# Transport Feasibility Assessment

Omahu Industrial Area

for Hastings District Council

November 2015

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# 1. Introduction

## 1.1 Background

In September 2012 Hastings District Council (Council) investigated the effects of a proposed plan change along Omahu Road that would provide up to 36 hectares of land to be re-zoned from Plains Zone under the Hastings District Plan (District Plan) to Industrial.

The 2012 Integrated Transportation Assessment found that the proposed re-zoning may generate up to 630 vehicles per hour during the weekday period, however the effects on the transport network where considered no more than minor following the completion of a number of infrastructure recommendations.

## 1.2 Purpose of this Report

The size of land currently being considered for re-zoning has increased to 72 hectares, and this report seeks to update the previous analysis and to provide a preliminary assessment of the anticipated traffic effects of any re-zoning, and any mitigation that may be required.

## 1.3 Scope and Limitations

This report has been prepared by GHD for Council. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

It must be noted that this assessment is limited to the immediate area expected to be affected by the proposed development, and while no wider affects are anticipated to the west of the site, it is recognised that volume increases are anticipated to the east on the Hawke's Bay Expressway which is a strategic route purposely built for this function and managed by the New Zealand Transport Agency.

Should Council be minded to progress this proposal it is recommended that a full Integrated Transport Assessment be completed.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

# 2. Existing Situation

## 2.1 Site Description

The proposed development is situated immediately adjacent Omahu Road, extending from its intersection with Ormond Road to Kirkwood Road, a distance of approximately 3.3 km. The location of the site is shown in Figure 1 below.


**Figure 1: Site Location**

The development site is made up of multiple titles comprising a total land area of approximately 72 hectares. This land is zoned Plains under the Hastings District Plan with existing land use predominantly consisting of horticultural and agricultural activities.

## 2.2 Omahu Road

Omahu Road is defined as a Regional Arterial in the Hastings District Council road hierarchy. Regional arterials are roads which are of strategic regional importance and hold a significant element in the regional economy.

The route currently services residential, light and heavy industrial traffic. It provides a direct link between the Hastings urban area, Flaxmere and Fernhill Township, providing high level connectivity to Hawkes Bay Expressway (SH50A), SH50, Hawkes Bay Regional Hospital and the existing Industrial/ commercial land uses.

The Hawkes Bay Expressway (SH50A) intercepts Omahu Road on the eastern fringe of the new industrial zone.

The carriageway width along its entire length varies with the average carriageway width being approximately 16 m. The road reserve varies between 23 and 30 m between Kirkwood Road and Wilson Road. The section between Jarvis and Raupare Road is the minimum at 23 m.


**Figure 2: Omahu Road between Chatham Road and Henderson Road**

Omahu Road is a two-lane road with a flush median, cycle lanes and parking.

The traffic volume on Omahu Road between Wilson Road and Henderson Road is approximately 12,300 vehicles per day. This reduces to 5,200 vehicles per day between Jarvis Road and Twyford Road.

In the vicinity of the site, Omahu Road is subject to two speed limits. A 50 km/hr speed limit extends from the Hawkes Bay Expressway, to a point south of its intersection with Barnes Place. A 70 km/hr speed limit extends from south of Barnes Place to just north of its intersection with Kirkwood Road. The speed limit changes to 100 km/hr beyond Kirkwood Road.

## 2.3 Traffic Volumes

The traffic volumes on the various streets in the vicinity of the site are tabulated in Table 1. These volumes were extracted from HDC http://www.hastingsdc.govt.nz/traffic-volumes

**Table 1: 2014 Traffic Volumes**

| Street | Location | ADT |
|---|---|---|
| Omahu Road | Wilson Road -Henderson Road | 11,439 *** |
| | Henderson Road– Chatham Road | 12,500 |
| | Chatham Road – Jarvis Road | 9,500 |
| | Jarvis Road – Twyford Road | 9,000 |
| | Twyford Road - Kirkwood Road | 8,000 |
| | Kirkwood Road- Hill Road | 5,000 |
| Chatham Road | Omahu Road – Hazelwood Street | 4,000 |
| Jarvis Road | Omahu Road – Thompson Road | 207 |
| Raupare Road | Omahu Road – Thompson Road | 1,000 |
| Thompson Road | Raupare Road - Jarvis Road | 894 *** |
| | Jarvis Road - Twyford Road | 550 |
| Twyford Road | Omahu Road – Thompson Road | 500 |
| Kirkwood Road | Wilkes Place - Omahu Road | 1,131 *** |

****** Represents 2014 Actual Counts***

## 2.4 Intersection Turning Flows

Detailed intersection surveys were undertaken on Monday 19 October 2015 on Omahu Road at the intersections of Jarvis Road, Chatham Road, Henderson Road and Raupare Road between 4:00pm and 5:30 pm.

The peak hour was identified to be 4:15pm to 5:15pm; the peak hour turning flows have been shown diagrammatically in Figure 3 below:

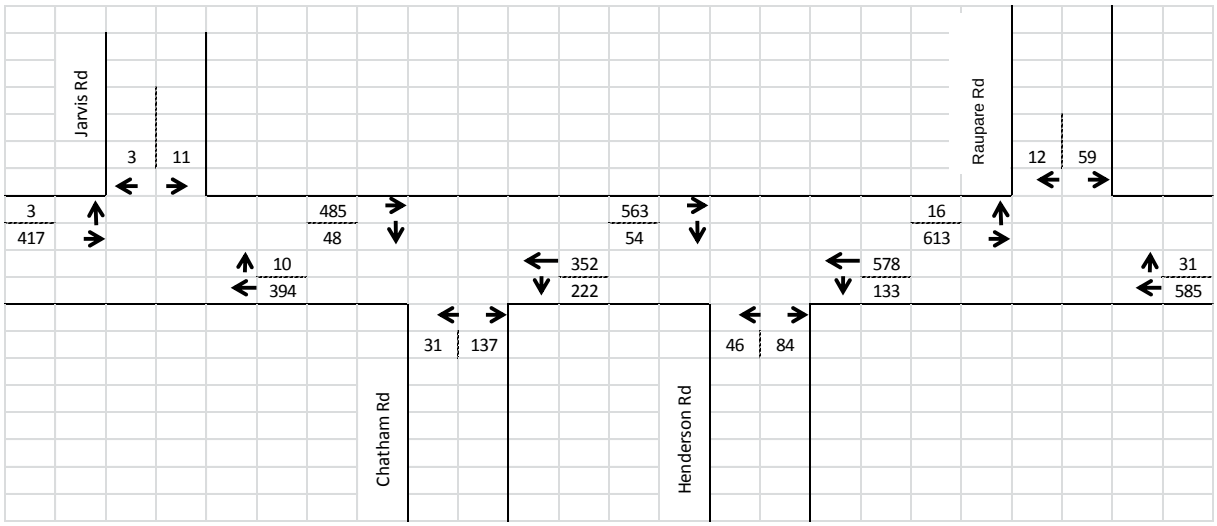



**Figure 3: Evening Peak Flows on Omahu Road**

The proportion of heavy commercial vehicles on Omahu Road is approximately 8.3%

The eastbound hourly flows on Omahu Road increase towards the east, and vary between 420 vph at Jarvis Road to 670 vph at Raupare Road. The westbound flows decrease as traffic drives west, with 620 vph at Raupare Road reducing to 400 vph at Jarvis Road.

Flows on the side roads are much smaller with maximum one-way flows of 270 vph entering Chatham Road.

## 2.5 Road widths

The road widths on the various streets in the vicinity of the site are tabulated below:

**Table 2: Road Widths**

| Location | Carriageway |
|---|---|
| Omahu Road (Jarvis – Raupare) | 16.0 m |
| Kirkwood Road | 10.0 m |
| James Rochfort | 12.0 m |
| Twyford Road | 4.8 m |
| Jarvis Road | 5.5 m |
| Barnes Place | 12.5 m |
| Chatham Road | 15.0 m |
| Henderson Road | 14.0 m |
| Raupare Road | 6.5 m |
| Ormond Street | 6.0 m |
| Wilson Road | 13.6 m |

## 2.6 Cyclists and Pedestrians

Omahu Road is highlighted as an integral part of the Hastings Cycling Strategy, with Omahu Road forming part of Hastings District Council's Arterial i-Way Network.

The Northern section of Omahu Road generally from Wilson Road through to Jarvis Road, provides two x 2.0 m on road cycle lanes.

A pedestrian footway is provided on the southern side of Omahu Road only and reflects the traffic generated by the existing industrial activities that have established there. There are no pedestrian crossing facilities provided either at the intersections or mid-block to safely provide for pedestrians wishing to cross and access this side of Omahu Road.

## 2.7 Traffic Growth

The Hastings District Council RAMM database was used to look at traffic growth patterns. Council regularly undertakes traffic count surveys on Omahu Road at eight different locations.

The traffic growth rates for different sections of Omahu Road are shown below:

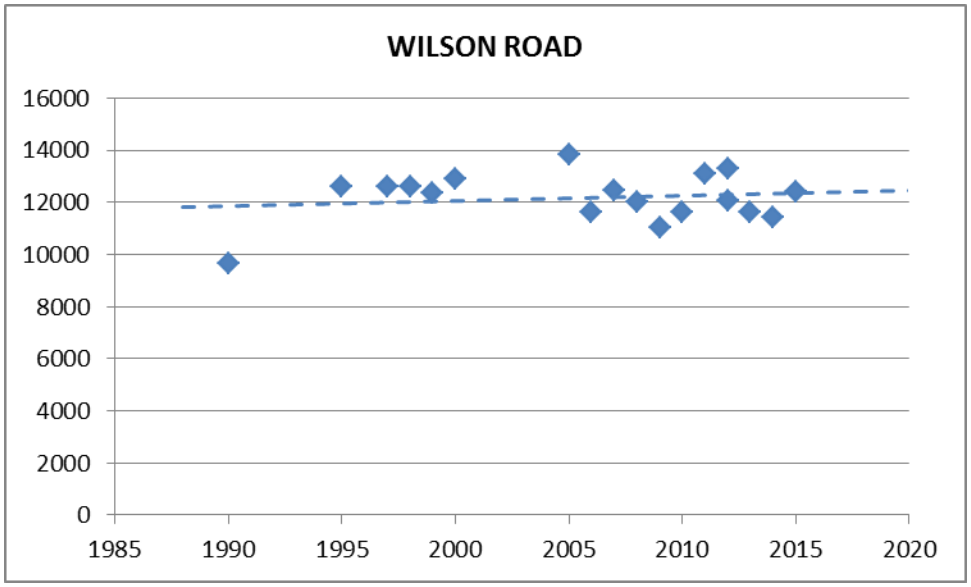
**Table 3: Traffic Growth**

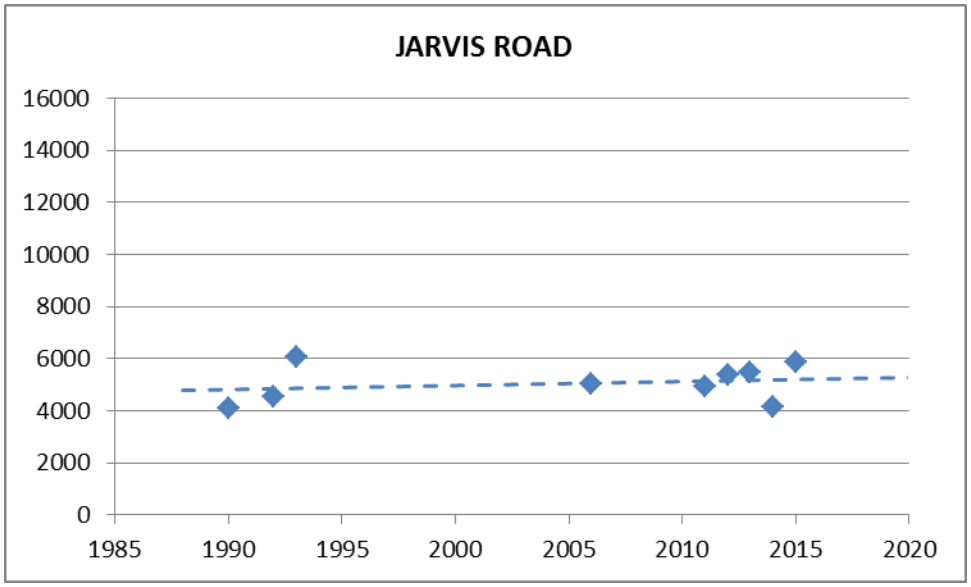
| Location | | 2015 Volume | Annual Growth |
|---|---|---|---|
| Maeraekakaho Road | McLeod Street | 17,100 | 0.6 % pa |
| McLeod Street | Canning Road | 16,900 | 0.5% pa |
| Canning Road | Stonycroft Street | 17,400 | 0.9% pa |
| Stonycroft Street | SH50A | 21,800 | 1.7% pa |
| SH50A | Wilson Road | 13,900 | -0.9% pa |
| Wilson Road | Henderson Road | 12,400 | 0.2% pa |
| Jarvis Road | Twyford Road | 5,200 | 0.3% pa |
| Kirkwood Road | Hill Road | 4,200 | -1.5% pa |

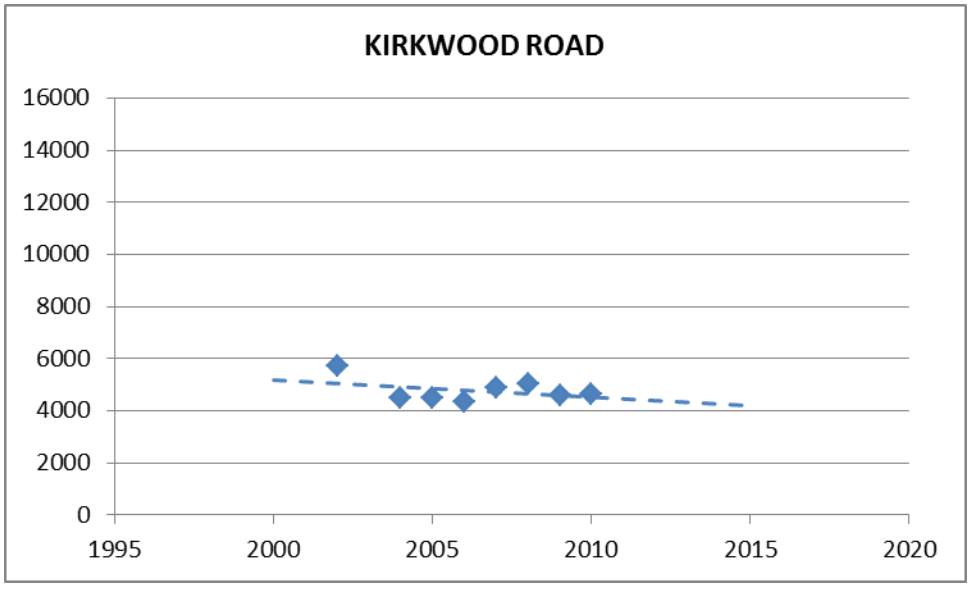
The traffic growth in the area has been pretty static over the past decade. The highest growth has all occurred east of SH50A. The growth on Omahu Road closest to the site has been negative in some sections and for these reasons no additional background growth has been applied in this initial feasibility assessment.

The traffic count patterns for the sites closest to the site are shown below:

**Figure 4 Traffic Growth Patterns - Omahu Road**



# 3. Proposed Re-zoning

## 3.1 Introduction

The Council is evaluating a Plan Change for a new industrial development on 72 hectares of land adjacent to the northern side of Omahu Road, Hastings.

The Council is unable to confirm the exact detail and composition of the businesses that are likely to establish on the site, however it is expected that the businesses will be those broadly summarised as dry industry reflecting the limited capacity for the supply of process water to this area.

Furthermore Council are likely to consider staging the development to reflect a number of issues including infrastructure capital costs, expected demand, and Council's overall strategy. Again council are currently unclear as to what staging options may look like and to some degree will be influenced by the outcomes of this report and other infrastructure assessments currently underway. Therefore no consideration has been given to staging options at this time.

## 3.2 Access and Egress

The level of access to the site is unknown at this stage; however at a minimum level multiple access points are anticipated along Omahu Road. The majority of the access points are anticipated from private driveways as commonly seen on the southern side of Omahu Road. It is also likely that a small quantity of high volume driveways will be established.

The existing road layout provides a central flush median. It is anticipated that this facility will provide effective holding and turning provision for vehicles performing right turn manoeuvres both to and from the site. Furthermore on road cycle lanes exists, which when unoccupied are commonly utilised as left turn deceleration lanes.

In addition, both the Hastings District Plan and Engineering Code of Practice provide specific requirements pertaining to the location, design and construction standards of private driveways.

## 3.3 Existing Trip Generation

The existing area is zoned as Plains Zone within the Hastings District Plan and land use is generally consisting of horticultural and agricultural activities. Some industrial and commercial activities are already located within the area. It has been estimated that during peak times, the existing trip generation is around 50 vehicles per hour.

## 3.4 Industrial Trip Generation

Table 4 below shows typical trip generation rates for alternative land uses.

**Table 4 Trip Generation Rates**

| Landuse Activity | Vehicles/day/hectare |
|---|---|
| Light Industry | 160 |
| Heavy Industry | 70 |
| Office | 600 |
| Residential | 160 |
| Retail | 1350 |

As it is not known whether the proposed developments on the rezoned sites will be light or heavy industry, it has been assumed that the development will comprise mainly of light industry as this has the higher trip generation rate and consequently the biggest potential impact on the surrounding road network.

Typical hourly and directional splits are tabulated below.

**Table 5 Hourly and Directional Splits**

| Time Period | % of daily | In | Out |
|---|---|---|---|
| Morning | 9% | 72% | 28% |
| Interpeak | 8% | 50% | 50% |
| Evening | 10% | 35% | 65% |

**Table 6 Site Trip Generations**

| Time Period | In | Out | Two-way |
|---|---|---|---|
| Morning | 716 | 279 | 995 |
| Interpeak | 436 | 436 | 872 |
| Evening | 401 | 751 | 1,152 |

Based on 72 hectares of industrial zoned land, the resulting trips in and out of the site during the evening peak period are 1152 vph.

## 3.5 District Plan Provisions

The development is bound by the requirements of the District Plan where it is currently zoned Rural Plains, and the proposed activities are described as being industrial. As such it will be necessary to assess the proposal against the General Performance Standards of Section 14.1 Traffic Sightlines, Parking, Access and Loading.

Individual sites that are developed once the re-zoning has been undertaken will be required to adhere to these standards. At this stage no specific assessment has been carried out for these performance standards however it is recognised that Council are maintaining an average development gap of 35% Developable Gross Floor Area. Therefore it is considered feasible that that developers will be able to comply with these performance standards within the remaining site areas.

# 4. Existing Intersection Performance

## 4.1 Level of Service

The capacity of a roadway varies according to a wide range of influences including the road type, location in the network and the nature of adjoining land uses.

The term Level of Service is provided to characterise operational conditions within a traffic stream and their perception by motorists and passengers. Six Levels of Service (LOS) are defined with A representing the highest level, and F the worst. As traffic volumes increase, the level of service decreases. For most design or planning purposes, service flow rates D or C are usually used. The following general statements describe the various Levels of Service.

**Table 7 Level of Service Descriptions**

| LOS | Description | Intersection Delay |
|---|---|---|
| A | Free-flowing | <10 |
| B | Reasonably unimpeded | 11 - 15 |
| C | Stable flow | 16 - 25 |
| D | Unsettled | 26 - 35 |
| E | Significant delays | 36 - 50 |
| F | Exceeds Capacity | 50 + |

## 4.2 Existing Intersection Performance

Hastings District Council has a microsimulation model called the Hastings Area Transport (HAT) Model. It was intended to use this model to test the network wide effects of the proposed plan change.

The HATs model uses the S-Paramics software which is traffic simulation software used by planning professionals to design efficient, economical, driver and pedestrian friendly transportation infrastructure.

The modelled network covers the entire extent of the Heretaunga Plains and was calibrated at a network level in 2012 when the model was updated to a 2012 base year model.

The model was interrogated for the Omahu area and assessed against the observed flows recorded during the manual traffic count surveys to assess its suitability for the area assessment. It was established that the base flow volumes contained within the model did not accurately represent the conditions observed for this particular area.

Therefore the existing intersection performance for 4:15 to 5:15 (PM peak) has been assessed using Sidra as an alternative analysis method. The result for each intersection, together with the layout that was modelled is provided in Appendix A:

However it should be noted that when applying this analysis technique, each intersection is assessed in isolation to the rest of the network, taking little account of predicted upstream or downstream influences. This notwithstanding, the method is considered appropriate for the initial feasibility testing of the proposed development.

## 4.3 Assessment

In this modelling assessment, the base line performance of the network, (being several identified intersections) was established through modelling the observed traffic conditions. The measured LOS currently available at the relevant locations is provided in Table 8 (2015 Do Nothing Model Scenario).

In order to accurately assess the impact of the proposed development, it is necessary to assign the development's calculated trip generation to a distribution route through the network and effectively assess the change in LOS. This change is summarised in Table 8 (2015 With Development Scenario).

From the modelling assessment carried out, looking at both LOS and other performance inputs (queue length, degree of saturation and expected safety performance), a significant deterioration occurs at the Chatham Road, Henderson Road and Raupare Road intersections.

While a deterioration in LOS is observed at the Jarvis Road intersection, changing from a LOS B to LOS D, this only applicable to approximately 15 vehicles in the peak hour, with ample capacity available and no queue length occurring. Ultimately this outcome is considered to be acceptable at this location.

Intersections located to the west of Jarvis Road are expected to operate similar to or better than Jarvis Road and have not been analysed.

## 4.4 Options

Given the significant deterioration of LOS at the Chatham Road, Henderson Road and Raupare Road intersections, alternative intersection arrangements have been assessed.

The traffic flow conditions observed at Henderson Road and Chatham Road are suitable to support a Roundabout intersection arrangement. This has been modelled and shown to significantly improve LOS to a level greater than that currently observed under the baseline. This is indicated in Table 8 (2015 With Development Scenario + Alternative Infrastructure) with both intersections predicted to operate at LOS B.

In respect to Raupare Road, 3 options where considered:

1. Roundabout
2. Multi lane approach on Raupare Road
3. Prohibition of Right Turn into and out of Raupare Road

In summary, the poor LOS (LOS F) is attributable to the 13 vehicles performing a right turn manoeuvre during the peak period. This volume of vehicles does not provide sufficient financial justification or suitable flow conditions to support a roundabout arrangement. This option was subsequently discounted.

When increasing the multi lane approach on Raupare Road, there is an overall improvement for left turning vehicles, however the ability for right turning vehicles to achieve suitable gaps in traffic is not addressed and the level of delay remains unchanged.

LOS standards are cognisant of safety and it is recognised that vehicles are more inclined to accept smaller gaps in traffic when long delays are incurred. This in turn is likely to reduce the safety performance of the intersection.

Given the presence of the existing roundabout to the east, at the Wilson Road/ Omahu Road intersection, and the recommended roundabout at Henderson Road, it is considered suitable to prohibit vehicles turning right from Raupare Road, in to Omahu Road. In order to physical restrict this manoeuvre, it is recommended that the right turn into Ruapare Road also be

removed, allowing for a central median to be installed throughout the length of the intersection. An alternative left in left out arrangement would ensue, with vehicles using the upstream and downstream roundabouts to facilitate destination choice.

### Table 8: Peak Hours Predicted Level of Service

| Intersection | Approach | 2015 Do Nothing Model Scenario | 2015 With Development Scenario | 2015 With Development Scenario + Alternative Infrastructure |
|---|---|---|---|---|
| | | PM Peak | PM Peak | PM Peak |
| Omahu Road / Jarvis Road | OM_JR_SB | A | A | A |
| | OM_JR_NB | A | A | A |
| | JR_OM_SWB | B | D | D |
| Omahu Road / Chatham Road | OM_CH_SB | A | A | A |
| | OM_CH_NB | A | A | A |
| | CH_OM_NEB | D | F | B |
| Omahu Road / Henderson Road | OM_HN_SB | A | A | A |
| | OM_HN_NB | A | A | A |
| | HN_OM_NEB | E | F | B |
| Omahu Road / Raupare Road | OM_RP_SB | A | A | A |
| | OM_RP_NB | A | A | A |
| | RP_OM_SWB | B | F | C |

# 5. Summary and Conclusion

This report has examined the traffic effects of rezoning 72 hectares of plains zoned land in Hastings to industrial land. The report has focussed on the additional trips that will be generated from the site and how this will integrate with the surrounding road network.

The resulting analysis indicates that the proposed development may generate up to 1152 vehicles per hour during the weekday evening peak period. While the peak hour traffic flows at the site are likely to coincide with the surrounding network peak, in general it is concluded there will be no significant impact on the functionality of Omahu Road or the main intersections along this route, following successful implementation of the recommendations contained within this report.

However it must be noted that this assessment is limited to the immediate area expected to be affected by the proposed development, and while no wider affects are anticipated to the west of the site, it is recognised that volume increases are anticipated to the east on the Hawke's Bay Expressway which is a strategic route purposely built for this function.

Should Council be minded to progress this proposal it is recommended that a full Integrated Transport Assessment be completed.

# 6. Recommendations

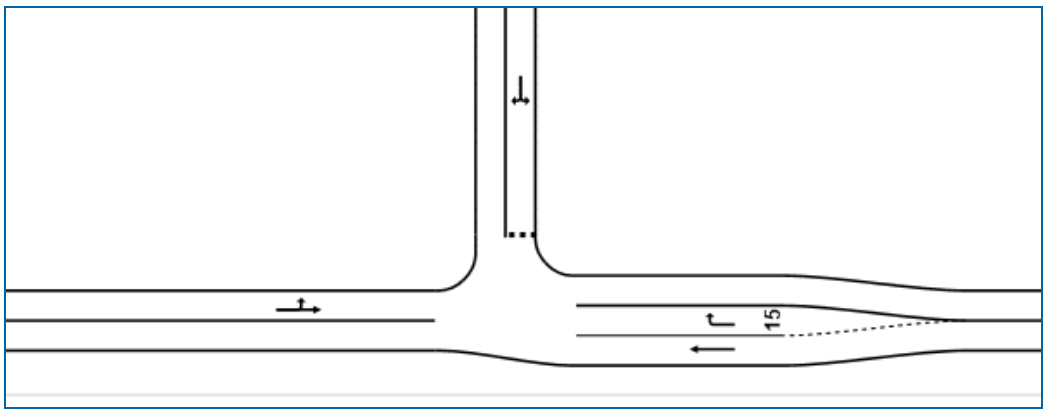
Based on the original 2012 Integrated Transport Assessment, the findings of this report and the associated conclusions, it is recommended that:

- The general recommendations that where provided within the 2012 report be adopted.
- The Henderson Road intersection with Omahu Road is upgraded to a roundabout intersection.
- The Chatham Road intersection with Omahu Road is upgraded to a roundabout intersection.
- The Raupare road intersection with Omahu Road is modified to prohibit right turning manoeuvres both into and out of Raupare Road.
- While not modelled in detail, the Twyford Road and Omahu Road intersection be upgraded to include a formal right turn lane for vehicles on Omahu Road.
- Consultation takes place with the New Zealand Transport Agency regarding anticipated effects on the strategic State Highway network.

# Appendices

# **Appendix A** – SIDRA Intersection Modelling

## Jarvis Road: (Existing Layout)



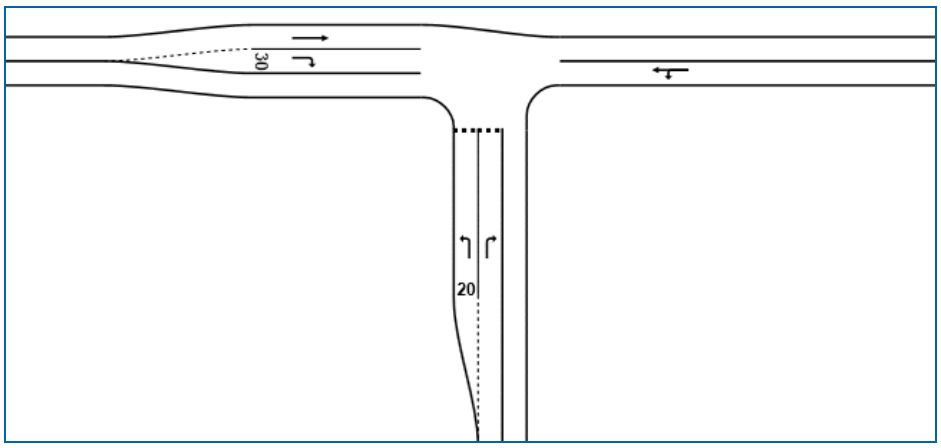

## Existing Situation

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: East | | | | | | | | | | | |
| 5 | T1 | 415 | 10.0 | 0.227 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| 6 | R2 | 11 | 0.0 | 0.009 | 7.1 | LOS A | 0.0 | 0.3 | 0.47 | 0.61 | 51.9 |
| Approach | | 425 | 9.8 | 0.227 | 0.2 | NA | 0.0 | 0.3 | 0.01 | 0.02 | 59.7 |
| North: Jarvis | | | | | | | | | | | |
| 7 | L2 | 3 | 0.0 | 0.035 | 12.6 | LOS B | 0.1 | 0.8 | 0.65 | 0.81 | 48.6 |
| 9 | R2 | 12 | 0.0 | 0.035 | 12.5 | LOS B | 0.1 | 0.8 | 0.65 | 0.81 | 48.1 |
| Approach | | 15 | 0.0 | 0.035 | 12.6 | LOS B | 0.1 | 0.8 | 0.65 | 0.81 | 48.2 |
| West: West | | | | | | | | | | | |
| 10 | L2 | 3 | 0.0 | 0.241 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 58.3 |
| 11 | T1 | 439 | 10.0 | 0.241 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 442 | 9.9 | 0.241 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| All Vehicles | | 882 | 9.7 | 0.241 | 0.3 | NA | 0.1 | 0.8 | 0.02 | 0.02 | 59.6 |

## With Development

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: East | | | | | | | | | | | |
| 5 | T1 | 659 | 10.0 | 0.360 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| 6 | R2 | 11 | 0.0 | 0.015 | 9.3 | LOS A | 0.1 | 0.4 | 0.61 | 0.73 | 50.3 |
| Approach | | 669 | 9.8 | 0.360 | 0.2 | NA | 0.1 | 0.4 | 0.01 | 0.01 | 59.7 |
| North: Jarvis | | | | | | | | | | | |
| 7 | L2 | 3 | 0.0 | 0.104 | 30.1 | LOS D | 0.3 | 2.2 | 0.89 | 0.95 | 39.4 |
| 9 | R2 | 12 | 0.0 | 0.104 | 30.0 | LOS D | 0.3 | 2.2 | 0.89 | 0.95 | 39.1 |
| Approach | | 15 | 0.0 | 0.104 | 30.1 | LOS D | 0.3 | 2.2 | 0.89 | 0.95 | 39.2 |
| West: West | | | | | | | | | | | |
| 10 | L2 | 3 | 0.0 | 0.407 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 58.2 |
| 11 | T1 | 742 | 10.0 | 0.407 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 745 | 10.0 | 0.407 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| All Vehicles | | 1429 | 9.8 | 0.407 | 0.4 | NA | 0.3 | 2.2 | 0.01 | 0.02 | 59.5 |

## Chatham Road (Existing Layout)



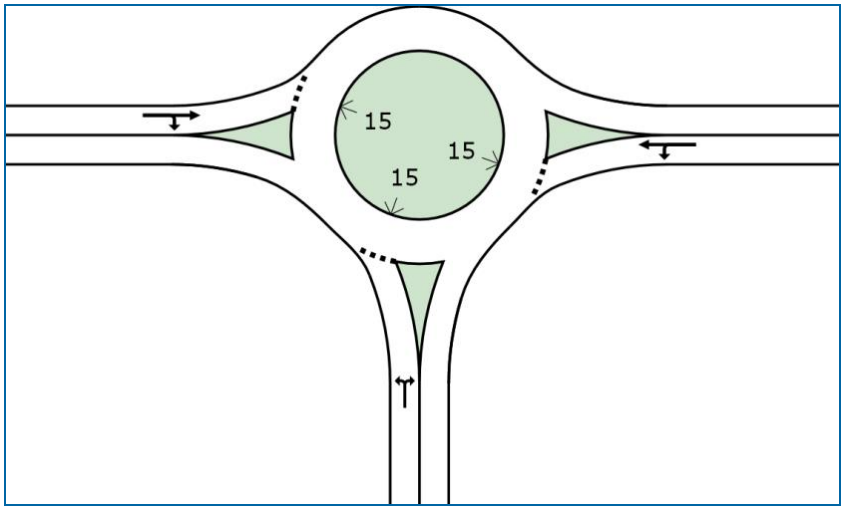

## Existing Situation

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows Total | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Chatham | | | | | | | | | | | |
| 1 | L2 | 33 | 16.0 | 0.032 | 7.3 | LOS A | 0.1 | 1.0 | 0.43 | 0.62 | 51.6 |
| 3 | R2 | 144 | 12.0 | 0.623 | 32.0 | LOS D | 3.1 | 23.7 | 0.91 | 1.13 | 38.0 |
| Approach | | 177 | 12.7 | 0.623 | 27.5 | LOS D | 3.1 | 23.7 | 0.82 | 1.04 | 40.0 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 234 | 5.0 | 0.333 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.23 | 56.1 |
| 5 | T1 | 371 | 10.0 | 0.333 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.23 | 57.8 |
| Approach | | 604 | 8.1 | 0.333 | 2.2 | NA | 0.0 | 0.0 | 0.00 | 0.23 | 57.1 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 511 | 6.0 | 0.272 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| 12 | R2 | 51 | 0.0 | 0.055 | 8.3 | LOS A | 0.2 | 1.5 | 0.56 | 0.73 | 51.3 |
| Approach | | 561 | 5.5 | 0.272 | 0.8 | NA | 0.2 | 1.5 | 0.05 | 0.07 | 59.0 |
| All Vehicles | | 1342 | 7.6 | 0.623 | 4.9 | NA | 3.1 | 23.7 | 0.13 | 0.27 | 54.8 |

## With Development

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows Total | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Chatham | | | | | | | | | | | |
| 1 | L2 | 33 | 16.0 | 0.047 | 9.4 | LOS A | 0.2 | 1.3 | 0.56 | 0.75 | 50.3 |
| 3 | R2 | 144 | 12.0 | 2.948 | 1866.5 | LOS F | 68.0 | 525.3 | 1.00 | 3.01 | 1.9 |
| Approach | | 177 | 12.7 | 2.948 | 1523.8 | LOS F | 68.0 | 525.3 | 0.92 | 2.59 | 2.3 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 234 | 5.0 | 0.476 | 5.7 | LOS A | 0.0 | 0.0 | 0.00 | 0.16 | 56.6 |
| 5 | T1 | 634 | 10.0 | 0.476 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.16 | 58.4 |
| Approach | | 867 | 8.7 | 0.476 | 1.6 | NA | 0.0 | 0.0 | 0.00 | 0.16 | 57.9 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 887 | 6.0 | 0.473 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| 12 | R2 | 51 | 0.0 | 0.087 | 11.1 | LOS B | 0.3 | 2.2 | 0.70 | 0.88 | 49.4 |
| Approach | | 938 | 5.7 | 0.473 | 0.7 | NA | 0.3 | 2.2 | 0.04 | 0.05 | 59.2 |
| All Vehicles | | 1982 | 7.6 | 2.948 | 137.0 | NA | 68.0 | 525.3 | 0.10 | 0.32 | 18.4 |

## Alternative Layout (Roundabout)



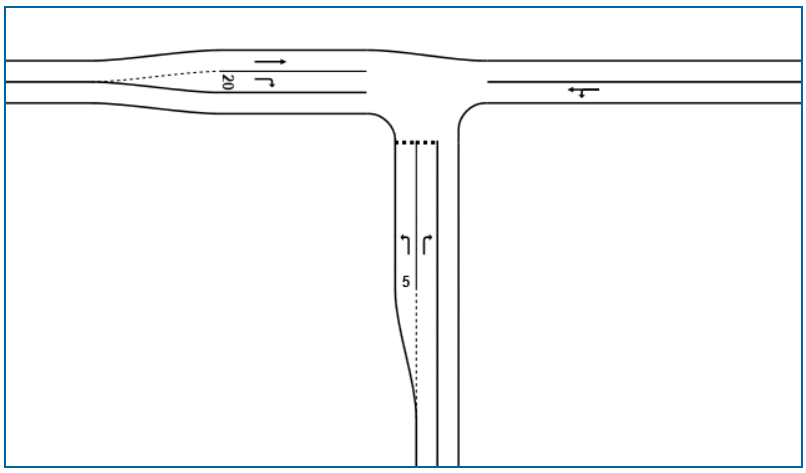

## Using Default Values:

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Chatham | | | | | | | | | | | |
| 1 | L2 | 33 | 16.0 | 0.294 | 10.4 | LOS B | 1.9 | 14.9 | 0.81 | 0.87 | 47.8 |
| 3 | R2 | 144 | 12.0 | 0.294 | 14.6 | LOS B | 1.9 | 14.9 | 0.81 | 0.87 | 48.4 |
| Approach | | 177 | 12.7 | 0.294 | 13.8 | LOS B | 1.9 | 14.9 | 0.81 | 0.87 | 48.3 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 234 | 5.0 | 0.625 | 4.7 | LOS A | 8.6 | 64.6 | 0.44 | 0.45 | 53.0 |
| 5 | T1 | 634 | 10.0 | 0.625 | 5.0 | LOS A | 8.6 | 64.6 | 0.44 | 0.45 | 53.9 |
| Approach | | 867 | 8.7 | 0.625 | 4.9 | LOS A | 8.6 | 64.6 | 0.44 | 0.45 | 53.7 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 887 | 6.0 | 0.803 | 7.6 | LOS A | 13.4 | 98.2 | 0.92 | 0.65 | 51.9 |
| 12 | R2 | 51 | 0.0 | 0.803 | 11.5 | LOS B | 13.4 | 98.2 | 0.92 | 0.65 | 51.9 |
| Approach | | 938 | 5.7 | 0.803 | 7.8 | LOS A | 13.4 | 98.2 | 0.92 | 0.65 | 51.9 |
| All Vehicles | | 1982 | 7.6 | 0.803 | 7.1 | LOS A | 13.4 | 98.2 | 0.70 | 0.58 | 52.3 |

## Using 1.2 Environment Factor:

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Chatham | | | | | | | | | | | |
| 1 | L2 | 33 | 16.0 | 0.417 | 14.6 | LOS B | 2.8 | 22.0 | 0.87 | 0.99 | 45.3 |
| 3 | R2 | 144 | 12.0 | 0.417 | 18.8 | LOS B | 2.8 | 22.0 | 0.87 | 0.99 | 45.9 |
| Approach | | 177 | 12.7 | 0.417 | 18.0 | LOS B | 2.8 | 22.0 | 0.87 | 0.99 | 45.8 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 234 | 5.0 | 0.714 | 5.1 | LOS A | 11.8 | 89.0 | 0.58 | 0.45 | 52.6 |
| 5 | T1 | 634 | 10.0 | 0.714 | 5.3 | LOS A | 11.8 | 89.0 | 0.58 | 0.45 | 53.4 |
| Approach | | 867 | 8.7 | 0.714 | 5.3 | LOS A | 11.8 | 89.0 | 0.58 | 0.45 | 53.2 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 887 | 6.0 | 0.959 | 24.1 | LOS C | 37.4 | 274.8 | 1.00 | 1.00 | 42.8 |
| 12 | R2 | 51 | 0.0 | 0.959 | 28.1 | LOS C | 37.4 | 274.8 | 1.00 | 1.00 | 42.8 |
| Approach | | 938 | 5.7 | 0.959 | 24.4 | LOS C | 37.4 | 274.8 | 1.00 | 1.00 | 42.8 |
| All Vehicles | | 1982 | 7.6 | 0.959 | 15.4 | LOS B | 37.4 | 274.8 | 0.80 | 0.76 | 47.1 |

## Henderson Road (Existing Layout)



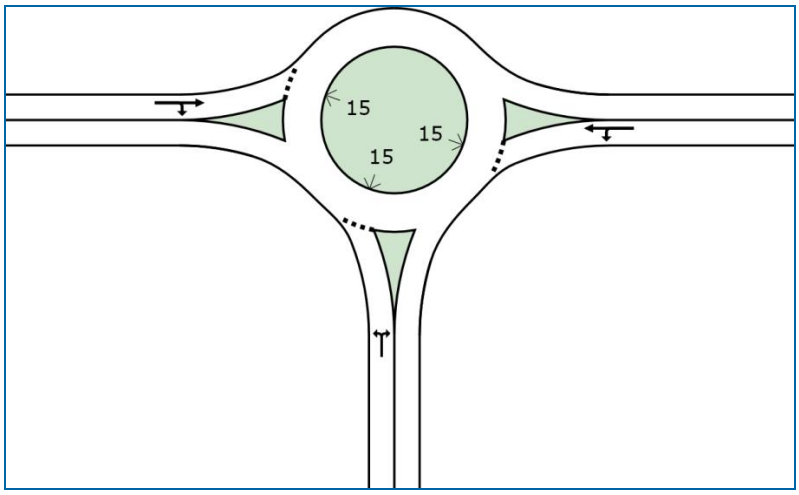

## Existing Situation

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Henderson | | | | | | | | | | | |
| 1 | L2 | 48 | 7.0 | 0.062 | 8.7 | LOS A | 0.2 | 1.7 | 0.55 | 0.75 | 51.0 |
| 3 | R2 | 88 | 10.0 | 0.758 | 66.7 | LOS F | 3.2 | 24.0 | 0.96 | 1.19 | 27.9 |
| Approach | | 137 | 8.9 | 0.758 | 46.2 | LOS E | 3.2 | 24.0 | 0.82 | 1.03 | 33.3 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 140 | 4.0 | 0.410 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.11 | 57.1 |
| 5 | T1 | 608 | 10.0 | 0.410 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.11 | 58.8 |
| Approach | | 748 | 8.9 | 0.410 | 1.1 | NA | 0.0 | 0.0 | 0.00 | 0.11 | 58.5 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 593 | 7.0 | 0.318 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| 12 | R2 | 57 | 6.0 | 0.084 | 10.0 | LOS B | 0.3 | 2.4 | 0.63 | 0.83 | 49.9 |
| Approach | | 649 | 6.9 | 0.318 | 0.9 | NA | 0.3 | 2.4 | 0.06 | 0.07 | 58.9 |
| All Vehicles | | 1535 | 8.1 | 0.758 | 5.0 | NA | 3.2 | 24.0 | 0.10 | 0.18 | 54.9 |

## With Development

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Henderson | | | | | | | | | | | |
| 1 | L2 | 48 | 7.0 | 0.104 | 12.4 | LOS B | 0.3 | 2.6 | 0.73 | 0.88 | 48.5 |
| 3 | R2 | 88 | 10.0 | 6.037 | 4842.6 | LOS F | 60.2 | 457.4 | 1.00 | 1.86 | 0.7 |
| Approach | | 137 | 8.9 | 6.037 | 3133.4 | LOS F | 60.2 | 457.4 | 0.90 | 1.51 | 1.1 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 140 | 4.0 | 0.566 | 5.7 | LOS A | 0.0 | 0.0 | 0.00 | 0.08 | 57.3 |
| 5 | T1 | 894 | 10.0 | 0.566 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.08 | 59.0 |
| Approach | | 1034 | 9.2 | 0.566 | 0.9 | NA | 0.0 | 0.0 | 0.00 | 0.08 | 58.8 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 1052 | 7.0 | 0.564 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| 12 | R2 | 57 | 6.0 | 0.156 | 15.5 | LOS C | 0.5 | 4.0 | 0.82 | 0.93 | 46.4 |
| Approach | | 1108 | 6.9 | 0.564 | 0.9 | NA | 0.5 | 4.0 | 0.04 | 0.05 | 58.9 |
| All Vehicles | | 2279 | 8.1 | 6.037 | 189.0 | NA | 60.2 | 457.4 | 0.07 | 0.15 | 14.6 |

## Alternative Layout (Roundabout)



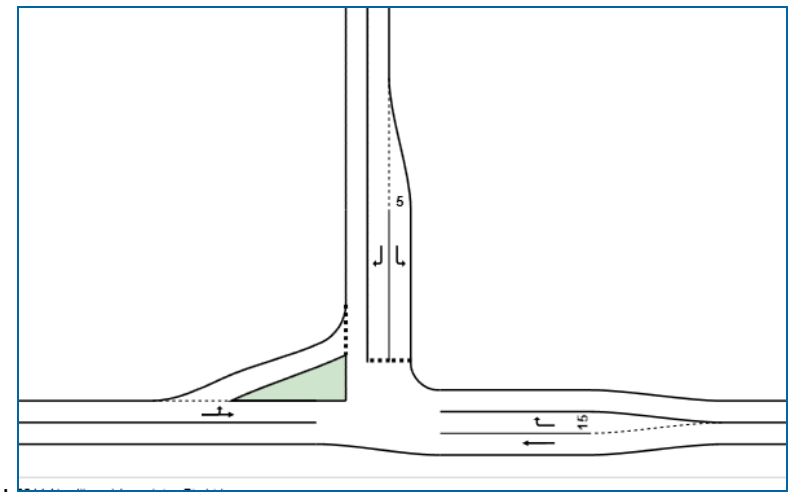

## Using Default Values

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Henderson | | | | | | | | | | | |
| 1 | L2 | 48 | 7.0 | 0.331 | 14.1 | LOS B | 2.3 | 17.5 | 0.94 | 0.97 | 46.1 |
| 3 | R2 | 88 | 10.0 | 0.331 | 18.3 | LOS B | 2.3 | 17.5 | 0.94 | 0.97 | 46.6 |
| Approach | | 137 | 8.9 | 0.331 | 16.9 | LOS B | 2.3 | 17.5 | 0.94 | 0.97 | 46.4 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 140 | 4.0 | 0.754 | 5.1 | LOS A | 13.6 | 102.9 | 0.63 | 0.45 | 52.3 |
| 5 | T1 | 894 | 10.0 | 0.754 | 5.3 | LOS A | 13.6 | 102.9 | 0.63 | 0.45 | 53.1 |
| Approach | | 1034 | 9.2 | 0.754 | 5.3 | LOS A | 13.6 | 102.9 | 0.63 | 0.45 | 53.0 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 1052 | 7.0 | 0.856 | 6.3 | LOS A | 18.2 | 135.2 | 0.96 | 0.54 | 51.8 |
| 12 | R2 | 57 | 6.0 | 0.856 | 10.3 | LOS B | 18.2 | 135.2 | 0.96 | 0.54 | 51.5 |
| Approach | | 1108 | 6.9 | 0.856 | 6.5 | LOS A | 18.2 | 135.2 | 0.96 | 0.54 | 51.8 |
| All Vehicles | | 2279 | 8.1 | 0.856 | 6.6 | LOS A | 18.2 | 135.2 | 0.81 | 0.53 | 52.0 |

## Using 1.2 Environment Factor:

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
| | | Total | HV | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Henderson | | | | | | | | | | | |
| 1 | L2 | 48 | 7.0 | 0.545 | 26.4 | LOS C | 4.2 | 31.5 | 0.99 | 1.10 | 40.0 |
| 3 | R2 | 88 | 10.0 | 0.545 | 30.6 | LOS C | 4.2 | 31.5 | 0.99 | 1.10 | 40.4 |
| Approach | | 137 | 8.9 | 0.545 | 29.1 | LOS C | 4.2 | 31.5 | 0.99 | 1.10 | 40.3 |
| East: East | | | | | | | | | | | |
| 4 | L2 | 140 | 4.0 | 0.861 | 5.9 | LOS A | 21.6 | 163.4 | 0.94 | 0.48 | 51.2 |
| 5 | T1 | 894 | 10.0 | 0.861 | 6.1 | LOS A | 21.6 | 163.4 | 0.94 | 0.48 | 52.0 |
| Approach | | 1034 | 9.2 | 0.861 | 6.1 | LOS A | 21.6 | 163.4 | 0.94 | 0.48 | 51.9 |
| West: West | | | | | | | | | | | |
| 11 | T1 | 1052 | 7.0 | 0.993 | 19.5 | LOS B | 49.7 | 368.8 | 1.00 | 0.72 | 45.3 |
| 12 | R2 | 57 | 6.0 | 0.993 | 23.5 | LOS C | 49.7 | 368.8 | 1.00 | 0.72 | 45.1 |
| Approach | | 1108 | 6.9 | 0.993 | 19.7 | LOS B | 49.7 | 368.8 | 1.00 | 0.72 | 45.2 |
| All Vehicles | | 2279 | 8.1 | 0.993 | 14.1 | LOS B | 49.7 | 368.8 | 0.97 | 0.63 | 47.6 |

## Raupare Road (Existing Layout)



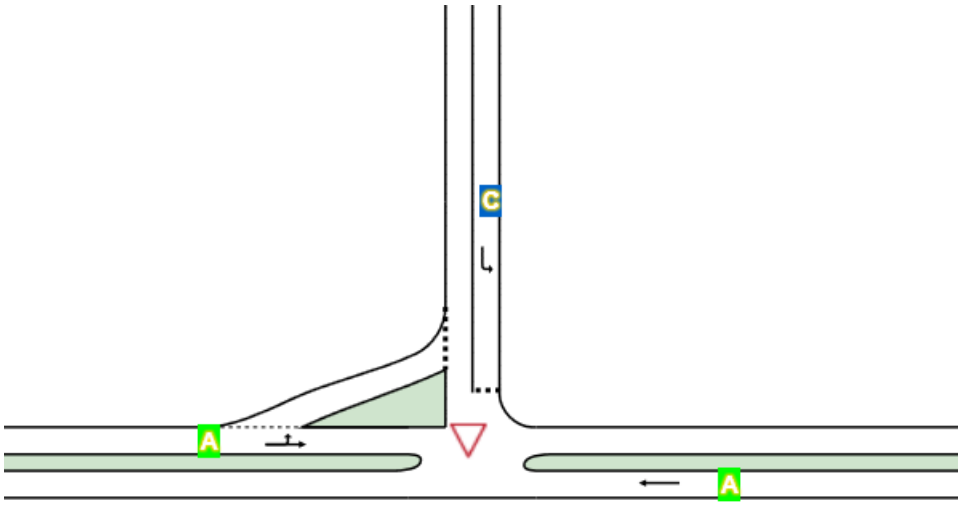
## Existing Situation

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows Total | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: East | | | | | | | | | | | |
| 5 | T1 | 615 | 9.0 | 0.334 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| 6 | R2 | 33 | 0.0 | 0.038 | 8.5 | LOS A | 0.1 | 1.0 | 0.57 | 0.72 | 51.2 |
| Approach | | 647 | 8.5 | 0.334 | 0.5 | NA | 0.1 | 1.0 | 0.03 | 0.04 | 59.4 |
| North: Raupare | | | | | | | | | | | |
| 7 | L2 | 62 | 0.0 | 0.077 | 8.6 | LOS A | 0.3 | 2.0 | 0.55 | 0.76 | 51.3 |
| 9 | R2 | 13 | 0.0 | 0.078 | 27.0 | LOS D | 0.2 | 1.7 | 0.87 | 0.95 | 40.4 |
| Approach | | 75 | 0.0 | 0.078 | 11.7 | LOS B | 0.3 | 2.0 | 0.61 | 0.79 | 49.1 |
| West: West | | | | | | | | | | | |
| 10 | L2 | 17 | 13.0 | 0.356 | 5.9 | LOS A | 2.5 | 18.5 | 0.14 | 0.01 | 57.8 |
| 11 | T1 | 645 | 6.0 | 0.356 | 0.2 | LOS A | 2.5 | 18.5 | 0.14 | 0.01 | 59.2 |
| Approach | | 662 | 6.2 | 0.356 | 0.3 | NA | 2.5 | 18.5 | 0.14 | 0.01 | 59.2 |
| All Vehicles | | 1384 | 7.0 | 0.356 | 1.0 | NA | 2.5 | 18.5 | 0.11 | 0.07 | 58.6 |

## With Development

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows Total | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: East | | | | | | | | | | | |
| 5 | T1 | 912 | 9.0 | 0.495 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| 6 | R2 | 33 | 0.0 | 0.107 | 17.2 | LOS C | 0.4 | 2.5 | 0.85 | 0.94 | 45.6 |
| Approach | | 944 | 8.7 | 0.495 | 0.7 | NA | 0.4 | 2.5 | 0.03 | 0.03 | 59.2 |
| North: Raupare | | | | | | | | | | | |
| 7 | L2 | 62 | 0.0 | 0.215 | 18.3 | LOS C | 0.7 | 4.9 | 0.86 | 0.95 | 45.2 |
| 9 | R2 | 13 | 0.0 | 0.781 | 418.3 | LOS F | 2.2 | 15.5 | 1.00 | 1.06 | 7.6 |
| Approach | | 75 | 0.0 | 0.781 | 85.9 | LOS F | 2.2 | 15.5 | 0.88 | 0.97 | 24.6 |
| West: West | | | | | | | | | | | |
| 10 | L2 | 17 | 13.0 | 0.622 | 6.0 | LOS A | 6.8 | 49.8 | 0.20 | 0.01 | 57.6 |
| 11 | T1 | 1145 | 6.0 | 0.622 | 0.3 | LOS A | 6.8 | 49.8 | 0.20 | 0.01 | 59.0 |
| Approach | | 1162 | 6.1 | 0.622 | 0.4 | NA | 6.8 | 49.8 | 0.20 | 0.01 | 59.0 |
| All Vehicles | | 2181 | 7.0 | 0.781 | 3.4 | NA | 6.8 | 49.8 | 0.15 | 0.05 | 56.4 |

## Alternative Layout (No Right Turn)




| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | ODMov | Demand Flows Total | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: East | | | | | | | | | | | |
| 5 | T1 | 944 | 9.0 | 0.513 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| Approach | | 944 | 9.0 | 0.513 | 0.1 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.8 |
| North: Raupare | | | | | | | | | | | |
| 7 | L2 | 75 | 0.0 | 0.259 | 18.9 | LOS C | 0.9 | 6.1 | 0.86 | 0.97 | 44.8 |
| Approach | | 75 | 0.0 | 0.259 | 18.9 | LOS C | 0.9 | 6.1 | 0.86 | 0.97 | 44.8 |
| West: West | | | | | | | | | | | |
| 10 | L2 | 17 | 13.0 | 0.620 | 5.9 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 58.5 |
| 11 | T1 | 1145 | 6.0 | 0.620 | 0.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 59.9 |
| Approach | | 1162 | 6.1 | 0.620 | 0.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.01 | 59.9 |
| All Vehicles | | 2181 | 7.1 | 0.620 | 0.8 | NA | 0.9 | 6.1 | 0.03 | 0.04 | 59.2 |

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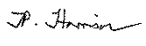
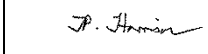
| Draft | Aaron Campion | Tony Harrison |  | Tony Harrison |  | 10/11/2015 |
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