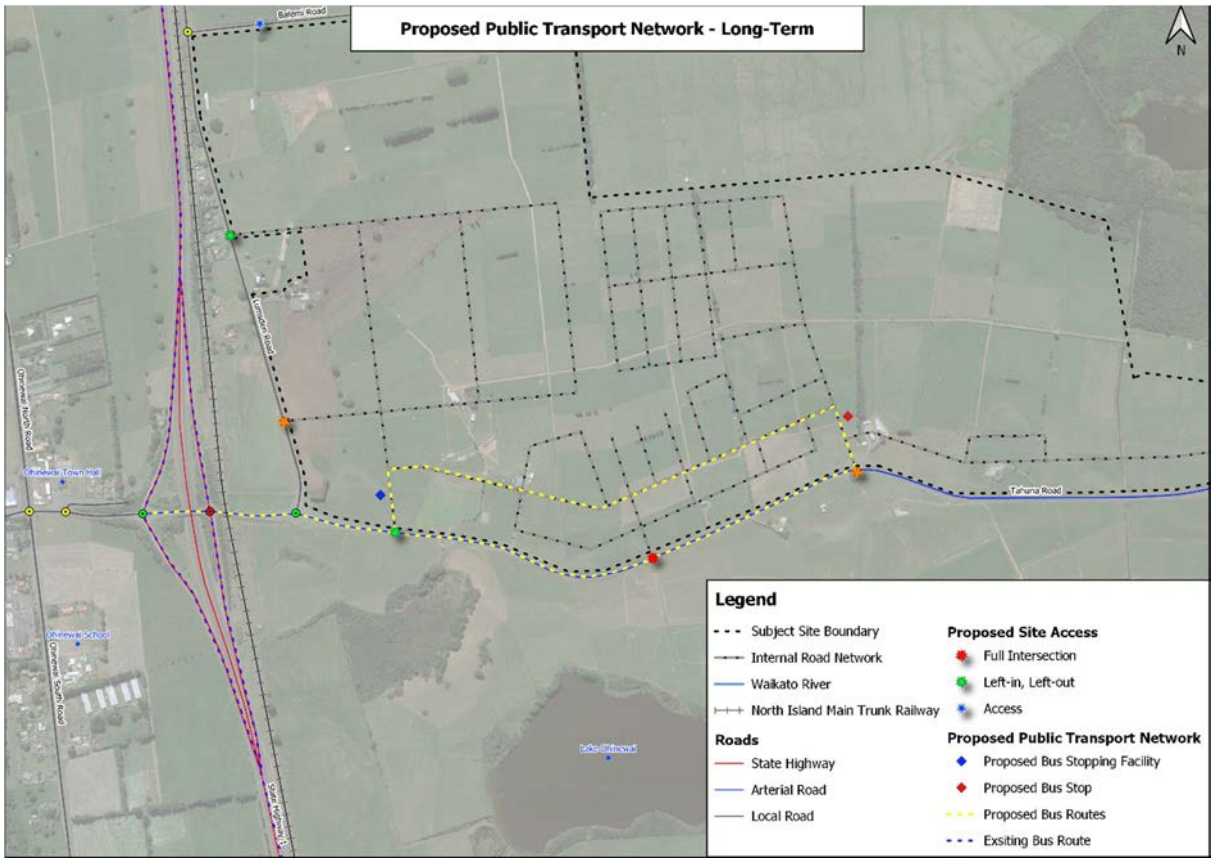


Figure 5-5: Proposed Public Transport Services - Long-Term Planning

Although current thinking by WRC is that future PT services should not extend into the development site, APL will not preclude such services across development stages in case the thinking changes in future. In the interim period before the development is completed an alternative may be to provide a bus stop on Tahuna Road between the interchange and Lumsden Road as this would enable the bus to then U-turn at the Lumsden Road roundabout and return quickly to the expressway via the interchange on ramp (refer to Figure 5-6).

If the bus stops are located on Tahuna Road between the interchange and Lumsden Road, then the distance to the stop for users would increase to approximately 1km. Although this distance is traditionally a barrier to people using PT, the rapid rise in popularity of electric bikes and e-scooters, particularly for "last and first mile" journeys means such distances is now less of a barrier than when walking or cycling were the only alternatives.

Alternatively, given the proximity of the Huntly rail station and its services to both Hamilton and Auckland (proposed mid 2020), a park-and-ride service (either publicly or privately operated) can be provided from the development's proposed bus stop facility to the Huntly public transport hub.

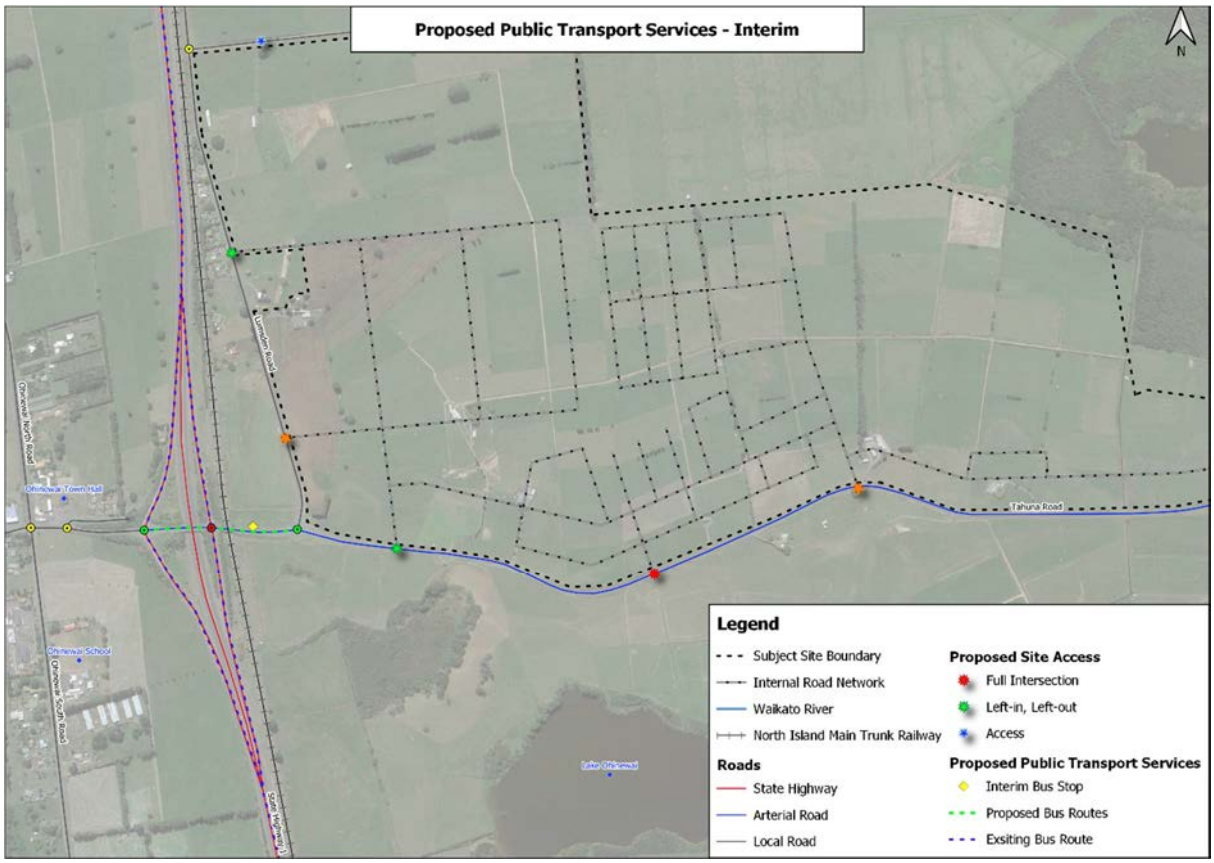


Figure 5-6: Proposed Public Transport Services - Interim Service

5.6.2. Walking and Cycling

As shown in the Structure Plan in Figure 1-2 and Figure 5-7 (Appendix A), an extensive walking and cycling network has been proposed within the proposed development which consists of shared paths within the public open spaces as well as pedestrian and cyclists paths on both sides of the proposed collector road network and on one or both sides of the proposed local road network within the site.

Shared paths are also proposed on one side of Tahuna Road and Lumsden Road. Walking and cycling linkages to Ohinewai Village and Huntly will be provided via Tahuna Road and over the SH1 expressway. These are discussed further in Section 7.5.

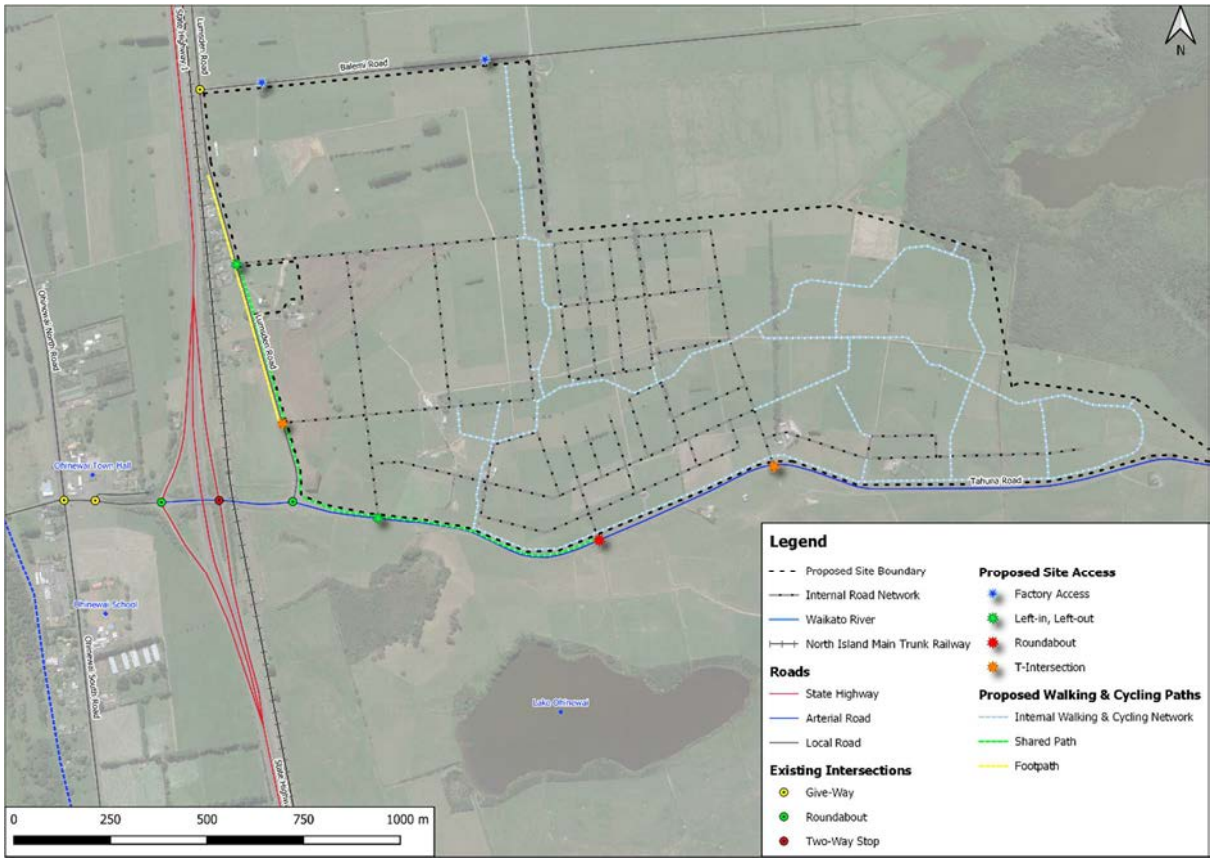


Figure 5-7: Proposed Walking and Cycling Paths

6. Predicted Trip Generation

The expected trip generation for the proposed development was determined using the following trip generation manuals and related reports:

- New Zealand Trips and Parking Database (TDB) (2016);
- Institute of Transportation Engineers (ITE) Trip Generation Manual (8th Edition);
- RTA Guide to Traffic Generating Developments (Version 2.2, 2002), and
- NZTA Research Report 453 (RR453) (2010).

The sections to follow provide a comparison of the trip rates provided in each of the documents above for each respective land use type, as well as the recommended trip rate to be applied. Where two or more rates were obtained for each land use, the more conservative rate was used.

6.1. Trip Generation Rates

6.1.1. Trip Rates - Manufacturing and Industrial Activity

Table 6-1 below provides a summary of the trip rates for the manufacturing and industrial land uses.

Table 6-1: Trip Rate Data - Industrial Land Uses

Source Document	Daily Trip Rate	AM Peak Trip Rate	PM Peak Trip Rate	Unit
Land Use: Manufacturing Facility				
ITE 8th Edition	2.13	0.4	0.36	Employee
	4.12	0.79	0.8	100m^2 GFA
RTA Guide	5.0	-	1.0	100m^2 GFA
NZTA Research Report (NZ)	30.0	-	2.70	100m^2 GFA
NZTA Research Report (AU)	5.0	-	1.0	100m^2 GFA
NZTA Research Report (USA)	4.11	-	0.79	100m^2 GFA
Land Use: General Light Industrial				
NZ TDB	9.27	0.86	0.96	100m^2 GFA
ITE 8th Edition	3.02	0.44	0.42	Employee
	7.5	0.91	0.93	100m^2 GFA

The following was deduced from Table 6-1 above:

- The trip rates for the manufacturing activities are similar - the daily trip rate ranges between 4 and 5 trips per 100m2 GFA, while the peak hour trip rate ranges between 0.8 and 1.0 trips per 100m2 GFA.
- The only outlier for the manufacturing activity trip rates was the rate provided for New Zealand in the NZTA Research Report. This high trip rate includes some component of warehousing, distribution and direct sales to the public. This rate was, however, based on a very small sample and was not deemed to be appropriate for the proposed developed.
- APL estimates that the manufacturing facility will employ up to 1,500 people once completed. Given this, the employee-based trip rates were considered for the manufacturing activity. The ITE employee-based trip rates were applied.
- The peak hour trip rate for the industrial activities was comparable – the peak hour rate ranged between 0.93 and 0.96 trips per 100m2 GFA. APL estimates an employee rate of 1 per 200m^2 GFA for the light industrial land uses; this equates to approximately 600 people that will likely be employed by the general light industrial areas. The ITE employee-based trip rates were applied.

The predicted trip rates and distribution factors for the manufacturing and industrial activities are provided in Table 6-2 below.

Table 6-2: Estimated trip generation - Manufacturing & Industrial activities

Land Use	Period	Trip Rate		Distribution	
		Rate	Unit	In (%)	Out (%)
Manufacturing Facility	AM Peak Hour	0.4	per employee	73%	27%
	PM Peak Hour	0.36	per employee	44%	56%
General Light Industrial	AM Peak Hour	0.44	per employee	83%	17%
	PM Peak Hour	0.42	per employee	21%	79%

6.1.2. *Trip Rates - Retail Activity*

As shown in Table 5-1, retail land uses consist of a retail outlet centre, a service station with convenience retail and a community corner shop. Table 6-3 below provides a summary of the various trip rates for the retail land uses.

Table 6-3: Trip Rate Data – Commercial Land Uses

Source Document	Daily Trip Rate	AM Peak Trip Rate	PM Peak Trip Rate	Unit
Land Use: Retail Outlet Centre				
ITE 8th Edition	28.63	0.73	2.47	100m^2 GFA
Land Use: Service Station with Convenience Store				
NZ TDB	120.66	10.88	16.06	Fuel positions
ITE 8th Edition	162.78	10.06	13.38	Fuel positions
Land Use: Corner Shop				
ITE 8th Edition	-	33.39	37.22	100m^2 GFA
RTA Guide	121	-	12.3	100m^2 GFA
NZTA Research Report	128.6	-	42.50	100m^2 GFA

The following was noted during the analysis of the trip rate data provided in Table 6-3 above:

- Trip rates for a retail outlet centre(s) were only provided in the ITE Trip Generation manual. These rates are typically lower than trip rates for shopping centres as they are targeted at specific consumers (i.e. only provide products from a specific manufacturer/ brand). The ITE rates were applied to the proposed development.
- The following rates were applied to the proposed development:
  - NZ TDB trip rates for the service station, and
  - NZTA Research Report rates for the community corner shop.

The predicted trip rates and distribution factors for the retail activities are provided in Table 6-4 below.

Table 6-4: Estimated trip generation – Retail Activities

Land Use	Period	Trip Rate		Distribution	
		Rate	Unit	In (%)	Out (%)
Retail Outlet Centre	AM Peak Hour	0.73	100m^2 GFA	73%	27%
	PM Peak Hour	2.47	100m^2 GFA	47%	53%
Service Station with Convenience Store	AM Peak Hour	10.88	Fuel positions	50%	50%
	PM Peak Hour	16.06	Fuel positions	50%	50%
Community Corner Shop	AM Peak Hour	33.39	100m^2 GFA	50%	50%
	PM Peak Hour	42.5	100m^2 GFA	49%	51%

6.1.3. Trip Rates - Residential Activity

As shown in Table 5-1, two types of residential dwellings are proposed within the development. The trip rates for the two dwelling types were obtained from the ITE Trip Generation manual – these are provided in Table 6-5.

Table 6-5: Trip Rate Data – Residential Land Uses

Land Use	Period	Trip Rate		Distribution	
		Rate	Unit	In (%)	Out (%)
General Density (Single Units)	AM Peak Hour	0.75	Dwelling Units	25%	75%
	PM Peak Hour	1.01	Dwelling Units	63%	37%
Medium Density (Attached Units)	AM Peak Hour	0.75	Dwelling Units	25%	75%
	PM Peak Hour	1.01	Dwelling Units	63%	37%

6.2. Trip Generation Adjustment Factors

The sections to follow provide the trip adjustment factors that were applied to the trip rates that were discussed in the preceding sections. Sensitivity testing was conducted to analyse the effect of the assumed factors. These are detailed in Section 7.1.7.

6.2.1. Mixed-use Development Adjustment

Mixed-use developments are defined as developments in an area that consists of two or more single-use developments between which trips can be made by means of walking or cycling. The proposed development can be considered a mixed-use area with multiple land uses that serve and support one another. The retail and residential components of the development were incorporate in the masterplan with the intention of firstly serving and supporting the manufacturing and industrial components of the development, and secondly serving the local community (i.e. Huntly, Hamilton, Te Kauwhata, etc. – external trips).

The trip generation rates were adjusted to exclude any internal trips (i.e. trips that will originate and terminate within the development). Table 6-6 provides the adjustment factors that were applied for each land use within the proposed development. These factors were based on the extent of the proposed land use activity within the mixed-use development, as well as the distance of the proposed development to the closest employment and population centres (e.g. Huntly, Hamilton, etc).

Table 6-6: Adjustment Factors - Mixed-use Development

Land Use	Mixed-use Adjustment Factor (Internal trips %)
Manufacturing Facility	50%
Light Industrial/ Industrial Park	50%
Retail Outlet Centre	10%
Service Station with Convenience Store	20%
Community Corner Shop	100%
General Density Residential	50%
Medium Density Residential	50%

6.2.2. *Shift Work Adjustment*

The manufacturing facility trip rates trip rates provided in the ITE Trip Generation manual were compared to trip rates surveyed[15] at the existing NZCG manufacturing operations in Auckland. It was found that the peak hour trip rates of the existing operations were 50% and 70% lower than the rates provided in the ITE manual. This is considered to be related to:

- Factory workers work in shifts - only a portion of the total work force arrives during each shift (i.e. not all employees arrive during the morning period and depart during the afternoon).
- The daily operations at both factories begin prior to the normal commuter peak (the operating hours at the Avondale site was between 05:30am and 5:30pm, while the operating hours at the Otahuhu site was between 05:00am and 11:00pm). As a result, a significant portion of the factory trips do not occur during the adjacent road network's peak hour.

The ITE Trip Generation manual cautions that industrial "*facilities with employees working on shift work may peak at other hours*" than what was specified in the manual – the trip rates provided in the manual do not account for the reduces employee numbers that can be attributed to shift work.

The proposed manufacturing facility will likely be a 24-hour operation, with a minimum of two work shifts per workday. Based on this, and the data collected from the trip rate survey[15], we have assumed that at most, 60% of the expected trips associated with the industrial land uses will occur during the normal AM and PM peak hours of the adjacent road network. This value is seen as conservative as the total manufacturing facility work force is expected to be spread over at least two and more work shifts. However, a sensitivity test of 100% in the peak hours has also been included (refer 8.1.7).

6.2.3. *Freight Trips Adjustment*

The implementation of a rail siding, which will connect the industrial land uses with the NIMT, is likely to provide a significant reduction in the number of heavy commercial vehicle trips generated by the site.

ITE Trip Generation manual states that of the sites that were surveyed, truck trips made up between 1% and 22% of the total daily trips that were generated; on average, truck trips accounted for 8% of the total traffic generated by industrial land uses. According to the trip surveyed[15] at the existing NZCG manufacturing operations in Auckland, heavy commercial trips accounted for approximately 14% of the peak hour traffic (both AM and PM peaks).

The figure of 14% HCV was assumed for all external vehicle trips related to the proposed industrial activities. From this figure, we have assumed that 80% of these trips will be removed from the road network (i.e. will be transported via freight rail). A sensitivity test of 100% of freight by road (i.e. 0% by rail) is included in Section 8.1.7.

6.2.4. *Public Transport, Walking and Cycling Adjustment – External Trips*

[15] Trip rate surveys were undertaken at the existing Avondale and Otahuhu sites in Auckland as part of a 2018 ITA report that was prepared by TDG for APL (Manufacturing Facility - 72 Tidal Road, Manegere ITA, (2018)).

According to the New Zealand Household Travel Survey, public transport (buses) makes up 1% of the total mode share for travellers in the Waikato region, with walking and cycling making up approximately 10% of total trips. These proportions were applied to this study to determine the proportion of daily trips that will be made use of these modes. For the peak periods, however, a lower proportion of pedestrians and cyclists were applied as follows:

- Public transport commuters: not more than 1% of the total mode share during the AM and PM peak periods, and
- Pedestrians and cyclists: not more than 2.5% of the total mode share during the AM and PK peak periods.

6.3. Total Trip Generation

Table 6-7 below provides a summary the expected trip generation for the proposed development.

The proposed development is expected to generate approximately 1,100 and 1,700 vehicle trips during the AM and PM peak hours respectively, with between 5% and 6% of the total peak hour trips being heavy commercial vehicles.

Approximately 275 and 315 walking and cycling trips are expected to be generated by the proposed development during the AM and PM peaks hours respectively.

Table 6-7: Total Estimated Trip Generation

Land Use Area	Mode	AM Peak			PM Peak		
		In	Out	Total	In	Out	Total
Industrial	Light Vehicles (vehicles/hour)	189	78	267	114	134	248
	Heavy Commercial Vehicles (vehicles/hour)	16	6	22	9	11	20
	Total Motorised Traffic (vehicles/hour)	205	84	289	123	145	268
	%HCV	8%	7%	8%	7%	8%	7%
	Walking and Cycling (persons/hour)	20	18	38	19	19	38
Commercial/ Retail	Light Vehicles (vehicles/hour)	177	95	270	346	385	731
	Heavy Commercial Vehicles (vehicles/hour)	0	0	0	0	0	0
	Total Motorised Traffic (vehicles/hour)	177	95	270	346	385	731
	%HCV	0%	0%	0%	0%	0%	0%
	Walking and Cycling (persons/hour)	11	7	18	18	20	38
Residential	Light Vehicles (vehicles/hour)	162	376	538	434	247	681
	Heavy Commercial Vehicles (vehicles/hour)	0	0	0	0	0	0
	Total Motorised Traffic (vehicles/hour)	162	376	538	434	247	681
	%HCV	0%	0%	0%	0%	0%	0%
	Walking and Cycling (persons/hour)	98	98	196	98	98	196
Total for Proposed Development	Light Vehicles (vehicles/hour)	528	549	1,077	894	766	1,660
	Heavy Commercial Vehicles (vehicles/hour)	16	6	22	9	11	20
	Total Motorised Traffic (vehicles/hour)	544	555	1,099	903	777	1,680
	%HCV	3%	1%	2%	1%	2%	1%
	Walking and Cycling (persons/hour)	129	123	252	135	137	272

6.4. External Trip Distribution Assumptions

The external trip distribution considered the following factors:

- Support of the Huntly economy – the location of the proposed development is such that it will form part of the larger Huntly community. It is expected that a larger portion of the trips generated by the development will travel south to Huntly.
- Existing travel patterns – these were derived from 2019 traffic survey data collected within the vicinity of the site. It was found that approximately 65% of the ADT through the SH1 Ohinewai interchange travels north (i.e. towards Auckland).
- Future growth projections – based on the 2045 population and employment-based growth projections16 for both major and minor centres located within a 30km radius of the proposed development site. Future growth within the Waikato district is projected to be more towards the south, with approximately 80% of the overall growth in the district expected along the southern population centres such as Huntly and Hamilton City.

Based on the above, the following assumptions are made regarding the external trip distribution:

- 35% to the north via the SH1 expressway,
- 60% to the south via the SH1 expressway, and
- 5% to the east via Tahuna Road.

The estimated traffic volumes that are expected to be generated by the proposed development during the AM and PM peak periods are shown in Figure 6-1 and Figure 6-2 respectively.

Sensitivity testing was conducted to analyse the effect of various external traffic distributions. These are detailed in Section 7.1.7.

[16] Based on population growth data provided in the Waikato District Blueprint's District Growth Strategy and NZ Census Data

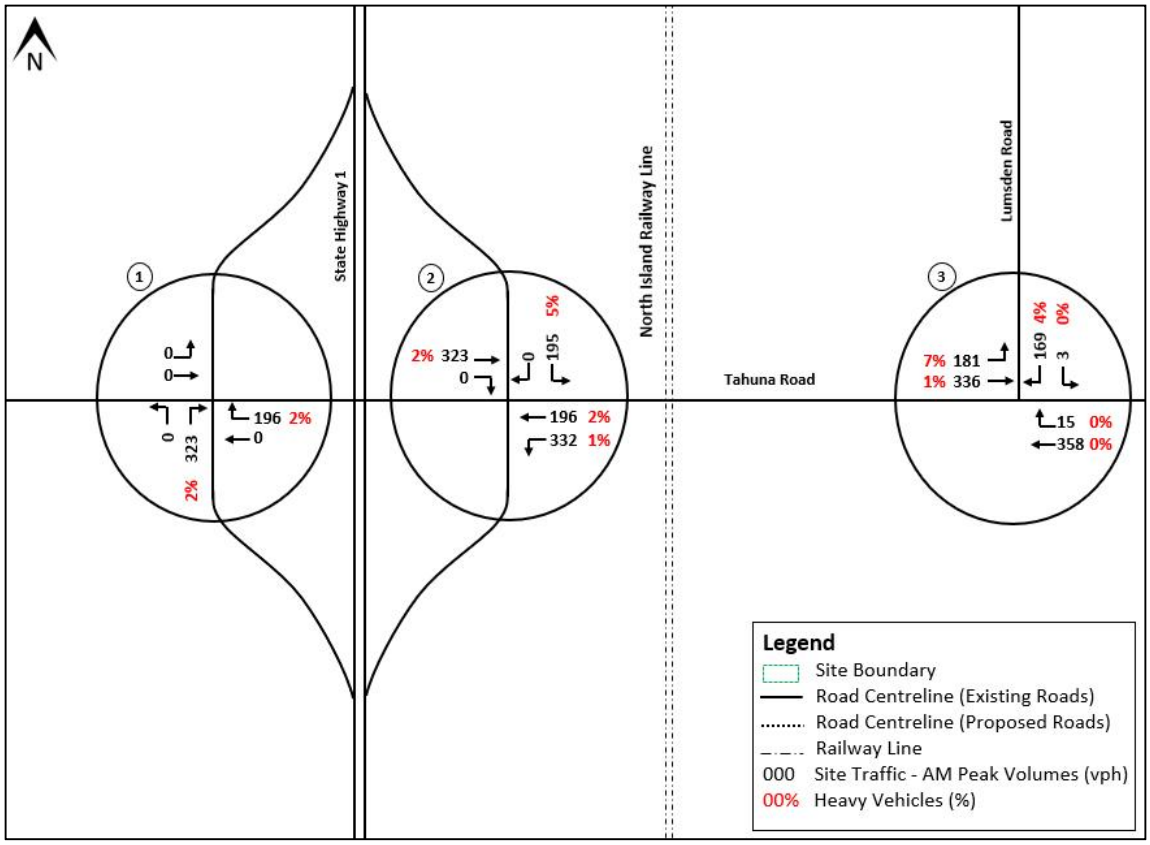


Figure 6-1: Estimated Traffic Volumes to be generated by the proposed Sleepyhead Estate development - AM Peak Hour

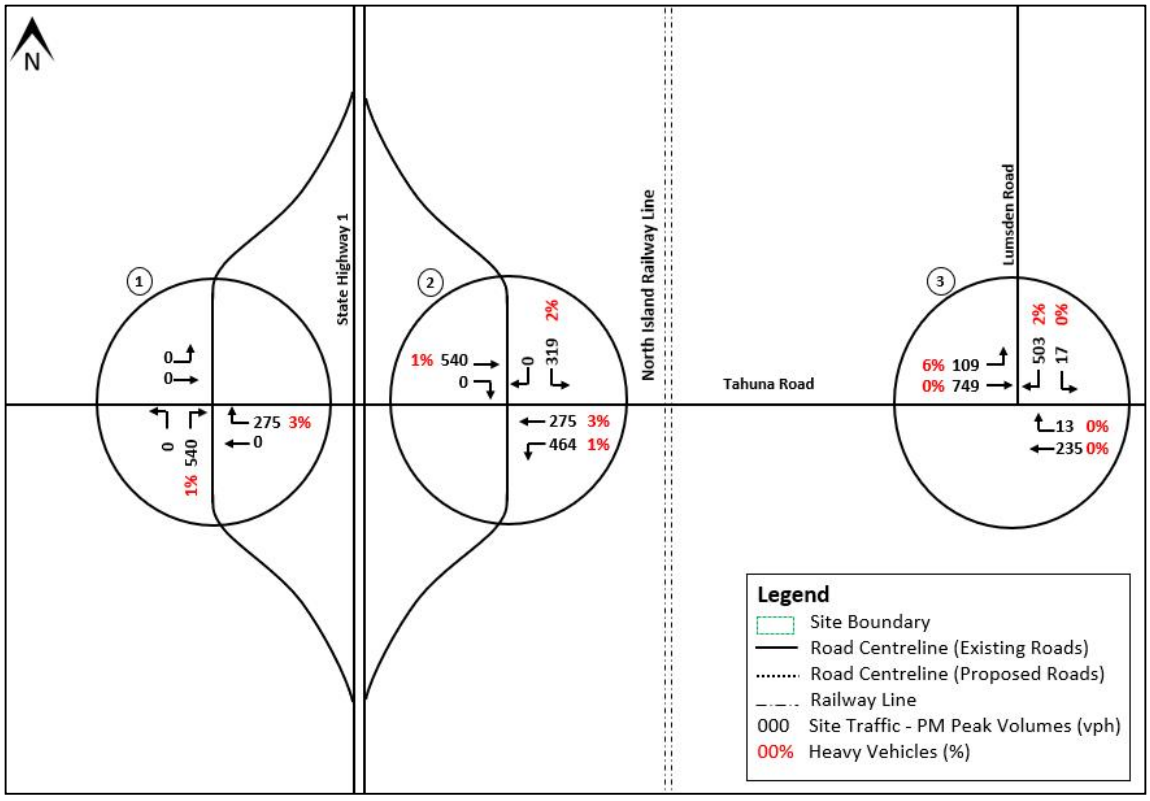


Figure 6-2: Estimated Traffic Volumes to be generated by the proposed Sleepyhead Estate development - PM Peak Hour

7. Appraisal of Transportation Effects

The following sections outline an assessment of the traffic effects of the proposed development enabled by the proposed re-zoning and Structure Plan.

7.1. Intersection Effects Assessment

7.1.1. Affected intersections

The following existing intersections, which are located within the vicinity of the proposed development, were analysed for the purposes of this study:

- SH1 Ohinewai interchange ramp intersection - western leg roundabout;
- SH1 Ohinewai interchange ramp intersection - eastern leg stop control, and
- Tahuna Road and Lumsden Road intersection.

The base (2019) and future year (2031) intersection performance (or Level of Service (LOS)) with and without the proposed development was assessed using Sidra Intersection 8.0. Given the close proximity of the intersections to each other (approximately 150m apart), the intersections were analysed as a network and not individually to account for the potential impact that an intersection would have on the adjacent intersection.

7.1.2. Analysis Scenarios

The following scenarios were analysed:

- Scenario 1: 2019 Baseline traffic on the existing road network, without the proposed development traffic.
- Scenario 2: 2019 Baseline traffic on the existing road network, including Scenario 1 road network upgrades if any, and including the proposed development traffic.
- Scenario 3: 2031 Future Year Baseline traffic on the future planned road network, without the proposed development traffic.
- Scenario 4: 2031 Future Year Baseline traffic on the future planned road network, including Scenario 3 road network upgrades if any, and including the proposed development traffic.

7.1.3. Capacity Analysis - 2019 Baseline without the Proposed Development (Scenario 1)

The capacity analysis results from Scenario 1 (2019 Baseline traffic without the proposed development) are summarised in Table 7-1. The Sidra Intersection summaries for this scenario are provided in Table E-1 to Table E-6 in Appendix E.

As shown in Table 7-1, no capacity upgrades are required for this scenario as all intersections operate at LOS B or better during the AM and PM peak periods.

A critical consideration for the interchange performance and safety is ensuring the queues on the off ramps do not extend down the ramp to a point that causes vehicles exiting the expressway at 110kph to not be able to brake to a stop safely before the back of the queue.

This is more likely to occur on the southbound off ramp at the eastern intersection given it is compulsory stop controlled at Tahuna Road. The length of this off ramp is 312m from the stop line to the nose of the gore area of the ramp.

The required deceleration distance (comfortable deceleration) from 110 kph to a stop is 185m (Table 5.2 in Austroads Road Design Guide Part 4a). On this basis, the 95th percentile queue length on the off ramp should not exceed 127m.

Table 7-1: Scenario 1 Performance Results (2019 Baseline without the Proposed Development)

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.4	1.8	A	10.4	1.2	B
	East: Tahuna Rd	10.0	0.0	A	10.6	0.0	B
	West: Tahuna Rd	8.5	2.0	A	8.7	1.9	A
	Intersection	9.4	2.0	A	10.1	1.9	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	2.3	0.0	-	3.1	0.0	-
	North: Off-ramp	10.2	1.9	B	10.1	2.2	B
	West: Tahuna Rd	4.4	1.4	-	2.4	0.9	-
	Intersection	5.5	1.9	-	5.2	2.2	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	8.6	2.6	A	8.7	2.3	A
	North: Lumsden Rd	13.0	0.7	B	13.1	2.3	B
	West: Tahuna Rd	7.8	2.7	A	7.8	3.4	A
	Intersection	8.6	2.7	A	9.6	3.4	A

7.1.4. Capacity Analysis - 2019 Baseline with the Proposed Development (Scenario 2)

The capacity analysis results from Scenario 2 (2019 Baseline traffic with the proposed development) are summarised in Table 7-2. The Sidra Intersection summaries for this scenario are provided in Table E-7 to Table E-23 in Appendix E.

Table 7-2: Scenario 2 Performance Results (2019 Baseline with the Proposed Development)

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	8.8	6.2	A	10.7	12.8	B
	East: Tahuna Rd	6.7	0.0	A	7.0	0.0	A
	West: Tahuna Rd	6.2	1.3	A	10.0	1.9	B
	Intersection	7.8	6.2	A	9.3	12.8	A
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	3.5	0.0	-	3.6	0.0	-
	North: Off-ramp	12.9	4.9	B	19.2	14.9	C
	West: Tahuna Rd	1.5	1.7	-	1.4	2.3	-
	Intersection	4.9	4.9	-	6.3	14.9	-
	East: Tahuna Rd	4.3	8.4	A	7.7	10.5	A

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	North: Lumsden Rd	9.6	3.4	A	50.0	67.9	D
	West: Tahuna Rd	2.9	9.6	A	2.9	23.6	A
	Intersection	4.5	9.6	A	18.6	67.9	B

The capacity analysis results from Scenario 2 (2019 Baseline with the proposed development traffic) were as follows (refer to Table 7-2):

- SH1 Ohinewai Interchange – Western ramps is expected to operate at acceptable levels of service during the AM and PM peak periods with the additional development traffic. No upgrades are required for this intersection.
- SH1 Ohinewai Interchange – Eastern ramps is expected to operate at acceptable levels of during the AM and PM peak periods with the additional development traffic. It is, however, worth noting that the right turn movement from the southbound off-ramp approach is expected to operate at LOS E during the PM peak period (refer to Table E-10 in Appendix E). This movement is expected to produce a 95th percentile queue of 8 vehicles during this period, with an average queue of 2 vehicles during the hour – given this small volume of vehicles, upgrading the ramp width to improve the capacity is not considered justified given the difficulty of widening the off ramp embankment and potential for disruption to the expressway and NIMT.
- Tahuna Road & Lumsden Road intersection is expected to operate at LOS A and LOS B during the AM and PM peak period respectively. However, the right-turn movement from the northern approach of the intersection (i.e. the Lumsden Road leg) is expected to operate at LOS E during the PM peak with average delays of up to 50 seconds (refer to Table E-12 in Appendix E) – the intersection will require upgrading to improve on the LOS of this major movement.

For scenario 2, the following road network upgrades are proposed based on the capacity assessment and safety results:

- SH1 Ohinewai Interchange: no capacity upgrades are required.
- The current interchange configuration will not be safe for pedestrians and cyclists. The following two configurations were considered and analysed, one which caters for pedestrians and one which does not (refer to Figure 7-1 for an illustration of the proposed upgrades):
  - Layout Option 1: The existing configuration with no pedestrian and cyclist crossing facilities. A separate pedestrian and cyclist bridge structure will, however, need to be provided over the NIMT and Expressway.
  - Layout Option 2: Upgrading the eastern ramp intersection to a traffic signal with pedestrian and cyclists crossing facilities, including providing a signalised pedestrian crossing on the northbound on-ramp of the western intersection. The following structures will require widening:
    - The Tahuna Road bridge over the NIMT (from two lanes to four lanes)

- The southbound off-ramp (from one to three lanes, to provide two dedicated left turn lanes and one right turn lane).

- Tahuna Rd & Lumsden Road Intersection: providing an additional right-turn lane on the northern approach (refer to Figure 7-2 for an illustration of the proposed upgrades). As shown in Figure 7-2, an additional through-lane will be required on the eastern approach to balance the intersection movements.

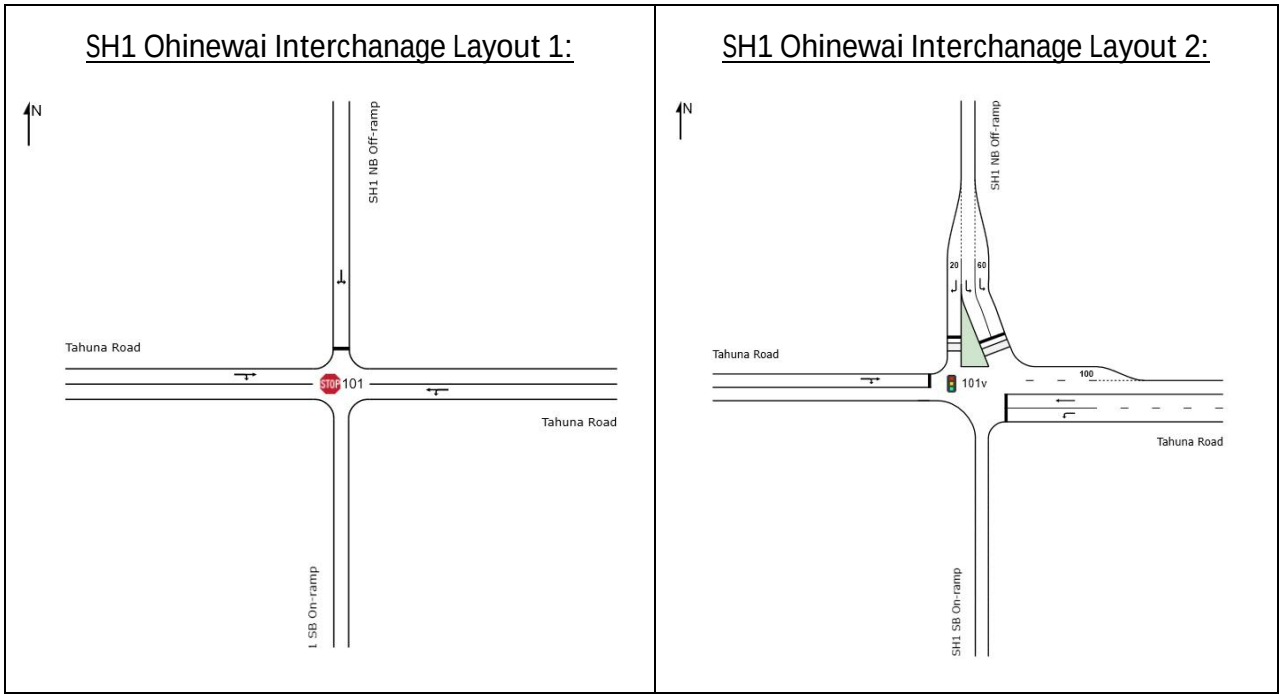


Figure 7-1: Proposed Intersection Upgrades - SH1 Ohinewai Interchange

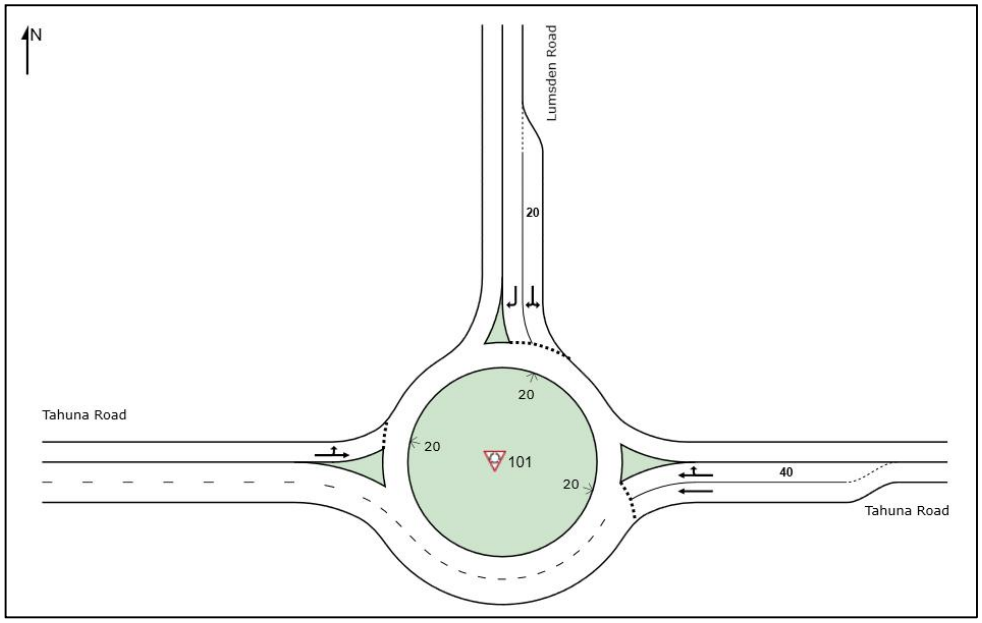


Figure 7-2: Proposed Intersection Upgrades – Tahuna Road & Lumsden Road Intersection

Table 7-3 below provides a summary of the performance of the external intersection with the proposed road network upgrades.

As shown in Table 7-3, the Tahuna Road and Lumsden Road intersection is expected to operate at LOS B and better with the implementation of the proposed road network upgrades. Both interchange layouts will operate at acceptable levels of service during both the AM and PM peak periods.

Table 7-3: Scenario 2 - Performance Results with proposed road network upgrades

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Layout Option 1							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	8.8	6.2	A	10.7	12.8	B
	East: Tahuna Rd	6.7	0.0	A	7.0	0.0	A
	West: Tahuna Rd	6.2	1.3	A	10.0	1.9	B
	Intersection	7.8	6.2	A	9.3	12.8	A
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	3.5	0.0	-	3.6	0.0	-
	North: Off-ramp	12.9	4.9	B	19.2	14.9	C
	West: Tahuna Rd	1.5	1.7	-	1.4	2.3	-
	Intersection	4.9	4.9	-	6.3	14.9	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	3.9	5.0	A	5.6	5.6	A
	North: Lumsden Rd	9.1	2.0	A	16.0	16.0	B
	West: Tahuna Rd	2.9	9.3	A	22.7	22.7	A
	Intersection	4.3	9.3	A	22.7	22.7	A
Layout Option 2							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.2	8.8	A	11.4	18.6	B
	East: Tahuna Rd	6.7	0.0	A	7.0	0.0	A
	West: Tahuna Rd	6.6	1.6	A	12.5	2.8	B
	Intersection	8.0	8.8	A	9.8	18.6	A
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Traffic Signal)	East: Tahuna Rd	18.1	29.5	B	24.6	55.6	C
	North: Off-ramp	17.9	11.1	B	20.7	22.6	C
	West: Tahuna Rd	19.3	43.2	B	30.1	97.3	C
	Intersection	18.4	43.2	B	25.5	97.3	C
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	3.9	3.2	A	6.2	3.9	A
	North: Lumsden Rd	9.5	2.0	A	23.8	22.6	C
	West: Tahuna Rd	2.9	8.3	A	2.9	22.2	A
	Intersection	4.3	8.3	A	10.0	22.6	B

7.1.5. Capacity Analysis - 2031 Baseline without the Proposed Development (Scenario 3)

The capacity analysis results from Scenario 3 (2031 Baseline traffic without the proposed development) are summarised in Table 7-4. The Sidra Intersection summaries for this scenario are provided in Table E-24 to Table E-29 in Appendix E.

As shown in Table 7-4, all three intersections are expected to operate at acceptable levels of service during both the AM and PM peak period. Without the proposed development, capacity upgrades will not be required by 2031.

Table 7-4: Scenario 3 Performance Results (2031 Baseline without the Proposed Development)

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.7	2.9	A	10.7	1.8	B
	East: Tahuna Rd	10.0	0.0	B	10.6	0.0	B
	West: Tahuna Rd	8.7	0.4	A	9.0	2.9	A
	Intersection	9.6	0.4	A	10.2	2.9	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	2.3	0.0	-	3.0	0.0	-
	North: Off-ramp	10.4	2.9	B	10.3	3.3	B
	West: Tahuna Rd	4.5	2.1	B	2.7	1.5	B
	Intersection	5.6	2.9	-	5.3	3.3	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	8.8	4.0	A	9.0	3.6	A
	North: Lumsden Rd	13.2	1.2	B	13.4	3.6	B
	West: Tahuna Rd	7.8	4.1	A	7.8	5.2	A
	Intersection	8.7	4.1	A	9.8	5.2	A

7.1.6. Capacity Analysis - 2031 Baseline with the Proposed Development (Scenario 4)

The capacity analysis results from Scenario 4 (2031 Baseline traffic with the proposed development) are summarised in Table 7-5. The capacity assessment was based on the intersection upgrades that were proposed and discussed in Section 7.1.4 to determine whether additional road network upgrades would be required.

The Sidra Intersection summaries for this scenario are provided in Table E-30 to Table E-47 in Appendix E.

Table 7-5: Scenario 4 Performance Results (2031 Baseline with the Proposed Development)

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Layout Option 1							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.0	7.0	A	11.7	15.1	B
	East: Tahuna Rd	6.5	0.0	A	6.9	0.0	A
	West: Tahuna Rd	6.6	2.0	A	10.9	3.1	B
	Intersection	7.8	7.0	A	9.8	15.1	A

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	3.4	0.0	-	3.6	0.0	-
	North: Off-ramp	13.7	6.5	B	23.3	21.6	C
	West: Tahuna Rd	2.4	2.9	-	2.8	4.7	-
	Intersection	5.4	6.5	-	7.7	21.6	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	4.0	5.7	A	6.6	6.6	A
	North: Lumsden Rd	9.3	2.3	A	18.6	20.6	B
	West: Tahuna Rd	3.0	10.6	A	2.9	26.2	A
	Intersection	4.3	10.6	A	8.5	26.2	A
Layout Option 2							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.6	10.4	A	12.3	21.3	B
	East: Tahuna Rd	6.5	0.0	A	6.9	0.0	A
	West: Tahuna Rd	7.1	2.5	A	14.2	4.8	B
	Intersection	8.1	10.4	A	10.3	21.3	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Traffic Signal)	East: Tahuna Rd	18.9	34.7	B	28.1	70.7	C
	North: Off-ramp	18.3	12.3	B	23.2	28.8	C
	West: Tahuna Rd	21.3	49.7	A	28.7	108.7	C
	Intersection	19.5	49.7	B	27.2	108.7	C
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	4.0	3.6	A	6.5	4.5	A
	North: Lumsden Rd	9.8	2.2	A	25.0	23.6	C
	West: Tahuna Rd	3.0	9.5	A	2.9	25.6	A
	Intersection	4.4	9.5	A	10.5	25.6	B

The capacity analysis results from Scenario 4 (2031 Baseline with the proposed development traffic) were as follows (refer to Table 7-5):

- SH1 Ohinewai Interchange:
  - Layout Option 1: Both the western and eastern ramp intersections are expected to operate at LOS C and better during both the AM and PM peak periods. It is, however, worth noting that the right turn movement on the southbound off-ramp is expected to operate at LOS F during the PM peak period (average delay experienced by right-turning vehicles is approximately 50 seconds - refer to Table E-33 in Appendix E). Because of this increased delay, drivers waiting to turn right are likely to get frustrated and may attempt to take shorter gap; this would likely contribute to more crashes occurring at the intersection. To mitigate this, a solution is to provide an exclusive short right-turn lane on the southbound off-ramp (refer to Figure 7-3 for an illustration of the proposed upgrade). The LOS of the right movement with this lane is expected to improve to LOS D (the average delay experienced by right-turning vehicles is reduced to approximately 30 seconds, which is considered acceptable give the low volume - refer to Table E-39 in Appendix E).

- Layout Option 2: The interchange is expected to operate at acceptable levels of service during both the AM and PM peak periods. No further capacity upgrades will be required at the interchange with the Option 2 signalisation and additional lanes.

- The Tahuna Road & Lumsden Road intersection is expected to operate at LOS B and better during both the AM and PM peak periods. No further capacity upgrades will be required at the intersection.

The proposed intersection upgrades are shown in the figures provided in Appendix F.

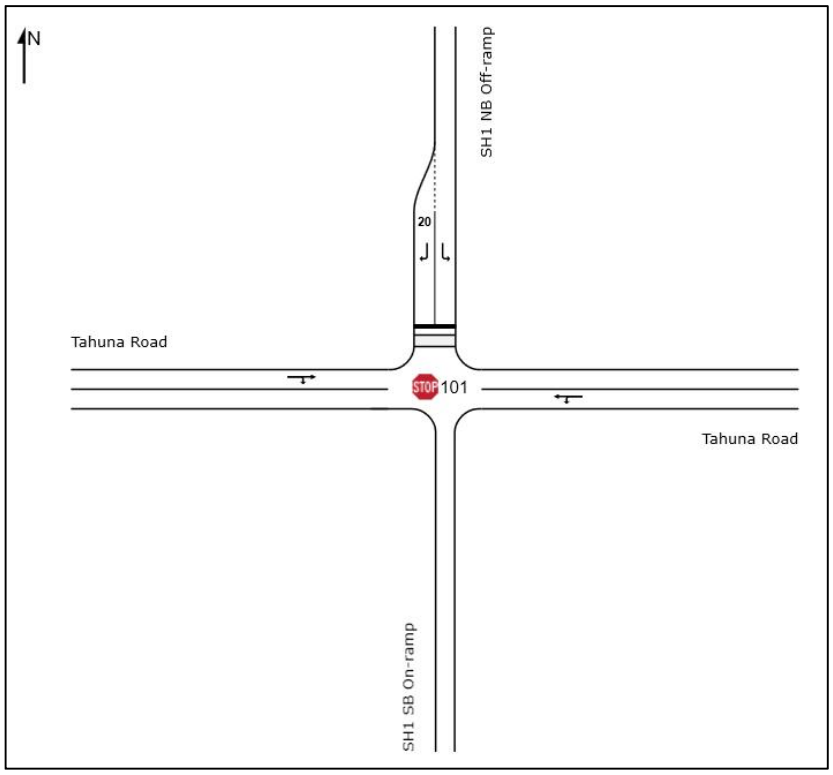


Figure 7-3: Proposed Intersection Upgrades – SH1 Ohinewai Interchange Eastern Ramp Intersection (for Layout Option 1)

7.1.7. Sensitivity Testing

Sensitivity testing was conducted to determine whether the proposed intersection upgrades will have sufficient capacity for various trip generation and distribution assumptions. Table 7-6 below provides a summary of the assumptions that were tested as part of the traffic effects assessment.

Table 7-6: Sensitivity Testing - Assumptions

	Sensitivity Analysis		
Item	Base Assumption	Assumption 1	Assumption 2
Mixed-use Development Adjustment			
Manufacturing	50%	20%	-
Light Industrial	50%	20%	-
Residential	50%	20%	-
Shift Work Adjustment			

	Sensitivity Analysis		
Item	Base Assumption	Assumption 1	Assumption 2
Manufacturing facility trips during peak period	60%	100%	-
Freight Trips			
Freight trips via road network	20%	80%	-
External Trip Distribution			
North (Te Kauwhata, Pokeno)	35%	60%	20%
South (Huntly, Hamilton)	60%	35%	80%
East (Tahuna, SH27)	5%	5%	0%

Table 7-7 below provides a summary of the sensitivity tests that were analysed as part of the traffic effects assessment.

Table 7-7: Sensitivity Testing - Assessment Scenarios

Test	Description	Mixed-use Development	Shift Work	Freight Trips	External Trip Distribution
Test 1	No adjustment for shift work	Base Assumption	Assumption 1	Base Assumption	Base Assumption
Test 2	External distribution – 60% north	Base Assumption	Base Assumption	Base Assumption	Assumption 1
Test 3	External distribution – 80% south	Base Assumption	Base Assumption	Base Assumption	Assumption 2
Test 4	Freight trips – 80% via road network	Base Assumption	Base Assumption	Assumption 1	Base Assumption
Test 5	Lower adjustment for mixed-use development	Assumption 1	Base Assumption	Assumption 1	Base Assumption

Table 7-8 and Table 7-9 to follow provides a LOS summary for the evaluated scenarios for Layout Option 1 and Layout Option 2 respectively.

Table 7-8: Sensitivity Analysis for Layout Option 1 – Intersection Performance for various trip generation and distribution assumptions for the 2031 Baseline with the Proposed Development

Intersection	Approach	Sensitivity Test 1				Sensitivity Test 2				Sensitivity Test 3				Sensitivity Test 4				Sensitivity Test 5			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Veh[17]	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh[18]	LOS	Veh	LOS	Veh	LOS	Veh	LOS
Layout Option 1																					
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	+8%	A	+3%	B	-35%	A	-39%	B	+28%	A	31%	B	+5%	A	+2%	B	+30%	B	+32%	C
	East: Tahuna Rd	+2%	A	+3%	A	+49%	A	+53%	A	-29%	A	-32%	A	+4%	A	+5%	A	+29%	A	+22%	A
	West: Tahuna Rd	0%	A	0%	B	0%	A	0%	B	0%	A	0%	B	0%	A	0%	B	0%	A	0%	C
	Intersection	+5%	A	+3%	B	+1%	A	-3%	A	+3%	A	+6%	B	+4%	A	+3%	B	+27%	A	+26%	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	+3%	-	+4%	-	0%	-	0%	-	+4%	-	+4%	-	+3%	-	+4%	-	+37%	-	+24%	-
	North: Off-ramp	+6%	B	+2%	C	+49%	B	+55%	C	-29%	B	-33%	C	+10%	B	+4%	C	+29%	C	+27%	F
	West: Tahuna Rd	+8%	-	+3%	-	-34%	-	-37%	-	+27%	-	+30%	-	+5%	-	+2%	-	+29%	-	+30%	-
	Intersection	+5%	-	+3%	-	0%	-	0%	-	+4%	-	+4%	-	+5%	-	+3%	-	+33%	-	+27%	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	+0%	A	0%	A	0%	A	0%	A	+2%	A	+2%	A	0%	A	0%	A	+40%	A	+37%	A
	North: Lumsden Rd	+9%	A	+5%	B	0%	A	0%	B	+3%	A	+1%	C	+9%	A	+5%	C	+26%	B	+16%	E
	West: Tahuna Rd	+8%	A	+3%	A	0%	A	0%	A	+4%	A	+5%	A	+8%	A	+3%	A	+32%	A	+30%	A
	Intersection	+5%	A	+3%	A	0%	A	0%	A	+3%	A	+3%	A	+5%	A	+3%	A	+34%	A	+27%	B

[17] Vehicle volume comparison between the base assumption and test scenario (% increase/decrease in the estimated vehicle demand for the approach)

Table 7-9: Sensitivity Analysis for Layout Option 2 – Intersection Performance for various trip generation and distribution assumptions for the 2031 Baseline with the Proposed Development

Intersection	Approach	Sensitivity Test 1				Sensitivity Test 2				Sensitivity Test 3				Sensitivity Test 4				Sensitivity Test 5			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		Veh[18]	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh	LOS	Veh[18]	LOS	Veh	LOS	Veh	LOS	Veh	LOS
Layout Option 2																					
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	+8%	A	+3%	B	-35%	B	-39%	B	+28%	A	31%	F	+5%	A	+2%	C	+30%	B	+32%	F
	East: Tahuna Rd	+2%	A	+3%	A	+49%	A	+53%	A	-29%	A	-32%	A	+4%	A	+5%	A	+29%	A	+22%	A
	West: Tahuna Road	0%	A	0%	B	0%	A	0%	B	0%	A	0%	A	0%	A	0%	B	0%	B	0%	C
	Intersection	+5%	A	+3%	B	+1%	A	-3%	B	+3%	A	+6%	F	+4%	A	+3%	B	+27%	A	+26%	F
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Traffic Signal)	East: Tahuna Rd	+3%	C	+4%	C	0%	B	0%	C	+4%	C	+4%	D	+3%	B	+4%	C	+37%	C	+24%	C
	North: Off-ramp	+6%	B	+2%	C	+49%	B	+55%	B	-29%	C	-33%	C	+10%	B	+4%	C	+29%	C	+27%	C
	West: Tahuna Rd	+8%	C	+3%	C	-34%	C	-37%	C	+27%	C	+30%	D	+5%	C	+2%	C	+29%	C	+30%	C
	Intersection	+5%	C	+3%	C	0%	B	0%	C	+4%	C	+4%	D	+5%	C	+3%	C	+33%	C	+27%	C
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	+0%	A	0%	A	0%	A	0%	A	+2%	A	+2%	A	0%	A	0%	A	+40%	A	+37%	A
	North: Lumsden Rd	+9%	A	+5%	C	0%	A	0%	C	+3%	B	+1%	C	+9%	B	+5%	C	+26%	B	+16%	E
	West: Tahuna Rd	+8%	A	+3%	A	0%	A	0%	A	+4%	A	+5%	A	+8%	A	+3%	A	+32%	A	+30%	A
	Intersection	+5%	A	+3%	B	0%	A	0%	B	+3%	A	+3%	B	+5%	A	+3%	B	+34%	A	+27%	C

[18] Vehicle volume comparison between the base assumption and test scenario (% increase/decrease in the estimated vehicle demand for the approach)

The following is concluded based on the results in Table 7-8 and Table 7-9:

SH1 Ohinewai Interchange – Layout Option 1 (Compulsory-stop at the eastern ramp intersection)

As shown in Table 7-8, the proposed upgrade to the eastern ramp intersection for Option 1 will be sufficient to accommodate four of the five scenarios that were tested.

Additional capacity upgrades would be required to alleviate the queues and delays on the southbound off-ramp of the eastern intersection for the fifth scenario (the scenario assumes that more than 80% of the trips that are expected to be generated by the development will be external trips (i.e. travel/ originate outside of the proposed development)). This scenario is, however, unlikely in our opinion to occur as the proposed land-uses within the mixed-use development were developed with the intention of supporting the NZCG factory – thus a notable portion of the trips that are expected to be generated by the proposed development are likely to remain within the development. However, should the 80% external trips become reality, the intersection would have to be signalised and more lanes added as per Option 2.

Overall, with the exception of Sensitivity test 5, the capacity upgrades proposed for the eastern ramp intersection are robust as the intersection is able to accommodate varying traffic volumes without any additional upgrades.

SH1 Ohinewai Interchange – Layout Option 2 (Signalisation of the eastern ramp intersection)

As shown in Table 7-9, the proposed upgrades to the interchange will be sufficient to accommodate three of the five scenarios that were tested. Additional capacity upgrades to the interchange will be required in cases where:

- 80% and more of the trips generated by the development travel to/ originate from the south (i.e. Huntly, Hamilton) (Sensitivity test 3). This scenario is, however, unlikely in our opinion given the proximity of Rangiriri and Te Kauwhata to the subject site. We except that a notable portion (at least more than 20%) of the trips generated by the proposed development will travel north given the projected population and economic growth figures for these townships.
- 80% and more of the trips generated by the development travel externally (i.e. Sensitivity test 5). As previously explained, it is our opinion that this scenario is unlikely to occur based on the premise that the proposed land-uses within the mixed-use development were developed with the intention of supporting the NZCG factory (i.e. a notable portion of the trips generated by the proposed development are likely to remain within the development).

The performance of the western ramp intersection deteriorates significantly in both cases as a result of the long queues at are formed on the western approach of the signalised eastern ramp intersection. These queues extend past the western ramp intersection, blocking right-turning vehicles at the intersection.

In both cases, the performance of the western ramp intersection can be improved by providing additional capacity on the western approach of the eastern ramp intersection (i.e. providing an additional eastbound through-lane at the eastern ramp intersection). This would, however, require widening the Tahuna Road overbridge from two lanes to at least

three lanes. This major capacity upgrade is expected to only be triggered if these worst-case scenarios are realised, which in our opinion is unlikely to improbable.

Tahuna Road & Lumsden Road Roundabout

As shown in Table 7-8 and Table 7-9, the proposed upgrades to the roundabout would be sufficient to accommodate all but one of the five scenarios that were tested. Even with the proposed upgrades, the performance of the northern approach is expected to deteriorate during the PM peak period for the fifth scenario – the scenario assumes that more than 80% of the trips that are expected to be generated by the development will be external trips (i.e. travel/ originate outside of the proposed development)). However, as previously explained, it is our opinion that this scenario is unlikely to occur based on the premise that the proposed land-uses within the mixed-use development were developed with the intention of supporting the NZCG factory (i.e. a notable portion of the trips generated by the proposed development are likely to remain within the development).

If this worst-case scenario were to be realised, additional capacity on the northern approach would need to be provided. This may also entail providing metering signals at the roundabout to enable gaps in the circulating flow for westbound traffic on Tahuna Road.

Overview of Findings

The scenario's tested (especially Tests 3 to 5) are seen as unlikely to improbable scenarios. As shown in the assessment, Layout Option 1 (i.e. stop-control at the eastern ramp intersection) outperforms Layout Option 2 (i.e. signalised intersection at the eastern ramp intersection) for all tested scenarios. Layout Option 1 offers a more robust solution for vehicular traffic compared Layout Option 2. This upgrade solution is preferred from a capacity perspective, provided that a separate pedestrian and cyclist bridge be built elsewhere over the Expressway (i.e. not at the interchange).

As previously mentioned, it is expected that the 2031 WRTM demands will be lower than the demands estimated in this draft report. Further sensitivity testing will be conducted once the WRTM demands become available.

7.2. Road Safety Assessment

7.2.1. SH1 Ohinewai Interchange

The sightlines at the western and eastern ramp intersection were assessed against the minimum sight distance requirements specified in the Austroads' Guide to Road Design document (Table 3.2 in Part 4A: Unsignalised and Signalised Intersections). The sight distance at the southbound off-ramp (looking both west and east) does not comply with the minimum sight distance requirements. The limited sight currently does not pose a significant road safety risk because of the relatively low volumes at the interchange and because the control is a compulsory Stop.

However, with the increased traffic demand associated with the proposed development (including the fact that the intersection has a "High" collective and personal risk rating), the obstructed sightlines are likely to increase the safety risk. The sightlines will have to be improved, and this is likely to require modifications to the concrete bridge railings on either side of the intersection.

Work is currently being undertaken by BBO structural engineers to ascertain what modifications to the bridge railings can be provided to improve existing sightlines.

The proposed improvements (concept only) will be incorporated as part of the intersection upgrade proposals to be included as part of the final ITA report.

7.2.2. *Level Crossing and Lumsden Road*

Given the current rural zoning, as well as the high volume of heavy commercial vehicles along Lumsden Road, the introduction of the s-bend (refer to Figure G-1 in Appendix G for the proposed alignment) along the relatively straight road is likely to impact on the safety of road users. However, with the envisaged future speed environment (70km/h) along the future urban/ industrial corridor, the associated road safety risks will be less severe.

The proposed alignment of Lumsden Road will aid in significantly reducing speeds over the level crossing, provided that the appropriate advanced warning signs and markings are implemented.

The following additional measures are also recommended to be included as part of the design of the new alignment to reduce vehicle operating speeds before traffic enters the s-bends:

- Speed threshold treatments (50km/h) approaching the s-bend and level crossing;
- Narrowing of the road carriageway to 7m (6.5m trafficable width + 0.5m shoulder) at the threshold pinch points;
- 20m Solid built outs on either side of Lumsden Road at the threshold pinch points;
- Implementing rumble strips on northern approach to reduce vehicle speeds.

7.3. Car Parking

Appendix A of the Operative Waikato District Plan has the following parking requirements that pertain to the site:

- Industrial activities: 1 car space per 100m^2 GFA and 1 HGV loading bay.
- Retail activity: 1 car space per 45m^2 GFA including indoor and outdoor retail area.
- Service stations: 1 car space per 45m^2 GFA excluding car washes and canopies over petrol pumps, plus3 queueing per car wash, plus 4 per repair bay.
- Dwellings: 1 car space per bedroom.

At least one accessible park (or disabled space) shall be provided for each activity. Where more than 50 parking bays are required for each activity, accessible parks shall be provided at a ratio of 1 for every 50 car parks required. Bicycle parking spaces are to be provided at a ratio of 1 bicycle space for every 10 car parking spaces required.

The exact number of parks will need to be determined in the detailed design phase once the exact land use and GFAs for each subdivision are confirmed.

That being said, parking should be provided at the ratio listed above as a minimum, unless a separate resource consent is obtained to reduce the required number of parking spaces for a particular activity on the site.

7.4. Public Transport

According to the most recent NZ Household Travel Survey and NZ Census data, approximately 1% of the trips within the Waikato district are undertaken using public transport. Based on this figure, approximately 125 and 130 in- and outbound commuters are expected to be generated by the proposed development during the AM and PM peaks hours respectively. Based on these figures, at least two buses will be required during each peak period to accommodate this demand.

The proposed interim and long-term public transport services that were discussed in Section 5.6.1 would be sufficient to accommodate the predicted demand.

7.5. Walking and Cycling

7.5.1. Sleepyhead Estate to Ohinewai Village Link

According to the most recent NZ Household Travel Survey and NZ Census data, approximately 10% of the daily trips within the Waikato district are undertaken by walking and cycling modes. Given the rural environment surrounding the proposed development and Ohinewai Village, as well as and the distance of the neighbouring urban centres, it is unlikely that walking and cycling trips to/ from the proposed site would exceed 5% of the total mode-share.

Based on this, we have assumed a figure of 2.5% during the AM and PK peak periods – based on this figure, approximately 250 walking and cycling trips are expected to be generated by the proposed development during the AM and PM peaks hours respectively. These trips are expected to be undertaken by:

- Students walking and cycling to/from Ohinewai Primary School, and
- Cyclists and pedestrians travelling between the proposed development, Ohinewai Village and Huntly for employment and/or recreational purposes.

An extensive network of footpaths and shared paths have been provided within the proposed development, with additional walking and cycle paths proposed on Lumsden Road and Tahuna Road as follows:

- A shared path on one side of the Tahuna Road (on the eastbound carriageway - the side bordering the proposed development) up to the Access 2;
- A shared path on one side of Lumsden Road (on the southbound carriageway - the side bordering the proposed development) up to Access 5, and
- A pedestrian footpath on the northbound carriageway of Lumsden Road along the section between Access 4 and Access 5.

Two options are proposed for walking and cycling connection over the SH1 expressway to Ohinewai Village and primary school:

- Option 1 (refer to Figure 7-4): Walking and cycling path along the SH1 Ohinewai Interchange.
  - Two pedestrian and cyclist bridges are provided: one over the rail, and another over the expressway.

- Pedestrian and cyclist phases are provided at the proposed traffic signal at the eastern ramp intersection to enable safe crossing.
- A signalised pedestrian crossing is provided approximately 20m north of the western ramp intersection on the SH1 northbound on-ramp. At this location, vehicle operating speeds are not expected to exceed 60km/h – this is based on the close proximity of the western ramp roundabout (the nature of the roundabout is to reduce vehicle speeds) as well as the fact that an 85th percentile speed of 74.5km/h was recorded approximately 100m north of the western ramp intersection (refer to Section 2.2.1).
- A shared path provided along Lilly Lane, Tahuna Road and Ohinewai South Road towards Ohinewai School.

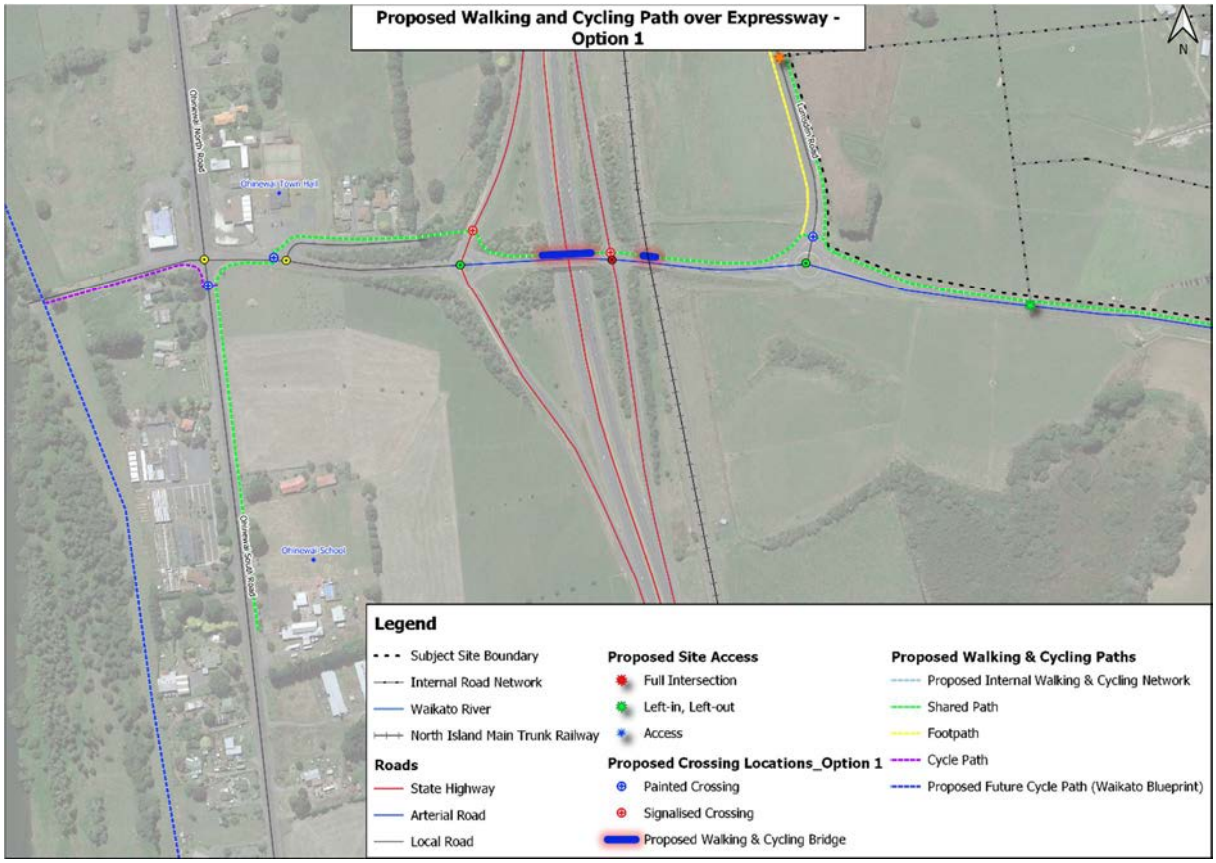


Figure 7-4: Proposed Walking and Cycling Connection over Expressway - Option 1

- Option 2 (refer to Figure 7-5 and Figure 7-6): A new purpose built walking and cycling bridge located approximately 315m south of the SH1 Ohinewai Interchange, connecting to a new shared path that connects through to Ohinewai South Road by the primary school.
- A shared walking and cycling path is provided through WDC reserve land to the east of the NIMT and south of Tahuna Road & Lumsden Road intersection.
- A 6m high walking and cyclist bridge is provided over the expressway and NIMT rail lines, with accessible grade ramps on either end of the bridge. The bridge would likely be two spans, one over the railway line and one over the expressway. The span over the expressway would be approximately 60-65 m long.

- Bridge connects to new walking and cycling path on western side of expressway through currently privately-owned land and joins with Ohinewai South Road as follows:

  Option 2A: The shared path connects to Ohinewai South Road along the southern boundary of the primary school. This alignment will require by-in from Ohinewai School.

  Option 2B: The shared path runs parallel with the Ohinewai Interchange northbound off-ramp and connects to Ohinewai South Road near the Tahuna Road & Ohinewai South Road intersection.

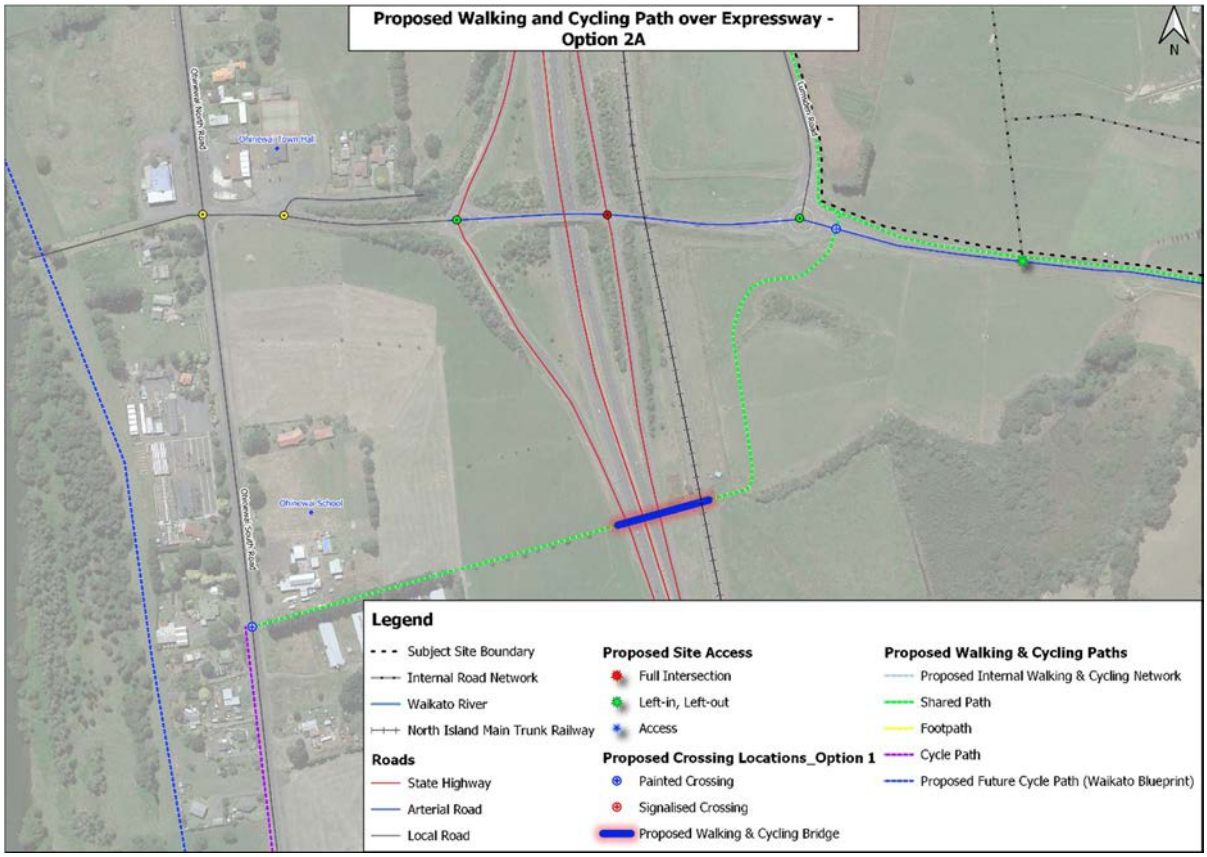


Figure 7-5: Proposed Walking and Cycling Connection over Expressway - Option 2A

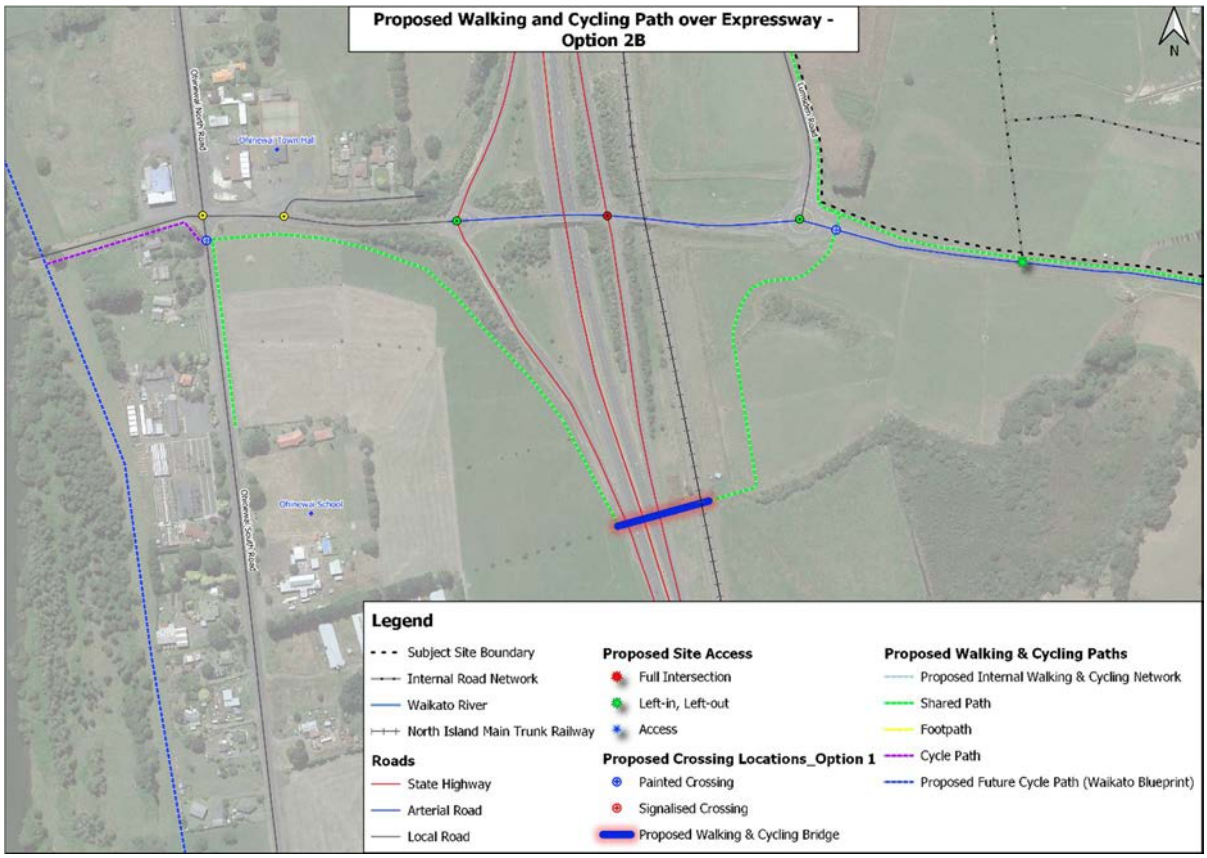


Figure 7-6: Proposed Walking and Cycling Connection over Expressway – Option 2B

The NZ Transport Agency confirmed in principle that a new pedestrian bridge could be established over the expressway, subject to design conditions and approvals including that the bridge could be removed temporarily if significant over-dimension loads need to pass through, or for future maintenance purposes.

Similarly, the affected private landowners on either side of the bridge position have been consulted on the potential walking and cycling path connections to the bridge. Both parties expressed positive feedback and were not opposed to the concept. Land for the paths would need to be purchased or made legally accessible to the public in some way, and the alignment on the west side would need to work in with the rural-residential development plans that the zone allows for.

Overall, Alternative Option 2A appears to be the preferred solution given it is mostly off road, and direct to the school. Option 1 has significant engineering challenges for providing a shared path through the Ohinewai Interchange, and more complexity and risk relating to the safety of pedestrians and cyclists crossing the on and off ramps. However, further investigations and consultation with NZTA and landowners is required to assess the feasibility of both alternatives before deciding on one.

The key outcome for the purposes of rezoning the APL land is that there are two potential solutions for safe pedestrian and cycling connectivity from the eastern to the western side of Ohinewai.

7.5.2. *Ohinewai to Huntly Walking and Cycling Link*

Figure 7-7 below shows an indicative walking and cycling linkage between Ohinewai and Huntly using the Ohinewai South Road (old SH 1) and current SH1 that will be revoked to a Council road following the opening of the Huntly Section of Waikato Expressway in early 2020.

There is significant amount of space in the road reserve that could be transformed to accommodate segregated paths for cycling and walking. However, a fully segregated path would only be possible once SH1 is revoked and the carriageway space reallocated to Council.

An alternative option is for the shared walking and cycling path to be on top of the river stop bank from Ohinewai to Huntly. This is already shown in the Waikato Blueprint as a future ambition for the district.

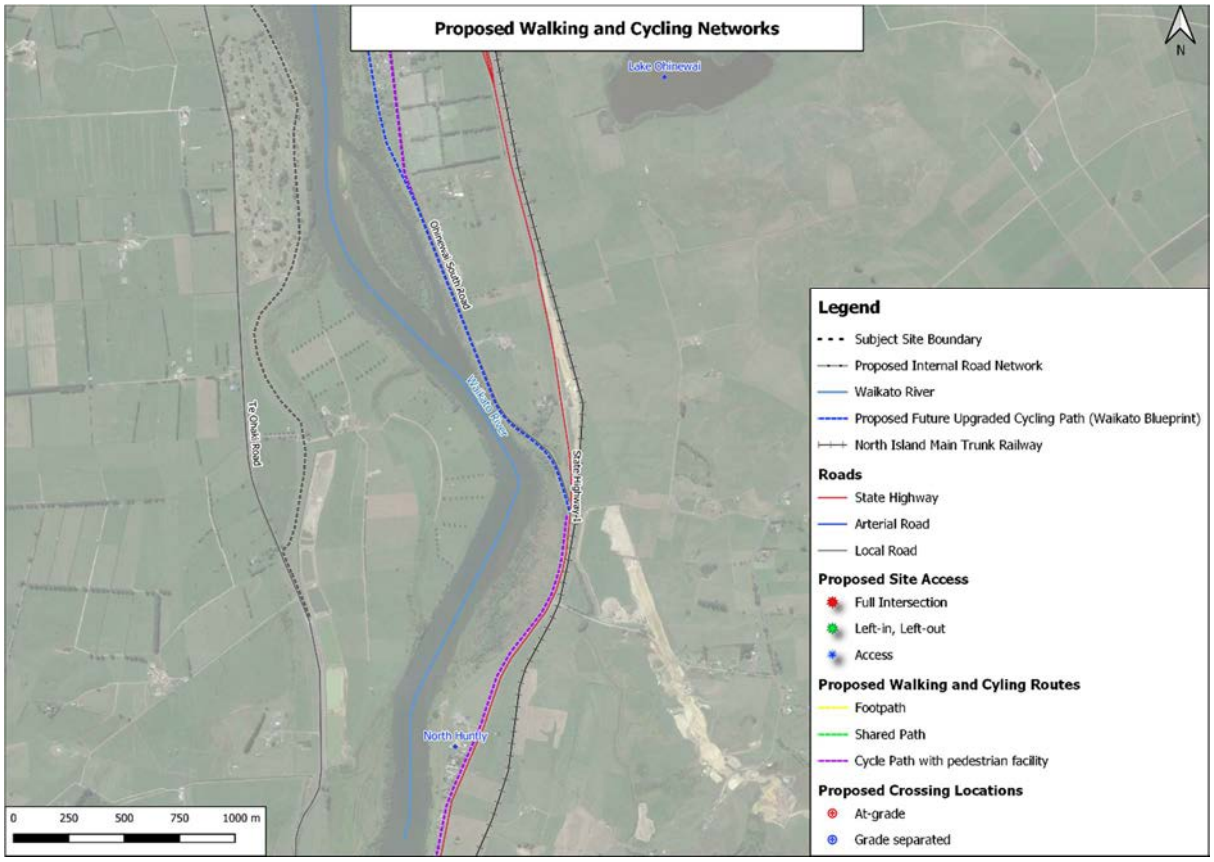


Figure 7-7: Proposed Walking and Cycling Networks towards Huntly

8. Other Relevant Rezoning Submissions

This section of the report relates to other rezoning submissions within the Ohinewai area and the implications on the provision of transport infrastructure required for the APL development. These rezoning submissions include:

- The Ohinewai Lands Limited (OLL) submission which relates to land located south of the proposed Sleepyhead Estate development on Tahuna Road; and
- The Shand Properties Limited (SPL) rezoning submission which relates to land located to the west of the Expressway on Ohinewai North Road.

Given the proximity of these rezoning proposals to the proposed APL development as well as the SH1 Ohinewai Interchange, these submissions have been considered as part of this Integrated Transport Assessment (ITA) report.

8.1. Shand Properties Limited

The Shand Properties Limited (SPL) rezoning submission relates to land located to the west of the Expressway on Ohinewai North Road. SPL is requesting to change the zoning of the site from Rural Zone to Country Living Zone to allow for the development of approximately 100 residential lots. Figure 8-1 below shows the location and extent of the proposed SPL rezoning).

Figure 8-1: Proposed Shand Properties Ltd Rezoning Proposal (Source: SPL Rezoning TIA report, 2018)

8.1.1. Trip Generation and Distribution

The expected trip generation for the SPL site was based on the Traffic Impact Assessment (TIA) report that was prepared by Tonkin & Taylor in October 2018.

The report estimates a daily trip generation of approximately 1,000 vehicles based on the development potential of 100 lots with a single dwelling on each, and a peak traffic generation

of 100 peak hour trips (based on the assumption that the peak hour traffic is typically 10% of the daily traffic).

The TIA report also assumes that the majority of vehicles will leave the site during the morning and return in the evening (80/20 split) based on the nature of the site being rural–residential and remote.

The TIA report assumes the following trip distribution split:

- 60% north via State Highway 1,
- 30% south via State Highway 1, and
- 10% east via Tahuna Road.

For purposes of this report, however, the trip distribution figures provided in Section 6.4 of this report were applied. Table 8-1 below provides the estimated number, and distribution, of trips that are expected to be generated by the proposed rezoning proposal.

Table 8-1: Expected Trip Generation - Shand Properties Ltd Rezoning Submission

	AM Peak Hour (vph)		PM Peak Hour (vph)	
Trip Distribution	In	Out	In	Out
North	7	28	28	7
South	12	48	48	12
East	1	4	4	1
Total	20	80	80	20

8.1.2. Intersection Effects Assessment

Modelling was undertaken to understand the impact on the capacity of the road network, if any, in the 2031 future year with the APL development and SPL rezoning scenario.

The results from the capacity assessment are summarised in Table 8-2. The capacity assessment was based on the intersection upgrades that were proposed and discussed in Section 7.1.6.

Table 8-2: Performance Results - 2031 Future Year with the Proposed APL and SPL rezoning traffic

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Layout Option 1							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.0	7.3	A	13.2	20.5	B
	East: Tahuna Rd	6.4	0.0	A	6.5	0.0	A
	West: Tahuna Rd	6.9	4.3	A	11.2	4.3	B
	Intersection	7.7	7.3	A	10.6	20.5	B
Intersection 2: SH1 Ohinewai Interchange –	East: Tahuna Rd	3.4	0.0	-	3.5	0.0	-
	North: Off-ramp	13.4	5.0	B	21.6	17.4	C
	West: Tahuna Rd	4.5	6.4	-	4.3	7.5	-

Intersection	Approach	AM Peak Hour			PM Peak Hour		
		Delay (sec)	Queue (m)	LOS	Delay (sec)	Queue (m)	LOS
Eastern Leg (Stop Control)	Intersection	5.9	6.4	-	8.0	17.4	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	4.1	5.7	A	6.7	6.9	A
	North: Lumsden Rd	9.4	2.3	A	19.2	21.8	B
	West: Tahuna Rd	3.0	10.8	A	2.9	26.7	A
	Intersection	4.3	10.8	A	8.7	26.7	A
Layout Option 2							
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	9.7	11.1	A	28.7	55.7	C
	East: Tahuna Rd	6.4	0.0	A	6.5	0.0	A
	West: Tahuna Rd	7.5	5.4	A	14.7	6.8	B
	Intersection	8.1	11.1	A	19.4	55.7	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Traffic Signal)	East: Tahuna Rd	20.8	38.1	C	28.7	73.5	C
	North: Off-ramp	19.2	13.1	B	24.4	28.0	C
	West: Tahuna Rd	23.6	60.0	C	31.9	118.9	C
	Intersection	21.4	60.0	C	28.7	118.9	C
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	4.0	3.7	A	6.6	4.7	A
	North: Lumsden Rd	9.9	2.3	A	25.2	23.9	C
	West: Tahuna Rd	3.0	9.7	A	2.9	26.2	A
	Intersection	4.4	9.7	A	10.6	26.2	B

The capacity analysis results were as follows (refer to Table 8-2):

SH1 Ohinewai Interchange:

- Layout Option 1: Both the western and eastern ramp intersections are expected to operate at acceptable levels of service during both the AM and PM peak periods. No further capacity upgrades are anticipated for the interchange with the additional SPL rezoning traffic.
- Layout Option 2: Both the western and eastern ramp intersections are expected to operate at acceptable levels of service during both the AM and PM peak periods. No further capacity upgrades are anticipated for the interchange with the additional SPL rezoning traffic.

The Tahuna Road & Lumsden Road intersection:

This intersection is expected to operate at acceptable levels of service during both the AM and PM peak periods. No further capacity upgrades are anticipated for the interchange with the additional SPL rezoning traffic.

8.1.3. Sensitivity Assessment with the SPL rezoning proposal

Sensitivity testing was conducted for the SPL rezoning proposal as described in Section 7.1.7 of this report. Table 8-3 provides a summary of the scenarios that were analysed, while Table 8-4 provides the LOS summary for the evaluated scenarios.

Table 8-3: Sensitivity Testing - Assessment Scenarios with the APL and SPL rezoning traffic

Scenario	APL Trip Generation & Distribution Assumptions	SPL Trip Generation & Distribution Assumptions
Scenario 1	No adjustment for shift work	No change in the base assumptions
Scenario 2	External distribution – 60% north	Adjusted external distribution – 60% north
Scenario 3	External distribution – 80% south	Adjusted external distribution – 80% south
Scenario 4	Freight trips – 80% via road network	No change in the base assumptions
Scenario 5	Lower adjustment for mixed-use development	No change in the base assumptions

Table 8-4: Sensitivity Analysis – LOS Summary for SPL Scenario Testing (2031 Future Year with the Proposed APL and SPL rezoning traffic)

Intersection	Approach	Test 1		Test 2		Test 3		Test 4		Test 5	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Layout Option 1											
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	A	B	A	B	A	B	A	B	B	C
	East: Tahuna Rd	A	A	A	A	A	A	A	A	A	A
	West: Tahuna Rd	A	B	A	B	A	B	A	B	A	B
	Intersection	A	B	A	A	A	B	A	B	A	B
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Stop Control)	East: Tahuna Rd	-	-	-	-	-	-	-	-	-	-
	North: Off-ramp	B	C	B	C	B	D	C	D	C	F
	West: Tahuna Rd	-	-	-	-	-	-	-	-	-	-
	Intersection	-	-	-	-	-	-	-	-	-	-
Intersection 3: Tahuna Road and Lumsden Road (Roundabout)	East: Tahuna Rd	A	A	A	A	A	A	A	B	A	A
	North: Lumsden Rd	A	C	A	B	A	C	A	C	A	E
	South: Off-ramp	A	A	A	A	A	A	A	A	A	A
	East: Tahuna Rd	A	A	A	A	A	A	A	B	A	B
Layout Option 2											
Intersection 1: SH1 Ohinewai Interchange – Western Leg (Roundabout)	South: Off-ramp	A	E	B	C	A	F	B	E	B	F
	East: Tahuna Rd	A	A	A	A	A	A	A	A	A	A
	West: Tahuna Rd	A	C	A	B	A	A	A	B	B	C
	Intersection	A	B	A	B	A	F	A	C	A	F
Intersection 2: SH1 Ohinewai Interchange – Eastern Leg (Traffic Signal)	East: Tahuna Rd	C	C	B	C	C	D	C	C	C	C
	North: Off-ramp	B	C	B	B	C	C	B	C	C	C
	West: Tahuna Rd	C	C	C	C	C	D	C	C	C	C
	Intersection	C	C	B	C	C	C	C	C	C	C
Intersection 3: Tahuna Road	East: Tahuna Rd	A	A	A	A	A	A	A	A	A	A
	North: Lumsden Rd	A	C	A	C	B	C	B	C	B	E

Intersection	Approach	Test 1		Test 2		Test 3		Test 4		Test 5	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
and Lumsden Road (Roundabout)	South: Off-ramp	A	A	A	A	A	A	A	A	A	A
	East: Tahuna Rd	A	B	A	B	A	B	A	B	A	B

The following can be concluded based on the results outlined in Table 8-4:

SH1 Ohinewai Interchange – Layout Option 1:

Overall, it is expected that the proposed upgrades to the eastern ramp intersection will be sufficient even with the inclusion of the SPL rezoning traffic. As discussed in Section 7.1.7, the APL rezoning traffic alone will trigger additional upgrades to the interchange if Scenario 5 were proved correct (the scenario assumes that more than 80% of the trips that are expected to be generated by the development will be external trips (i.e. travel/ originate outside of the proposed development)). As previously explained, this scenario is unlikely to occur as the proposed land-uses within the mixed-use development were developed with the intention of supporting the NZCG factory, so a notable portion of the trips that are expected to be generated by the proposed development are likely to remain within the development. However, should the 80% external trips become reality, the intersection would have to be signalised and more lanes added as per Option 2.

SH1 Ohinewai Interchange – Layout Option 2:

The performance of the western ramp intersection is expected to deteriorate significantly for four of the five scenarios that were tested. This as a result of the long queues at are formed on the western approach of the signalised eastern ramp intersection.

As discussed in Section 7.1.7, the APL rezoning traffic alone will trigger additional upgrades to the interchange if Scenarios 3 and 5 were proved correct (these triggers and upgrades are discussed in Section 7.1.7) - the performance of the western ramp intersection can be improved by providing additional capacity on the western approach (i.e. an additional through-lane at the intersection) of the eastern ramp intersection. This would, however, require widening the Tahuna Road overbridge from two lanes to at least three lanes.

The addition of SPL's rezoning traffic to the road network will trigger upgrades to the western ramp intersection if Scenario 1 (the scenario assumes that all 1,500 factory workers will arrive at the factory during the morning peak period, and depart during the afternoon period) and Scenario 4 (this scenario assumes that at least 80% of all freight trips to the industrial hub will be made via the road network) were proved correct; the performance of the western ramp intersection can be improved by providing additional capacity on the southern approach (i.e. the addition of an exclusive left-turn lane at the intersection). This can be addressed by SPL at the appropriate time of their development.

Tahuna Road & Lumsden Road Roundabout:

The proposed upgrades to the roundabout would be sufficient to accommodate four of the five scenarios that were tested. The APL rezoning traffic alone will trigger additional upgrades to the interchange if Scenario 5 were proved correct. These triggers and upgrades are discussed in Section 7.1.7.

8.1.4. *Other Transport Modes*

Public Transport

The SPL site is over 1 km from the commercial precinct of APL so it is unlikely that the public transport proposals discussed in Section 7.4 would be attractive to residents of the SPL development.

Walking and Cycling

Walking and cycling linkages between the APL and SPL sites are envisaged as utilising the shared path as proposed in either Option 1 or Option 2 (paths across SH1) (refer to Section 7.5).

8.2. Ohinewai Land Limited

Ohinewai Lands Limited (OLL) propose a 'future development area' on a site to the south of the development site that would require a private Plan Change at some time in the future.

OLL are not seeking a 'live-zone' and the development timeframes are unknown at this stage. Accordingly, it is recommended that OLL provide for their own transportation assessments at the relevant time of their proposed Plan Change, and if necessary, infrastructure upgrades are provided for at that time.

9. Construction Traffic Management

Construction of the proposed APL site and the internal road network is expected to occur in stages starting with ground improvements in 2019 through to completion approximately by 2028. However, this 10 year development period is subject to market conditions. Based on a preliminary geotechnical investigation, it expected that signification volumes of clean fill material will be imported during this 10-year period from off-site to lift the ground levels above the existing site levels as there is unlikely to be enough fill available from designated "cut" area.

The clean fill material is expected to be sourced from several quarries within the Waikato Region and transported to site using 50MAX truck-and-trailer units. Given the proximity of the nearest quarries to the site are also near SH1 expressway, it is expected that most, if not all, of the truck-and-trailer units hauling fill material will access the site via the Ohinewai Interchange and Tahuna Road. The ground improvement earthworks, subdivision and building construction activities will all temporarily increase traffic volumes at various stages throughout development, on the expressway, Tahuna Road and Lumsden Road. Separate resource consent applications and Construction Traffic Management Plans (CTMP) for each phase of works will be required to determine, quantify and mitigate any transportation related effects of construction traffic.

However, an overarching principle for the bulk import fill phase of earthworks in particular is to minimise amenity effects on residents on Lumsden Road opposite the site. This will be achieved by requiring access to the site from purpose built accesses (either temporary or at future permanent intersection locations) on Tahuna Road, connecting to internal haul roads. The importation of fill material will be restricted to the temporary access(es) on Tahuna Road

and the proposed haul road. The proposed temporary access(es) should be constructed as per the RITS standards for heavy commercial rural entranceways. The location and access design will be subject to planning and engineering approvals from Waikato District Council.

10. Travel Demand Management

Travel Demand Management (TDM) refers to methods to reduce the need to travel as well as reducing short private vehicle trips. TDM is about providing greater choices of sustainable transportation options to the public, thereby spreading all trips over more travel modes and over more times of the day or removing the need to travel at all. TDM therefore also helps to reduce the impact on the environment by reducing the level of carbon produced by travel.

The proposed land uses within the proposed mixed-use development make it such that it reduces the need for external private vehicle trips, with the potential for trips to be made using alternative modes of transport such as walking and public transport.

The location of the proposed development is close to the existing regional public transport route and the Huntly passenger rail station, which makes it convenient for the proposed NZCG factory workers to use these modes of transport to get to work.

The proposed pedestrian and cycle facilities, which will link the Ohinewai and Huntly areas, will encourage the use of alternative methods of transport (e.g. bicycles (electric and manual), scooters, etc.).

The proximity of the NIMT also allows utilisation of rail for freight trips. This will have the effect of reducing the overall road-based trip to/from the proposed development.

11. Staging of Transportation Infrastructure Improvements

This section of the report provides a summary of the staging, and associated triggers, for the recommended transportation infrastructure improvements. The recommended improvements are based on the findings from the transportation effects assessments that were undertaken in the preceding sections of the report.

The triggers associated with each improvement are related to one or both of the following:

- Safety improvements associated with the subdivision and/or development of specific land use areas.
- Capacity and safety improvements associated with the advancement of the proposed development stages of the plan change. These improvements relate to the associated number of trips that are expected to be generated and distributed on the local road network as the site is successively developed.

Table 11-1 below provides the staging of the proposed transportation infrastructure upgrades associated with this rezoning submission.

Table 11-1: Proposed Staging of Transportation Infrastructure Improvements with the APL rezoning submission

No.	Proposed Intervention	Indicative Timing	Development Stage Trigger	Commentary
1.	Upgrading of Lumsden Road to urbanised industrial formation	Short-term Years 1-3	To coincide with the subdivision of the general industrial lots (after the development of the Stage 1 NZCG Factory but prior to development of Stage 2).	The environment along Lumsden Road is expected to change from the existing rural environment to a peri-urban industrial environment with the subdivision and subsequent development of the industrial lots. A recommendation of this ITA is that the speed limit is reduced from the existing 100km/h to 70km/h. Works involve upgrading Lumsden Road in line with the proposed road cross-section to match the changed road environment, and includes walking and cycling provisions. The upgrade may include the construction of the proposed site accesses/intersections on Lumsden Road (dependant on development extents)
2.	Upgrading of Tahuna Road to peri-urban formation	Short-term Years 1-3	To coincide with the subdivision of the commercial/ business and residential zones.	The environment along Tahuna Road is expected to change from the existing rural environment to a semi-rural environment as part of the subdivision and subsequent development of the first commercial and residential lots bordering Tahuna Road. A recommendation of this ITA is that the speed limit is reduced from the existing 100km/h to 70km/h. Works involve upgrading Tahuna Road in line with the proposed road cross-section section to match the changed road environment, and includes walking and cycling provisions. The upgrade also includes the construction of proposed site accesses/intersections on Tahuna Road.
3.	Upgrading of Balemi Road	Short-term Years 1-3	To coincide with the construction of Stage 1 of the NZCG Factory.	Widening (to a minimum of 6m) and sealing of the road carriageway will be required to enable access to the factory.

No.	Proposed Intervention	Indicative Timing	Development Stage Trigger	Commentary
4.	Pedestrian and cyclist bridge over SH1 Expressway, connecting to Ohinewai South Road	Short-term Years 1-3	To coincide with the development of the first residential lots and provision of shared paths along Tahuna Road and Lumsden Road.	Walking and cycling linkages over SH1 will be necessitated with the development of the first residential lots. These paths will link the development with Ohinewai Village and Primary School and Huntly. Two options are proposed for consideration: **Option 1:** A pedestrian & cyclist route through at the Ohinewai Interchange. This will require signalisation of the eastern ramp intersection, widening of the NIMT overbridge, widening of the southbound ramp embankment, and providing a signalised pedestrian crossing along the northbound on-ramp. **Option 2:** A pedestrian & cyclist overbridge approximately 300m to the south of the Ohinewai Interchange. This will require providing pedestrian & cyclist paths through private owned land to the south of Tahuna Road. No further intersection upgrades will be required.
5.	Upgrading of the Tahuna Rd & Lumsden Rd intersection, if required	Long-term Years 8-10	±1,400 peak hour trips generated by the development (to coincide with full development of the NZCG factory, light industrial and commercial/retail lots based on the assumed trip generation and distribution figures).	Capacity modelling indicates that an additional right-turn lane will be required on the northern approach (Lumsden Road) to support the proposed land-uses along Lumsden Road.
6.	Upgrading of the eastern ramp intersection (only required if the intersection is not signalised as described in Intervention 4. above).	Long-term Years 8-10	±1,700 peak hour trips generated by the development (to coincide with full development of the site, including all residential lots, based on the assumed trip generation and distribution figures)	Capacity modelling indicates that an exclusive right-turn lane will be required on the southbound off-ramp, to allow more capacity for left turn movements. This will likely require widening of the ramp embankment.
Potential upgrades if sensitivity test scenarios prove correct				
7.	Signalisation of the Tahuna Rd & Lumsden Rd intersection	-	Based on sensitivity testing – triggered when the factory, light industrial lots and commercial/retail hub all generate over 20% more peak trips that what this ITA	Capacity modelling indicates that additional capacity will be required on the northern approach. This upgrade could potentially involve implementing metering signals

No.	Proposed Intervention	Indicative Timing	Development Stage Trigger	Commentary
			estimates.	at the roundabout. Separate ITA reports will be required for each stage of the proposed development to assess whether this upgrade will be warranted, the timing for it, and design details.
8.	Signalisation (& further upgrading) of the eastern ramp intersection	-	Based on sensitivity testing – triggered when the entire proposed development (industrial, commercial and residential) generates over 30% more peak hour trips than what this ITA predicts as the expected volume.	Capacity modelling indicates that additional capacity will be required at the eastern ramp intersection to cater for the increased vehicle volumes. For this volume of traffic, the intersection will likely need to be signalised and four-lanes provided between the intersection and Lumsden Road roundabout. As a minimum, this will entail replacing the bridge over the NIMT (to a new four lane structure) and at worst, also widening the Tahuna Road overbridge (from two lanes to at least three lanes). Separate ITA's will be required for each stage of the proposed development to assess whether this upgrade will be warranted, and the timing and specific design details.

12. Strategy and Policy Assessment

There are a number of national and regional transportation strategies and policies that influence transportation investment in the Waikato Region. Those most relevant to the proposed re-zoning are discussed below.

12.1. National

12.1.1. Government Policy Statement on Land Transport 2018/19 - 2027/28 (Draft)

The Government Policy Statement (GPS2018) outlines this Government's priorities for expenditure from the National Land Transport Fund over the next 10 years. It also provides guidance to decision-makers about where the Government will focus resources, consistent with the purpose of the Land Transport Management Act, which is:

"To contribute to an effective, efficient, and safe land transport system in the public interest."

GPS2018 identifies new strategic priorities and amended objectives to the previous GPS, with themes focussed on safety, mode neutrality, liveable cities, regional economic development, protecting the environment, and delivering the best possible value for money.

Accordingly, the key strategic priorities of the GPS2018 are defined as Safety and Access, with supporting strategic priorities of Value for Money and Environment protection. These are defined further as follows:

- *Safety: A safe system, free of death and serious injury;*
- *Access: Provides increased access to economic and social opportunities, enables transport choice and is resilient;*
- *Value for Money: Delivers the right infrastructure and services to the right level, at the best cost;*
- *Reduces the adverse effects on the climate, local environment and public health.*

Further explanation of the Themes in the GPS2018 to assist with delivering the strategic priorities are:

- *Addresses current and future demand for access to economic and social opportunities;*
- *Provide appropriate transport choices;*
- *Is resilient;*
- *Is a safe system, increasingly free of death and serious injury;*
- *Mitigates the effects of land transport on the environment; and*
- *Delivers the right infrastructure and services to the right level at the best cost.*

12.1.2. Connecting New Zealand (2012)

Connecting New Zealand (2012) was prepared by the NZ Transport Agency to provide an overview of the government's broad policy direction for the transport sector from 2012 to 2022. The overall objective for transport is as follows:

"The government is seeking an effective, efficient, safe, secure, accessible and resilient transport system that supports the growth of our country's economy, in order to deliver greater prosperity, security and opportunities for all New Zealanders."

12.1.3. The Transport Outlook 2017

The Transport Outlook 2017 provides an overview of what we can expect by way of traffic movements in the future. The population is expected to grow consistently over the next 50 years which will create additional demand on New Zealand's transport networks. Of particular relevance to this proposal is the projected increase in freight movements and general traffic movements on Waikato's Transport network.

12.1.4. NZTA Statement of Intent 2017-2021

This statement of intent presents a new direction for the NZ Transport Agency. Over the next three to five years the Transport Agency aims to deliver three big changes that form the foundation of this new direction:

- One connected transport system: Transform the performance of the land transport system by integrating digital technology with physical infrastructure to create a safe, connected system that works for everyone.
- People-centred services: Simplify our customers' lives and our partners' work with innovative services and experiences that make it easy for them to do what they need to.
- Partnerships for prosperity: Unlock social and economic opportunities for customers, businesses and communities through targeted partnerships.

12.1.5. New Zealand Transport Agency Long Term Strategic View

The Long-Term Strategic View captures the pressure points and key economic, environmental, and population factors that will shape the transport system we need for the future.

12.1.6. National Land Transport Programme 2015-2018

The National Land Transport Programme provides an overview of the investment expected between 2015 and 2018 and what this spending will be focused on achieving. The National Land Transport Fund's investment is aimed squarely at improving economic growth and productivity, safety, and value for money. This reflects the strategic direction set by the 2015 Government Policy Statement on land transport as stated above.

12.2. Regional

12.2.1. The Waikato Plan 2017

The Waikato Plan was created as a collaborative effort between the Waikato Councils, the Central Government and other private and public agencies. The Plan provides an overview of the important issues that affect the region now and are likely to affect the region over the next 30 years. The plan provides strategic guidance and advocacy to multiple agencies across the Waikato Region. Of particular relevance in this instance is priority 2 which is:

"Connecting our communities through targeted investment - To maximise our resources and access what we need, we must be able to connect with others quickly, safely and efficiently. Whether by road, rail, air or via new technology, the Waikato Plan will ensure we have the right infrastructure in the right place, at the right time so our people and economy can succeed and prosper."

12.2.2. 2018 Update to the Waikato Regional Land Transport Plan (WRLTP) 2015-2045

The 2018 update of the WRLTP, builds on the 2015 Plan. As a mid-term review, it focuses in particular, on the regions key transport problems and priorities over the next three years, leading up to a full review of the plan in 2021. The plan is built around the regions three key transport problems, being:

- *Protecting the function of our strategic corridors in the context of growth pressures in and around Hamilton, the North Waikato and in the upper North Island;*
- *Tackling our complex road safety problem and the disproportionate number of deaths and serious injuries in the region*
- *Providing for the access and mobility needs of our communities in a changing social, demographic, economic and technological landscape.*

12.2.3. Waikato Regional Public Transport Plan 2015 – 2025

The Waikato Regional Public Transport Plan is a strategic document that sets the objectives and policies for public transport in the region and contains details of the public transport network and development plans between 2015 and 2025. The plan builds on the strategic direction for transport established through the Waikato Regional Land Transport Plan 2015-2045 (detailed above), and aims to deliver an effective, efficient and integrated public transport system for the people of Waikato. The overall goal set-out in this plan is as follows:

"A growing and affordable public transport system that contributes to the economic, social and environmental vitality of the region."

12.3. District

12.3.1. Waikato District and Local Area Blueprints 2019

The WDC commissioned the development of a Blueprint for the district to provide a high-level spatial picture of how the district could progress over the next 30 years, address the community's social, economic and environmental needs, and respond to its regional context. The Waikato District Blueprint works to achieve the overall vision established by the Council for the district:

"Liveable, Thriving and Connected Communities."

Of the nine district-wide themes that were developed, the following are the most relevant in this instance:

- Theme 4: Communities – Strengthen, enable and connect local communities and citizens, and support those in need.

- Theme 6: Economy – Support the rural and urban economy, attract more visitors and employment uses.
- Theme 7: Transport – Leverage value off accessibility, help those disadvantaged by the lack of transport options, prepare for the future passenger rail.

12.4. Commentary

It is considered that the proposal is consistent with the above strategies and policies, for the following reasons:

a) The development will support economic growth in the region by providing access to more industrial land that can be developed, which will lead to more jobs and increased prosperity. This is in line with numerous national, regional and district policies.

b) The development provides for mode neutrality by providing walking and cycling infrastructure within the development and also on the surrounding network to enable connections to the existing Ohinewai Village and School. Linkages south to Huntly are also encouraged by connections enabled by the development.

c) In relation to the NZ Statement of Intent, it is considered that 'partnerships for prosperity' is the only change relevant to the proposal and that consenting of the development will contribute to the social and economic opportunities for the future industrial activities expected to be established in Ohinewai and the Huntly area.

d) The proximity of the North Island Main Trunk rail line allows utilisation of rail for freight trips which will reduce the overall demand on the road network.

e) The proximity of the proposed development to the proposed Huntly passenger rail station and the existing regional bus service, as well as the proposed pedestrian and cycle facilities provided between the site, Ohinewai Village and Huntly, ensures that the development is suitably connected to multi-modal travel, helping to reduce demand on roads and facilitate future sustainability.

13. Stakeholder Engagement

13.1. NZ Transport Agency

Consultation with the NZ Transport Agency has been undertaken during the development of this ITA report. The NZ Transport Agency advised that the following matters would need to be considered and/or addressed as part of the ITA:

- In the absence of the WRTM model demands, that the traffic effects assessment should be based on fairly conservative assumptions (in terms of traffic generation and distribution) and take adequate account of future growth.
- The effects of the proposed development on the wider transportation network – the assessment of the wider transport network should not be limited to Ohinewai Village; the assessment needs to include Te Kauwhata in the north and Huntly in the south as the rezoning proposal relies on these adjoining townships. The wider transportation network effects will be assessed once the projected WRTM demands are available (in early 2020).

- The safety of the proposed signalised pedestrian crossing on the northbound on-ramp, particularly regarding the approach speed of the northbound vehicles.

These matters have been considered as part of this report.

13.2. KiwiRail

Consultation with KiwiRail has been undertaken in relation to the proposed rail siding access and level crossing design requirements. KiwiRail has indicated their support for a new rail siding connecting into the site from the NIMT, and that they support in principle a suitable, approved level crossing on Lumsden Road as necessary in order for the new site to be accessed by rail. A copy of that correspondence is included in Appendix H.

KiwiRail stated that such connectivity will enable the APL to utilise rail instead of road for the movement of their freight, which then provides NZ Inc with significant other associated benefits such as reductions in CO2 emissions, safer roads with less congestion, reduced road maintenance costs, greater productivity and export capability etc.

13.3. Waikato District Council

Consultation has been undertaken with Waikato District Council during the development of this draft ITA. The following preliminary comments were provided by Council staff:

- The approach curvature for the proposed s-bend on Lumsden Road needs to match the existing speed environment and not out of context.
- Council's position on road designation is set on what is in the district plan and RITS; consideration for deviation from this is only if there are significant constraints/ topography, etc.
- Safe speeds and future road environment - the NTZA speed management guide should be considered in relation to the applicable safe speeds that can be provided on the adjoining road network.

These matters have been addressed in this report.

14. Conclusions

The following key conclusions are drawn from this assessment of the proposed re-zoning and development enabled by the Ohinewai Structure Plan:

- The proposed mixed-use development will consist of a 63ha industrial hub with 52ha of residential development and 8.7ha of commercial development. The proposed development is expected to generate approximately 1,100 and 1,700 vehicle trips during the AM and PM peak hours respectively, with only 2% of the total peak hour trips being heavy commercial vehicles.
- A 2031 assessment year was applied (application year plus 10 years). Further analyses will be conducted, likely in early 2020 once the 2018, 2031 and 2041 WRTM demand data become available.

- The road network peak periods were between 08:00 and 09:00 for the AM peak, between 16:45 and17:45 for the PM peak, and between 11:00 and 12:00 for the Saturday peak.
- Given the extent of the proposed land-use changes, as well as the increases volumes on the external road network, the speed environment along Tahuna Road and Lumsden Road is expected to change from rural to semi-urban/ industrial. The speed limit along both roads is recommended to be reduced from 100km/h to 70km/h (or less).
- A network of internal roads (collector and local roads) to service the development has been developed. The internal roads are configured in a grid-network formation based around the site's geotechnical constraints, connectivity between the different land use areas, and connection to the existing external road network (Tahuna Road and Lumsden Road). The configuration avoids the need for heavy traffic to use the residential streets while at the same time providing a high degree of connectivity between the land uses, including for active transport such as walking, cycling, scooters etc.
- Access to the mixed-use development will be via various new road intersections on Tahuna Road, Lumsden Road, and Balemi Road. New accesses and intersections will be located and designed in accordance with Council standard sas provided in Appendix A of the Waikato District Plan, and Austroads geometric design guidelines Part 4a and b.
- A rail siding, which will connect the industrial hub to the adjacent NIMT, is proposed as part of the development. Specific design details are yet to be determined but conceptual design to KiwiRail requirements shows that the rail siding can be safely achieved with a series of back to back horizontal curves on Lumsden Road to Austroads design guidelines, and a suite of active safety measures to reduce vehicle speeds before the curves and at the level crossing.
- The surrounding road network will not have sufficient capacity to accommodate the additional traffic if our conservative assumptions about trip generation, distribution and percentage of external trips prove true. The eastern ramp intersection of the SH1 Ohinewai Interchange and the Tahuna Road & Lumsden Road intersection are expected to operate at poor levels of service (i.e. LOS E and worse) in the peak hour with the additional site traffic added to the 2031 Baseline.
- Sensitivity testing for higher trip generation values and varying trip distribution figures indicates as expected, that improvement works will likely be required earlier with less development completed. Given the assumptions, these intersections should be upgraded on a staged basis as traffic generation and assignment becomes realised over time. Staging should be as set out in Table 11-1 to increase the capacity and maintain low levels of safety risk for all transport users.
- Parking should be provided at the ratio listed in Appendix A of the Operative Waikato District Plan, unless a separate resource consent is obtained to reduce the required number of parking spaces for a particular activity on the site. The exact number of parks will need to be determined in the detailed design phase once the exact land use and GFAs for each subdivision are confirmed.

- Approximately 130 commuter trips are expected to be generated by the proposed development during the AM and PM peaks hours; this is equivalent to providing least two in- and outbound buses during each peak period. Given this demand, APL have designed the masterplan to allow for future public transport services to the site to service the local Ohinewai community.
- Walking and cycling linkages are critical for promoting public health and reducing vehicle dependency for short trips. Approximately 250 walking and cycling trips are expected to be generated by the proposed development during the AM and PM peaks hours when the site is full developed. An extensive network of footpaths and shared paths have been recommended as part of the development masterplan and future road cross-sections within the development. This includes shared walking and cycle paths on Lumsden Road and Tahuna Road.
- In addition, it is evident that high quality and convenient walking and cycling connections are required to link the proposed development across SH1 expressway to the Ohinewai village, and also to Huntly. Two possible options have been identified for crossing the SH1 expressway and connecting to the local school, and two options also exist for providing a shared path from this point back to Huntly. The preferred options will be determined as a result of detailed engineering assessments, costings and through collaboration with key stakeholders.
- In addition, a shared active modes path is recommended to link the proposed development to the existing Ohinewai Village, school and through to Huntly. Two options exist for connecting a shared path from the site over the SH1 expressway to Ohinewai Village, and a further two options exist for connecting the path to Huntly.
- APL current expects to develop the site in stages over a 10-year period, although subject to market conditions. The vast majority of construction traffic will access the site via the Ohinewai Interchange and Tahuna Road, with temporary access(es) to the site provided on Tahuna Road. Separate resource consents will be required for each earthworks / construction phase to determine and mitigate the associated transport related effects (including safety effects), if any. The construction traffic effects should be managed for the duration of works through conditions requiring specific Construction Traffic Management Plans.
- The assessment of the Shand Properties rezoning submission has shown that the proposed infrastructure proposed as part of the APL development can account for the Country Living proposed on the west of SH1.
- The Ohinewai Lands submission outlines a long-term development timeframe that is unknown and subject to a further Plan Change process. That process will require a separate ITA report and other environmental effects assessments to be completed.

15. Recommendations

On the basis of this assessment, the following recommendations are made by with regards to the transportation aspects of the proposed APL rezoning and required network upgrades:

Road upgrades and speed limit reductions

Tahuna Road and Lumsden Road are expected to change from the existing rural formation and environment to a peri-urban/ industrial environment as a result of the proposed development and the resulting increased traffic movements (vehicles, pedestrians and cyclists) along both roads.

The following road upgrades and speed limit changes are recommended:

Tahuna Road

- Reduction to 70km/h posted speed limit (or less) from the existing 100km/h speed limit, from the SH1 interchange to the eastern extents of the development.
- Provision of a kerb and channel drainage and shoulder treatment along the side of the road bordering the proposed development (i.e. eastbound carriageway).
- Provision of a shared active modes path with street lighting along the eastbound carriageway
- These are required at the time of development of the commercial lots bordering Tahuna Road.

Lumsden Road

- Reduction to 70km/h (or less) from the existing 100km/h speed limit, from Tahuna Road to 200m north of Balemi Road.
- Provision of a kerb & channel drainage treatment along the side of the road bordering the proposed development (i.e. southbound carriageway) to match the existing northbound kerb and channel.
- Provision of a shared walking and cycling path with street lighting along the southbound side of the carriageway.
- These are required at the first industrial subdivision (and prior to construction of Stage 2 of the NZCG Factory), estimated to be in development Years 1-3.

Balemi Road

- Upgrading Balemi Road (i.e. widening and sealing) to a minimum of six-metre trafficable carriageway width.
- Reduction to 70km/h (or less) from the existing 100km/h speed limit (over full length)
- Provision of a kerb & channel drainage and shoulder treatment along the side of the road bordering the proposed development (i.e. westbound carriageway).
- These upgrades are required with Stage 1 of the NZCG Factory, estimated to be in Year 1.

Intersection Upgrades

Tahuna Road & Lumsden Road intersection

- An additional right-turn lane will be required on the northern roundabout approach once approximately 1,400 peak hour trips are generated by the proposed development.
- This corresponds to full development of the industrial and commercial areas, and only partial development of the residential lots estimated to be in development Years 8-10.

Balemi Road and Lumsden Road intersection

- The eastern leg of the intersection (i.e. Balemi Road) be upgraded (i.e. widened and sealed) to a minimum six-metre trafficable carriageway width.
- The realigned rural intersection be formed in accordance with the requirements set out in the Waikato District Plan and the Regional Infrastructure Technical Specifications (RITS).
- This corresponds to development of the NZCG factory estimated to be in development by Years 1-3.

Ohinewai Interchange Upgrades

Southbound off ramp

- An additional right turning lane on southbound off ramp is required once approximately 1700 peak hour trips are generated by the proposed development.
- This corresponds to full development of the industrial and commercial areas estimated to be in development Years 8-10.
- Note, this upgrade does not provide for walking and cycling requirements for the Interchange.
- The sight distance for drivers shall be improved prior to operation of the NZCG factory and/or industrial hub. The improvement shall be as much as practicable through vegetation removal and structural modifications to the bridge railings that obstruct sight lines on either side of the intersection.

Lumsden Road and Rail Siding

To enable the implementation of the proposed rail siding in accordance with KiwiRail standards, the following upgrades to Lumsden Road are recommended:

- Introducing a series of back to back horizontal curves in the otherwise straight alignment, with speed reduction measures including:
  - Reduced the speed limit to 70 kph (or less) via gated sign speed threshold treatments on both approaches of Lumsden Road
  - Narrowing the carriageway cross-section,
  - Implementing kerb & channel on both sides,
  - Installing roadside barriers, chevron boards and speed advisory signs

- installing rumble strips perpendicular to traffic flow on the southbound approach prior to the first horizontal curve
- Signal control, with flashing lights, bells and barrier arms are recommended for the proposed level crossing due to the limited approach visibility that is available.

- These changes to the road configuration are recommended as part of the rail siding and level crossing construction works.

Walking and Cycling Infrastructure

Design and construction of each stage include the extensive network of footpaths and shared paths identified in the development masterplan and future road cross-sections within the development. This includes shared walking and cycle paths on Lumsden Road and Tahuna Road.

In addition, construction of the shared active modes path is recommended to link the proposed development to the existing Ohinewai Village, school and through to Huntly. The preferred option of the following two options for connecting from the site over the SH1 expressway to Ohinewai Village, should be determined and implemented following detailed anaylsis, costing and collaboration with key stake holders (Ohinewai community, Waikato District Council, NZ Transport Agency and Waikato Regional Council).

- Option 1 – Walking and cycling path along the SH1 Ohinewai Interchange with signal control. This requires the replacement of the NIMT overbridge with a four as well as widening the southbound off ramp embankment. Pedestrian and cyclist crossing phases will be required at the signals.
- Option 2 – A new purpose built walking and cycling bridge spanning the NIMT and SH 1 Expressway, at a location approximately 315m south of the SH1 Ohinewai Interchange.

The preferred connection over the expressway solution should be implemented prior to the completion of the first stage of residential development, estimated to be in development Years 1-3.

The preferred option of the following two options for walking and cycling connection to Huntly should be determined and implemented following detailed anaylsis, costing and collaboration with key stake holders (Ohinewai community, Waikato District Council, NZ Transport Agency and Waikato Regional Council).:

- Option 1: Utilising the ample space on the Ohinewai South Road (old SH 1) and current SH1 corridor that will be revoked to a Council road following the opening of the Huntly Section of Waikato Expressway in early 2020. Both corridors could be transformed to provide a segregated walking and cycling path in addition to narrowed traffic lanes and redeveloped berms
- Option2: A shared walking and cycling path be constructed on top of the eastern stopbank of the Waikato River, from Ohinewai to Huntly. This is already shown in the Waikato Blueprint as a future ambition for the district.

The preferred option should be identified and implemented in collaboration with Waikato District Council, NZ Transport Agency and Waikato Regional Council.

Public Transport

Public transport is promoted within the site through the provision of a bus stop facility located within the proposed commercial precinct. An additional stop is proposed for the eastern residential areas - this will ensure that commuters in these areas do not have to travel longer distances (more than 1km) to access the bus service.

Although current thinking by Waikato Regional Council is that future PT services should not extend into the development site, APL will not preclude such services across development stages in case the thinking changes in future. In the interim period before the development is completed, an alternative may be to provide a bus stop on Tahuna Road between the interchange and Lumsden Road as this would enable the bus to then U-turn at the proposed roundabout and return quickly to the expressway via the interchange on ramp (refer to Figure 5-6).

Given the proximity of the Huntly rail station and its services to both Hamilton and Auckland (proposed mid 2020), a park-and-ride service could be provided from the development's proposed bus stop facility to the Huntly public transport hub.

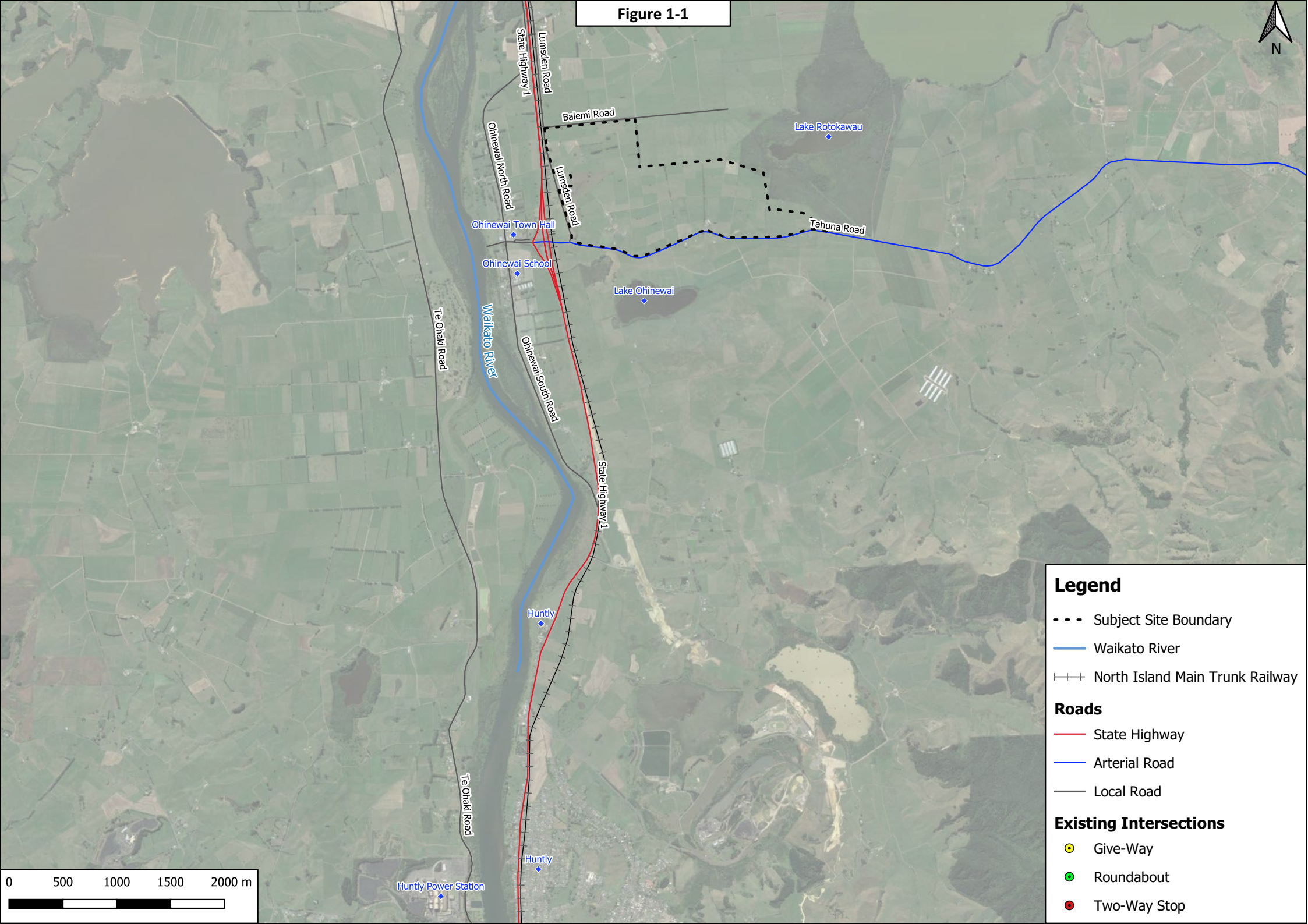
Modelling re-assessment

Intersection performance be re-assessed during the detailed design stage with the most recent WRTM volumes to ensure that the final design is appropriate for the proposed APL development.

Appendix A

ITA Report Figures

Figure 1-1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Lumsden Road
Balemi Road
Lake Rotokawau
Ohinewai North Road
Lumsden Road
Tahuna Road
Ohinewai Town Hall
Ohinewai School
Lake Ohinewai
Te Ohaki Road
Waikato River
Ohinewai South Road
State Highway 1
Huntly
Te Ohaki Road
Huntly
Huntly Power Station
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500
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1500
2000 m
Legend
Subject Site Boundary
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop

Sleepyhead | ADAPT STUDIO | gaze commercial Smart Property Solutions

N

0 250m

1:7,500 @ A3

OHINEWAI STRUCTURE PLAN

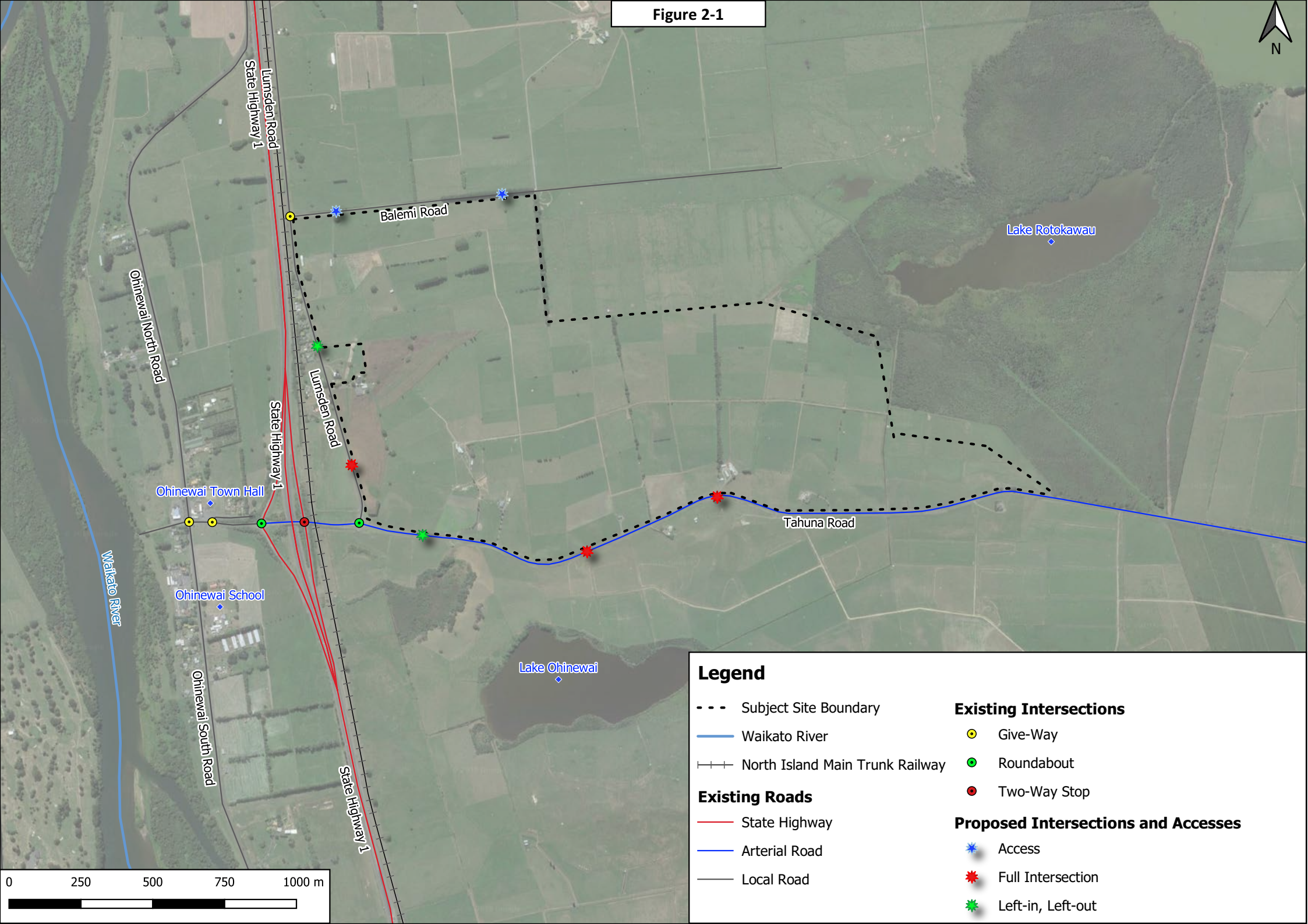
Illustrative Masterplan

Date: 22 November 2019 | Revision K

Drawing Number: 1805_018

Plan prepared by Adapt Studio Ltd for Gaze Property Solutions

Figure 2-1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Lumsden Road
Balemi Road
Lake Rotokawau
Ohinewai North Road
Lumsden Road
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Ohinewai Town Hall
Tahuna Road
Waikato River
Ohinewai School
Lake Ohinewai
Ohinewai South Road
State Highway 1
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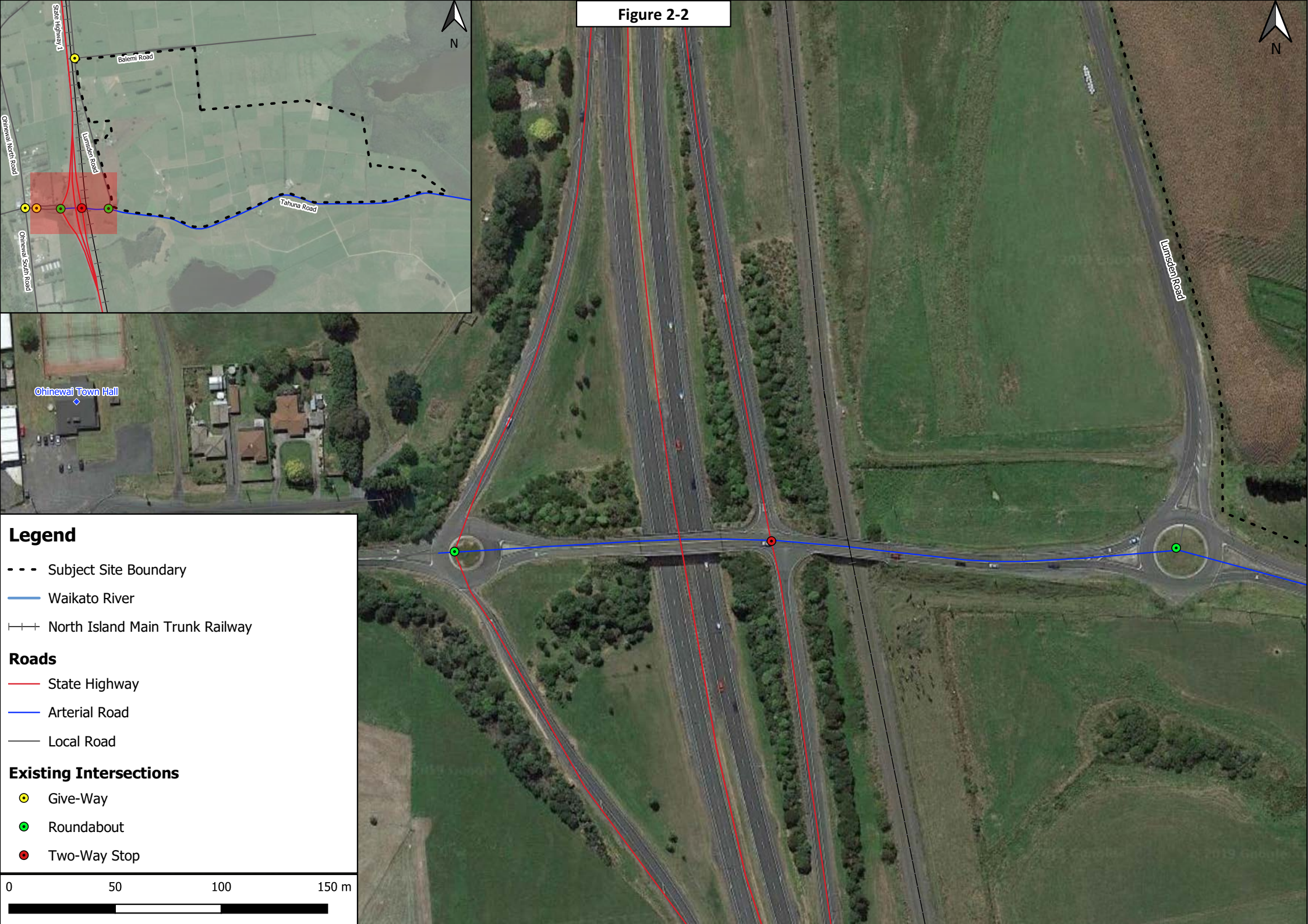
750
1000 m
Legend
Subject Site Boundary
Waikato River
North Island Main Trunk Railway
Existing Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
Proposed Intersections and Accesses
Access
Full Intersection
Left-in, Left-out

Figure 2-2


State Highway 1
Balemi Road
Ohinewai North Road
Lumsden Road
Tahuna Road
Ohinewai South Road
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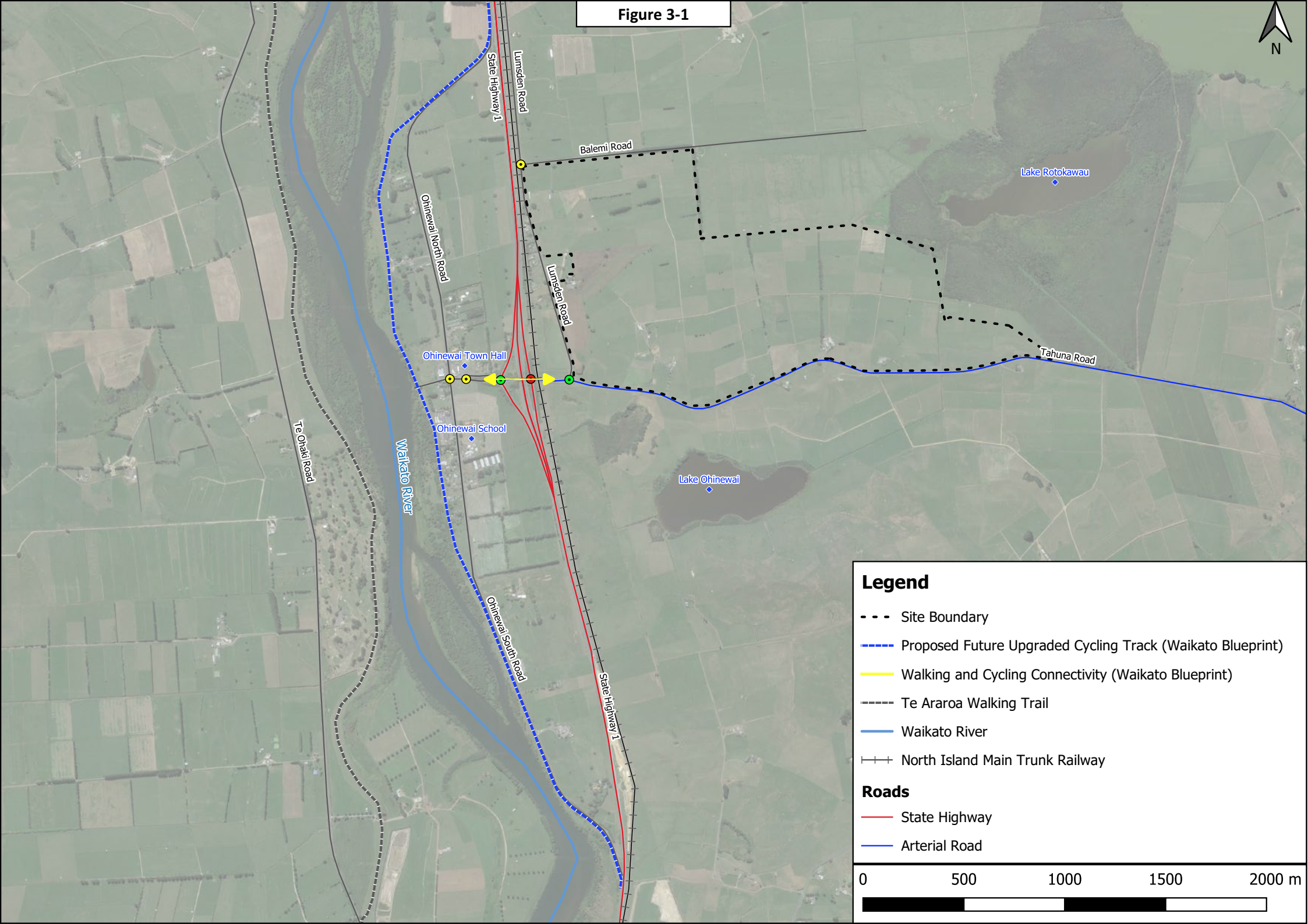
Ohinewai Town Hall
Lumsden Road
N
Legend
Subject Site Boundary
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
0
50
100
150 m

Figure 3-1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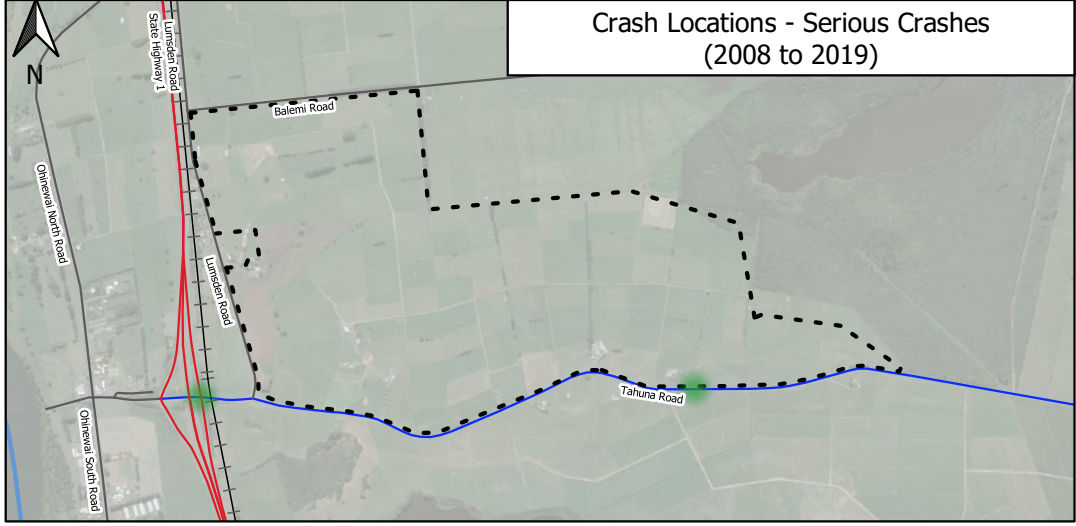
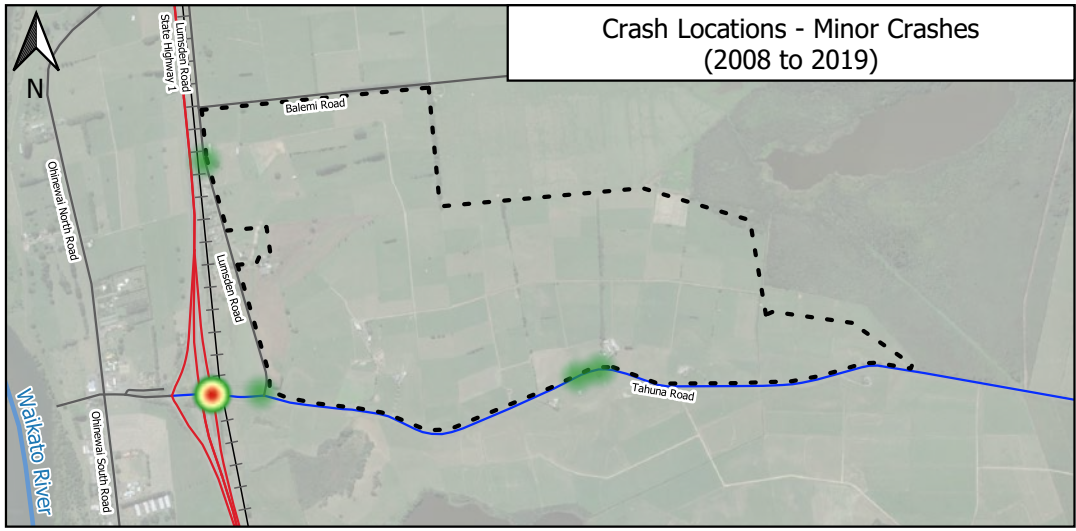
State Highway 1
Lumsden Road
Balemi Road
Lake Rotokawau
Ohinewai North Road
Lumsden Road
Tahuna Road
Ohinewai Town Hall
Ohinewai School
Te Ohaki Road
Waikato River
Lake Ohinewai
Ohinewai South Road
State Highway 1
Legend
Site Boundary
Proposed Future Upgraded Cycling Track (Waikato Blueprint)
Walking and Cycling Connectivity (Waikato Blueprint)
Te Araroa Walking Trail
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
0
500
1000
1500
2000 m


Crash Locations - All Crashes
(2008 to 2019)
N
Lumsden Road
State Highway 1
Balemi Road
Ohinewai North Road
Ohinewai South Road
Tahuna Road
Ohinewai Town Hall
Ohinewai School
Lake Ohinewai
Waikato River
Legend
Site Boundary
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road


Crash Locations - Serious Crashes
(2008 to 2019)
N
Lumsden Road
State Highway 1
Balemi Road
Ohinewai North Road
Ohinewai South Road
Tahuna Road


Crash Locations - Minor Crashes
(2008 to 2019)
N
Lumsden Road
State Highway 1
Balemi Road
Ohinewai North Road
Ohinewai South Road
Tahuna Road
Waikato River

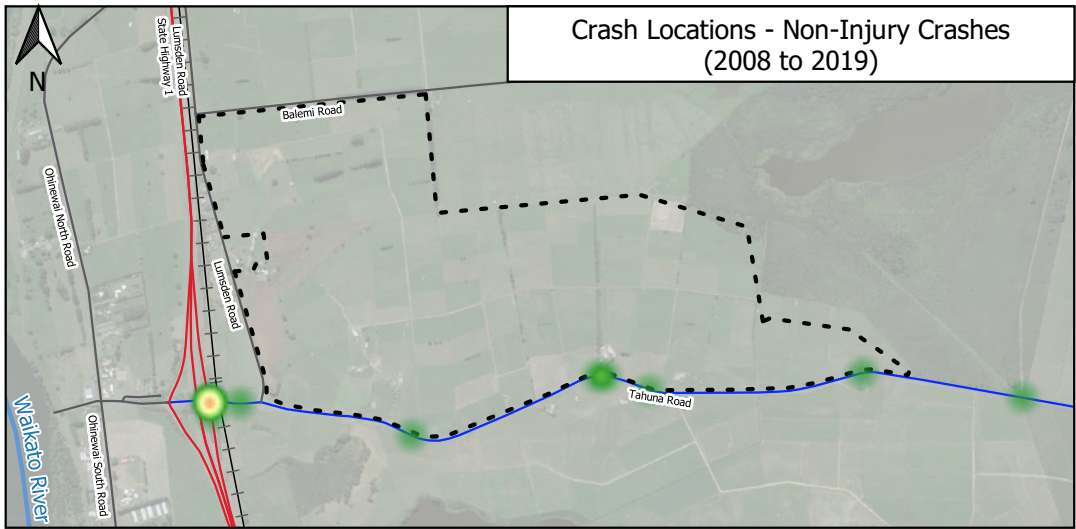

Crash Locations - Non-Injury Crashes
(2008 to 2019)
N
Lumsden Road
State Highway 1
Balemi Road
Ohinewai North Road
Ohinewai South Road
Tahuna Road
Waikato River

Figure 4-1

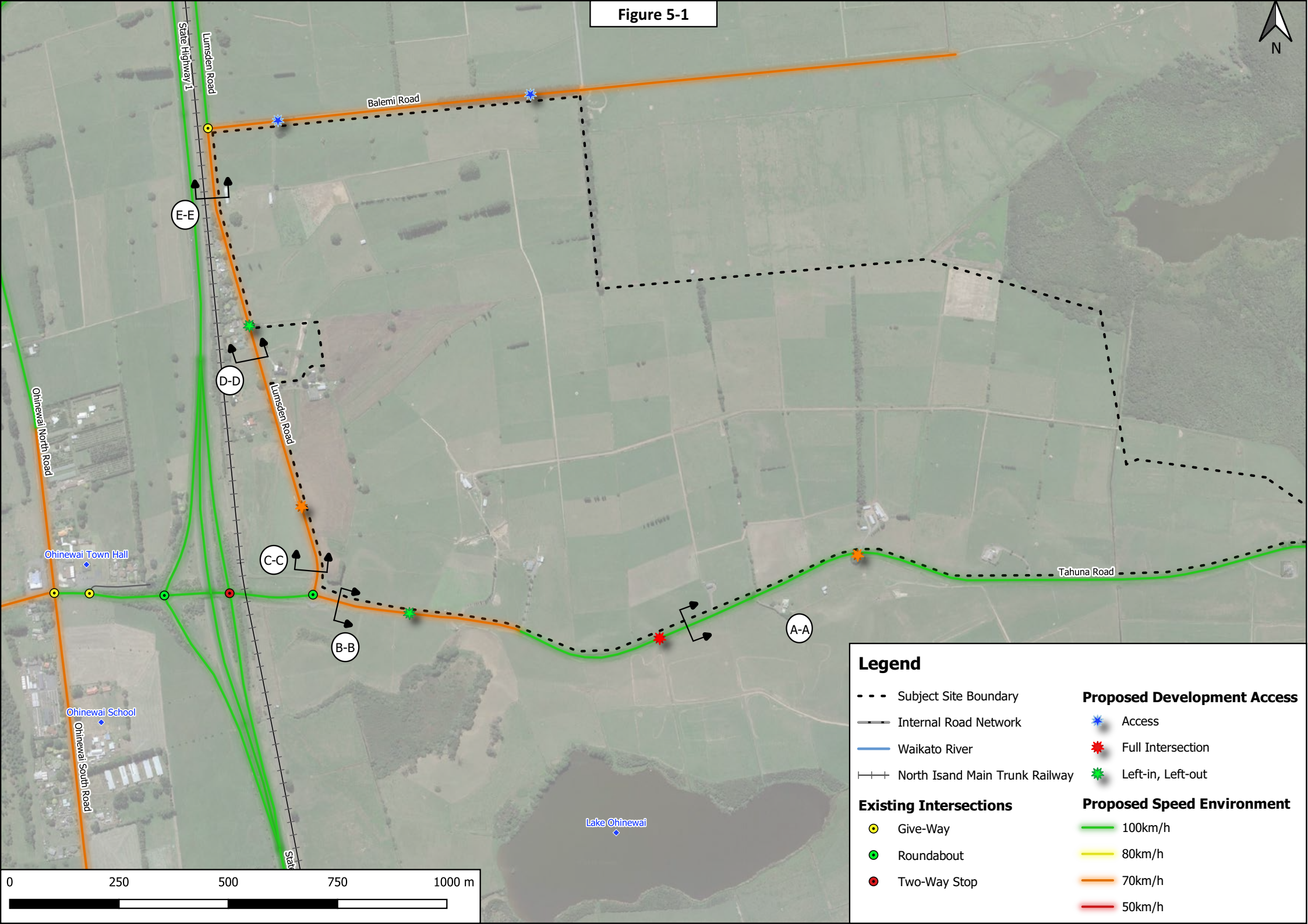


Figure 5-1
N
State Highway 1
Lumsden Road
Balemi Road
E-E
D-D
Lumsden Road
Ohinewai North Road
C-C
B-B
A-A
Tahuna Road
Ohinewai Town Hall
Ohinewai School
Ohinewai South Road
Lake Ohinewai
0
250
500
750
1000 m
Legend
Subject Site Boundary
Internal Road Network
Waikato River
North Isand Main Trunk Railway
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
Proposed Development Access
Access
Full Intersection
Left-in, Left-out
Proposed Speed Environment
100km/h
80km/h
70km/h
50km/h

Figure 5-2

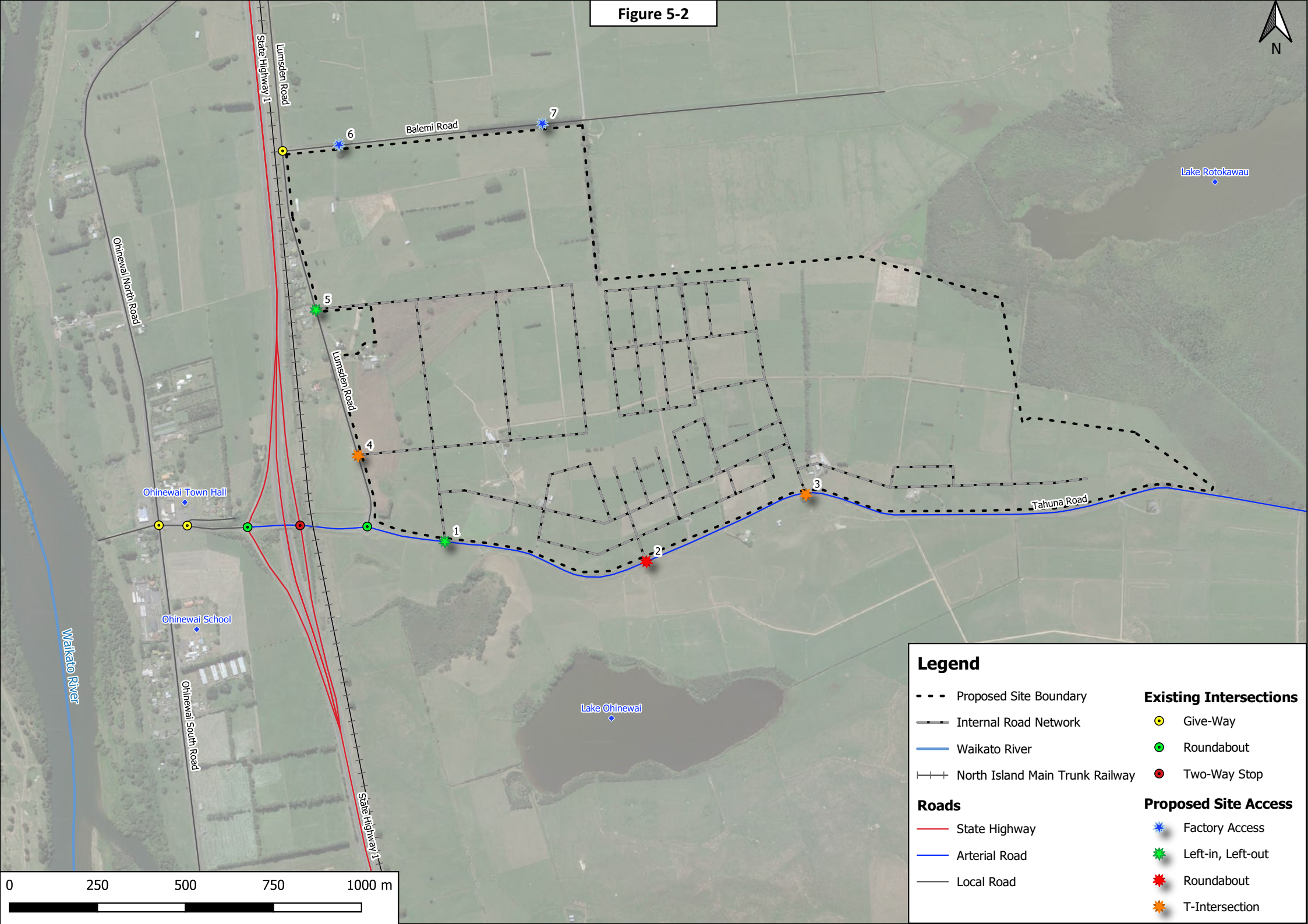

N
State Highway 1
Lumsden Road
Balemi Road
6
7
Lake Rotokawau
Ohinewai North Road
5
Lumsden Road
4
Ohinewai Town Hall
3
Tahuna Road
1
2
Ohinewai School
Waikato River
Ohinewai South Road
Lake Ohinewai
State Highway 1
0
250
500
750
1000 m
Legend
Proposed Site Boundary
Internal Road Network
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
Proposed Site Access
Factory Access
Left-in, Left-out
Roundabout
T-Intersection

Figure 5-4

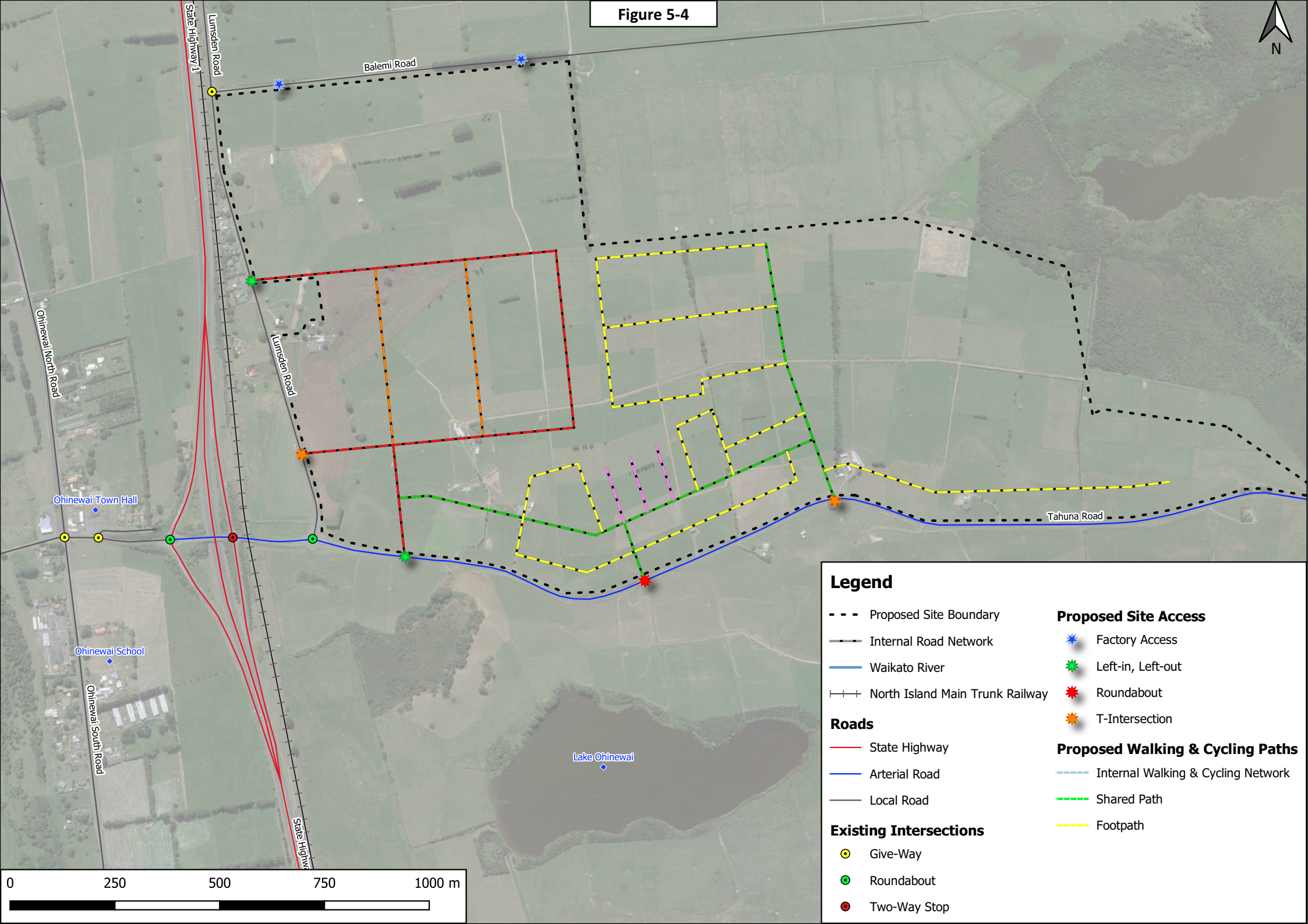

N
State Highway 1
Lumsden Road
Balemi Road
Ohinewai North Road
Lumsden Road
Ohinewai Town Hall
Tahuna Road
Ohinewai School
Ohinewai South Road
Lake Ohinewai
State Highway
0
250
500
750
1000 m
Legend
Proposed Site Boundary
Internal Road Network
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
Proposed Site Access
Factory Access
Left-in, Left-out
Roundabout
T-Intersection
Proposed Walking & Cycling Paths
Internal Walking & Cycling Network
Shared Path
Footpath

Figure 5-5: Proposed Public Transport Network - Long-Term Planning

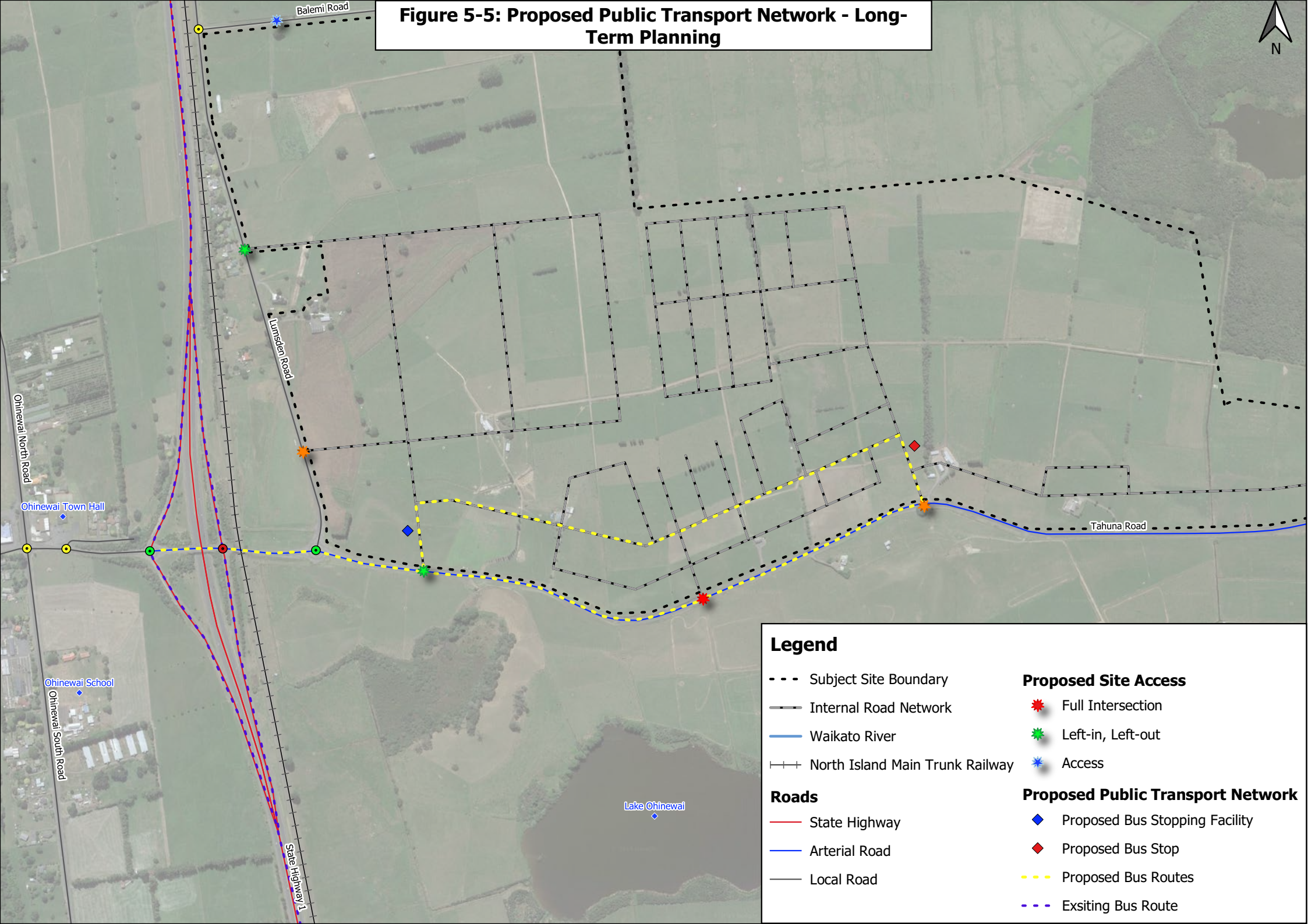


Figure 5-6: Proposed Public Transport Services - Interim Service

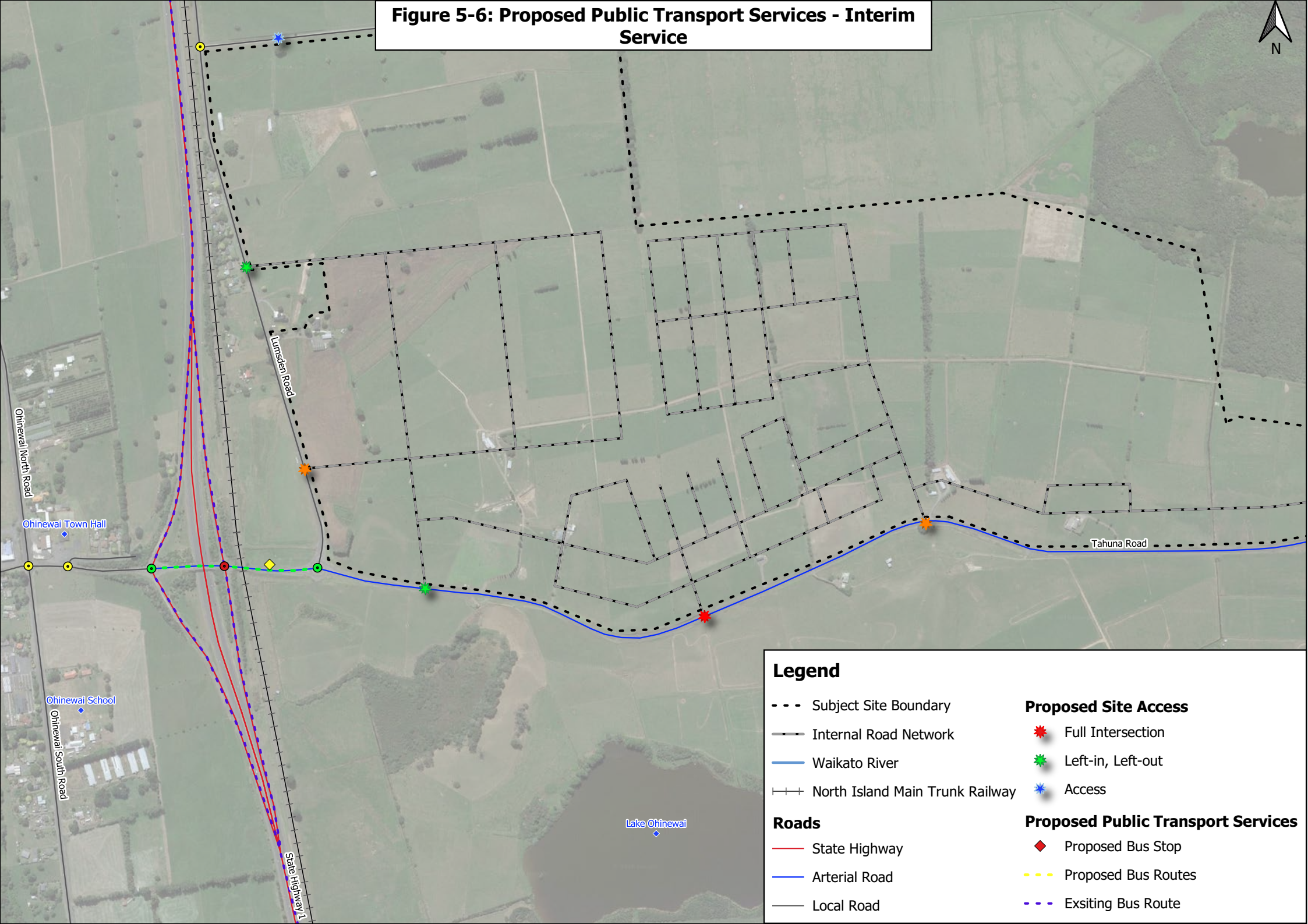


Figure 5-7

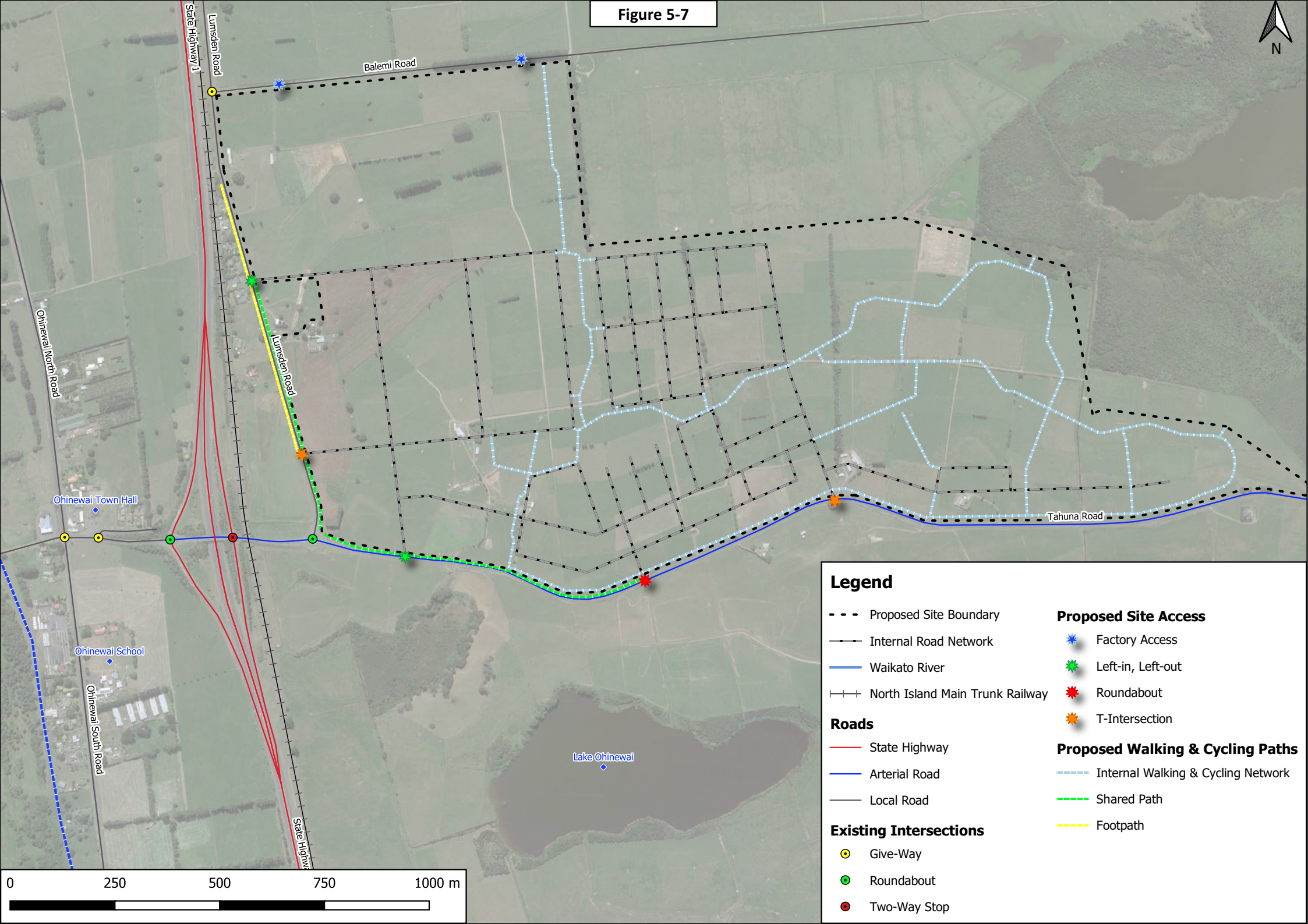

State Highway 1
Lumsden Road
Balemi Road
Ohinewai North Road
Lumsden Road
Ohinewai Town Hall
Tahuna Road
Ohinewai School
Ohinewai South Road
Lake Ohinewai
State Highway
N
0
250
500
750
1000 m
Legend
Proposed Site Boundary
Internal Road Network
Waikato River
North Island Main Trunk Railway
Roads
State Highway
Arterial Road
Local Road
Existing Intersections
Give-Way
Roundabout
Two-Way Stop
Proposed Site Access
Factory Access
Left-in, Left-out
Roundabout
T-Intersection
Proposed Walking & Cycling Paths
Internal Walking & Cycling Network
Shared Path
Footpath

Figure 7-4: Proposed Walking and Cycling Path over Expressway - Option 1

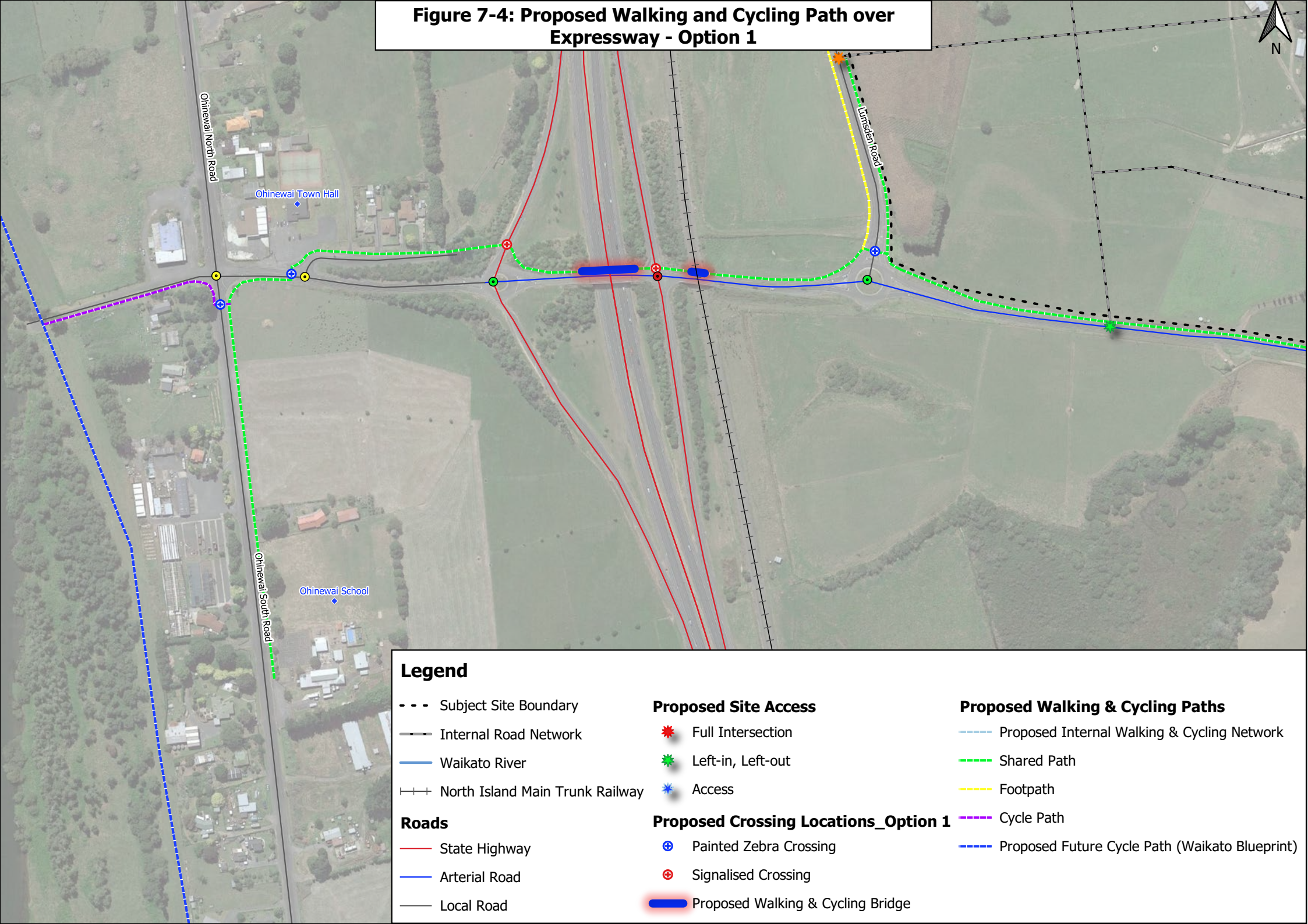
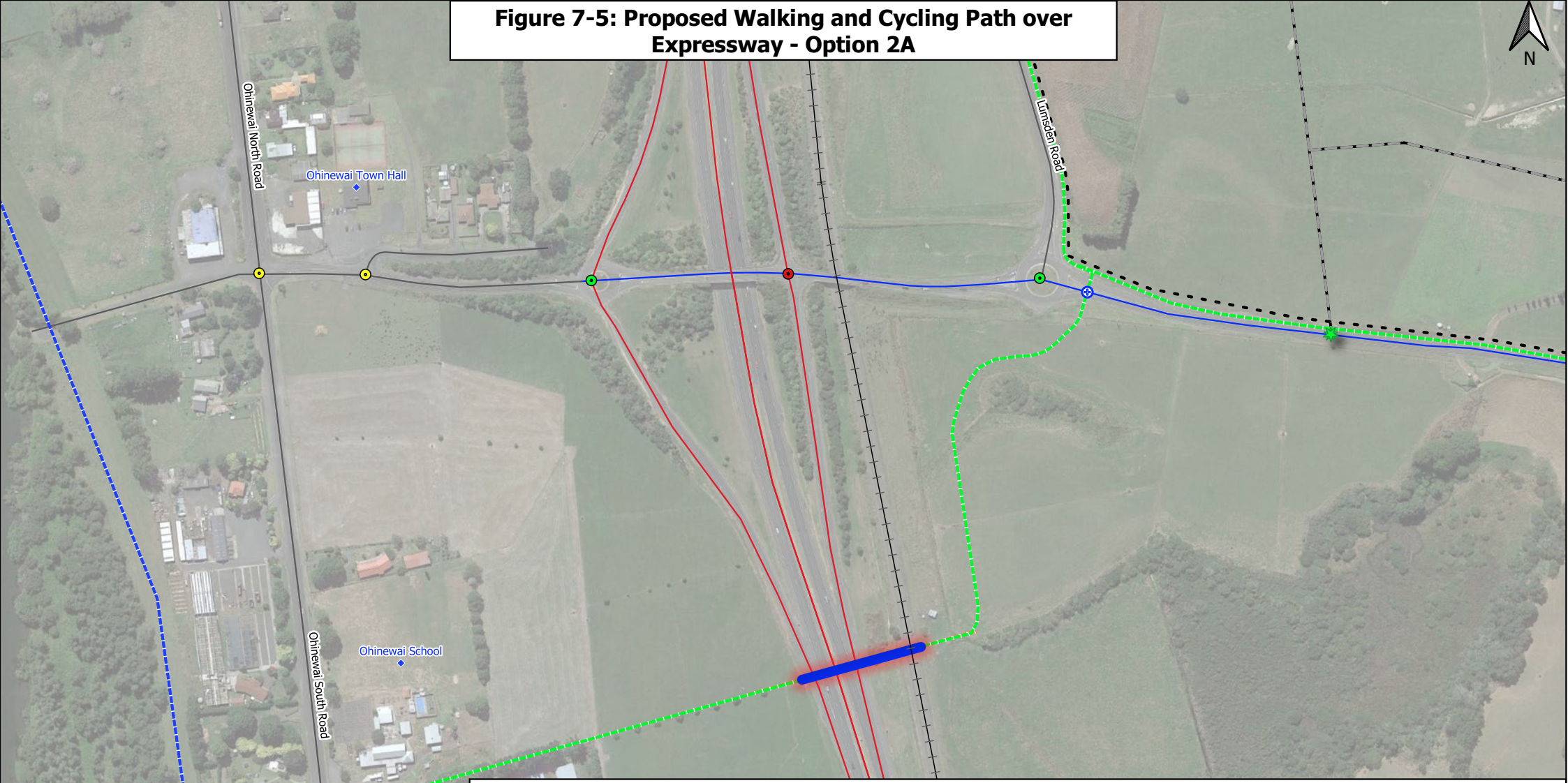


Figure 7-5: Proposed Walking and Cycling Path over Expressway - Option 2A



Legend

- Subject Site Boundary
- Internal Road Network
- Waikato River
- North Island Main Trunk Railway

Roads

- State Highway
- Arterial Road
- Local Road

Proposed Site Access

- Full Intersection
- Left-in, Left-out
- Access

Proposed Crossing Locations_Option 1

- Painted Crossing
- Signalised Crossing
- Proposed Walking & Cycling Bridge

Proposed Walking & Cycling Paths

- Proposed Internal Walking & Cycling Network
- Shared Path
- Footpath
- Cycle Path
- Proposed Future Cycle Path (Waikato Blueprint)

Figure 7-6: Proposed Walking and Cycling Path over Expressway - Option 2B

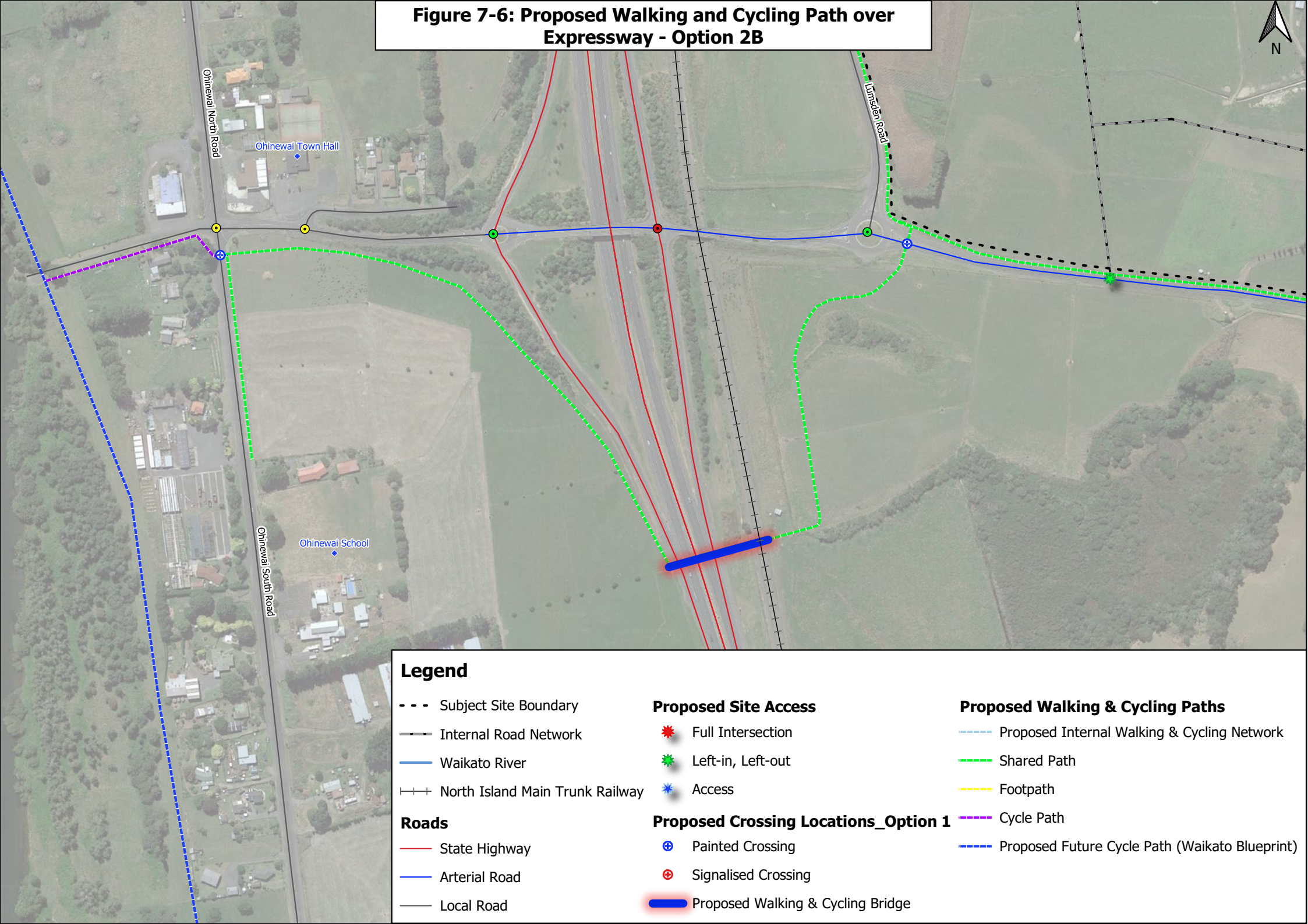
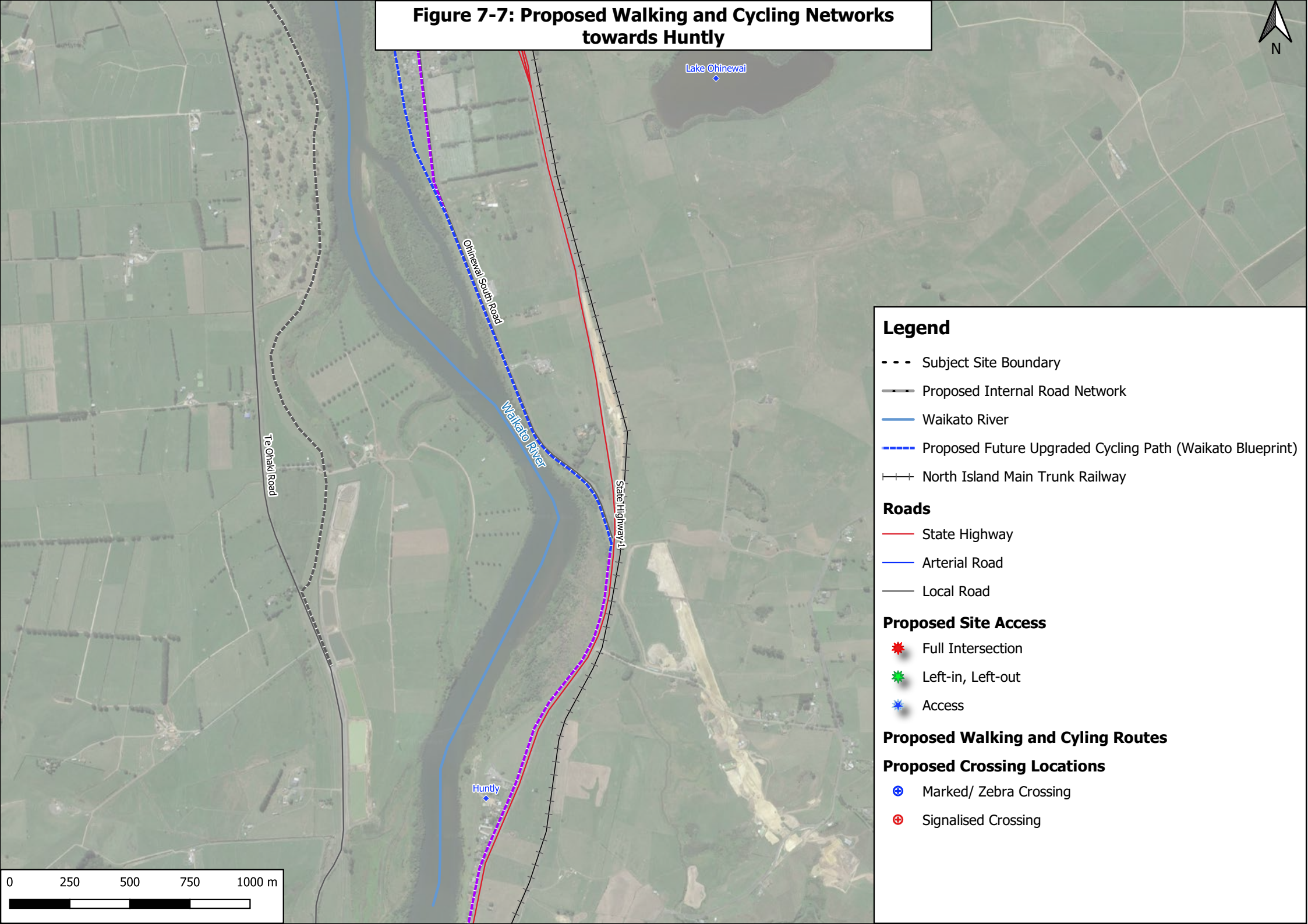


Figure 7-7: Proposed Walking and Cycling Networks towards Huntly



Appendix B

NZTA CAS Data

NZ TRANSPORT AGENCY WAKA KOTAHI CAS

SH1 & Tahuna Road Intersection (Eastern Terminal)

Saved sites

Sh1 & Tahuna Road Intersection (Eastern Terminal)

Crash year

2008 — 2019

Crash severity

Fatal Crash, Serious Crash, Minor Crash, Non-Injury Crash

Intersection

Yes

Plain English report

13 results from your query.

1-13 of 13

Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
TAHUNA OFF SBD		I	TAHUNA ROAD	201230580	19/03/2012	Mon	11:40	Car/Wagon1 SDB on TAHUNA OFF SBD missed intersection or end of road	CAR/WAGON1, did not stop at stop sign, failed to notice control, lost control under braking, ENV: heavy rain	Wet	Overcast	Heavy rain	Crossroads	Stop	0	0	0
TAHUNA OFF SBD		I	TAHUNA ROAD	201615583	02/09/2016	Fri	14:50	Van1 SDB on Ohinewai Off Ramp hit Van2 crossing at right angle from right	VAN1, alcohol suspected, did not stop at stop sign	Dry	Overcast	Fine	Crossroads	Stop	0	2	0
TAHUNA OFF SBD		I	TAHUNA ROAD	201635806	07/03/2016	Mon	07:05	Car/Wagon1 SDB on TAHUNA OFF SBD lost control turning left	CAR/WAGON1, other inappropriate speed, other lost control, wrong pedal/foot slipped	Dry	Bright sun	Fine	Crossroads	Stop	0	0	0
TAHUNA OFF SBD		I	TAHUNA ROAD	201432736	04/03/2014	Tue	08:50	Car/Wagon1 SDB on TAHUNA OFF SBD lost control turning left, Car/Wagon1 hit non specific guard rail	CAR/WAGON1, lost control when turning, speed entering corner/curve	Wet	Bright sun	Fine	Crossroads	Stop	0	0	0
TAHUNA OFF SBD		I	TAHUNA ROAD	201003223	23/04/2010	Fri	15:05	Car/Wagon1 SDB on TAHUNA OFF SBD missed intersection or end of road , Car/Wagon2 hit non specific guard rail	CAR/WAGON1, failed to notice control, lost control under braking	Dry	Bright sun	Fine	Crossroads	Stop	0	0	1

Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
TAHUNA OFF SBD		I	TAHUNA ROAD	201616081	17/09/2016	Sat	11:46	Car/Wagon1 SDB on SH1 missed intersection or end of road, Car/Wagon1 hit non specific bridge	CAR/WAGON1, speed approaching a traffic control	Wet	Overcast	Heavy rain	Crossroads	Stop	0	0	1
TAHUNA ROAD		I	TAHUNA OFF SBD	201441096	11/07/2014	Fri	08:50	Van1 WDB on TAHUNA ROAD hit Car/Wagon2 merging from the right	CAR/WAGON2, did not stop at stop sign	Dry	Bright sun	Fine	Crossroads	Stop	0	0	0
TAHUNA ROAD		I	TAHUNA OFF SBD	201104627	19/09/2011	Mon	16:50	Truck1 WDB on TAHUNA ROAD hit Car/Wagon2 merging from the right , Car/Wagon2 hit non specific guard rail	CAR/WAGON2, did not stop at stop sign, failed to notice control, other fatigue	Dry	Bright sun	Fine	Crossroads	Stop	0	0	1
TAHUNA ROAD		I	TAHUNA OFF SBD	201204847	14/10/2012	Sun	15:04	Car/Wagon1 WDB on TAHUNA ROAD hit Car/Wagon2 crossing at right angle from right	CAR/WAGON2, failed to give way at priority traffic control, misjudged another vehicle	Dry	Bright sun	Fine	Crossroads	Stop	0	0	1
TAHUNA ROAD		I	TAHUNA OFF SBD	2903675	19/04/2009	Sun	13:44	Car/Wagon1 EDB on TAHUNA ROAD hit Car/Wagon2 crossing at right angle from right	CAR/WAGON1, did not stop at stop sign, failed to notice control	Dry	Bright sun	Fine	Crossroads	Stop	0	0	3
TAHUNA ROAD		I	TAHUNA OFF SBD	201414435	17/07/2014	Thu	15:25	SUV1 WDB on TAHUNA ROAD hit SUV2 crossing at right angle from right	SUV2, did not stop at stop sign, failed to notice control	Dry	Bright sun	Fine	Crossroads	Stop	0	0	4
TAHUNA ROAD		I	TAHUNA ON SBD	201131711	08/02/2011	Tue	20:24	Car/Wagon1 EDB on TAHUNA ROAD lost control turning right, Car/Wagon1 hit non specific guard rail	CAR/WAGON1, alcohol test above limit or test refused, emotionally upset/road rage	Dry	Twilight	Fine	T Junction	Nil	0	0	0
TAHUNA ROAD		I	TAHUNA ROAD OFF RAMP	201954155	24/04/2019	Wed	15:23	Car/Wagon1 WDB on TAHUNA ROAD, OHINEWAI, WAIKATO hit SUV2 crossing at right angle from right	CAR/WAGON1, alcohol test below limit SUV2, alcohol test below limit, attention diverted by passengers, failed to give way at priority traffic control, failed to notice control	Dry	Bright sun	Fine	Crossroads	Stop	0	0	1

1-13 of 13

Tahuna Road & Lumden Road Intersection

Saved sites

Tahuna Road & Lumsden Road Intersection

Crash year

2008 — 2019

Crash severity

Fatal Crash, Serious Crash, Minor Crash, Non-Injury Crash

Plain English report

2 results from your query.

1-2 of 2

Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
TAHUNA ROAD	60m	N	LUMSDEN ROAD	201830288	01/01/2018	Mon	14:57	Car/Wagon1 WDB on Tahuna Road lost control; went off road to left, Car/Wagon1 hit non specific cliff, non specific traffic sign	CAR/WAGON1, alcohol test below limit	Wet	Overcast	Fine	Nil (Default)	Unknown	0	0	0
TAHUNA ROAD		I	LUMSDEN ROAD	201410565	20/01/2014	Mon	18:10	Car/Wagon1 WDB on TAHUNA ROAD lost control turning right, Car/Wagon1 hit non specific bridge	CAR/WAGON1, attention diverted by food, cigarettes, beverages, lost control under acceleration	Wet	Overcast	Light rain	Roundabout	Give way	0	0	1

1-2 of 2

Lumsden Road (Tahuna Rd and Balemi Rd)

Saved sites

Lumsden Road (between Tahuna Road & Balemi Road)

Crash severity

Fatal Crash, Serious Crash, Minor Crash, Non-Injury Crash

Crash year

2008 — 2019

Plain English report

1 results from your query.

1-1 of 1

Crash road	Distance	Direction	Side road	ID	Date	Day of week	Time	Description of events	Crash factors	Surface condition	Natural light	Weather	Junction	Control	Crash count fatal	Crash count severe	Crash count minor
LUMSDEN ROAD	200m	S	BALEMI ROAD	201816237	22/06/2018	Fri	15:40	Car/Wagon1 SDB on Lumsden Road lost control turning left, Car/Wagon1 hit non specific fence, non specific ditch	CAR/WAGON1, alcohol suspected, swung wide on bend	Dry	Bright sun	Fine	Nil (Default)	Unknown	0	0	1

1-1 of 1

Appendix C

Proposed Road Cross-Sections

100mm

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

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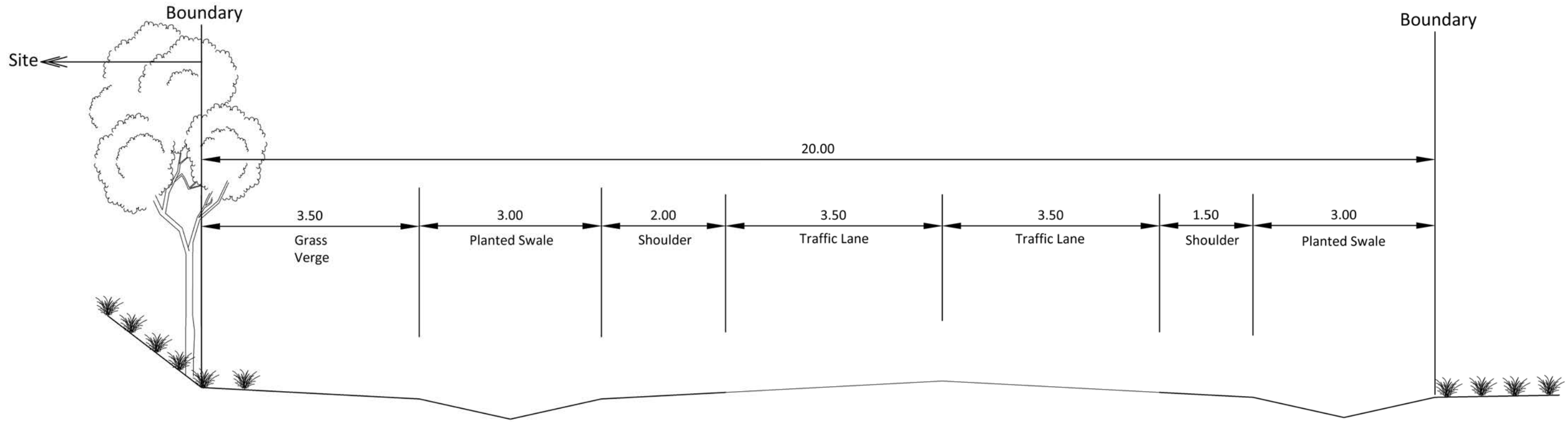
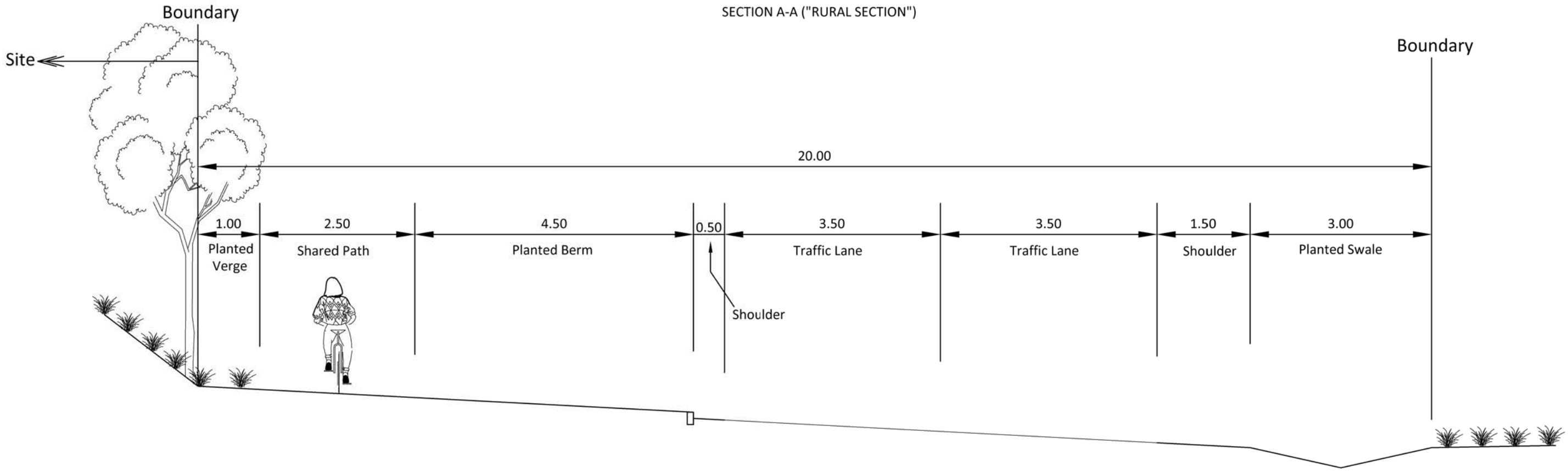


TYPICAL CROSS SECTION THROUGH TAHUNA ROAD

SECTION A-A ("RURAL SECTION")



TYPICAL CROSS SECTION THROUGH TAHUNA ROAD

SECTION B-B ("SEMI-RURAL SECTION")

K:\145860 Ohinewai Development\08 Sleepyhead Estate Rezoning (TA1)\Drawings\145860_08_0210.dwg 7/11/2019 3:05 PM rbaloyi

DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
-	-	-	-	-

Version 3.0 - September 2017

DESIGNED	CHECKED
RB	CI
DRAWN	APPROVED
RB	CI

mx model version:

BLOXAM BURNETT OLLIVER

Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Development
Sleepyhead Estate Rezoning

DRAWING: Typical Road Cross Section
Tahuna Road

STATUS: PRELIMINARY

DRAFT COPY NOT APPROVED

DATE	SCALE (ORIGINAL SIZE A3)
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DRAWING NUMBER	REVISION
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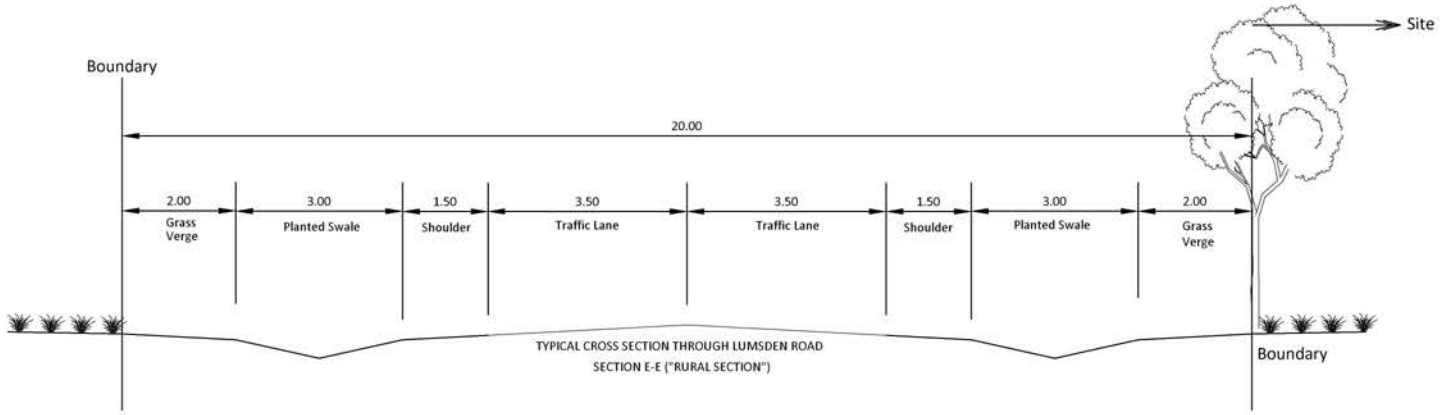
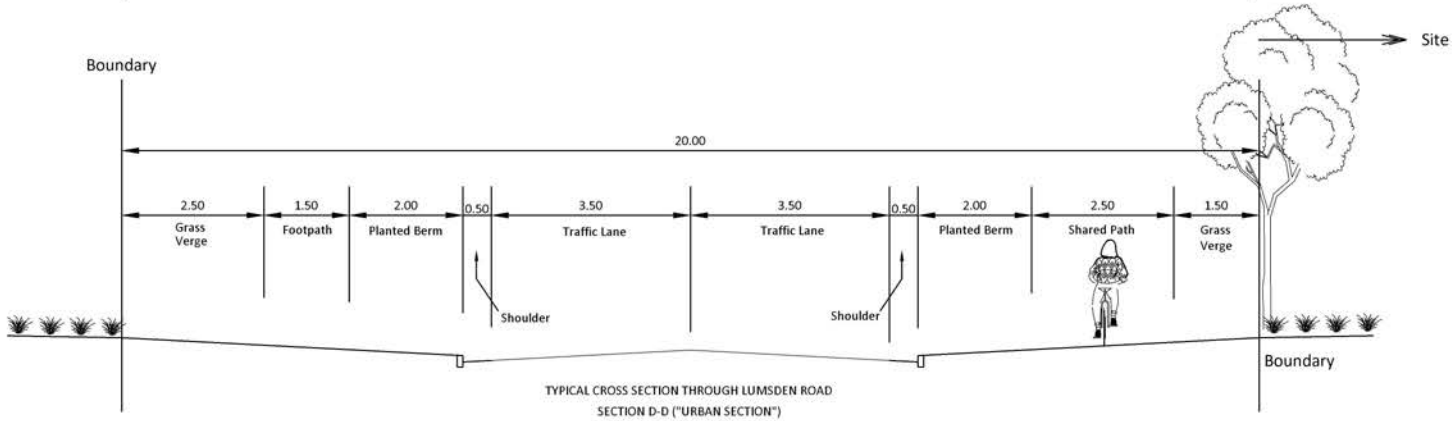
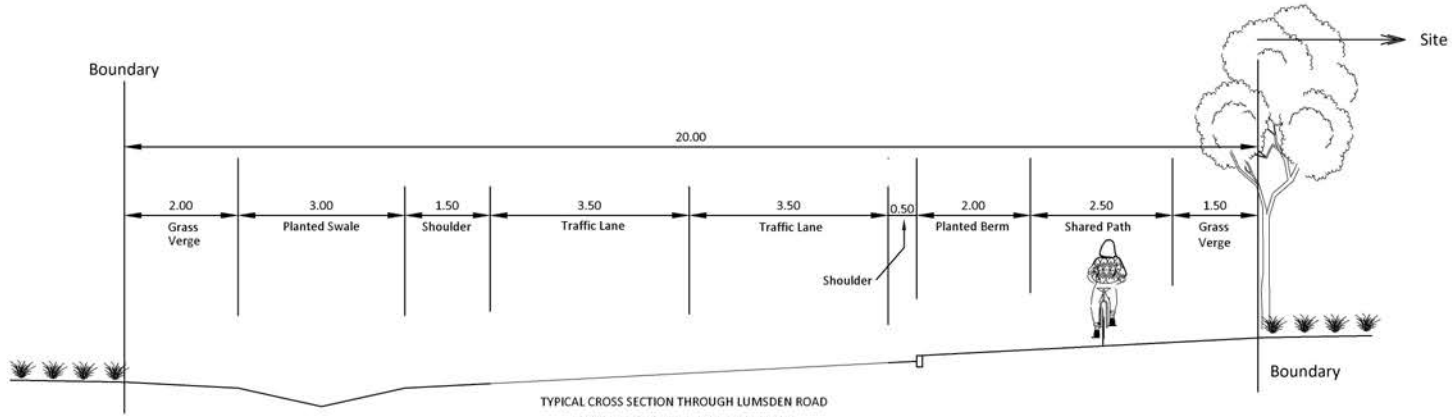


TYPICAL CROSS SECTION THROUGH LUMSDEN ROAD
SECTION E-E ("RURAL SECTION")



TYPICAL CROSS SECTION THROUGH LUMSDEN ROAD
SECTION D-D ("URBAN SECTION")



TYPICAL CROSS SECTION THROUGH LUMSDEN ROAD
SECTION C-C ("SEMI-RURAL SECTION")

100mm

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SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

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					DRAWN: RB	APPROVED: CI	
-	-	-	-	-	me model version:		
DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR			

Version 3.0 - September 2017

BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Development
Sleepyhead Estate Rezoning

DRAWING: Typical Road Cross Section
Lumsden Road

STATUS: PRELIMINARY

DATE	SCALE (ORIGINAL SIZE A3)
-	-

DRAWING NUMBER	REVISION
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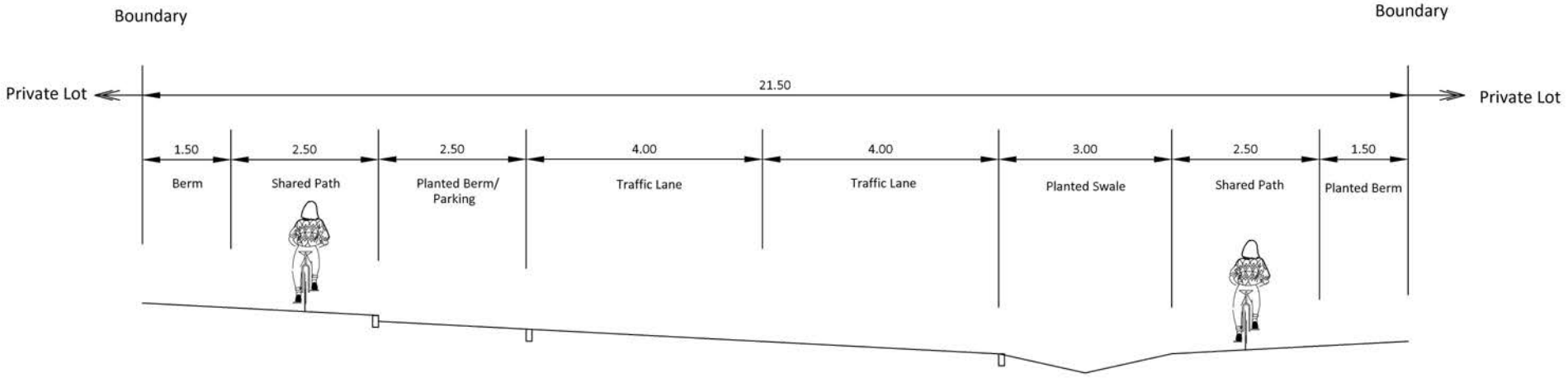


TYPICAL CROSS SECTION THROUGH AN INDUSTRIAL ROAD

(LOCAL ROAD)

DRAFT COPY NOT APPROVED

-	-	-	-	-	-	-	DESIGNED RB	CHECKED CI	BLOXAM BURNETT OLLIVER	CLIENT Ambury Properties Limited	PROJECT Ohinewai Development Sleepyhead Estate Rezoning
DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR			DRAWN RB	APPROVED CI	Phone +64-7-838 0144, Fax +64-7-839 0431		
							mx model version:				

DRAWING: Typical Road Cross Section Proposed Industrial Roads

STATUS: PRELIMINARY

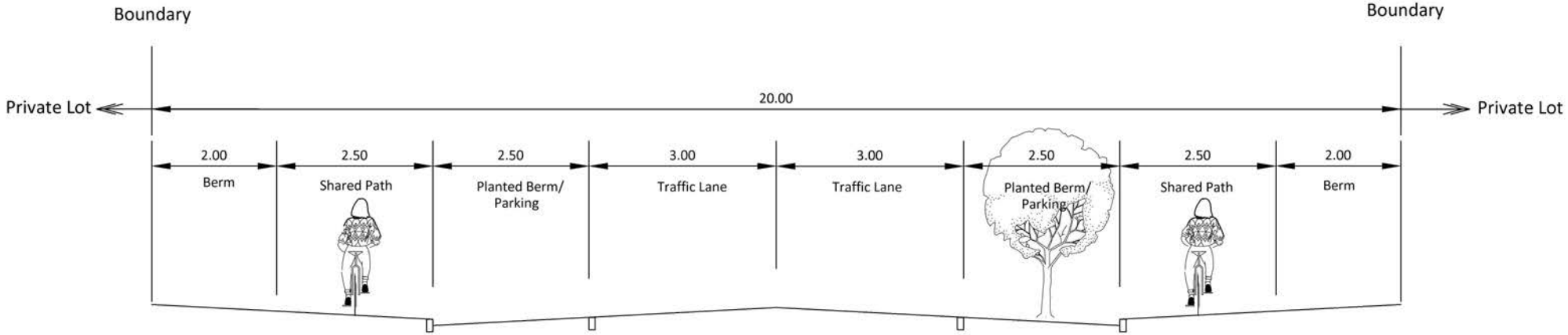
DATE: -

SCALE (ORIGINAL SIZE A3): -

DRAWING NUMBER: 145860_08_0212 V1

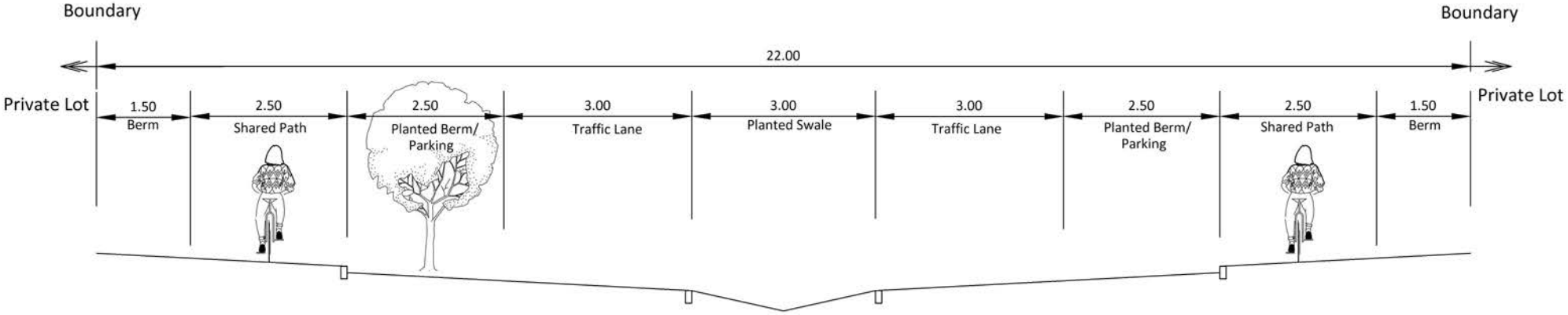
REVISION: -

Version 3.0 - September 2017



TYPICAL CROSS SECTION THROUGH PRIMARY RESIDENTIAL ROAD

(COLLECTOR ROAD)



TYPICAL CROSS SECTION THROUGH PRIMARY RESIDENTIAL ROAD WITH CENTRAL SWALE

(COLLECTOR ROAD WITH CENTRAL SWALE)

-	-	-	-	-	-	DESIGNED: RB	CHECKED: CI	
-	-	-	-	-	-	DRAWN: RB	APPROVED: CI	
-	-	-	-	-	-	mx model version:		
DATE		ISSUE/REVISION DETAIL	BY	CHK	APPR			

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BLOXAM BURNETT OLLIVER

Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Development
Sleepyhead Estate Rezoning

DRAWING: Typical Road Cross Section
Proposed Primary Residential Road

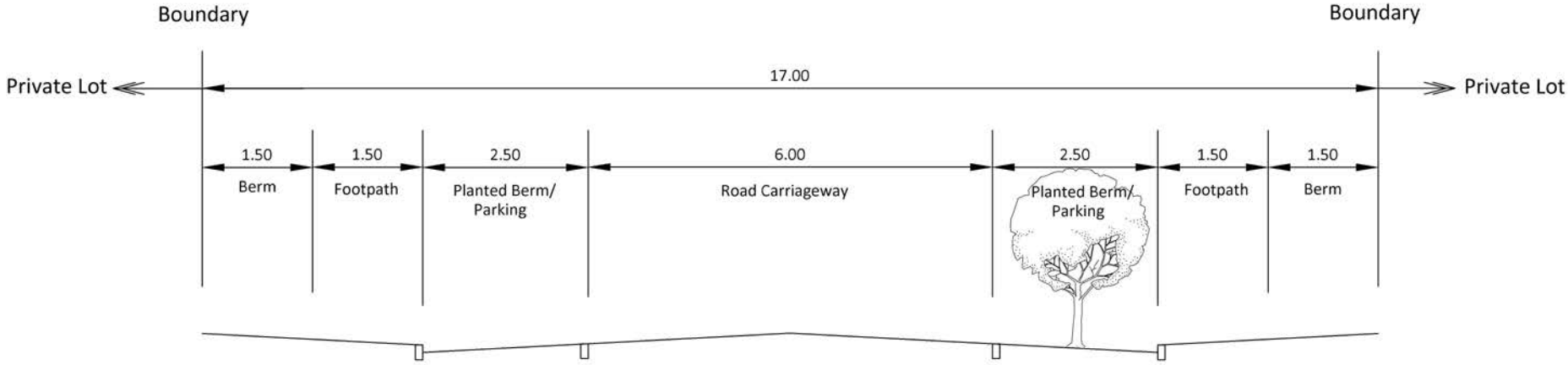
STATUS: PRELIMINARY

DATE: -

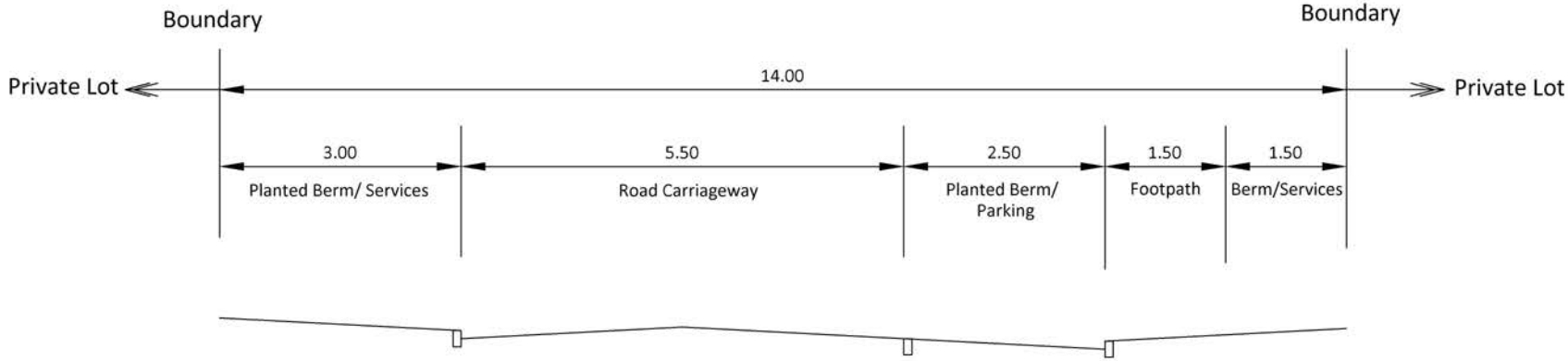
SCALE (ORIGINAL SIZE A3): -

DRAWING NUMBER: 145860_08_0213

REVISION: -



TYPICAL CROSS SECTION THROUGH SECONDARY RESIDENTIAL ROAD
(LOCAL ROAD)



TYPICAL CROSS SECTION THROUGH LOW TRAFFIC VOLUME STREET

(LOCAL ROAD)

100mm

0

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

K:\145860 Ohinewai Development\08 Sleepyhead Estate Rezoning (Tal)\Drawings\145860_08_0214.dwg 7/11/2019 1:02 PM rbailey

DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR
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mx model version:

Version 3.0 - September 2017

BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Development
Sleepyhead Estate Rezoning

DRAWING: Typical Road Cross Section
Proposed Local Residential Roads

STATUS: PRELIMINARY

DATE	SCALE (ORIGINAL SIZE A3)
-	-

DRAWING NUMBER	REVISION
145860_08_0214	-

Appendix D

Preliminary Access Configurations

SCALE FOR VALIDATING SIZE OF A3 PLOT ONLY

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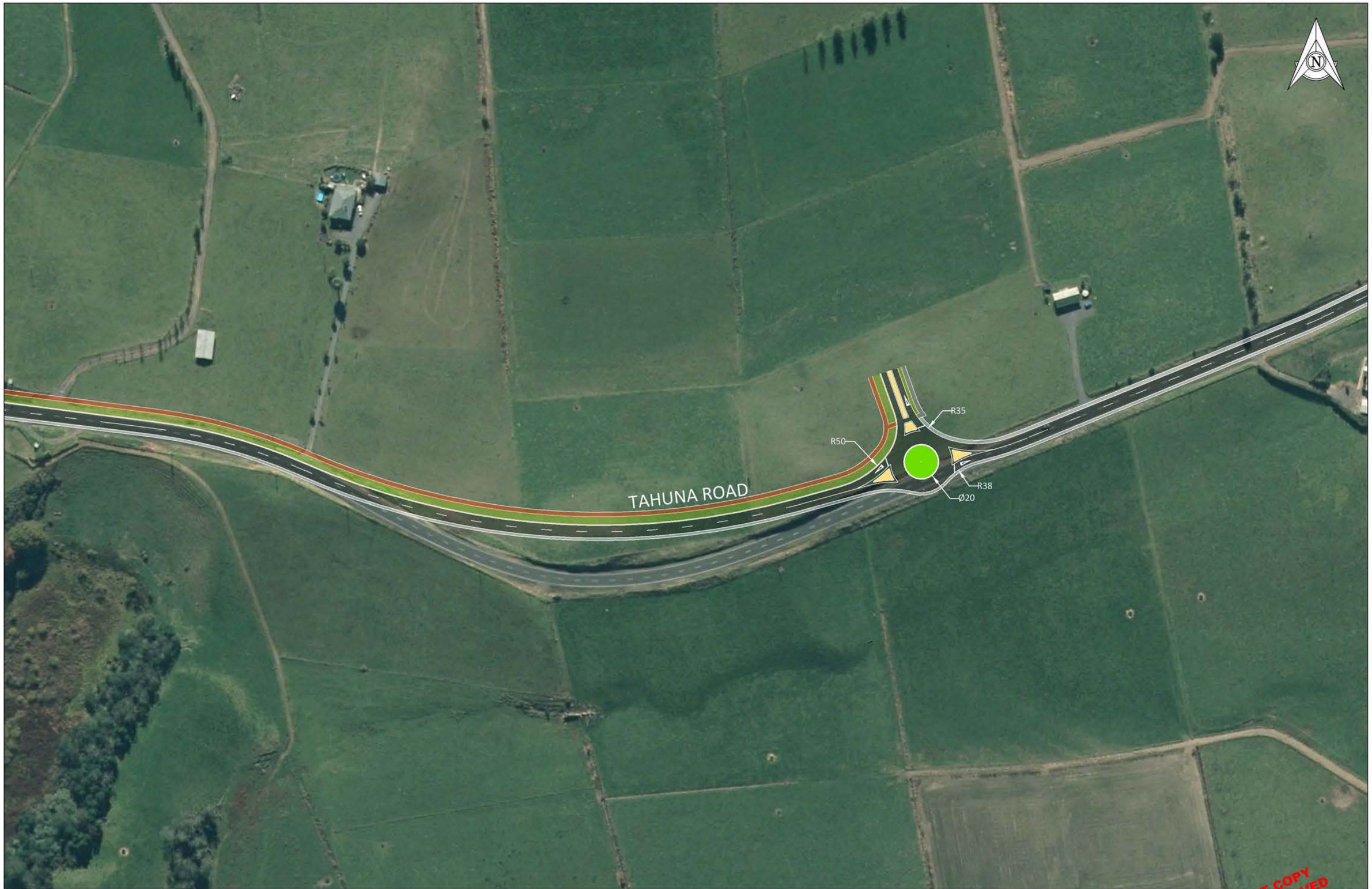

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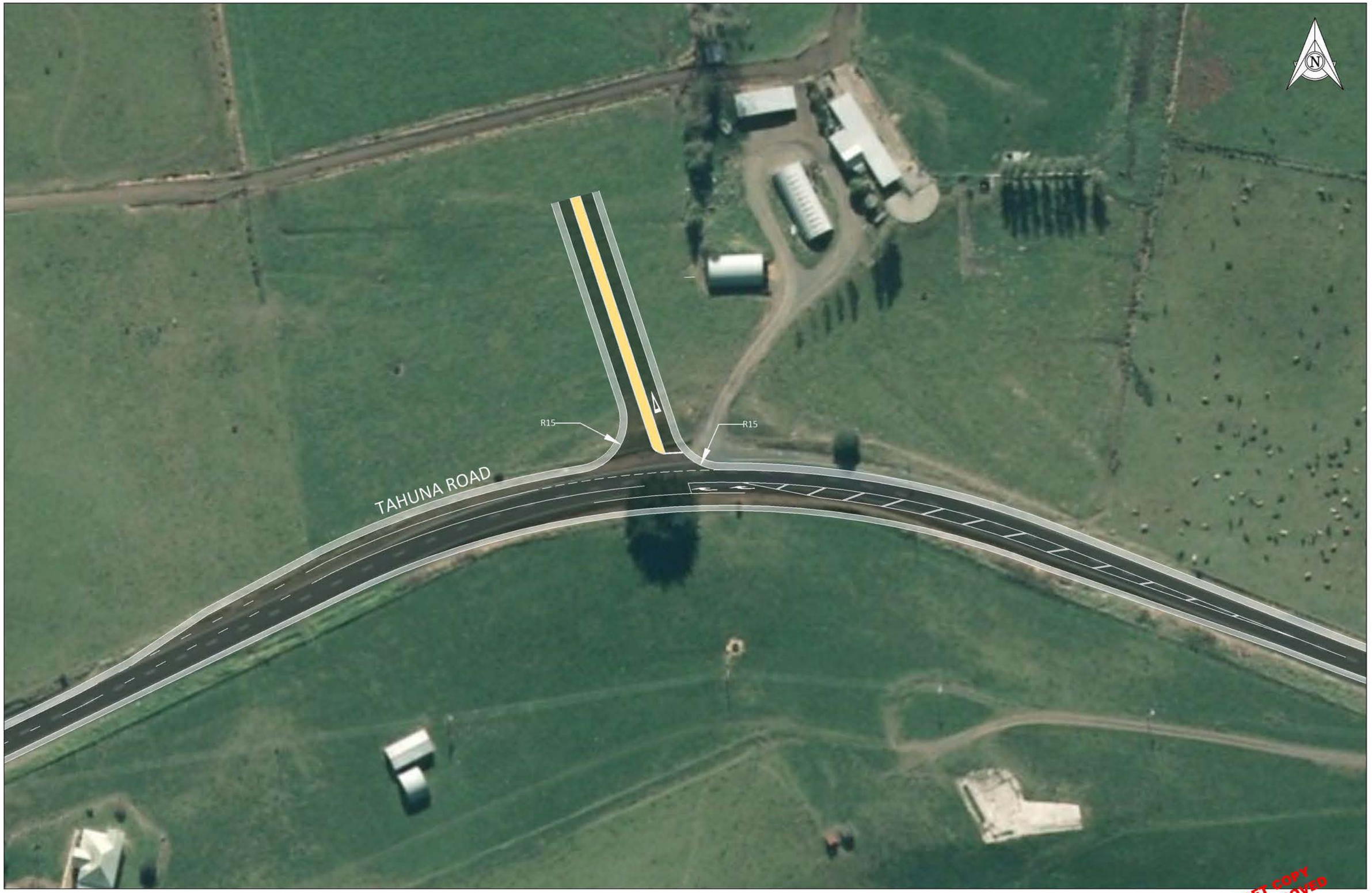

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SCALE (ORIGINAL SIZE A3): 1 : 1 000

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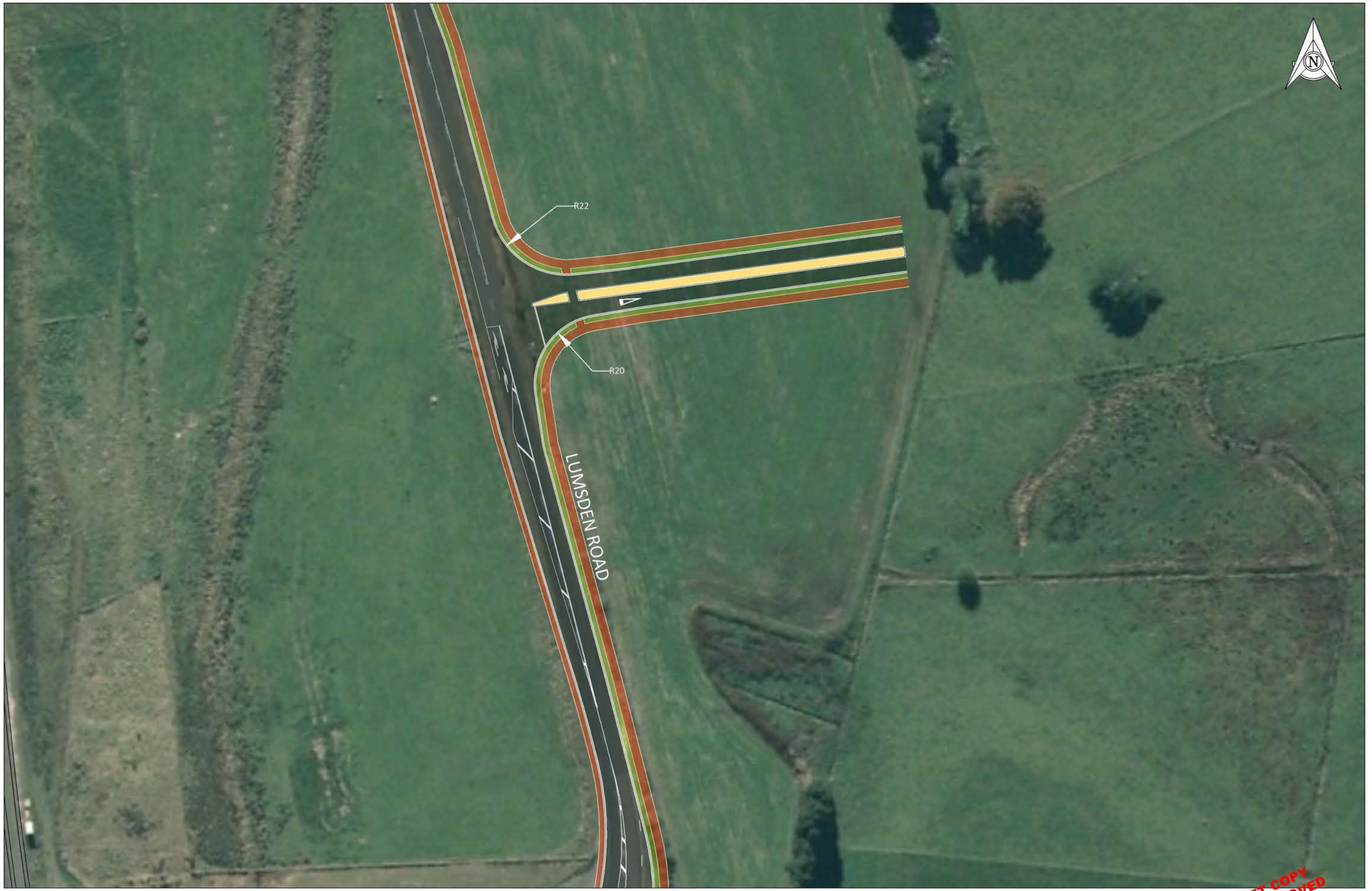

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Appendix E

Sidra Intersection Summaries

Scenario 1 – Without Upgrades

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	35	4.0	0.047	7.3	LOS A	0.2	1.8	0.26	0.61	0.26	71.1
3	R2	21	20.0	0.047	12.7	LOS B	0.2	1.8	0.26	0.61	0.26	67.4
Approach		56	10.0	0.047	9.4	LOS A	0.2	1.8	0.26	0.61	0.26	69.7
East: Tahuna Road												
5	T1	42	10.0	0.052	8.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.3
6	R2	44	12.0	0.052	11.9	LOS B	0.0	0.0	0.00	0.68	0.00	69.7
Approach		86	11.0	0.052	10.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.0
West: Tahuna Road												
10	L2	11	0.0	0.046	7.1	LOS A	0.2	2.0	0.23	0.54	0.23	73.2
11	T1	42	28.0	0.046	8.8	LOS A	0.2	2.0	0.23	0.54	0.23	66.9
Approach		53	22.4	0.046	8.5	LOS A	0.2	2.0	0.23	0.54	0.23	68.1
All Vehicles		195	13.8	0.052	9.4	LOS A	0.2	2.0	0.14	0.62	0.14	69.4

Figure E-1: 2019 Baseline AM Peak Without the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	15	0.0	0.032	7.3	LOS A	0.2	1.2	0.26	0.63	0.26	70.7
3	R2	24	5.0	0.032	12.3	LOS B	0.2	1.2	0.26	0.63	0.26	70.5
Approach		39	3.1	0.032	10.4	LOS B	0.2	1.2	0.26	0.63	0.26	70.6
East: Tahuna Road												
5	T1	33	46.0	0.057	8.7	LOS A	0.0	0.0	0.00	0.70	0.00	61.3
6	R2	57	4.0	0.057	11.7	LOS B	0.0	0.0	0.00	0.70	0.00	71.1
Approach		89	19.3	0.057	10.6	LOS B	0.0	0.0	0.00	0.70	0.00	67.1
West: Tahuna Road												
10	L2	9	0.0	0.042	7.2	LOS A	0.2	1.9	0.26	0.54	0.26	73.1
11	T1	36	36.0	0.042	9.1	LOS A	0.2	1.9	0.26	0.54	0.26	64.9
Approach		45	28.5	0.042	8.7	LOS A	0.2	1.9	0.26	0.54	0.26	66.5
All Vehicles		174	18.1	0.057	10.1	LOS B	0.2	1.9	0.13	0.64	0.13	67.7

Figure E-2: 2019 Baseline PM Peak Without the Proposed Development – No Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	35	4.0	0.047	7.3	LOS A	0.2	1.8	0.26	0.61	0.26	71.1
3	R2	21	20.0	0.047	12.7	LOS B	0.2	1.8	0.26	0.61	0.26	67.4
Approach		56	10.0	0.047	9.4	LOS A	0.2	1.8	0.26	0.61	0.26	69.7
East: Tahuna Road												
5	T1	42	10.0	0.052	8.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.3
6	R2	44	12.0	0.052	11.9	LOS B	0.0	0.0	0.00	0.68	0.00	69.7
Approach		86	11.0	0.052	10.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.0
West: Tahuna Road												
10	L2	11	0.0	0.046	7.1	LOS A	0.2	2.0	0.23	0.54	0.23	73.2
11	T1	42	28.0	0.046	8.8	LOS A	0.2	2.0	0.23	0.54	0.23	66.9
Approach		53	22.4	0.046	8.5	LOS A	0.2	2.0	0.23	0.54	0.23	68.1
All Vehicles		195	13.8	0.052	9.4	LOS A	0.2	2.0	0.14	0.62	0.14	69.4

Figure E-3: 2019 Baseline AM Peak Without the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	15	0.0	0.032	7.3	LOS A	0.2	1.2	0.26	0.63	0.26	70.7
3	R2	24	5.0	0.032	12.3	LOS B	0.2	1.2	0.26	0.63	0.26	70.5
Approach		39	3.1	0.032	10.4	LOS B	0.2	1.2	0.26	0.63	0.26	70.6
East: Tahuna Road												
5	T1	33	46.0	0.057	8.7	LOS A	0.0	0.0	0.00	0.70	0.00	61.3
6	R2	57	4.0	0.057	11.7	LOS B	0.0	0.0	0.00	0.70	0.00	71.1
Approach		89	19.3	0.057	10.6	LOS B	0.0	0.0	0.00	0.70	0.00	67.1
West: Tahuna Road												
10	L2	9	0.0	0.042	7.2	LOS A	0.2	1.9	0.26	0.54	0.26	73.1
11	T1	36	36.0	0.042	9.1	LOS A	0.2	1.9	0.26	0.54	0.26	64.9
Approach		45	28.5	0.042	8.7	LOS A	0.2	1.9	0.26	0.54	0.26	66.5
All Vehicles		174	18.1	0.057	10.1	LOS B	0.2	1.9	0.13	0.64	0.13	67.7

Figure E-4: 2019 Baseline PM Peak Without the Proposed Development – No Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road												
5	T1	75	19.0	0.058	8.2	LOS A	0.3	2.6	0.11	0.53	0.11	70.7
6	R2	3	100.0	0.058	14.0	LOS B	0.3	2.6	0.11	0.53	0.11	61.7
Approach		78	22.3	0.058	8.6	LOS A	0.3	2.6	0.11	0.53	0.11	70.2
North: Lumdsen Road												
7	L2	2	0.0	0.017	7.0	LOS A	0.1	0.7	0.21	0.63	0.21	68.7
9	R2	18	30.0	0.017	13.7	LOS B	0.1	0.7	0.21	0.63	0.21	62.7
Approach		20	26.8	0.017	13.0	LOS B	0.1	0.7	0.21	0.63	0.21	63.3
West: Tahuna Road												
10	L2	32	17.0	0.060	7.1	LOS A	0.3	2.7	0.04	0.55	0.04	70.5
11	T1	58	24.0	0.060	8.2	LOS A	0.3	2.7	0.04	0.55	0.04	70.7
Approach		89	21.5	0.060	7.8	LOS A	0.3	2.7	0.04	0.55	0.04	70.6
All Vehicles		187	22.4	0.060	8.6	LOS A	0.3	2.7	0.09	0.55	0.09	69.6

Figure E-5: 2019 Baseline AM Peak Without the Proposed Development – No Upgrades

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: Tahuna Road												
5	T1	57	26.0	0.049	8.7	LOS A	0.3	2.3	0.25	0.52	0.25	68.1
6	R2	1	0.0	0.049	13.0	LOS B	0.3	2.3	0.25	0.52	0.25	75.1
Approach		58	25.5	0.049	8.7	LOS A	0.3	2.3	0.25	0.52	0.25	68.3
North: Lumdsen Road												
7	L2	1	100.0	0.061	9.0	LOS A	0.3	2.3	0.28	0.65	0.28	57.5
9	R2	76	2.0	0.061	13.3	LOS B	0.3	2.3	0.28	0.65	0.28	68.8
Approach		77	3.3	0.061	13.1	LOS B	0.3	2.3	0.28	0.65	0.28	68.6
West: Tahuna Road												
10	L2	16	7.0	0.077	6.8	LOS A	0.4	3.4	0.02	0.55	0.02	73.1
11	T1	112	13.0	0.077	8.0	LOS A	0.4	3.4	0.02	0.55	0.02	73.4
Approach		127	12.3	0.077	7.8	LOS A	0.4	3.4	0.02	0.55	0.02	73.3
All Vehicles		262	12.6	0.077	9.6	LOS A	0.4	3.4	0.15	0.57	0.15	70.7

Figure E-6: 2019 Baseline PM Peak Without the Proposed Development – No Upgrades

Scenario 2 – Without Upgrades

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	35	3.0	35	3.0	0.352	4.4	LOS A	0.9	6.2	0.51	0.67	0.51	44.7
3	R2	365	3.0	365	3.0	0.352	9.2	LOS A	0.9	6.2	0.51	0.67	0.51	40.6
Approach		400	3.0	400	3.0	0.352	8.8	LOS A	0.9	6.2	0.51	0.67	0.51	41.2
East: Tahuna Road														
5	T1	42	10.0	42	10.0	0.169	2.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.0
6	R2	251	4.0	251	4.0	0.169	7.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.5
Approach		293	4.9	293	4.9	0.169	6.7	LOS A	0.0	0.0	0.00	0.58	0.00	46.4
West: Tahuna Road														
10	L2	11	0.0	11	0.0	0.070	5.7	LOS A	0.2	1.3	0.65	0.60	0.65	46.2
11	T1	42	28.0	42	28.0	0.070	6.3	LOS A	0.2	1.3	0.65	0.60	0.65	42.9
Approach		53	22.4	53	22.4	0.070	6.2	LOS A	0.2	1.3	0.65	0.60	0.65	43.9
All Vehicles		745	5.1	745	5.1	0.352	7.8	LOS A	0.9	6.2	0.32	0.63	0.32	43.5

Figure E-7: 2019 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	15	0.0	15	0.0	0.559	5.9	LOS A	1.8	12.8	0.68	0.78	0.73	44.0
3	R2	593	1.0	593	1.0	0.559	10.8	LOS B	1.8	12.8	0.68	0.78	0.73	39.5
Approach		607	1.0	607	1.0	0.559	10.7	LOS B	1.8	12.8	0.68	0.78	0.73	39.7
East: Tahuna Road														
5	T1	33	45.0	33	45.0	0.221	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.5
6	R2	346	3.0	346	3.0	0.221	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
Approach		379	6.6	379	6.6	0.221	7.0	LOS A	0.0	0.0	0.00	0.59	0.00	46.1
West: Tahuna Road														
10	L2	9	0.0	9	0.0	0.090	8.9	LOS A	0.2	1.9	0.82	0.76	0.82	44.3
11	T1	36	35.0	36	35.0	0.090	10.3	LOS B	0.2	1.9	0.82	0.76	0.82	39.7
Approach		45	27.7	45	27.7	0.090	10.0	LOS B	0.2	1.9	0.82	0.76	0.82	41.1
All Vehicles		1032	4.2	1032	4.2	0.559	9.3	LOS A	1.8	12.8	0.44	0.71	0.47	42.2

Figure E-8: 2019 Baseline PM Peak With the Proposed Development – No Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	374	3.0	374	3.0	0.349	6.1	LOS A	0.0	0.0	0.00	0.38	0.00	72.8
5	T1	275	5.0	275	5.0	0.349	0.0	LOS A	0.0	0.0	0.00	0.38	0.00	63.1
Approach		648	3.8	648	3.8	0.349	3.5	NA	0.0	0.0	0.00	0.38	0.00	71.1
North: SH1 NB Off-ramp														
7	L2	264	7.0	264	7.0	0.331	12.6	LOS B	0.7	4.9	0.53	0.96	0.60	61.9
9	R2	18	0.0	18	0.0	0.331	17.4	LOS C	0.7	4.9	0.53	0.96	0.60	61.9
Approach		282	6.6	282	6.6	0.331	12.9	LOS B	0.7	4.9	0.53	0.96	0.60	61.9
West: Tahuna Road														
11	T1	371	5.0	371	5.0	0.239	0.8	LOS A	0.2	1.7	0.16	0.06	0.17	78.7
12	R2	33	13.0	33	13.0	0.239	10.2	LOS B	0.2	1.7	0.16	0.06	0.17	70.2
Approach		403	5.6	403	5.6	0.239	1.5	NA	0.2	1.7	0.16	0.06	0.17	76.2
All Vehicles		1334	5.0	1334	5.0	0.349	4.9	NA	0.7	4.9	0.16	0.41	0.18	69.0

Figure E-9: 2019 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	540	1.0	540	1.0	0.488	6.1	LOS A	0.0	0.0	0.00	0.39	0.00	73.6
5	T1	371	6.0	371	6.0	0.488	0.0	LOS A	0.0	0.0	0.00	0.39	0.00	62.1
Approach		911	3.0	911	3.0	0.488	3.6	NA	0.0	0.0	0.00	0.39	0.00	71.6
North: SH1 NB Off-ramp														
7	L2	419	3.0	419	3.0	0.668	18.8	LOS C	2.1	14.9	0.77	1.16	1.51	51.6
9	R2	8	13.0	8	13.0	0.668	38.6	LOS E	2.1	14.9	0.77	1.16	1.51	51.6
Approach		427	3.2	427	3.2	0.668	19.2	LOS C	2.1	14.9	0.77	1.16	1.51	51.6
West: Tahuna Road														
11	T1	613	2.0	613	2.0	0.354	1.0	LOS A	0.3	2.3	0.11	0.02	0.14	80.0
12	R2	16	20.0	16	20.0	0.354	17.7	LOS C	0.3	2.3	0.11	0.02	0.14	66.7
Approach		628	2.5	628	2.5	0.354	1.4	NA	0.3	2.3	0.11	0.02	0.14	78.4
All Vehicles		1966	2.9	1966	2.9	0.668	6.3	NA	2.1	14.9	0.20	0.44	0.37	65.0

Figure E-10: 2019 Baseline PM Peak With the Proposed Development – No Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	452	3.0	452	3.0	0.397	4.1	LOS A	1.2	8.4	0.51	0.47	0.51	43.3
6	R2	19	17.0	19	17.0	0.397	8.9	LOS A	1.2	8.4	0.51	0.47	0.51	47.4
Approach		471	3.6	471	3.6	0.397	4.3	LOS A	1.2	8.4	0.51	0.47	0.51	43.6
North: Lumsden Road														
7	L2	5	0.0	5	0.0	0.207	5.1	LOS A	0.5	3.4	0.56	0.71	0.56	44.4
9	R2	196	6.0	196	6.0	0.207	9.7	LOS A	0.5	3.4	0.56	0.71	0.56	40.3
Approach		201	5.8	201	5.8	0.207	9.6	LOS A	0.5	3.4	0.56	0.71	0.56	40.4
West: Tahuna Road														
10	L2	222	8.0	222	8.0	0.402	3.0	LOS A	1.3	9.6	0.15	0.34	0.15	46.5
11	T1	412	5.0	412	5.0	0.402	2.9	LOS A	1.3	9.6	0.15	0.34	0.15	48.2
Approach		634	6.1	634	6.1	0.402	2.9	LOS A	1.3	9.6	0.15	0.34	0.15	47.6
All Vehicles		1305	5.1	1305	5.1	0.402	4.5	LOS A	1.3	9.6	0.34	0.44	0.34	45.1

Figure E-11: 2019 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	304	5.0	304	5.0	0.447	7.5	LOS A	1.4	10.5	0.87	0.86	0.91	41.2
6	R2	15	0.0	15	0.0	0.447	11.8	LOS B	1.4	10.5	0.87	0.86	0.91	46.2
Approach		319	4.8	319	4.8	0.447	7.7	LOS A	1.4	10.5	0.87	0.86	0.91	41.6
North: Lumsden Road														
7	L2	19	6.0	19	6.0	0.951	45.9	LOS D	9.5	67.9	1.00	1.90	3.01	30.1
9	R2	605	2.0	605	2.0	0.951	50.1	LOS E	9.5	67.9	1.00	1.90	3.01	22.1
Approach		624	2.1	624	2.1	0.951	50.0	LOS D	9.5	67.9	1.00	1.90	3.01	22.5
West: Tahuna Road														
10	L2	131	6.0	131	6.0	0.622	3.0	LOS A	3.3	23.6	0.19	0.31	0.19	46.3
11	T1	900	2.0	900	2.0	0.622	2.9	LOS A	3.3	23.6	0.19	0.31	0.19	48.0
Approach		1031	2.5	1031	2.5	0.622	2.9	LOS A	3.3	23.6	0.19	0.31	0.19	47.8
All Vehicles		1974	2.8	1974	2.8	0.951	18.6	LOS B	9.5	67.9	0.56	0.90	1.20	35.6

Figure E-12: 2019 Baseline PM Peak With the Proposed Development – No Upgrades

Scenario 2 – With Proposed Upgrades (Option 1)

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	35	3.0	35	3.0	0.352	4.4	LOS A	0.9	6.2	0.51	0.67	0.51	44.7
3	R2	365	3.0	365	3.0	0.352	9.2	LOS A	0.9	6.2	0.51	0.67	0.51	40.6
Approach		400	3.0	400	3.0	0.352	8.8	LOS A	0.9	6.2	0.51	0.67	0.51	41.2
East: Tahuna Road														
5	T1	42	10.0	42	10.0	0.169	2.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.0
6	R2	251	4.0	251	4.0	0.169	7.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.5
Approach		293	4.9	293	4.9	0.169	6.7	LOS A	0.0	0.0	0.00	0.58	0.00	46.4
West: Tahuna Road														
10	L2	11	0.0	11	0.0	0.070	5.7	LOS A	0.2	1.3	0.65	0.60	0.65	46.2
11	T1	42	28.0	42	28.0	0.070	6.3	LOS A	0.2	1.3	0.65	0.60	0.65	42.9
Approach		53	22.4	53	22.4	0.070	6.2	LOS A	0.2	1.3	0.65	0.60	0.65	43.9
All Vehicles		745	5.1	745	5.1	0.352	7.8	LOS A	0.9	6.2	0.32	0.63	0.32	43.5

Figure E-13: 2019 Baseline AM Peak With the Proposed Development – Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	15	0.0	15	0.0	0.559	5.9	LOS A	1.8	12.8	0.68	0.78	0.73	44.0
3	R2	593	1.0	593	1.0	0.559	10.8	LOS B	1.8	12.8	0.68	0.78	0.73	39.5
Approach		607	1.0	607	1.0	0.559	10.7	LOS B	1.8	12.8	0.68	0.78	0.73	39.7
East: Tahuna Road														
5	T1	33	45.0	33	45.0	0.221	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.5
6	R2	346	3.0	346	3.0	0.221	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
Approach		379	6.6	379	6.6	0.221	7.0	LOS A	0.0	0.0	0.00	0.59	0.00	46.1
West: Tahuna Road														
10	L2	9	0.0	9	0.0	0.090	8.9	LOS A	0.2	1.9	0.82	0.76	0.82	44.3
11	T1	36	35.0	36	35.0	0.090	10.3	LOS B	0.2	1.9	0.82	0.76	0.82	39.7
Approach		45	27.7	45	27.7	0.090	10.0	LOS B	0.2	1.9	0.82	0.76	0.82	41.1
All Vehicles		1032	4.2	1032	4.2	0.559	9.3	LOS A	1.8	12.8	0.44	0.71	0.47	42.2

Figure E-14: 2019 Baseline PM Peak With the Proposed Development – Option 1 Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	374	3.0	374	3.0	0.349	6.1	LOS A	0.0	0.0	0.00	0.38	0.00	72.8
5	T1	275	5.0	275	5.0	0.349	0.0	LOS A	0.0	0.0	0.00	0.38	0.00	63.1
Approach		648	3.8	648	3.8	0.349	3.5	NA	0.0	0.0	0.00	0.38	0.00	71.1
North: SH1 NB Off-ramp														
7	L2	264	7.0	264	7.0	0.331	12.6	LOS B	0.7	4.9	0.53	0.96	0.60	61.9
9	R2	18	0.0	18	0.0	0.331	17.4	LOS C	0.7	4.9	0.53	0.96	0.60	61.9
Approach		282	6.6	282	6.6	0.331	12.9	LOS B	0.7	4.9	0.53	0.96	0.60	61.9
West: Tahuna Road														
11	T1	371	5.0	371	5.0	0.239	0.8	LOS A	0.2	1.7	0.16	0.06	0.17	78.7
12	R2	33	13.0	33	13.0	0.239	10.2	LOS B	0.2	1.7	0.16	0.06	0.17	70.2
Approach		403	5.6	403	5.6	0.239	1.5	NA	0.2	1.7	0.16	0.06	0.17	76.2
All Vehicles		1334	5.0	1334	5.0	0.349	4.9	NA	0.7	4.9	0.16	0.41	0.18	69.0

Figure E-15: 2019 Baseline AM Peak With the Proposed Development – Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	540	1.0	540	1.0	0.488	6.1	LOS A	0.0	0.0	0.00	0.39	0.00	73.6
5	T1	371	6.0	371	6.0	0.488	0.0	LOS A	0.0	0.0	0.00	0.39	0.00	62.1
Approach		911	3.0	911	3.0	0.488	3.6	NA	0.0	0.0	0.00	0.39	0.00	71.6
North: SH1 NB Off-ramp														
7	L2	419	3.0	419	3.0	0.668	18.8	LOS C	2.1	14.9	0.77	1.16	1.51	51.6
9	R2	8	13.0	8	13.0	0.668	38.6	LOS E	2.1	14.9	0.77	1.16	1.51	51.6
Approach		427	3.2	427	3.2	0.668	19.2	LOS C	2.1	14.9	0.77	1.16	1.51	51.6
West: Tahuna Road														
11	T1	613	2.0	613	2.0	0.354	1.0	LOS A	0.3	2.3	0.11	0.02	0.14	80.0
12	R2	16	20.0	16	20.0	0.354	17.7	LOS C	0.3	2.3	0.11	0.02	0.14	66.7
Approach		628	2.5	628	2.5	0.354	1.4	NA	0.3	2.3	0.11	0.02	0.14	78.4
All Vehicles		1966	2.9	1966	2.9	0.668	6.3	NA	2.1	14.9	0.20	0.44	0.37	65.0

Figure E-16: 2019 Baseline PM Peak With the Proposed Development – Option 1 Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	452	3.0	452	3.0	0.265	3.8	LOS A	0.7	5.0	0.42	0.43	0.42	43.8
6	R2	19	17.0	19	17.0	0.265	8.4	LOS A	0.7	5.0	0.42	0.43	0.42	47.6
Approach		471	3.6	471	3.6	0.265	3.9	LOS A	0.7	5.0	0.42	0.43	0.42	44.1
North: Lumsden Road														
7	L2	5	0.0	5	0.0	0.060	5.4	LOS A	0.1	0.9	0.52	0.66	0.52	44.5
9	R2	196	6.0	196	6.0	0.124	9.2	LOS A	0.3	2.0	0.51	0.66	0.51	40.4
Approach		201	5.8	201	5.8	0.124	9.1	LOS A	0.3	2.0	0.51	0.66	0.51	40.5
West: Tahuna Road														
10	L2	222	8.0	222	8.0	0.402	3.0	LOS A	1.3	9.3	0.15	0.34	0.15	46.5
11	T1	412	5.0	412	5.0	0.402	2.9	LOS A	1.3	9.3	0.15	0.34	0.15	48.2
Approach		634	6.1	634	6.1	0.402	2.9	LOS A	1.3	9.3	0.15	0.34	0.15	47.6
All Vehicles		1305	5.1	1305	5.1	0.402	4.3	LOS A	1.3	9.3	0.30	0.42	0.30	45.3

Figure E-17: 2019 Baseline AM Peak With the Proposed Development– Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	304	5.0	304	5.0	0.262	6.1	LOS A	0.8	5.6	0.74	0.67	0.74	42.0
6	R2	15	0.0	15	0.0	0.262	10.2	LOS B	0.8	5.6	0.75	0.67	0.75	46.7
Approach		319	4.8	319	4.8	0.262	6.3	LOS A	0.8	5.6	0.74	0.67	0.74	42.3
North: Lumsden Road														
7	L2	19	6.0	19	6.0	0.266	10.9	LOS B	0.7	4.8	0.82	0.89	0.82	41.9
9	R2	605	2.0	605	2.0	0.548	16.3	LOS B	2.2	16.0	0.91	1.01	1.11	35.5
Approach		624	2.1	624	2.1	0.548	16.1	LOS B	2.2	16.0	0.90	1.00	1.10	35.8
West: Tahuna Road														
10	L2	131	6.0	131	6.0	0.622	3.0	LOS A	3.2	22.7	0.18	0.31	0.18	46.3
11	T1	900	2.0	900	2.0	0.622	2.9	LOS A	3.2	22.7	0.18	0.31	0.18	48.0
Approach		1031	2.5	1031	2.5	0.622	2.9	LOS A	3.2	22.7	0.18	0.31	0.18	47.8
All Vehicles		1974	2.8	1974	2.8	0.622	7.6	LOS A	3.2	22.7	0.50	0.59	0.56	42.9

Figure E-18: 2019 Baseline PM Peak With the Proposed Development– Option 1 Upgrades

Scenario 2 – With Proposed Upgrades (Option 2)

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	35	3.0	35	3.0	0.338	4.8	LOS A	1.2	8.8	0.55	0.59	0.55	44.7
3	R2	365	3.0	365	3.0	0.338	9.6	LOS A	1.2	8.8	0.55	0.59	0.55	40.5
Approach		400	3.0	400	3.0	0.338	9.2	LOS A	1.2	8.8	0.55	0.59	0.55	41.1
East: Tahuna Road														
5	T1	42	10.0	42	10.0	0.169	2.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.0
6	R2	251	4.0	251	4.0	0.169	7.4	LOS A	0.0	0.0	0.00	0.58	0.00	46.5
Approach		293	4.9	293	4.9	0.169	6.7	LOS A	0.0	0.0	0.00	0.58	0.00	46.4
West: Tahuna Road														
10	L2	11	0.0	11	0.0	0.067	6.2	LOS A	0.2	1.6	0.69	0.57	0.69	46.1
11	T1	42	28.0	42	28.0	0.067	6.7	LOS A	0.2	1.6	0.69	0.57	0.69	42.6
Approach		53	22.4	53	22.4	0.067	6.6	LOS A	0.2	1.6	0.69	0.57	0.69	43.6
All Vehicles		745	5.1	745	5.1	0.338	8.0	LOS A	1.2	8.8	0.34	0.59	0.34	43.4

Figure E-19: 2019 Baseline AM Peak With the Proposed Development – Option 2 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	15	0.0	15	0.0	0.610	6.6	LOS A	2.6	18.6	0.77	0.62	0.77	43.7
3	R2	593	1.0	593	1.0	0.610	11.5	LOS B	2.6	18.6	0.77	0.62	0.77	39.0
Approach		607	1.0	607	1.0	0.610	11.4	LOS B	2.6	18.6	0.77	0.62	0.77	39.2
East: Tahuna Road														
5	T1	33	45.0	33	45.0	0.221	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.5
6	R2	346	3.0	346	3.0	0.221	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
Approach		379	6.6	379	6.6	0.221	7.0	LOS A	0.0	0.0	0.00	0.59	0.00	46.1
West: Tahuna Road														
10	L2	9	0.0	9	0.0	0.096	11.6	LOS B	0.3	2.8	0.96	0.70	0.96	43.0
11	T1	36	35.0	36	35.0	0.096	12.7	LOS B	0.3	2.8	0.96	0.70	0.96	37.8
Approach		45	27.7	45	27.7	0.096	12.5	LOS B	0.3	2.8	0.96	0.70	0.96	39.4
All Vehicles		1032	4.2	1032	4.2	0.610	9.8	LOS A	2.6	18.6	0.50	0.62	0.50	41.8

Figure E-20: 2019 Baseline PM Peak With the Proposed Development – Option 2 Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	374	3.0	374	3.0	0.442	16.1	LOS B	3.9	27.8	0.72	0.80	0.72	52.8
5	T1	275	5.0	275	5.0	0.654	20.8	LOS C	4.0	29.5	0.96	0.82	1.04	22.6
Approach		648	3.8	648	3.8	0.654	18.1	LOS B	4.0	29.5	0.82	0.81	0.86	43.7
North: SH1 NB Off-ramp														
7	L2	264	7.0	264	7.0	0.202	17.1	LOS B	1.5	11.1	0.62	0.75	0.62	52.6
9	R2	18	0.0	18	0.0	0.079	29.9	LOS C	0.3	1.8	0.92	0.70	0.92	38.1
Approach		282	6.6	282	6.6	0.202	17.9	LOS B	1.5	11.1	0.64	0.74	0.64	51.4
West: Tahuna Road														
11	T1	371	5.0	371	5.0	0.714	18.8	LOS B	5.9	43.2	0.95	0.85	1.05	22.9
12	R2	33	13.0	33	13.0	0.714	24.4	LOS C	5.9	43.2	0.95	0.85	1.05	46.1
Approach		403	5.6	403	5.6	0.714	19.3	LOS B	5.9	43.2	0.95	0.85	1.05	26.4
All Vehicles		1334	5.0	1334	5.0	0.714	18.4	LOS B	5.9	43.2	0.82	0.81	0.87	41.3

Figure E-21: 2019 Baseline AM Peak With the Proposed Development – Option 2 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	540	1.0	540	1.0	0.669	20.9	LOS C	7.9	55.6	0.85	0.84	0.85	48.3
5	T1	371	6.0	371	6.0	0.837	30.1	LOS C	7.5	55.2	1.00	0.95	1.29	16.8
Approach		911	3.0	911	3.0	0.837	24.6	LOS C	7.9	55.6	0.91	0.89	1.03	37.9
North: SH1 NB Off-ramp														
7	L2	419	3.0	419	3.0	0.333	20.4	LOS C	3.2	22.6	0.68	0.77	0.68	48.2
9	R2	8	13.0	8	13.0	0.049	35.7	LOS D	0.1	1.1	0.93	0.67	0.93	34.2
Approach		427	3.2	427	3.2	0.333	20.7	LOS C	3.2	22.6	0.69	0.77	0.69	47.8
West: Tahuna Road														
11	T1	613	2.0	613	2.0	0.890	30.0	LOS C	13.6	97.3	1.00	1.02	1.32	16.0
12	R2	16	20.0	16	20.0	0.890	35.5	LOS D	13.6	97.3	1.00	1.02	1.32	36.9
Approach		628	2.5	628	2.5	0.890	30.1	LOS C	13.6	97.3	1.00	1.02	1.32	16.9
All Vehicles		1966	2.9	1966	2.9	0.890	25.5	LOS C	13.6	97.3	0.89	0.91	1.05	33.9

Figure E-22: 2019 Baseline PM Peak With the Proposed Development – Option 2 Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	452	3.0	452	3.0	0.182	3.7	LOS A	0.5	3.2	0.41	0.43	0.41	43.9
6	R2	19	17.0	19	17.0	0.182	8.5	LOS A	0.4	3.2	0.42	0.45	0.42	47.6
Approach		471	3.6	471	3.6	0.182	3.9	LOS A	0.5	3.2	0.41	0.43	0.41	44.2
North: Lumsden Road														
7	L2	5	0.0	5	0.0	0.087	5.2	LOS A	0.3	2.0	0.54	0.59	0.54	44.4
9	R2	196	6.0	196	6.0	0.087	9.6	LOS A	0.3	2.0	0.55	0.60	0.55	40.3
Approach		201	5.8	201	5.8	0.087	9.5	LOS A	0.3	2.0	0.55	0.60	0.55	40.4
West: Tahuna Road														
10	L2	222	8.0	222	8.0	0.402	3.0	LOS A	1.1	8.3	0.11	0.34	0.11	46.7
11	T1	412	5.0	412	5.0	0.402	2.9	LOS A	1.1	8.3	0.11	0.34	0.11	48.4
Approach		634	6.1	634	6.1	0.402	2.9	LOS A	1.1	8.3	0.11	0.34	0.11	47.8
All Vehicles		1305	5.1	1305	5.1	0.402	4.3	LOS A	1.1	8.3	0.28	0.41	0.28	45.4

Figure E-22: 2019 Baseline AM Peak With the Proposed Development– Option 2 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	304	5.0	304	5.0	0.187	5.9	LOS A	0.5	3.9	0.74	0.67	0.74	42.0
6	R2	15	0.0	15	0.0	0.187	10.7	LOS B	0.5	3.6	0.74	0.71	0.74	46.6
Approach		319	4.8	319	4.8	0.187	6.2	LOS A	0.5	3.9	0.74	0.67	0.74	42.3
North: Lumsden Road														
7	L2	19	6.0	19	6.0	0.385	19.4	LOS B	3.2	22.6	1.00	0.60	1.00	38.2
9	R2	605	2.0	605	2.0	0.385	23.9	LOS C	3.2	22.6	1.00	0.62	1.00	31.3
Approach		624	2.1	624	2.1	0.385	23.8	LOS C	3.2	22.6	1.00	0.62	1.00	31.6
West: Tahuna Road														
10	L2	131	6.0	131	6.0	0.622	3.0	LOS A	3.1	22.0	0.12	0.32	0.12	46.6
11	T1	900	2.0	900	2.0	0.622	2.9	LOS A	3.1	22.0	0.12	0.32	0.12	48.3
Approach		1031	2.5	1031	2.5	0.622	2.9	LOS A	3.1	22.0	0.12	0.32	0.12	48.1
All Vehicles		1974	2.8	1974	2.8	0.622	10.0	LOS B	3.2	22.6	0.50	0.47	0.50	41.2

Figure E-23: 2019 Baseline PM Peak With the Proposed Development– Option 2 Upgrades

Scenario 3 – Without Upgrades

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	51	5.0	0.072	7.6	LOS A	0.4	2.9	0.32	0.62	0.32	70.5
3	R2	31	21.0	0.072	13.0	LOS B	0.4	2.9	0.32	0.62	0.32	66.8
Approach		81	11.0	0.072	9.7	LOS A	0.4	2.9	0.32	0.62	0.32	69.1
East: Tahuna Road												
5	T1	61	11.0	0.077	8.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.1
6	R2	64	14.0	0.077	12.0	LOS B	0.0	0.0	0.00	0.68	0.00	69.0
Approach		125	12.5	0.077	10.0	LOS B	0.0	0.0	0.00	0.68	0.00	69.5
West: Tahuna Road												
10	L2	16	0.0	0.070	7.3	LOS A	0.4	3.1	0.29	0.55	0.29	72.8
11	T1	61	28.0	0.070	9.1	LOS A	0.4	3.1	0.29	0.55	0.29	66.5
Approach		77	22.2	0.070	8.7	LOS A	0.4	3.1	0.29	0.55	0.29	67.7
All Vehicles		283	14.7	0.077	9.6	LOS A	0.4	3.1	0.17	0.63	0.17	68.9

Figure E-24: 2031 Baseline AM Peak Without the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	21	0.0	0.049	7.5	LOS A	0.3	1.8	0.32	0.64	0.32	70.3
3	R2	36	6.0	0.049	12.6	LOS B	0.3	1.8	0.32	0.64	0.32	69.9
Approach		57	3.8	0.049	10.7	LOS B	0.3	1.8	0.32	0.64	0.32	70.0
East: Tahuna Road												
5	T1	47	45.0	0.082	8.7	LOS A	0.0	0.0	0.00	0.70	0.00	61.5
6	R2	82	4.0	0.082	11.7	LOS B	0.0	0.0	0.00	0.70	0.00	71.1
Approach		129	19.0	0.082	10.6	LOS B	0.0	0.0	0.00	0.70	0.00	67.2
West: Tahuna Road												
10	L2	14	0.0	0.063	7.4	LOS A	0.3	2.9	0.32	0.56	0.32	72.6
11	T1	53	36.0	0.063	9.4	LOS A	0.3	2.9	0.32	0.56	0.32	64.6
Approach		66	28.6	0.063	9.0	LOS A	0.3	2.9	0.32	0.56	0.32	66.1
All Vehicles		253	18.1	0.082	10.2	LOS B	0.3	2.9	0.16	0.65	0.16	67.5

Figure E-25: 2031 Baseline PM Peak Without the Proposed Development – No Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	51	5.0	0.072	7.6	LOS A	0.4	2.9	0.32	0.62	0.32	70.5
3	R2	31	21.0	0.072	13.0	LOS B	0.4	2.9	0.32	0.62	0.32	66.8
Approach		81	11.0	0.072	9.7	LOS A	0.4	2.9	0.32	0.62	0.32	69.1
East: Tahuna Road												
5	T1	61	11.0	0.077	8.0	LOS A	0.0	0.0	0.00	0.68	0.00	70.1
6	R2	64	14.0	0.077	12.0	LOS B	0.0	0.0	0.00	0.68	0.00	69.0
Approach		125	12.5	0.077	10.0	LOS B	0.0	0.0	0.00	0.68	0.00	69.5
West: Tahuna Road												
10	L2	16	0.0	0.070	7.3	LOS A	0.4	3.1	0.29	0.55	0.29	72.8
11	T1	61	28.0	0.070	9.1	LOS A	0.4	3.1	0.29	0.55	0.29	66.5
Approach		77	22.2	0.070	8.7	LOS A	0.4	3.1	0.29	0.55	0.29	67.7
All Vehicles		283	14.7	0.077	9.6	LOS A	0.4	3.1	0.17	0.63	0.17	68.9

Figure E-26: 2031 Baseline AM Peak Without the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp												
1	L2	21	0.0	0.049	7.5	LOS A	0.3	1.8	0.32	0.64	0.32	70.3
3	R2	36	6.0	0.049	12.6	LOS B	0.3	1.8	0.32	0.64	0.32	69.9
Approach		57	3.8	0.049	10.7	LOS B	0.3	1.8	0.32	0.64	0.32	70.0
East: Tahuna Road												
5	T1	47	45.0	0.082	8.7	LOS A	0.0	0.0	0.00	0.70	0.00	61.5
6	R2	82	4.0	0.082	11.7	LOS B	0.0	0.0	0.00	0.70	0.00	71.1
Approach		129	19.0	0.082	10.6	LOS B	0.0	0.0	0.00	0.70	0.00	67.2
West: Tahuna Road												
10	L2	14	0.0	0.063	7.4	LOS A	0.3	2.9	0.32	0.56	0.32	72.6
11	T1	53	36.0	0.063	9.4	LOS A	0.3	2.9	0.32	0.56	0.32	64.6
Approach		66	28.6	0.063	9.0	LOS A	0.3	2.9	0.32	0.56	0.32	66.1
All Vehicles		253	18.1	0.082	10.2	LOS B	0.3	2.9	0.16	0.65	0.16	67.5

Figure E-27: 2031 Baseline PM Peak Without the Proposed Development – No Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road												
5	T1	107	19.0	0.085	8.2	LOS A	0.5	4.0	0.15	0.53	0.15	70.3
6	R2	5	100.0	0.085	14.1	LOS B	0.5	4.0	0.15	0.53	0.15	61.5
Approach		113	22.8	0.085	8.8	LOS A	0.5	4.0	0.15	0.53	0.15	69.8
North: Lumdsen Road												
7	L2	3	0.0	0.027	7.1	LOS A	0.1	1.2	0.26	0.63	0.26	68.4
9	R2	27	31.0	0.027	13.9	LOS B	0.1	1.2	0.26	0.63	0.26	62.2
Approach		31	27.8	0.027	13.2	LOS B	0.1	1.2	0.26	0.63	0.26	62.8
West: Tahuna Road												
10	L2	46	19.0	0.088	7.1	LOS A	0.5	4.1	0.06	0.55	0.06	69.8
11	T1	83	25.0	0.088	8.2	LOS A	0.5	4.1	0.06	0.55	0.06	70.4
Approach		129	22.9	0.088	7.8	LOS A	0.5	4.1	0.06	0.55	0.06	70.2
All Vehicles		273	23.4	0.088	8.7	LOS A	0.5	4.1	0.12	0.55	0.12	69.1

Figure E-28: 2031 Baseline AM Peak Without the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road												
5	T1	82	26.0	0.074	8.9	LOS A	0.4	3.6	0.31	0.53	0.31	67.6
6	R2	2	0.0	0.074	13.2	LOS B	0.4	3.6	0.31	0.53	0.31	74.5
Approach		84	25.4	0.074	9.0	LOS A	0.4	3.6	0.31	0.53	0.31	67.8
North: Lumdsen Road												
7	L2	2	100.0	0.092	9.6	LOS A	0.5	3.6	0.35	0.66	0.35	57.3
9	R2	109	2.0	0.092	13.6	LOS B	0.5	3.6	0.35	0.66	0.35	68.5
Approach		112	3.8	0.092	13.4	LOS B	0.5	3.6	0.35	0.66	0.35	68.2
West: Tahuna Road												
10	L2	23	10.0	0.112	6.9	LOS A	0.7	5.2	0.03	0.55	0.03	72.2
11	T1	160	13.0	0.112	8.0	LOS A	0.7	5.2	0.03	0.55	0.03	73.3
Approach		183	12.6	0.112	7.8	LOS A	0.7	5.2	0.03	0.55	0.03	73.1
All Vehicles		379	12.9	0.112	9.8	LOS A	0.7	5.2	0.19	0.58	0.19	70.4

Figure E-29: 2031 Baseline PM Peak Without the Proposed Development – No Upgrades

Scenario 4 – Layout Option 1 (Without Further Upgrades)

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	51	4.0	51	4.0	0.385	4.7	LOS A	1.0	7.0	0.56	0.69	0.56	44.7
3	R2	371	4.0	371	4.0	0.385	9.6	LOS A	1.0	7.0	0.56	0.69	0.56	40.6
Approach		421	4.0	421	4.0	0.385	9.0	LOS A	1.0	7.0	0.56	0.69	0.56	41.4
East: Tahuna Road														
5	T1	61	10.0	61	10.0	0.193	2.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.2
6	R2	271	5.0	271	5.0	0.193	7.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.7
Approach		332	5.9	332	5.9	0.193	6.5	LOS A	0.0	0.0	0.00	0.57	0.00	46.6
West: Tahuna Road														
10	L2	16	0.0	16	0.0	0.105	6.0	LOS A	0.2	2.0	0.68	0.65	0.68	46.1
11	T1	61	28.0	61	28.0	0.105	6.7	LOS A	0.2	2.0	0.68	0.65	0.68	42.7
Approach		77	22.2	77	22.2	0.105	6.6	LOS A	0.2	2.0	0.68	0.65	0.68	43.8
All Vehicles		829	6.5	829	6.5	0.385	7.8	LOS A	1.0	7.0	0.35	0.64	0.35	43.7

Figure E-30: 2031 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	21	0.0	21	0.0	0.595	7.0	LOS A	2.1	15.1	0.73	0.84	0.84	43.5
3	R2	604	1.0	604	1.0	0.595	11.8	LOS B	2.1	15.1	0.73	0.84	0.84	38.8
Approach		625	1.0	625	1.0	0.595	11.7	LOS B	2.1	15.1	0.73	0.84	0.84	39.1
East: Tahuna Road														
5	T1	47	44.0	47	44.0	0.246	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.6
6	R2	372	3.0	372	3.0	0.246	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.3
Approach		419	7.6	419	7.6	0.246	6.9	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
West: Tahuna Road														
10	L2	14	0.0	14	0.0	0.140	9.7	LOS A	0.4	3.1	0.85	0.82	0.85	43.8
11	T1	53	36.0	53	36.0	0.140	11.2	LOS B	0.4	3.1	0.85	0.82	0.85	39.0
Approach		66	28.6	66	28.6	0.140	10.9	LOS B	0.4	3.1	0.85	0.82	0.85	40.5
All Vehicles		1111	5.1	1111	5.1	0.595	9.8	LOS A	2.1	15.1	0.46	0.75	0.52	41.9

Figure E-31: 2031 Baseline PM Peak With the Proposed Development – No Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	384	4.0	384	4.0	0.373	6.1	LOS A	0.0	0.0	0.00	0.37	0.00	72.5
5	T1	304	6.0	304	6.0	0.373	0.0	LOS A	0.0	0.0	0.00	0.37	0.00	63.8
Approach		688	4.9	688	4.9	0.373	3.4	NA	0.0	0.0	0.00	0.37	0.00	70.9
North: SH1 NB Off-ramp														
7	L2	289	7.0	289	7.0	0.393	13.2	LOS B	0.9	6.5	0.57	1.00	0.71	60.3
9	R2	26	0.0	26	0.0	0.393	19.5	LOS C	0.9	6.5	0.57	1.00	0.71	60.3
Approach		316	6.4	316	6.4	0.393	13.7	LOS B	0.9	6.5	0.57	1.00	0.71	60.3
West: Tahuna Road														
11	T1	384	6.0	384	6.0	0.272	1.3	LOS A	0.4	2.9	0.24	0.08	0.27	70.5
12	R2	47	13.0	47	13.0	0.272	10.9	LOS B	0.4	2.9	0.24	0.08	0.27	68.6
Approach		432	6.8	432	6.8	0.272	2.4	NA	0.4	2.9	0.24	0.08	0.27	69.8
All Vehicles		1436	5.8	1436	5.8	0.393	5.4	NA	0.9	6.5	0.20	0.42	0.24	67.3

Figure E-32: 2031 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	562	1.0	562	1.0	0.521	6.1	LOS A	0.0	0.0	0.00	0.38	0.00	73.7
5	T1	406	8.0	406	8.0	0.521	0.0	LOS A	0.0	0.0	0.00	0.38	0.00	62.3
Approach		968	3.9	968	3.9	0.521	3.6	NA	0.0	0.0	0.00	0.38	0.00	71.7
North: SH1 NB Off-ramp														
7	L2	455	3.0	455	3.0	0.785	22.5	LOS C	3.0	21.6	0.84	1.27	2.09	46.5
9	R2	13	17.0	13	17.0	0.785	50.4	LOS F	3.0	21.6	0.84	1.27	2.09	46.5
Approach		467	3.4	467	3.4	0.785	23.3	LOS C	3.0	21.6	0.84	1.27	2.09	46.5
West: Tahuna Road														
11	T1	633	3.0	633	3.0	0.396	2.1	LOS A	0.7	4.7	0.18	0.03	0.26	67.1
12	R2	24	22.0	24	22.0	0.396	21.0	LOS C	0.7	4.7	0.18	0.03	0.26	63.3
Approach		657	3.7	657	3.7	0.396	2.8	NA	0.7	4.7	0.18	0.03	0.26	66.5
All Vehicles		2093	3.7	2093	3.7	0.785	7.7	NA	3.0	21.6	0.25	0.47	0.55	61.0

Figure E-33: 2031 Baseline PM Peak With the Proposed Development – No Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	484	4.0	484	4.0	0.289	3.8	LOS A	0.8	5.7	0.44	0.44	0.44	43.7
6	R2	21	25.0	21	25.0	0.289	8.6	LOS A	0.8	5.7	0.45	0.44	0.45	47.5
Approach		505	4.9	505	4.9	0.289	4.0	LOS A	0.8	5.7	0.44	0.44	0.44	44.0
North: Lumsden Road														
7	L2	6	0.0	6	0.0	0.065	5.6	LOS A	0.1	1.0	0.54	0.67	0.54	44.4
9	R2	205	7.0	205	7.0	0.134	9.4	LOS A	0.3	2.3	0.53	0.67	0.53	40.3
Approach		212	6.8	212	6.8	0.134	9.3	LOS A	0.3	2.3	0.53	0.67	0.53	40.5
West: Tahuna Road														
10	L2	237	9.0	237	9.0	0.432	3.0	LOS A	1.4	10.6	0.17	0.34	0.17	46.4
11	T1	437	6.0	437	6.0	0.432	2.9	LOS A	1.4	10.6	0.17	0.34	0.17	48.1
Approach		674	7.1	674	7.1	0.432	3.0	LOS A	1.4	10.6	0.17	0.34	0.17	47.5
All Vehicles		1391	6.2	1391	6.2	0.432	4.3	LOS A	1.4	10.6	0.32	0.43	0.32	45.2

Figure E-34: 2031 Baseline AM Peak With the Proposed Development – No Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	329	6.0	329	6.0	0.296	6.4	LOS A	0.9	6.6	0.78	0.71	0.78	41.7
6	R2	16	0.0	16	0.0	0.296	10.5	LOS B	0.9	6.6	0.79	0.71	0.79	46.5
Approach		345	5.7	345	5.7	0.296	6.6	LOS A	0.9	6.6	0.78	0.71	0.78	42.1
North: Lumsden Road														
7	L2	20	11.0	20	11.0	0.297	12.1	LOS B	0.8	5.5	0.85	0.92	0.85	41.4
9	R2	639	2.0	639	2.0	0.613	18.8	LOS B	2.9	20.6	0.95	1.10	1.28	34.0
Approach		659	2.3	659	2.3	0.613	18.6	LOS B	2.9	20.6	0.95	1.09	1.26	34.3
West: Tahuna Road														
10	L2	138	7.0	138	7.0	0.657	3.0	LOS A	3.7	26.2	0.21	0.31	0.21	46.2
11	T1	948	2.0	948	2.0	0.657	2.9	LOS A	3.7	26.2	0.21	0.31	0.21	47.9
Approach		1086	2.6	1086	2.6	0.657	2.9	LOS A	3.7	26.2	0.21	0.31	0.21	47.7
All Vehicles		2091	3.0	2091	3.0	0.657	8.5	LOS A	3.7	26.2	0.54	0.62	0.64	42.2

Figure E-35: 2031 Baseline PM Peak With the Proposed Development – No Upgrades

Scenario 4 – Layout Option 1 (With Proposed Upgrades)

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	51	4.0	51	4.0	0.385	4.7	LOS A	1.0	7.0	0.56	0.69	0.56	44.7
3	R2	371	4.0	371	4.0	0.385	9.6	LOS A	1.0	7.0	0.56	0.69	0.56	40.6
Approach		421	4.0	421	4.0	0.385	9.0	LOS A	1.0	7.0	0.56	0.69	0.56	41.4
East: Tahuna Road														
5	T1	61	10.0	61	10.0	0.193	2.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.2
6	R2	271	5.0	271	5.0	0.193	7.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.7
Approach		332	5.9	332	5.9	0.193	6.5	LOS A	0.0	0.0	0.00	0.57	0.00	46.6
West: Tahuna Road														
10	L2	16	0.0	16	0.0	0.105	6.0	LOS A	0.2	2.0	0.68	0.65	0.68	46.1
11	T1	61	28.0	61	28.0	0.105	6.7	LOS A	0.2	2.0	0.68	0.65	0.68	42.7
Approach		77	22.2	77	22.2	0.105	6.6	LOS A	0.2	2.0	0.68	0.65	0.68	43.8
All Vehicles		829	6.5	829	6.5	0.385	7.8	LOS A	1.0	7.0	0.35	0.64	0.35	43.7

Figure E-36: 2031 Baseline AM Peak With the Proposed Development – Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	21	0.0	21	0.0	0.595	7.0	LOS A	2.1	15.1	0.73	0.84	0.84	43.5
3	R2	604	1.0	604	1.0	0.595	11.8	LOS B	2.1	15.1	0.73	0.84	0.84	38.8
Approach		625	1.0	625	1.0	0.595	11.7	LOS B	2.1	15.1	0.73	0.84	0.84	39.1
East: Tahuna Road														
5	T1	47	44.0	47	44.0	0.246	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.6
6	R2	372	3.0	372	3.0	0.246	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.3
Approach		419	7.6	419	7.6	0.246	6.9	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
West: Tahuna Road														
10	L2	14	0.0	14	0.0	0.140	9.7	LOS A	0.4	3.1	0.85	0.82	0.85	43.8
11	T1	53	36.0	53	36.0	0.140	11.2	LOS B	0.4	3.1	0.85	0.82	0.85	39.0
Approach		66	28.6	66	28.6	0.140	10.9	LOS B	0.4	3.1	0.85	0.82	0.85	40.5
All Vehicles		1111	5.1	1111	5.1	0.595	9.8	LOS A	2.1	15.1	0.46	0.75	0.52	41.9

Figure E-37: 2031 Baseline PM Peak With the Proposed Development – Option 1 Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	384	4.0	384	4.0	0.373	6.1	LOS A	0.0	0.0	0.00	0.37	0.00	72.5
5	T1	304	6.0	304	6.0	0.373	0.0	LOS A	0.0	0.0	0.00	0.37	0.00	63.8
Approach		688	4.9	688	4.9	0.373	3.4	NA	0.0	0.0	0.00	0.37	0.00	70.9
North: SH1 NB Off-ramp														
7	L2	289	7.0	289	7.0	0.322	12.7	LOS B	0.6	4.7	0.53	0.96	0.58	62.5
9	R2	26	0.0	26	0.0	0.071	16.2	LOS C	0.1	0.6	0.65	1.00	0.65	54.8
Approach		316	6.4	316	6.4	0.322	13.0	LOS B	0.6	4.7	0.54	0.97	0.59	61.8
West: Tahuna Road														
11	T1	384	6.0	384	6.0	0.272	1.3	LOS A	0.4	2.9	0.24	0.08	0.27	70.6
12	R2	47	13.0	47	13.0	0.272	10.9	LOS B	0.4	2.9	0.24	0.08	0.27	68.6
Approach		432	6.8	432	6.8	0.272	2.4	NA	0.4	2.9	0.24	0.08	0.27	69.9
All Vehicles		1436	5.8	1436	5.8	0.373	5.2	NA	0.6	4.7	0.19	0.41	0.21	67.8

Figure E-38: 2031 Baseline AM Peak With the Proposed Development – Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	562	1.0	562	1.0	0.521	6.1	LOS A	0.0	0.0	0.00	0.38	0.00	73.7
5	T1	406	8.0	406	8.0	0.521	0.0	LOS A	0.0	0.0	0.00	0.38	0.00	62.3
Approach		968	3.9	968	3.9	0.521	3.6	NA	0.0	0.0	0.00	0.38	0.00	71.7
North: SH1 NB Off-ramp														
7	L2	455	3.0	455	3.0	0.703	19.8	LOS C	2.3	16.7	0.80	1.18	1.66	50.8
9	R2	13	17.0	13	17.0	0.082	30.6	LOS D	0.1	0.8	0.85	1.00	0.85	39.3
Approach		467	3.4	467	3.4	0.703	20.1	LOS C	2.3	16.7	0.80	1.18	1.63	50.4
West: Tahuna Road														
11	T1	633	3.0	633	3.0	0.396	2.1	LOS A	0.7	4.7	0.18	0.03	0.26	67.1
12	R2	24	22.0	24	22.0	0.396	21.0	LOS C	0.7	4.7	0.18	0.03	0.26	63.3
Approach		657	3.7	657	3.7	0.396	2.8	NA	0.7	4.7	0.18	0.03	0.26	66.6
All Vehicles		2093	3.7	2093	3.7	0.703	7.0	NA	2.3	16.7	0.24	0.45	0.45	63.0

Figure E-39: 2031 Baseline PM Peak With the Proposed Development – Option 1 Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	484	4.0	484	4.0	0.289	3.8	LOS A	0.8	5.7	0.44	0.44	0.44	43.7
6	R2	21	25.0	21	25.0	0.289	8.6	LOS A	0.8	5.7	0.45	0.44	0.45	47.5
Approach		505	4.9	505	4.9	0.289	4.0	LOS A	0.8	5.7	0.44	0.44	0.44	44.0
North: Lumsden Road														
7	L2	6	0.0	6	0.0	0.065	5.6	LOS A	0.1	1.0	0.54	0.67	0.54	44.4
9	R2	205	7.0	205	7.0	0.134	9.4	LOS A	0.3	2.3	0.53	0.67	0.53	40.3
Approach		212	6.8	212	6.8	0.134	9.3	LOS A	0.3	2.3	0.53	0.67	0.53	40.5
West: Tahuna Road														
10	L2	237	9.0	237	9.0	0.432	3.0	LOS A	1.4	10.6	0.17	0.34	0.17	46.4
11	T1	437	6.0	437	6.0	0.432	2.9	LOS A	1.4	10.6	0.17	0.34	0.17	48.1
Approach		674	7.1	674	7.1	0.432	3.0	LOS A	1.4	10.6	0.17	0.34	0.17	47.5
All Vehicles		1391	6.2	1391	6.2	0.432	4.3	LOS A	1.4	10.6	0.32	0.43	0.32	45.2

Figure E-40: 2031 Baseline AM Peak With the Proposed Development– Option 1 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	329	6.0	329	6.0	0.296	6.4	LOS A	0.9	6.6	0.78	0.71	0.78	41.7
6	R2	16	0.0	16	0.0	0.296	10.5	LOS B	0.9	6.6	0.79	0.71	0.79	46.5
Approach		345	5.7	345	5.7	0.296	6.6	LOS A	0.9	6.6	0.78	0.71	0.78	42.1
North: Lumsden Road														
7	L2	20	11.0	20	11.0	0.297	12.1	LOS B	0.8	5.5	0.85	0.92	0.85	41.4
9	R2	639	2.0	639	2.0	0.613	18.8	LOS B	2.9	20.6	0.95	1.10	1.28	34.0
Approach		659	2.3	659	2.3	0.613	18.6	LOS B	2.9	20.6	0.95	1.09	1.26	34.3
West: Tahuna Road														
10	L2	138	7.0	138	7.0	0.657	3.0	LOS A	3.7	26.2	0.21	0.31	0.21	46.2
11	T1	948	2.0	948	2.0	0.657	2.9	LOS A	3.7	26.2	0.21	0.31	0.21	47.9
Approach		1086	2.6	1086	2.6	0.657	2.9	LOS A	3.7	26.2	0.21	0.31	0.21	47.7
All Vehicles		2091	3.0	2091	3.0	0.657	8.5	LOS A	3.7	26.2	0.54	0.62	0.64	42.2

Figure E-41: 2031 Baseline PM Peak With the Proposed Development– Option 1 Upgrades

Scenario 4 – Layout Option 2 (Without Further Upgrades)

SH1 Ohinewai Interchange - Western Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	51	4.0	51	4.0	0.367	5.3	LOS A	1.4	10.4	0.61	0.60	0.61	44.6
3	R2	371	4.0	371	4.0	0.367	10.2	LOS B	1.4	10.4	0.61	0.60	0.61	40.3
Approach		421	4.0	421	4.0	0.367	9.6	LOS A	1.4	10.4	0.61	0.60	0.61	41.2
East: Tahuna Road														
5	T1	61	10.0	61	10.0	0.193	2.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.2
6	R2	271	5.0	271	5.0	0.193	7.4	LOS A	0.0	0.0	0.00	0.57	0.00	46.7
Approach		332	5.9	332	5.9	0.193	6.5	LOS A	0.0	0.0	0.00	0.57	0.00	46.6
West: Tahuna Road														
10	L2	16	0.0	16	0.0	0.100	6.7	LOS A	0.3	2.5	0.73	0.60	0.73	45.9
11	T1	61	28.0	61	28.0	0.100	7.3	LOS A	0.3	2.5	0.73	0.60	0.73	42.2
Approach		77	22.2	77	22.2	0.100	7.1	LOS A	0.3	2.5	0.73	0.60	0.73	43.4
All Vehicles		829	6.5	829	6.5	0.367	8.1	LOS A	1.4	10.4	0.38	0.59	0.38	43.5

Figure E-42: 2031 Baseline AM Peak With the Proposed Development – Option 2 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: SH1 NB Off-ramp														
1	L2	21	0.0	21	0.0	0.726	7.5	LOS A	3.0	21.3	0.85	0.63	0.85	43.3
3	R2	604	1.0	604	1.0	0.726	12.4	LOS B	3.0	21.3	0.85	0.63	0.85	38.4
Approach		625	1.0	625	1.0	0.726	12.3	LOS B	3.0	21.3	0.85	0.63	0.85	38.6
East: Tahuna Road														
5	T1	47	44.0	47	44.0	0.246	2.5	LOS A	0.0	0.0	0.00	0.59	0.00	45.6
6	R2	372	3.0	372	3.0	0.246	7.4	LOS A	0.0	0.0	0.00	0.59	0.00	46.3
Approach		419	7.6	419	7.6	0.246	6.9	LOS A	0.0	0.0	0.00	0.59	0.00	46.2
West: Tahuna Road														
10	L2	14	0.0	14	0.0	0.166	13.2	LOS B	0.6	4.8	1.00	0.74	1.00	42.2
11	T1	53	36.0	53	36.0	0.166	14.5	LOS B	0.6	4.8	1.00	0.74	1.00	36.5
Approach		66	28.6	66	28.6	0.166	14.2	LOS B	0.6	4.8	1.00	0.74	1.00	38.3
All Vehicles		1111	5.1	1111	5.1	0.726	10.3	LOS B	3.0	21.3	0.54	0.62	0.54	41.5

Figure E-43: 2031 Baseline PM Peak With the Proposed Development – Option 2 Upgrades

SH1 Ohinewai Interchange - Eastern Ramp Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	384	4.0	384	4.0	0.458	16.2	LOS B	4.0	29.1	0.73	0.80	0.73	52.4
5	T1	304	6.0	304	6.0	0.729	22.3	LOS C	4.7	34.7	0.98	0.87	1.14	21.4
Approach		688	4.9	688	4.9	0.729	18.9	LOS B	4.7	34.7	0.84	0.83	0.91	42.3
North: SH1 NB Off-ramp														
7	L2	289	7.0	289	7.0	0.221	17.2	LOS B	1.7	12.3	0.62	0.75	0.62	52.5
9	R2	26	0.0	26	0.0	0.117	30.1	LOS C	0.4	2.6	0.92	0.71	0.92	37.9
Approach		316	6.4	316	6.4	0.221	18.3	LOS B	1.7	12.3	0.65	0.75	0.65	50.9
West: Tahuna Road														
11	T1	384	6.0	384	6.0	0.771	20.6	LOS C	6.7	49.7	0.97	0.90	1.15	21.2
12	R2	47	13.0	47	13.0	0.771	26.2	LOS C	6.7	49.7	0.97	0.90	1.15	44.4
Approach		432	6.8	432	6.8	0.771	21.3	LOS C	6.7	49.7	0.97	0.90	1.15	25.8
All Vehicles		1436	5.8	1436	5.8	0.771	19.5	LOS B	6.7	49.7	0.84	0.83	0.92	40.1

Figure E-44: 2031 Baseline AM Peak With the Proposed Development – Option 2 Upgrades

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
4	L2	562	1.0	562	1.0	0.704	24.1	LOS C	9.8	69.4	0.88	0.86	0.89	45.4
5	T1	406	8.0	406	8.0	0.844	33.6	LOS C	9.4	70.7	1.00	0.96	1.25	15.3
Approach		968	3.9	968	3.9	0.844	28.1	LOS C	9.8	70.7	0.93	0.90	1.04	34.9
North: SH1 NB Off-ramp														
7	L2	455	3.0	455	3.0	0.372	22.7	LOS C	4.0	28.8	0.70	0.78	0.70	45.5
9	R2	13	17.0	13	17.0	0.088	41.8	LOS D	0.3	2.1	0.95	0.69	0.95	30.7
Approach		467	3.4	467	3.4	0.372	23.2	LOS C	4.0	28.8	0.71	0.78	0.71	44.9
West: Tahuna Road														
11	T1	633	3.0	633	3.0	0.860	28.5	LOS C	15.1	108.7	0.98	0.97	1.18	16.6
12	R2	24	22.0	24	22.0	0.860	34.1	LOS C	15.1	108.7	0.98	0.97	1.18	37.4
Approach		657	3.7	657	3.7	0.860	28.7	LOS C	15.1	108.7	0.98	0.97	1.18	18.0
All Vehicles		2093	3.7	2093	3.7	0.860	27.2	LOS C	15.1	108.7	0.90	0.90	1.01	32.7

Figure E-45: 2031 Baseline PM Peak With the Proposed Development – Option 2 Upgrades

Tahuna Road and Lumsden Road Intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	484	4.0	484	4.0	0.199	3.8	LOS A	0.5	3.6	0.43	0.44	0.43	43.8
6	R2	21	25.0	21	25.0	0.199	8.8	LOS A	0.5	3.6	0.44	0.46	0.44	47.4
Approach		505	4.9	505	4.9	0.199	4.0	LOS A	0.5	3.6	0.43	0.44	0.43	44.1
North: Lumsden Road														
7	L2	6	0.0	6	0.0	0.094	5.4	LOS A	0.3	2.2	0.57	0.59	0.57	44.3
9	R2	205	7.0	205	7.0	0.094	9.9	LOS A	0.3	2.2	0.57	0.60	0.57	40.1
Approach		212	6.8	212	6.8	0.094	9.8	LOS A	0.3	2.2	0.57	0.60	0.57	40.3
West: Tahuna Road														
10	L2	237	9.0	237	9.0	0.432	3.0	LOS A	1.3	9.5	0.12	0.34	0.12	46.6
11	T1	437	6.0	437	6.0	0.432	2.9	LOS A	1.3	9.5	0.12	0.34	0.12	48.4
Approach		674	7.1	674	7.1	0.432	3.0	LOS A	1.3	9.5	0.12	0.34	0.12	47.7
All Vehicles		1391	6.2	1391	6.2	0.432	4.4	LOS A	1.3	9.5	0.30	0.42	0.30	45.3

Figure E-46: 2031 Baseline AM Peak With the Proposed Development– Option 2 Upgrades

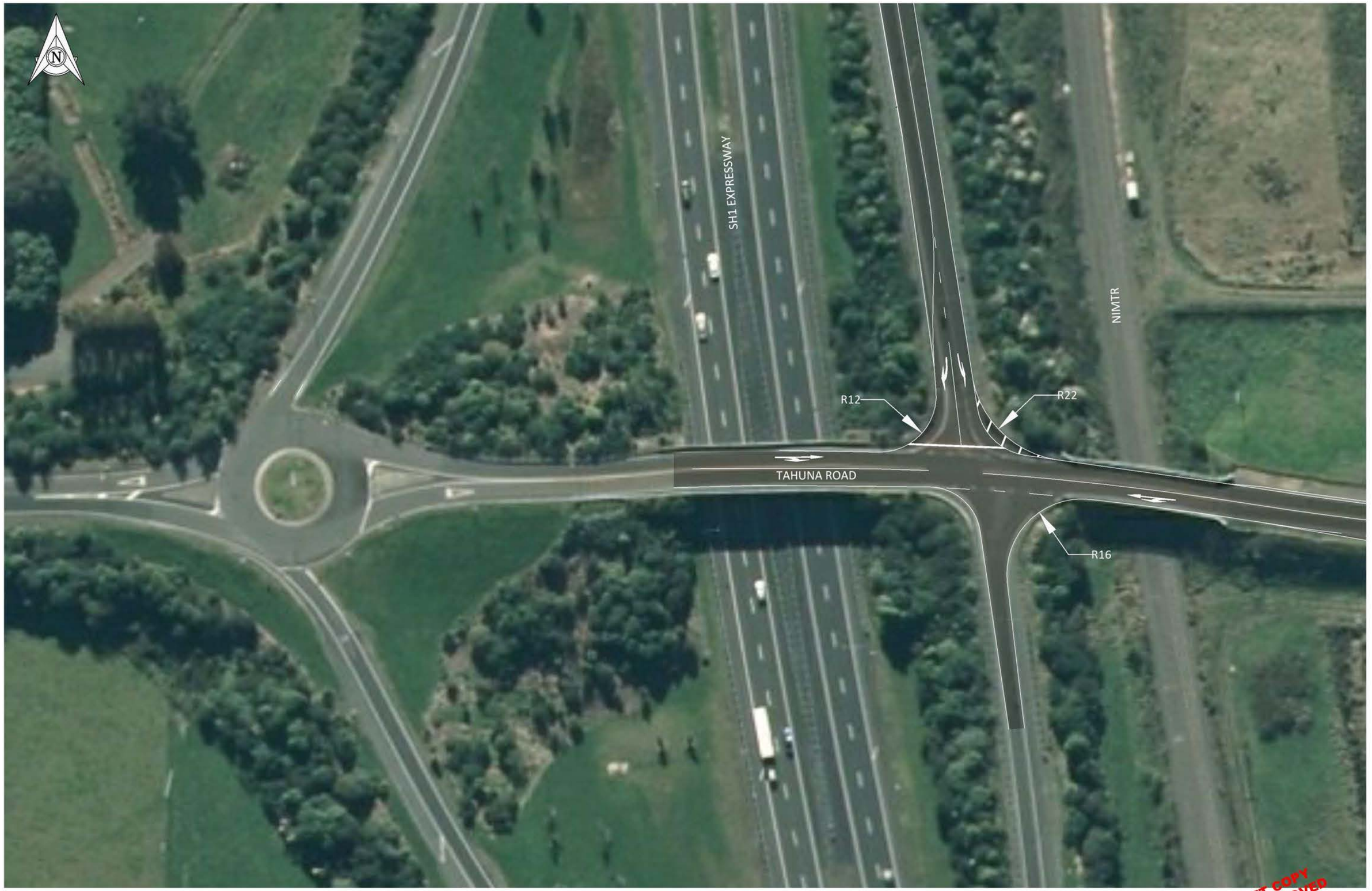
Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	Aver. Back of Queue Vehicles veh	Aver. Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Tahuna Road														
5	T1	329	6.0	329	6.0	0.211	6.3	LOS A	0.6	4.5	0.77	0.70	0.77	41.8
6	R2	16	0.0	16	0.0	0.211	11.1	LOS B	0.6	4.1	0.76	0.74	0.76	46.5
Approach		345	5.7	345	5.7	0.211	6.5	LOS A	0.6	4.5	0.77	0.70	0.77	42.2
North: Lumsden Road														
7	L2	20	11.0	20	11.0	0.448	20.5	LOS C	3.3	23.6	1.00	0.63	1.00	37.8
9	R2	639	2.0	639	2.0	0.448	25.1	LOS C	3.3	23.6	1.00	0.65	1.00	30.7
Approach		659	2.3	659	2.3	0.448	25.0	LOS C	3.3	23.6	1.00	0.65	1.00	31.0
West: Tahuna Road														
10	L2	138	7.0	138	7.0	0.657	3.0	LOS A	3.6	25.6	0.14	0.32	0.14	46.5
11	T1	948	2.0	948	2.0	0.657	2.9	LOS A	3.6	25.6	0.14	0.32	0.14	48.3
Approach		1086	2.6	1086	2.6	0.657	2.9	LOS A	3.6	25.6	0.14	0.32	0.14	48.0
All Vehicles		2091	3.0	2091	3.0	0.657	10.5	LOS B	3.6	25.6	0.51	0.49	0.51	40.8

Figure E-47: 2031 Baseline PM Peak With the Proposed Development– Option 2 Upgrades

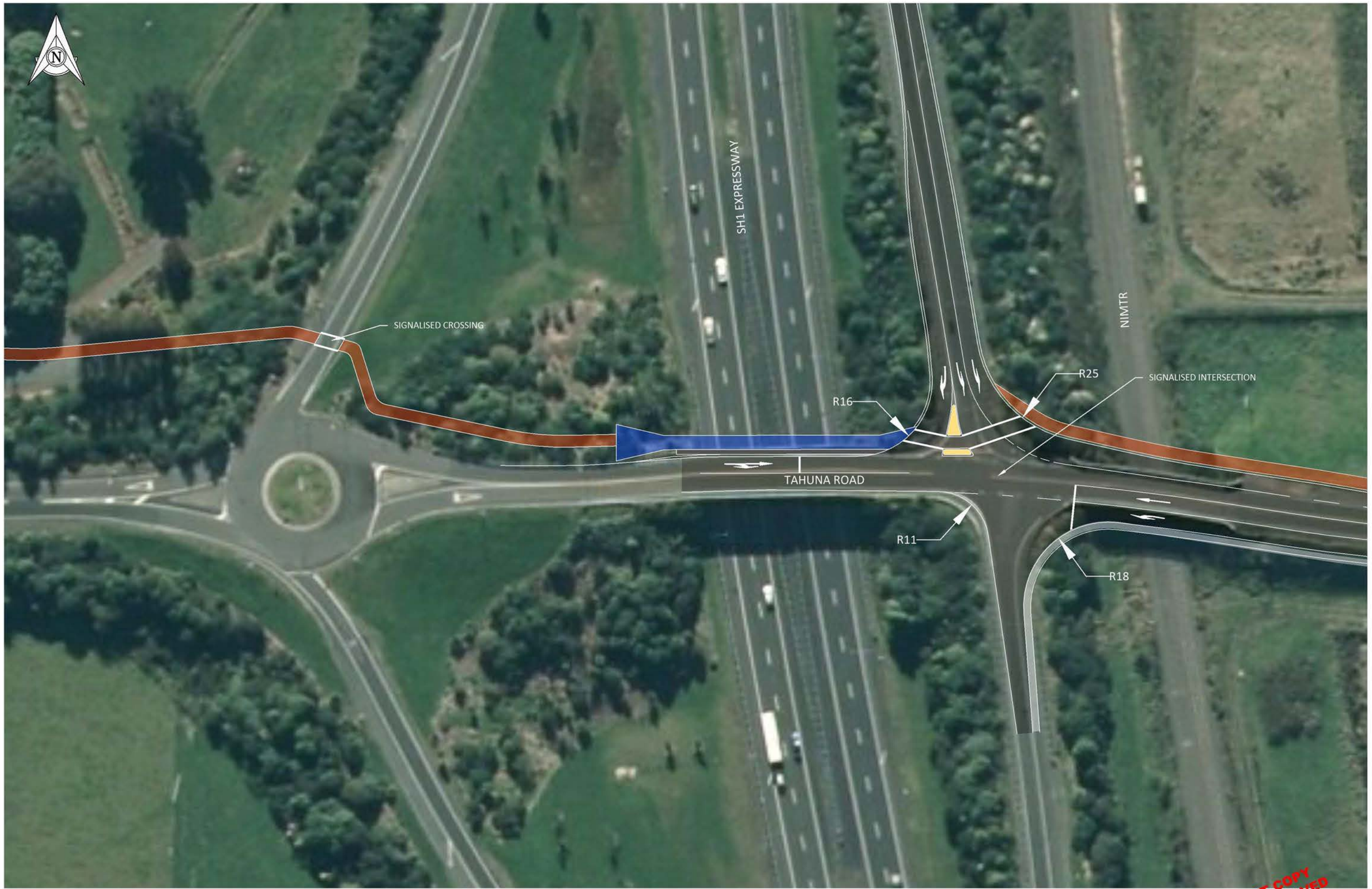
Appendix F

Proposed Intersection Upgrades



-	-	-	-	-	-	DESIGNED: LB	CHECKED: RB	BLOXAM BURNETT & OLLIVER	CLIENT: Ambury Properties Limited
						DRAWN: LB	APPROVED: CI	Phone +64-7-838 0144, Fax +64-7-839 0431	PROJECT: Ohinewai Structure Plan Sleepyhead Estate Rezoning
						mx model version:			DRAWING: SH1 Ohinewai Interchange Proposed Intersection Upgrades OPTION 1
DATE		ISSUE/REVISION DETAIL	BY	CHK	APPR				

STATUS: DRAFT COPY NOT APPROVED — PRELIMINARY
DATE: 29/10/2019 | SCALE (ORIGINAL SIZE A3): 1 : 750
DRAWING NUMBER: 145860-00-0203 | REVISION: -



						DESIGNED: LB	CHECKED: RB	
						DRAWN: LB	APPROVED: CI	
-	-	-	-	-	-	mx model version:		
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR			

Version 3.0 - September 2017

BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Structure Plan
Sleepyhead Estate Rezoning

DRAWING: SH1 Ohinewai Interchange
Proposed Intersection Upgrades
OPTION 2

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DATE	SCALE (ORIGINAL SIZE A3)
29/10/2019	1 : 750
DRAWING NUMBER: 145860-00-0204	REVISION: -

						DESIGNED: LB	CHECKED: RB
						DRAWN: LB	APPROVED: CI
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BLOXAM BURNETT & OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Structure Plan
Sleepyhead Estate Rezoning

DRAWING: Tahuna Road & Lumsden Road
Proposed Intersection Upgrades

STATUS: DRAFT COPY NOT APPROVED
PRELIMINARY

DATE	SCALE (ORIGINAL SIZE A3)
29/10/2019	1 : 500
DRAWING NUMBER: 145860-00-0202	REVISION: -

Appendix G

Conceptual layout - Lumsden Road Realignment

						DESIGNED: LB	CHECKED: RB	
						DRAWN: LB	APPROVED: CI	
-	-	-	-	-	-	mx model version:		
	DATE	ISSUE/REVISION DETAIL	BY	CHK	APPR			

BLOXAM BURNETT OLLIVER
Phone +64-7-838 0144, Fax +64-7-839 0431

CLIENT: Ambury Properties Limited

PROJECT: Ohinewai Structure Plan
Sleepyhead Estate Rezoning

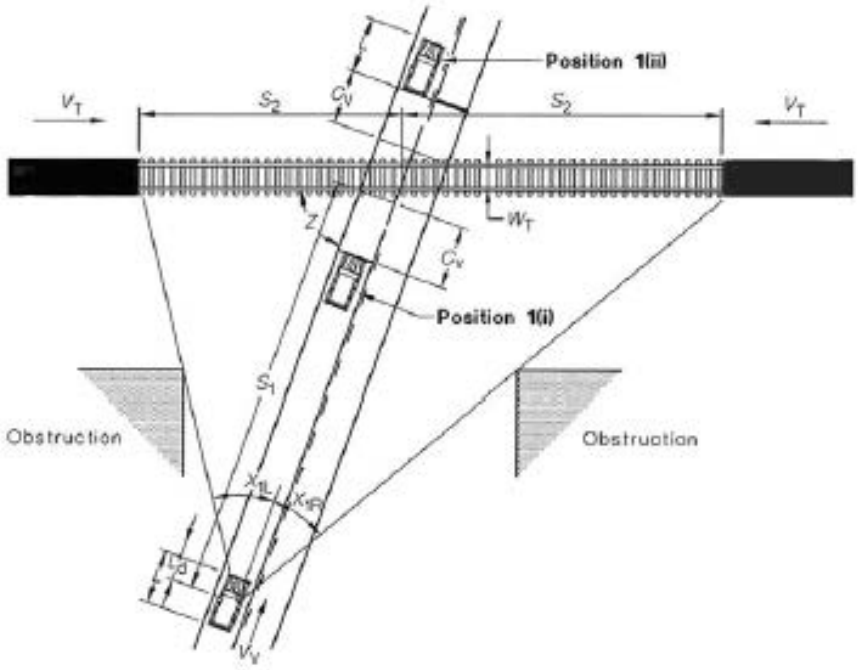
DRAWING: Lumsden Road Re-alignment

STATUS: PRELIMINARY
DRAFT COPY NOT APPROVED

DATE	SCALE (ORIGINAL SIZE A3)
24/10/2019	1 : 2 000

DRAWING NUMBER	REVISION
145860-00-1201	-

Figure G-2: Approach visibility at passive-controlled level crossings (Source: Figure B1 of the NZTA Traffic Control Devices Manual Part 9 Level Crossings)



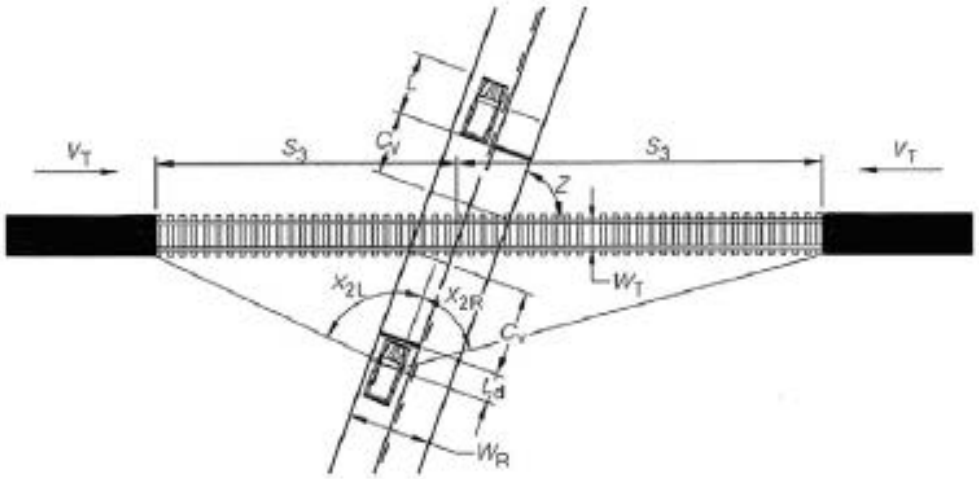
Position 1(i): Driver approaching level crossing sights train, judges that a stop is needed, decelerates and stops at the limit line.

Position 1(ii): Driver approaching the level crossing either cannot see approaching train or sights train too far distant to be a collision threat, continues at speed and crosses ahead of the train.

Legend (general case assumptions are shown in brackets):

- S_1 = minimum distance of an approaching road vehicle from the nearest rail when driver must be able to see an approaching train in time to stop if necessary before reaching the level crossing limit line (m).
- S_2 = minimum distance of a train from the level crossing at which a road vehicle driver at distance S_1 from the level crossing can proceed at speed and safely clear the level crossing ahead of that train (m).
- V_T = the highest-authorised speed of a train approaching the level crossing (km/h).
- V_V = the 85th percentile road vehicle speed at the position at which a driver will first recognise and react to the level crossing controls (km/h). (The road speed limit plus 10 percent may be used where the 85th percentile speed is not known.)
- C_V = clearance from the vehicle limit line to the nearest rail (general case assumption 2.4m).
- L_d = distance from the driver to the front of the vehicle (general case assumption 2m).
- W_T = width, outer rail to outer rail, of the railway lines at the level crossing (m).
- X_{1L}, X_{1R} = sighting angles (see B4).
- Z = angle between the road and the railway at the level crossing (degrees).

Figure G-3: Crossing visibility at passive-controlled level crossings (Source: Figure B2 of the NZTA Traffic Control Devices Manual Part 9 Level Crossings)



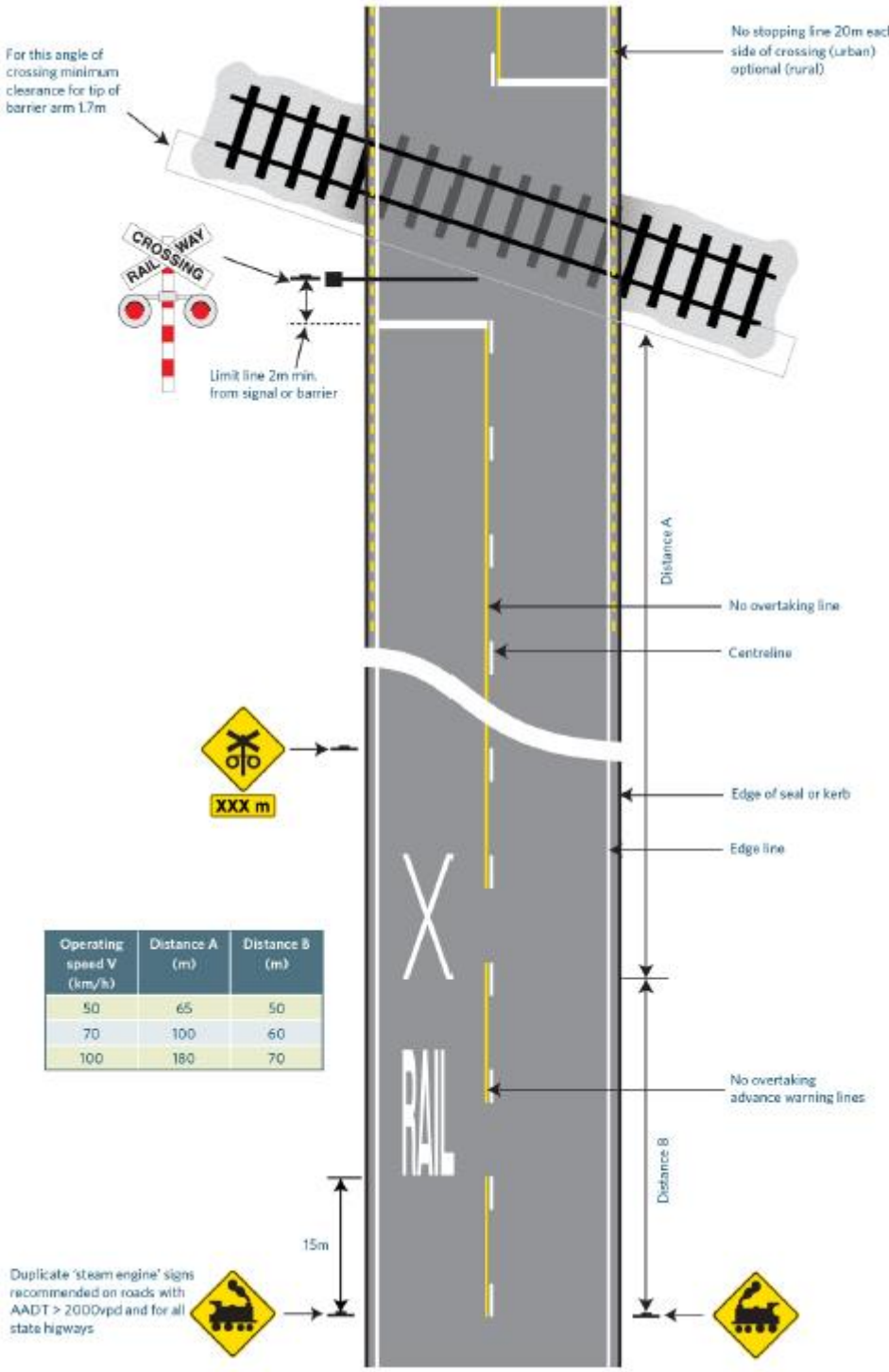
A motorist stopped at a level crossing requires adequate time to accelerate and safely clear the level crossing.

Legend (general case assumptions are shown in brackets):

- S_3 = minimum distance of an approaching train from the centre of the level crossing, when the road vehicle driver must first see an approaching train in order to safely clear the level crossing ahead of that train (m).
- V_T = the highest-authorised speed of the train approaching the level crossing (km/h).
- L_d = distance from the driver to the front of the vehicle (general case assumption 2m)
- C_V = clearance from the vehicle stop line to the nearest rail (general case assumption 2.4m).
- W_R = width of the travelled way (portion of the roadway allocated for the movement of the vehicles) at the level crossing (m).
- W_T = width, outer rail edge to outer rail edge, of the railway lines at the level crossing (m)
- X_{2L}, X_{2R} = sighting angles measured from the stop line (see B4).
- Z = angle between the road and the railway at the level crossing (degrees).

Figure G-4: Active Control at Level Crossing (Source: Figure A6 of the NZTA Traffic Control Devices Manual Part 9 Level Crossings)

Figure A7 FLB or HAB active control with intermediate signs



Operating speed V (km/h)	Distance A (m)	Distance B (m)
50	65	50
70	100	60
100	180	70

Appendix H

KiwiRail Letter of Support

Rhulani Baloyi

From: David Brinsley <David.Brinsley@kiwirail.co.nz>
Sent: Friday, 13 September 2019 4:57 PM
To: David Gaze
Cc: Terry Hodder; Cameron Inder; Rhulani Baloyi
Subject: RE: Ohinewai Project - rail crossing ;Sleepyhead

Good afternoon David, as discussed earlier today, I've followed this up internally and am pleased to be able to advise that there will be no issues with KiwiRail supporting your requirement to install a suitable, approved level crossing as necessary in order for the new site to be railed enabled.

Such connectivity will enable the Comfort Group to utilise rail instead of road for the movement of their freight, which then provides NZ Inc with significant other associated benefits such as reductions in CO2 emissions, safer roads with less congestion, reduced road maintenance costs etc..

I apologise on behalf of KiwiRail for any distress that may have been caused by the comments in the e-mails below which may have indicated that we would not have provided such agreement.

We wish to support your growth and become a valuable service provider.

Cheers.

David Brinsley | **National Manager - IMEX**

DDI: +64 4 498 2076 (internal extn 42076) | MOB: +64 21 803 174

Wellington Railway Station, 2 Bunny Street, Wellington 6011 | Private Bag 39988, Wellington Mail Centre, Lower Hutt 5045, New Zealand

KiwiRail

www.kiwirail.co.nz

Please consider the environment before printing.

From: David Gaze [mailto:david.gaze@gaze.co.nz]
Sent: Thursday, 12 September 2019 3:55 p.m.
To: David Brinsley <David.Brinsley@kiwirail.co.nz>
Cc: Terry Hodder <terry.hodder@vitruvius.co.nz>; Cameron Inder <cinder@bbo.co.nz>; Rhulani Baloyi <rbaloyi@bbo.co.nz>
Subject: Ohinewai Project - rail crossing ;Sleepyhead

David,

Your comment please……who in your organisation can I talk too??

- Your initial information for a Rail Siding was excellent & we have been working off that, thank you.